SCHEDULE 14

TECHNICAL REQUIREMENTS

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100.0 GENERAL

100.1 INTRODUCTION

References to section numbers in this Schedule are to section numbers of the Technical Requirements unless expressed otherwise.

This Section covers the general technical requirements applicable to all design and construction of the New Infrastructure.

The information in the Technical Requirements is organized as follows:

- Section 100 - General;
- Section 200 - Project Specifics;
- Section 300 – Design – New Infrastructure;
- Section 400 – Construction – New Infrastructure;
- Appendix A - Drawings;
- Appendix B – Reporting Summary;
- Appendix C - *Historical Resources Act* (Alberta) Clearance Letter;
- Appendix D - Guide Signing for New Infrastructure;
- Appendix E – List of Acronyms;
- Appendix F – Alberta Infrastructure Land Lease Summary and Drawings; and
- Appendix G – Road Weather Information System Drawing.

In the event of any conflict or inconsistency between the Sections/Appendices, such conflict or inconsistency shall be resolved on the basis of the wording in the higher up in the following list:

- Sections 100.1, 100.4, and 200, including Appendices A, B, C, D, E, F, and G
- Sections 300 and 400; and
- Section 100.2.

References to any standards, publications, policies, guidelines or other requirements in the Technical Requirements (the "Standards"), are to the Standards that existed as of the deadline for the Technical Proposal (as defined in the Request for Proposals issued by the Department for the Design and Build of Anthony Henday Drive and Stony Plain Road/100 Avenue Interchange in the City of Edmonton, Alberta, Canada).

100.1.1 DEFINITIONS

In this Schedule 14 (Technical Requirements), capitalized terms shall have the corresponding meaning as set out in section 1.1 of the DB Agreement (as defined below) and the following expressions shall have the following meanings (and where applicable their plurals have corresponding meanings):

"**Access Roads**" has the meaning set out in Section 200.2.5.4 (Access Roads);

"**As-Built Construction Reports"** has the meaning set out in Section 400.1.7 (As-Built Roadway Construction Report);

"Bridge Design Code" means CAN/CSA-S6-06 (*Canadian Highway Bridge Design Code*);

"bridge structures" include bridges, bridge size culverts (1.5 metre diameter or larger), retaining walls, high-mast lighting (over 20 metres in height), and overhead and cantilevered sign structures that form the New Infrastructure;

"C-D" means collector-distributor;

"Design Engineer" means the Professional Engineer, engineers, or organization that is a registered permit holder eligible to practice engineering under the *Engineering, Geological and Geophysical Professions Act*, R.S.A. 2000, c. E-11, and who is employed by or retained by the Contractor for engineering services during the design and construction of the Project and is the design team leader named in Schedule 13;

"DB Agreement" means the Agreement to Design and Build the Anthony Henday Drive and Stony Plain Road/100 Avenue Interchange, City of Edmonton, Alberta, Canada, between Her Majesty the Queen in right of Alberta and the Contractor, as defined therein, to which agreement this Schedule 14 (Technical Requirements) is attached;

"Department" means the Province, as represented by the Minister of Transportation, or its expressly authorized representatives or agents. The Department or Alberta Transportation was formerly known as Alberta Infrastructure and Transportation and so references to Alberta Infrastructure and Transportation are to the Department;

"Detailed Designs" means the plans, specifications and drawings that the Contractor is required to provide pursuant to section 5.9 of the DB Agreement;

"Final Acceptance" is assessed upon expiry of the warranty period subject to satisfactory correction of all defects in the work occurring prior to and during the warranty period;

"Final Acceptance Certificate" has the meaning set out in section 6.1 of the DB Agreement;

"Functional Plan" means the *Highway 216:06 Anthony Henday Drive Interchange at Stony Plain Road (Highway 16A)/100 Avenue Interchange Functional Planning Study Final Report October 2008* as prepared by Al-Terra Engineering Ltd.;

"Geotechnical Report" means *the Anthony Henday Drive and Stony Plain Road/100th Avenue Interchange Geotechnical Investigation Report* dated September 18, 2008 as prepared by Thurber Engineering Ltd.;

"Lands" means the lands, within the Road Right of Way, described in Schedule 10 (Lands) as the Lands, and includes any lands added to the Lands by operation of Section 4.1 or section 4.5 of the DB Agreement;

"Local Authority" means The City of Edmonton;

"Maintenance Contractor" means Access Roads Edmonton Ltd. and its operations and maintenance subcontractor Transportation Systems Management Inc. or "TSMI";

"Ministerial Consent" means the written consent of Alberta Infrastructure pursuant to section 5(2) of *Edmonton Restricted Development Area Regulations* (AR 287/74, as amended);

"New Infrastructure" means the infrastructure described in Schedule 11, and subject to the foregoing generally means the Anthony Henday Drive and Stony Plain Road/100 Avenue interchange and impacted roadways in the City of Edmonton;

"Professional Engineer" means an individual who holds a certificate of registration to engage in the practice of engineering under the *Engineering, Geological and Geophysical Professions Act*, R.S.A. 2000, c. E-11, or any replacement legislation;

"Project Limits" means the limits of the Project as identified in Drawings 14-A-02 to 14-A-03, which limits are subject to adjustment in accordance with the Detailed Designs;

"Province" means Her Majesty the Queen in right of Alberta;

"Reclamation Certificate" means a reclamation certificate for disturbed lands as required by under the *Environmental Protection and Enhancement Act* (Alberta), R.S.A. 2000, c. E-12, or any replacement legislation;

"Road Right of Way" means the lands described in Schedule 10 (Lands) as the Road Right of Way;

"roadways" include all mainline lanes and shoulders, interchange ramps, crossroads and other roads that form the Project, as well as the associated drainage systems, lighting, signage, signals, markings, landscaping, fencing and other appurtenances, excluding bridge structures;

"Stage 1" means the initial configuration of the New Infrastructure as described in the Functional Plan and as modified and further detailed in the Technical Requirements;

"Ultimate Stage" means the planned final configuration of the New Infrastructure as described in the Functional Plan and as modified and further detailed in the Technical Requirements.

Appendix E contains a list of acronyms frequently used within the Technical Requirements.

Words and abbreviations which are not defined in the Technical Requirements or the DB Agreement and which have well known technical or trade meanings and which are used in the Technical Requirements are used in accordance with such recognized meanings.

Standard units of measurement may be abbreviated in the Technical Requirements.

100.2 MANAGEMENT SYSTEMS AND PLANS

Subject to section 5.5 of the DB Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, until Construction Completion, the Contractor's Construction Schedule and the Contractor's Management Systems and Plans to comply with the Technical Requirements.

100.2.1 QUALITY MANAGEMENT SYSTEM

Subject to section 5.5 of the DB Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, until Construction Completion, the Quality Management System (the "QMS"), as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DB Agreement.

The QMS shall cover all activities, products and services related to the Project. It shall include but not be limited to the following:

- The general requirement and planning for quality management,
- Documentation requirements for quality management including how documents are controlled,
- How the Contractor will provide evidence of commitment to complying with the QMS including the quality policy and objectives and how the Contractor will ensure compliance with the Technical Requirements and QMS.
- The organization for quality including an organization chart, methods of communication and names of all persons responsible for quality,
- How the Contractor intends to review the performance of the QMS and at what intervals,
- How the Contractor will manage equipment and resources including assessment of competence and training needs,
- How the Contractor will plan, develop and implement the processes needed to complete the Project including the design and construction phases,
- How the Contractor will plan and implement the required monitoring, measurement, analysis and improvement processes during the Project. This should include monitoring of customer satisfaction, auditing, control of non-conforming product, corrective actions and preventive actions;
- How the Contractor intends to incorporate into its QMS the design and plan certification process and review requirements in Schedule 5 and the Department's acceptance requirements as expressly set out in the Technical Requirements.

The Contractor shall make all quality records available to the Department for inspection and review. The Contractor shall provide the Department with a copy of any or all quality records when requested.

The QMS shall stipulate how compliance with the Technical Requirements and the Contractor's Management Systems and Plans is ensured. During all stages of the Project, work shall not be started on any component of the work until after the QMS has been completed and implemented for that component of the work. All records from the QMS for design and construction, including all audits, shall be maintained and retained by the Contractor until Final Acceptance or until otherwise agreed to in writing by the Department.

The individuals responsible for carrying out quality control and quality assurance shall be identified in the QMS.

The QMS shall include, but not be limited to:

100.2.1.1 Design

The QMS shall require all designs, drawings, specifications and similar documents, for all aspects of the Project, to be stamped and signed by Professional Engineers in accordance with *Association of Professional Engineers, Geologists, and Geophysicists of Alberta (APEGGA) Practice Standard for Authenticating Professional Documents V2.0*.

The QMS shall require two levels of design checks as listed below:

(a) The QMS shall require all design work, including supplier designs, to be checked by a qualified Professional Engineer (the "Check Engineer"). The Check Engineer may be employed by the same legal entity doing the design work, provided the Check Engineer was not involved in that component of the design work. The Check Engineer shall stamp and sign all applicable design reports, drawings and specifications.

(b) The QMS shall require all bridge structure design work, including supplier designs, to be reviewed by a qualified, independent Professional Engineer (the "Review Engineer") selected within 30 days of signing of the DB Agreement by the Contractor but approved by the Department, acting reasonably. The Review Engineer shall be employed by a legal entity that is not carrying out any design work for the Project, and that is at arm's length from and completely independent of the Contractor and any entity carrying out any design or design checking work for the Project. The design review for bridge structures done by the Review Engineer shall include, but not be limited to, the following:

- Complete review of the design data drawings including re-analysis of all aspects of the original design including hydrotechnical, geotechnical, geometric and operational safety components;
- Complete review and re-analysis of all aspects of the original structural design, preferably (but not essentially) by a methodology other than that used in the original design to ensure that the design parameters are relevant, the structural system is sound and the structural members are appropriately sized and detailed;
- Ensuring that the engineering drawings and construction specifications accurately convey the requirements of the original design; and
- Ensuring the completeness, integrity and accuracy of all aspects of the engineering drawings and construction specifications.

The Review Engineer shall provide independent design check notes and shall report that the design checks have been completed based on the information provided by the design engineer of record and is satisfied that the designs meet the Technical Requirements.

If a non-conformance in the design is determined at any time, including after construction, the Contractor shall undertake the necessary modifications to ensure the as-built New Infrastructure is in accordance with the Project Requirements.

100.2.1.2 Construction

The QMS shall provide for ensuring that the as-built Project is in conformance with the requirements of the Detailed Designs and Technical Requirements for the New Infrastructure. The Contractor shall implement a methodology to verify compliance of the construction with the design requirements. Changes made to the design during construction shall be stamped and signed by Professional Engineers from the design team. During the construction term, on a monthly basis and at the end of construction the Design Engineer shall be required to stamp and sign a declaration that the New Infrastructure has been constructed in accordance with the Detailed Designs and the Technical Requirements.

The Contractor shall make all QMS records available to the Department for inspection and review. The Contractor shall provide the Department with a copy of any or all quality records when requested.

For all construction materials and products, the QMS shall detail the testing and acceptance program, including, but not limited to, the following:

- Material property or characteristics to be measured or inspected;
- Test methods and reference standards;
- Testing frequency;
- Inspection criteria and frequency;
- Criteria for product acceptance/rejection;
- Summary and analysis reports for testing/inspection results; and
- Timelines for completion of reporting and documentation.

The QMS shall require complete testing/inspection reports be prepared for the Project, including all test results and inspection activities for all grade, subbase, base and surfacing materials, bridge structures, curb and gutter, sidewalks, drainage items, lighting, signals, signage, pavement markings, and other appurtenances.

Contractor-prepared testing/inspection reports for the Project shall be submitted in a timely fashion for review and acceptance by the Department.

The Department will conduct acceptance testing and on-site inspections during construction in accordance with Schedule 14. The Contractor shall incorporate the Department's acceptance testing into the QMS. The acceptance of work based on the Department's testing will in no way relieve the Contractor's responsibility for the quality of the New Infrastructure.

Non-conforming construction works will be considered unacceptable and the Contractor shall undertake the necessary modifications to ensure the as-built New Infrastructure conforms to the requirements of the engineering drawings and construction specifications.

100.2.1.3 Audits

100.2.1.3.1 Internal Audit

The Contractor shall undertake QMS Internal Audits, at planned intervals, during design, and construction, through to Construction Completion. The auditor(s) shall be competent based on qualifications and experience. They shall be objective and not audit their own work. The audit shall, at a minimum, ensure that all input requirements are adhered to and that the QMS is effectively implemented, maintained and in compliance with the requirements of Section 100.2.1 (Quality Management System), customer requirements and applicable regulatory standards. Audit reports shall be produced and copied to the Department. All elements of the QMS shall be audited at least once per year.

All QMS deficiencies identified by the internal QMS auditor during the audit, must be addressed and corrective measures implemented by the Contractor. The Contractor shall communicate the results of all audits to the Department.

100.2.1.3.2 External Audit

In addition to the internal audits, the Contractor shall undertake QMS external audits during the design and construction through to Construction Completion.

These external audits must be conducted by an independent QMS auditor certified by an accredited auditors' registration body such as International Register for Certificated Auditors (IRCA), Registrar Accreditation Board (RAB), National Quality Institute (NQI), or other equivalent body. The auditor must also be qualified to audit the scope of the QMS. The audit shall, at a minimum, ensure that all input requirements are adhered to and that the QMS is effectively implemented and maintained in compliance with the requirements of the Section 100.2.1 (Quality Management System), customer requirements and applicable regulatory standards. A full system audit shall be completed within one year of the signing of the DB Agreement and thereafter at least once per year until Construction Completion.

All QMS deficiencies identified by the external QMS auditor during the audit shall be addressed and corrective measures implemented by the Contractor within 30 days of completion of the audit. The results of the audit shall be documented and shall be submitted by the Contractor to the Department within seven days of audit completion. Evidence of the correction of any deficiencies identified in the audit shall be submitted by the Contractor to the Department within 30 days of completion of the audit.

If an external audit has not been completed within the specified time, Payment Adjustments of \$2,400/week or any partial week, for the first four weeks and \$6,000/week or any partial week, thereafter shall apply until so completed. Payment Adjustments shall be deducted from the monthly progress payment for each week or partial week for which the Payment Adjustment applies.

If any deficiencies identified by the external QMS auditor have not been corrected within the specified time, Payment Adjustments of \$6,000/week or any partial week, for the first four weeks and \$12,000/week or any partial week, thereafter shall apply until corrected. Payment

Adjustments shall be deducted from the monthly progress payment for each week or partial week for which the Payment Adjustment applies.

100.2.2 ENVIRONMENTAL MANAGEMENT SYSTEM

Subject to section 5.5 of the DB Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, until Construction Completion, the Environmental Management System (the "EMS"), as attached in Schedule 4 (Contractor's Management Systems and Plan) to the DB Agreement.

The EMS shall cover all activities, products and services related to the Project. It shall include but not be limited to the following:

- the general requirements and planning for environmental management including how the Contractor has defined and documented the scope of the EMS;
- documentation requirements (including records) for environmental management including how documents are controlled;
- how the Contractor will provide evidence of commitment to comply with the EMS including the environmental policy and objectives and how the Contractor will ensure compliance with the Technical Requirements, environmental assessment report(s) and EMS;
- the organization for environmental management including an organization chart, methods of communication and names of persons responsible for environmental management;
- how the Contractor intends to review the performance of the EMS and at what intervals;
- how the Contractor will manage resources required for environmental management including assessment of competence and training needs;
- how the Contractor will plan, implement and maintain operational controls and programmes or plans needed to effectively implement and maintain environmental compliance and protection throughout the Project until Construction Completion; and
- how the Contractor will plan, implement and maintain the required monitoring, measurement, analysis and improvement processes during the Project. This should include evaluation of compliance, environmental monitoring, auditing, handling of non-conformances, corrective actions and preventive actions.

The Contractor shall make all environmental records available to the Department for inspection and review. The Contractor shall provide the Department with a copy of any or all environmental records when requested.

The EMS shall stipulate how compliance with all applicable laws and all the requirements in the DB Agreement (including without limiting the generality of the foregoing the technical requirements/commitments in the Functional Plan), is ensured. During all stages of the Project, work shall not be started on any component of the work until after the EMS has been completed for that component of the work. The EMS shall include, but not necessarily be limited to the following:

100.2.2.1 Internal Audit

The Contractor shall undertake EMS internal audits, at planned intervals, during design, and construction, through to Construction Completion. The auditor(s) shall be competent based on qualifications and experience. They shall be objective and not audit their own work. The audit shall, at a minimum, ensure that all input requirements are adhered to and that the EMS is effectively implemented, maintained and in compliance with the requirements of Section 100.2.2 (Environmental Management System), customer requirements and applicable environmental legal requirements. Audit reports shall be produced and copied to the Department. All elements of the EMS shall be audited at least once per year.

All EMS deficiencies identified by the internal EMS auditor during the audit, must be addressed and corrective measures implemented by the Contractor. The Contractor shall communicate the results of all audits to the Department.

100.2.2.2 External Audit

In addition to the internal audits, the Contractor shall undertake EMS external audits during design and construction.

These external audits must be conducted by an independent EMS auditor certified by an accredited auditors' registration body. The auditor must also be qualified to audit the scope of the EMS. The audit shall, at a minimum, ensure that all the input requirements are adhered to and that the EMS is effectively implemented and maintained in compliance with its requirements, customer requirements and applicable legal and other requirements. A full system audit shall be completed within one year of the signing of the DB Agreement and thereafter at least once per year until Construction Completion.

All EMS deficiencies identified by the external EMS auditor during the audit shall be addressed and corrective measures implemented by the Contractor within 30 days of the completion of the audit. The results of the audit shall be documented and shall be submitted by the Contractor to the Department within seven days of audit completion. Evidence of the correction of any deficiencies identified in the audit shall be submitted by the Contractor to the Department within 30 days of completion of the audit.

If an external audit has not been completed within the specified time, Payment Adjustments of $2,400/week or any partial week, for the first four weeks and $6,000/week or any partial week, thereafter shall apply until completed. Payment Adjustments shall be deducted from the monthly progress payment for each week or partial week for which the Payment Adjustment applies.

If any deficiencies identified by the external EMS auditor have not been corrected within the specified time, Payment Adjustments of $6,000/week or any partial week, for the first four weeks and $12,000/week or any partial week, thereafter shall apply until corrected. Payment Adjustments shall be deducted from the monthly progress payment for each week or partial week for which the Payment Adjustment applies.

100.2.3 PROJECT SCHEDULE

Subject to section 5.5 of the DB Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, until Construction Completion, the Contractor's Construction Schedule.

During the construction of the Project, the Contractor shall provide the Department with a Contractor's Construction Schedule that is sufficiently detailed to give the Department a minimum of two working days advance notice of all significant construction and fabrication activities.

100.2.4 TRAFFIC MANAGEMENT PLAN

Subject to section 5.5 of the DB Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, until Final Acceptance, the Traffic Management Plan, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DB Agreement. The Traffic Management Plan for specific components of the Project shall be reviewed against Section 400.2.49 (Traffic Accommodation and Temporary Signing) and in accordance with Schedule 5 (Design and Plan Certification and Review Procedure) prior to the start of that component of the Project.

100.2.5 SAFETY PLAN

Subject to section 5.5 of the DB Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, until Construction Completion, the Safety Plan, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DB Agreement. The Safety Plan for a specific component of the Project shall be reviewed in accordance with Schedule 5 (Design and Plan Certification and Review Procedure) prior to the start of that component of the Project.

100.2.6 PUBLIC COMMUNICATION STRATEGIES

Subject to section 5.5 of the DB Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, until Construction Completion, the Public Communication Strategies, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DB Agreement. The Public Communication Strategies for a specific component of the Project shall be reviewed in accordance with Schedule 5 (Design and Plan Certification and Review Procedure) prior to the start of that component of the Project.

The Contractor shall be responsible for all public communications, which shall include but not be limited to, public presentations and construction update open houses, public advertisements and mail drops, project website development, project phone hotlines, handling public complaints, etc.

Any direct contact the Contractor makes with the media shall be subject to the prior review and approval of the Department. This shall include media releases, interviews, advertisements, etc.

The Contractor shall maintain comprehensive records of all communications activities including documentation of the information presented, the audience, relevant dates, etc.

If the Contractor proposes major deviations from the Functional Plan or approved plans, at anytime after execution of the DB Agreement until Construction Completion, and is deemed to be meeting the Technical Requirements, the Contractor shall in any event proceed through a public consultation process to obtain public approval/acceptance of such deviations including undertaking the following:

- defining who the stakeholders are;
- developing a communication plan including those stakeholders as participants;
- determining a process and mechanism on how public acceptance is to be determined, measured, and obtained;
- seeking and obtaining acceptance of the communication plan and approval process from the Department; and
- potentially seeking and obtaining approval from the Local Authority and meeting the Local Authority design standards for the deviation.

100.2.7 CONSTRUCTION MANAGEMENT PLAN

Subject to section 5.5 of the DB Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, until Construction Completion, the Construction Management Plan, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DB Agreement. The Construction Management Plan for a specific component of the Project, shall be reviewed in accordance with Schedule 5 (Design and Plan Certification and Review Procedure) prior to the start of that component of the Project.

100.3 DEPARTMENT REVIEW

The Contractor shall make all documentation relating to the design, construction and performance of the New Infrastructure available to the Department for the Department's review, measurement and observation purposes in a timely manner and, if applicable, in accordance with Schedule 5 (Design and Plan Certification Process and Review Procedure).

100.4 DEPARTMENT ACCEPTANCE

The Contractor and the Province expressly intend and agree that neither acceptance by the Province of the Contractor's design and construction work on the Project (as may be contemplated in the Technical Requirements) nor failure by the Province to accept or otherwise participate in any manner in respect of the review of the Contractor's design and construction work on the Project shall shift or detract from the Contractor's absolute responsibility under the DB Agreement to carry out the Project in accordance with the Project Requirements.

200.0 PROJECT SPECIFICS

200.1 INFRASTRUCTURE LIMITS

200.1.1 NEW INFRASTRUCTURE

The New Infrastructure consists of construction of a systems interchange at Anthony Henday Drive and Stony Plain Road/100 Avenue in Edmonton, including modifications to Anthony Henday Drive between Whitemud Drive and the CNR Edson Subdivision. The modifications include Anthony Henday Drive ramp reconfigurations at Whitemud Drive, 87 Avenue, 109 Avenue and 111 Avenue and also ramp reconfigurations on Stony Plain Road/100 Avenue west of Anthony Henday Drive and as set out in Schedule 11 (New Infrastructure) attached to the DB Agreement.

All references to Stations along Anthony Henday Drive (Station 5+600 to 11+200) and along Stony Plain Road and 100 Avenue (Station 0+300 to 2+600) are extracted from the Functional Plan.

The New Infrastructure shall also include existing roadways, existing grading and related appurtenances (such as drainage works, lighting, and signage), including, but not limited to, the following components:

- Improvements to Anthony Henday Drive between Whitemud Drive and north boundary of the CNR Edson Subdivision right of way;
- Improvements to interchanges at Whitemud Drive and at 87 Avenue;
- Development of systems interchange at Stony Plain Road/100 Avenue at Anthony Henday Drive;
- Elimination of the median crossing on Anthony Henday Drive at 109 Avenue; and
- Improvements to Anthony Henday Drive ramps at 109 Avenue and 111 Avenue.

Currently, Anthony Henday Drive functions as a four-lane divided roadway (northbound and southbound) which intersects with Stony Plain Road (westbound) and 100 Avenue (eastbound) at four signalized intersections. The program for the New Infrastructure as a free-flow systems interchange at this location includes the removal of the existing four sets of traffic signals.

The soils underlying the New Infrastructure include compressible, frost susceptible materials. In recognition of the soils conditions, partial fills were constructed in the 1990s to compress the underlying soils in preparation for Anthony Henday Drive mainline lanes overpassing Stony Plain Road and 100 Avenue in a split diamond interchange configuration.

The Department tendered a contract in 2008 to initiate site preparation, and install wick drains and instrumentation in preparation for construction of Anthony Henday Drive mainline fills at Stony Plain Road and on the north side of 100 Avenue. The intent of this contract was to enable systems interchange fills to be constructed early in the construction of the New Infrastructure, hence reducing differential settlement relative to the existing partial fills due to differential compression of underlying materials.

200.1.1.1 New Infrastructure Limits - Interim Restrictions

The Province is in the process of acquiring some properties (the "To Be Acquired Lands") required for the construction of the New Infrastructure. The To Be Acquired Lands are set out in section 4 of Schedule 10 (Lands) to the DB Agreement. Unless otherwise authorized in advance and in writing by the Province, the Contractor shall not enter upon the To Be Acquired Lands until the To Be Acquired Lands have been transferred to the Province which will be by July 1, 2010.

200.2 DESIGN OF NEW INFRASTRUCTURE

200.2.1 GENERAL

The Contractor is responsible for the design and construction of the New Infrastructure which includes, but is not limited to, a multi-lane roadway on Anthony Henday Drive, including connecting roadways, crossroads, interchanges, bridge structures and associated infrastructure.

The design and construction requirements of the Department with respect to the location, function, stages and interconnection of the New Infrastructure are defined in the Functional Plan unless stated otherwise elsewhere in the Technical Requirements. The Contractor is responsible for the detailed design of the Project. The design shall meet all project requirements and shall achieve or exceed the operational function of the interchange configurations, ramps, mainline roadway, and crossroads as shown in the Functional Plan unless stated otherwise elsewhere in the Technical Requirements.

The requirements of the Department for the New Infrastructure are consistent with Stage 1 as generally described below:

- Anthony Henday Drive mainlines from Whitemud Drive to the north right of way boundary of the CNR Edson Subdivision with paving of three lanes in each direction with increased median width between approximately Station 6+800 and Station 11+490 to suit current safety standards and future widening,
- Two sets of twin bridges to carry Anthony Henday Drive mainline lanes and ramp roadways over both the Stony Plain Road and 100 Avenue roadways and associated ramps,
- Modifications to the existing Whitemud Drive interchange to relocate the entrance ramp onto northbound Anthony Henday Drive,
- Modifications to the existing 87 Avenue interchange consisting of:
    - o Design and construction of a right turn bay including channelization at the west intersection for the SB to WB movement,
    - o Relocation of the Anthony Henday Drive northbound exit ramp to 87 Avenue, including a bridge over the northbound entrance ramp from Whitemud Drive to Anthony Henday Drive,
    - o Relocation of the 87 Avenue northbound entrance ramp to Anthony Henday Drive,
    - o Modifications to existing retaining wall between 87 Avenue and the powerline tower on the south side of 87 Avenue, including additions of a retaining structure to enable the 87 Avenue northbound entrance ramp to Anthony Henday Drive;

  - Relocation of the at-grade intersection east of Anthony Henday Drive on 87 Avenue complete with traffic signals, street lighting, and urban infrastructure tie-ins,
  - Obliteration of the existing Anthony Henday Drive northbound exit ramp to 87 Avenue and existing 87 Avenue northbound entrance ramp to Anthony Henday Drive,
- Systems interchange directional ramps at the Anthony Henday Drive and Stony Plain Road/100 Avenue interchange and ramps underpassing Anthony Henday Drive, including a bridge to carry the Anthony Henday Drive northbound exit ramp over 100 Avenue and another bridge to carry the Anthony Henday Drive southbound exit ramp over Stony Plain Road,
- Elimination of the median crossing at 109 Avenue west of Anthony Henday Drive and replacement of the existing turning movements with geometry suitable for northbound and southbound exit and entrance ramps to match the widened median of Anthony Henday Drive,
- Grading of the following Ultimate Stage roadways:
  - Anthony Henday Drive mainline median lanes;
  - Anthony Henday Drive outside lanes between Whitemud Drive and the north boundary of the CNR Edson Subdivision;
  - Approach fills for Anthony Henday Drive bridge structures over 100 Avenue and Stony Plain Road;
  - Stony Plain Road;
  - The WB to SB loop ramp at AHD and Stony Plain Road; and
  - The EB to NB C-D road between the EB to NB loop ramp and Stage 1 WB to NB directional ramp.
- Grading and paving for relocation of Stony Plain Road exit ramp to Winterburn Road;
- Frost protection of roadways in areas of high frost susceptibility and to match the existing frost protective measures on existing roadways in the Project;
- Pavement rehabilitation on Stony Plain Road and on 100 Avenue and selected ramps as outlined elsewhere in Section 200;
- Access management of local roads disrupted by the Project, including installation of curb and gutter once access to lands corresponding to Leases #900J and 935J (set out in Appendix F) is removed;
- All drainage; roadway lighting; guide signing; utility protection and/or relocation; traffic signals removal; access management including right-of-way fencing; traffic management during construction and lane markings for operation of the completed Project; landscaping including topsoiling and seeding; all safety protection including hazard protection; environmental protection; and all coordination with the Local Authority, roadway maintenance forces and emergency service providers, all as specified in Section 200;
- Construct AHD Southbound bridge structures over Stony Plain Road and 100 Avenue to the Ultimate Stage geometry on the west extent to accommodate the WB-SB two-lane loop ramp and tapers. Future widening of this structure will occur on the inside only.

200.2.2 TRAFFIC SIMULATION

Traffic simulation shall be performed using the Simulation File Package provided by the Department for the Contractor's use for developing and evaluating alternatives and for confirmation/validation of designs, as outlined in Section 200.2.5 (Design Specifics). The Simulation File Package (the "Package") will be posted in the Project electronic data room for this purpose and includes Stage 1 a.m. and p.m. peak hour Synchro/SimTraffic model files for the New Infrastructure.

Specific instructions will be provided in the Package for the following:

For Interchange Designs:

- Fixed Synchro/SimTraffic Model Parameters for interchanges – parameters that are fixed and not to be modified in any way by the Contractor;
- Adjustable Synchro/SimTraffic Model Parameters for interchanges – parameters that can be modified by the Contractor in searching for design alternatives;
- List of Measures of Effectiveness (MOE) and performance criteria for traffic signals at interchanges. Alternative designs proposed by the Contractor shall meet these performance criteria;
- Signal Phasing Requirements and Application Notes for interchanges;
- Minimum Traffic Signal Timing Requirements and Application Notes; and
- Method for determining the turn bay requirements at the interchange ramp intersections based on the Synchro/SimTraffic simulation run results.

For Operation of Existing At-Grade Signalized Intersections During Construction (for the purpose of deriving detour plans or construction staging strategies):

- This is applicable to the four signalized intersections at Anthony Henday Drive and Stony Plain Road/100 Avenue.
- Fixed Synchro/SimTraffic Model Parameters for existing at-grade signalized intersections – parameters that are fixed and not to be modified in any way by the Contractor;
- Adjustable Synchro/SimTraffic Model Parameters for existing at-grade signalized intersections – parameters that can be modified by the Contractor in searching for design alternatives or detour or construction staging options;
- List of Measures of Effectiveness and performance criteria for existing at-grade signalized intersections;
- Signal phasing requirements and application notes for at-grade signalized intersections;
- Minimum Traffic Signal Timing Requirements and Application Notes for at-grade intersections;
- Acceptable Measure of Effectiveness and Congestion Thresholds for managing traffic congestion along Anthony Henday Drive; and
- Procedures for determining optimized intersection and corridor operations along Anthony Henday Drive and on Stony Plain Road and 100 Avenue throughout construction.

If the design proposed by the Contractor to meet the requirements of Stage 1 (the "Contractor's First Stage Design") or the Ultimate Stage (the "Contractor's Final Stage Design") is different from the interchange configurations shown in the Package, the Contractor shall:

- demonstrate that operation of the Contractor's First Stage Design will be acceptable under the Stage 1 a.m. and p.m. peak hour traffic conditions;
- demonstrate that the Contractor's First Stage Design is compatible with the Ultimate Stage; and

- verify that the Contractor's Final Stage Design is equivalent to the Ultimate Stage and will operate satisfactorily under the Ultimate Stage a.m. and p.m. peak hour traffic conditions.

200.2.3 GEOMETRIC DESIGN

The following design guides shall form the basis for the geometric design:

- *Alberta Transportation Highway Geometric Design Guide* and associated *Design Bulletins;*
- *Alberta Transportation Roadside Design Guide, November 2007* and associated Bulletins and revised Pages H4-5, H-13, H-14, APP-C1-2 Appendix C1 and H-APP-D1-8 Appendix D1. The Department has issued the revised pages by Errata to the *Alberta Transportation Roadside Design Guide* in March 2008*;*
- *The City of Edmonton Design and Construction Standards;*
- *Transportation Association of Canada (TAC) Design Guide for Canadian Road,* where the above guides are silent; and
- *American Association of State Highway and Transportation Officials (AASHTO) Geometric Design of Highways and Streets,* where the above guides are silent.

In addition, the design shall meet the following requirements:

Anthony Henday Drive and Stony Plain Road/100 Avenue:

- The mainline is to be designed as a rural, illuminated, high speed, free-flow, fully access-controlled facility;
- No left-hand side exit or entrance ramps will be permitted off of or onto Anthony Henday Drive;
- Only one exit ramp per direction is to be provided at the interchanges at Whitemud Drive and Stony Plain Road/100 Avenue with the following exceptions:
    - Anthony Henday Drive at Whitemud Drive, which will allow separate exits in Stage 1; and
    - Anthony Henday Drive at Stony Plain Road/100 Avenue, which will allow separate exits from Stony Plain Road to NB and SB AHD;
- Interchange exit terminals are to provide decision sight distance appropriate to applicable design speed;
- Transition from rural standards to urban standards (curb and gutter), where applicable, is to occur at the urban end of interchange ramps connecting to the crossroads;
- Lane balance shall be provided in Stage 1 and the design shall provide for lane balance throughout subsequent staging up to the Ultimate Stage;
- The use of combinations of inter-related minimum design criteria shall be avoided;
- The design of 100 Avenue is to allow for a future additional EB lane in the Ultimate Stage to be located to the south of the 3 lanes provided in Stage 1; and
- Grade lines which reduce the existing pavement structure for all rehabilitation areas indicated in Table 200.2.5.9.1 (New Construction and Rehabilitation Pavement Structure Minimums) are not permitted.

Design Speed:

- Mainline .... 110 km/h

- Stony Plain Road/100 Avenue
  - East of the TUC..70 km/h
  - Within the TUC..90 km/h
  - West of the TUC ....110 km/h
- Whitemud Drive...100 km/h
- C-D Road ....90 km/h
- Directional Ramps - Systems and Service Interchanges (main level) ....90 km/h
- Directional Ramps – (elevated level)
  - AHD NB to Stony Plain Road WB[1] ....80 km/h
  - AHD SB to 100 Avenue EB[2] ....70 km/h
- Directional Ramps – entering Crossroads ....Match Design Speed of Crossroad
- Loop Ramp Off Main Line and Stony Plain Road.............................50 km/h
- Loop Ramp Off C-D Road[3] ....45 km/h
- Crossroads - General ....70 km/h

Exceptions to Design Speed include:

- AHD/Whitemud Drive Interchange
  - WB to NB directional ramp where design speed at gore exit from Whitemud Drive may be reduced to 80 km/h;
  - AHD SB to Whitemud Drive WB where design speed at gore exit from AHD may be reduced to 80km/hr; and
  - AHD NB to SPRWB/100 Avenue EB where design speed at gore exit from AHD may be reducted to 80km/hr.

- AHD/87 Avenue Interchange
  - SB to EB/WB ramp where design speed at gore exit from AHD may be reduced to 80 km/h.

- AHD/Stony Plain Road/100 Avenue Interchange
  - WB to NB ramp design speed at gore exit from Stony Plain Road may be reduced to 70 km/h;
  - SB to EB/WB ramp where design speed at gore exit from AHD may be reduced to 80 km/h;
  - SB to WB ramp where design speed at gore entrance at Stony Plain Road may be reduced to 50 km/h; and
  - 100 Avenue C-D Road to AHD SB ramp vertical alignment design speed may be reduced to 80 km/hr.

- 109 Avenue and 111 Avenue crossroads where curve radii at AHD exits and entrances as shown on Drawing 14-A-04 in Appendix A are acceptable.
- SPR WB to Winterburn Road NB/SB where design speed at gore exit from SPR may be reduced to 80km/hr.

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[1] *Design Speed shall be 80 km/h with the exception of lateral stopping sight distance with no reduction in horizontal geometry from what is shown in the Functional Plan.*
[2] *Design Speed shall be 70 km/h with the exception of lateral stopping sight distance with no reduction in horizontal geometry from what is shown in the Functional Plan.*
[3] *Minimum radii of these ramps shall be 70 m.*

Posted Speed: Posted speed shall be 10 km/h less than the design speed.

Vertical Grades:

- AHD Mainline .... 3.0% Max.
- Directional Ramps and C-D Roads (90 km/h) .... 4.0% Max.
- Directional Ramps and C-D Roads (80 km/h) .... 4.5% Max.
- Directional Ramps and C-D Roads (70 km/h) .... 5.0% Max.
- Ramps
    - On ramps .... 6.0% Max.
    - Off ramps .... 4.0 % Max.

K Values:

The K Values shall meet or exceed the values shown in the following table:

Design Speed (Km/h)	Crest K Factor	SAG K Factor
110	120	72
100	90	60
90	66	48
80	42	42
70	30	30
60	18	24
50	12	15
45	9	12

Vertical Curves:

- Minimum length of sag and crest vertical curves:
    - On mainline 300m
    - On directional ramps, C-D roads and other roads (90 km/h) 250m
    - On directional ramps, C-D roads and other roads (80 km/h) 200m
    - On directional ramps, C-D roads and other roads (70 km/h) 150m
    - On loop ramps 100m

- Minimum distance between crest and sag vertical Points of Intersection (PI):
    - On mainline 500m
    - On directional ramps, C-D roads and other roads (90 km/h) 350m
    - On directional ramps, C-D roads and other roads (80 km/h) 250m
    - On directional ramps, C-D roads and other roads (70 km/h) 200m
    - On loop ramps (70 km/h) 150m

- 100 Avenue and Stony Plain Road will be exempt from the requirements above related to minimum length of vertical curves and minimum distance between crest and sag vertical points of intersection (VPIs).

  The gradeline for these roadways shall be smooth with K values of vertical curves meeting or exceeding the minimum K values outlined above divided by a factor of 1.2. The roadway cross section shall have a normal crown of 2.0% and superelevation to match the superelevation required for the design speed.

Superelevation (e max):

- All Roads 0.06m/m

Ramp Terminals Along Mainline, Freeways and C-D Lanes:

- Direct taper design as per Alberta Transportation Highway Geometric Design Guide for both exit and entrance terminals.
- The minimum weaving distance on the mainline facility shall be 600m unless shown otherwise in the Functional Plan, in which case, the minimum weaving distance shall be no less than that shown in the Functional Plan. The weave distances shall be measured in accordance with the *Alberta Transportation Highway Geometric Design Guide.*

Lane Widths:

• Mainline, Stony Plain Road /100 Avenue		3.7m
• C-D Road	- 1 Lane	4.8m
	- 2 Lanes	3.7m
• Ramp	- 1 Lane	4.8m
	- 2 Lanes	3.7m
• Crossroads	Tie in to existing at Project Limits	

- Directional Ramps
  - 2 lanes 3.7m
  - 1 lane 4.8m

Shoulder Widths:

- Mainline/Stony Plain Road/100 Avenue
  - Inside (4 and 6 Basic Lanes) 2.5m
  - Inside (8 Basic Lanes) 3.0m
  - Outside 3.0m
- Directional Ramps
  - Inside (1 lane) 1.0m
  - Inside (2 lanes) 2.5m
  - Outside (1 lane) 2.5m
  - Outside (2 lanes) 3.0m
- C-D Road
  - Inside (1 Lane) 1.0m
  - Inside (2 Lanes) 2.5m
  - Outside (1 Lane) 2.5m
  - Outside (2 Lanes) 3.0m
- Ramp
  - Inside (1 Lane) 1.0m
  - Inside (2 Lanes) 2.5m
  - Outside (1 Lane) 2.5m
  - Outside (2 Lanes) 3.0m
- Crossroads .... Tie into existing cross streets

Median Width:

- Ultimate Stage lane configuration north of 87 Avenue 23.2m

- Stage 1 and Ultimate Stage lane configuration south of 87 Avenue 20.1m

Outer Separation:
- C-D Road (1 Lane) (edge of C-D Road driving lane to edge of mainline driving lane) 17.0m
- C-D Road (2 Lanes) (edge of C-D Road driving lane to edge of mainline driving lane)............. 20.0m
- Separation between 100 Ave EB and the CD Road at Ultimate Stage 17m

Pedestrian Walk:

- Width of Pedestrian Walk
  - on grade 2.5m

Slopes:[4]
- Pavement Structure Sideslopes
  - Mainline, System Connectors, and Directional Ramps 6:1
  - C-D Roads, Ramps, and Crossroads 5:1
- Subgrade Sideslopes
  - Mainline and System Connector
    - Fill 0 - 2.5m 6:1
    - Fill 2.5 - 3.0m .... Slope Variable, Toe at 15m Fixed
    - Fill 3.0 - 4.0m 5:1
    - Fill 4.0 - 5.0m .... Slope Variable, Toe at 20m Fixed
    - Fill Over 5.0m 4:1
  - C-D Roads and Ramps
    - Fill 0 - 4.0m 5:1
    - Fill 4.0 - 5.0m .... Slope Variable, Toe at 20 m Fixed
    - Fill Over 5.0.. 4:1
- Bridge Approaches
  - 3:1 sideslope acceptable at bridge locations with barrier and with subgrade to be widened by 1.0 m on each side.
  - The subgrade width shall be tapered back to the unwidened subgrade width at a ratio of 30:1.
- Bridge Headslopes .... 2.5:1 Max.
- Ditch Backslopes (Top of backslopes to be rounded)
  - Height 0.0 - 3.0 m.. 5:1
  - Height 3.0 - 5.0 m.. Slope Variable, Toe at 15 m Fixed
  - Height Over 5.0 m 3:1
- Berms within the TUC .... 3:1 Max.

Ditch Width:[5] .... 3.0m Min.

Vertical Clearances:
- Roadway - Underside of superstructure to top of roadway .... 5.4m Min.[6]
- Sign Structures – Roadway surface to underside of sign structure or sign panel, whichever is

[4] *All slope ratios are expressed in horizontal:vertical.*
[5] *Ditches shall be rounded.*
[6] *Allowance shall be made for roadway/bridge widenings. Pavement overlay under the roadway bridge structures will be achieved through milling and infilling.*

lower ....6.0m Min.[7]

- Roadway - To High Voltage Power Lines (up to 500 kV) .... 11.4m Min.[7/8]

Horizontal Clearances:

- Edge of shoulder to Bridge Headslope ....3.0 m
- Edge of Ultimate Stage travel lane to face of bridge substructure element, retaining walls, existing or relocated power poles and towers, and overhead sign support for structures with two or more vertical supports shall be equal to or greater than the clear zone as specified in the *Alberta Transportation Highway Geometric Design Guide.* Use of barrier to reduce clear zone dimensions is not acceptable for these elements on Anthony Henday Drive mainline, Stony Plain Road and 100 Avenue, C-D roads, directional ramps or loop ramps where the loop ramp cross-section is an extension of the mainline, Stony Plain Road, 100 Avenue, or C-D cross-sections.
  Exception to the clear zone requirements as outlined above include:
  - The retaining wall structure under the existing 87 Avenue bridge near the east abutment must be located as far as possible from AHD NB lanes. A barrier will be permitted at this location if the clear zone requirements are not achieved.
- Edge of Travel Lane to Face of Bridge Parapet or Barrier
  - Shall meet *Alberta Transportation Highway Geometric Design Guide's* lateral clearance on horizontal curves for stopping sight requirements, but shall not exceed 3.5m.
  - Shall meet or exceed TAC suggested shy line offsets.
- Back of Barrier to Solid Object
  - Distance to meet manufacturer's recommendation for design deflection at each design speed.
- Clear zone calculations for loop ramps adjacent to bridges shall be based on the directional ramp standard of 90 km/h.

Stopping Sight Distance (SSD)*:*

- Vertical - Exceed *Alberta Transportation Highway Geometric Design Guide's* SSD requirements by 20%
- Horizontal - Meet or exceed *Alberta Transportation Highway Geometric Design Guide's* SSD for trucks with conventional braking systems
- Horizontal – In case of curves at bridge and/or barrier locations, meet or exceed *Alberta Transportation Highway Geometric Design Guide's* SSD or have a shoulder width not to exceed 3.5m.

Horizontal and Vertical Alignments:

The Contractor shall design the horizontal and vertical alignment to avoid any perceived roller coaster or kinked curve appearance, and shall ensure that the alignment complements the existing topography.

Number of Ramp Approach Lanes at Intersection:

- At 87 Avenue, the ramp intersection approach shall have two lanes to permit double left turn movements from the ramp.

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[7] *Allowance shall be made for future overlays.*
[8] *Contractor to confirm clearance requirements with power line utility and obtain confirmation in writing.*

Medians:

- Median barriers will not be permitted except for as extensions to bridge parapets.
- All bridge piers shall be placed outside the clear recovery zone.

Intersections:
At-grade intersections shall be designed to accommodate a WB 23 design vehicle except for the design of the Access Roads intersections, in which case the WB21 shall be the design vehicle. Intersection design shall use *desirable* standards from design guides and bulletins as an absolute minimum. At intersections where dual left turn movements are required, the WB-21 design vehicle shall be used for the outside turning land and the SU design vehicle shall be used for the inside turning lane.

200.2.4 MISCELLANEOUS DESIGN REQUIREMENTS

The Contractor shall meet or exceed the following miscellaneous design requirements:

- Rumble Strips - Longitudinal rumble strips on either shoulder or centreline shall not be used;
- Barrier - Unless noted otherwise in this Section, barriers used on mainline, connectors, ramps and C-D roads shall be modified thrie beam guardrail using steel posts, (Type SGR09B as defined in "*A Guide to Standardized Highway Barrier Hardware*" by the Joint AASHTO-AGC-ARTBA Committee, May 1995). The minimum length of the steel posts shall be 2.06m. Post spacing shall be 1.905 metres. Steel offset blocks shall be used;
  - High tension cable barrier system shall be installed in the median of Anthony Henday Drive from Station 9+600 to 11+200 immediately following removal of the median crossing at 109 Avenue by the Contractor. The high tension cable barrier system shall pass all required tests for Test Level 4 (TL-4) on NCHRP Report 350.
- Transitions to Bridge Parapets - The transitions to bridge parapets shall pass all required tests for a Test Level 4 (TL-4) of *NCHRP Report 350*;
- Bridge Barrier – Barriers on bridges shall be concrete. Bridge barriers shall meet, as a minimum, the requirements of Performance Level 2 as defined by the *Canadian Highway Bridge Design Code* (CAN/CSA-S6-06);
- Maintenance cross-overs in the median of the mainline or between the mainline, C-D roads or ramps shall not be allowed;
- Roadway set-back distances from abandoned oil and gas wells shall be compliant with Energy Resources Conservation Board (ERCB) regulations and guidelines;
- Retaining Structures – The use of pile supported retaining structures, e.g. concrete cantilever retaining structures on piles, at Retaining Structures At Bridge Structures (as defined below) will be permitted. Retaining structures not supported on piles, e.g. MSE walls, will not be permitted at Retaining Structures At Bridge Structures except at the east abutment of the existing 87 Avenue structure. For the purposes of this Section 200.2.4, "Retaining Structures At Bridge Structures" is defined as retaining structures supporting bridge structures and include any retaining structures that are an extension of a retaining structure supporting a bridge structure;
- Hazard Protection - The Contractor is responsible for the design and construction of all required hazard protection for the Contractor's constructed roadway and bridge structure elements;
- Signage - The Contractor is responsible for the design, supply, and installation of all required signage for the Contractor's constructed roadway and bridge structure elements;

- Traffic Signals – The signals at the Stony Plain Road and 100 Avenue intersections shall be removed and returned to The City of Edmonton. The signals for the east intersection at AHD and 87 Avenue shall be removed and may be retained by the Contractor or used for the relocated intersection;
- Pavement Markings - The Contractor is responsible for design and construction of all required pavement markings for the New Infrastructure roadway and bridge structure elements;
- Walks - The Contractor shall be responsible for the design and construction of all walks to conform to The City of Edmonton specifications as shown on The City of Edmonton Drawings 5032 and 5033;
- Precast Concrete Barrier – Precast concrete barrier (810 mm high) shall be installed in Stage 1 to limit the width of the outer shoulder along AHD Southbound to three metres across the southbound Stony Plain Road and 100 Avenue bridges and along the southbound lanes of AHD between the same bridges. The precast concrete barrier shall incorporate standard Department end terminal treatments at each end. The precast concrete barrier shall remain in place during the period in which the WB-SB loop ramp operates as a single lane loop ramp;
- "Ramps entering and exiting auxiliary lanes (additional lanes or lane aways) shall have taper ratios at the terminals as outlined in Figure E – 1.1 of the "Alberta Transportation Highway Geometric Design Guide";
- Where lanes are introduced or terminated at locations other than at ramp terminal locations the taper ratio shall be as following:

Location	**Lane Introduction**	**Lane Termination**
AHD Mainline	60:1	60:1
100 Avenue	N/A	60:1
Stony Plain Road	N/A	60:1

200.2.5 DESIGN SPECIFICS

Additional location specific guidelines have been developed to provide additional directions for Stage 1 construction. These guidelines are intended to ensure specific key elements are addressed in the New Infrastructure.

200.2.5.1 Roadway Mainline

Stage 1 construction shall include Ultimate Stage grading for: the mainline lanes; mainline bridge structure fills; and for the future C-D road at the Stony Plain Road/100 Avenue interchange.

Stage 1 shall include the construction of Anthony Henday Drive mainline, with paving of three lanes in each direction from Whitemud Drive to the north property line of the CNR Edson Subdivision. Stage 1 paving shall include lane configuration and minimum pavement structure as indicated in Section 200 and in Appendix A.

The mainline profile for Anthony Henday Drive must meet the Technical Requirements with no Stage 1 or Ultimate travel lanes lower than any existing lanes on Anthony Henday Drive.

200.2.5.2 Crossroads

The Contractor shall grade all crossroads to the Stage 1 configuration. Crossroads shall be paved to the Stage 1 configuration up to the Project Limits and then transitioned beyond the Project Limits to match the existing crossroad section.

The New Infrastructure shall be tied into and shall match existing roadways at the east and west Project limits.

The median crossing at 109 Avenue shall not be removed prior to 2010.

The Contractor shall consult with and coordinate its work with the Local Authority, as appropriate, regarding timing and tie-ins of the crossroads at the boundaries of the TUC.

Para curb ramps shall be constructed at all pedestrian crossings. These ramps shall be in accordance with the standards required by The City of Edmonton for the design and construction of roads within The City of Edmonton.

Approach nose treatments for islands and medians shall be in accordance with the standards required by The City of Edmonton for the design and construction of roads within The City of Edmonton.

200.2.5.3 Bridges

Bridge Design Data drawings for all seven bridges to be designed and constructed as part of the Project have been prepared as part of the Functional Plan. These Bridge Design Data drawings identify clearance requirements and deck cross-section; lane, shoulder configurations, approach fill requirements; and key plan for all bridge structures forming part of the New Infrastructure. The information shown on these Bridge Design Data drawings will need to be modified to meet the Technical Requirements or to reflect actual structure depths (girder soffit to finished overpassing roadway surface) used in the Contractor's Designs and selection of materials. Additionally, the Contractor shall modify these Bridge Design Data drawings as required to suit the Detailed Designs and resubmit the Bridge Design Data drawings in accordance with the requirements of Section 300.4.3. To the extent there is any inconsistency between these Bridge Design Data drawings and the Technical Requirements, the Technical Requirements shall govern.

Bridges requiring future widening to accommodate the Ultimate Stage shall be designed to enable future widening.

200.2.5.4 Access Roads

The Contractor shall design and construct the new access roads outlined in Section 200 and as detailed in the Drawings in Appendix A (the "Access Roads"). The Contractor is responsible for all necessary signing for the Access Roads. A new Access Road (with gravel surface) is to be constructed to connect 199 Street to the existing south access road along 100 Avenue with a cross section as shown in Appendix A. At the time this new access road is constructed the existing direct connection to the existing south access road from 100 Avenue is to be removed as a requirement of the Project.

A new access road (with gravel surface) is to be constructed to connect the towers on leases 934F, 937M and 937N. At the time this new access road is constructed, the existing connection is to be removed as a requirement of the Project. The new access road shall match the standards of the existing access road.

200.2.5.5 Road Closures

The Contractor shall be responsible for the physical closure of existing roads at locations shown on Drawings 14-A-04 and 14-A-05 in Appendix A.

The Contractor is responsible for all permits and approvals for the physical road closures and removals, construction of the required turnarounds, installation of appropriate signing regarding "no exit", installation of barricades and disposal of all materials and restoration of the closed road to a natural landscaped area including restoration of drainage. The roadway structure shall be removed, topsoiled, and seeded in accordance with Sections 200.2.9 (Topsoil and Seeding).

The Contractor is responsible for coordination of all removals and closures with the relevant Local Authority. The Department will be responsible for obtaining legal road closure and the Contractor shall cooperate with the Department in the supply of information for legal road closure.

Turnarounds (cul de sacs) shall be constructed in accordance with Drawing 14-A-08 in Appendix A.

200.2.5.6 Detours and Traffic Management During Construction

The Contractor is responsible for implementing their Traffic Management Plan to provide safe and efficient passage of the traveling public throughout the Project Limits during the construction phase to the extent that the roadway is open to public traffic. The Contractor shall submit proposed signal timing changes to the Department for review and acceptance. The Department will coordinate with the applicable authorities to implement any accepted signal timing changes.

200.2.5.6.1 Existing AHD Mainline and Stony Plain Road/100 Avenue

The Contractor shall provide safe and continuous access through or along the existing roadways within the Project Limits and shall submit detailed plans for accommodating traffic (with particular emphasis on peak traffic hours) during construction. The Contractor's plans for accommodating traffic during construction shall include all applicable intersections and interchanges. The Contractor shall perform traffic simulation to confirm that an equivalent level of service or measure of effectiveness will be attained for a.m. and p.m. peak hours when compared to the Package (as defined in Section 200.2.2 (Traffic Simulation)).

The Package includes without limitation the following intersection geometry upgrades that are required at the outset of the construction schedule:

- Widen Stony Plain Road to add an additional westbound lane immediately west of the existing advance warning signal pole/guardrail installation (total length of road widening is ~270 m); and
- Widen AHD northbound lanes to add an additional northbound lane from approximately 150 m south of 100 Avenue (total length of road widening is ~ 350 m).

The following minimum requirements shall apply for all through roadways and intersections:

Lane width ....3.7 m
Shoulder width ....1.0 m
Design Speed - Anthony Henday Drive..80 km/h
Design Speed - Stony Plain Road/100 Avenue..70 km/h

Any existing intersections that are relocated or altered during construction shall be treated as if existing for the purpose of achieving acceptable traffic operations when compared to the Package.

200.2.5.6.2 Detours or Lane Closures

The Contractor is responsible for maintaining existing traffic movements and accesses to properties affected by construction activities until access is to be removed, where applicable. The extent of all detours shall be constructed entirely within the TUC.

Detours for all crossroads, if required, shall maintain safe passage of traffic, and shall allow for the minimum number of specified lanes open in each direction at all times. All such detours must be constructed with a surface type equal to or better than the surface on the connecting roadways on either end of the detour, and shall meet specified minimum design and posted speeds. Detours shall be illuminated to equivalent standards of existing roadway and have painted lane markings.

Traffic simulation, including number of lanes, traffic signal operation and traffic operational factors such as storage capacity, is required prior to design and construction of all detours on the Project.

Detour standards (minimum number of lanes, minimum lane widths, minimum shoulder widths, and minimum design and posted speeds) are indicated in the following table:

Short Term Detours (Minimum Requirements)				
Roadway	**Min. No. of Lanes per direction**	**Min. Lane Width (m)**	**Min. Shoulder Width (m)**	**Design Speed (km/h)**
Stony Plain Road WB to Winterburn Road exit ramp	1	3.7	1.0	60
109 Avenue – All Movements	1	3.7	1.0	60
111 Avenue - All Movements	1	3.7	1.0	60
87 Avenue - All Movements	1	3.7	1.0	60

Whitemud Drive - All Movements	1	3.7	1.0	60

The Department may permit short term local detours to reroute traffic at crossroads or partially-directional interchanges to accommodate construction operations such as girder erection. Short term localized detours with reduced capacity or lane closures for all roadways shall be restricted to periods of two weeks or less in duration. Prior to the implementation of short term local detours the Contractor shall submit to the Department for review a detailed detour plan and other material to comply with The City of Edmonton OSCAM processes for incorporation into the Contractor's Traffic Management Plan under Section 100.2.4, and an updated Traffic Management Plan identifying the number of lanes, all horizontal and vertical detour geometry, anticipated traffic volumes relative to peak traffic volumes, traffic modeling files, traffic management and traffic control devices, and hours of operation. A single lane detour may be used for short term, local detours wherever the traffic can be safely accommodated on a single lane. The Contractor shall notify the Local Authority and emergency service providers a minimum of one week prior to all proposed short term traffic interruptions. Short term detours shall be limited to the hours of 10:00 pm to 6:00 am local time.
All detours, other than short term as above, created by the Contractor for the purpose of construction activities must achieve an equivalent level of service for the a.m. and p.m. peak hour traffic conditions to the level of operation achieved in the Package (as defined in Section 200.2.2 (Traffic Simulation)), or meet the minimum level of service (or other MOE) specified. The Contractor shall submit traffic modeling files in accordance with Section 200.2.2 (Traffic Simulation).

200.2.5.6.3 Seasonal Maintenance of Detours

The City of Edmonton will perform winter maintenance (snow and ice control) of Stony Plain Road, 100 Avenue, Whitemud Drive, 109 Avenue, and 111 Avenue during the Construction Period.

Access Roads Edmonton Ltd., through its subcontractor, Traffic Systems Management Inc. (TSMI) is the maintenance contractor for the Anthony Henday Drive mainline and ramps within the Project Limits and at 87 Avenue.

The Contractor shall provide TSMI and The City of Edmonton with details of all temporary construction installations to be operated and maintained throughout seasonal shut-down periods. A schedule of planned seasonal shut-down periods shall be provided to the Maintenance Contractor and updated as required and the Contractor shall notify TSMI and The City of Edmonton one month before construction stops/starts on the roadway seasonally.

During active construction periods (i.e. non-shutdown periods), the Contractor is responsible for operations and maintenance of any detours installed on the Project.

The Contractor is expected to act responsibly and professionally throughout the construction term and take all reasonable precautions to prevent damage to existing infrastructure.

The Contractor will be permitted to detour Anthony Henday Drive (northbound or southbound or both) traffic onto the bridges over Stony Plain Road and/or 100 Avenue prior to Traffic Availability.

200.2.5.7 Demolition

The Contractor shall demolish, remove and dispose (the "Demolition") of all buildings, associated works (wells, poles, etc.), other structures or installations located on the Affected Areas (as defined below). The Contractor shall obtain all required permits and approvals for the Demolition. The Province shall ensure the Affected Areas have been vacated by the Affected Areas' tenants so as to enable the Contractor to carry-out the Demolition. The Contractor shall restore the Affected Areas after the Demolition to a landscaped state consistent with the surrounding area. Burial of the demolition materials shall not be allowed.

The "Affected Areas" means those lease areas with File #s 936R, 935J, 916U, 910C, 919F, 919H, 921P, 937P, and 900J as set out in Appendix F (Alberta Infrastructure Land Lease Summary and Drawing). The portion of lease area 937P that is in the Road Right of Way will be vacated by June 1, 2009. Nothwithstanding the foregoing, the other Affected Areas noted in Appendix F will be vacated prior to signing of the DB Agreement.

200.2.5.8 Geotechnical

200.2.5.8.1 Vertical Wick Drains

Vertical wick drains and granular drainage layer shall be installed under all approach fills to allow for adequate dissipation of pore water pressure during construction as shown on the drawings in the Geotechnical Report.

The wick drains shall be installed from the top of the granular drainage layer and shall penetrate through the clay layer and at least 1m into the underlying sand. A stick-up of about 0.3m shall be left above the top of the drainage layer. The actual depths of the wick drains may vary depending on the design grades established for the granular pad.

The Department has awarded a contract for installation of wick drains at Stony Plain Road/Anthony Henday Drive to facilitate compression of underlying materials with a fixed completion date of November 15, 2008. The extent of the work completed by November 15, 2008 will be revealed by November 30, 2008. The Contractor shall complete all wick drain installations required in the Geotechnical Report and preserve all wicks, drainage layers and instrumentation installed in the Department's advanced wick drain installation and prior instrumentation during the design and construction of the Project.

Minimum requirements for wick drain spacing and lengths for each abutment fill area are presented in Table 200.2.5.8.1.1.

TABLE 200.2.5.8.1.1
MINIMUM REQUIREMENTS FOR WICK DRAINS

LOCATION	HEAD SLOPE	WICK DRAIN SPACING (m x m)		ESTIMATED AVERAGE WICK DRAIN LENGTH (m)
		Zone 1	Zone 2	
AHD and 100th Avenue	South	2.0 x 2.5	2.5 x 3.0	7

	North	2.0 x 2.5	N/R	7
AHD and SPR	South	2.0 x 2.5	2.5 x 3.0	11
	North	2.0 x 2.5 (West and east sides of approach fill)	N/R	10
AHD, NB Ramp over SPR	South	2.0 x 2.5	2.5 x 3.0	12
	North	2.0 x 2.5	2.5 x 3.0	12
AHD, NB Ramp over 100th Avenue	South	2.0 x 2.5	2.5 x 3.0	11
	North	2.0 x 2.5	2.5 x 3.0	11
AHD, NB Ramp connecting 87th Avenue	South	2.0 x 2.5	2.5 x 3.0	14
	North	2.0 x 2.5	2.5 x 3.0	14

N/R – Not Required.

The specified locations for wick drain installation are shown on the drawings contained in the Geotechnical Report.

200.2.5.8.2 Granular Drainage Layer

A granular drainage layer, consisting of free draining granular material shall be placed at all areas where wick drains are installed. The granular drainage material shall consist of sand or gravel free from silt and clay lumps having less than 5% passing a 0.080 mm sieve.

Gradation specifications are provided in Table 200.2.5.8.2.1.

TABLE 200.2.5.8.2.1
GRADATION FOR FREE DRAINING GRANULAR MATERIAL

SIEVE	% PASSING
1 ½ in. (38,000 µm)	100%
⅜ in. (10,000 µm)	65 - 100
No. 4 (5,000 µm)	50 - 100
No. 10 (2,000 µm)	35 - 90
No. 40 (400 µm)	10 - 45
No. 100 (150 µm)	0 - 20
No. 200 (75 µm)	0 - 5

The drainage layer shall be at least 0.3m thick and shall be compacted to 95% of Standard Proctor maximum dry density. The drainage layer shall be properly crowned to provide drainage to the toes of the fills after underlying materials have been compressed by the weight of the fill.

In all locations where wick drains are added by the Contractor the functionality of the granular layer constructed in the advanced wick drain contract shall be preserved.

200.2.5.8.3 Fills

Embankment fills shall be placed in accordance with the Technical Requirements. Where fills are placed over existing approach fill side slopes (e.g. north of Stony Plain Road), the existing fills shall be benched to provide adequate bonding between the existing and new fill. The benching shall be undertaken from the bottom of slope and subsequent benches shall not be excavated until the fill has been raised in layers to the top of the previous bench.

The Contractor will be required to install instrumentation for the purpose of monitoring slope movements, pore pressures and time-settlement relationships in all bridge approach fills. Acceptable instrumentation for monitoring slope movement during approach fill construction shall be limited to slope inclinometers. The Contractor will be required to undertake monitoring and satisfy himself that the stability of all fills is maintained. The Contractor will be required to regulate its rate of fill placement on the basis of porewater pressures in the underlying materials. The Contractor shall be required to provide the results of all monitoring to the Department.

The Contractor shall make all reasonable efforts to place all bridge fills in the first construction season. The Contractor should make all reasonable effort to place mainline fills as expediently as possible. The width of all fills is to be overgraded to achieve the required subgrade width on the basis of predicted time-settlement relationships for the fills.

200.2.5.9 Pavement Structure

The Department has prepared basic pavement designs using a long life pavement strategy with a 50-year initial service life. The basic pavement designs, associated layer thicknesses, and material requirements are contained in Tables 200.2.5.9.1 and 200.2.5.9.2, below. Modifications to the specified grade of asphalt cement are outlined in Section 200.2.5.10.

Widening of a portion of the AHD-SB to WMD-WB ramp is needed to meet geometric requirements. The pavement structure of the widened area is to match the existing ramp pavement structure which is approximately 300mm of ACP over 350mm of GBC.

Reduction of the existing pavement structure for all rehabilitation areas indicated in Table 200.2.5.9.1 (New Construction and Rehabilitation Pavement Structure Minimums) by cold milling or other means is not permitted.

The Contractor is responsible for providing embankment / subgrade materials that result in a minimum effective subgrade resilient modulus of 30 MPa, as defined within the AASHTO Pavement Design Guide (1993) when tested in an unmodified condition (i.e. without the use of stabilizing additives). When the Department suspects that the embankment / subgrade material does not meet the minimum effective subgrade resilient modulus requirement the Contractor will be required to undertake laboratory testing of the suspect embankment / subgrade material according to AASHTO T307, Determining the Resilient Modulus of Soils and Aggregate Materials. Alternatively, the embankment / subgrade material will be considered suitable if it has a minimum soaked California Bearing Ratio (CBR) value of 3.0 when tested in accordance with ASTM D1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils. The laboratory samples used in ASTM D1883 shall be compacted at a moisture content of between 3 percent below the optimum water content and the optimum water content and to no more than 100 percent of the maximum unit weight, as determined by

ASTM D688, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/cu.ft (600 kN-m/cu.m)].

Table 200.2.5.9.1 identifies deferred ACP material to be placed in the future. This Table also identifies roadway sections under overhead bridge structures where either a mill and inlay treatment or placement of the deferred ACP is to be done. Contrary to what is listed in Table 200.2.5.9.2 the asphalt grade for any deferred ACP placed under the DB Agreement shall be the same as the surface lift of the adjacent pavement.

Modification of the proposed subgrade material may be undertaken for construction expediency but it cannot be used in order to meet the minimum resilient modulus value. Subgrade materials that have a resilient modulus value in excess of 30 MPa will not result in a corresponding reduction in the pavement design thicknesses provided by the Department.

The Contractor shall determine the need and location for subsurface roadway drainage and how it is to be installed.

All granular base layers shall be designed and constructed to ensure lateral drainage within all granular materials, both new and existing, is not impeded.

The elevation and cross-slope of all new subgrade shall be designed and constructed to ensure that lateral drainage is not interrupted or impeded, particularly at all tie-in locations both longitudinally and transversely, with existing pavements.

Where the Stage 1 median width is to be 38.0m, the entire existing payment structure is to be removed.

In the event that the pavement structure for the New Infrastructure differs from that of the existing pavements, the New Infrastructure shall transition to the existing pavement so as to match seamlessly at all tie-in locations.

The Contractor shall assume ownership of all salvaged pavement materials and shall haul them from the Project to its own storage site or otherwise dispose of them.

Existing granular roadway materials may be salvaged and only reused on the Project for subgrade materials provided they are placed, at least 150mm, in thickness and for the complete roadway width. No pavement structure is tabulated below for the westbound exit ramp to Winterburn Road. The pavement structure for this ramp, as a minimum shall match the existing pavement where joined, and shall ensure internal drainage and continuity of subgrade and GBC.

Table 200.2.5.9.1: New Construction and Rehabilitation Pavement Structure Minimums

Roadway Section	Pavement Structure Layer Thickness (mm)			Rehabilitation Strategy Treatment Thickness (mm)		
	ACP (Deferred) (1)	Initial ACP	GBC (11)	Mill and Inlay (12)	ACP Overlay	ACP Overlay (1)
New Construction - AHD Mainline - NB & SB ~ Sta. 6+900 to ~ Sta. 11+000	50	350 (2)	400			
Rehabilitation - AHD Mainline - NB (3) ~ Sta. 5+600 to ~ Sta. 6+900				50		50
Rehabilitation - AHD Mainline - SB (4) ~ Sta. 5+600 to ~ Sta. 6+900				100		50
Rehabilitation - AHD Mainline - NB & SB (5) ~ Sta. 11+000 to ~ Sta. 11+450				50	70	50
Rehabilitation - AHD - SB to WMD - WB				100		50
New Construction - AHD - SB to WMD - WB	50	300 (14)	350			
Re-Construction - WMD - EB to WMD WB/AHD - NB	50	200	350			
New & Re-Construction - WMD - WB to AHD - NB (6)	50	350	350			
New Construction - AHD - NB to 87 Ave. EB & WB	50	150	350			
New Construction - 87 Ave. EB & WB to AHD - NB (7)	50	200	350			
New Construction - 87 Ave. EB & WB to AHD - SB (7)	50	200	350			
Rehabilitation - 87 Ave. EB & WB to AHD - SB				--		50 (10)
New Construction - AHD - SB to 87 Ave. EB & WB	50	150	350			
Rehabilitation - AHD - SB to 87 Ave. EB & WB				--		50
New Construction - AHD - NB to SPR - WB (8)	50	250	400			
New Construction - AHD - NB/SPR - WB to 100 Ave. - EB	50	200	400			
Rehabilitation - 100 Ave. - EB (8)				50	70	50 (8)
New Construction - 100 Ave. - EB to AHD - NB (8)	50	250	400			
New Construction - 100 Ave. - EB/AHD - NB to AHD - SB	50	250	400			
Rehabilitation - SPR - WB (8 & 9)				50 (9, 13)	50	50 (8)
New Construction - SPR - WB to AHD - NB	50	150	350			
Rehabilitation - SPR - WB to AHD - NB					50	50
New Construction - SPR - WB to AHD - SB (8)	50	250	400			
New Construction - AHD - SB to 100 Ave. - EB (8)	50	200	400			
New Construction - AHD - SB/100 Ave. - EB to SPR - WB	50	200	400			
New Construction - AHD - NB to 111 Ave. - EB	50	200	400			
New Construction - 111 Ave. - WB to AHD - NB	50	200	400			
New Construction - AHD - SB to 109 Ave. - WB	50	200	400			
New Construction - 109 Ave. - EB to AHD - SB	50	200	400			
New Construction - SPR - WB Winterburn Road ramp	50	150	400			

Notes:

(1) not part of the Project (deferred to the future)
(2) reduce outside shoulder ACP thickness by 200 mm and replace with GBC, except at all current and future ramp tie-ins
(3) except under 87 Ave. structure plus 50 m on either side, 100 mm mill & inlay with no overlay, widening pavement structure to be same as AHD new mainline
(4) except under 87 Ave. structure plus 50 m on either side, 150 mm mill and inlay with no overlay, widening pavement structure to be same as AHD new mainline
(5) except under CNR structure plus 50 m south, mill and inlay 100 mm with no overlay
(6) deferred ACP to be placed under "basket weave" structure plus 50 m on either side
(7) deferred ACP to be placed under 87 Ave. structure plus 50 m on either side
(8) deferred and ACP overlay to be placed under AHD and Ramp structures plus 50 m on either side
(9) increase milling to 100 mm ~ 100 m E of existing AHD - NB to ~ 50 m W of existing AHD - SB and replace with ACP prior to ACP overlay
(10) except under 87 Ave. structure, no ACP overlay
(11) Designation 2 Class 25
(12) to include all travel lanes
(13) increase milling to 100 mm for outer driving lane from ~ 300 m E to ~ 100 m W of start of the pavement gore for the existing Winterburn Road exit and replace with ACP prior to ACP overlay
(14) for any widened area, match existing ramp pavement structure which is approximately 300 mm of ACP over 350 mm of GBC.

Table 200.2.5.9.2: New Construction and Rehabilitation Pavement - ACP Mix Types and Binder Grades

Roadway Section	ACP Mix Type - New Construction / Asphalt Binder Grade				ACP Mix Type - Rehabilitation / Asphalt Binder Grade		
	ACP (Deferred) (1)	Top 100 mm Initial ACP	Bottom 100 mm Initial ACP (2)	Remaining Lifts Initial ACP (3)	Mill and Inlay	ACP Overlay	ACP Overlay (1)
New Construction - AHD Mainline - NB & SB ~ Sta. 6+900 to ~ Sta. 11+000	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34	H1 / PG 58-34			
Rehabilitation - AHD Mainline - NB (3) ~ Sta. 5+600 to ~ Sta. 6+900					H1 / 120/150A		H1 / 120/150A
Rehabilitation - AHD Mainline - SB (4) ~ Sta. 5+600 to ~ Sta. 6+900					H1 / 120/150A	H1 / 120/150A	H1 / 120/150A
Rehabilitation - AHD Mainline - NB & SB (5) ~ Sta. 11+000 to ~ Sta. 11+450					H1 / 120/150A		H1 / 120/150A
Rehabilitation - AHD - SB to WMD - WB					H1 / 120/150A		H1 / 120/150A
Re-Construction - WMD - EB to WMD WB/AHD - NB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
New & Re-Construction - WMD - WB to AHD - NB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34	H1 / PG 58-34			
New Construction - AHD - NB to 87 Ave. EB & WB	H1 / PG 64-37	H1 / PG 58-37 (4)	S3 / PG 58-34				
New Construction - 87 Ave. EB & WB to AHD - NB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
New Construction - 87 Ave. EB & WB to AHD - SB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
Rehabilitation - 87 Ave. EB & WB to AHD - SB							H1 / 120/150A
New Construction - AHD - SB to 87 Ave. EB & WB	H1 / PG 64-37	H1 / PG 58-37 (4)	S3 / PG 58-34				
Rehabilitation - AHD - SB to 87 Ave. EB & WB						H1 / 120/150A	H1 / 120/150A
New Construction - AHD - NB to SPR - WB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34	H1 / PG 58-34			
New Construction - AHD - NB/SPR - WB to 100 Ave. - EB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
Rehabilitation - 100 Ave. - EB					H1 / 120/150A		H1 / 120/150A
New Construction - 100 Ave. - EB to AHD - NB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34	H1 / PG 58-34			
New Construction - 100 Ave. - EB/AHD - NB to AHD - SB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34	H1 / PG 58-34			
Rehabilitation - SPR - WB					H1 / 120/150A	H1 / 120/150A	H1 / 120/150A
New Construction - SPR - WB to AHD - NB	H1 / PG 64-37	H1 / PG 58-37 (4)	S3 / PG 58-34				
Rehabilitation - SPR - WB to AHD - NB						H1 / 120/150A	H1 / 120/150A
New Construction - SPR - WB to AHD - SB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34	H1 / PG 58-34			
New Construction - AHD - SB to 100 Ave. - EB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
New Construction - AHD - SB/100 Ave. - EB to SPR - WB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
New Construction - AHD - NB to 111 Ave. - EB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
New Construction - 111 Ave. - WB to AHD - NB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
New Construction - AHD - SB to 109 Ave. - WB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
New Construction - 109 Ave. - EB to AHD - SB	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				
New Construction - SPR - WB Winterburn Road ramp	H1 / PG 64-37	H1 / PG 58-37	S3 / PG 58-34				

Notes:

(1) not part of the Project (deferred to the future)

(2) the Design Air Voids shall be chosen as the lowest value, within the range of 2.5 to 3.0 percent, inclusive such that all other mix design criteria (excluding VFA) are met

(3) PG 58-37 may be substituted for PG 58-34 to facilitate construction scheduling

(4) lift thickness 50 mm

A subsequent lift of pavement will be placed by the Department. The Contractor shall design and construct the roadway width and elevation to accommodate the final stage paving while achieving ultimate roadway width and ultimate vertical clearances under bridge structures and allowing for settlement of fills due to consolidation of underlying materials.

200.2.5.10 Roadway Insulation

It has been documented that frost lensing and heaving occurred in sections of AHD mainline north of 87 Avenue and along sections of 100 Avenue, prompting The City of Edmonton to install extruded polystyrene insulation below sections of the existing roadway, around a concrete culvert south of 100 Avenue, and around drainage culverts on sections of 100 Avenue and AHD in the vicinity of 100 Avenue. Some sections of the existing Anthony Henday Drive, as indicated in The City of Edmonton's drawing FFRR 210 D12 (posted in the Electronic Data Room), required a "granular working pad" to be constructed prior to the replacement of the insulation. The granular working pad was similar to the requirements contained in Section 400.2.53 (Extruded Polystyrene Pavement Insulation).

As-built records of the roadway construction were obtained from The City of Edmonton and were reviewed to determine approximate locations of road insulation. The locations of existing insulation are noted to the best of the Department's knowledge in Table 200.2.5.10.1 below. Based on the information provided by The City of Edmonton, the insulation generally consisted of 25-100mm of Styrofoam HI on the sections south of Stony Plain Road. At the location of the CN underpass north of Stony Plain Road, 900mm of bottom ash was used to provide subgrade insulation.

To reduce the effects of frost heave, all areas where the frost heave potential is high are be insulated to limit the depth of frost penetration. These areas are shown in Table 200.2.5.10.2. These areas were identified based on existing insulation installations on the existing roadway. Additional locations have also been identified, where the frost potential is considered high mainly due to high ground water levels and depressed surface elevations, where roadway insulation is also required

For continuity, the insulation is to extend laterally across the road subgrade at new and grade widening locations, where insulation is present under the existing roadways. Extruded polystyrene insulation shall be Grade 3 in accordance with Section 400.2.53 (Extruded Polystyrene Pavement Insulation). The roadway insulation is to extend a minimum of 2.7 metres from the outer edge of the Stage 1 asphalt pavement.

Re-use of any salvaged existing extruded polystyrene insulation shall not be permitted on the Project.

Areas requiring insulation are approximate only and must be verified during the detailed designs. In addition, the locations of existing insulation must be verified in the field and the new insulation designed to match the existing locations. All roadway subgrade are be inspected by the design geotechnical engineer during construction and additional areas containing potentially frost susceptible soils must be identified and treated to mitigate frost heave effects. The frost heave mitigation must be similar to those used in adjacent areas.

All extensions to existing insulated culverts and any new culverts in frost susceptible areas are to be insulated to ensure they are not affected by frost penetration.
The material requirements for ACP over insulated areas are contained in Table 200.2.5.10.3, below.

For this Project, contrary to Section 400.2.33 (Supply of Asphalt), all asphalt cement specified as PG 58-37 and PG 58-40 shall be modified through the addition of polymers to meet the requirements of Table 2 in AASHTO M320 Performance-Graded Asphalt Binder with the following modifications for the PG 58-37 asphalt:

- The critical low cracking temperature shall be no higher than -27°C; and
- The test temperature for dynamic shear on PAV residue shall be 15°C.

TABLE 200.2.5.10.1
INSULATION DETAILS FOR EXISTING PAVEMENT STRUCTURES

ROADWAY SECTION	CHAINAGE	PAVEMENT Bottom Ash Thickness (mm)	PAVEMENT Extruded Polystyrene Thickness (mm)	DRAWING REFERENCE
AHD NB	21+096 - 21+100		25	FFRR 210 D07
	21+100 - 21+480		50	FFRR 210 D07-D10
	21+480 - 21+484		25	FFRR 210 D10
	21+680 - 21+700		25	FFRR 210 D11.
	21+700 - 21+710		50	FFRR 210 D11.
	21+710 - 21+720		75	FFRR 210 D11.
	21+720 - 22+300		100	FFRR 210 D12
	22+300 - 22+340		75	FFRR 210 D13
	22+340 - 22+380		50	FFRR 210 D13
	22+380 - 22+400		25	FFRR 210 D13
	1122+923 - 1122+927		25	FFRR 210 D18
	1122+927 - 1122+931		50	FFRR 210 D18
	1122+931 - 1122+935		75	FFRR 210 D18
	1122+935 - 1123+210		100	FFRR 210 D18 & 19
	1123+210 - 1123+215		75	FFRR 210 D19
	1123+215 - 1123+220		50	FFRR 210 D19
	1123+220 - 1123+225		25	FFRR 210 D19
	101+310 - 101+897	900		ANHE 981 D04
AHD SB	21+120 - 21+124		25	FFRR 210 D07
	21+124 - 21+445		50	FFRR 210 D07-D10
	21+445 - 21+449		25	FFRR 210 D10
	21+660 - 21+680		25	FFRR 210 D11.
	21+680 - 21+700		50	FFRR 210 D11.
	21+700 - 21+710		75	FFRR 210 D11.
	21+710 - 22+310		100	FFRR 210 D12
	22+310 - 22+330		75	FFRR 210 D13
	22+330 - 22+410		50	FFRR 210 D13
	22+410 - 22+460		25	FFRR 210 D13

TABLE 200.2.5.10.2
INSULATION DETAILS FOR NEW CONSTRUCTION

ROADWAY SECTION	CHAINAGE			CONSTRUCTION TYPE	PAVEMENT INSULATION	
					Bottom Ash Thickness (mm)	Extruded Polystyrene Thickness (mm)
AHD NB	6+644	-	6+648	Widen		25
	6+648	-	6+650	Widen		50
	6+650	-	6+654	Widen		75
	6+654	-	7+031	Widen		100
	7+031		7+035	Widen		75
	7+035		7+039	Widen		50
	7+039	-	7+043	Widen		25
	7+232	-	7+252	Reconstruct		25
	7+252	-	7+262	Reconstruct		50
	7+262	-	7+272	Reconstruct		75
	7+272	-	7+852	Reconstruct		100
	7+852	-	7+892	Reconstruct		75
	7+892	-	7+932	Reconstruct		50
	7+892	-	7+952	Reconstruct		25
	10+990	-	NPL[1]	Widen	900	
AHD SB	6+666	-	6+670	Widen		25
	6+670	-	6+674	Widen		50
	6+674	-	6+678	Widen		75
	6+678	-	6+995	Widen		100
	6+995	-	6+999	Widen		75
	6+999	-	7+003	Widen		50
	7+003	-	7+007	Widen		25
	7+212	-	7+232	Reconstruct		25
	7+232	-	7+252	Reconstruct		50
	7+252	-	7+262	Reconstruct		75
	7+262	-	7+862	Reconstruct		100
	7+862	-	7+882	Reconstruct		75
	7+882	-	7+962	Reconstruct		50
	7+962	-	8+012	Reconstruct		25
	10+980	-	NPL[1]	Widen	900	

Table 200.2.5.10.3: New Construction - Insulated Pavement - ACP Mix Types and Binder Grades

Roadway Section	ACP Mix Type – New Construction - Extruded Polystyrene Insulation / Asphalt Binder Grade			
	50 mm ACP (Deferred) (1)	Top 100 mm Initial ACP	Bottom 100 mm Initial ACP (2)	Remaining Lifts Initial ACP (3)
New Construction - AHD Mainline - NB & SB	H1 / PG 64-40	H1 / PG 58-40	S3 / PG 58-37	H1 / PG 58-37
Re-Construction - WMD - EB to WMD WB/AHD - NB	H1 / PG 64-40	H1 / PG 58-40	S3 / PG 58-37	
New & Re-Construction - WMD - WB to AHD - NB	H1 / PG 64-40	H1 / PG 58-40	S3 / PG 58-37	H1 / PG 58-37
New Construction - AHD - NB to 87 Ave. EB & WB	H1 / PG 64-40	H1 / PG 58-40 (4)	S3 / PG 58-37	
New Construction - 87 Ave. EB & WB to AHD - NB	H1 / PG 64-40	H1 / PG 58-40	S3 / PG 58-37	
New Construction - 87 Ave. EB & WB to AHD - SB	H1 / PG 64-40	H1 / PG 58-40	S3 / PG 58-37	
New Construction - AHD - SB to 87 Ave. EB & WB	H1 / PG 64-40	H1 / PG 58-40 (4)	S3 / PG 58-37	
New Construction - 100 Ave. - EB to AHD - NB	H1 / PG 64-40	H1 / PG 58-40	S3 / PG 58-37	H1 / PG 58-37
New Construction - 100 Ave. - EB/AHD - NB to AHD - SB	H1 / PG 64-40	H1 / PG 58-40	S3 / PG 58-37	H1 / PG 58-37
New Construction - AHD - SB to 100 Ave. - EB	H1 / PG 64-40	H1 / PG 58-40	S3 / PG 58-37	
New Construction - AHD - SB/100 Ave. - EB to SPR - WB	H1 / PG 64-40	H1 / PG 58-40	S3 / PG 58-37	

Notes:

(1) not part of the Project (deferred to the future)

(2) the Design Air Voids shall be chosen as the lowest value, within the range of 2.5 to 3.0 percent, inclusive such that all other mix design criteria (excluding VFA) are met

(3) PG 58-40 may be substituted for PG 58-37 to facilitate construction scheduling

(4) lift thickness 50mm

200.2.6 DRAINAGE

The basis for drainage design shall be as outlined in the Functional Plan unless stated otherwise elsewhere in the Technical Requirements. Drainage works shall be designed in accordance with Alberta Transportation's Design Bulletin #16/2003 - *Drainage Guidelines for Highways Under Provincial Jurisdiction in Urban Areas* (Revised July 2007), Alberta Transportation's *Best Practice Selection of Culvert Types (Guidelines for Culvert Material Selection)*, and in accordance with the requirements of the Local Authority. Notwithstanding what is stated in the Design Bulletin #16/2003:

- the highway ditch bed slopes shall be as steep as possible while maintaining non-erosive flow velocity during design discharge, to prevent standing water, and to avoid excessive erosion;
- the highway ditches shall maintain a minimum slope of 0.2% to prevent standing water and also be designed to minimize velocities to avoid excessive erosion;
- for dry ponds the maximum allowable fluctuation for the 1:100 year event shall be 2.5m and the minimum bottom slope shall be 1.0%; and
- for wet ponds the allowable fluctuation depth above the permanent pool shall be 2.5m.

Stormwater storage facilities shall be sized to accommodate stormwater from within the Road Right of Way, remaining areas of the TUC, and pre-development flow volumes from areas outside the TUC within the natural drainage basin. The facilities shall be designed and operated to regulate all runoff discharge to receiving bodies at the general locations and in quantities outlined in the Functional Plan and confirmed by the Contractor. Subject to The City of Edmonton's permitted release rates, detention of some or all of the pre-development runoff may also be required. All stormwater storage facilities and minor conveyance systems shall be designed for the Ultimate Stage. All other drainage components shall be designed for the same scenario as the grading in the general vicinity of the individual drainage components.

Stormwater management facility locations shall be determined by the Contractor. Any proposed use of lands outside the Road Right of Way and within the TUC for stormwater management facilities shall require the Contractor to obtain prior written agreement from Alberta Infrastructure. Stormwater storage facilities placed adjacent to power transmission towers shall be shaped to allow overland access to the tower and a surrounding work area for power company maintenance equipment at the time water levels in the ponds are at design high water levels. Specific details of the access and work area requirements will be developed jointly by the Contractor and the affected power company. The stormwater storage facilities shall be enclosed by fences.

Stormwater storage facility wet ponds shall have vegetation for water quality enhancement, and erosion control.

If the Contractor makes an agreement to handle stormwater from outside the TUC with any party, then the Contractor shall ensure such agreements shall indemnify the Department from any future liability. Any such agreements shall require prior written approval of the Department.

Agreements for stormwater management facilities, ditch easements or other agreements which the Contractor may enter into, shall not provide for any payments from the Department without the Department's prior written consent. Such agreements must transfer to the Department at Construction Completion, at no cost to the Department, and must be enforceable in perpetuity.

The Contractor shall not sell drainage capacity in the stormwater management facilities to any third party.The following miscellaneous drainage requirements shall be met:

- Use of smooth wall steel pipes shall require prior written agreement with the Department for the intended use;
- Manholes shall not be located within the paved area of the roadway, except for catch basin/manholes in the urban section of the crossroads;
- All manholes in excess of 1.0m depth shall have galvanized metal ladder rungs;
- For sizing of the storage facilities, the Contractor shall use the rainfall events indicated in the latest City of Edmonton Design and Construction Standards; and
- Including freeboard, the stormwater management facilities shall accommodate a total storage volume equal to 1.25 times the volume of the critical (synthetic and historical) rainfall event.

In addition to the design and construction of the New Infrastructure drainage system, the Contractor is responsible for ensuring the previously installed drainage systems on other portions of the Road Right of Way and the TUC are compatible and the overall system meets the Technical Requirements. This includes the entire drainage network from the source points to the various outfalls and all features in between. The Contractor shall ensure that the design hydraulic capacity of the network as a whole and each of its elements meets the Technical Requirements. The Contractor shall note that some elements of the drainage network are shared between the Department and the Local Authority. The Contractor acknowledges as having reviewed the agreements describing the shared systems. The Contractor shall not be permitted to interfere with the function of any shared system without the permission of both the Department and the affected communities.

200.2.7 ROADWAY LIGHTING

The Contractor is responsible for design and installation of all required roadway lighting for the Contractor's constructed roadway and bridge structure elements. All existing roadway lighting on Stony Plain Road, 100 Avenue and AHD mainline north of Station 7+780 shall be replaced with new roadway lighting. The standard of existing median mainline lighting south of Station 7+780 is to be duplicated for the New Infrastructure required along AHD mainline. The scope of replacement and new installation includes without limitation bases, poles, luminaires, and power supplies if necessary. The north Project Limit for the New Infrastructure for median mainline lighting shall include the streetlight north of the CNR Edson Subdivision property.

The power supply for AHD mainline lighting shall tie into the Province's circuitry.

All existing lighting on Stony Plain Road and 100 Avenue within the Project Limits shall be replaced. This includes without limitation: bases, poles, luminaires, conduit and power supply if necessary. All power supply sources for Stony Plain Road and 100 Avenue shall be retained.

All detours and existing roadways that carry traffic during construction are to be illuminated.

Transitions between adjacent sections of lighting shall be gradual, in both colour and intensity. The lighting system shall meet or exceed the following requirements:

- *Alberta Transportation Highway Lighting Guide Specifications*;
- Light standards shall be set back to meet clear zone requirements for additional lanes to be added in the Ultimate Stage;
- The lighting system shall be low or medium light pole systems. High mast system may be used in areas located 600m or more away from existing or future residential areas;
- Light standards shall be located in the centreline median or off the right side of the roadways for the mainline illumination and off the right side of the roadway for illumination of connectors, ramps, C-D roads and crossroads;
- The level of illumination shall meet Table 5.1 of the *Alberta Transportation Highway Lighting Guide* utilizing high pressure sodium lamps;
- Anthony Henday Drive shall be considered an urban freeway for the purposes of the application of Table 5.1 in the *Alberta Transportation Highway Lighting Guide*;
- All light poles that are not considered to be high mast light poles shall have breakaway bases;
- Crossroads shall be considered urban arterial for the purposes of the application of Table 5.1 in the *Alberta Transportation Highway Lighting Guide*;
- Both Stony Plain Road and 100 Avenue west of the east terminals of the interchange ramps at Anthony Henday Drive shall be considered rural freeway for the purposes of the application of Table 5.1 in the *Alberta Transportation Highway Lighting Guide*;
- The lighting system on both Stony Plain Road and 100 Avenue between the east ramp terminals and the west Project Limit shall be new including new poles, luminaires and wiring;
- Replace power supply cabinets at existing locations on Stony Plain Road and 100 Avenue;
- Under-structure lighting shall be provided beneath Anthony Henday Drive bridges on both Stony Plain Road and 100 Avenue;
- Power supply for under-structure lighting may be provided from Anthony Henday Drive supply source;
- Notwithstanding those items listed below which shall be returned to The City of Edmonton, all roadway lighting materials salvaged or removed from any location on the Project will become the property of the Contractor;
- All luminaires salvaged or removed from 100 Avenue, Stony Plain Road, 109 Avenue, and 111 Avenue shall be returned to The City of Edmonton;
- Electrical Cables - All electrical cables and communications/signals wiring shall be underground;
- Continuous lighting is required on Anthony Henday Drive mainline, including all ramps, connector roads, crossroads, and C-D roads;
- *The Alberta Transportation Highway Lighting Guide Specifications* shall govern when determining clear zone requirements for lighting;
- If the median clear zone exceeds 10.5m, pole heights of up to 20m may be permitted on break-away bases;

- Luminaires are to be "semi-cutoff";
- Lighting along Stony Plain Road and 100 Avenue shall have standards 43' in height and IP66 luminaires;
- Lighting requirements for Access Roads shall be governed by the Local Authority in which the Access Roads exist; and
- Light standard foundations shall be designed to resist frost jacking.

The Department has issued Construction Bulletin #35/2006 regarding the incorporation of the *TAC Guide for the Design of Roadway Lighting (2006)* into an updated Province's *Highway Lighting Guide*. The *TAC Guide for the Design of Roadway Lighting (2006)* shall be a source for lighting design parameters (i.e. lighting levels and warrants). The general design guidelines from the Province's *Highway Lighting Guide* (including general design requirements, constructing and maintenance) are still the primary guidelines to be used.

200.2.8 GUIDE SIGNING

Guide signing and guide sign structures for the New Infrastructure shall be designed and installed by the Contractor. The guide signing for the Project, including all mainline, interchanges and crossroad components, is identified on guide sign drawings ("Guide Signing for New Infrastructure") in Appendix D of Schedule 14 (Technical Requirements). The New Infrastructure guide sign structures shall be designed to accommodate the loadings imposed by the addition of Ultimate Stage guide sign panels at a future time. They shall also be designed for additional guide sign panels, which will be added by others when the New Infrastructure is eventually expanded.

All guide signs for the Project shall comply with the Department's *Highway Guide and Information Sign Manual,* dated October 2006 and Appendix D drawings. The guide sign panels shown in Appendix D have individually been identified according to the Department's Guide Sign Panel Identification Protocol in the Department's Guide Sign Master Plan (the "Protocol"). In general, the principles being followed in the Protocol are as follows:

For example, the designation 39-SW-01-OH-L indicates:

- 39 = Exit 39 and identifies the exit located 39 km originating from Calgary Trail along Anthony Henday Drive and travelling clockwise;
- SW = identifies the location as being in the southwest quadrant of the interchange;
- 01 = Panel number at this location;
- OH = Support Structure Type (OH for Overhead, C for Cantilever, GM for Ground Mounted); and
- L = Panel Position on this structure (L for Left, M for Middle, R for Right).

This Protocol will apply to all guide sign panels for the New Infrastructure.

The details regarding the location, messaging and sizing of all overhead and cantilever mounted guide signs are set out in Appendix D. The Contractor shall design and install all overhead and cantilever signs and ground mounted guide signs required for the New Infrastructure, including without limitation, those signs set out in Appendix D. The Contractor acknowledges that certain overhead and cantilever mounted signs set out in Appendix D are located outside the

TUC ("Signs Outside the TUC"). For the Signs Outside the TUC, the Contractor shall obtain all the necessary permits and approvals from the appropriate authorities in order to design and install the Signs Outside the TUC.

The Contractor shall remove all guide signs that contain messaging inconsistent with the requirements set out in Appendix D regarding sign messaging for the New Infrastructure and to comply with the Contractor's Traffic Management Plan; including such guide signs to be removed from existing sign structures located outside the Project Limits. Existing crossroad guide signs containing messaging inconsistent with requirements set out in Appendix D which may be located outside of the Project Limits shall be removed by the Contractor in consultation with the Local Authority. In this regard, the Contractor shall be provide advance notification to, and liaise/coordinate with the Local Authority. In all cases, the timing of such guide sign removals shall be coordinated with the Contractor's schedule for Traffic Availability.

The Clearview Highway font shall be used on all guide signing in accordance with Design Bulletin #36, which is posted on the Department's web site.

The following font sizes and letter heights shall be used for the Project:

- Anthony Henday Drive Mainline, ramps, and Stony Plain Road/100 Avenue Overhead Signage – 406mm (16 inch) EM font.
- Anthony Henday Drive Mainline, ramps, and Stony Plain Road/100 Avenue Shoulder Mounted Signage – 330mm (13 inch) EM font. In cases where the street name is very long, the letter height may be reduced to 305 mm (12 inch).
- Non Mainline Overhead Signage – 330mm (13 inch) EM font.
- Non Mainline Shoulder Mounted Signage – 254mm (10 inch) EM font.

Overhead directional signs shall have reflective sheeting as specified under Section 400.2.38 (Supply of Permanent Highway Signs, Posts and Bases).

The Contractor shall submit shop drawings using the "Clearviewhwy font software" package for the message content and layout on the major guide signs prior to manufacturing. The Contractor shall obtain the Department's final written approval of all guide sign message content prior to manufacturing the guide signs.

200.2.9 TOPSOIL AND SEEDING

Topsoil material shall be uniformly spread over the prepared areas to facilitate the required seeding and landscaping. Under no circumstances shall any topsoil be buried, wasted or otherwise disposed of. In the case of large amounts of surplus topsoil, the Contractor shall indicate how the material shall be handled and stored in a manner applicable to relevant regulatory requirements. The handling and storage of topsoil is to be included in the Contractor's Environmental Management System (Section 100.2.2) operational procedures.

Conventional seeding and/or hydro-seeding shall be carried out at the Contractor's discretion to meet the requirements of these specifications related to drainage and erosion.

All seed supplied by the Contractor shall be certified free of all noxious weed varieties identified in the *Weed Control Act* (Alberta).

In order to maintain consistency in vegetation within the TUC, seeding of the New Infrastructure shall be the same as for existing portions of Anthony Henday Drive where the following seed mixes have been used:

Areas within the Road Right of Way:

Slender/Awned/Bearded Wheatgrass	*Agropyron trachycaulum*	30%
Mountain Brome	*Bromus carinatus*	25%
Sheep Fescue	*Festuca ovina*	25%
Green Needle Grass	*Stipa viridula*	5%
Western Wheatgrass	*Agropyron smithii*	5%
Northern/Streambank Wheatgrass	*Agropyron dasystachyum*	5%
Fringed/Nodding Brome	*Bromus ciliatus/anomalus*	5%

Areas within TUC but outside the Road Right of Way

Paddock Meadow Brome	*Bromus biebersteinii*	48%
Intermediate Wheatgrass	*Elytrigia intermedia ssp. Intermedia*	24%
Rangelander Alfalfa	*Medicago sativa*	12%
Highlander Slender (Awned) Wheatgrass	*Agropyron trachycaulum*	8%
Boreal Creeping Red Rescue	*Festuca rubra*	4%
Climax Timothy	*Phleum pratense*	4%

Ravine Areas (top of valley bank to top of valley bank)

Fowl Bluegrass	*Poa palustris*	25%
June Grass	*Koeleria macrantha*	20%
Green Needlegrass	*Stipa viridula*	15%
Elbee Northern Wheatgrass	*Agropyron dasystachyum*	15%
Adanac Slender Wheatgrass	*Agropyron trachycaulum*	15%
Rocky Mountain Fescue	*Festuca saximontana*	10%

Stormwater Storage Facilities (below design high water level)

Fowl Bluegrass	*Poa palustris*	30%
Tufted Hairgrass	*Deschampsia caespitosa*	20%
Giant Wild Rye	*Elymus pipuris*	15%
Western Wheatgrass	*Agropyron smithii*	15%
Slough Grass	*Beckmania syzigachne*	10%
Awned (Bearded) Wheatgrass	*Agropyron trachycaulum*	10%

In Dry Pond Areas:

Slender Wheatgrass	*Elymus trachycaulus*	25%
Northern Wheatgrass	*Agropyron dasystachyum*	10%
Fringed Brome (coated)	*Bromus cilatus*	15%
Green Needlegrass	*Stipa viridula*	15%
Canada Wildrye	*Elymus canadensis*	10%
Indian Rice Grass	*Orzyopsis hymenoides*	10%
Nuttall’s Alkali Grass	*Puccinellia nuttalliana*	10%
Western Wheatgrass	*Agropyron smithii*	5%

200.2.10 UTILITIES

Major utilities and pipelines within the Project Limits, along with contact information, are listed in Table 200.2.10.1.

Table 200.2.10.1
Major Utilities and Pipelines

Company	Utility	Location	Contact
Kinder Morgan	610 mm Oil Pipeline (steel)	5+930	Sandi Topilko 780-449-5906
Epcor Water	750 mm Water (concrete cylinder)	6+370	Lloyd Penner 780-412-3136
City of Edmonton Drainage	1200 mm Sanitary Sewer (gravity concrete tunnel)	7+970	Siri Fernando 780-496-6580
ATCO Pipelines	150 mm/200 mm Gas (steel high pressure)	8+915	Allan Toledo 780-420-3441
Parkland Regional Water Commission	600 mm Water (steel)	9+010	David Hales 780-962-7622
Epcor Water	300 mm Water (steel)	9+010	Lloyd Penner 780-412-3136
City of Edmonton Drainage	200 mm Sanitary Sewer (force main – 200 mm PVC Series 100)	9+600	Siri Fernando 780-496-6580
Epcor Power	240 kV Double Circuit Transmission		Wilf Behr 780-412-3962
Telus	Telecommunication facilities (copper, fibre)	5+600 8+800	Pasquale Rizzo 780-493-4050

The above table of utility contacts does not necessarily include all relevant utility companies. Many minor utilities, including power, telephone, cable TV, gas distribution, and street lighting are located within the TUC. Modification and/or relocation may be required to facilitate road construction.

This Section 200.2.10 (Utilities) is subject to section 4.7 of the DB Agreement. The Contractor shall locate all utility rights of way, easements, or similar interests (whether registered against title to the land or not) affected by the New Infrastructure. The Contractor shall deal with existing utilities in a manner that is consistent with the Department's approach throughout the Province. The Contractor shall apply the information outlined in the "*Alberta Transportation Utility Guidance Manual*" when entering into an agreement with a utility company on behalf of the Department. The Contractor shall use one of the sample agreements provided in Appendix H of the "*Engineering Consultant Guidelines for Highway and Bridge Projects - Volume 1, Design and Tender, 2002*". Prior to the agreements being signed by the utility company and the Contractor, they are to be sent to the Department for review. In the event that changes to the wording of the standard agreements are required, the changes will require prior written approval by the Department. A period of two weeks will be required to review new agreement formats after which the Department will provide comments on the suitability. There may be cases in which a utility company consents to enter into a Utility Agreement (as defined in section 4.7 of the DB Agreement) with the Contractor, where such utility company does not require its pipeline facilities to have any casing protection. In such cases, notwithstanding, the Department requires that all pipelines constructed of jointed pipe shall require continuous casing (i.e. casing with welded joints) as a protective measure for containment of a ruptured pipeline. The casing requirement shall apply when jointed pipelines are crossed by the new construction of a highway or by the new construction of its associated interchanges.

The casings shall extend to a minimum of 5 metres beyond the backslope of the outer roadside ditch as required for the grading set out in the Technical Requirements.

The direct out-of-pocket costs that are incurred by the Contractor pursuant to this casing requirement in relation to the Project shall be subject to the cost-sharing arrangement between the Contractor and the Province as set forth in section 15.4(b) (Assistance with Permits and Utility Agreements) of the DB Agreement.

There may be cases in which a utility company consents to enter into a Utility Agreement with the Contractor, where such utility company does not require its powerline facilities to be buried. In such cases, notwithstanding, the Department requires that all powerline facilities rated at 25kv or less shall be buried when crossed by the new construction of a highway or by the new construction of its associated flyovers and interchanges. The buried powerline facilities shall extend to a minimum of 5 metres beyond the backslope of the outer roadside ditches as required for the Ultimate Stage grading.

The direct out-of-pocket costs that are incurred by the Contractor pursuant to this requirement to bury powerline facilities in relation to the Project shall be subject to the cost-sharing arrangement between the Contractor and the Province as set forth in section 15.4(b) (Assistance with Permits and Utility Agreement) of the DB Agreement.

The Contractor shall pay all costs associated with design, utility protection, relocation, damage to or other costs with respect to all utility rights of way, easements, or similar interests (whether registered against title to the land or not) affected by the New Infrastructure.

The Contractor shall locate any abandoned utilities which impact construction of the New Infrastructure. The Contractor shall remove and decommission any such abandoned utilities in accordance with industry practice and in accordance with any applicable laws.

The Contractor shall accommodate future utility rights of way, easements, or similar interests (the "Future Utility") on, under or above the Lands when requested by the Department. All costs associated with the installation and maintenance of the Future Utility shall be the responsibility of the applicable Future Utility owner.

The Contractor shall recognize the authority of the Department to manage the TUC at all times. The Contractor shall follow the *Transportation/Utility Corridor (TUC) Program Policy*, as may be amended from time to time, at all times when processing requests for Future Utility. For the purposes of the *Transportation/Utility Corridor (TUC) Program Policy*, the Contractor shall be considered a "stakeholder" in the TUC.

Applications for Ministerial Consent will be referred to the Contractor for comments who shall return such comments to Alberta Infrastructure (Land Planning North) for further review. The

Contractor recognizes that its comments will not be binding. In its response, the Contractor shall identify commercially reasonable steps to accommodate any proposal forwarded to it by the Department. The Contractor must be prepared (at minimum) to identify standard crossing requirements to proposed Future Utility providers at all time. The Contractor will take an open and cooperative approach in its dealings with existing and future TUC-housed utility suppliers at all times.

At Construction Completion, the Contractor shall return any and all utility as-built drawings and utility agreements to the Department.

200.2.11 MUNICIPAL AUTHORITIES

The Department has established contacts with the Local Authority:

- The City of Edmonton
  Contact: Paul Szczepanski. Director, Roadways Design
  The City of Edmonton,
  Telephone: 780.496.4498
  Fax: 780.496.4671
  Email: paul.szczepanski@edmonton.ca

200.2.12 ENVIRONMENTAL

An environmental assessment (the "Environmental Assessment") study has been undertaken as part of the Functional Plan and will be available November 2008. All requirements identified in the Environmental Assessment including design, construction, monitoring, maintenance and/or reporting, shall be the responsibility of the Contractor. The Contractor shall be responsible for obtaining and complying with all required environmental approvals, authorizations, and permits.

Regulatory Approval Application Process

- The Contractor shall incorporate all environmental protection measures and/or requirements identified in the Environmental Assessment report(s) into its EMS. The Contractor shall be responsible for all aspects related to the planning and implementation of all environmental requirements identified in the Environmental Assessment report(s) including, but not limited to, compensation measures for wetlands, wildlife, and fish habitat.
- The Contractor will meet with the Department to discuss all proposed mitigation measures and/or compensation measures to be incorporated on the Project. These meetings shall occur prior to discussions with regulatory authorities.
- With the approval of the Department the Contractor may enter into negotiations with the regulatory authorities with respect to mitigation/compensation measures.
- Upon completion of the negotiations the Contractor will prepare draft regulatory applications, complete with all necessary documents, for review to the Department.
- The Department will return signed final regulatory applications to the Contractor for submission to the regulatory authorities. No applications shall be submitted to the regulatory authorities until agreed to, and signed by, the Department.

- It is the responsibility of the Contractor to identify and obtain all environmental regulatory approvals, authorizations, permits and/or licenses for the Project.
- The Contractor shall be responsible for all regulatory monitoring requirements until Construction Completion.
- Applications for any amendments to regulatory approvals will follow the above protocol.

The Contractor must implement an ECO Plan which consists of written procedures and drawings addressing the environmental mitigation and protection measures relevant to construction activities being performed on the Project site. The Contractor must utilize the Alberta Transportation ECO Plan Framework (May 2005). The Contractor will be responsible for all aspects of ECO Plan development, review and implementation. A complete ECO Plan must be in place prior to the start of site construction activities.

200.2.13 NOISE ATTENUATION

No noise attenuation measures are required as part of this Project.

200.2.14 FENCING

Fencing shall be consistent with the Department's approach on other areas of Anthony Henday Drive already constructed. The fencing shall be installed to separate the Lands from the rest of the TUC. The fence shall be the Department's Class B Standard as shown on Standard Drawing CB6-2.12M2 in Alberta Transportation's CB-6 Manual (Highway Standard Plate).

The Contractor must obtain approval from the Department for the proposed fence lines. The fenced areas must be of a practical size and dimension with free and clear access so that lease potential or other future uses of the rest of the TUC have not been compromised.

The Road Right of Way shall be fenced and the fencing shall extend to the TUC boundaries at the crossroads. Any stormwater storage facilities shall also be fenced.

Access to the utility components shall be controlled by gates. The Contractor shall install gates at various locations throughout the fence line so as to permit ease of access to the utility components, ensuring that no area is inaccessible. Gates shall be large enough to accommodate passage of vehicles, equipment, utility vehicles and farm equipment. The Contractor shall obtain prior written approval from the Department for gate types, sizes and locations. TUC access will be permitted from the crossroads only. No access points will be permitted from the mainline or its associated entrance and exit ramps.

As soon as reasonably practicable after May 31, 2009 unless otherwise notified by the Department in writing, the Contractor shall construct a new permanent Class B fence along the eastern boundary of the Amended Lease Area using fencing suitable for the containment of horses and shall ensure that any horses or other livestock then present in the original lease area 937P are confined to the Amended Lease Area during construction of the new fence. The "**Amended Lease Area**" means the original lease area 937P minus any of the original lease area 937P that falls inside the Road Right of Way. Once the new fence has been constructed, the existing fence along the current east boundary of lease area 937P shall be removed and will become the property of the Contractor.

200.2.15 MISCELLANEOUS ENVIRONMENTAL CONCERNS

200.2.15.1 Wetland Compensation

The Contractor is responsible for wetland replacement, compensation and management activities during construction and until Construction Completion. All regulatory requirements including design, construction, maintenance, monitoring and/or reporting shall be the responsibility of the Contractor. The Department must be kept apprised of all discussions and agreements respecting wetland replacement and compensation.

200.2.15.2 Campsites

There shall be no campsites or sleeping trailers permitted within the TUC.

200.2.15.3 Burning

No burning will be allowed within the TUC.

200.2.15.4 Historical Resources

A copy of the July 17, 2008 *Historical Resources Act* clearance letter is attached as Appendix C.

Pursuant to Section 31 of the *Historical Resources Act*, should any paleontological or historical resources be discovered during the conduct of construction activities, the Contractor shall inform the Department in writing immediately.

200.2.15.5 Pollutants

The Contractor shall ensure that no pollutant occasioned by the construction of the Project, including debris from clearing operations, petroleum products from equipment operations and construction refuse, is allowed to enter any water body whether flowing or static.

200.2.15.6 Organic Materials

Organic materials from excavation operations may contain peat, topsoil and subsoil materials. These materials shall be salvaged and stockpiled in separate stockpiles all in accordance with environmental requirements. No burial, removal and/or sale of organic materials salvaged is allowed.

It is anticipated that most of the salvaged organic materials with the possible exception of peat materials will be reused in the Project.

200.2.16 AESTHETICS

Having regard to the Department's "Bridge Aesthetics Study" dated April 2005, the aesthetics of the New Infrastructure shall be generally compatible with the southwest leg of Anthony Henday Drive, as defined from 87 Avenue to Calgary Trail. The following specific aesthetic features shall be incorporated into the New Infrastructure:

- the "wild rose" emblem on abutment wingwalls facing traffic;
- the aesthetic treatment of pier shapes for roadway grade separation bridges;
- the aesthetic treatment of concrete slope protection surfaces; and
- the use of pigmented sealers (three colours) on exposed concrete surfaces.

In addition, artistic renderings that cover a minimum of 25% of the exposed surface area shall be provided on all retaining walls.

The Contractor acknowledges having visually inspected the aesthetic features in the southwest leg of Anthony Henday Drive prior to signing the DB Agreement.

The use of circular or square or nearly square column cross sections in the piers for structures on this Project is prohibited as well as the use of block-resembling or blunt ended pier caps. Similar type architectural treatment should be used as far as practicable for all structures having similar characteristics such as spans, superstructure type, etc. Architectural treatment similar to nearby structures at 87 Avenue and at Whitemud Drive is desirable and should be incorporated into the Contractor's design as much as practicable.

The fascia surfaces of concrete bridge barriers shall have the shape shown on the Department's Standard Drawing S-1700-06. Bicycle rails on top of concrete bridge barriers shall be in accordance with Standard Drawings S-1700-06 and S-1701-06 published on the Department's website.

200.2.17 WEED CONTROL AND LANDSCAPE MAINTENANCE

200.2.17.1 General

All areas within the Project Limits that are disturbed by the Contractor shall be maintained in a weed free condition by the Contractor until Construction Completion. This includes areas within the Road Right of Way and any stormwater management facilities forming part of the New Infrastructure that are outside the Road Right of Way.
Weeds to be eradicated include all species identified under the *Weed Control Act* (Alberta) and the Local Authority's bylaws, or species which interfere or compete with the seeded varieties. Volunteer crops from previous land use will be considered as weeds.

The Contractor shall be responsible for any fines or weed control notices issued for the TUC until Construction Completion. All notices shall be dealt with in a timely fashion. Copies of all fines and notices shall be provided to the Department.

200.2.17.2 Method

Weed control shall be carried out by cultivation, seeding, and spraying. The areas (as set out in the first sentence of Section 200.2.17.1 (General) not affected by the construction of the New Infrastructure as determined by the Contractor shall be tilled to ensure that all nuisance weeds are controlled. In addition, the tilled areas shall be seeded in the Spring of 2011 using the seed mixes in Section 200.2.9 (Topsoil and Seeding).

Any method of weed control adopted by the Contractor shall take into account wind directions and velocities. The Contractor shall ensure that residents located near the New Infrastructure are not subjected to dust and/or spray drift resulting from its weed control operations. Natural areas shall not be subjected to spray drift. The Contractor shall be responsible for all costs associated with any damage to residential property, natural areas or retained plant materials resulting from spray drift or poor agricultural or weed control practices carried out by or for the Contractor.

In the event the Contractor chooses seeding with commercial crops as a method of weed control, any crops harvested shall become the property of the Contractor. The use of commercial crops as a method of weed control shall be allowed during the Construction Period.

Pesticide applicators must meet all requirements in the *Code of Practice for Pesticides* (applicable by regulation under *Section 36* of the *Environmental Protection and Enhancement Act* (Alberta)). Pesticide applicators must also comply with all requirements of the *Environmental Protection and Enhancement Act* (Alberta), its associated regulations and all other applicable laws. The Contractor or any subcontractor that the Contractor hires for herbicide application must hold a valid Pesticide Service Registration with Alberta Environment, or its successor.

200.2.17.3 Weed Control Signage and Notification

The Contractor shall provide signs and notices to residents affected by the work prior to commencement of chemical applications. Signage and notification shall follow policies and procedures set by the Local Authority. The Contractor shall become familiar with the policies and procedures of the Local Authority.

The Contractor shall notify the Local Authority a minimum of 48 hours prior to spraying with information including the following: location, target weeds, chemicals to be used and date and time of application.

Prior to spraying, the Contractor shall purchase all necessary signage from the Local Authority to assist in identifying spray areas. Signage shall be installed at a minimum 100 m interval and at all entry points, corridors and walkways adjacent to the TUC or as directed by the Local Authority. The Contractor shall be responsible for displaying and removing signs in accordance with the time frame required for public notification and re-entry intervals. The Contractor is to ensure that signs refer project inquires to the Contractor’s contact number.

The Contractor shall be responsible for obtaining information from the Local Authority regarding citizens in the vicinity of the TUC with medical sensitivities or other concerns related to spraying. The Contractor shall be responsible for determining if any such area residents are affected and then take appropriate measures to meet their specific needs.

200.2.17.4 Mowing and Fence Trimming

The Contractor shall carry out mowing and trimming around fences, as part of weed control in the following instances:

- as an emergency procedure in response to weed notices;

- to control weeds that are not effectively responding to the weed management program;
- as a clean up procedure at the end of the growing season; and
- in areas adjacent to residences where spraying is not feasible.

The trimming of weeds around fences shall be conducted as reasonably required and in any event at least once every 60 days during the period April 1 to October 31 each year.

200.2.17.5 Seed Establishment and Maintenance of Seeded Areas

Any area of unsatisfactory seed establishment shall be top dressed and reseeded by the Contractor. The acceptable minimum number of plants of all seeded species per square metre shall be 150.

The seeded areas shall be mowed/cut to 100 millimetre height a minimum of twice during the growing season. Baling and/or raking of the mowed/cut plant material shall be performed upon completion of the mowing/cutting operation in order to prevent accumulation of mulch. Bales and raked material shall be removed from site immediately upon completion of the baling/raking operation. All bales and raked material shall become the property of the Contractor.

Weeds that emerge during the one year establishment period are to be controlled as per the requirements and methods described in the Section 200.2.17.2. (Method).

200.2.18 SPECIAL EVENTS

There will be occasions where the Department requires the cooperation and coordination of the Contractor for special operations. Any work required by the Contractor under this Section 200.2.18 (Special Events) shall require a Change Order.

200.2.18.1 Full Lane Availability Events

Sometimes special events will be approved by the Department in the area which will generate extra traffic in the New Infrastructure. Some events that generate extra traffic on the New Infrastructure will occur independently of approval by the Department.

Such events may require:

- Installation of special banners or special signs;
- Adjustment of traffic signals; and
- Additional traffic management or traffic accommodation measures.

200.2.18.2 Partial or Full Closure Events

There will be times when the New Infrastructure is utilized for special events ("Approved Special Events"), approved by the Department that may require closure or partial closure of the New Infrastructure. The following measures may be required:

- Installation of special signs; and

- Additional traffic management or traffic accommodation measures.

200.2.19 BRIDGE DURABILITY

200.2.19.1 Single Slope Concrete Bridge Barriers

All reinforcing bars in single slope concrete bridge barriers shall be either glass fibre-reinforced polymer (GFRP) reinforcing bars, or solid stainless steel reinforcing bars. The minimum concrete cover adjacent to the front face of the barrier shall be 50mm.

200.2.19.2 Concrete Curbs/Barriers Supporting Double Tube Type Bridgerails

All reinforcing bars in concrete curbs/barriers supporting double tube type bridgerails shall be solid stainless steel reinforcing bars. The minimum concrete cover requirements adjacent to the front face of the curb/barrier shall be 50mm.

200.2.19.2.1 GFRP Reinforcing Bars

The GFRP reinforcing bars, manufacturers' quality control plans, testing, and reporting documentation shall meet the requirements of the ISIS Canada Research document "Specifications for Product Certification of Fibre Reinforced Polymers (FRPs) as Internal Reinforcement in Concrete Structures" and as specified herein. The GFRP reinforcing bars shall have a modulus of elasticity designation (E) of Grade I – 50 GPa or Grade II – 40 GPa and a durability designation (D) of Grade I. The polymer used for GFRP reinforcing bars shall be a vinyl ester thermoset resin.

As a minimum the vertical steel reinforcing in each face of the standard concrete barrier shown on S-1650 shall be substituted for an equivalent size GFRP reinforcing bar. The number of horizontal steel reinforcing bars in the standard concrete barrier shown on S-1650 shall be increased by 20% when substituted by GRFP and the size of bar shall remain equal.

At least three weeks prior to the commencement of fabrication of GFRP bars, the Contractor shall submit to the Department two copies of the following:

(i) Mechanical Property Reports
For all the relevant mechanical properties specified in Table 2 of the ISIS Canada Research document "Specifications for Product Certification of Fibre Reinforced Polymers (FRPs) as Internal Reinforcement in Concrete Structures", a complete report on tests conducted in accordance with the standards also given in Table 2 of the ISIS Canada Research document "Specifications for Product Certification of Fibre Reinforced Polymers (FRPs) as Internal Reinforcement in Concrete Structures", shall be provided. The manufacturer shall certify that all the qualification tests have been carried out in accordance with this specification and that the requirements herein have been met.

(ii) Physical and Durability Property Reports
For all the relevant physical and durability properties specified in Table 3 of the ISIS Canada Research document "Specifications for Product Certification of Fibre Reinforced Polymers

(FRPs) as Internal Reinforcement in Concrete Structures", a complete report on tests conducted in accordance with the standards also given in Table 3 of the ISIS Canada Research document "Specifications for Product Certification of Fibre Reinforced Polymers (FRPs) as Internal Reinforcement in Concrete Structures" shall be provided. The manufacturer shall certify that all the qualification tests have been carried out in accordance with this specification and that the requirements herein have been met.

(iii) Certification of Manufacturer:
A statement from the manufacturer testifying that they are specialised in the manufacture of GFRP reinforcement, and that their manufacturing process is certified according to ISO 9002. In lieu of the ISO certification, the manufacturer may submit quality control plans for their manufacturing process to the Department for approval. The Department at its sole discretion would accept or reject the quality control plan. Rejection of the quality control plan would be deemed to be rejection of the product.

Manufacturer's Quality Control Tests

At the time of material delivery to site, the Contractor shall submit two copies of quality control test reports from the manufacturer that contain the following information; together with a certification from the manufacturer stating that each production lot of each product has been manufactured in accordance with this specification.

(i) Materials

With regard to materials, the manufacturer's quality control test report shall include:

(a) bar diameter and grade supplied;
(b) type of resin;
(c) primary fibre type;
(d) secondary fibre type, if any;
(e) fibre content by volume for primary and secondary fibres separately;
(f) longitudinal tensile modulus and ultimate elongation;
(g) strength of FRP bent bars and stirrups at bend locations;
(h) longitudinal tensile strength and modulus of FRP bent bars at bend locations;
(i) void content;
(j) water absorption (long-term immersion at 50C) for both straight and bent bars; and
(k) glass transition temperature.

(ii) Production

With regard to production, the manufacturer's quality control test report shall include:
(a) type of manufacturing process used (e.g., pultrusion);
(b) the definition of a production lot (for example, a production lot may be defined by change in the supplier of additives);;
(c) total linear meters/feet produced in each production lot; and
(d) the date of beginning and end of production for each production lot of material.

(iii) Product Characterization

With regard to product characterization, the manufacturer's quality control test reports shall include:

(a) number of samples tested;
(b) the result of every test and their average;
(c) the standard deviation;
(d) minimum tensile strength, where applicable, defined as the average minus 2.6 standard deviations;
(e) mode of failure if applicable;
(f) any deviations from the standard test method; and
(g) a statement explaining whether the FRP tested meets the specification requirements for each property measured.

(iv) Test Setup

With regard to the test setup, if applicable, the manufacturer's quality control test report shall include:
(a) details of the apparatus used to perform tests, capacity of test machine and date of calibration;
(b) the type of extensometer used to perform the tests for tensile modulus of elasticity; and
(c) lengths of the samples tested, the free length and anchor length used.

Shop drawings
At least three weeks before the commencement of installation of GFRP bars, the Contractor shall submit the following:

(i) Bar Placing Drawings: Three sets of placing drawings. These drawings shall include quantity, bar size, location and spacing for all GFRP bars.

(ii) Bar Schedule: Six copies of GFRP bar schedule. GFRP bar schedule shall include quantity, bar size, type, length and bending dimensions.

Packing and marking
The manufacturer shall label each GFRP bar and container/packaging with the following information at no more than 2.0 m spacing:
(i) Manufacturer's name and symbol
(ii) Type of fibre
(iii) Nominal bar diameter
(iv) Strength grade
(v) Designated Modulus of Elasticity
(vi) Production lot or batch number

For delivery at the construction site, all bars shall be grouped and bundled according to their designation and tagged with the following information:

(a) Manufacturer's symbol,
(b) Length of the bar, and
(c) Production lot or batch number.

All chairs or bar supports shall be non-metallic. Tie-wire shall be plastic, nylon, stainless steel of grades described in Section 200.2.19.3 (Reinforcing Bars Projecting from the Webs of

Precast Concrete Girders into Bridge Decks) except that tie wire used to tie GFRP to epoxy coated reinforcing bars may be epoxy coated wire.

The GFRP reinforcing bars shall be protected during handling, storage and installation in accordance with the manufacturer's requirements and section 11 of the ISIS Canada Research document "Reinforcing Concrete Structures with Fibre Reinforced Polymers".

Damage to a GFRP reinforcing bar resulting in visible fibres (other than at cut ends) or a cut defect greater than 1 mm deep shall be cause for rejection of the bar. Visible damage to the GFRP bars exceeding 2% of surface area per 300mm shall be cause for rejection of the bar. Accumulation of mortar on the projecting GFRP during concrete placement shall be prevented.

200.2.19.2.2 Solid Stainless Steel Reinforcing Bars

Solid stainless steel reinforcing bars shall conform to the requirements of ASTM A276 and A955M "Deformed and Plain Stainless Steel Bars for Concrete Reinforcement" and shall be deformed stainless steel meeting the material requirements of AISI Grade 316LN, 2205, 2101, 2304 or UNS-S24100 (XM28). The minimum yield strength shall be 400 MPa. The design of the reinforcing bars shall be based on a yield strength of 400 MPa. The detailing of the reinforcing bars, including hooks, development lengths and bar splices shall be based on the specified yield strength of the bars.

Fabrication of the solid stainless steel reinforcing bars shall be such that the bar surfaces are not contaminated with deposits of iron and non-stainless steels. Solid stainless steel reinforcing bars shall be stored separately from carbon steel reinforcing bars.

All chairs or bar supports shall be non-metallic. Tie-wire shall be Grade 316L stainless steel except that tie wire used to tie solid stainless steel reinforcing bars to epoxy coated reinforcing bars may be epoxy coated wire.

200.2.19.3 Reinforcing Bars Projecting from the Webs of Precast Concrete Girders into Bridge Decks

All reinforcing bars projecting from the webs of precast concrete girders into bridge decks shall be either Type ASTM 1035 (MMFX2) reinforcing bars, or solid stainless steel reinforcing bars.

200.2.19.3.1 Type ASTM 1035 Reinforcing Bars

The minimum yield strength shall be 690 MPa. The design of the reinforcing bars shall be based on a yield strength of 400 MPa. The detailing of the reinforcing bars, including hooks, development lengths and bar splices shall be based on the specified yield strength of the bars.

200.2.19.3.2 Solid Stainless Steel Reinforcing Bars

Solid stainless steel reinforcing bars shall meet the requirements of Section 200.2.19.3 (Reinforcing Bars Projecting from the Webs of Precast Concrete Girders into Bridge Decks).

200.3 MISCELLANEOUS

200.3.1 THE CITY OF EDMONTON

The Contractor acknowledges having reviewed a copy of the Highway Transfer Agreement between the Province and The City of Edmonton dated March 15, 2005 and amended by amendment dated August 25, 2008 (the "City Agreement"). The Contractor shall take all such actions, or refrain from such actions, as are necessary so as to enable the Province to comply with the Province's obligations under the City Agreement in respect of the Project and the New Infrastructure.

200.3.2 HOURS OF WORK / WORK RESTRICTIONS

The Contractor shall comply with the Local Authority's by-laws. When the Contractor's work on the Project is being carried out within the jurisdictional boundaries the Local Authority, then the Contractor's work shall be restricted to the hours permitted bythe Local Authority's by-laws. The Contractor may, however, obtain a noise by-law waiver from the Local Authority and from the Department accordingly.

200.3.3 COORDINATION WITH LOCAL AUTHORITY

The Contractor is responsible for coordinating all operations on crossroads with the Local Authority during construction. Should a Local Authority initiate a lane rental policy for operations on the Local Authority's streets and roads, the policy will not apply on New Infrastructure crossroads.

The Contractor is responsible for obtaining an On-Street Construction and Maintenance ("OSCAM") Permit from The City of Edmonton for work on the New Infrastructure.

The Contractor shall be responsible for the coordination of the design requirements and construction phasing with the Local Authority. The Contractor shall also be responsible for removal of and for coordination with the Local Authority regarding any required road removals and closures in the TUC.

200.3.4 POLICE, FIRE AND EMERGENCY SERVICES

Police, fire and emergency services for any area of the New Infrastructure within the boundaries of a Local Authority will be provided by and under the jurisdiction of the Local Authority and obtained by 911 call.

The Contractor shall take all such actions, or refrain from all such actions, as are necessary to enable the police, the Local Authority, and others with statutory duties or functions in relation to the New Infrastructure or adjoining roads to fulfil those duties and functions. Without limiting the generality of the foregoing, the Contractor shall permit the police, the Local Authority, and others with statutory duties or functions in relation to the New Infrastructure, to carry out "Check Stops" and speed enforcement activities.

For any follow-up response necessary as a direct result of the emergency, the Contractor shall be responsible for all costs for such follow-up responses incurred as a direct result of the emergency including the placement and removal of barricades and timely removal of debris, which may be deposited on the New Infrastructure.

200.3.5 LAND ISSUES

Administration of the TUC is undertaken by Alberta Infrastructure on behalf of the Province. Any individual or organization proposing to enter the TUC outside the Road Right of Way to undertake an activity or use requires at least one authorization from Alberta Infrastructure. The document entitled "*Transportation/Utility Corridor (TUC) Program Policy*" published by Alberta Infrastructure, as may be amended from time to time, explains in detail the objectives of the TUC program. Steps for obtaining Ministerial Consent and other related authorizations from Alberta Infrastructure are included in this policy**.**

200.3.6 LAND REQUIREMENTS IN THE EXISTING TUC

By Construction Completion, the Contractor shall have installed a fence separating the Road Right of Way from the remaining utility components of the TUC (the "TUC Outside the ROW"). The TUC Outside the ROW shall be fully vegetated and in a healthy and vigorous weed-free growing condition in accordance with the Contractor's Environmental Management System.

Currently, the lands forming the TUC in West Edmonton are leased by Alberta Infrastructure to tenants. A detailed tabulation of the leases and schedules for termination is given in Section 200.2.5.7 (Demolition).

The design and construction of any features or appurtenances related to the roadway, such as stormwater management facilities, that may fall within the TUC Outside the ROW shall remain the responsibility of the Contractor. Any application for Ministerial Consent, as required for all work within the TUC Outside the ROW, should be initiated in a timely manner. The Contractor shall make specific arrangements with Alberta Infrastructure to ensure that the design and construction of these features does not interfere with any future tenants or other land uses. The Contractor shall make all reasonable efforts to cooperate with third parties installing utilities within the TUC.

200.3.7 WORK BY OTHER FORCES

The Contractor shall coordinate all construction activities with any work that may be undertaken by utility stakeholders within the TUC or by the Local Authority at or beyond the Project Limits.

The Department has engaged NORTHWESTCONNECT General Partnership to design, construct, operate and maintain elements of the interchange at Highway 16 as part of the Northwest Anthony Henday Drive project. The Contractor shall cooperate and coordinate construction activities with this contractor.

The Contractor shall cooperate and coordinate construction activities with Access Roads Edmonton Ltd. and its subcontractor, Traffic Systems Management Inc. (TSMI), which is the operations and maintenance contractor responsible for the existing Anthony Henday Drive mainline and ramps and 87 Avenue within the Project Limits.

The Contractor shall cooperate and coordinate construction activities related to Stony Plain Road, 100 Avenue, 109 Avenue, 111 Avenue, and Whitemud Drive with The City of Edmonton, who is responsible for operations and maintenance.

The Contractor shall provide TSMI and The City of Edmonton with details of all temporary construction installations to be operated and maintained throughout seasonal shut-down periods. A schedule of planned seasonal shut-down periods shall be provided to the appropriate maintenance forces and updated as required. The Contractor is expected to act responsibly and professionally throughout the construction term and take all reasonable precautions to prevent damage to existing infrastructure.

200.3.8 SURVEY

The Contractor shall, as soon as reasonably practical after Construction Completion, prepare at its cost but on the Department's behalf, a Descriptive Plan of Survey (the "Survey") showing the constructed highway in a manner satisfactory for registration at the Alberta Land Titles Office. The Contractor shall provide the Department with copies of the Surveyas soon as reasonably practical after obtaining the Survey..

200.3.9 CLEANING OF ROADWAYS

The Contractor shall not track material from the construction site onto roadways used by the public. If tracking should occur, the Contractor shall immediately remove all tracked material.

200.3.10 ROADWAY OBLITERATION AND SALVAGED MATERIALS

All roadways, ramps and access roads designated for removal, shall be landscaped neatly with slopes not steeper than 5 horizontal to 1 vertical within the Road Right of Way and not steeper than 6 horizontal to 1 vertical outside the Road Right of Way. The landscaped areas shall be topsoiled and seeded in accordance with Section 200.2.9 (Topsoil and Seeding). Culverts shall be removed and the drainage pattern shall not be altered unless changes are incorporated in the drainage elements of the Contractor's Designs.

The Contractor shall assume ownership of all salvaged materials such as culverts, roadway lighting and roadway signal materials. These materials shall be removed from the Project Limits or otherwise disposed of.

For AHD Mainline where grading will be completed to Ultimate Stage, the Contractor shall salvage ACP and base course materials but shall not remove insulation materials such as extruded polystyrene and bottom ash that will be under future lanes and shoulders.

For ramps and access roads to be removed, the Contractor shall salvage ACP, granular base course and excess earth materials.

Salvaged ACP, granular base course and excess earth materials may be reused in the work on the Project.

200.3.11 PREFERENTIAL BRIDGE DECK ICING

The Contractor shall address the prevention of preferential bridge deck icing on the following bridges (the "PBD Bridges") by permitting the installation and commissioning of Road Weather Information Systems ("RWIS") as described below, prior to Traffic Availability:

PBD Bridges

- AHD (Highway 216) N-W Ramp over 100 Avenue (Structure 8)

The PBD Bridges will be fitted with the RWIS by the Department's contractor, Telvent Canada Ltd. ("Telvent") pursuant to an agreement dated April 11, 2005 (as amended) between the Department and Telvent (the "RWIS Contract"). The Contractor acknowledges having been provided with what the Department considers are the relevant portions of the RWIS Contract and having reviewed a copy of those portions of the RWIS Contract.

For each of the PBD Bridges, the RWIS Contractor shall be permitted by the Contractor to install sensors in the pavement approaching the applicable bridge and on the bridge itself and install RWIS tower structures in the Road Right of Way, in locations determined by the RWIS Contractor, acting reasonably.

The Contractor shall:

a. provide all reasonable cooperation with Telvent, or any replacement RWIS contractor of the Department's, (the "RWIS Contractor") in respect of the installation of the RWIS for the New Infrastructure (the "RWIS Work");

b. coordinate and schedule the Project in such manner as will facilitate the RWIS Work;

c. if and as often as it becomes aware of deficiencies in the RWIS Work as will materially adversely affect or interfere with the Project or the obligations of the Contractor under the DB Agreement, immediately provide the Department with notice, including reasonable details, of those deficiencies;

d. without limiting (a) and (b) above, design and build the New Infrastructure to accommodate the RWIS as set out in Drawing 14-G-01 in Appendix G.

e. without limiting (a) and (b) above, complete grading and landscaping to enable the installation of the RWIS tower structures for the PBD Bridges prior to Traffic Availability;

f. without limiting (a) and (b) above, permit the RWIS Contractor to obtain power from the power source used for the interchange lighting, provided the RWIS Contractor provides a separate power feed and meter and separately pays the power costs for the RWIS Work; and

g. without limiting (a) and (b) above, provide traffic accommodation services to the RWIS Contractor, as reasonably requested by the RWIS Contractor, but at the cost of the RWIS Contractor, such cost as determined by the Contractor acting reasonably.

The Department shall arrange the reciprocal reasonable cooperation of the RWIS Contractor

300.0 DESIGN - NEW INFRASTRUCTURE

300.1 INTRODUCTION

This Section covers general design requirements applicable to roadways and bridge structures in the New Infrastructure. Project specific design requirements are covered in Section 200 (Project Specifics).

300.2 DESIGN – GENERAL

300.2.1 GENERAL DESIGN REQUIREMENTS

The requirements to be met in the design of all roadways, bridge structures and other appurtenances are generally specified in this Schedule 14 (Technical Requirements) and address the areas of safety, functionality/serviceability, durability/maintainability and aesthetics. If a requirement is not specified in this Schedule 14 (Technical Requirements), the requirement shall be set to a standard generally being met on new roadways and bridge structures of similar type on the Provincial highway system.

Bridge structures must be designed to be structurally and operationally safe in terms of accommodation of traffic, operations and maintenance activities for the duration of the 75-year service life.

All designs shall incorporate the appropriate selection of design concepts, design details, specifications, materials and construction methods and techniques.

300.2.2 RESPONSIBILITY FOR DESIGN

The Contractor is responsible for the design of the elements of the New Infrastructure including, but not limited to, all geotechnical investigations, environmental considerations and permits, topographic surveys, in-stream watercourse surveys, approvals and permits, other field investigations and technical analysis required to complete the designs in a professional and competent manner.

300.2.3 DESIGN DOCUMENTATION

Detailed design documents shall cover the full range of infrastructure required in the Project. Design documentation shall include, but not be limited to:

- Design reports for all aspects of the work that include the design decision process, criteria and assumptions used for each aspect of the design, agreements, permits, authorizations and special construction requirements.
- Detailed design drawings prepared in accordance with the Department's *Engineering Drafting Guidelines for Highway and Bridge Projects*, including availability in electronic format.

As a basis for this documentation, the Contractor shall further develop and finalize, as required, the design reports, plans and specifications in the Contractor's Designs, including, but not limited to:

- Design plans and profiles;
- Design cross-sections;
- Design appurtenances;
- Signing;
- Lighting;
- Roadside hazards;
- Pavement Design Report;
- Roadway Design Report;
- Geotechnical Grading Design Report;
- Bridge Structures Design Report; and
- Drainage Design Report.

Details of design documentation requirements for these and other design issues are further expanded in this Schedule 14 (Technical Requirements).

Complete design document packages must be available prior to starting construction of the elements designed in any specific package and must follow the requirements outlined in Schedule 5 (Design and Plan Certification Process and Review Procedure). Any non-conformance with the Technical Requirements shall be rectified by the Contractor, whether the work has been constructed or not and whether or not the Department has commented on the design document packages.

300.2.4 AESTHETICS

The Contractor is advised that the Department supports and encourages the inclusion of cost effective features to improve the overall roadway and bridge structure aesthetics.

The Contractor shall develop and incorporate in its design an aesthetic theme throughout the New Infrastructure that shall complement the surrounding environment and generally be compatible with similar features and structures located in the general vicinity, as indicated in Section 200 (Project Specifics).

Aesthetics shall be considered in the layout and design of all roadway elements. The aesthetic principles outlined in the Department's Bridge Aesthetics Study (Version 1.0, April 2005) shall be considered in the layout, shapes, details, finishes and architectural features of all bridge structures. Any proposed aesthetic features shall take into consideration routine and long-term maintenance costs and not lead to potential maintenance and rehabilitation problems in the future.

Proposed twin bridge structures shall be aesthetically similar and constructed of the same material type. Twin bridge structures are structures spanning a common opening and close enough to be located on the same bridge approach fills. Twin bridge structures shall have similar head slopes and openings.

Bridge headslopes are typically incapable of supporting vegetation due to the shadow created by the bridge structure. On railway overpass and grade separation bridge structures, the bridge headslope shall be covered with concrete slope protection that prevents erosion and enhances the appearance of the headslopes.

All electrical and communications wiring for the New Infrastructure shall be underground.

300.2.5 PROVISIONS FOR FUTURE STAGES

During design of the roadway elements, the Contractor shall be cognizant of the requirement for future expansion through the addition of lanes or other elements as detailed in Section 200 (Project Specifics). Design and construction must feasibly allow for future economical expansion through addition of lanes and other elements.

During design of the bridge structures, the Contractor shall be cognizant of the potential requirement for future widening and/or lengthening of the bridge structures. When required, the initial design and construction of the bridge structures shall consider provisions that feasibly allow for future economical bridge structure widening and/or lengthening.

Vertical grade lines shall be set so that all vertical clearance requirements are met after any anticipated bridge structure widening and/or lengthening or roadway rehabilitation/widening has occurred.

300.2.6 ROADWAY SAFETY AUDITS

Roadway safety audits shall be performed pursuant to the DB Agreement and the Contractor's Management Systems and Plans. Roadway safety audits shall follow the Transportation Association of Canada ("TAC") work scope detailed in the *Canadian Road Safety Audit Guide*, for both design and pre-opening stages. The pre-opening safety audit must be conducted after the roadway is paved and all signage and pavement markings are complete. Roadway safety audits shall be an integral part of the QMS.

The Contractor shall provide the Department as soon as practicable with a copy of the Contractor's Response Report to each of the design and pre-opening safety audits. The Contractor shall implement, at its cost, those recommendations or suggestions in the design and pre-opening safety audits as determined by the Contractor, acting reasonably. The Contractor shall provide the Department with a written explanation as to those recommendations or suggestions in the design and pre-opening safety audits that the Contractor has decided not to implement. The Contractor shall implement or shall refrain from implementing, at its costs, those recommendations or suggestions in the design and pre-opening safety audits as directed in writing by the Department.

300.3 ROADWAYS

300.3.1 DESIGN REQUIREMENTS

300.3.1.1 Geometric Design

The design shall be undertaken in accordance with the latest edition of *Alberta Transportation's Highway Geometric Design Guide* and applicable *Design Bulletins*, Section 200 (Project Specifics) and where noted, associated reference manuals or guidelines. Where specific design elements are not included in the *Alberta Transportation's Highway Geometric Design Guide* and applicable *Design Bulletins*, or the *City of Edmonton Design and Construction Standards*, the design shall be undertaken to conform to the *TAC Geometric Design Guide for Canadian Roads*. Where specific design elements are not included in the foregoing guidelines set out in this paragraph, the design shall be undertaken to conform to American Association of State Highway Transportation Official (AASHTO) *Geometric Design of Highways and Streets Guide*.

The design shall utilize, as a minimum, the design criteria stipulated in Section 200 (Project Specifics). Where design criteria are not specified, desirable design criteria shall be utilized, except where minimum design criteria are acceptable to the safety auditor. In no circumstance will the use of combinations of inter-related minimum design criteria be accepted.

The Contractor shall consider the ultimate design identified in the Functional Plan, and as modified in the Technical Requirements if applicable, in all design decisions in order to facilitate any additions to the New Infrastructure. The design shall consider future costs, throwaway costs, user costs, safety, and identify an optimal design within such constraints. Life cycle cost considerations shall be documented in the design report to support the design decisions. The Project mainline, ramps and crossroads shall be designed for the design speeds identified in Section 200 (Project Specifics).

300.3.1.2 Intersections and Interchanges

The design of at-grade intersections shall be in accordance with *Alberta Transportation's Highway Geometric Design Guide* and any applicable *Alberta Transportation Design Bulletins*.

Interchanges shall be designed to the configurations established in the Functional Plan, and as modified in the Technical Requirements if applicable, or to equivalent alternative configurations accepted, in advance and in writing, by the Department.

300.3.1.3 Soils

The Contractor shall undertake the grading design with due consideration for the soil types encountered. A geotechnical investigation shall be carried out by the Contractor in sufficient detail to allow for the identification of all soils issues.

Where embankments must be built over soft or yielding ground, stability and settlement of the embankment fill shall be carefully evaluated, in accordance with the recommendations set out in of the Department's Guidelines for Consulting Geotechnical Assignments, November 2005 (updated) or latest version.

The Contractor shall prepare detailed geotechnical reports for the entire Project for the purpose of documenting soil conditions and the engineering recommendations for all soils issues. The reports shall be completed in accordance with the *Canadian Foundation Manual* and the Department's *Engineering Consultant Guidelines for Highway and Bridge Projects*.

300.3.1.4 Drainage

The drainage design shall prevent damage to the Road Right of Way, the TUC and the lands adjacent the TUC, caused by flooding or drainage problems.

The Contractor shall be responsible for obtaining all necessary permits and authorizations from, but not limited to, Alberta Environment, the Department, Department of Fisheries and Oceans, and the Local Authority, as applicable.

The drainage design shall include erosion control installations necessary for the existing conditions of the drainage works. Such designs shall be consistent with the Department's *Design Guidelines for Erosion and Sediment Control for Highways*.

300.3.1.4.1 Condition of the Drainage System

All components of the drainage system on or related to the New Infrastructure must be installed and functioning as designed. Culverts shall have no perforations. Any perforated culverts shall be replaced or lined as directed by the Department. All ditches, culverts, storm sewers, manholes, inlet and outlet structures, stormwater management ponds and other appurtenances shall be fully operational and clear of any debris or accumulated material.

300.3.1.4.2 Overall System Requirements

In addition to the design and construction of the New Infrastructure drainage system, the Contractor is responsible for ensuring the previously installed drainage systems on other portions of the Road Right of Way and the TUC are compatible and the overall system meets the Technical Requirements. This includes the entire drainage network from the source points to the various outfalls and all features in between. The Contractor shall ensure that the design hydraulic capacity of the network as a whole and each of its elements meets the Technical Requirements. Permanent drainage systems and facilities shall be designed for gravity flow.

Prior to Construction Completion, in the event of a roadway spill that impacts the drainage system, the Contractor shall be responsible for managing the clean up. This shall include but not be limited to implementing any safeguards to prevent contaminants from entering adjacent water bodies or the groundwater system.

300.3.1.5 Hazard Protection

The use of barriers shall be limited to those areas where it is necessary to protect the travelling public from roadside hazards. All grade line design shall be such as to minimize the need for barriers. The design shall be in accordance with the Department's *Roadside Design Guide*

The Contractor shall undertake the design to minimize the need for protection. Where required, the Contractor shall utilize the appropriate barrier configuration for providing protection for roadside hazards based on safety considerations. In circumstances where protection is required, the Contractor shall protect the public from the hazard using a barrier and barrier end treatments that have passed all required tests for *NCHRP Report 350*, Test Level 3, unless otherwise specified in Section 200 (Project Specifics).

Where barriers are required and cannot be avoided by altering design characteristics of the roadway, thrie beam rail shall be used. The rail, support posts, and ancillary hardware shall be specified to meet the performance requirements described in *NCHRP Report 350*, Test Level 3 and Section 200 (Project Specifics).

300.3.1.6 Roadway Lighting

The Contractor shall design the roadway lighting in accordance with the requirements of the *Alberta Transportation Highway Lighting Guide*. The design shall result in lighting to levels identified in Section 200 (Project Specifics) for the full length of all roadways. The poles and bases shall meet the requirements of the *Alberta Transportation Highway Lighting Guide.*

All designed systems shall be in accordance with the *Canadian Electrical Code* and the regulations of the electrical inspection department having jurisdiction. The Contractor shall prepare shop drawings of all electrical components as part of the design. The drawings shall include poles, luminaires, distribution enclosures, bases and foundations. Shop drawings shall be stamped and signed by a Professional Engineer.

300.3.1.7 Landscaping

All non-hard surfaced areas within the Road Right of Way and other disturbed areas within the TUC shall be topsoiled and seeded to grass as noted in Section 200 (Project Specifics).

300.3.1.8 Pavement Structure

The Contactor shall undertake the task of designing the pavement structures in accordance with the AASHTO Pavement Design Guide (1993 edition) procedure and supplemented by mechanistic analysis on the basis of actual soil and material parameters for the roadway subgrade and any requirements of Section 200 (Project Specifics), only if the Contractor believes the minimum pavement structures identified in Section 200 are inadequate. The pavement structures for all roadways within the New Infrastructure shall be designed as long-life asphalt pavements such that no structural strengthening will be required within 50 years.

Any subgrade widening at tie-ins to existing roadways shall be constructed to avoid disruption of drainage along the subgrade surface and protect the integrity of the existing pavement structure. Pavement structure variation for the New Infrastructure shall be introduced beyond the tie-in points to preserve subgrade drainage and structural integrity of existing roads.

300.3.1.8.1 Pavement Design Report

The Contractor shall prepare a pavement design report that shall include, as a minimum:

- Site plans showing the limits of the roadway covered by the design report:
- Cross section drawings for the recommended pavement design strategy, layer thicknesses and materials;
- For any pavement design prepared by the Contractor, all pertinent design inputs such as traffic, soils characteristics, characteristics of the proposed construction materials, environmental inputs to the design for rehabilitation design, the existing pavement structures (only required where the Contractor wishes to increase the pavement structure from the minimum structure provided in Section 200);
- For any rehabilitation design prepared by the Contractor, graphical presentation of calculated moduli, overlay needs, and existing cross sections (only required where the Contractor wishes to increase the pavement overlay structure from the minimum structure provided in Section 200).

300.3.1.9 Traffic Control Devices

300.3.1.9.1 Signs

Sign patterns for standard signs shall conform to the *Alberta Transportation Sign Pattern Manual*. For signing not addressed by the *Alberta Transportation Sign Pattern Manual*, sign patterns shall conform to the *TAC Uniform Traffic Control Devices of Canada Sign Pattern Manual*. All lettering on signs shall conform to the series Type Highway Font from the *Standard Alphabet for Highway Signs*, available from the Federal Highway Administration (CHTO-20), Washington, D.C., 20590, unless otherwise specified by the *Alberta Transportation Sign Pattern Manual* or the *TAC Uniform Traffic Control Devices of Canada Sign Pattern Manual* for the applicable signs.

300.3.1.9.2 Traffic Signals

All traffic signal installations, including pedestrian controls, shall be designed in accordance with the current edition of the *TAC Manual of Uniform Traffic Control Devices for Canada*, and the *Canadian Capacity Guide for Signalized Intersections*. The Contractor shall consider as part of the Contractor's Designs any staging of signal installations required based on future traffic volumes on the New Infrastructure.

The Contractor shall design all signalization to interface with the Local Authority signal system. The Contractor shall cooperate with the Local Authority to meet all of the requirements of the Local Authority's control system and have the ability to be controlled by the Local Authority's system.

All electronics for New Infrastructure shall be NEMA approved electronics. LED lights shall be implemented as per Alberta Transportation's Design Bulletin #32 "LED Lamp Usage in Traffic Signals, Pedestrian Signals and Beacons". All signals shall be mounted on cantilever style poles and no alternative mounting systems will be allowed at any time. All poles and associated hardware shall be galvanized. All signal systems shall be similar in appearance to those used by the Local Authority on roadways of the same standard in adjacent areas.

300.3.1.9.3 Pavement Markings

The Contractor shall design and install painted or durable pavement markings with or without "cat eye reflectors" in conformance with the *Alberta Transportation Pavement Marking Guide* and the *Alberta Transportation Highway Geometric Design Guide***.**

Pavement markings shall be maintained until Construction Completion to provide clear and positive lane delineation for the safe and orderly movement of traffic. In general, the Contractor shall install painted roadway lines twice per year on all pavements open to traffic and constructed under this DB Agreement in accordance with Section 400.2.50 (Painted Roadway Lines). For pavement surfaces completed in prior year(s) the first yearly application shall be completed prior to May 30th. All pavements shall have the roadway lines painted again in the fall prior to seasonal shutdown. Pavements where the first application of line painting was completed after August 15th may be exempted from the second application for that year. Notwithstanding the previous five sentences, if at any time in the Department's opinion, any of the pavement markings are not accurate, neat or visible in appearance the Contractor shall remove, repair or replace the pavement markings to the satisfaction of the Department.

300.3.1.10 Miscellaneous

300.3.1.10.1 Fencing

Fencing shall be designed and installed along the entire length of the Road Right of Way and around any stormwater management facilities related to the New Infrastructure outside the Road Right of Way but inside the TUC, as specified in Section 200 (Project Specifics).

300.3.1.10.2 Guide Signing

Highway Guide Signs shall be designed and installed by the Contractor. The requirements for font, size, layout and appearance of messaging on guide sign panels shall be in conformance with Alberta Transportation's *Highway Guide and Information Sign Manual (October 2006).*

300.3.2 MATERIALS

The Contractor shall select the materials to be used for construction to meet the project requirements as outlined in the Technical Requirements. Materials for roadway elements such as culverts and ducting should be selected to achieve a minimum of a 50-year life**.**

Except for reclaimed asphalt pavement ("RAP") materials, all construction materials shall be new materials specifically manufactured for their intended purposes.

The Contractor is required to submit for acceptance to the Department any specifications for materials to be used for the Project if there are no specifications included in this Schedule 14 (Technical Requirements).

300.4 BRIDGE STRUCTURES

300.4.1 GENERAL

300.4.1.1 Existing Reference Documents

Existing reference documents that are binding to the Project are noted below.

- *Bridge Welding Code* (AWS D1.5);
- *Canadian Highway Bridge Design Code* (CSA Standard S6-06);
- *Alberta Transportation's Engineering Drafting Guidelines for Highway and Bridge Projects; and*
- *Alberta Transportation's Navigable Waters Protection Act Procedure Manual.*

Standard Drawings referenced in Section 300 are available on the Department's website.

300.4.2 DESIGN CRITERIA

300.4.2.1 Design Codes

The Contractor shall complete all bridge structure design in accordance with *CAN/CSA-S6-06* (*Canadian Highway Bridge Design Code*) (the "Bridge Design Code"), which may be supplemented with other relevant codes and recognized current engineering practices and specifications with the prior written approval of the Department. Exceptions to CAN/CSA-S6-06 requirements are noted in this Section 300.4.2 (Design Criteria).

Live load distribution factors used for girder design shall not be less than the empirical factors specified in the Bridge Design Code unless specifically agreed to in writing by the Department. If a bridge does not satisfy the criteria that allow the empirical factors to be used, the live load distribution factors used for girder design shall not be less than the empirical factors that would have been used if the bridge had met these criteria. The distribution factors used shall be shown on the drawings.

Notwithstanding section 1.4.2.5 of the Bridge Design Code, approval will not be given for the use of single load path structures. Slab and girder bridge structures shall have a minimum of four girder lines. Piers with two columns or less shall meet the requirements of Section 300.4.2.12 (Substructures/Foundations).

300.4.2.2 Design Load

(a) Highway Bridges

The minimum highway bridge live load shall be CAN/CSA-S6-06 CL-800 plus Dynamic Load Allowance. Truck axle and wheel loads shall be proportioned from the CL-625 truck. No adjustments are required for the 9 kN/m uniformly distributed load for lane load.

In section 5.7.1.3 of the Bridge Design Code the width (B) of the bridge may be assumed to be reduced to a width that provides a value of β < 10. The number of design lanes (n) shall be reduced as required to be consistent with the assumed bridge width (B);

(b) Pedestrian Bridges

The minimum pedestrian bridge live load shall be in accordance with section 3.8.9 of the Bridge Design Code.

(c) Future Wearing Surface

Bridges shall be checked for the effects of removing the top 25mm of the deck and the subsequent placement of a 90mm non-composite ACP wearing surface.

(d) Fatigue

All new bridges shall be designed to comply with CAN/CSA-S6-06 Class A Highway requirements (section 1.4.2.2). This requirement shall apply to all bridge components for considerations of structural fatigue.

(e) Vehicle collision load

The application of the collision load of 1400 kN as specified in Section 3.15 of the Bridge Design Code, shall be limited to roadways with design speeds less than 80 km/hr. For roadways with design speed ≥ 80 km/hr, and bridge structural support within 10m from edge of ultimate pavement, the vehicle collision load shall be increased to 1800 kN, assumed to act in any direction in a horizontal plane, and at a distance of 1200mm above ground (Reference AASHTO LRFD Bridge Design specifications).

300.4.2.3 Hydrotechnical

Unless otherwise noted, the provisions of the Bridge Design Code with reference to section 1.3.4 Hydraulic Definitions and 1.9 Hydraulic Design shall NOT apply to the Project.

For proposed bridge structures over watercourses, including bridge size culverts (1.5m diameter or larger), the Department will evaluate the proponent's hydrotechnical design using the Department's current "*Hydrotechnical Design Guidelines*" document.

Bridge structure openings on watercourses shall be sized and protected so that over the 75 year service life of the structure they do not:

- Cause an unacceptable level of flooding on neighbouring flood sensitive lands and developments;
- Cause any flooding of the highway road surface;
- Have a negative impact on local channel stability; and
- Cause erosion affecting the stability of the bridge structure or roadway fills.

300.4.2.3.1 Minimum Freeboard for Stream Crossings

Bridges shall be designed to have a minimum 1.0m freeboard.

Bridge size culverts shall be designed to have a minimum freeboard of one-sixth the culvert diameter (to a maximum of 1.0m) and a minimum invert burial depth of one-quarter the culvert diameter (to a maximum of 1.0m).

300.4.2.4 Geotechnical

Bridge structure foundations shall be designed in accordance with the Bridge Design Code. Bridge substructure elements shall be supported on pile foundations.

The selection of representative or "characteristic" geotechnical parameters used to determine foundation capacity shall be based on the results of appropriate field and laboratory investigations and shall represent the Design Engineer's "best" estimate of the likely values of the parameters, taking into account all the factors that may have influence on the soil properties, in accordance with the Canadian Foundation Engineering Manual, 4th Edition, 2006, Chapter 8.5.

Silt material shall not be used in the design and construction of headslopes and approach fills for the bridge structures. The global stability of bridge headslopes and approach fills, including the effects of retaining walls, shall be designed for a minimum factor of safety of 1.5.

Silt material specified as "ML" or "MH" material (in accordance with the "Modified Unified Soil Classification System") shall not be used in the design and construction of the bridge headslopes and approach fills, nor in the roadway embankments.

The design of the bridge approach fills and retaining walls, shall account for stability, long-term settlements and wall deformations. Stability analyses shall be carried out to determine that head slopes and retaining walls shall have acceptable short term and long term stability in order to prevent failure or excessive deformation. Deformations of embankment and walls (including settlement and lateral movements) shall be determined using appropriate deformation analyses, with representative soil parameters derived from site specific geotechnical investigations and local experience. The expected range of embankment and wall displacements including settlement and lateral movements shall be taken into account in the design of the bridge and shall provide for acceptable structural and aesthetic performance of the embankments and walls. Any differential settlement between the bridge structure and approach fills shall not cause a deviation of more than 1% from the roadway design grade.

300.4.2.5 Geometrics

The Contractor shall design a roadway grade line that optimizes the location and length of the bridge structures. Where practical, bridges shall be located on tangent horizontal alignments.

In addition to and notwithstanding the geometric design requirements stated in Section 200 (Project Specifics), bridge decks shall have a maximum grade of 3%. Bridges shall not be located on spiral curves.

For deck drainage purposes, the Department considers a minimum grade of 1% to be desirable. However, the Department recognizes that grade line constraints for grade separation structures may require crest curves that result in portions of the bridge deck having a grade of less than 1%. Where practical, the crests of crest curves shall be located off of or at one end of the bridge opening.

Bridge deck widths shall as a minimum have the same width as the clear roadway on the bridge approaches. The bridge deck shall also have a 2% crown unless the grade line over the bridge structure is superelevated. The tops of sidewalks and medians shall slope 2% towards the roadway. The tops of abutment seats, pier caps, curbs and barriers shall have a wash slope of 3%.

Top of bridge headslope fill widths shall be out-to-out bridge end width plus 2 m. Taper rate from headslope fill width to approach roadway fill width shall be 30:1 or flatter. Corner transitions between headslope and sideslope shall use an elliptical curve at the toe of the slope.

Bridge structure support locations, e.g. piers, abutments, retaining walls, shall not be located within the underpassing roadway's clear recovery zone and shall allow all required sight distances to be met.

The vertical clearance posting (as determined below) for any grade separation bridge structures shall be a minimum of 5.4m.

The minimum vertical clearance for any sign structures over the roadway shall be the greater of 6.0m or 300mm higher than the lowest grade separation structure in the vicinity.

The Department's process for determining the vertical clearance posting is as follows:

- Measure minimum vertical clearance between the roadway surface and lower bottom edge of the girder within roadway width including shoulders to the nearest centimetre (e.g. 5.74m);
- Round down to the nearest decimetre (e.g. 5.7m); then
- Subtract one decimetre for tolerance (e.g. Post vertical clearance as 5.6m)

300.4.2.6 Preferential Bridge Deck Icing

Bridge decks that are on a resultant slope of 4% or greater due to roadway grade and cross-slope or are located in areas where changes in traffic speed are required, shall be designed with systems that can either prevent preferential bridge deck icing or predict its occurrence in advance so that preventative measures can be taken.

300.4.2.7 Durability

Bridge structures shall be designed for a service life of 75 years unless noted otherwise. The designs shall recognize the need for ease of replacement of components whose service life is expected to be less than 75 years and the provision of access for inspection and maintenance. The level of maintenance, rehabilitation and/or repair required during the service life of the bridge structures shall be consistent with or better than that generally anticipated to be required for other bridge structures of similar age and type on the Provincial highway system.

The Department's standard system for protecting a bridge deck from deterioration due to de-icing salts and rebar corrosion consists of a combination of:

- Class HPC concrete deck;
- Epoxy-coated deck rebar; and
- A waterproofing membrane.

This standard bridge deck protection system shall be used unless otherwise specified in Section 200 (Project Specifics).

The number of deck joints shall be kept to a minimum and bridge superstructures shall be continuous for live load over the piers. All deck joints shall include provision to capture and manage deck drainage such that it does not come into contact with other concrete and steel surfaces of other bridge elements.

Class HPC concrete shall be used for all bridge decks, curbs, sidewalks, medians, roof slabs, approach slabs, concrete overlays and any other bridge components that will come into direct contact with de-icing salts.

An approved Type 1c sealer shall be applied to all concrete surfaces which are susceptible to deterioration by water and de-icing salts.

The Department standard deck waterproofing system as shown on the Department's Standard Drawing S-1443-98 shall be used on all bridge decks. Bridge decks with waterproofing membranes shall have provisions made along the gutter lines to allow for the drainage of water that penetrates the asphaltic wearing surface. The asphalt mix type and grade shall be the same as used in the surface lift on the adjacent roadway.

The following minimum clear cover for reinforcing steel shall be specified on the Detailed Designs. These are minimum requirements for inspection and checking during construction:

- Reinforcing steel in concrete subject to normal exposure 50mm
- Reinforcing steel in concrete cast in contact with soil (no form) 75mm
- Reinforcing steel adjacent to front face of curb, median or barrier 100mm
- Reinforcing steel in cast-in-place decks with waterproofing and overlay system.
    - Top layer 50mm
    - Bottom layer 40mm
- Reinforcing steel in cast-in-place decks without waterproofing and overlay system
    - Top layer 75mm
    - Bottom layer 40mm

The minimum clear cover for post-tensioning ducts in pre-cast concrete girders with 28 day concrete strength greater than or equal to 65 MPa shall be 45mm (+ 5mm).

Epoxy coated reinforcing steel shall be used for the following locations unless otherwise specified in Section 200 (Project Specifics). Uncoated black steel reinforcing steel shall not be accepted as a substitute:

- Both layers of reinforcing steel in cast in place decks.
- All reinforcing steel and prestressing strand in partial depth precast concrete deck panels, including the portions of the reinforceming steel and prestressing strands extending into the cast-in-place concrete deck.
- Both layers of reinforcing steel in abutment roof slabs.
- Stirrups projecting from precast girders into deck slab.
- Reinforcing steel in curbs and barriers (abutments and superstructure).
- Reinforcing steel within 150mm of the top of abutment backwalls, diaphragms and corbels.
- Reinforcing steel in wingwalls within 150mm of the top of the concrete deck surface.
- Reinforcing steel dowels that connect the approach slab to the abutment corbel.
- Reinforcing steel in approach slabs, including sleeper slabs.

Prestressing strand used in stay-in-place partial depth precast deck panels shall be grit-impregnated epoxy coated strand conforming to the requirements of ASTM A882-04a "Standard Specification for Filled Epoxy Coated Seven-Wire Prestressing Steel Strand".

300.4.2.8 Sign and Lighting Structures

Overhead and cantilevered sign structures and high mast lighting structures with a height greater than 20 m shall be designed in accordance with the requirements of AASHTO "*Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*" (the "AASHTO Standard Specs"), latest edition plus interims and the following additional criteria:

- Equation 3-1 of AASHTO Clause 3.8.1 shall be modified as follows:

$$P_z = 2.7\, q\, K_z\, C_d$$

where q shall be taken from *CAN/CSA S6-06*, Table A3.1.7 for a return period of 50 years;
- The design ice thickness for ice accretion shall be the value given in *CAN/CSA S6-06*, Figure A3.1.4;
- For the design of all cantilevered sign structures, the Fatigue Importance Factors in Table 11-1 of the AASHTO Standard Specs shall be based on Fatigue Category I. The deflection for cantilevered sign structures, as specified in Clause 11.8 of the AASHTO Standard Specs shall not exceed 200mm;
- Stresses for anchor bolts shall be limited to $0.50F_{pu}$ applied to the root tensile stress area at the Group Load Combination I, II and III. Stress range for Group IV shall be in accordance with Section 11 of the AASHTO Standard Specs. The design shall allow for the failure of one anchor at any one location for each pile foundation. After such failure, the remaining anchors shall still be capable of meeting the above design requirements;
- Anchor bolts shall be pre-tensioned to $0.70\ F_{pu}$;
- Design sign panel area shall be taken as the largest of:
  - Initial stage sign panels;
  - Ultimate Stage sign panels (Ultimate Stage shall consider any potential changes due to safety audits, which changes and audits are the Contractor's responsibility); and
  - Area of 3.5m x 60% of horizontal span length, placed in any position along the span;
- Sign structures shall have a permanent vertical camber of L ÷ 200 where L is the span of the horizontal arm of the sign structure;

- The tops of the concrete foundations shall project from 700mm to 850mm above the adjacent ground surface on the traffic side. The exposed portion of the concrete foundation shall be of circular cross-section;
- The minimum vertical clearance below the sign panels shall be 6.0 metres; and
- The Contractor shall determine placement, clearance requirements, need for barrier protection, and type of structure (bridge or cantilevered) in accordance with guidance provided in *Alberta Infrastructure and Transportation Roadside Design Guide*, and prepare a general layout drawing for each individual sign structure in accordance with Standard Drawing S-1721-07.

300.4.2.9 Retaining Wall Structures

Non-mechanically stabilized earth retaining walls shall be designed in accordance with the provisions of *CAN/CSA-S6-06*.

Mechanically Stabilized Earth Walls shall be designed to the more severe requirements of CAN/CSA-S6-06 and the AASHTO LRFD Bridge Design, 4th Edition, 2007, except that global stability shall be designed in accordance with Section 300.4.2.4 (Geotechnical). The design life of all MSE components shall be 100 years.

Abutments on top of MSE walls shall be supported on piles.

The height of retaining walls shall be limited to 6m for highway interchange and overpass structures and 8m for railway underpasses. The height of wall shall be measured from the top of the wall to the top of pavement or rail in front of the wall.

Lateral wall displacements due to internal mechanically stabilized earth wall deformations, if applicable, and due to movements of the wall foundation shall not result in the top of the wall leaning outwards relative to the bottom of the wall during the life of the structure. Any structural elements supported on the walls, such as abutments, abutment deck joints, abutment bearings and barriers, shall be designed to accommodate any movements resulting from lateral wall displacements. Lateral wall displacements shall also not exceed 50mm at any part of the wall.

When MSE walls are used at bridge structures, they shall be considered an integral part of the bridge structure and shall be designed and detailed to interact with the rest of the bridge structure (i.e. abutment piles, seat, wingwalls, barriers, backwalls, diaphragms, and approach slabs) in a manner that will provide adequate structural capacity and long-term durability. All MSE walls at bridge structures shall use steel reinforcements.

Retaining walls with traffic running parallel to the top of the wall shall have rigid bridge barriers meeting, as a minimum, the Performance Level 2 requirements of CAN/CSA-S6-06 Section 12. The retaining wall shall be designed to fully resist the barrier loads applied to the barrier. Safety handrails shall be mounted along the tops of all other retaining walls.

MSE wall panels and concrete fascia shall be supported by compacted backfill without voids or equivalent on the non-exposed side. MSE wall panels shall be precast concrete panels topped with a cast-in-place concrete coping. Tops of the cast-in-place concrete coping shall be smooth and have no steps or abrupt change in height. Precast concrete panels shall be Class HPC concrete and shall have a minimum thickness of 140mm. The minimum cover to the reinforcing steel shall be 50mm on the front face and 40mm on the back face. Differential settlements of the precast panel walls shall not exceed the limits shown in Table C11.10.4.1 of the AASHTO LRFD Bridge Design Specifications, 4th Edition.

Obstructions such as piles and associated casings, or casings for future pile installations in the soil reinforcement zone of MSE walls, shall be accommodated with appropriate arrangement of soil reinforcing around such obstructions. Splaying of soil reinforcement shall not exceed 20º from the perpendicular to the facing panel.

Precast concrete panels for MSE walls shall be designed to accommodate a differential settlement of 100mm in 10 metres of length along the wall. The joint gaps between adjacent panels shall be designed to be 20mm nominal. Joints between panels shall have a lip and recess (ship lap) configuration so that joint material is protected and overall aesthetics is enhanced.

Special corner units shall be used for MSE walls when the interior angle between adjacent panels is 130º or less. Acute corners less than 70º inside panels shall not be allowed.

For stepped levelling pads for MSE walls, the maximum elevation difference between adjacent steps shall not exceed 750mm. The minimum length of each stepped section shall be 2250mm.

Where staged construction is required and large differential settlement is expected between stages, appropriately located full height vertical slip joints shall be provided.

For MSE retaining wall abutments, the MSE wingwalls shall be flared away from the overpassing roadway so that they clear the abutment wingwalls or run generally parallel to the underpassing roadway. The ends of wingwalls running generally parallel to the underpassing roadway shall be flared back in accordance with the Flare Rate Table in Section H5.4.2 of the Roadside Design Guide and buried into the ground.

Proper drainage, with a drainage swale on top and weeping tile near the bottom, is required. Highway and bridge surface drainage shall be controlled and channelled away from the back of the walls and mechanically stabilized earth mass. The weeping tile drains shall consist of 150 mm diameter PVC complete with filter sock and shall be located near the front and back bottom corners of the mechanically stabilized earth mass. The weeping tile drains shall be daylighted or connected for positive drainage.

Dry cast concrete block walls are not permitted.

300.4.2.10 Deck, Curbs, Medians, Concrete Barriers, Sidewalks

(a) Deck slabs for beam and slab bridges shall be designed with the empirical method in accordance with section 8.18.4 of the Bridge Design Code except that Section 8.18.4.1 (b) shall be amended to limit the girder spacing to slab depth ratio to 15.0. Use of this method requires composite action between the slab and girder over the entire girder length.

(b) Deck and curb reinforcement required to develop the capacity of bridgerail post anchors are site specific designs. Guidance for design of decks supporting bridgerail posts is available from AASHTO LRFD Bridge Design Specifications 2007 Appendix Section A13.4.3.

(c) Cast-in-place deck slabs for beam and slab bridges shall be minimum 225 mm thick.

(d) Stay in place partial depth precast deck panels shall be designed in accordance with section 8.18.4.3 of the Bridge Design Code. Additionally, top transverse deck rebar shall be designed for transverse bending moments in accordance with section 5.7.1.7.1(a) of the Bridge Design Code using the simplified elastic method.

(e) Full depth precast deck construction shall not be allowed.

(f) Stay in place corrugated steel, timber or other deck soffit formwork types are not allowed.

(g) The Contractor shall provide one 75 mm diameter utility duct on each side of the bridge deck for the future accommodation of utilities. If a bridge deck is to be widened on one side at the Ultimate Stage a utility duct is only required on the nonwidened side of the bridge deck. If a bridge deck is to be widened on both sides at the Ultimate Stage a utility duct is only required on one side of the bridge deck and the Department will determine on which side of the bridge deck the utility duct will be placed. The utility ducts shall be placed within the bridge curbs/barriers and shall be extended beyond the ends of the abutment wingwalls and terminated behind the roadway approach rails. If additional utility ducts are required for the utility needs of the Project they may be placed within bridge curbs/barriers that will not be removed at the Ultimate Stage. Utility ducts shall not be placed within the bridge deck or attached to the bridge girders.

(h) Concrete curbs and barriers shall have crack control joints at a maximum spacing of 3m (centred between bridgerail posts where applicable). Longitudinal reinforcing in the curbs shall be discontinuous at the joints. Control joints shall extend down to the top of the concrete deck and shall be caulked prior to application of deck waterproofing membrane.

(i) Concrete paving lips along the edge of ACP are not permitted.

(j) The sidewalk portion of the deck slab shall consist of a structural deck slab protected by an asphalt waterproofing membrane. A second slab shall be poured on top of the structural deck slab with transverse tooled joints at a spacing matching adjacent curb/barrier control joints. The sidewalk shall have a curb projecting 100mm above the finished top of the sidewalk along the outside edge. The sidewalk shall be higher than the adjacent road surface and drain through slots in the traffic separation barrier onto the roadway surface.

(k) The median portion of the deck slab shall consist of a structural deck slab protected by an asphalt waterproofing membrane. A second slab shall be poured on top of the structural deck slab with transverse tooled joints at a spacing matching adjacent curb/barrier control joints. For posted speeds greater than 60 km/hr the median shall have semi-mountable or mountable curbs in accordance with the requirements of the Roadside Design Guide.

(l) The following set-back requirements or protective measures shall be followed when attachments, such as signs, lamp posts, sign structure support columns, piers of adjacent bridges, etc. are on top of or close behind bridge or retaining wall barriers:

Applicable roadside barrier standard	Set-back or other treatment
TL 2	305mm minimum

Applicable roadside barrier standard	Set-back or other treatment
TL 3	610mm minimum
TL 4	For lamp posts and sign structure columns, provide PL2 combination barrier (Standard Dwg. S-1700 & S-1701 with a height of 1400 mm). If a PL3 bridgerail is required by the Bridge Design Code the overall height of the standard PL3 barrier (Dwg. S-1700, S-1701, S-1703) shall be increased to 1370 by increasing the height of the concrete base. A set-back of 610 mm is required behind the top rail. For piers of adjacent bridges, a 3,000 mm minimum set-back is required.

Attachments shall be mounted on top of the curb or concrete barrier at locations close to the centreline of piers to avoid excessive vibration from traffic.

Base plates and anchors shall be grouted and sealed with a penetrating sealer. A minimum 50mm nominal thickness grout pad shall be provided under base plates. The grout shall sit in a grout pocket recessed 20mm into the surface of the structure. The grout pocket shall be 40mm larger than the base plate around the perimeter.

300.4.2.11 Girders

300.4.2.11.1 General

Attachment of utilities to bridge girders or other primary load carrying members shall not be permitted.

Clearance signs shall be provided on all bridge structures at the locations of underpassing roadways and shall be attached to the upstream fascia girder.

Except for integral abutment designs, abutment diaphragms shall be steel to provide open access for inspection and maintenance of bearings and abutment deck joints.

300.4.2.11.2 Precast-Prestressed Concrete Girder Bridges

Precast-prestressed concrete girder bridges shall be designed to meet the following requirements:

(a) Typical NU girder details shall be in accordance with the Department's Standard Drawings S-1757-08 and S-1758-08 (NU Girder Bridges-Typical Details Sheet 1 and 2).

(b) Pier diaphragms shall be continuous cast-in-place concrete diaphragms and shall be either pinned, fully monolithic with the pier top or permit free expansion. Positive moment connections at piers shall be developed by either one or a combination of grouted unstressed tendons, bent-up strands or cast in hooked rebar. Minimum separation between girders ends shall be 150 mm with grouted tendons only, and 300mm with bent strands or hooked rebar. For pier diaphragms with a pinned or expansion connection to the pier, girders ends shall be supported on double reinforced elastomeric pads. For pier diaphragms connected monolithically to the pier top, girder ends may be supported on plain elastomeric pads for erection loads only.

(c) Minimum age for girders before field cast continuity shall be 30 days. Girder design and detailing shall consider the effects of differential camber between girders, such as in haunch height variations and diaphragm connectors. Girder design strength shall be based on the nominal girder depth assuming the minimum haunch height.

(d) Appropriate allowance for prestress (pre-tension and post-tension) shortening, shrinkage and creep shall be included in the fabricated length of the girders.

(e) Stirrup projections from the top of the precast girder into the deck shall meet all code requirements for lap splicing with vertical stirrups, and anchorage requirements for developing full composite action. All stirrups shall have 135º hooks around longitudinal bars. When projection of stirrups is less than 40mm above the underside of the bottom mat of deck bars, additional hat shape extension bars shall be provided to tie the slab and the deck haunch. Longitudinal deck bars shall be detailed with a bar centred directly over the girder webs and the remaining bars spaced evenly between girder lines.

(f) Horizontal interface shear design for composite action shall satisfy the requirements from CAN/CSA-S6-06 or AASHTO LRFD Bridge Design Specifications 2007, whichever is more stringent.

(g) Additional vertical stirrups and closed ties for the bottom flange for crack control at pretension girder ends shall be provided in accordance with section 8.16.3.2 of the Bridge Design Code. Closed ties shall also be provided in the rest of the girder at a spacing of 300mm. The top of the ties can be left open in the midspan region where there is conflict with post-tensioned cables.

(h) For post-tensioning ducts in pre-cast concrete girders with 28 day concrete strength greater than or equal to 65 MPa, the inside duct diameter shall not exceed 50% of the web thickness and the inside duct area shall be $\geq$ 250% of the strand area.

(i) For conventional abutments, abutment girder ends shall be thickened and designed as part of the abutment steel diaphragm for transfer of lateral forces.

(j) For NU Girders and other "I" shaped girders all girder ends shall have cast-in shoe plates anchored into the girders.

(k) For NU Girders four bonded prestressing strands shall be incorporated in the top flange to assist in controlling stresses due to transportation and deck construction.

(l) For connecting diaphragms in exterior girders, no connection components shall be visible on the exterior surface of the girders.

300.4.2.11.3 Steel Girder Bridges

Welded steel plate girder bridges shall be designed to meet the following requirements:

(a) Typical welded steel plate girder details shall be in accordance with the Department's Standard Drawings S-1759-08 and S-1760-08 (Steel Plate Girder Bridge-Typical Details Sheet 1 and 2).

(b) Vertical stiffeners and girder ends shall normally be square to the girder flanges. Abutment detailing dimensions shall account for the effects of girder end tilt.

(c) Stiffened plate girder webs shall in no case have intermediate transverse stiffeners spaced at greater than 1.5 times the girder depth.

(d) All welded steel girders, regardless of span, shall be cambered for 100% of dead load deflection and roadway gradeline profile.

(e) All bearing stiffeners shall be "fit to bear bottom" and "fit only top", and then fillet welded to both top and bottom flanges.

(f) For long bridges with large expansion movements, the use of multiple bearing stiffeners shall be considered.

(g) Location of jacking stiffeners shall be based on estimated jack sizes required for bearing replacement, plus sufficient clearance to the edge of the abutment seat or pier cap.

(h) Diaphragm connector plates and intermediate stiffeners at stress reversal locations shall be welded to both top and bottom flanges. Corner cope of plates shall normally be 80 x 35 mm for weld thicknesses of 14 to 20, and can be reduced to 25 x 25 mm when extra weld is required at narrow girder flanges. Intermediate stiffeners, other than at stress reversal locations, shall be welded to the compression flange only, and cut short of the tension flange with web gap meeting the requirement of section 10.10.6.4 of the Bridge Design Code.

(i) Corners of stiffener plates projecting past the outside edge of flange plates shall be coped 45º.

(j) No intersecting welds are allowed. Horizontal stiffeners on the same side of the web as vertical stiffeners shall be terminated a minimum 6 mm from intersecting vertical stiffener welds.

(k) All weld ends shall terminate 10mm from the edge or end of plates.

(l) Gusset plates for attachment of horizontal lateral bracing shall be bolted and not welded to girders.

(m) The following material properties shall be followed:

1) Girders and all materials welded to girders.	CSA G40.21-Grade 350AT CAT 3 or ASTM A709 Grade 345WT Type B with Charpy value of 27J @ -30°C.

2)	Ungalvanized bearing and bracing materials bolted to girders.	CSA G40.21M-Grade 350A
3)	Structural bolts	22 mm diameter A325M - Type 3 weathering steel

All weathering steel shall be uncoated.

(n) The following features shall be used to prevent staining of sub-structure concrete:

- At pier locations, the exterior edge of the bottom flange of exterior steel girders shall have a 19 x 19 x 8000mm long rubber strip centred over the pier, in accordance with the Department's Standard Drawing S-1760-08.
- At abutments, the bottom flanges of exterior steel girders shall have the same rubber strip attached all around the low end of the bottom flange 2 metres in front of the abutment face.
- Where steel girders are cast into fully integral abutments a second rubber strip shall be applied all around the bottom flange of all girders immediately in front of the concrete abutment face.

(o) Changes in girder flange widths shall be tapered at a taper of 2 (longitudinal):1 (transverse).

300.4.2.11.4 Intermediate Diaphragms

(a) Typical intermediate diaphragm locations and details shall be in accordance with the Department's Standard Drawings S-1757-08 to S-1760-08.

(b) Intermediate diaphragms are required in bridge structures with girder and slab superstructures unless their omission is agreed to in advance and in writing by the Department. Intermediate diaphragms in bridge structures with steel beam and slab superstructures shall have a maximum spacing of 8.0m. Intermediate diaphragms in bridge structures with precast concrete beam and slab superstructures shall have a maximum spacing of 13.0mm

(c) Intermediate diaphragms for steel or precast girders 1200mm deep or shallower, shall be channel or W shape of at least 1/3 and preferably 1/2 the girder depth. For girders deeper than 1200mm, full depth X or K bracing with top and bottom horizontals shall be provided.

(d) Intermediate diaphragms and girders shall be designed for construction loads during deck concrete placement in accordance with section 3.16 of the Bridge Design Code and other code requirements. Specifically, diaphragms, exterior steel and precast girders carrying deck overhangs shall be checked to ensure sufficient strength and stability to handle concentrated loads from deck finishing machines, work bridges, fog misting equipment, and loads from temporary walkways outside the edge of the deck slab. Loads assumed for such design shall be based on realistic estimates for each bridge and shall be shown on Detailed Designs. Diaphragms provided shall become part of the permanent structure and be left in place for possible future maintenance, i.e. widening, rehabilitation, etc.

300.4.2.12 Substructure/Foundations

(a) All substructure/foundation components, except for piles, trough drains and slope protection shall have a minimum concrete strength of 35 MPa.

(b) All welded pile splices whose tensile or flexural capacity is deemed to be critical to the structural integrity of the bridge (for example with integral bridges), shall be identified as tension splice welds on the Detailed Designs. These welds will require testing using non-destructive testing techniques. The following note is an example:

"ALL OF THE PILE SPLICE WELDS THAT ARE REQUIRED WITHIN THE TOP "X" METRES OF THE PILE ARE TENSION SPLICE WELDS"

(c) Full length piles shall be provided wherever possible to avoid field splicing.

(d) Steel piles designed to be exposed shall be hot-dip galvanized to a minimum of one metre below grade or stream bed. All damaged galvanizing shall be zinc metalized.

(e) The ends of pier cap cantilevers shall have cast-in stainless steel drip sheets across the full underside width of the pier cap to prevent staining of sub-structure concrete.

(f) Bridge plaques meeting the Department's requirements shall be attached to all bridge abutments.

(g) Good drainage details shall be incorporated into the design of abutments and shall include the following:

- The joints around the approach slab shall be well sealed to prevent water infiltration.
- A secondary system consisting of granular backfill, sheet wall drains and of sub-soil weeping drains shall be provided to collect, channel and remove the seepage.
- Sheet wall drains shall be provided and spot-glued to the earth face of the abutment seat and wingwalls to intercept and channel seepage into a perforated weeping drain with a minimum positive drain slope of 2% that will be day-lighted on the headslope.
- Clean, well graded, crushed granular backfill with a maximum aggregate size of 25 mm (Des 2, Class 25) shall be provided behind abutment seats and wingwalls, complete with perforated weeping drains under the abutment seat and wingwalls.
- Concrete drain troughs shall be placed at abutment corner locations at the low ends of bridges in accordance with Section 300.4.2.16 (Bridge Drainage).

(h) Approach slabs shall be in accordance with the provisions of section 1.7.2 of the Bridge Design Code except as noted:

- Approach slabs shall have sufficient length to limit their rotation due to settlement to 1.0%.
- Approach slabs shall have a minimum length of 6000mm (measured parallel to centreline of roadway).
- Approach slabs thickness shall be as required by the designer but shall have a minimum thickness of 250mm.

- The minimum reinforcing in approach slabs shall be 20M @ 150mm placed parallel to centreline of roadway and 15M @ 150mm placed parallel to the abutment backwall.
- Approach slabs shall be connected to the bridge in a manner that provides for free hinging rotation without causing restraining moments.

(i) Piers with one column shall have a minimum cross-section of $2.8m^2$. Piers with two columns shall have a minimum cross-section area of $2.8m^2$ for each column or the columns shall be linked together with a strut extending from the top of the foundation to 1.4m above the adjacent ground between the two columns.

(j) For piers and abutments which are cast around girders, the girders shall be set on a minimum 100 mm high plinth to provide sufficient clear distance between the girders and previously cast concrete to facilitate the flow of concrete around the girder and to ensure complete encapsulation of the ends of the girders.

(k) Ends of pier caps and pier shafts shall either be circular or chamfered (minimum 300 x 300mm).

300.4.2.12.1 Integral Abutments

Integral abutments (includes fully integral and semi-integral abutments) shall be designed to meet the following requirements (for guidance see the Department's Bridge Structures Design Criteria, "Appendix A – Guidelines for Design of Integral Abutments"):

(a) Integral abutments may be used for steel girder bridges less than or equal to 75m in length and for concrete girder bridges less than or equal to 100m in length.

(b) The effects of skew and potential for twisting of superstructure on plan shall be analyzed and accounted for, especially for skew greater than 20°.

(c) The amount of structure and earth that have to move with the abutment during thermal movement of the superstructure shall be minimized. Abutment seat heights shall not be greater than 1.2m and wingwall length shall not be greater than 8m.

(d) All the abutments negative bending moments will be present in the girders due to rotational restraints provided by the abutments as well as by rotational restraints provided by adjacent less heavily loaded girders with smaller end rotations. These negative bending moments shall be considered in the design.

(e) For fully integral abutments the abutment foundation shall be a single row of H-piles oriented for weak axis bending unless otherwise accepted by the Department. For large movements, piles can be installed in permanent steel casings. The casings shall be filled with Styrofoam pellets. Steel casings shall be designed to last the same life as the bridge, and an appropriate sacrificial corrosion thickness or galvanizing shall be provided. The H-piles shall be embedded a minimum of 2 pile widths into the abutment seat.

(f) The approach slab shall extend 0.5m longer than the wingwalls such that the cycle control joint is located beyond the ends of the wingwalls.

(g) Installation of expansion foam material behind integral abutments for the purpose of relieving earth pressures is not permitted.

(h) Integral approach slabs shall not be designed to move longitudinally in and out between stationary and parallel non-integral wingwalls.

(i) Two layers of polyethylene sheet or fabric shall be provided under the approach slab to minimize frictional forces due to horizontal movement. The connection between the approach slab and the superstructure shall be designed to resist these forces.

The following table shall be used to determine required joint types for various bridge superstructure lengths (centreline bearing abutment to centreline bearing abutment). When using this table, engineering judgement with due considerations for site specifics, such as traffic type and volume, are required. Alternative joint types will be considered for use by the Department based on a demonstration of their satisfactory performance.

Steel girder bridges	Concrete girder bridges	Joint type[9]	Approx. movement range
< 40m	< 50m	C1	< 16mm
40m to 75m	50m to 100m	C2 or C3	16 < range < 32mm
> 75m	> 100m	C4	> 32mm

300.4.2.13 Bearings

(a) Unless accepted in advance and in writing by the Department, bearing types for beam and slab bridges shall be: a) steel reinforced elastomeric bearing pads with or without stainless steel and Teflon sliding surfaces, b) fixed steel plate rocker bearings, c) proprietary pot bearings. Typical expansion bearing details shall be in accordance with the Department's Standard Drawing S-1761-08 (Typical Expansion Bearing Details).

(b) Steel reinforced elastomeric bearings with or without stainless steel and Teflon sliding surfaces shall incorporate the following standard features:

- steel sole plates and base plates shall be provided.
- self-rocking pintel welded under base plate shall be used to ensure uniform contact between the elastomeric bearing pad and the girder bottom flange at erection. No extra construction tolerance is required when using the self-rocking pintel.
- All bearings shall be grouted in prior to casting deck concrete. Bearings pads shall be designed for all rotations that take place after the bearings are grouted.
- Notwithstanding section 11.6.6.2.2 of the Bridge Design Code elastomeric bearings shall conform to Section 18 "Bearings" Division II of AASHTO Standard Specifications for Highway Bridges. Elastomeric material shall meet the requirements of AASHTO Grade 5 for cold temperature performance.
- Notwithstanding section 11.6.3.4.1 of the Bridge Design Code unconfined sheet PTFE may be bonded to an elastomeric bearing with a Shore A durometer hardness of 60.

[9] *Details of "Joint Types" C1 to C4 are shown in "Appendix A - Guidelines for Design of Integral Abutments" of the Department's Bridge Structures Design Criteria.*

- For expansion bearings, the elastomeric cover for the uppermost steel shim shall not be greater than 2mm. Unfilled 1 mm thick Teflon sheet shall be bonded to the top of the elastomeric pad. The stainless steel sliding surface shall conform to AISI 304, No. 8 (0.2 µm) mirror finish.
- Un-lubricated PTFE shall be specified.
- Elastomeric pads shall be restrained from walking out by means of 6mm high corner keeper bars welded to the top of the base plate. The 6mm height is to limit girder raising/jacking for future removal and replacement of bearing pads.

(c) Fixed steel plate rocker bearings consist of a curved steel rocker plate and a base plate, connected with anchor bolts or pintels. The curved surface of the rocker plate and the top central 250mm width of the base plate shall be machined to a surface finish of 3.2 µm and a flatness tolerance of 0.001 x bearing dimension.

The base plates are installed level on galvanized steel shim stacks, and shall be grouted prior to casting deck concrete. A tapered shoe plate is not required with these bearings because of the large rotational capacity.

(d) Notwithstanding section 11.6.5.4 of the Bridge Design Code, the average stress in the elastomer at serviceability limit states loads shall not exceed 40 MPa. The elastomer shall conform to Section 18 "Bearings", Division II of AASHTO Standard Specifications for Highway Bridges and shall meet the requirements of AASHTO Grade 5 for cold temperature performance.

Notwithstanding section 11.6.3.6 of the Bridge Design Code, the average contact pressure for unfilled PTFE elements, based on the recessed area of the PTFE, shall not exceed the following:

Limit State	Permanent Load (MPa)	All Loads (MPa)
SLS	25	35
ULS	40	55

Notwithstanding section 11.6.3.6 of the Bridge Design Code, the average contact pressure for all loads at the ultimate limit state for PTFE elements filled with up to 15% by mass of glass fibres and used to face mating surfaces of guides for lateral restraint shall not exceed 55 MPa.

Pot bearings shall be installed on a level base plate on galvanized steel shim stacks, and grouted in prior to casting deck concrete. The bearings shall be designed for all rotations that take place after grouting, plus a fabrication and construction tolerance allowance of 0.01 radian.

(e) Bearings shall be set level by using tapered sole plates except that for long bridges, the sliding plane of the abutment expansion bearings shall be set parallel to the grade slope for proper functioning of finger joints. Effects of longitudinal forces generated by the inclined sliding bearings on the structure shall be investigated.

(f) The following material properties shall be followed:

1)	Anchor rods for bearings in contact with black steel.	Stainless steel AISI Standard Type 316
2)	Anchor rods for bearings in contact with galvanized steel.	Galvanized anchor bolts CSA G40.21M Grade 300 W or ASTM A307
3)	Structural Bolts	To match the type of structural steel being bolted

(g) Bearing finishing and attachments

- Base plates shall be hot-dip galvanized or metalized.
- For steel girders, sole plates or rocker plates shall be Grade 350 CAT 3 black steel when welded to the girder bottom flange. Sole plates or rocker plates which are bolted to the bottom flange shall be hot-dip galvanized.
- For precast girders, sole plates shall be hot-dip-galvanized or metalized, and field welded to galvanized shoe plates cast into the girders. All damaged galvanizing shall be repaired by metalizing.
- Attachment by welding shall be in the longitudinal direction along the edge of the girder. Transverse welding requires underhand welding and shall not be permitted. Transverse ends shall be sealed with Sikaflex 1a or an approved caulking material.
- Pot bearing components shall be metalized or galvanized and shall be attached to galvanized plates by bolting.

(h) Bearing contact face preparation

- Steel plates in contact shall be machined to a surface finish of 3.2 µm and a flatness tolerance of 0.001 x bearing dimension. Contact surfaces with elastomeric pad and grout or cast-in-place concrete do not require machining. Where required, machining shall be performed prior to hot-dip galvanizing. Where the galvanizing process may cause distortion, metalizing shall be used instead.
- Galvanized surfaces shall be isolated from black steel by painting with two coats of epoxy mastic paint.
- Galvanized surfaces in contact with concrete or cementitious grout shall have the contact surfaces protected by a barrier coating.

(i) Expansion bearings shall provide an excess travel capacity in each direction of at least 25% of the theoretical thermal movement, but not less than 25 mm, beyond theoretical travel. An allowance shall be made for additional movement if required for concrete creep and shrinkage and foundation conditions. The stainless steel plate shall be wider than the elastomeric pad by at least 10 mm on each side.

(j) An 80 mm nominal thickness grout pad shall be provided under bearing base plates. The grout should sit in a grout pocket recessed 40 mm into the top of the sub-structure. The grout pocket shall be 75 mm larger than the base plate around the perimeter.

(k) Uplift bearings shall not be used.

(l) Shim plates used for shim stacks shall be hot-dip galvanized.

(m) Bridges and bearings shall be designed and detailed to allow for bearing replacement. Typical bearing replacement includes simultaneously jacking all girder lines to avoid damage to the deck, diaphragms and deck joint components. Locations for future jacking shall be shown on the Detailed Designs and shall be based on estimated jack and distribution plate sizes.

(n) Shear transfer mechanisms required to transfer permanent horizontal loads between the superstructure and substructure shall have stainless steel on Teflon sliding surfaces if required to accommodate superstructure expansion/contraction.

300.4.2.14 Deck Joints

(a) New structures shall be fully continuous from end to end. Deck joints shall only be permitted at abutments. The following standard deck joints shall be used unless prior written approval is obtained from the Department to use other deck joints:

Standard Drawing	**Joint Type**	**Movement Range**
S-1493	Multi-cell strip seal	115 – 60 = 55mm
S-1638, S-1639, S-1640	Finger plate joint	> 100mm
S-1626	Multi-cell strip seal for skew = 20º to 45º	55mm square to joint

(b) Only approved strip seals listed on the Department's deck joint Standard Drawings shall be used.

(c) Deck joints shall incorporate stop movement bars to maintain a minimum joint gap of 60mm to facilitate seal replacement. Designers should note that this is often larger than the minimum gap indicated on manufacturer's brochures, which provide gap widths suitable for first installation only.

(d) For strip seal type deck joints with skew angles within the range of 20º to 45º, snow plow guard plates shall be installed in accordance with Standard Drawing S-1626 to prevent snow plow blades from catching the edge of the joint extrusion. Welded snow plow guard plates shall not be located directly under wheel paths.

(e) Fingers plates shall be fixed to the deck side to allow jacking and raising of the superstructure.

(f) Modular seal deck joint systems are not permitted.

(g) Deck joints shall be recessed 5mm below riding surfaces and 8mm behind the vertical traffic faces of curbs, sidewalks, medians and barriers. The free ends of any cover plates shall be pointed towards the bridge abutments.

(h) Deck joints on steel girder superstructures shall be erected by bolting to the girders. The bolted connections shall utilize slotted holes to provide for adjustment in the vertical, lateral and longitudinal directions. Deck joints on concrete girder superstructures or abutments shall be erected on adjustable supports by projecting dowels with threaded couplers for elevation adjustment.

300.4.2.15 Bridgerails

(a) The Contractor shall use Department standard bridgerails, barriers, and approach end transitions, as listed in the following table.

Standard Drawing	Title	Application/ Transition Type
S-1642-00	PL-2 (TL-4) Double Tube Type Bridgerail – Bridgerail Details (Sheet 1 of 2)	Preferred bridgerail for most applications.
S-1643-00	PL-2 (TL-4) Double Tube Type Bridgerail – Approach Rail Transition Details (Sheet 2 of 2)	14 m long Thrie Beam Approach Rail Transition PL-2 (TL-4) and Strong Post Approach Rail (TL-3).
S-1650-00	PL-2 (TL-4) Single Slope Concrete Bridge Barrier – Barrier Details (Sheet 1 of 2)	Bridgerail for use in urban areas where aesthetics is important.
S-1651-00	PL-2 (TL-4) Single Slope Concrete Bridge Barrier – Approach Rail Transition Details (Sheet 2 of 2)	14 m long Thrie Beam Approach Rail Transition PL-2 (TL-4) and Strong Post Approach Rail (TL-3).
S-1681-07	PL-3 (TL-4) Bridgerail to Modified Thrie Beam Transition Details	8.2 m long Modified Thrie Beam Approach Rail Transition PL-2 (TL-4).
S-1700-06	PL-2 (TL-4) Combination Barrier – Bridgerail Details (Sheet 1 of 6)	Bridgerail for use on urban bridges with 4.2 m widened outside lane for cyclists.
S-1701-06	PL-2 (TL-4) Combination Barrier – Barrier End Details (Sheet 2 of 6)	Connects to single slope concrete road barrier.
S-1702-06	PL-3 (TL-5) Double Tube Type Bridgerail a. Bridgerail Details (Sheet 3 of 6)	Bridgerail for use when high AADT with heavy truck volumes and/or high structure requires a PL-3 (TL-5) bridgerail.
S-1703-06	PL-3 (TL-5) Double Tube Type Bridgerail – Barrier End Details (Sheet 4 of 6)	N/A
S-1704-06	PL-3 (TL-5) Double Tube Type Bridgerail – Concrete Barrier Details (Sheet 5 of 6)	N/A
S-1705-06	PL-3 (TL-5) Double Tube Type Bridgerail – Approach Rail Transition Details (Sheet 6 of 6)	14 m long Thrie-Beam Approach Rail Transition PL-2 (TL-4) and Strong Post Approach Rail (TL-3).
S-xxxx-08	PL-2 (TL-4) Single Slope Concrete Barrier Along Top of MSE Wall	To be used on MSE retaining walls running parallel to traffic.

(b) When a vehicular bridge includes a sidewalk, a traffic separation barrier shall be provided between the sidewalk and the roadway. The barrier shall have a minimum height of 0.60 m measured from the surface of the sidewalk.

(c) Pedestrian/Cyclist railing:

The pedestrian/cyclist handrail shall be 1300mm high, mounted on a concrete curb projecting 100mm above the sidewalk for a total handrail height of 1400mm. Details of the handrail shall be based on the Department's Standard Drawings S-1401 (Vertical Bar Type Handrail) or S-1426 (Staggered Vertical Bar Type Handrail) as appropriate.

(d) Bridgerail Layout:

- Bridgerail expansion joints shall be provided at all deck joint locations. For long bridges, additional expansion joints shall be provided at a maximum spacing of 45m.
- Bridgerail Standard Drawings show a standard bridgerail expansion joint with a gap of 100mm, and a large expansion joint with a gap of 200mm. The selection of the bridgerail expansion joint gap should ensure that the bridge deck expansion gap closes before the bridgerail expansion gap.
- Steel bridge railing for bridges with curve radii of 600m or less shall be fabricated curved.

(e) Exterior bridge barriers adjacent to 4.2m wide traffic lanes shall be combination traffic/cyclist railings with a minimum height of 1400mm.

300.4.2.16 Bridge Drainage

(a) Concrete drain trough terminals shall be located at low corners of bridges to channel water off of the bridge and to a drainage ditch lined by "Scourstop" or equivalent accepted by the Department. The drainage ditch shall extend to the bottom of the roadway approach fills. The concrete trough drains shall be designed to function as intended while accommodating differential settlements and other movements between the bridge and the roadway approach fills.

(b) Additional drains required to accommodate deck drainage or drainage through deck joints shall be hidden from view where practical. Drains, including mounting brackets, that can not be hidden from view shall receive a finish that is acceptable to the Department and that causes them to blend into the surrounding structure.

300.4.2.17 Engineering Drafting Requirements

(a) General

Drafting standards and standard details shall be in accordance with Section 2 – Guidelines for Bridge Projects of the "Engineering Drafting guidelines for Highway and Bridge Projects".

All dimensions shall be ground dimensions. Stations shall be given in grid coordinates. Skew angles shall be given to the nearest minute.

(b) The preferred drawing order for bridge type structures is as follows:

- General Layout.
- Information Sheet/Sheets.
- Abutments.

- Pier/Piers.
- Bearings.
- Girders.
- Deck.
- Deck Joints.
- Other (If required).
- Standard Drawings.

(c) Other types of structures (culverts, etc.) should follow the same basic order with drawings added and/or deleted as necessary.

(d) Clear zone requirements, calculated critical vertical clearances with their critical locations for current construction as well as the Ultimate Stage construction shall be shown on the General Layout for all grade separation structures. Design high water elevation, high ice elevation, low water elevation (with date of survey), design general and local scour elevations shall be shown on the General Layout of all river structures.

(e) Full detailed drawings for MSE walls shall be incorporated into the bridge drawing package. These drawings shall show details of how the MSE components interact with the abutment components. The drawings for the abutment components (i.e. piles, seat, wingwalls, backwalls, diaphragms, and approach slabs) shall also show details of how the MSE walls will interact with the abutment components.

(f) An index listing of all drawings included in the drawing set shall be shown on the first sheet of the set. The index shall be orientated from the bottom up; i.e., sheet No. 1 shown at the bottom and successive sheets listed upward from there.

(g) Control line designations shall be selected from the following list and be used consistently throughout the same set of drawings: Centreline NBL Hwy XX, Centreline N-W RAMP, Centreline RDWY, Centreline CROWN, Centreline BRG ABUT #X, Centreline ABUT #X, Centreline PIER #X.

(h) "Top of Finished Centreline Crown" stations and elevations are to be shown for each end of the structure. Top of Finished Centreline Crown is defined as the point where the headslope line intersects the finished centreline roadway profile. Station is given to the nearest decimetre and elevation to the nearest centreline.

(i) Substructure elements are to be numbered in the direction of increasing chainage, i.e. abutment no. 1 or pier no. 1 occurs at the lower chainage location and numbering increases from there.

(j) Reinforcing Steel Details

- All reinforcing steel bar marks, if used, are to be as per the Department's *Engineering Drafting Guidelines for Highway and Bridge Projects*.
- Bar marks shall not be duplicated on the Project unless the bars are identical.
- Incremented bars should each have their own bar mark.
- Epoxy coated bars are to be denoted with the suffix 'C'.

(k) Substructure / Foundations

The following design pile load information for abutment and/or pier piles shall be shown in the General Notes on the Information Sheet:

- SLS permanent loads only
- SLS extreme loads (combination #)
- ULS permanent loads only
- ULS extreme loads (combination #)
- Outlines of the foundations and estimated pile tip elevations are to be shown relative to test holes on the geotechnical information sheet.

(l) Girders

Span lengths established from preliminary engineering requirements shall be rounded up to the nearest whole metre.

Girder camber variations shall be accommodated by adjusting the deck formwork elevation and thickness of the deck haunch on the girders. The following standard note shall be shown on the deck drawing and shall apply to the nominal girder haunch and the outside of curb/fascia dimensions:

"THESE DIMENSIONS WILL VARY DUE TO VARIATIONS IN GIRDER CAMBER. THE CONTRACTOR SHALL DETERMINE THE ADJUSTMENTS AND MAKE THE APPROPRIATE CORRECTIONS."

i. Steel Girder Superstructures:

The span lengths shown on the general layout drawings shall be measured at a fabrication temperature of +20˚C, from centreline bearing to centreline bearing along the bottom flange for uniform depth girders, and along the top flange for tapered or haunched girders. Expansion bearings are to be centred on centreline bearing at -5˚C.

Ground stationing for locating the centreline bearing of sub-structure elements shall be adjusted to account for the following:

- length difference between gradeline profile and horizontal surveyed distances,
- length difference due to thermal change between +20˚C and -5˚C,
- longitudinal shift due to off-plumb tilting of bearing stiffeners or control sections set perpendicular to the top flange, when span lengths are measured along the top flange,
- differences between ground distances and other surveying systems.

For expansion bearings, a bearing temperature setting chart shall be provided for positioning bearing components according to the girder temperature at the time of setting the bearing.

The following standard note shall be incorporated on the general layout drawing:

"GIRDER LENGTHS SHOWN ARE MEASURED ALONG BOTTOM (TOP) FLANGE AND ARE CORRECT AT +20˚C. ABUTMENT AND PIER STATIONINGS ARE LOCATED SUCH THAT BEARINGS ARE CENTRED AT -5˚C".

Welded steel girders shall be cambered for 100% of dead load deflection and roadway gradeline profile. Camber data shall be shown on a camber diagram, at 10th span points, centreline of supports, and centreline of field splices, along with net camber values for individual girder segments between splices. For spans longer than 50m, data shall be presented at 20th span points. Data shall include girder DL, deck DL, Super-imposed DL (including curb/barrier/median/sidewalk + wearing surface), and vertical grade.

Structural steel mass for steel girder superstructures shall be calculated and the mass, in tonnes, shall be shown in the 'General Notes' area on the steel girder drawings. Mass shall include girders, diaphragms, stiffeners, and splice plates but does not include deck joints, bearings, and bolts.

ii. Precast Concrete Girder Superstructures:

Lengths of precast concrete girders are to be shown on the general layout drawings together with pier diaphragm thicknesses between girder ends, and distance from abutment girder end to centreline abutment bearing. Precast girder lengths shall be set to meet geometric and clearance requirements and shall be measured along the bottom flange at a fabrication temperature of +20˚C. Expansion bridge bearings are to be centred on centreline bearing at -5˚C.

Ground stationing for locating the centreline bearing of sub-structure elements shall be adjusted to account for the following:

- differences between ground distances and other surveying systems,
- length difference between gradeline profile and horizontal surveyed distances,
- length difference due to thermal change between +20˚C and -5˚C,
- differences between ground distances and other surveying systems.

For expansion bearings, a bearing temperature setting chart shall be provided for positioning bearing components according to the girder temperature at the time of setting the bearing. The bearing design and setting chart shall make allowances for girder shortening due to post-tensioning and long term shrinkage and creep.

The following standard note shall be incorporated on the general layout drawing:

"GIRDER LENGTHS SHOWN ARE MEASURED ALONG BOTTOM FLANGE AND ARE CORRECT AT +20˚C. ABUTMENT AND PIER STATIONINGS ARE LOCATED SUCH THAT BEARINGS ARE CENTRED AT -5˚C. APPROPRIATE ALLOWANCE FOR PRESTRESS (PRE-TENSION AND POST-TENSION) SHORTENING, SHRINKAGE AND CREEP SHALL BE INCLUDED IN THE FABRICATED LENGTH OF THE GIRDERS".

Theoretical calculated cambers based on best estimates shall be shown on the Detailed Designs. Camber data shall be provided at various construction stages, such as at transfer, erection, deck pour, post-tensioning, Super-imposed DL, gradeline profile, etc.

Camber for precast girders can vary substantially from estimated values due to variations in concrete properties, storage conditions and shrinkage and creep. Proper detailing of stirrup projections, girder end/bearings and selection of deck haunch thickness are required.

iii. Cast in Place Superstructures:

Data shall be presented on the drawings to allow setting of form elevations. The deflection data used in the determination of the form elevations shall be presented.

(m) Bridgerail

All dimensions for bridgerail layouts are to be given on centreline of bridgerail anchor bolts.

300.4.3 DESIGN REPORT REQUIREMENTS

Prior to initiating construction of a bridge structure, the Contractor shall submit a complete design package for the bridge structure, including as applicable *Canada Transportation Act* ("CTA") applications, approvals and agreements, *Navigable Waters Protection Act* ("NWPA") drawings, permit applications, approvals, and proof of advertising, Department of Fisheries and Oceans ("DFO") applications, approvals and orders, design drawings and construction specifications, to the Department. The completed design packages may be submitted in a manner suiting the Contractor's proposed design and construction schedule. They may also be submitted individually by bridge component, substructure, superstructure or for the complete bridge structure.

Unless otherwise noted, the design package for each bridge structure shall have the following:

- Design Data ("DD") Drawings as defined in Appendix J1 of the Department's *Engineering Consultant Guidelines for Highway and Bridge Projects*
- Site specific design (P) drawings [10].
- Applicable Department Standard Drawings.
- Geotechnical report in accordance with CAN/CSA-S6-06 section 6.5.6, and including the global stability of bridge headslopes and retaining walls.

Design Data ("DD") Drawings, including hydrotechnical and geotechnical reports, shall be submitted prior to submission of the site specific Design Drawings. Design Data ("DD") Drawings are not required for bridge size culverts less than 4.5m in diameter and for sign structures.

[10] *'P' is the designation used in the Department's bridge drawing record system for all bridge drawings relating to site specific projects. (i.e. 16523-P). These drawing numbers will be assigned by the Department. The 'P' designation is changed to a 'C' for the as-constructed drawings.*

300.4.4 FINAL DESIGN REPORT REQUIREMENTS

Following final completion of the detailed design of a bridge structure, the Contractor shall submit copies of the following documents for the bridge structure, if applicable, to the Department for its bridge structure records system.

- Hydrotechnical report;
- Design notes;
- Design check notes;
- Geotechnical report;
- Corrosion survey report;
- *Canada Transportation Act* ("CTA") applications, approvals and agreements;
- *Navigable Waters Protection Act* ("NWPA") drawings, permit applications, approvals, and proof of advertising;
- Department of Fisheries and Oceans ("DFO") applications, approvals and orders;
- Design Data ("DD") Drawings, hardcopy and electronic Microstation.dgn format;
- Site specific (P) drawings, hardcopy and electronic Microstation.dgn format; and
- Construction and material specifications not contained in Section 400 (Construction-New Infrastructure).

400.0 CONSTRUCTION – NEW INFRASTRUCTURE

400.1 CONSTRUCTION - GENERAL

400.1.1 RESPONSIBILITY FOR CONSTRUCTION

The Contractor is responsible for the supply of all management, professional and technical services, supervision services, construction quality management, labour, materials, and equipment for performing all of the duties and obligations necessary for delivering all of the requirements of the Project. The Contractor is responsible for obtaining and complying with requirements of all permits and other authorizations required for the construction of the New Infrastructure.

The Contractor shall ensure that construction conforms to the requirements of the Detailed Designs and the Technical Requirements. All construction is to reflect a high degree of workmanship and all materials incorporated into the New Infrastructure shall meet long-term safety, durability and functionality requirements.

Any changes to the Detailed Designs during construction shall be approved by the Design Engineer prior to submission to the Department for acceptance. The changes shall not be implemented until accepted by the Department.

The Contractor is responsible for reclaiming all areas of the Road Right of Way and/or drainage system that have been disturbed during construction of the Project and shall obtain any required Reclamation Certificates related to these activities within 12 months of completing the reclamation activity.

400.1.2 SPECIFICATIONS

Construction specifications for roadways, bridge structures and other appurtenances are generally covered in Sections 400.2 (Roadways) and 400.3 (Bridges) and are intended to provide adequate safety, functionality/serviceability, durability/maintainability and aesthetics for the Project. If a material or construction specification is not covered in Sections 400.2 (Roadways) or 400.3 (Bridges), the material or construction specification shall meet the same standard generally being met on new roadways and bridge structures of similar type on the Provincial highway system.

Procedures for measuring and units of measurement are included within the Technical Requirements for most types of work on the Project. These procedures are not to be used for determining payment of individual work components but are to be used in verifying the overall progress of work on the Project and assessing Payment Adjustments, if applicable.

400.1.3 TRAFFIC MANAGEMENT

The Contractor shall maintain the safe and efficient passage of traffic on existing roadways within the Road Right of Way. All detours required to meet this requirement shall be paved. The Contractor is required to demonstrate that traffic operations during construction will be equivalent or better than the a.m. and p.m. peak hour traffic conditions indicated in the Package (as defined in Section 200.2.2 (Traffic Simulation)).

If at any stage of the construction the existing intersection geometry, roadway geometry, or traffic signals timings/phasings will be modified from that indicated in the Package to accommodate construction activities, the Contractor shall:

- demonstrate that the Contractor's proposed changes throughout construction will provide an equivalent level of service for the a.m. and p.m. peak hour traffic conditions by modifying the a.m. and p.m. peak period Synchro/SimTraffic files provided to reflect accurately the impact of the roadway and intersection changes proposed during construction;
- prepare separate a.m. and p.m. peak period Synchro/SimTraffic files for each construction staging scenario;
- provide video traffic detection capacity to the existing traffic signals to ensure responsiveness and flexibility of the traffic signal;
- upgrade the traffic signals to provide Traffic Responsive Plans (TRP) operations along Anthony Henday Drive. A number of basic TRP plans and initial TRP plan programming shall be pre-determined by the Contractor and be selected based on real time traffic flow detected by the TRP system detectors for plan selection; and
- for the Anthony Henday Drive and Stony Plain Road/100 Avenue traffic signals, provide wireless communication and remote access so that intersection operations can be monitored remotely and timing plans can be changed if needed.

The Contractor shall maintain an acceptable level of traffic operation on Anthony Henday Drive within the construction zone by following the procedures provided in the Simulation File Package. The procedures shall include:

- model parameter adjustments to reflect road geometry or road width changes;
- TRP parameters and thresholds;
- acceptable Levels of Service (or other specified Measure of Effectiveness) for Anthony Henday Drive, Stony Plain Road, 100 Avenue, 109 Avenue, 111 Avenue, and 87 Avenue; and
- data collection frequencies, as required to ensure that the traffic operations will be monitored regularly and signal operations adjusted as required.

The Contractor shall cooperate and coordinate construction activities with Access Roads Edmonton Ltd. and its subcontractor, Traffic Systems Management Inc. (TSMI), which is the operations and maintenance contractor responsible for the existing Anthony Henday Drive mainline and ramps within the Project Limits. The City of Edmonton operates and maintains Stony Plain Road and 100 Avenue within the Project Limits.

The Contractor shall provide TSMI and The City of Edmonton with details of all temporary construction installations to be operated and maintained throughout seasonal shut-down periods. A schedule of planned seasonal shut-down periods shall be provided to the appropriate maintenance forces and updated as required. The Contractor is expected to act responsibly and professionally throughout the construction term and take all reasonable precautions to prevent damage to existing infrastructure.

Paved detours and roadways available to public traffic shall operate at the minimum number of lanes with an even paved surface over the course of seasonal shut down periods.

Requirements for the accommodation of traffic during construction until Final Acceptance are set out in Section 200 (Project Specifics).

400.1.4 TRUCK WEIGH SCALES

The Contractor shall supply a platform scale of sufficient length and capacity to accommodate in a single loading any truck, including pups or trailers that are used.

All weigh scales must be certified by Measurement Canada of the Federal Department of Consumer and Corporate Affairs. The most recent certificate for a scale shall be displayed at all times. In the event a certified scale is modified in any way, it must be re-certified prior to being used.

Prior to use on the Project and in each instance that a certified weigh scale is moved and set up, the Contractor shall test the weigh scale using the procedures established by Measurement Canada. This test shall be performed to ensure that the weigh scale conforms with the current standards required by Measurement Canada of the Federal Department of Consumer and Corporate Affairs. The Contractor shall complete a scale accuracy inspection form to include all applicable test and scale information and provide a copy to the Department.

The approach ramps shall be rut free and level for a minimum distance of 3 m from each end of the scale.

All trucks including pups or trailers shall have all wheels and axle combinations completely on the scale during taring and final weight measurements.

The Department, when it deems necessary, may verify the accuracy of the weigh scale at any time and the Contractor shall provide all test weights, equipment, facilities and operating staff required to verify the weigh scale and shall cooperate fully in the verification process.

The Contractor shall not use grain elevator scales or inspection station scales in lieu of testing the weigh scale. The Department, when he deems it necessary, direct that haul trucks be weighed on inspection station scales for verification purposes.

The Contractor shall be responsible for loading and weighing all loads.

Weigh tickets for each load shall be generated using an automatic pre-programmed printer which is certified and sealed to prevent manual override of any weight information.

Each weigh ticket shall include the following information.

- i.) Project No.
- ii.) Material Type
- iii.) Date
- iv.) Time

v.) Ticket Number (consecutive)
vi.) Haul Unit No.
vii.) Net load (tonnes)
viii.) Subtotal of tonnes for each haul unit for that day
ix.) An accumulated total for all haul units for that day.

All tickets are to be summarized daily by material type, and the summary provided to the Department daily.

400.1.5 HIRED TRUCKS

The Contractor shall ensure that all privately owned trucks hired for the haul of granular and earth materials shall have Alberta Class 1 registration in accordance with the *Traffic Safety Act* (Alberta).

Each truck used for hauling shall be equipped with a CB radio with which they shall communicate hauling information with the Department's checker during unloading operations. Additionally, the Contractor shall supply compatible, portable CB radios to the gravel checkers for the duration of the haul. The Contractor shall ensure that all radio sets are maintained in proper working order and that power packs or batteries for portable sets are supplied as needed.

400.1.6 AS-BUILT INFORMATION

The Contractor shall compile and record information on the dimensions and physical characteristics of the New Infrastructure. The Contractor shall compile and submit the As-Built Roadway Construction Report, As-Built Surfacing Information, As-Built Pavement Structural Information, As-Built Construction Report – Bridge Structures, and As-Built Drawings, all as described below (the "As-Built Construction Reports") that include full descriptions of each phase of the work, including, but not limited to, as-built drawings, and inspection and test reports.

The maximum time for completion and the providing of the As-Built Construction Reports to the Department shall be six months after Traffic Availability.

A sum of $600,000 will be withheld until the As-Built Construction Reports are made available and accepted by the Department at which time it will be released as part of the Holdback (as defined in the DB Agreement) in accordance with the DB Agreement. A Payment Adjustment of $12,000/month or any partial month, for every month in excess of six months after Traffic Availability shall apply until the As-Built Construction Reports in respect of the work on the Project completed as of Traffic Availability are delivered and accepted by the Department, and such Payment Adjustment shall be deducted from the Holdback and permanently retained by the Department.

400.1.7 AS-BUILT ROADWAY CONSTRUCTION REPORT

The As-Built Roadway Construction Report means an as-built report that contains sufficient detail so that an independent reviewer can gain a clear understanding of the Project. The report must be in an electronic PDF format and in hard copy. The As-Built Roadway Construction Report shall contain, but not be limited to the following:

- Project title;
- Scope of the Project, Project description and site plan;
- Project staff, subcontractors, equipment and suppliers;
- Project schedule and key dates;
- Work progress, problems and solutions;
- Innovative and unique aspects of the Project;
- Safety, traffic accommodation and utility relocation;
- Relief Events (as defined in the DB Agreement), Change Orders, or supplemental work;
- Environmental issues;
- Photographs of key activities;
- Inventory of appurtenances (e.g. culverts, signs, guardrail, lighting, etc.);
- Project summary report;
- Summary of Change Orders;
- Mylar and digital copies of as-built plans;
- Utility agreements and costs for utility adjustments;
- Commentary on the materials testing results; and
- Copies of all correspondence to the Department and to the Contractor from the Department including minutes of meetings.

400.1.8 AS-BUILT SURFACING INFORMATION

The Contractor shall prepare an as-built report known as the "As-Built Surfacing Information" which shall include but not be limited to the following:

Project Description - A complete description of the Project, including, but not limited to, the following:

- Highway control section number (e.g. 2:02);
- Project title;
- Project description and site plan;
- Project staff, subcontractors, equipment and suppliers;
- Surfacing schedule and key dates;
- Work progress, problems and solutions;
- Innovative and unique aspects of the surfacing;
- Safety, traffic accommodation and utility relocation;
- All concrete and asphalt mix designs;
- Change Orders;
- Environmental issues;
- Width and thickness charts;
- Daily lot paving reports;
- Summary of segregation inspection and obvious defects;
- Summary of profilograph inspection;
- Segregation rating worksheets;
- Profilograph rolls and index summary report;

- Summary of GBC and ACP placed;
- Electronic data for GBC and ACP placed;
- Photographs of key activities;
- Commentary and summary of the quality management testing results for grading and granular base course; and
- Commentary and summary of asphalt pavement and Portland cement concrete quality management testing results.

400.1.9 AS-BUILT PAVEMENT STRUCTURAL INFORMATION

The Contractor shall prepare an as-built report known as the "As-Built Pavement Structural Information" which shall include, but not be limited to:

- Soil classifications;
- Subgrade additives used, if any (e.g. lime);
- The applicable plans, annotated to show any deviation from the original design;
- The results of any coring or drilling undertaken on the Project;
- Width and thickness diagrams - for each section greater than 200 m in length with a common width and thickness, containing:

  - The finished surface width (rounded to the nearest 100 mm);
  - The constructed sideslope ratios of pavement structure and subgrade as applicable; and
  - The constructed pavement structure thickness (rounded to the nearest 5 mm) including:
    - The thickness of each layer; and
    - The ACP mix type and grade of asphalt cement and/or type and classification of Portland Cement concrete used.

400.1.10 AS-BUILT CONSTRUCTION REPORT - BRIDGE STRUCTURES

The Contractor shall prepare an as-built report known as the "As-Built Construction Report – Bridge Structures" which shall contain, but not be limited to the following:

- Shop drawings for bridge structures fabrication;
- Weld procedures;
- Stress-strain curves for stressing strand;
- Stressing calculations;
- Camber records;
- Construction Data Sheets for precast concrete girders;
- Mill certificates;
- Test reports for Charpy impact, hardness, radiography, ultrasonic, magnetic particle, and dye penetrant;
- Heat treatment records;
- Concrete and ACP mix designs;
- Pile driving, pile drilling, foundation records;
- Concrete test results;

- ACP test results;
- Post-tensioning and stressing records;
- Material testing results including gradation analysis for backfill materials, clay seal, etc.; and
- Any other information recorded as part of the QMS and required to document material properties or construction details.

The documents listed in Section 300.4.4 (Final Design Report Requirements), shall also be submitted as part of the As-Built Construction Report - Bridge Structures.

400.1.11 AS-BUILT DRAWINGS

As-Built drawings are to be stamped and signed by a Professional Engineer.

As-Built drawings shall be in the same format as Detailed Design drawings. The Contractor shall supply 3 mil matte finish mylar film drawings and digital copies in Microstation.dgn format of all As-Built drawings for the Department's record purposes.

The As-Built drawings shall show all relevant details of the New Infrastructure including, but not limited to, bridge structures, horizontal alignment, vertical alignment, cross-section elements, intersection layouts, interchanges, etc. Details of signing and pavement markings shall be described through reference to standard plans where possible. A detailed description and location of all underground utilities and conduits, showing horizontal locations, elevations, size and type of utility, etc., shall be shown on As-Built drawings. As-built construction drawings will be subject to review and acceptance by the Department as outlined in Schedule 5 (Design and Plan Certification Process and Review Procedure).

400.1.11.1 (Highway Street Lighting As-Builts)

The Contractor shall maintain a set of drawings of the lighting system on the site at all times and record any changes required by the Design Engineer or the Department that may occur and on the set mark "AS BUILT". These drawings shall be submitted to the Design Engineer and the Department upon completion of the Project.

At the completion of the Project the Contractor shall provide 6 full copies of an operating and maintenance manual to the Department. This manual shall include the following:

- All accepted shop drawings.
- All dimensioned and annotated as-built drawings.
- Schematics for lighting control and associated equipment.
- Recommended preventative maintenance task, procedures and servicing frequency for:
    1. Each luminaire type used on the Project
    2. Control cabinet components – including procedures for changing components
- Manufacturer's technical data on all cables supplied to the Project.
- Complete list of replacement parts, manufacturers and distributors for all equipment supplied.

Included with each manual, the Contractor shall supply three sets of keys to cabinets and padlocks, and a set of all specific tools or equipment required for access to, or maintenance of the lighting system.

400.1.11.2 (Traffic Singals As-Built)

The Contractor shall maintain a set of drawings of traffic signals on the site at all times and record any changes approved by the Design Engineer and as accepted by the Department that may occur and on the set mark "AS-BUILT". These drawings shall be submitted to the Department upon completion of the Project. A marked-up controller cabinet wiring diagram shall be submitted as part of the record drawing package.

The Contractor shall submit a set of as-built drawings to the Desing Engineer and the Department as part of the Signals Completion Inspection. The as-built drawings shall indicate (in red) the location and accurate alignments of all junction boxes, conduits, poles, detector loops, and other equipment or fixtures installed, as well as all changes, additions, deletions, or any other modifications made to the original design.

400.2 ROADWAYS

400.2.1 CLEARING

400.2.1.1 General

400.2.1.1.1 Description

Clearing shall consist in general of cutting, piling, removing and burning or otherwise disposing of trees, brush, stumps, logs and roots from areas specified on the Detailed Designs.

400.2.1.1.2 Clearing in Forest Protection Areas

The Contractor's attention is drawn to the Alberta Forest and Prairie Protection Act and the associated regulations thereunder pertaining to Fire Permits. Brush disposal shall be in accordance with the Fire Permit requirements in the forest protection area.

400.2.1.1.3 Clearing in Municipal Districts, Counties, and Municipalities

The Contractor shall obtain permission to undertake the burning of clearing within Municipal Districts, Counties, and Municipalities from the Local Authority.

400.2.1.2 Materials and Procedures

400.2.1.2.1 Clearing - General

The Contractor shall cut trees and brush, remove all roots, and remove, pile and burn all trees (except trees to be preserved), brush, stumps, logs and roots within the limits of the Road Right of- Way, and also from such areas as may be required for drainage ditches, channel changes, easements, borrow excavations, etc., as indicated on the Detailed Designs, or as directed by the Design Engineer subject to acceptance by the Department. All underbrush and down trees protruding into the Road Right of- Way are to be disposed of in the same manner. Timber, brush, stumps, logs or roots shall not be piled upon adjacent lands, and the limits of the Road Right of- Way shall be left in proper condition for fencing.

All tree branches extending into the Road Right of- Way, which hang within 6 m of the ground, shall be cut off close to the trunk in a neat and workmanlike manner.

400.2.1.2.2 Preservation of Trees

The Detailed Designs may require the Contractor to preserve certain trees within the Road Right of- Way. Underbrush, down timber, snags and roots shall be removed from the vicinity of such preserved trees and then disposed of.

400.2.1.2.3 Clearing and Timber Salvage

Areas to be cleared and salvaged will be identified in the Detailed Designs . Generally, salvage shall be required where trees have a stump diameter of 125mm or greater.

The Contractor shall fell, top, limb and deck timber designated as salvageable, to the satisfaction of the Design Engineer. The salvaged timber shall be neatly piled in areas designated by the Detailed Designs.

400.2.1.2.4 Dangerous Trees

The Design Engineer or the Department may require the Contractor to cut down unsafe trees which are located outside the areas designated for clearing.

400.2.1.2.5 Disposal of Clearing Trees

During periods of extreme fire hazard in forest protection areas fire permits may be refused. In the event the Contractor is unable to burn the debris, through no fault of his own, the Design Engineer may direct the Contractor to chip or shred the woody debris and spread it on-site; or the Design Engineer may direct the Contractor to remove the debris from the Road Right of Way to his own disposal site and shall dispose of the debris to the satisfaction of the Design Engineer. The direction provided by the Design Engineer is subject to acceptance by the Department.

400.2.1.2.6 Disposal of Clearing Debris by Mulching

The Contractor shall dispose of clearing debris by chipping and mulching debris and spreading it on site as directed by the Detailed Designs.

Mulching shall mean the following:

- Mulching shall include the complete disposal of the standing timber or snags, brush, shrubs, and any slash, waste wood or wood debris left after timber salvage operations have been completed. Areas that do not require timber salvage but require clearing shall utilize this mulching standard.

- Mulching may include but not be limited to the following example operations, flail operations, rotary grinding operations, pulverizing operations, rotary or alternative cutting operations, chipping operations and or any other type of treatment which will meet the final requirements of the work required.

Mulching methodologies used by the Contractor shall achieve the following requirements:

- All materials shall lay flat to the soil. In cases of convoluted or mixed material the height protruding above the soil level shall not exceed 0.3 metres and will not exceed a single stem protrusion;
- No single portion of the mulched material will be longer than 0.5 metres and shall not exceed 0.07 metres in diameter. Exceptions for large diameter woody materials, which upon mechanical manipulation, resist break-up into a size of less than 0.07 metres showing evidence of debarking, may be considered by the Design Engineer. When the Contractor mulches the woody material on site, there is no minimum residual height requirement, but when the Contractor stockpiles the mulched material and spreads out later to a maximum residual height for all material shall be 0.07 metres;
- The Contractor shall undertake fringe clean-up operations to remove displaced materials in adjacent timber; including tangled or hung-up material, leaning or broken material, or any material displaced by the mulching process. This also includes any material damaged by the mulching process within proximity to the cleared area deemed to be a safety hazard by the Design Engineer and the Department;
- Roadways and adjacent lands shall be inspected for a minimum of 20 metres from the edge of the property or border of the area cleared by the mulching operation. Materials deposited on adjacent lands by the clearing or mulching process shall be returned to the Road Right of- Way and must meet minimum mulching standards;
- Burial of material will not be allowed;
- All stumps shall be reduced to ground level through the mulching process, or using any other means acceptable to the Design Engineer and the Department;
- Mulching operations shall not incorporate or mix mulched materials into the subsoil. In cases where topsoil is limited, surface mulching operations shall not be allowed to mix topsoil and subsoil horizons.

400.2.1.2.7 Fire Damage Prevention

The Contractor shall be solely responsible for ensuring all fires are totally extinguished. If a fire results from an improperly extinguished fire, the Contractor may be held responsible for the damage.

400.2.1.3 Quality Management Sampling and Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.1.4 Acceptance Sampling and Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.1.5 Construction

Intentionally Deleted

400.2.1.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.1.7 Measurement

Clearing and Clearing and Timber Salvage will be measured in hectares based on horizontal measurements. No allowance will be made for uneven or sloping ground.

400.2.1.8 Payment Adjustment

Intentionally Deleted

400.2.2 GRADING

400.2.2.1 General

400.2.2.1.1 Description

Grading consists of the excavation of soil materials, the salvage of select soil materials, the operation of borrow areas, and the construction of embankment. This work includes the removal and/or satisfactory placement of all materials necessary for the construction and preparation of embankments, slopes, drainage works, and connections to the required alignment, grade, and cross-sections. It also includes the excavation for culverts, underdrains, and foundation pits for bridges, trestles, buildings, and other structures.

400.2.2.2 Materials and Procedures

400.2.2.2.1 General Description of Suitable and Unsuitable Materials

The following provides a general description of the materials typically encountered during grading construction and how such materials shall be handled in the course of performing the work. Specific requirements concerning the use of these materials are specified elsewhere in this specification.

Materials considered as "suitable" shall be used for backfilling and constructing embankments. Materials considered as "unsuitable" shall either be disposed of or salvaged depending on the nature of the material.

Vegetation, roots, stumps, and refuse are considered as unsuitable materials. Such materials shall be disposed of in a manner satisfactory to the Design Engineer and as accepted by the Department.

Topsoil excavated from inside and outside the Road Right of- Way is considered as an unsuitable material. Topsoil shall be salvaged and subsequently handled as specified elsewhere in this specification.

Subsoil excavated from inside the Road Right of- Way is considered as a suitable material. Subsoil excavated from outside the Road Right of- Way or from a roadway, which is to be obliterated, is considered as an unsuitable material and shall be salvaged and subsequently handled as specified elsewhere in this specification.

Excess subsoil excavated from dugout borrow sources may be designated as a suitable material by the Design Engineer and as accepted by the Department.

All other excavated material obtained from inside or outside the Road Right of- Way, may be considered a suitable material, regardless of the moisture content of the material.

During the performance of the work, the Department will be the final authority in determining suitable and unsuitable materials.

400.2.2.2.2 Description of Topsoil and Subsoil

In this specification, the terms Topsoil and Subsoil are used to describe separate select soils requiring specific handling during construction. The following general descriptions are provided to assist the Contractor in distinguishing these select soils in the course of performing the work. The specific handling requirements for Topsoil and Subsoil are specified elsewhere in this specification.

The uppermost layers of soil both inside and outside the Road Right of- Way may consist of any or all of the following.

- Topsoil is the uppermost layer of soil that:

  (i) contains the majority of plant roots.
  (ii) is normally referred to as the plough layer in agriculture soils.
  (iii) is typically darker in colour than the subsoil layer.

- Subsoil is the layer of soil directly below the topsoil layer that:

  (i) contains the lower portion of the root zone.
  (ii) is typically lighter in colour than the topsoil layer.

400.2.2.2.3 Classes of Excavation

All excavation, for whatever purpose, will be classified as specified herein. The classifications for Solid Rock, Channel Excavation, Common Excavation, and Borrow Excavation stipulate excavating and placing the material. In the event the excavated material is unsuitable, the term "excavating and placing" shall be taken to mean "excavating and stockpiling" or "excavating and disposing", as the case may be.

Solid Rock Excavation

Solid Rock Excavation shall include the removal from their original position of rock in solid beds or masses, and boulders or detached rock having a volume of one-half cubic metre content or more, and placing of the material.

Rippable Rock

When identified in the Detailed Designs, any rock that can be ripped by a Group 12 dozer equipped with a ripper, as defined in the Alberta Roadbuilders and Heavy Construction Association (ARHCA) Equipment Rental Rate Guidelines, and excavated using conventional earthmoving equipment will be classified as Common Excavation, Borrow Excavation or Channel Excavation as applicable.

Rock that cannot be ripped by a Group 12 Dozer equipped with a single ripper will be classified as "Solid Rock".

Channel Excavation

Channel Excavation shall include the excavation and placing of material excavated for the improvement of existing water courses, water course channel realignments, and off-set muskeg drainage ditches located parallel to the roadway and not forming the normal contiguous roadway ditch. Excavation for a ditch section, which is adjoining the roadway embankment, shall not be classed as Channel Excavation.

Channel Excavation shall include material excavated for the installation of culverts down to the culvert invert elevation and will also include sub-excavation for culvert base construction. In cut sections, channel excavation shall only be that material excavated for culvert installation subsequent to undercut excavation as shown on the Detailed Designs. In fill sections, channel excavation shall only be that material excavated below original ground.

Channel Excavation shall also include any trench excavated for the installation of perforated pipe sub-drains.

Any material excavated during channel excavation operations, which meets the specification for Solid Rock Excavation, as described in Section 400.2.2.2.3 (Class of Excavation – Solid Rock Excavation), shall be so classified.

Common Excavation

Common Excavation shall consist of the excavation and placement of material obtained from within the Road Right of- Way, subject to the exceptions specified herein. Common Excavation shall also consist of the excavation and placement of material obtained as prescribed in Subsection (i) below.

Any such material excavated from stockpile and redistributed over a disturbed area shall also be classified as Common Excavation.

The following are exceptions to the classification of Common Excavation:

(i) any material excavated from within the Road Right of- Way which conforms to the description of Solid Rock Excavation, shall be so classified.

(ii) any material excavated from within the Road Right of- Way which conforms to the description of Channel Excavation, shall be so classified.

Borrow Topsoil Excavation

Borrow Topsoil Excavation shall consist of the excavation and salvage of topsoil, and subsoil separately from borrow areas and borrow area haul roads. Such materials excavated from a stockpile and redistributed on borrow areas and borrow area haul roads shall also be classified as "Borrow Topsoil Excavation".

Borrow Excavation

Borrow Excavation shall consist of the excavation and placing of material obtained from locations outside the Road Right of- Way with the following exceptions:

(i) The excavation of roadways, which are being obliterated, will be classified as Common Excavation.

(ii) With the exception of topsoil and subsoil excavated from outside the Road Right of-Way, as described in (i) above, all other topsoil and subsoil excavated from outside the Road Right of- Way will be classified as Borrow Topsoil Excavation.

Common and/or Borrow Excavation Loaded to Trucks

Common and/or Borrow Excavation Loaded to Trucks shall consist of the excavating, loading to trucks and placing of material obtained from locations inside the Road Right of- Way or borrow areas as shown on the Detailed Designs or as designated in the Technical Requirements. Any material not designated to be loaded to trucks will not be so classified.

400.2.2.3 Quality Management Sampling and Testing

Quality management testing is the responsibility of the Contractor. Tests performed by the Department will not be considered to be quality management tests.

The Contractor shall use Professional Engineering services and a qualified testing laboratory, licensed to practice in the Province of Alberta to assess and where necessary, modify the materials to ensure their end use meets all the Technical Requirements.

The Contractor shall provide and maintain equipment and qualified personnel to perform all field-testing necessary to determine and monitor the characteristics of the materials being incorporated into the work.

The Contractor shall be responsible for the cost of quality management and shall be responsible for the cost of all consulting services retained by him.

All quality management sampling and testing will be carried out in accordance with the Contractor's "Quality Management System (QMS)", Table 400.2.2.4.1, and the Technical Requirements.

Copies of all quality management tests shall be submitted to the Department within 24 hours of the completion of each test.

400.2.2.3.1 Test Methods

Inspection, sampling, and testing to follow requirements of Table 400.2.2.4.1. Alternative or supplemental test methods may be used but shall be outlined in the QMS.

400.2.2.4 Acceptance Sampling and Testing

The Department will undertake acceptance sampling and testing of the work.

The Department will from time to time take samples and carry out testing and inspection of the materials incorporated or being incorporated into the work. The Contractor shall cooperate with the Department for such sampling, testing, and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the work strictly in accordance with the Technical Requirements.

Various alternative test methods may be used by the Department to confirm that the Technical Requirements are being met.

In cases of dispute regarding the degree of compaction and / or moisture contents, all testing to confirm compliance with the Technical Requirements will be carried out by the Department, using the most recent edition of the following standard test methods indicated in Table 400.2.2.4.1.

TABLE 400.2.2.4.1
SAMPLING and TESTING METHODS

	Test Descriptions	Method No.
1.	Classification of Soils for Engineering Purposes	ASTM Designation D2487 (1)
	a) Determining the Liquid Limit of Soils	AASHTO Designation T 89
	b) Determining the Plastic limit and Plasticity Index of Soils	AASHTO Designation T 90

	Test Descriptions	Method No.
	c) Particle Size Analysis of Soils	AASHTO Designation T 88
2.	Soils Identification, Hand Method	ATT-29
3.	Moisture-Density Relation	
	a) Standard Compaction, - 5 000 µm Material	ATT-23
	b) Standard Compaction, + 5 000 µm Material	ATT-19
	c) One-Point	ATT-20
4.	Density	
	a) In-Place, Sand Method	ATT-9
	b) In-Place, Balloon Method	ATT-8
	c) In-Place, Nuclear Method	ATT-11
5.	Moisture Content	
	a) Oven Method, Soil and Gravel	ATT-15, Part I
	b) Microwave Oven Method	ATT-15, Part IV
	c) Speedy Moisture Teller	ATT-44
	d) In-Place, Nuclear Method	ATT-11
6.	Correction Factors, Nuclear Moisture-Density Measurements	ATT-48

Notes:

(1) As modified by the Prairie Farm Rehabilitation Administration (PFRA) to include medium plastic clay with the symbol CI.

(2) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specifications 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Section 400.2.20 (Aggregate Production and Stockpiling).

400.2.2.5 Construction

400.2.2.5.1 General Requirements

Restraining of Livestock

The Contractor shall erect and maintain such temporary fences as may be required to prevent livestock or other animals from straying upon the Road Right of- Way or adjoining property or upon borrow area perimeters. The Contractor shall at all times provide against the escape of livestock or other animals through openings made by it in Road Right of Way or other fences.

Towing Traffic

Where necessary during grading operations, the Contractor shall, upon orders in writing from the Department, provide sufficient men and equipment to hook-up and tow vehicular traffic through the work. The amount and type of equipment to be used in towing traffic will be stipulated and accepted in the orders by the Department. The Contractor shall be responsible for the hook-up of towed vehicles, and shall be responsible for any damage caused by such hook-up and towing.

Equipment Operation on Paved Surfaces

Where the location of excavation material necessitates the hauling across or on an existing paved roadway the operation shall be carried out as follows:

(i) Haul across an existing roadway shall be limited to a single equipment crossing point for each borrow site indicated by the Design Engineer and as accepted by the Department.

(ii) Where haul across a road is by conventional earth moving equipment, an earth pad or steel plates of sufficient dimensions shall be placed on the existing road surface so that no damage to the highway surface or roadbed is incurred. Steel plates may remain in place throughout the use of the crossings.

Unless otherwise permitted by the Design Engineer and as accepted by the Department, earth pads shall be placed no sooner than daybreak and removed no later than sunset each day that haul operations are in progress. In all cases, the use of earth pads on existing roads must be addressed by the Contractor in the traffic accommodation strategy.

(iii) Where haul along or across a road is undertaken by trucks, the prevalent load limit restrictions for haul along roadways or over bridges shall apply. Haul of excavation material on the existing roadway will only be permitted until completion of sufficient new grade.

(iv) Under no circumstances shall regular grading equipment be allowed to operate on the existing highway surface or use the highway surface as a haul road.

(v) Dust abatement material shall be applied when necessary.

Repair of any damage incurred in the pavement or subgrade structure, as a result of the haul operations, shall be the sole responsibility of the Contractor. The damage shall be repaired and the surface restored to a condition equivalent to that which existed prior to the commencement of haul operations.

Preservation of Survey Monuments

The Contractor shall preserve all survey monuments and property marks along and adjacent to the roadway. The Contractor shall use suitable precautions to protect from damage or disturbance such survey monuments and property marks until their location has been witnessed, or otherwise referenced, and he shall not remove them until directed by the Design Engineer and as accepted by the Department.

Slides

All material in slips, slides, and subsidences shall be removed by the Contractor and either properly disposed of or used in the work.

Construction, Surfacing, Maintenance, And Removal Of Staged Construction

Sections of new highway which are used for traffic operation prior to the application of base course shall conform to the permanent grade section, with temporary connections constructed at the end points as required. Immediately upon completion of the grading (or in the case of an alignment revision, immediately prior to instituting traffic thereon), the roadway shall be gravel surfaced and sprayed with asphalt or other dust abatement material. The Contractor shall be responsible for continuously maintaining the surface in a satisfactory bladed and dust-free condition until the application of the base course.

As practical and where required by the Detailed Designs, the material removed from the temporary connections shall be utilized for grade construction.

400.2.2.5.2 Solid Rock Excavation

Rock Cuts

All rock cuts shall be excavated to below grade, to a depth determined by the Design Engineer and accepted by the Department and then backfilled to grade with suitable material.

In solid rock cuts, where pockets which will not drain are formed below the design roadway elevation by blasting, the Contractor shall provide drainage by ditching to a free outlet as determined by the Department, and backfilling both the pockets and the trench to an elevation 0.30 m below profile grade with broken rock or coarse gravel.

Overbreak

Overbreak will be considered as that portion of rock which is excavated, displaced or loosened outside and beyond the slopes or grade as established by the Design Engineer and accepted by the Department, regardless of whether any such overbreak is due to blasting, to the inherent character of any formation encountered, or to any other cause.

If any rockslide occurs as a result of overbreak, all slide debris will be considered as overbreak.

Overbreak material may, as determined by the Department, be used to replace material which would otherwise have to be obtained from other sources, or shall be disposed of to the satisfaction of the Department.

Pre-Shearing

Where required by the Department, the Contractor shall pre-shear rock faces to minimize overbreak and produce a stable slope.

Trimming Rock Slopes

Slopes undercut at the base, or destroyed in any manner by act of the Contractor, shall be resloped by the Contractor to the slope as staked by the Design Engineer.

The slopes shall be carefully scaled down, and all rocks and fragments likely to slide or roll down the slopes removed to the satisfaction of the Department.

400.2.2.5.3 Catch Water Ditches

Catch water ditches shall be constructed in accordance with the typical plans, where shown on the Detailed Designs and/or where designated by the Department. In the case of a catch water ditch along the top of an excavation, the Department may require that the catch water ditch be constructed prior to commencement of excavation.

400.2.2.5.4 Common Excavation

All topsoil in disturbed areas or to the limits shown on the Detailed Designs or where designated by the Department, shall be salvaged for reuse. Any required stockpiling of topsoil material shall be performed to minimize topsoil losses and contamination of the topsoil and surrounding materials.

Following the excavation and salvage of topsoil, all other material shall be excavated to the extent specified in Section 400.2.2.5.7 (Constructing Roadways) and as shown on the Detailed Designs. Suitable material shall be used for constructing embankments. Any unsuitable material encountered shall be disposed of in a manner satisfactory to the Design Engineer and as accepted by the Department.

400.2.2.5.5 Borrow Topsoil Excavation

All topsoil and subsoil materials from borrow and borrow haul road areas shall be separately excavated, salvaged, stockpiled and reused in accordance with the requirements for development and reclamation of borrow areas specified in Section 400.2.2.5.6 (Borrow Excavation).

400.2.2.5.6 Borrow Excavation

General

The use of Borrow Excavation for constructing embankments will be allowed only after all Common Excavations have been completed and the resulting suitable material hauled into the embankment, or after all the economic possibilities of obtaining further material by the widening of roadway excavations or ditches have been exhausted.

Borrow areas shall be regular in width and, if required, shall be connected with ditches and drained to the nearest watercourse. Particular care shall be taken to work the area so as to cause a minimum of damage and inconvenience to the landowner. On completion of the work, borrow areas shall be trimmed and left in a neat and uniform condition. The Contractor shall not operate or park equipment in the borrow locations outside of the limits of the actual borrow area, haul roads or stockpile sites. Any areas disturbed, compacted or otherwise affected by the Contractor's operations shall be reclaimed to its original condition.

Borrow areas will be staked out and cross-sectioned by the Design Engineer and accepted by the Department before the Contractor begins work therein. Any material excavated from borrow areas prior to measurement will not be accepted by the Department. When a borrow area is provided by the Contractor, the Contractor shall provide proof of landowner consent and the right-to-enter for the Department.

Borrow areas provided by the Department, may be entered only with the permission of the Department. Such areas, may be subject to revisions, additions or deletions at the discretion of the Department. The Contractor shall be prepared to accept such borrow location arrangements as will ultimately be made by the Department and shall have no claim against the Department on this account. Changes in borrow locations could result in the required use of soil material of undetermined characteristics and may also affect the equipment fleet required to undertake the work, as well as the quantities associated with the work.

The Contractor shall not change the location of a borrow area provided by the Department, without prior consent of the Department.

<u>When the construction of access or haul roads for borrow areas are required, the location and dimensions of the access roads shall be in accordance with the Detailed Designs. Notification Requirements</u>

The Contractor shall inform the Department at least 10 days before starting:

(i) annual activities at the borrow site.

(ii) any salvage of topsoil, subsoil materials.

(iii) any replacement of topsoil, subsoil materials.

If the borrow area is provided by the Contractor, the Contractor shall also inform the local Reclamation Inspector of the appropriate regulatory agency within this same time frame.

<u>Pre-Disturbance Assessment of Borrow Areas</u>

A pre-disturbance assessment shall be completed for each borrow area in accordance with the procedures detailed in the document "Alberta Transportation Pre-Disturbance Assessment Procedures For Borrow Excavations For Road Construction, May 2002". The pre-disturbance assessment must be completed in advance of any construction related activity at the site.

When a borrow area is provided by the Department, the pre-disturbance assessment of the site will be completed by the Department. The Contractor shall provide the Department with adequate notice of his intention to commence construction activities at the borrow site such that the Department has sufficient time to complete the pre-disturbance assessment. The Department will provide the Contractor with a copy of the completed pre-disturbance assessment.

When a borrow area is provided by the Contractor, the Contractor shall complete the pre-disturbance assessment of the site, prepared by a Soil Specialist. The Contractor shall provide the Department with a copy of the completed pre-disturbance assessment at least 72 hours prior to the commencement of construction operations in the borrow area.

Soil Specialist

A soil specialist is an individual who is proficient in soil classification, land management and soil conservation practices and has considerable experience in soil and vegetation impact assessment and problem diagnosis.

Individuals with demonstrated field experience with soil conservation and road building practices, but no formal education related to soil management and conservation may carry out the pre and post assessments under the supervision of a soil specialist.

Conservation of Topsoil, Subsoil on Borrow Areas and Stockpile Sites

The Contractor shall excavate, salvage, and stockpile the topsoil and subsoil in a manner, which prevents contamination of one material with another. A minimum distance of 3m is required between stockpiles of different materials. The materials shall be stockpiled separately in a safe, stable, and accessible location.

If topsoil is to be stockpiled for periods exceeding 2 months or when required by the Detailed Designs, the Contractor shall protect the stockpile from erosion by applying an approved seed mixture or other approved biodegradable soil stabilizer.

The Contractor shall suspend the excavation, salvage, and stockpiling of topsoil and subsoil materials when wet, frozen or other adverse conditions are encountered.

The Contractor shall not construct stockpiles at locations where they are subject to erosion. The Contractor shall maintain erosion and drainage control in the vicinity of all borrow areas and stockpiles to the satisfaction of the Design Engineer and as accepted by the Department and shall ensure that surface drainage does not adversely affect adjacent lands, watercourses or future reclamation operations.

Buffer Zones

The Contractor shall ensure an undisturbed buffer zone exists between the disturbed borrow areas and adjacent land and permanent structures. For property boundaries, road allowances and permanent structures, normal buffer zones shall be 4m or equal to the depth of excavation, whichever is greater.

Dugout borrows shall be a minimum of 40m from the right-of-way or 70m from the highway centreline; whichever is greater. For watercourses or waterbodies, a minimum 30m wide buffer is required.

Stockpiles shall not be situated within 30m of a watercourse or permanent structure or within 4 m of adjacent property boundary.

Extended buffers shall be implemented where local conditions dictate.

Reclamation

General

The Contractor shall reclaim borrow areas and borrow area haul road in accordance with the applicable legislation and the Technical Requirements.

Borrow reclamation shall be performed as soon as possible after completion of excavation operations in any borrow area. Notwithstanding the requirement for expeditious reclamation of borrows, reclamation may not be permitted to proceed, if in the opinion of the Design Engineer and as accepted by the Department, there is insufficient time left in the season to allow vegetation to root and minimize soil erosion of the reclaimed areas.

General Reclamation Conditions For Landscape Borrows or Disturbed Areas Around Dugouts, Borrow Haul Roads, and Stockpile Sites

No work of any kind shall take place on frozen or wet surface areas, or using frozen or wet material.

Upon completion of the excavation operations, the Contractor shall contour the site to match the surrounding lands and to ensure positive drainage. The entire area shall be scarified to a minimum depth of 0.5m or to the depth of compaction, whichever is greater. Where large clay clumps or ridges are prevalent, discing shall be performed following scarification. All rocks larger than 70mm maximum dimension shall be removed. Subsoil material shall only be used for contouring the site with the consent of the Design Engineer and as accepted by the Department and the local Reclamation Inspector from the appropriate regulatory agency. Topsoil material shall not be used to contour the site.

The Contractor shall replace all soil levels uniformly in lifts in the reverse order that they were removed. The Contractor shall disc each replaced soil layer.

Topsoil shall be evenly redistributed over the entire area and rocks, roots and stumps removed in accordance with Section 400.2.5 (Topsoil Placement). Redistribution of topsoil shall only be done in suitable weather conditions. The Contractor shall not perform such work when wind conditions are such that material is being carried beyond the designated work areas or that the material is not being uniformly applied.

In areas where dry soils are encountered, discing and harrowing may destroy soil structure and lead to loss through wind erosion. When these types of areas are encountered, the Contractor shall contact the local Reclamation Inspector from the appropriate regulatory agency to explore alternative procedures for site reclamation.

Rock picking shall be performed to ensure rock content of the reclaimed land does not exceed the rock content before disturbance. If rock content prior to disturbance is not known, the Department will use adjoining land to determine the extent of rock picking required.

Material salvaged from dugout borrow excavations shall generally not be replaced inside the dugout.

Seeding of Reclaimed Areas

The Contractor shall seed reclaimed sites in accordance with Section 400.2.14 (Seeding). The appropriate grass mixture and if applicable, the fertilizer type and application rates will be specified in the Technical Requirements.

All disturbed areas resulting in exposed soils within borrow areas and haul roads shall be seeded unless otherwise determined by the Design Engineer and as accepted by the Department.

Post-Disturbance Assessment of Borrow Areas

The Contractor shall immediately notify the Design Engineer and the Department when reclamation at a borrow site is complete.

A post-disturbance assessment shall be completed for each reclaimed borrow site in accordance with the procedures detailed in the document "Alberta Transportation Post-Disturbance Reclamation and Assessment Procedures for Borrow Excavations for Road Construction, May 2002", with the exception that the vegetation component of the assessment will not be required.

The post-disturbance assessment must be completed within 15 days following the completion of the reclamation work at the site.

When a borrow site is provided by the Department, the post-disturbance assessment of the site will be completed by the Department. The Department will provide a copy of the assessment to the Contractor within 15 days following the completion of the assessment.

A reclaimed borrow site that does not comply with the Technical Requirements and the reclamation criteria, shall be rectified by the Contractor. In such cases, the site will be re-assessed for compliance with the Technical Requirements and the reclamation criteria. The Contractor will be invoiced $1,500.00 each time an additional post-disturbance assessment is required.

When the borrow site is provided by the Contractor, the Contractor shall complete the post-disturbance assessment of the site, prepared by a Soil Specialist as defined in Section 400.2.2.5.6 (Borrow Excavation) Soil Specialist. The Contractor shall provide the Department with a copy of the completed post-disturbance assessment within 15 days following the completion of the assessment.

Acceptance of Reclaimed Borrow Sites

Each reclaimed borrow site will be assessed for compliance with the Technical Requirements and the reclamation criteria specified in "Alberta Transportation Post-Disturbance Reclamation Criteria and Assessment Procedures for Borrow Excavations for Road Construction", with the exception that the vegetation criteria component will not apply.

Notwithstanding the foregoing and further to Section 400.2.2.6 (Product Acceptance,) the completion of an acceptable Post-Disturbance Assessment will not release the Contractor from its responsibilities with regard to the borrow site, until the issuance of the Construction Completion Certificate.

400.2.2.5.7 Constructing Roadways

Embankments

Embankment shall be constructed by placing, shaping, adjusting the moisture content where necessary and compacting excavation materials. Only suitable materials shall be used for constructing the embankment except as otherwise approved by the Design Engineer and as accepted by the Department under the specific conditions specified herein.

The embankments shall be constructed in conformity with the lines, grades, and cross-sections shown on the Detailed Designs, or staked on the ground by the Design Engineer and accepted by the Department.

400.2.2.5.8 Constructing New Roadways

Fill Sections

All topsoil shall be salvaged unless otherwise shown on the Detailed Designs or in the Technical Requirements.

If the exposed surface is 0.6m or greater below the design subgrade surface it shall be bladed, compacted, and backfilled using suitable materials in successive layers, to the required lines and grades.

If the exposed surface is less than 0.6m below the design subgrade surface, excavation shall be carried out to 0.6m below the design subgrade surface or to the elevation as determined by the Department and the suitable excavated material shall be used to construct embankments. The exposed surface shall then be bladed and compacted and backfilled using suitable materials and in successive layers, to the required lines and grades.

Cut Sections

Where the design subgrade surface is in cut and following the excavation and salvage of topsoil and subsoil, excavation shall be carried out to a depth of 0.6m below the design subgrade surface, and the suitable excavated material shall be used to construct embankments. The exposed surface shall be bladed, compacted, and the excavated area backfilled using suitable materials and in successive layers, to the required lines and grades.

At the transition point from a cut section to a fill section, excavation shall be done to 1.0m below design subgrade surface or to the elevation as determined by the Design Engineer and as accepted by the Department, for a distance of 60m in both directions from the transition point and the suitable excavated material shall be used to construct embankments. The exposed surface shall then be bladed, compacted, and then backfilled using suitable materials and in successive layers, to the required lines and grades.

Hillside Benching

When embankments are to be made on a hillside of a nature that will, in the opinion of the Design Engineer and as accepted by the Department, preclude a proper bond between the existing and the newly placed materials, the existing ground on which the embankment is to be placed shall be benched before embankment construction is commenced. The extent of the benching required including the height of the vertical bench cuts will be determined by the Design Engineer and as accepted by the Department. Otherwise, before any embankment is placed on a smooth, firm surface, the existing ground shall be scarified to obtain a bonding of the new material with the existing ground.

400.2.2.5.9 Reconstructing Existing Roadways

Grade Widening

Where existing roadbeds are being widened or the existing embankments and roadway ditches extended, the sideslopes, the affected ditch bottoms and backslopes shall be denuded of all vegetation. Any topsoil from these disturbed areas shall be excavated and salvaged. Side-slopes shall be benched one level at a time (starting at the ditch bottom) in order to obtain bonding between the existing grade and the new embankment for all cuts greater than 2m in depth. Attempts to obtain bonding by the use of vertical cuts for the full depth of the embankment will not be permitted. In all cases, cuts shall not be steeper than 0.5 horizontal to 1 vertical.

Suitable material excavated from the benching operation and any reconstruction of the ditches and back-slopes shall be used for constructing embankments.

Where required by the Design Engineer and as accepted by the Department, any unsuitable material in the existing grade shall be excavated, disposed of and replaced with suitable material. Generally, the unsuitable material shall be disposed of to the satisfaction of the Design Engineer and as accepted by the Department. However, the Design Engineer and as accepted by the Department may require that the unsuitable material be used in the new sideslopes provided that, in the opinion of the Design Engineer and as accepted by the Department, it will not adversely affect the structural integrity of the roadway.

When it is necessary to cut the roadway surface for construction of the last bench, the Contractor shall control traffic such that it is not permitted to travel within 0.5m of the edge of the surface cut.

The length of surface cut shall not exceed 2 km, or a length as established by the Design Engineer and as accepted by the Department. In addition, the work shall be restricted to one side of the roadway in any work area. The Contractor shall promptly backfill sections of exposed vertical cut to provide safe accommodation of traffic.

For any location where surface cutting is required, the Contractor shall erect orange coloured, reflectorized traffic delineators along the pavement edge at intervals of 20m, all in a manner acceptable to the Design Engineer and as accepted by the Department.

When base course construction does not immediately follow grade widening or when the surface cut is longer than 1 km, the Contractor shall promptly place and compact a wedge of suitable material in the cut area adjacent to the roadway surface. This wedge of material shall be tapered to a slope no steeper than 3 horizontal to 1 vertical.

Embankment Placed on Existing Road

Prior to the placement of embankment on an existing roadbed, material within the roadbed designated by the Design Engineer and as accepted by the Department as unsuitable, shall be excavated and replaced with material acceptable to the Design Engineer and as accepted by the Department. Generally, the unsuitable material shall be disposed of to the satisfaction of the Design Engineer and as accepted by the Department. However, the Design Engineer and as accepted by the Department may require that the unsuitable material be used in the new sideslopes, provided that, in the opinion of the Design Engineer and as accepted by the Department, it will not adversely affect the structural integrity of the roadway.

To obtain bonding between the existing and new embankment materials on sideslopes, the existing roadbed sideslopes shall be denuded of vegetation, any topsoil excavated and salvaged and where required by the Design Engineer and as accepted by the Department, benched as described in Section 400.2.2.5.8 (Constructing New Roadways) Hill Side Benching.

Where a new embankment of 0.3m or less is placed on an existing road, which is not surfaced with asphalt material, the existing surface shall be scarified to a depth of 0.15m unless otherwise required by the Design Engineer and as accepted by the Department. The moisture content in this scarified material shall be adjusted, as required, and the material shall be compacted to the density requirements in accordance with the Technical Requirements.

400.2.2.5.10 Placing Material

Use of Rock Material

Where rock is being used in the embankment, such rock shall be carefully distributed and the interstices filled with finer suitable material, as approved by the Design Engineer and as accepted by the Department, to form a dense compact mass. Any large rocks encountered during the construction of the embankment in the final finishing operations, which the Design Engineer and as accepted by the Department determines to constitute a hazard to traffic, due to size or protrusion from the finished embankment surface, shall be removed and disposed of to the satisfaction of the Design Engineer and as accepted by the Department.

Snow, Ice or Frozen Material

Embankment material shall not be placed on frozen earth, snow or ice, nor shall frozen soils, ice or snow be placed in any embankment. Any frozen material in the embankment shall be removed and disposed of by the Contractor before proceeding with further embankment construction.

Grade Settlement

Embankment shall be constructed so that after settlement is complete the required grade and cross-section is attained at all points. If at any time before the time of Construction Completion the embankment settles below the required grade, it shall be brought back to the required grade by the Contractor.

400.2.2.5.11 Compaction

Compaction Operations

Compaction over the entire surface area of each layer shall be obtained by the use of tamping rollers or other equipment to meet the specified density requirements. Hauling equipment will not be accepted in lieu of compaction equipment. Compaction to the specified density shall be obtained uniformly throughout each layer.

Construction on Muskeg or Yielding Ground

Where the embankment to be placed traverses muskeg or yielding ground and it is not possible to place the initial embankment lift in a 0.15m compacted depth, the Contractor may, upon consent of the Design Engineer and as accepted by the Department, construct the first embankment lift to a depth sufficient to support the construction equipment. All embankment to be constructed above this support will be constructed in 0.15m compacted depths, as hereinbefore specified.

Moisture Content Adjustments For Compaction

Drying

Where moisture content tests indicate that material being used for embankment is above optimum moisture, the material shall be thoroughly disced and worked until a uniform optimum moisture content is reached.

The use of lime or any other material to assist in drying wet material shall be entirely at the Contractor's discretion.

Contractor’s use of Lime

The type of lime used shall be pulverized quicklime.

Supply, Delivery, and Handling of Quicklime

Where using quicklime the Contractor shall order the quicklime at his own expense and:

(a) Make all arrangements for the delivery of pulverized quicklime in suitable tanker trucks equipped with distribution equipment appropriate for the direct application of the quicklime onto the wet soils.

(b) So organize his work that all personnel are able to avoid contact with the quicklime.

(c) Take special precautions during windy conditions at the site to avoid damage to personnel, livestock and property during the quicklime application.

(d) Shall be responsible for any trucking costs related to standby.

(e) Pay all transportation charges on quicklime returned to the supplier as surplus to requirements, for any cause whatsoever.

Construction with Lime

Prior to treatment with the quicklime, the soil shall be loosened with suitable equipment. The Contractor shall thoroughly mix the quicklime with the soil until a uniform colour and texture is achieved.

Water for Compaction

Where moisture content tests indicate the material for embankment is below optimum moisture, water shall be added. The material shall be thoroughly disced and broken down, water added in amounts as required, and the material thoroughly worked to mix the water uniformly throughout the soil prior to commencing compaction operations.

Obliteration of Existing Roadway

When sections of the existing roadway, accesses and crossings, are obliterated upon completion of the new roads or when approved alternative roads are operational, any topsoil and subsoil from the area to be obliterated shall be excavated and salvaged separately. The material excavated from the obliteration operation shall be utilized for embankment construction or disposed of as determined by the Design Engineer and as accepted by the Department.

Obliterated areas shall be graded to provide positive drainage, and shall be reclaimed to a neat and tidy condition comparable to that of the adjacent ground. The work shall be in accordance with Section 400.2.2.5.6 (Borrow Excavation) Reclamation, Section 400.2.5 (Topsoil Placement), Section 400.2.14 (Seeding), and to the satisfaction of the Design Engineer and as accepted by the Department.

400.2.2.5.12 Approach Fills for Bridge Structures (Other than Bridge Culverts)

Preparation of Existing Ground

Prior to the placement of embankment on the existing ground where bridge approach fills are to be located and in order to allow unrestricted pile penetration, all areas where piles are to be driven shall be cleared of obstructions such as pavement, granular and soil cement materials, compacted subgrade, topsoil and subsoil, boulders or rock of any nature, trees, stumps and any other undesirable debris. Where the subsurface of the area is known to contain boulders, they shall be removed to a minimum depth of 2m below the existing ground surface. All the materials removed shall be utilized or disposed of as determined by the Design Engineer and as accepted by the Department.

The locations where bridge piling is to be located shall be as shown on the Detailed Designs.

Placing Material in Bridge Approach Fills

Construction of approach fill embankments shall be undertaken in accordance with Sections 400.2.2.5.10 (Placing Material) and 400.2.2.5.11 (Compaction), excepting that the embankment material shall be free of stones, rocks or other solid material greater than 150mm.

Finishing Bridge Headslopes

Bridge headslopes shall be accurately trimmed, particularly at the intersection of the toe of the headslope with the underpassing roadway or with the bank of a stream, to the lines, grades and cross-sections as shown on the Detailed Designs.

Drainage requirements shall be constructed to the lines and grades as shown on the Detailed Designs.

400.2.2.5.13 Finishing Previous Clearing

The Contractor shall remove and dispose of any stumps, debris and new tree growth within the limits of the previously cleared areas.

400.2.2.6 Product Acceptance

400.2.2.6.1 General

In addition to the specific requirements included in the Technical Requirements, the conditions requisite for suitable and completed work will be a roadway that is smooth and compact over the entire width, firm side slopes with regular shoulder lines, clean side ditches, satisfactory approaches, intersections and entrances, smooth and/or scarified back slopes as applicable, and meeting the requirements of Section 400.2.23 (Tolerance for Surface Finish).

All loose stones, clods, weeds, trash, etc., shall be removed from the roadway or other work, side slopes, ditches and back slopes. All improperly compacted material in the roadway or other work shall be excavated, brought to optimum moisture content if required and recompacted by the Contractor.

On the side slopes and back slopes, and in the bottom of ditches, all projecting boulders shall be removed or broken off at least flush with the lines and grades, and the resultant cavities, if any, backfilled.

All borrow sites shall be reclaimed in accordance with the Technical Requirements and the reclamation criteria specified in "Alberta Transportation Post-Disturbance Reclamation Criteria and Assessment Procedures for Borrow Excavations for Road Construction". Any remedial work necessary to achieve these requirements will be by the Contractor until the issuance of the Construction Completion Certificate.

400.2.2.6.2 End Product Acceptance or Rejection

During the performance of the work, the Department will be the final authority in determining suitable and unsuitable materials. The Design Engineer will make recommendations to the Department with respect to the suitability or unsuitability of all materials in dispute.

Layer and Density Requirements

Unless otherwise specifically permitted by the Design Engineer and as accepted by the Department, all material placed in embankments shall be spread and bladed smooth in successive layers, not to exceed 0.15m in depth when compacted and to the full width of the cross-section. Each layer shall be compacted by means suitable to the Design Engineer and as accepted by the Department to a minimum of 95 percent of the maximum dry density established by the Moisture-Density Relation tests using Standard Compaction, with the exception of the upper 0.30m, which shall be compacted in 0.15m layers to a minimum of 100 percent. The material in each layer shall be compacted at the optimum moisture content, unless otherwise required by the Design Engineer and as accepted by the Department. In case of controversy, the degree of compaction and/or moisture content will be determined by a moisture-density test before the succeeding layer is placed.

Finishing

The Contractor shall, as soon as practicable, bring the excavations and embankments to the correct widths, lines, and grades.

Backslopes that are 2m and greater in height and with a slope steeper than 3 horizontal to 1 vertical shall be scarified to reduce the potential for erosion. A typical method for scarifying such backslopes shall be "walking a dozer" over the entire slope, operating the equipment in a direction perpendicular to the roadway. All other backslopes shall be finished in the normal manner.

A maximum of 2 km of grade shall be in the rough at any one time. However, where no traffic accommodation is required through the work, up to 5 km of grade may be in the rough. In these situations, having more than 2 km of grade in the rough at any one time will be subject to the prior consent of the Design Engineer and as accepted by the Department.

As soon as the excavations and embankments are completed to the correct widths, lines and grades, the Contractor shall maintain the roadway with a blade machine.

Interim Acceptance of Roadway Surface

Roadway surfaces, which have been entirely completed (constructed and finished), in accordance with the Detailed Designs, will be eligible for inspection and interim acceptance by the Design Engineer and as accepted by the Department under the following conditions:

(i) The roadway surface is not being covered with granular base course as indicated in the Technical Requirements.

(ii) The section of roadway surface being considered for interim acceptance is not less than 1 km in length and is contiguous to a section of roadway surface previously accepted.

Interim acceptance shall apply to the roadway surface only, and shall not relieve the Contractor of his responsibility to complete other portions of the roadway such as the sideslopes, ditches, and backslopes in accordance with the Detailed Designs.

Acceptance of the other portions of the roadway will not be made on an "interim" basis and will only be considered once the entire project is completed and ready for the Construction Completion inspection as detailed in the Technical Requirements.

In addition, interim acceptance of a roadway surface shall not relieve the Contractor of its responsibility to repair any failures occurring in the roadway surface prior to the Construction Completion inspection, which, in the opinion of the Design Engineer and as accepted by the Department, are workmanship related.

Maintenance Requirements and Responsibilities

Uncompleted Roadway Surface

Maintenance shall be completed by the Contractor and shall continue daily or at frequent intervals, depending on the effects of traffic and weather upon the uncompleted portion of the roadway. Ditches and culverts shall be kept free from obstructions so that water will flow freely at all times.

For the purposes of determining maintenance responsibilities and requirements, a roadway surface, which is being covered by granular base course under the Technical Requirements, will be considered an "uncompleted roadway surface".

Roadway Surface Accepted on an Interim Basis

Maintenance of roadway surface, which has been accepted on an interim basis, shall be performed by the Contractor at intervals as determined by the Design Engineer and as accepted by the Department.

400.2.2.7 Measurement

The dimensions of the excavations and embankments shall be, in accordance with the Detailed Designs, but the dimensions of any or all excavations and embankments may be increased or decreased at any time by the Design Engineer with the written consent of the Department as conditions and circumstances may determine.

The unit of measure of all classes of excavation will be the cubic metre as measured in its original position recorded by the Design Engineer and as accepted the Department.

400.2.2.8 Payment Adjustment

A reclaimed borrow site, which does not comply with the requirements of the Technical Requirements and the reclamation criteria shall be rectified by the Contractor at its expense. In such cases, the site will be re-assessed for compliance with the Technical Requirements and the reclamation criteria. The Contractor will be invoiced $1,500.00 each time an additional post-disturbance assessment is required.

400.2.3 CULVERTS

400.2.3.1 General

400.2.3.1.1 Description

This specification covers the installation of pipe culverts less than 1500mm equivalent diameter.

Abbreviations for the various types of culverts when indicated on the Detailed Designs, or used in the Technical Requirements are as follows:

C.S.P.	Corrugated Steel Pipe
C.S.P. Arch	Corrugated Steel Pipe Arch
R.C.P.	Reinforced Concrete Pipe
R.G.R.C.P.	Rubber Gasket Reinforced Concrete Pipe
P.P.	Polyethylene Pipe
C.A.P.	Corrugated Aluminum Pipe
C.A.P. Arch	Corrugated Aluminum Pipe Arch
C.M.P.	Corrugated Metal Pipe (General Term for Corrugated Steel and Aluminum Pipe)
R.C.B.	Reinforced Concrete Box

400.2.3.2 Materials And Procedures

400.2.3.2.1 Culvert Material

The Contractor shall supply culvert material in accordance with Section 400.2.41 (Supply of Corrugated Metal Pipe and Pipe Arches), Section 400.2.42 (Supply of Polyethylene Pipe) and Section 400.2.36 (Supply of Reinforced Concrete Culvert).

400.2.3.2.2 Gravel Material for Culverts

When the Detailed Designs stipulates, the Contractor shall produce gravel material for culvert backfill in accordance with Section 400.2.20 (Aggregate Production and Stockpiling) for the designation and class of materials specified. The Contractor shall supply aggregate in accordance with Section 400.2.31 (Supply of Aggregate).

400.2.3.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.3.4 Acceptance Sampling and Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.3.5 Construction

400.2.3.5.1 Excavation and Preparation of Base

Excavation for the culvert base shall be to a depth of not less than 0.3m below the invert grade, and shall be of sufficient width to permit assembly of the pipe and the operation of compaction equipment on either side of the pipe. All soft, yielding, or unsuitable material at this level shall be removed to a depth as directed by the Design Engineer and as accepted by the Department, and replaced with gravel or other acceptable material to provide a firm foundation of uniform density throughout the entire length of the pipe.

On completion of excavation for the culvert base and the removal and replacement of any soft, yielding or unsuitable material the Contractor shall compact the exposed surface to uniform density. The Contractor shall then construct the culvert bed to the established elevation using gravel material or other material acceptable to the Design Engineer and as accepted by the Department. The culvert bed shall be compacted in accordance with Section 400.2.2 (Grading). The width of the culvert bed shall be 3 times the culvert diameter or span.

When the culvert installation is in rock, excavation for the culvert base shall be carried out to a depth of not less than 0.2m below the invert grade. The width of the culvert bed shall be a minimum of 1.5 times the diameter or span of the culvert.

Where gravel bedding or backfill is used, impervious, compacted clay cut-offs shall be constructed at both ends of the culvert as shown on drawing CB6-2.4M1.

400.2.3.5.2 Installation

400.2.3.5.2.1 General

The culvert shall be installed on the prepared base, true to the designed lines and grades unless otherwise established by the Design Engineer and as accepted by the Department. Separate sections shall be securely joined together in accordance with the manufacturer's instructions. Coupler bands shall be used for metal and polyethylene pipe and unless otherwise specified, rubber gasket type joints shall be prepared and made between sections of reinforced concrete culvert. At all coupling and joint areas and at areas of concrete pipe that have external bells, depressions shall be constructed in the culvert bed so that the pipe is uniformly supported along its entire length.

The Contractor shall use due care when installing the culvert to avoid damaging the material. Damaged culvert shall be removed and replaced by the Contractor.

400.2.3.5.2.2 Installation Of Corrugated Metal Pipe And Pipe Arches

When required, elbows shall be installed to accommodate sharp changes in gradient or direction of the pipe.

Pipe shall be carefully handled to prevent damage to the protective coating. Any damage to coatings shall be repaired by the Contractor in accordance with CAN 3-G401.

400.2.3.5.2.3 Installation Of Reinforced Concrete Culvert

Reinforced concrete culvert shall be placed beginning at the downstream or lower end of the culvert. The pipes shall be placed with the bell or grooved ends facing upstream. The interior sections of the culverts shall conform to the grade and alignment as shown on the Detailed Designs.

Culvert sections shall be joined using either a wedge and block, or mechanical pipe pullers to bring the pipe to the homed position. Joints shall not be deflected beyond the manufacturer's recommended maximum.

Culvert sections shall be anchored to adjacent sections by tie bars, where provided. Lifting holes and holes for engaging bars shall be filled with mortar, and finished flush with the pipe surface.

400.2.3.5.2.4 Installation Of Polyethylene Pipe

The culvert bed shall be shaped to the curvature of the pipe to a depth of 75mm using a template.

Blocking shall not be used to bring the pipe to grade. The pipe shall be placed on the prepared base to the lines and grades as indicated on the Detailed Designs, with the separate sections securely joined with the applicable welds and gasket joints as specified in Section 400.2.42 (Supply of Polyethylene Pipe). Temporary hold downs shall be used to maintain the position of the pipe during installation.

Sections of pipe with a minimum length of 6 m shall be used on each end of each culvert.

400.2.3.5.2.5 Installation of Downdrains

When required, downdrain pipes shall be installed as shown on the Detailed Design drawings, at the locations as shown on the Detailed Designs or designated by the Design Engineer and as accepted by the Department. A trench shall be excavated to the established depth and grade required for the installation of the downdrain pipe and connecting elbows, and its bottom surface shall provide a uniform, firm foundation throughout the length of the installation, with sufficient width to permit satisfactory jointing and thorough compaction of the backfill material around the pipe.

400.2.3.5.2.6 Extension of Existing Culverts

Extensions to existing culverts will be considered as new installations. Where an existing culvert is to be extended, the removal, salvage and reinstallation of the existing sloped end sections may be required as shown on the Detailed Designs or as directed by the Department.

Where the existing pipe was manufactured to imperial dimensions and the new pipe is manufactured to metric dimensions and a mismatch occurs at the joint, the Contractor shall caulk the joint with oakum to obtain a water resistant joint.

400.2.3.5.3 Backfilling

400.2.3.5.3.1 General

Backfill under the haunches and immediately adjacent to the culvert extending from the culvert base up to an elevation of 30 percent of the vertical height of the culvert shall be comprised of select gravel or soil material, as directed by the Design Engineer and as accepted by the Department. Backfill immediately adjacent to the culvert above this level shall be comprised of select soil material. All backfill material shall be free from frozen lumps and organic material. Backfill within 300mm of the culvert wall shall be free from stones of diameter larger than 80mm.

All backfill material shall be placed in layers not exceeding 0.15m in depth. Each layer shall be thoroughly compacted at optimum moisture content by means of pneumatic or other mechanical tamping equipment. Backfill and compaction layers shall be brought up simultaneously and evenly on both sides of the culvert filling all corrugations and ensuring firm contact with the entire bottom surface of the pipe. This compaction procedure shall be continued until the backfill reaches a minimum elevation of 0.3m above the top of the pipe, or greater, as determined by the Design Engineer and as accepted by the Department if necessary to carry the weight of construction equipment without damage to the culvert.

Backfilling of the remainder of the culvert excavation, beyond the immediate region of the culvert, shall be carried out in accordance with Section 400.2.2 (Grading). Compacting equipment shall be operated parallel to the longitudinal axis of the culvert, until sufficient fill has been placed to proceed with construction of the embankment in the normal manner.

The remaining construction of the grade embankment over the installation may then proceed in accordance with Section 400.2.2 (Grading).

400.2.3.5.3.2 Backfilling Polyethylene Pipe

The minimum height of fill above the top of the pipe shall be 0.6m or as directed by the Design Engineer and as accepted by the Department.

Immediately after backfill is completed, the Contractor shall saw cut the sloped ends at a ratio of 4:1 as shown on drawing CB6-2.4M9.

400.2.3.5.4 Hand-Laid Riprap

Immediately following completion of culvert installation, hand-laid riprap shall be placed in accordance with Section 400.2.4 (Riprap).

400.2.3.5.5 Removal

400.2.3.5.5.1 Removal, Salvage and Reinstallation of Existing Culverts

Where removal and salvage of existing culverts or drainage structures from the roadbed, ditches, or other waterways is specified, the Contractor shall carefully excavate, remove and store the material at locations suitable to the Design Engineer and as accepted by the Department. Salvaged materials shall be reinstalled in accordance with these specifications.

400.2.3.5.5.2 Removal and Disposal of Existing Culverts

Where removal and disposal of existing culverts or drainage structures from the roadbed, ditches, or other waterways is specified, the Contractor shall remove and dispose of the material at locations acceptable to the Design Engineer and as accepted by the Department.

400.2.3.5.5.3 Culvert Installation and Removal on Roadways in Service

Where culvert installation or removal must take place on roadways that must remain in service during construction, the Contractor shall carry out his installation or removal by either building and maintaining a detour or by working on one half of the roadway while maintaining flagperson controlled and adequately signed traffic flow on the other half. Details of all proposed traffic accommodation methodologies shall be provided in the Contractor’s traffic accommodation strategy.

400.2.3.5.5.4 Grouting Abandoned Culverts

When directed by the Design Engineer and as accepted by the Department or at the locations shown on the Detailed Designs, the Contractor shall completely fill existing culverts, starting at the upstream end, with a permanent cementitious fill material with a minimum compressive strength of 0.5 MPa to prevent future collapse of the culverts.

The filling of the culverts shall be carried out using methods and materials acceptable to the Design Engineer and as accepted by the Department. The Contractor shall take precautions during filling operations to ensure that no blow outs or disruptions of the existing roadway occur.

When a replacement culvert is being installed, the replacement culvert shall be in operation before grouting of the abandoned culvert begins.

400.2.3.6 Product Acceptance

When a culvert is identified by the Design Engineer and as accepted by the Department to be salvaged and the culvert is damaged by the Contractor during the removal operations due to his negligence, the Contractor shall replace the damaged culvert.

400.2.3.7 Measurement

400.2.3.7.1 Excavation for Removal of Existing Culverts

Measurement for excavation for the removal of existing culverts, including the excavation of existing base or surfacing courses, will be in accordance with Section 400.2.2 (Grading).

400.2.3.7.2 Removal, Salvage and Reinstallation of Existing Culverts

Measurement for the removal, salvage and reinstallation of existing culverts and drainage structures including sloped ends, will be made in metres based on the total invert length of pipe removed and reinstalled.

400.2.3.7.3 Removal and Disposal of Existing Culverts

Measurement for the removal and disposal of existing culverts and drainage structures will be made in metres based on total invert length of pipe removed.

400.2.3.7.4 Excavation for Culvert Installation

Measurement for excavation for culvert installation will be in accordance with Section 400.2.2 (Grading).

400.2.3.7.5 Supply and Installation of Culverts

Measurement for the supply and installation of culverts, and downdrains will be made in metres based on the total invert length of pipe installed, including elbows and sloped end sections.

400.2.3.7.6 Gravel Material For Culverts

Measurement of gravel material for culverts will be made in cubic metres.

400.2.3.7.7 Culvert Installation and Removal on Roadways in Service

Where the construction of detours is required, the construction and subsequent removal of detours will be measured. Maintenance of detours will be the Contractor's responsibility.

400.2.3.7.8 Grouting of Abandoned Culverts

The Contractor shall provide a means of measuring the volume of material used to fill the culverts.

400.2.3.8 Payment Adjustment

Intentionally Deleted

400.2.4 RIPRAP

400.2.4.1 General

400.2.4.1.1 Description

This specification covers the supply and placement of riprap. Riprap is a protective covering consisting of hand-laid or randomly deposited rock, sacked concrete or sacked cement stabilized material which is placed around culvert inlets and outlets and along slopes, embankments and ditches.

400.2.4.2 Materials And Procedures

400.2.4.2.1 General

All riprap material shall be supplied by the Contractor and shall be resistant to weathering and water action and shall not consist of sandstone or shale. Where sources of rock riprap material exist within the Road Right of- Way, the materials may be provided to the Contractor.

400.2.4.2.2 Random Rock Riprap

Random rock riprap shall consist of a graded mixture of sound, durable stone or pit-run gravel. The gradation of the mixture shall be such that 50 percent of the riprap consists of material having a least minimum dimension of 250mm.

400.2.4.2.3 Hand-Laid Riprap

400.2.4.2.3.1 General

The Contractor has the option of supplying Hand-Laid Rock Riprap or Sacked Concrete Riprap both of which will be classed as Hand-Laid Riprap.

400.2.4.2.3.2 Rock Riprap

Hand-laid rock riprap material shall consist of sound, durable stones that meet the following Class 1M gradation requirements:

CLASS 1M RIPRAP (Nominal Diameter of 175 mm)	**Equivalent Diameter (mm)**	**Percentage (by weight) of Riprap Greater than Equivalent Diameter**
	300	0%
	200	20% to 50%
	175	50% to 80%
	125	100%

Note:	Sizes are equivalent spherical diameter, and are for guidance only. The minimum dimensions of any single rock shall not be less than one third of its maximum dimension

400.2.4.2.3.3 Sacked Concrete Riprap

Concrete shall be manufactured in accordance with Section 400.2.34 (Supply of Portland Cement), for Class "S" Concrete.

Upon approval of the Design Engineer and as accepted by the Department, clean, well graded pit-run gravel, in lieu of separated sand and gravel, may be used in the manufacture of concrete.

400.2.4.2.3.4 Burlap Sacks

Sacks for sacked riprap shall be 370mm x 685mm, 285 g burlap of approximately 0.03m^3 capacity. The bags shall be of sufficient strength to permit them to be lifted by the top corners of the bag when filled with the applicable materials.

400.2.4.3 Quality Management Sampling and Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.4.4 Acceptance Sampling and Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.4.5 Construction

400.2.4.5.1 Placing Random Rock Riprap

Random riprap gravel shall be dumped over the area to be treated, until the required depth is attained. Manual handling of the material may be required.

400.2.4.5.2 Placing Hand-Laid Riprap

400.2.4.5.2.1 General

Hand-laid riprap shall be placed at culvert inlets and outlets and at other locations as directed by the Design Engineer and as accepted by the Department. Riprap aprons as shown on Dwg. No CB6-2.5 M1 will only be required when specified in the Detailed Designs.

400.2.4.5.2.2 Placing Rock Riprap

The stones shall be placed with their beds at right angles to the slope, the larger stones being placed first in the bottom courses and graduating to the smaller stones at the top. Stones shall be laid in close contact so as to break joints, and in such manner that the weight is carried by the earth and not by the adjacent stones. The spaces between the larger stones shall be filled with spalls, securely rammed into place. The finished work shall present an even, tight surface as shown on the Detailed Designs.

400.2.4.5.2.3 Preparation of Base for Sacked Concrete

The base shall be formed by excavating, filling and shaping to the required depth below and parallel to the finished surface of the riprap. The entire base shall be thoroughly compacted to provide a smooth and firm foundation of uniform density.

400.2.4.5.2.4 Placing Sacked Concrete

Each burlap sack shall be filled to 70 percent of its capacity with concrete, securely sewn or stapled to form a straight edge closure, and immediately placed in its final position on the prepared base. The filled sack shall be placed to conform to the prepared base and adjacent sacks already in position, to form a closely moulded, smooth surface of uniform average depth of not less than 125mm.

All joints between rows shall be staggered to pattern, and all dirt and debris shall be removed from tops of sacks before successive courses are placed.

Not more than five courses of sacks shall be placed in any tier before such time as initial set has taken place in the first course of any such tier.

Following placing, the sacked concrete or sacked cement stabilized riprap shall be kept moist for a period of twenty-four hours, by sprinkling water, moist earth covering, or other satisfactory means as approved by the Design Engineer and as accepted by the Department.

400.2.4.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.4.7 Measurement

400.2.4.7.1 Random Rock Riprap

Measurement of random rock riprap will be by the cubic metre of material incorporated into the work.

400.2.4.7.2 Hand-Laid Riprap

Hand-Laid Riprap placed at locations other than aprons or culvert inlets and outlets will be measured by the square metre.

400.2.4.8 Payment Adjustment

Intentionally Deleted

400.2.5 TOPSOIL PLACEMENT

400.2.5.1 General

Topsoil placement shall consist of the placing and finishing of select topsoil material on the areas designated on the Detailed Designs or as directed by the Design Engineer and as accepted by the Department, for the purpose of establishing vegetation for erosion control.

Generally, those areas containing highly erodible soils such as sand, those areas containing sterile soils such as gravel, and those areas containing exposed subsoil which is subjected to highly erosive action such as in the case of flow channels, will be considered for a covering of topsoil.

400.2.5.2 Materials and Procedures

400.2.5.2.1 Topsoil

Topsoil shall consist of a natural, friable surface soil of organic character, suitable for agricultural purposes. Topsoil shall be free of objectionable quantities of sub-soil, roots, stones and other deleterious substances.

Topsoil shall be obtained from within the highway right-of-way, unless otherwise directed by the Design Engineer and as accepted by the Department.

The excavation and removal of topsoil from any source shall be under the direction of the Design Engineer and as accepted by the Department, insofar as the selection of material and/or the exact location of excavation is involved.

400.2.5.3 Quality Management Sampling and Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.5.4 Acceptance Sampling and Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.5.5 Construction

400.2.5.5.1 General

The excavation of the topsoil shall be carried out to the lines and depths as established by the

Design Engineer and as accepted by the Department. Topsoil shall be selected as to quality during excavation. Excavated material, which in the opinion of the Design Engineer and as accepted by the Department, is not suitable for use as topsoil shall be disposed of as directed by the Design Engineer and as accepted by the Department.

Topsoil placement shall be undertaken as either a single- or two-phase operation.

When topsoil placement is done in a single operation, the excavated topsoil shall be moved directly to its final position without intermediate stockpiling.

When done in two phases, the first phase of the work shall consist of excavating select topsoil from the designated sources and hauling to stockpile sites. Generally, stockpile sites shall be located within Road Right of- Way. The location of all sites shall be subject to the approval of the Design Engineer and as accepted by the Department.

The second phase shall be undertaken when the highway grade is near completion. In this operation, the topsoil shall be excavated from the stockpiles, hauled and placed in its final position.

Upon completion of excavation, stockpile sites shall be trimmed to present a neat and tidy appearance, fences removed for purposes of entry shall be replaced, and debris resulting from the operation shall be removed and disposed of, all in a manner satisfactory to the Design Engineer and as accepted by the Department.

400.2.5.5.2 Preparation of Placement Areas

Before placing the topsoil, the areas to be covered with topsoil shall be shaped to the uniform lines prescribed. The surface shall then be loosened to a minimum depth of 50mm, by means of discs, spike-tooth harrows, or other means satisfactory to the Design Engineer and as accepted by the Department.

400.2.5.5.3 Placing Topsoil

Topsoil shall be uniformly spread on the prepared areas, to the minimum required depth of 70mm, or a greater depth as directed by the Design Engineer and as accepted by the Department. If there is insufficient topsoil to attain a 70mm depth throughout the work, the Design Engineer and as accepted by the Department may direct spreading topsoil to a lesser depth or over a lesser area. After spreading, all hard lumps shall be broken down and all rocks larger than 70mm in dimension, roots, stumps, and other foreign matter shall be removed and disposed of in a manner satisfactory to the Design Engineer and as accepted by the Department. After the topsoil has been spread, it shall be satisfactorily compacted. The area covered with topsoil shall be left in a condition suitable for seeding or planting, without additional preparation of any nature.

At the completion of topsoil placement, the adjacent roadway surface shall be cleaned of all debris resulting from the operation, and the completed work left in a neat and tidy condition.

400.2.5.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the

completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.5.7 Measurement

400.2.5.7.1 Excavation

Measurement for excavation from the original source will be in accordance with Section 400.2.2 (Grading), for the classification of soil as described.

400.2.5.7.2 Topsoil Placement

Topsoil placement will be measured by the square metre of surface topsoiled based on horizontal measurements. No allowances will be made for uneven or sloping ground.

Work on areas which were not specifically designated for topsoil placement, but were disposal areas or embankments constructed of surplus topsoil material, will not be classified as "Topsoil Placement".

400.2.5.8 Payment Adjustment

Intentionally Deleted

400.2.6 UNDERGROUND ELECTRICAL CONDUITS

400.2.6.1 General

400.2.6.1.1 Description

This specification covers the supply and installation of underground electrical conduit and appurtenances.

400.2.6.2 Materials and Procedures

All materials shall be supplied by the Contractor in accordance with Drawings CB6-2.7M1 and CB6-2.7M2 and the following:

400.2.6.2.1 Conduit

The Contractor shall supply the conduit with all necessary couplings, fittings and cement. Flexible conduit for underground electrical installation shall be heavy duty 75 psi medium density polyethylene made to quality assurance Z299.3.

Rigid conduit for underground electrical installation shall be either Polyvinyl Chloride (PVC), type DB2 or Reinforced Thermosetting Resin Conduit (RTRC) conforming to CSA Standards C22.2 No.211.1 and C22.2 No. 211.3 respectively.

400.2.6.2.2 Fish Wire

Fish wire (brace wire) shall be 3.66mm soft galvanized wire with a minimum weight of 2.5 kg per 30.5m of wire.

400.2.6.2.3 Conduit Locating Pins

Conduit locating pins shall be 450mm x 12 mm bent steel, deformed bars, or 300mm x 10mm spikes, as required.

400.2.6.2.4 Select Backfill Material

Select backfill material may be the previously excavated material free of lumps and stones larger than 25mm in diameter, sand, uncrushed rock not exceeding 25mm in diameter, or crushed rock not exceeding 16mm in diameter.

400.2.6.3 Quality Management Sampling and Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.6.4 Acceptance Sampling and Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.6.5 Construction

400.2.6.5.1 General

The conduit shall be installed by either the trench excavation or pushed conduit method in accordance with Drawings CB6-2.7M1 and CB6-2.7M2. Underground conduit shall normally be trench excavated except where underground conduit is designated to be placed under existing pavement or surfacing structure, in which case the conduit shall be installed by the pushed conduit method.

The fish wire shall be placed in the conduit and wound around the conduit locating pins for future assistance in locating the ends of the conduit.

Conduit required to be installed concurrently with a grading operation shall be installed upon completion of the subgrade construction.

400.2.6.5.2 Saw-Cutting

Saw-cutting shall be in accordance with Section 400.2.26, (Cutting of Pavement).

400.2.6.5.3 Trench Excavation

A trench shall be excavated to the depth and grade required, and a base shall be formed to provide a firm foundation of uniform density throughout the length of the trench. The trench shall be no wider than necessary to permit satisfactory installation of the conduit and thorough compaction of the backfill material around the conduit. The excavation shall be performed in such a manner as to cause the least possible damage to the adjacent embankment surface and other improvements.

Excavation through roadways open for use by public traffic shall be performed in such a manner that not more than one traffic lane is restricted at any time.

400.2.6.5.4 Pushed Conduit

Installation by means of augering, drilling, or pushing shall be classified as pushed conduit. Pushed conduit shall be installed at a minimum depth of 0.8 metres below the existing surface. The Contractor shall not be allowed to cut the existing surface without permission from the Design Engineer and as accepted by the Department. Permission to cut the existing surface will not be considered unless the Contractor has made a minimum of three workmanlike attempts at each crossing and has been unable to successfully install the conduit by pushing.

The diameter of the auger or drill bit shall not exceed the diameter of the conduit by more than 50 mm.

400.2.6.5.5 Placing Conduit and Backfill

The conduit shall be placed in the prepared trench. Select backfill material shall be used in the first 0.15m layer of backfill and shall be left untamped. The remaining backfill comprised of the previously excavated material or select backfill material shall be placed in layers not exceeding 0.15m in depth and shall be thoroughly compacted for the full limits of the trench. Excess excavated material shall be deposited in embankment or uniformly distributed, as directed by the Department, and any disturbed areas shall be shaped and left in a neat and tidy condition.

When excavation of trenches for installation of conduit requires the removal of concrete, asphalt pavement, asphalt bases and/or base materials, the Contractor shall replace and reconstruct the disturbed portion of the surface with materials of equal quality. The work shall be left in a condition satisfactory to the Design Engineer and as accepted by the Department and shall conform with the adjacent surface.

Flexible conduit shall be placed in continuous lengths with no joints between junction or pole bases.

Rigid conduits may be jointed with approved couplings cemented in accordance with the manufacturer's instructions.

400.2.6.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Design Engineer and as accepted by the Department prior to accepting.

400.2.6.7 Measurement

400.2.6.7.1 Underground Electrical Conduit - Trench Excavation

Conduit installed by the trench excavation method will be measured by the length in metres of conduit pipe complete in place.

Replacement and reconstruction of disturbed portions of the subgrade will not be measured separately, but shall be considered incidental to the work.

400.2.6.7.2 Underground Electrical Conduit - Pushed Conduit

Pushed conduit installation will be measured by the length in metres of the augered hole. Any remaining conduit extending beyond the augered hole will be measured as "Underground Electrical Conduit - Trench Excavation".

400.2.6.8 Payment Adjustment

Intentionally Deleted

400.2.7 PERFORATED PIPE SUBDRAINS

400.2.7.1 General

The work shall consist of trenching, supplying and installing perforated pipe wrapped in filter fabric and backfilling with select filter material at locations and to the depth and grade as established in the Detailed Designs.

400.2.7.2 Materials And Procedures

400.2.7.2.1 Perforated Pipe

The Contractor shall supply perforated pipe in accordance with Section 400.2.41 (Supply of Corrugated Metal Pipe and Pipe Arches) or Section 400.2.42 (Supply of Polyethylene Pipe).

400.2.7.2.2 Filter Fabric

The filter sock or filter fabric material for wrapping the perforated pipe shall meet the requirements of Type “A” Non-Woven in accordance with Section 400.2.46 (Geotextile).

400.2.7.2.3 Filter Material

The Contractor shall supply filter material composed of hard, durable mineral particles free from organic matter, clay balls, soft particles and other deleterious materials and meeting the gradation requirements as specified in Section 400.2.20 (Aggregate Production and Stockpiling), for Designation 8 Class 25 material. The Contractor shall supply aggregate materials in accordance with Section 400.2.31 (Supply of Aggregate) and haul aggregate materials in accordance with Section 400.2.30 (Hauling).

400.2.7.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.7.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.7.5 Construction

400.2.7.5.1 Trench Excavation

Trenches shall be excavated to depths and grades as established by the Detailed Designs. The trench shall be kept as narrow as practicable and still permit jointing to be done. The minimum width of the trench shall be the inside diameter of the pipe plus 0.25m. The bottom of the trench shall be stable to afford a firm and uniform bearing throughout the entire length of the culvert. Where the bottom of the trench is in an impervious layer which has become wet and puddled, gravel material shall be added to stabilize the bottom. However, the depth of gravel material shall be kept to a minimum to prevent possibilities of water flow under the subdrain pipe.

400.2.7.5.2 Pipe Installation

Perforated pipe shall be installed to the depth and grade established by the Detailed Designs Perforations shall be oriented in directions as indicated by the Detailed Designs in accordance with the requirements for either collecting or carrying of water.

400.2.7.5.3 Filter Fabric Installation

The perforated pipe shall be wrapped with filter fabric or fitted with a filter fabric sock prior to installation.

400.2.7.5.4 Trench Backfill

The subdrain trench shall be backfilled with pervious filter material conforming to Section 400.2.7.2.3 (Filter Material). Filter material shall be placed in 0.15m layers, shall be thoroughly tamped and carried to a minimum of 0.15m above the seepage zone, or to height as directed by the Design Engineer and as accepted by the Department. The remainder of the trench shall be backfilled with impervious material and thoroughly compacted.

400.2.7.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.7.7 Measurement

400.2.7.7.1 Trench Excavation

Measurement for excavation for the subdrain trench will be made in accordance with Section 400.2.2 (Grading), for the various classes of material excavated.

400.2.7.7.2 Supply and Install Perforated Pipe Subdrain

Measurement for the supply and installation of perforated pipe subdrains will be in metres, measured along the pipe invert

400.2.7.7.3 Filter Material

Measurement of filter material for backfilling will be per cubic metre

400.2.7.8 Payment Adjustment

Intentionally Deleted

400.2.8 SALVAGE OF BASE COURSE MATERIAL

400.2.8.1 General

400.2.8.1.1 Description

This work shall consist of the salvaging and stockpiling of existing base course materials, in accordance with the Detailed Designs.

400.2.8.2 Materials And Procedures

Intentionally Deleted

400.2.8.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.8.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.8.5 Construction

400.2.8.5.1 Salvaging and Stockpiling

Where required by the Detailed Designs, the existing base course material shall be carefully salvaged and stockpiled.

Stockpiles shall be placed at locations designated by the Detailed Designs, and shall be uniform in dimension and accessible for loading. Where directed by the Design Engineer and as accepted by the Department, the salvaged material shall be loaded, hauled, spread and compacted on the finished roadbed.

400.2.8.5.2 Use of Salvaged Material

When directed by the Design Engineer and as accepted by the Department, salvaged material shall be excavated from the stockpiles, hauled, spread and compacted on sections of completed subgrade as indicated.

400.2.8.5.3 Excavation and Recompaction of Subgrade

Subgrade exposed by the salvage of base materials shall be excavated and/or recompacted to the depth and grade established by the Detailed Designs.

400.2.8.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.8.7 Measurement

400.2.8.7.1 Excavation of Base Course or Pavement Material

Base course material excavated and stockpiled or used on the roadway will be measured in cubic metres in its original position.

400.2.8.7.2 Excavation and/or Reworking Subgrade

Where subgrade preparation is required on subgrade exposed by salvage operations, it will be measured in accordance with the provisions of Section 400.2.19 (Subgrade Preparation).

400.2.8.8 Payment Adjustment

Intentionally Deleted

400.2.9 MANHOLES, INLETS AND CATCH BASINS

400.2.9.1 General

400.2.9.1.1 Description

This work shall consist of supplying materials and constructing manholes, inlets and catch basins of concrete, with or without steel reinforcement as specified, and of precast reinforced concrete units, complete with necessary frames, castings and fittings in accordance with the Detailed Designs and in conformity with the dimensions, lines, elevations and design shown on the plans herein, at locations as indicated.

400.2.9.2 Materials And Procedures

The Contractor shall supply all materials required in accordance with the Technical Requirements.

400.2.9.2.1 Aggregate

The Contractor shall produce aggregate materials for backfill in accordance with Section 400.2.20 (Aggregate Production and Stockpiling). The Contractor shall supply aggregate in accordance with Section 400.2.31 (Supply of Aggregate) and haul aggregate in accordance with Section 400.2.30 (Hauling).

400.2.9.2.2 Concrete

All materials for the manufacture of concrete shall be supplied by the Contractor and shall comply with requirements specified in Section 400.2.32 (Supply of Portland Cement Concrete). Class "B" air-entrained Portland Cement Concrete shall be used, unless otherwise specified or shown on the plans.

400.2.9.2.3 Reinforcing Bars and Wires

Steel reinforcing bars shall be deformed bars in accordance with the most recent edition of CSA G30.12 - M "Billet Steel Bars for Concrete Reinforcement".

Cold drawn wire or welded wire fabric for concrete reinforcement shall conform to the requirements of the latest edition of CSA G30.5.

400.2.9.2.4 Precast Reinforced Concrete

Precast reinforced concrete units shall be as specified in the Detailed Designs and shall be supplied by the Contractor.

400.2.9.2.5 Concrete Block Units

Concrete block for the construction of concrete block units shall be supplied by the Contractor. Concrete masonry blocks used for construction of manholes, inlets, and catch basins shall conform to the requirements of ASTM C139.

400.2.9.2.6 Mortar

Mortar shall be composed of one part Portland cement and two parts fine aggregate by volume. Materials for the manufacture of mortar shall be supplied by the Contractor.

400.2.9.2.7 Frames, Castings and Fittings

All required metal frames, castings and fittings shall be supplied by the Contractor.

400.2.9.3 Quality Management Sampling And Testing

Sampling and Testing of cast-in-place Concrete shall meet the requirements of Section 400.2.32 (Supply of Portland Cement Concrete).

400.2.9.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

The Contractor shall supply a Certificate of Manufacture which indicates all concrete block units conform to the requirments of ASTM C139

400.2.9.5 Construction

400.2.9.5.1 Preparation of Base

Foundation pits for manholes, inlets and catch basins shall be excavated to elevations established by the Design Engineer and as approved by the Department, and shall be of sufficient size to accommodate the entire dimensions of the structure and foundation slab. All soft and yielding, or other unsuitable material, when encountered at foundation elevation, shall be removed to depth as required and replaced with acceptable gravel backfill. The backfill shall be placed in uniform layers not exceeding 0.15m in depth and thoroughly compacted. The base shall be finished to provide a smooth and firm surface.

400.2.9.5.2 Forms

Forms for poured-in-place structures shall be of wood or metal, straight and free from distortion and of sufficient strength to resist springing during the process of depositing and tamping the concrete. All forms shall be thoroughly cleaned and oiled before the concrete is placed therein.

400.2.9.5.3 Reinforcing Steel

Reinforcing steel shall be accurately placed, and during placing of concrete firmly held in the position shown on the Detailed Designs by means of stays, blocks, ties, hangers or other approved devices.

400.2.9.5.4 Mixing and Placing Concrete

Concrete for poured-in-place manholes, inlets, catch basins and foundation slabs shall be proportioned and mixed in accordance with requirements specified in Section 400.2.32 (Supply of Portland Cement Concrete).

Concrete shall be placed in such manner as to avoid segregation, spread in horizontal layers when practicable and consolidated sufficiently to eliminate all voids.

Exposed surfaces shall be thoroughly floated with a moist wooden float to produce a uniform even surface, and edges rounded with an approved finishing tool having a radius of 5mm.

400.2.9.5.5 Precast Reinforced Concrete Units

Precast reinforced concrete units shall be constructed on poured-in-place foundations, in accordance with the details shown on the Detailed Designs. All structures shall have the lower section from the foundation to the top of the inlet and outlet pipes built up with poured-in-place concrete. Precast units shall be used for the structure above the top of the pipe inlets or outlets. All joints of the precast unit shall be sealed with mortar.

Inlet or outlet pipe entering precast units of the structure shall be accommodated in precast holes, having a diameter 75mm larger than the outside diameter of the pipe. No holes for inlet or outlet pipes shall be made in precast units at the site of the work, unless otherwise directed by the Design Engineer and as accepted by the Department.

Pipes placed in foundation slabs or precast units shall extend through the walls and beyond the outside surface a sufficient distance to allow for connections. Joints around pipes entering precast units shall be carefully sealed with mortar to prevent leakage.

400.2.9.5.6 Concrete Block Units

Concrete block units shall be constructed on poured-in-place foundations in accordance with the details shown on the plans. All joints of the concrete block units shall be sealed with mortar.

Pipes placed in foundation slabs or concrete block units shall extend through the walls and beyond the outside surface a sufficient distance to allow for connections. Joints around pipes entering precast units shall be carefully sealed with mortar to prevent leakage.

400.2.9.5.7 Ladder Rungs

Galvanized metal ladder rungs shall be installed in all poured-in-place structures having a depth greater than 1 m. When ladder rungs are required in structures constructed of precast units, the units shall be supplied with ladder rungs installed.

400.2.9.5.8 Frames, Castings and Fittings

Metal frames and fittings shall be set in the concrete true to line and elevation, as established and as required to fit the adjacent surfaces.

Castings shall be set in full mortar beds, or otherwise secured, as shown on the Detailed Designs.

400.2.9.5.9 Cleaning

Upon completion, each manhole, inlet, and catch basin shall be thoroughly cleaned of any accumulations of silt, debris, or other foreign matter, and shall be maintained free of such accumulations until final acceptance of the work.

400.2.9.5.10 Backfill

After the concrete or mortar has set sufficiently, approved granular backfill material shall be placed and thoroughly compacted in layers not exceeding 0.15m in depth. The backfill shall be neatly graded off flush with the top of the structure, or to depth as directed by the Design Engineer and as accepted by the Department, and the complete work left in a neat and tidy condition.

400.2.9.5.11 Adjusting Existing Manholes, Catch Basins and Water Valves

Where specified, the height of existing manhole, catch basin and water valve frames and covers shall be adjusted to match the elevation of a new surface by means of bricks and mortar or precast risers and mortar or cast iron extension rings as directed by the Design Engineer and as accepted by the Department. The maximum amount of adjustment allowed using bricks, risers or extension rings is 300mm. Adjustments in excess of 300mm will require alterations of the manhole, catch basin or water valve barrel in conjunction with adjustment of the frame and cover as described above.

400.2.9.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.9.7 Measurement

400.2.9.7.1 Manholes, Inlets and Catch Basins

Manholes, inlets and catch basins, of dimensions and standard depths as shown on the Detailed Designs, will be measured by the unit complete in place. Structures which exceed the standard depth shown on the Detailed Designs will be measured by the unit of standard depth complete in place, plus the vertical length in excess of the standard depth as measured by the metre.

The depth of the structures will be measured from the top of the foundation slab to the top of the manhole cover, or to the flow line of the inlet grating of catch basin or inlets.

400.2.9.7.2 Placing Reinforcing Steel

Measurement of reinforcing steel incorporated into the work will be based on either a lump sum or will be measured by the kilogram. When measurement is by the kilogram the total weight will be determined using the theoretical weight of bars as shown in the following table:

BAR NUMBER	10	15	20	25	30	35	45	55
WEIGHT kg/m	0.785	1.570	2.355	3.925	5.495	7.850	11.775	19.625

400.2.9.8 Payment Adjustment

Intentionally Deleted

400.2.10 <u>FENCING</u>

400.2.10.1 General

400.2.10.1.1 Description

Fencing shall consist of supplying and erecting wire fence, chain-link fence, gates and related appurtenances of the class or classes specified, in accordance with the Technical Requirements and in conformance with the dimensions, details and requirements shown on the Design Drawings or as directed by the Design Engineer and as accepted by the Department.

Where specified, existing fences shall be taken down and removed or re-erected to standards approved by the Design Engineer and as accepted by the Department.

400.2.10.1.2 Classification of Fence

Fencing will be classified according to type as follows:

Class A: 3 barbed wires with wooden posts at 5m maximum spacing (Dwg. CB6-2.12M1)

Class B: 4 barbed wires with wooden posts at 3.75m maximum spacing (Dwg. CB6-2.12M2)

Class C: 2 barbed wires and 813mm paige wire with wooden posts (Dwg. CB6-2.12M3)

Class D: 2 barbed wires and 914mm paige wire with wooden posts (Dwg. CB6-2.12M4)

Class E: 2 barbed wires and 1067mm paige wire with wooden posts (Dwg. CB6-2.12M5)

Class F: 2134mm paige wire with wooden posts (Dwg. CB6-2.12M7)

Class G: 4 barbed wires with wooden posts at 5 m maximum spacing (Dwg. CB6-2.12M8)

Class H: Chain link Fence

Details of each classification are shown on the Department's drawings. The use of alternative Class B fencing as shown on Drawings CB6-2.12M2A and CB6-2.12M11 will be allowed only when specified or directed by the Design Engineer and as accepted by the Department.

400.2.10.2 Materials And Procedures

The Contractor shall supply all materials for new fencing, including posts, wire, staples, and gates in accordance with Section 400.2.35 (Supply of Fence Material).

400.2.10.2.1 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.10.3 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.10.4 Construction

400.2.10.4.1 General

Fencing shall be constructed in accordance with the Detailed Designs, at the locations as designated on the Detailed Designs and Drawing CB6-2.12.M6 or as directed by the Design Engineer and as accepted by the Department.

All trees, brush, or other obstacles which interfere with the construction of the fence shall be removed prior to commencing fence construction.

Openings for gates shall be provided at locations designated by the Design Engineer and as accepted by the Department.

The whole work of fencing shall be carried out in a substantial and workmanlike manner.

400.2.10.4.2 Wood Posts

The posts shall be set in holes to the required depth, and tamped in a plumb and firm position to the line and spacing shown on the Detailed Designs or as directed by the Design Engineer and as accepted by the Department. Post holes shall be large enough to allow for proper tamping. Posts shall be set with the large end down. Backfill shall be placed in layers not exceeding 0.15m, and compacted by hand tampers, machine tampers, or other suitable equipment. Completed backfill shall be crowned slightly to permit drainage away from the posts.

Driving of posts, including methods employing drilled pilot holes, will only be permitted if the results of these methods produces a satisfactory, uniform, undamaged plumb product, with the post firmly implanted into the soil to the depth as indicated on the Detailed Designs. If, in the opinion of the Design Engineer and as accepted by the Department, the results obtained from the driving of posts, as described, are not satisfactory, then this method shall be discontinued.

Sharpening of posts will not be permitted.

Intermediate brace posts shall be erected in conformance with the maximum spacing requirements as shown on the Detailed Designs, or at such additional locations as directed by the Design Engineer and as accepted by the Department.

400.2.10.4.3 Metal Stays and Reflective Tubing

Where applicable, metal stays shall be installed to the line and spacing as shown on the Detailed Designs or as directed by the Design Engineer and as accepted by the Department. Fence wire shall be placed into the pre-punched slots of the metal stay and locked in place with a keeper wire inserted into the back of the metal stay. Reflective tubing shall be installed between the top wire and the second wire at each metal stay as indicated on the Detailed Designs.

400.2.10.4.4 Wire

All fence wire shall be pulled tight with hand stretchers, or tensioning apparatus capable of adjustment. The use of tractors or trucks for tightening the fence wire will not be permitted, unless the pull is controlled by adjustable tensioning apparatus.

400.2.10.4.5 Gates

Gates shall be constructed and located as shown on the Detailed Designs or as directed by the

Design Engineer and as accepted by the Department. All gates shall be constructed and/or installed in a workmanlike manner.

400.2.10.4.6 Taking Down and Re-Erecting of Existing Fence

Where specified, existing fences shall be taken down, the materials carefully salvaged, and the fence re-erected in accordance with the class specified, to the satisfaction of the Design Engineer and as accepted by the Department. Fencing materials damaged through the carelessness of the Contractor shall be replaced.

400.2.10.4.7 Remove and Salvage of Existing Fences

Where removal and salvage of existing fences is specified, the Contractor shall carefully take down the fence, roll the wire, and pile and place the material at locations as directed by the Design Engineer and as accepted by the Department. Materials that are not suitable for salvage shall be disposed of at locations as directed or acceptable to the Design Engineer and as accepted by the Department.

400.2.10.4.8 Remove and Dispose of Existing Fences

Where removal and disposal of existing fences is specified, the Contractor shall completely remove the fence and dispose of all materials at locations acceptable to the Design Engineer and as accepted by the Department.

400.2.10.4.9 Chain Link Fence Construction

For chain link fencing the Contractor shall perform minor levelling or landscaping of the ground where necessary. The fence shall be installed with a consistent elevation or slope and shall follow ground contours smoothly without any sharp changes in grade.

<u>Post Location</u>

Line posts shall be set not more than 3 meters apart, measured parallel to the ground surface.

Corner posts shall be installed where the alignment change exceeds 20 degrees.

Where end or corner posts are more than 150 meters apart over reasonably smooth grade, the Contractor shall set straining posts at equal intervals not exceeding 150 meters on a straight continuous stretch of fence. The Contractor shall set additional straining posts at sharp changes in grade and where directed by the Design Engineer and as accepted by the Department.

<u>Post Setting</u>

Post holes shall be dug or drilled to the following minimum diameters and depths that will allow at least 150mm of footing below the bottom of the post:

Fabric Height (m)	1.5	1.8	2.1	2.4

Line post hole diameter (mm)	200	250	250	250
Line post depth (m)	0.9	0.9	0.9	0.9
Terminal Post hole diameter (mm)	300	360	360	360
Terminal Post depth (m)	1.2	1.2	1.2	1.2

The concrete footings shall be constructed by placing concrete in the post holes embedding the posts to a minimum depth below ground of 0.75 meters for line posts and 1.05 meters for terminal posts. The concrete shall be extended 50mm above ground level and crowned to drain away from the post. The posts shall be braced in plumb position and true to alignment and elevation until the concrete has set. The concrete footings shall cure for a minimum of 5 days before proceeding with further work.

Top Rail

Top rails shall be supported at each line post with a line post cap so that a continuous brace is formed between terminal posts. The rails shall be joined with sleeves to allow for expansion and contraction. Connections to terminal posts shall be made securely using rail ends and brace bands.

Terminal Post Bracing

Braces shall be installed from end and gate posts to the nearest line post at midpanel and parallel to the top rail. Braces shall be installed on both sides of corner and straining posts in a similar manner.

Bottom Tension Wire

A tension wire shall be installed within the bottom 150mm of fabric. The wire shall be stretched taut and free of sag and fastened securely to the end, corner, gate and straining posts with tension bands and turnbuckles.

Chain Link Fabric

The fabric shall be placed outside of the enclosed area or as directed by the Design Engineer and as accepted by the Department. The bottom of the fabric shall be 50mm above the finished ground. The fabric shall be stretched to tension as recommended by the manufacturer and fastened to the end, corner, gate and straining posts with tension bands at 300mm spacing. The fabric shall also be secured to line posts, top rails and the bottom tension wire with tie wire at 450mm intervals. The tie wire shall have a minimum of 2 twists. The fabric shall have a smooth uniform appearance, free of sag, dent and bulge.

Damaged Surfaces

Damaged surfaces shall be cleaned with a wire brush to remove loose and cracked spelter coatings. Two coats of approved zinc pigmented paint shall be applied.

400.2.10.5 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the

completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Design Engineer and as accepted by the Department prior to accepting.

400.2.10.6 Measurement

400.2.10.6.1 General

The construction of fences of all classifications and the taking down and re-erecting of existing fences will be measured by the kilometre, or fraction thereof, complete in place, including the length across constructed, installed or re-erected gates.

Where fences are removed only, the existing fence will be measured by the kilometre, or fraction thereof.

Length measurement will be calculated on the basis of through highway centreline chainage for fencing parallel to the highway, and on the basis of measured length in all other cases.

400.2.10.7 Payment Adjustment

Intentionally Deleted

400.2.11 REMOVAL OF MISCELLANEOUS STRUCTURES

400.2.11.1 General

400.2.11.1.1 Description

This work shall consist of removing concrete curbs, concrete curbs and gutters, concrete surfaces such as sidewalks, pavement and medians, manholes, inlets, catch basins, concrete or masonry walls and other structures; salvaging and disposing of the resulting material as directed, and backfilling the resulting trenches, holes and pits in accordance with the Technical Requirements.

400.2.11.2 Materials And Procedures

400.2.11.2.1 Salvage

All materials having salvage value shall be carefully removed to avoid damage, and shall be stored outside the limits of construction at locations and in a manner satisfactory to the Design Engineer and as accepted by the Department.

Approved salvage material shall be used in the new work when directed by the Design Engineer and as accepted by the Department.

400.2.11.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.11.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.11.5 Construction

400.2.11.5.1 Breaking Down and Removing Structures

The structures designated for removal, complete with all attached parts and connections, shall be removed in their entirety to the limits as shown on the Detailed Designs or as directed by the Design Engineer and as accepted by the Department.

In removing concrete curbs, concrete curbs and gutters, and concrete surfaces where portions of the existing structures are to be left in the surface of the finished work, the old structures shall be removed to an existing joint or cut to a true vertical face on a line established by the Design Engineer and as accepted by the Department.

During the removal of manholes, inlets and catch basins, any live sewers connected with them shall be properly reconnected, and a satisfactory bypass shall be maintained during the construction operations.

Concrete or masonry walls, piers, foundations and similar masonry structures shall be removed entirely, or broken down to an elevation of at least 0.60m below the finished subgrade surface when the structure falls within the area of the roadbed, and to an elevation of at least 0.30m below the finished ground surface when the structure exists elsewhere.

When a portion of the existing structure is to be retained, care shall be taken not to damage the retained portion during the removal operations.

All operations necessary for the removal of any structures which might endanger the new construction shall be completed prior to the construction of the new work.

400.2.11.5.2 Disposing of Materials

As far as practicable, all concrete, stone and brick having no salvage value shall be broken into pieces, such that the largest face is not greater than $0.1m^2$ in area, and placed in embankments in parallel layers. All voids shall be completely filled with suitable common embankment material and thoroughly compacted. No rubble material shall be placed within the top 0.30m of the subgrade surface.

Material that cannot be used in embankment construction shall be buried in pits outside the limits of the roadway, in a manner satisfactory to the Design Engineer and as accepted by the Department.

All poles, posts, timbers, stumps and similar debris shall be disposed of by burning.

400.2.11.5.3 Backfilling

All trenches, holes and pits resulting from the removal of miscellaneous structures shall be filled with approved material, placed in layers not exceeding 0.15m in depth. Each layer shall be thoroughly compacted, by mechanical tamping or rolling, to one hundred percent proctor density on areas falling within the limits of the subgrade, and to a density of not less than the density of the undisturbed adjacent soil on areas outside the limits of the subgrade.

400.2.11.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.11.7 Measurement

400.2.11.7.1 General

Measurement for the removal of structures will be made per unit removed from its original position.

400.2.11.7.2 Curb Removal

Removing concrete curb, and concrete curb and gutter, will be measured by length in metres along the base of the curb face, or along the flow line of the gutter.

400.2.11.7.3 Removing Concrete Surfaces

Removing concrete surfaces will be measured by area in square metres. Where removal of an integral curb and gutter is required in conjunction with the removal of concrete surfaces, these structures will be classed as removing concrete surface and will be measured by area in square metres.

400.2.11.7.4 Removing Miscellaneous Structures

Removing manholes, inlets, catch basins, and similar structures will be measured as units, including all attached parts and connections.

400.2.11.7.5 Removing Concrete or Masonry Walls

Removing concrete or masonry walls and similar structures will be measured by volume in cubic metres.

400.2.11.8 Payment Adjustment

Intentionally Deleted

400.2.12 CONCRETE AND/OR CORRUGATED STEEL STORM SEWER

400.2.12.1 General

The work shall consist of trenching, preparation of base, laying of sewer pipe, backfilling, and constructing related items such as manholes, storm drain inlets, catch basins, special fittings, and special inlet and outlet structures.

400.2.12.2 Materials And Procedures

400.2.12.2.1 Storm Sewer Pipe

The Contractor shall supply pipe material in accordance with Section 400.2.41 (Supply of Corrugated Metal Pipe and Pipe Arches) or Section 400.2.36 (Supply of Reinforced Concrete Culvert), as applicable.

Storm sewer material supplied shall include couplings, bands, bolts, hoops, gaskets, tie bars, and any other applicable hardware.

Corrugated steel pipe material may, where specified, be of the asbestos bonded and/or bituminous coated type.

400.2.12.2.2 Cement Mortar

If concrete pipe is specified, the supply of cement mortar shall be the responsibility of the Contractor. This cement mortar mixture shall be composed of one part Portland Cement and two parts sand by volume. The quantity of water in the mixture shall be sufficient to produce a stiff, workable mortar. The sand shall conform to the requirements of AASHTO. Specification M45-42 and latest revisions thereof, or shall be an equivalent subject to approval by the Department. The cement shall conform to the requirements of AASHTO. Specification M85-63, or latest revisions thereof.

400.2.12.2.3 Granular Materials

The Contractor shall produce aggregate in accordance with Section 400.2.20 (Aggregate Production and Stockpiling) for the designation and class of materials specified or as shown below. The Contractor shall supply aggregate in accordance with Section 400.2.31 (Supply of Aggregate) and haul of aggregate shall be in accordance with Section 400.2.30 (Hauling).

The Contractor shall produce uniformly graded material, containing sufficient fines to act as a binder, which shall be composed of sound, hard, durable particles free from injurious quantities of flaky particles, soft shale, organic matter, frozen lumps and other foreign material. If, due to foundation conditions, pit-run gravel is required for the bedding material, the Contractor shall supply gravel capable of passing a 50mm screen, and shall be so graded as to provide a stable foundation.

400.2.12.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.12.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.12.5 Construction

400.2.12.5.1 Excavation and Preparation of Base

In general, the storm sewer shall be placed in a trench, the dimensions of which shall be in accordance with the Detailed Designs. The trench shall be excavated to a depth of not less than 100mm below the base of the storm sewer.

All soft, yielding, or otherwise unsuitable material encountered at the bottom of the trench shall be removed to a depth as indicated by the Design Engineer and as accepted by the Department, and replaced with gravel or other acceptable material to afford a firm foundation of uniform density throughout the entire length of the storm sewer. The exposed surface of the excavation shall then be thoroughly compacted, and the excavation backfilled with pit-run gravel material to within the 100mm grade elevation established for the storm sewer installation.

Where ledge rock, boulders, rocky or gravelly soil, hardpan, or other unyielding material is encountered, the material shall be removed to provide for a minimum bedding thickness of 100mm. The excavation shall then be backfilled with sand to the elevation established for the storm sewer installation.

The bedding shall be carefully and accurately shaped by means of a template to fit the lower 15 percent of the overall storm sewer height, so as to provide a uniform and firm contact for the bottom of the storm sewer. If concrete pipe is specified, particular care must be taken during shaping of the bedding to ensure that it is shaped to conform to the bell joint for uniform support. There shall be no rocks or other protuberances projecting into the template-formed bed section.

Unless otherwise directed by the Design Engineer and as accepted by the Department, excavated trench material may be stockpiled alongside the trench, provided the working space is adequate for this purpose, and provided the material does not spill onto private property. All excavated material, other than that required and suitable for backfill, shall be removed to a suitable disposal area as shown on the Detailed Designs, or as directed by the Design Engineer and as accepted by the Department.

Excavated material piled along the trench shall not be allowed to unduly restrict cross traffic at road intersections. Material shall be cleared from road intersections and provisions made for use of the cross road by traffic, as soon as possible after excavation has taken place. Pedestrian traffic to individual properties shall be maintained at all times, and where required, temporary timber bridges shall be provided where it is necessary to cross open trenches.

Roadways, driveways, and drainage facilities shall not be blocked unnecessarily. Hindrance to local traffic must be kept to a minimum. In order that excavated material may be piled along the trench, roads may be temporarily closed to traffic if so approved by the Design Engineer and as accepted by the Department, provided adequate detours are available.

Where excavated material cannot be piled along the trench in compliance with the above provisions, it shall be trucked to locations where backfilling is taking place, or to a temporary stockpile for return to the trench at the time of backfilling, as directed by the Design Engineer and as accepted by the Department. Temporary stockpile sites or disposal areas will be located as shown on the Detailed Designs, or as directed by the Design Engineer and as accepted by the Department.

During construction operations, all necessary precautions are to be taken to protect the workers, the public, and both public and private installations and property. All Workers' Compensation Board regulations regarding trench shoring and safety are to be adhered to. The amount of open trench at any one time is to be limited to 100m, or as otherwise directed by the Design Engineer and as accepted by the Department.

400.2.12.5.2 Assembly

General

Placing and assembling the pipe may proceed only after the excavation, foundation and bedding for the pipe have been approved by the Design Engineer and as accepted by the Department. Where ground or surface water is encountered, the trench is to be de-watered before pipe laying commences.

A system of batter boards, or other such method, shall be used to control the grade of the installation to the elevations as staked by the Design Engineer.

When the work is left for any time, the open end of the sewer must be securely closed. When the sewer is completed, it shall be thoroughly cleaned of all earth, stones and any other debris.

Concrete Storm Sewer

Storm sewer pipe materials shall be handled and lifted by means of the lifting holes or slings. Assembly of the pipe shall start with the placing of the downstream end section, laid with its bell or grooved end facing upstream. Each successive section shall be placed to the true alignment, and shall bear firmly on the shaped bedding throughout its full length. After preparation of each joint, as described following, successive sections shall be drawn tightly together using a cable and winch method, or such other method as may be approved by the Design Engineer and as accepted by the Department, to provide a positive, uniform and tight fitting joint. The mechanical tightening device shall be anchored a sufficient distance beyond the joint being tightened to avoid disturbance of previously tightened joints. Assembly tightening and joint construction shall be completed to the satisfaction of the Design Engineer and as accepted by the Department before backfilling may commence.

Field cast wye connections shall be free of any cracks, and shall be fabricated to provide a field strength equivalent to the adjoining pipes.

Unless otherwise specified on the Detailed Designs, a minimum of three end sections shall be anchored to adjacent sections by means of approved anchoring devices. All lift holes shall be filled with an approved mortar, finished off flush with the surface of the pipe.

Mortar Joints

Unless otherwise specified, all joints shall be filled with mortar. The mortar used shall conform to the mixture as outlined in Section 400.2.12.2.2 (Cement Mortar) of these specifications.

The pipe ends shall be thoroughly cleaned and wetted with water immediately before the joint is made. Stiff mortar shall then be applied to the lower half of the groove section of the pipe already laid and, simultaneously, to the upper half of the tongue of the sections being placed, and the joint shall then be drawn up tightly. Sufficient mortar shall be used to fill the joint completely and form a bead on the outside of the pipe. The inside of the pipe shall have the joint pointed all the way around. The outside of the pipe shall have the joint mudded all the way around.

The mortar shall be protected from the elements with a proper covering until satisfactorily cured. No water shall be allowed to drain through the newly laid pipe until the joints have satisfactorily cured. No backfilling around the joint shall be undertaken until the joints have been approved by the Design Engineer and as accepted by the Department.

Rubber Gasket Joints

Where specified, rubber gaskets shall be fitted between the bevelled surfaces of the tongue and groove ends of the connecting concrete pipe sections, to form a flexible, watertight seal.

Gaskets and jointing materials shall be placed in accordance with the recommendation of the particular manufacturer in regard to the use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements and adhesives shall be dry and thoroughly cleaned of all foreign matter. The rubber gasket shall be placed on the tongue end of the pipe section being laid, and the gasket checked for proper positioning.

Gaskets and jointing shall be inspected before installation of the pipe, and loose or improperly affixed gaskets and jointing materials shall be removed and replaced to the satisfaction of the Design Engineer and as accepted by the Department. Both joint surfaces shall be thoroughly coated with the lubricant supplied, and the tongue of the pipe section being laid shall be lined up true with the groove of the preceding section, and the two sections united together to the tightest position by means of cable and winch, or other approved methods. If, while making the joint, the gasket becomes loose and can be seen through the exterior joint recess when the joint is pulled up to within 25mm of closure, the pipe shall be removed and the joint remade to the satisfaction of the Design Engineer and as accepted by the Department.

<u>Corrugated Steel Storm Sewer</u>

Corrugated steel pipe shall be laid on the prepared base, with the separate sections securely joined together by means of the coupling bands provided. Corrugated steel pipe of the round or elongated type, and pipe arch culvert constructed from individual steel plates, shall have the outside laps of circumferential joints in each pipe section on the upstream end, and the longitudinal lap seams at the sides of the pipe.

The pipe shall be laid true to the lines and grades as established by the Detailed Designs. When designated, elbows shall be installed at locations as established by the sharp changes in gradient or direction of the pipe.

All pipe shall be carefully handled to prevent damage to the protective coating. Unavoidable damage to coatings shall be repaired by the Contractor by painting with two coats of zinc oxide or asphaltic type cement paint prior to backfilling.

400.2.12.5.3 Backfill

<u>General</u>

After assembly of the pipe has been approved, the backfill shall commence, utilizing sand material to be compacted by means of pneumatic or other mechanical tamping equipment. As the backfill between the sides of the pipe and the sides of the trench must carry a part of the total vertical load on the horizontal plane at the top of the pipe, it is essential that it be good material, carefully placed and compacted.

<u>Sand Backfill</u>

Backfill under the haunches and up to the quarter points shall be carefully compacted and rammed into place in thin layers, to fill all voids and ensure firm contact with the entire bottom surface. Backfill alongside and above the pipe for a minimum of 0.30m, unless otherwise shown on drawings contained in this contract, shall also be sand material. Backfilling shall be laid down and compacted in layers not exceeding 0.15m, and shall proceed simultaneously to the same level on each side of the pipe. Sand backfill shall be compacted to 100 percent of Standard Proctor density at the optimum moisture content. Puddling of the backfill will not be permitted.

In all backfilling operations, care shall be exercised, and it shall be the Contractor's responsibility to ensure that the pipe is not damaged by vertical or lateral forces imposed during installation and by compaction of the backfill. Circular pipe with elliptical reinforcement, and elliptical pipe with circular reinforcement are particularly vulnerable to damage by careless compaction of backfill, and it may be necessary to install horizontal or vertical strutting until the fill over the pipe has been completed. Strutting, so required, shall be undertaken in an approved manner.

Sand backfill will be considered as Class B Bedding, as shown in the Detailed Designs .

Earth Backfill

Unless otherwise directed by the Design Engineer and as accepted by the Department, native earth backfill as excavated from the trench shall be used where shown on the Detailed Designs, provided it is an approved, frost-free, fine grained soil. Such soil backfill shall be compacted to a density as specified in the Detailed Designs.

Extra Sand Backfill

Where, in the opinion of the Design Engineer and as accepted by the Department, the excavated trench material is unsuitable to be used as backfill, the area shown in the Detailed Designs as earth backfill shall be constructed with sand. The extra sand backfill material shall be placed and compacted to the density specified in the Detailed Designs.

Granular Backfill Bedding

In areas where the Design Engineer and as accepted by the Department directs excavation to be done below the normal 100mm beneath the pipe grade as shown in the Detailed Designs, granular backfill of the designation and class specified shall be used as bedding material for that portion of the pipe bed below the 100mm grade line. The granular backfill shall be placed and compacted to 100 percent of Standard Proctor Density.

400.2.12.6 Product Acceptance

In addition to compliance with the details of construction, the completed structure shall show careful finished workmanship in all particulars.

If, in the opinion of the Department, any of the following defects are present in the structure, they shall be considered sufficient cause for rejection:

(a) variation from the designed centerline or grade;

(b) concrete pipe tongue or grooved edge which has been chipped such that 10 percent of the bevelled surface area is destroyed, or chipped at any point to such a degree that in the opinion of the Department a proper joint will not be achieved;

(c) concrete pipe joined by the construction of improperly formed or cracked joints;

(d) concrete pipe which shows as a result of negligent handling the exposure of reinforcing steel, or any permanent cracks in the concrete of 0.25mm or greater width, or deformation induced through improper bedding, backfilling or construction procedures; or

(e) steel pipe connected with improperly installed couplers and/or gaskets.

Structures exhibiting defects will be rejected, and the Contractor shall be held responsible for replacing and reinstalling the unacceptable section(s). Any material damaged or destroyed by the Contractor shall be replaced by the Contractor.

In addition to any other terms and conditions as set forth in this Project, a sewer thoroughly cleaned of any accumulations of silt, debris, or other foreign matter, any loose material or waste resulting from the activities of the Contractor shall be disposed of, and the working areas restored to the satisfaction of the Department.

400.2.12.7 Measurement

400.2.12.7.1 Supply and Install Storm Sewer

Measurement for the supply and installation of storm sewers will be in metres along the invert centreline length of the sewer. The measurement will be continuous through manholes.

The measurement of laterals and leads shall be taken along the invert centreline of the branch line to the invert centreline of the main sewer. The measurement will be continuous through manholes or storm drains. In cases where the branch line originates at a manhole or storm drain, the measurement will be taken from the mid point of the facility.

400.2.12.8 Payment Adjustment

Intentionally Deleted

400.2.13 GUARDRAIL, ENERGY ATTENUATORS AND GUIDE POSTS

400.2.13.1 General

400.2.13.1.1 Guardrail and Guide Posts

The work consists of the erection, removal, salvage and reinstallation or disposal of guardrail and guide posts.

400.2.13.1.2 Modified Thrie Beam

The work shall be performed in accordance with Section 400.3.15 of the Technical Requirements and the Detailed Designs.

The Contractor shall supply and install modified thrie-beam guardrail at the locations shown on the Detailed Designs.

400.2.13.1.3 Energy Attenuators

The Contractor shall supply and install energy attenuator systems for all upstream modified thrie-beam guardrail terminals and other hazards at locations required by the Detailed Designs.

400.2.13.2 Materials And Procedures

400.2.13.2.1 Guardrail and Guide Posts

The Contractor shall supply all new materials required for the construction of guardrail, barrier and guide posts in accordance with:

Section 400.2.43 (Supply of W-Beam Guardrail and Posts);
Section 400.2.55 (Supply of Cable Barrier and Metal Posts); and
Section 400.2.44 (Supply of Flexible Guide Post Traffic Delineators).

When the Detailed Designs specifies the removal, salvage and reinstallation of guardrail, only materials from the existing installations shall be used. Contractor stockpiles of used material from other sources will not be considered acceptable.

The Contractor has the option of supplying plastic guardrail posts in place of wooden posts except at the following locations:

- The transition area between a roadway guardrail system and a bridgerail system.
- As part of a proprietary end treatment such as a Breakaway Cable Terminal (BCT) or Cable Attenuator Terminal (CAT) which normally use wood posts.
- In any cable barrier system.
- At any other installation specifically prohibited by the Technical Requirements.

400.2.13.2.2 Energy Attenuators

All energy attenuator systems shall be re-directive for side vehicle impact angles of 20 degrees or less at 100 km/h.

The Design Engineer shall produce a certificate that the system meets or exceeds the requirements of the NCHRP tests as specified. The Contractor shall ensure that the system performs as intended when attached to modified thrie-beam guardrail or concrete hazard.

400.2.13.2.3 Unidirectional Energy Attenuator System

The unidirectional energy attenuator systems shall pass all required tests for a Test Level 3 (TL-3) for terminals and re-directive crash cushions of the National Cooperative Highway Research Program (NCHRP) Report 350 and will be subject to the approval of the Design Engineer and as accepted by the Department.

Energy attenuator systems which meet or exceed these requirements for this project are listed below:

Trinity Industries, Inc. - ET-PLUS or ET-2000
Roadway Systems Inc. - FLEAT 350

The impact head of the energy attenuator system shall be properly positioned outside of the edge of ACP as required by the manufacturer of the system selected.

Other systems that meet or exceed the specified requirements may be considered subject to acceptance by the Design Engineer and as accepted by the Department.

400.2.13.2.4 Bi-directional Energy Attenuator System

Bi-directional energy attenuator systems shall pass all required tests for a Test Level 2 (TL-2) for terminals and re-directive crash cushions of the National Cooperative Highway Research Program (NCHRP) Report 350 and will be subject to acceptance by the Design Engineer and as accepted by the Department.

Energy attenuator systems which meet the requirements for this installation are listed below:

Energy Absorption Systems Inc. - "Quadguard" (762mm Wide) - 4.42m long system.
Trinity Industries, Inc. - "Shortracc" (610mm Wide) - 4.34m long system

Other systems that meet or exceed the specified requirements may be considered subject to acceptance by the Design Engineer and as accepted by the Department.

The energy attenuator installation shall be installed as per the manufacturer's instructions for the intended application as a bi-directional device and shall be affixed to the concrete portion of the barrier forming part of the piers.

400.2.13.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.13.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.13.5 Construction

400.2.13.5.1 General

Guardrail and guide posts shall be accurately set to the required depth and alignment, in a manner resulting in a smooth continuous installation, as shown on the Detailed Designs. Permissible tolerance for plumb and grade of posts shall be 6mm maximum.

Holes shall be excavated by auger. The diameter of the holes augered for guardrail shall be of sufficient size to allow for pneumatic tamping. Prior to digging any holes, the Contractor shall contact all applicable utility companies to arrange for utility location and marking.

Unsuitable material at the bottom of the holes excavated for guardrail shall be replaced with granular material by the Contractor, as directed by the Design Engineer and as accepted by the Department. The Contractor shall thoroughly compact the bottom of the hole. The guardrail posts shall rest directly and solidly on the bottom of the hole at the time of installation.

Excavated material which is unsuitable for use as backfill shall be substituted with granular material by the Contractor. Backfill shall be thoroughly compacted, using pneumatic tampers, in layers not exceeding 150mm, for the full depth of the excavation.

Guardrail laps shall be in the direction of traffic flow. Bolts shall be tightened to a minimum torque of 100 N.m.

A 40mm x 300mm reflective sheeting strip shall be fastened to the top of every third guardrail post by mechanical means such as nailing or stapling. Fastening by adhesives alone will not be accepted.

The reflective sheeting strip shall be High-Intensity encapsulated glass bead reflective sheeting, with a conformable aluminum foil backing meeting or exceeding the minimum requirements as specified in ASTM-D4956, Type III or Type IV and Class I pressure sensitive adhesive backing requirements.

The Contractor shall take all necessary precautions to eliminate damage to galvanizing. Minor abrasions shall be repaired by painting with two coats of zinc rich paint. Major abrasions shall be repaired by re-galvanizing. The method to be used for repair of any damage shall be reviewed by the Design Engineer and as accepted by the Department before such work is commenced. The Contractor shall carry out the repair or replace components to the satisfaction of the Design Engineer and as accepted by the Department.

The guardrail shall be connected to new or existing bridge walls or parapets as shown on the Detailed Designs. Surplus excavated material and debris shall be removed from the site by the Contractor.

Upon completion of the installation, the work area shall be restored to its original condition.

At the end of the warranty period, the permissible tolerance for plumb and grade of all posts shall be 13mm provided that the Contractor shall not be responsible for any variances to such tolerances caused by the actions of the Province or its employees or agents or those for whom it is legally responsible, or third parties (other than subcontractors of the Contractor), or by events beyond the reasonable control of the Contractor and not related to the choice of materials and workmanship of the Contractor.

Construction of guardrail and guide posts will include several types of installations in accordance with the Detailed Designs. Drawings referenced as TEB drawings are found in the latest edition of the Department's manual entitled "Typical Barrier Drawings". Installations will include but not be limited to:

<u>W-Beam Guardrail</u>

Standard w-beam installations shall be in accordance with drawing TEB 3.12. Installations at bridge approaches shall be in accordance with drawing TEB 3.48, and construction shall always be started at the bridge. A Strong Post System of installation as shown in drawing TEB 3.09, shall be used when directed by the Design Engineer and as accepted by the Department.

<u>Box Beam Guardrail</u>

Standard box beam installations shall be in accordance with drawings TEB 3.27, TEB 3.28, TEB 3.33, TEB 3.34, TEB 3.35, TEB 3.36, TEB 3.37, TEB 3.38, TEB 3.39, TEB 3.40, TEB 3.41, TEB 3.46, and TEB 3.47. Installations at bridge approaches shall be in accordance with drawings TEB 3.41 and TEB 3.47 and construction shall always be started at the bridge.

Median box beam installations shall be in accordance with drawings TEB 3.22, TEB 3.23, TEB 3.24, TEB 3.25, TEB 3.26, TEB 3.27A, TEB 3.28A, TEB 3.29 and TEB 3.30. Installations at bridge approaches shall be in accordance with drawing TEB 3.29 and construction shall always be started at the bridge.

Cable Barrier

Cable barrier installations shall be in accordance with drawings TEB 3.42, TEB 3.43, TEB 3.44 and TEB 3.45.

Installation on Base Course Projects

When installing guardrail on base course projects, installation of guardrail and construction of base course shall be performed in accordance with drawing TEB 3.56 as directed by the Design Engineer and as accepted by the Department.

Guide Posts

The Contractor shall remove and dispose of existing guide posts and/or install new guide posts at locations identified in the Detailed Designs.

Guide posts shall be installed straight and plumbed vertical to a uniform depth in accordance with the applicable drawings found in the latest edition of the Department's manual entitled "Alberta Highway Pavement Marking Guide". All replaced soil around the delineator shall be firmly compacted. The Contractor shall supply any additional material required to ensure that the delineator has a suitable foundation.

Modified Thrie Beam

The Contractor shall note that the entire length of need or protection length of the modified thrie-beam guardrail is installed without flare, along the future edges of pavement.

Post positioning shall be such that the face of the guardrail aligns with the edge of the future ACP overlay as indicated in the Detailed Designs. For installations along the ACP, post installation is required through the pavement. Holes for the guardrail post shall be cored or augered through the pavement and backfilled with GBC. If the augering method results in any damage or lifting to the surrounding pavement, the Contractor shall core the remaining holes as directed by the Design Engineer and as accepted by the Department.

A TL-3 approved energy attenuator system shall be installed at the upstream end of the modified thrie-beam guardrail locations designated by the Design Engineer and as accepted by the Department.

All exit end treatments at the end of the thrie-beam installed shall consist of a modified thrie-beam cable anchor terminal with a thrie-beam winged end.

400.2.13.5.2 Modified Thrie-Beam Cable Anchor Terminals

Exit end treatments shall be constructed with a modified thrie-beam cable anchor terminal exit end treatment as indicated in the Detailed Designs. The end treatment includes the following components:

- One section of thrie-beam guardrail (3.81 metres long) and one winged end terminal section.
- BCT cable strut, angle strut, bearing plates and anchor assemblies.
- 2 - 1.22 metre long breakaway timber posts mounted in steel foundation tubes complete with soil plates and hardware.

400.2.13.5.3 Thrie-Beam Bridge Approaches

Thrie-beam guardrail connections shall be constructed in accordance with Drawing S-1705-06 . The thrie-beam connection plates and end caps affixed to the bridgerail shall be installed as part of the bridgerail. Each bridge approach connection unit consists of the following components as shown in the Detailed Designs:

- Thrie-beam terminal connector
- 2 - Layers of 2.7mm thick thrie-beam guardrail (3.81 metres long)
- 7 - W 150 x 14 steel posts and W 200 x 22 spacers

The difference in elevation between the modified thrie-beam guardrail and bridge approach rail on the approach side shall be transitioned over the last 7.62 metres of modified thrie-beam, prior to connecting to the bridge approach rail as directed by the Design Engineer and as accepted by the Department.

400.2.13.5.4 Energy Attenuators

Installation of the system shall be in accordance with the manufacturer's instructions and to the satisfaction of the Design Engineer and as accepted by the Department. Two sets of shop drawings and installation procedures along with maintenance manuals for the system chosen, shall be submitted to the Department for review a minimum of three (3) weeks prior to installation.

A thrie beam to W-beam guardrail transition section, as detailed on Drawing RDG B1.8, will be required to transition between the energy attenuator system to the modified thrie beam guardrail being treated.

All work required to grade, prepare the subgrade, and any special foundation requirements such as concrete pads, as required by the manufacturer for the proper installation of the energy attenuator system shall be completed by the Contractor and will be considered incidental to the work.

400.2.13.5.5 Removal and Salvage or Disposal of Existing Guardrail

General

The Contractor shall remove the designated sections of guardrail including posts and shall fill and compact all holes left from post removal before nightfall.

Material damaged by the Contractor during removal shall be replaced with new material by the Contractor.

Remove and Salvage

When salvaged material is being reinstalled, the Contractor shall haul it when necessary, and neatly pile the salvaged material near the site of the proposed installation as directed by the Design Engineer and as accepted by the Department.

At sites where existing guardrail is to be removed and new or salvaged guardrail is to be installed at the same location, the Contractor shall complete the installation within 5 working days of the site becoming available for re-erection of the guardrail.

When existing posts are not salvageable as determined by the Design Engineer and as accepted by the Department, the Contractor shall replace the damaged posts with new posts as part of the guardrail reinstallation work. The Contractor shall assume ownership of the damaged posts and shall dispose the materials to the satisfaction of the Design Engineer and as accepted by the Department.

Until guardrail is erected, the Contractor shall erect barricades as shown on drawing TCS-B-4.2. Other safety protection shall be provided as directed by the Design Engineer and as accepted by the Department.

Remove and Dispose

All materials designed for removal and disposal, those damaged during removal and any materials not required for reinstallation as determined by the Design Engineer and as accepted by the Department, shall become the property of the Contractor and shall be disposed of in a manner and location satisfactory to the Design Engineer and as accepted by the Department.

400.2.13.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.13.7 Measurement

400.2.13.7.1 Supply and Install Guardrail or Barrier

Measurement for supplying and installing barrier or guardrail sections, including end terminals and bridge connections and posts, will be in metres of the length of each type of barrier or guardrail installed.

Measurement for the supply and installation of the modified thrie-beam guardrail will be by the linear metre of guardrail installed including winged ends (where required). Modified thrie-beam cable anchor terminals, thrie-beam to W-beam transitions, or bridge approach connections will not be included in this length.

400.2.13.7.2 Modified Thrie-Beam Cable Anchor Terminals

Measurement for the supply and installation of modified thrie-beam cable anchor terminals will be by the number of units acceptably constructed.

400.2.13.7.3 Removal, Salvage and Reinstallation of Existing Guardrail or Barrier

Measurement for removal, salvage and reinstallation of barrier or guardrail sections, including end terminals and bridge connections and posts, will be in metres of the length of each type of guardrail or barrier removed and reinstalled.

Replacement posts as determined by the Department that are necessary for the completion of guardrail re-installations will be measured on a per post basis.

400.2.13.7.4 Removal and Disposal of Existing Guardrail or Barrier

Measurement for removal and disposal of barrier or guardrail sections, including end terminals and bridge connections and posts, will be in metres of the length of each type of barrier or guardrail removed.

400.2.13.7.5 Supply and Install Guide Posts

Measurement will be made of the number of each type of guide post installed.

400.2.13.8 Payment Adjustment

Intentionally Deleted

400.2.14 SEEDING

400.2.14.1 General

This specification covers preparation of the area to be seeded, the supply and application of seed and fertilizer, and the finishing of seeded areas.

Areas to be seeded shall include any disturbed or exposed earth surfaces within the right-of-way, borrow and waste areas, and as determined by the Detailed Designs.

400.2.14.2 Materials And Procedures

400.2.14.2.1 Supply of Materials

Materials for seeding, including grass seed mix, fertilizer, mulch and water shall be supplied by the Contractor.

Seed and fertilizer materials shall be stored dry and protected from direct sunlight and other detrimental conditions. Materials that have been subjected to detrimental conditions, as determined by the Design Engineer and as accepted by the Department, will not be accepted for use on the Project.

400.2.14.2.2 Grass Seed

Grass seed shall meet the minimum requirements for Common No. 1 Seed as defined by the Grade Tables under the Canada *Seeds Act* & regulations, and shall be of the composition specified in Section 200 (Project Specifies). The seed shall be mixed by a conditioner and bulk storage facility approved by the Authority responsible for Canada *Seeds Act* & regulations. All seed shall be tested by a Registered Seed Lab, and each bag shall be clearly marked with the name of the supplier and the mixture composition.

Prior to the use on the Project, the Contractor shall provide the Design Engineer and the Department with a Certificate of Analysis for each lot of seed supplied. Test results from the Certificate of Seed Analysis shall specify the germination, or for native seeds that are not a part of the seed tables the Tetrazolium, and purity for each seed species of the mix as well as the seed mix composition expressed as a percentage of each seed species by dry mass for each seed mix specified.

400.2.14.2.3 Fertilizer

Fertilizer shall be of the composition specified in the Detailed Designs.

Fertilizer shall be stored in standard containers clearly marked with the name of the manufacturer, weight and specified composition.

400.2.14.2.4 Hydro-Mulch

Mulch material shall be cellulose fibre unless otherwise specified in the Detailed Designs. Mulch shall be clean and free of weeds and other foreign matter. Mulch shall be 100 percent biodegradable, compatible with the environment, and shall contain no germination-inhibiting components.

400.2.14.2.5 Tackifier

The binder must be capable of joining together the mulch particles to secure the mulch to the ground. The binder shall not form an impervious seal that will prevent the penetration of moisture to underlying soil.

400.2.14.2.6 Water

Water supplied by the Contractor shall be free of any impurities that might inhibit germination of the seed.

400.2.14.3 Quality Management Sampling And Testing

Sampling and testing for the purposes of Quality Management shall be performed in accordance with the Contractor's Quality Management System.

400.2.14.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed. However, the Department may undertake any form of inspection, sampling or testing as is necessary to determine specification compliance and acceptance..

400.2.14.5 Construction

400.2.14.5.1 Traffic Accommodation

The Contractor shall address the traffic accommodation issues associated with his seeding operations in the traffic accommodation strategy. No seeding operations or associated activities shall be started without a Design Engineer and as accepted by the Department-accepted traffic accommodation strategy.

When hydro-seeding operations are remote from the Contractor's main work area or when otherwise directed by the Design Engineer and as accepted by the Department, the Contractor shall provide a truck mounted arrowboard to assist in the accommodation of traffic during hydro-seeding operations.

400.2.14.5.2 Notification of Commencement of Work

The Contractor shall notify the Department a minimum of 48 hours prior to any seeding work. Seeding operations shall not commence until all areas designated for seeding have been prepared to the satisfaction of the Design Engineer and as accepted by the Department.

Seeding operations shall not commence until the Design Engineer and the Department has reviewed the Certificate of Seed Analysis and verified the specified seed mixture supplied.

400.2.14.5.3 Surface Preparation

Grading or topsoil placement shall be completed to the satisfaction of the Design Engineer and as accepted by the Department prior to any surface preparation.

All eroded areas shall be corrected prior to surface preparation, as determined by the Design Engineer and as accepted by the Department, using imported material or material adjacent to the area being filled.

Areas to be seeded shall be finished to a smooth and uniform surface, which is loosened to a depth of not less than 25mm at the time of seeding. Where necessary, the surface shall be scarified and the Contractor shall dispose of stones and other debris as determined by the Design Engineer and as accepted by the Department.

Seeding will not be permitted on hardened, crusted or rutted soil.

400.2.14.5.4 Weather Conditions

The Contractor shall not proceed with the work when, in the opinion of the Design Engineer and as accepted by the Department, weather conditions are unsuitable. The Design Engineer and as accepted by the Department will not allow work to proceed when wind conditions are such that material is being carried beyond the designated work areas or that the material is not being uniformly applied.

400.2.14.5.5 Classes of Seeding

All seeding, for whatever purpose, will be classified as specified herein:

<u>Drill-Seeding</u>

Drill seeding shall include the supply of suitable equipment to perform the work, the supply and placement of the specified seed mixtures and fertilizer (when specified) at locations specified in the Technical Requirements or as directed by the Design Engineer and as accepted by the Department. In areas that are inaccessible to conventional equipment, the Contractor may utilize broad-cast seeding methods.

Distribution of the seed and fertilizer (if required) shall be at a uniform rate and not less than the minimum specified rate of application. The Contractor's equipment shall be calibrated to distribute seed and fertilizer into the soil at not less than specified minimum rates of application. The equipment shall then cover the seed and fertilizer with a suitable covering of soil.

<u>Broad-Cast Seeding</u>

Broad-cast seeding shall include the application of the specified seed mixtures and fertilizer (when specified) at locations specified in the Technical Requirements, or as determined by the Design Engineer and as accepted by the Department using an acceptable cyclone seeder or approved hand methods. Any areas seeded using broad-cast methods shall be immediately harrowed to provide an acceptable covering of soil for the seed, and surface textured using track-walking or some other means acceptable to the Design Engineer and as accepted by the Department.

The Contractor shall provide a means of verifying the quantities of seed and fertilizer applied using cyclone or hand-methods; either by weight or by a system of volume measurement acceptable to the Design Engineer and as accepted by the Department.

Hydro-Seeding

Hydro-seeding shall include the supply of suitable equipment and the application of a spray-pumped mixture of water, seed, fertilizer (if required), hydro-mulch and tackifier at locations specified in the Technical Requirements or as directed by the Design Engineer and as accepted by the Department.

Hydro-seeding equipment shall have a storage tank with continuous agitation to maintain seed, fertilizer and hydro-mulch uniformly mixed until pumped from the tank. The pump pressure shall maintain a continuous non-fluctuating stream of solution that is calibrated to distribute seed into the soil at not less than specified minimum rates of application.

Generally, those areas which, in the opinion of the Design Engineer and as accepted by the Department, are impractical to drill-seed due to the terrain characteristics or access problems will be designated for hydro-seeding.

400.2.14.5.6 Slope Texturing

Slope texturing is the roughening of the surface by some mechanical means acceptable to the Department, or by track-walking a dozer or similar tracked vehicle perpendicular to the slope, to provide a serrated texture that will reduce erosion potential. The work shall be performed in accordance with B.M.P. 34a of the Design Guidelines for Erosion and Sediment Control, except as modified herein.

The Contractor shall slope texture the following conditions:

- All cut and fill slopes with slopes equal to or steeper than 3H:1V with a vertical height greater than 1.5 metres, and;
- All cut and fill slopes longer than 8 metres regardless of the actual slope, and;

For hydro-seeding, the slope texturing shall be performed prior to the application of seed. For broad-cast seeding, the slope texturing shall be performed after the application of seed. For drill-seeding, slope texturing is not required.

400.2.14.5.7 Application Rates

The following application rates are the minimum required:

Drill Seeding	7 - 15 kg/hectare
Broad-cast Seeding	30 kg/hectare
Fall Cover Crop	5 kg/hectare
Hydro-Seeding	75 - 100 kg/hectare
Hydro-Mulch	1150 kg/hectare

400.2.14.5.8 Fertilizer

Fertilizer applications are only permitted when using agronomic/forage mixtures. Fertilizer shall not to be used when using native seed mixtures.

Formulation and application rates of fertilizers will be as specified in the Technical Requirements.

400.2.14.5.9 Harrowing

When required, the Contractor shall harrow areas designated for harrowing immediately after seed and fertilizer is applied.

400.2.14.5.10 Protection

The Contractor shall take reasonable care to prevent the contamination of structures, signs, guardrails, fences, utilities and other installations by his operations. Where such contamination occurs, the Contractor shall remove the offending material using methods acceptable to the Design Engineer and as accepted by the Department.

The Contractor shall ensure that hydro-seeding does not dislodge soil or cause erosion.

The Contractor shall be responsible for the protection of the work and shall repair all areas damaged by any cause, until the work has been accepted by the Design Engineer and as accepted by the Department.

400.2.14.5.11 Reseeding

At locations that fail to show a uniform stand of grass for any reason during the calendar year following the year of initial seeding, the Contractor shall repair the defective locations as determined by the Design Engineer and as accepted by the Department. A uniform stand of grass will be considered growth that shows no deterioration or bare spots greater than 1 square metre in size, and provides a minimum of 80 percent ground cover as determined by the Design Engineer and as accepted by the Department.

The initial inspection of seeding will occur during the month of May of the calendar year following the year of initial seeding. The Contractor shall complete any required reseeding work prior to June 15 of that year. This date will be extended if, in the opinion of the Design Engineer and as accepted by the Department, the weather conditions prior to June 15 are not suitable for reseeding work.

The requirement to reseed will be considered to be a warranty requirement and shall meet all the requirements for the initial seeding, including seeding method, seed and fertilizer mixtures, application rates, harrowing, and slope texturing as applicable. The Contractor will not be required to reseed any area more than once during the warranty period.

The Contractor shall supply all materials necessary for reseeding work and complete all reseeding work.

400.2.14.5.12 Compliance Requirements

Intentionally deleted.

400.2.14.6 End Product Acceptance Or Rejection

Intentionally Deleted

400.2.14.6.1 Appeal Of Acceptance Test Results And Appeal Testing

Intentionally Deleted

400.2.14.7 Measurement

Seeding, for the methods specified, will be measured in hectares to the nearest 0.01 hectare based on horizontal measurements as determined by the Department. No allowance will be made for uneven or sloping ground, overlap.

Slope texturing will be measured in horizontal square metres. No allowances will be made for slope.

400.2.15 CABLE DUCTS

400.2.15.1 General

400.2.15.1.1 Description

The scope of work shall include the construction of 100mm cable ducts in accordance with these specifications, in accordance with the Detailed Designs.

400.2.15.2 Materials And Procedures

400.2.15.2.1 Ducts

Duct shall be 100mm nominal inside diameter and of rigid non-metallic P.V.C. pipe. Couplings are to suit the pipe.

400.2.15.2.2 Spacers

Spacers shall be cast concrete or interlocking plastic designed for 100mm standard duct on 200mm by 200mm centres. Wooden or metal spacers shall not be used.

400.2.15.2.3 Concrete

All materials for the manufacture of concrete shall be supplied by the Contractor and shall comply with requirements specified in Section 400.2.32 (Supply of Portland Cement Concrete).

Concrete shall have a minimum compressive strength of 20 MPa at 28 days. Aggregate shall have a maximum size of 19mm. Cement shall be Type HS (Sulphate Resistant) Portland Cement. Slump shall not exceed 80mm. An air-entrainment agent shall be added to result in an air content between 5 and 7 percent.

400.2.15.2.4 Rope

Pull rope shall be 7mm diameter nylon cord. The rope shall be continuous through each duct with 3 metres spare at each end.

400.2.15.2.5 Sealant

Duct seal shall be a non-thermoplastic compound used for electrical applications. Acceptable compounds are shown on the Alberta Transportation Products List.

400.2.15.3 Quality Management Sampling And Testing

Sampling and Testing shall meet the requirements of Section 400.2.32 (Portland Cement Concrete).

400.2.15.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.15.5 Construction

400.2.15.5.1 Trenching

The trench shall be carefully excavated to the required depth to allow the duct run to be set on undisturbed soil. Where soft spots or unsuitable material are encountered the Contractor shall, at no extra cost, undercut a minimum of 150mm, or as directed by the Design Engineer and as accepted by the Department, replace with acceptable material and compact to 95 percent Standard Proctor Maximum Dry Density.

400.2.15.5.2 Duct Installation

The duct shall not be placed until the trench has been checked for line and grade by the Design Engineer and as accepted by the Department. All ducts shall be placed a minimum of 600mm below subgrade. Duct runs shall be graded uniformly to their ends.

Duct installation shall be by the tier method using the specified spacers. The duct group shall be securely banded together using metal strapping.

Duct couplings shall be staggered by at least 150mm along the duct run. The cutting and tapering of duct joints shall be made with tools as specified by the duct manufacturer. All duct joints shall be made water tight. Where ducts are to be connected to existing conduits a suitable conduit to duct coupling shall be used. All ducts shall terminate with a duct coupling that is set flush with the end of the concrete envelope.

Split duct shall be wrapped with a waterproof, impregnated paper or plastic sheeting and securely taped to prevent entry of any concrete.

The duct assembly shall be securely anchored to the trench bottom to prevent ducts from shifting or floating when concrete is poured.

The concrete shall be carefully placed by chute down on the sides of the duct bank so that the concrete flows under the ducts and rises up around the ducts to fill all spaces. The concrete shall be carefully rodded with a flat bar.

Pull ropes shall be installed in each duct and shall be checked to ensure they are free of kinks, bends or joints. The surplus shall be coiled 3 metres at each end on the duct.

Duct locations shall be marked by the Design Engineer in the field prior to backfilling. A 50mm by 100mm marker (painted red) shall extend from the duct entrance to 450mm above grade.

A spike shall be driven flush in the edge of the pavement over the duct run.

400.2.15.5.3 Backfilling and Compaction

Backfilling shall not be undertaken until the concrete and ducts have been checked by the Design Engineer and as accepted by the Department. The backfill of trenching shall be with material similar to that removed except that organic material or stones larger than 150mm in diameter shall be removed.

The degree of compacting shall be similar to existing or to the degree required for various pavement layers under other sections of the Technical Requirements. The ends of each duct system shall be backfilled using an envelope of sand, or other suitable backfill, extending 1 metre from the duct for a width of 600mm and from the bottom of the duct system to 500mm above the top duct.

400.2.15.6 Product Acceptance

400.2.15.6.1 Acceptance

After each section of duct run is completed and the concrete thoroughly set, a test mandrel that is 65mm smaller in diameter than the nominal duct size shall be drawn through each individual duct. This test shall be done in the presence of the Design Enginerr and the Department.

The Contractor shall be responsible to clear or replace any ducts that do not pass the mandrel test.

Acceptance of the work will be given upon certification that all ducts have been tested and proven clear of any obstructions.

400.2.15.6.2 Sealing

At the completion of the acceptance the Contractor shall seal in a tight manner the ends of all ducts by using duct seal.

400.2.15.7 Measurement

400.2.15.7.1 Cable Duct

Measurement will be made per metre of encasement (including 2-100mm standard ducts).

400.2.15.8 Payment Adjustment

Intentionally Deleted

400.2.16 SMOOTH WALL STEEL PIPE CULVERT EXTENSIONS AND CULVERT LINERS

400.2.16.1 General

This specification covers the installation of smooth wall steel pipes as liners inside existing culverts, and extensions of these smooth wall steel pipes beyond the ends of the existing culverts.

The abbreviation SWSP will mean smooth wall steel pipe.

400.2.16.2 Materials And Procedures

400.2.16.2.1 Smooth Wall Steel Pipe

The Contractor shall supply smooth wall steel pipe in accordance with Section 400.2.40 (Supply and Install Smooth Wall Steel Pipes).

400.2.16.2.2 Grout

The Contractor shall supply grout suitable for low pressure pumping into the void between the steel pipe used as a liner and the surrounding existing culvert and which has a minimum compressive strength of 500 kPa at 28 days.

Cement shall be sulphate resistant.

400.2.16.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.16.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.16.5 Construction

400.2.16.5.1 Preparation For Installation

The Contractor shall prepare the designated existing culverts for installation of the culvert liners by flushing and scouring the existing culverts with water under pressure, and by inspecting and correcting any minor protrusions within the existing culvert.

400.2.16.5.2 Liner Installation

The Contractor shall excavate or clear a trench for assembly of liner pipes at the upstream end of the existing culvert. The Contractor shall then push or pull the SWSP pipe through the existing culvert with the spigot end first (working down grade) preventing any damage to the liner and connecting sections thereafter securely joined together. Joints shall be welded and the pipe shall be joined using either a wedge and block or mechanical pipe pullers to bring the pipe to the home position to form a watertight seal. Joints shall not be deflected beyond the manufacture's recommended maximum.

The Contractor shall ensure that the liner remains at the existing culvert invert elevation during the grouting operation. Liners shall be installed in accordance with drawing CB6-2.29M1, Plastic and SWSP Liner Installation and Grouting within Existing Culverts.

400.2.16.5.3 Welding

Welding of smooth wall steel pipe shall only be performed by journeyman welders. All Welders' qualifications shall be current and shall be available for examination by the Design Engineer and the Department.

Smooth wall steel pipe sections shall be joined together with a full strength and continuous butt weld which forms a watertight seal in accordance with CSA standard W59, Welded Steel Construction. Welding procedures shall be prepared and stamped by a Professional Engineer and shall be submitted to the Design Engineer for approval and to the Department for review and acceptance prior to welding.

When the ambient air temperature is between $0^{O}C$ and $5^{O}C$ the Contractor shall pre-heat the smooth wall steel pipe to a minimum of $100^{O}C$ for a distance of 80mm beyond the weld in each direction, and shall shelter the section being welded from the wind. When the ambient air temperature is below $0^{O}C$ the Contractor shall provide suitable hoarding and heating of the sections being welded. The Design Engineer and the Department has the right to require the Contractor to modify or cease his welding operation if, in the opinion of the Design Engineer or the Department, adequate shelter and heating is not being provided during cold weather welding.

At the discretion of the Design Engineer or the Department, Non-Destructive Examinations such as Radiography and Ultrasonic testing may be required to verify quality and strength of the welds. Non-destructive examinations shall only be done by qualified technicians and the results shall be provided to the Design Engineer and Department for review. The Contractor shall arrange and provide non-destructive testing when required by the Design Engineer or the Department. Any defects found by such testing shall be repaired by the Contractor.

400.2.16.5.4 Grouting

The Contractor shall place grout using a low pressure pump to fill the void completely. When extension of the SWSP culverts beyond the ends of the existing pipe is required, the Contractor shall complete grouting of the liner pipe before completing the backfill of the extension pipe and allow the Design Engineer and the Department to observe the grouting operation and the completion of the grouting.

400.2.16.5.5 Smooth Wall Steel Pipe Culvert Extension Installation

Installation of SWSP extensions shall be made in accordance with Section 400.2.3 (Culverts) and Section 400.2.40 (Supply and Install Smooth Wall Steel Pipes), modified as follows:

- The pipe shall be installed true to the lines and grades as established by the Design Engineer and as accepted by the Department. When designated, elbows shall be installed at locations as established to accommodate sharp changes in gradient or direction of the pipe.

400.2.16.5.6 Hand-Laid Riprap

Immediately following completion of culvert installation, hand-laid riprap shall be placed in accordance with Section 400.2.4 (RIPRAP).

400.2.16.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.16.7 Measurement

400.2.16.7.1 Supply and Install Smooth Wall Steel Pipe Liner

Measurement for the supply and installation of SWSP culvert liners will be in metres based on the length along the centreline invert of pipe installed as a liner.

400.2.16.7.2 Supply and Install Grout

The Contractor shall provide a suitable means to measure the quantity of grout that has been placed into voids between the liner and the culvert to the nearest tenth of a cubic metre.

400.2.16.7.3 Smooth Wall Steel Pipe Culvert Extensions

Measurement for the supply and installation of SWSP culvert extensions will be made in accordance with Section 400.2.40 (Supply and Install Smooth Wall Steel Pipes).

400.2.16.8 Payment Adjustment

Intentionally Deleted

400.2.17 HIGHWAY STREET LIGHTING

400.2.17.1 General

This work shall consist of the supply and installation of highway lighting and all associated electrical work in accordance with the Detailed Designs. The electrical installation shall be in accordance with the current edition of the "Canadian Electrical Code", regulations of the Electrical Inspection Department having jurisdiction and as determined by the Design Engineer and the Department. Any work, even if not shown or specified, which is obviously necessary or reasonably implied to complete the work, shall be done as if it were both shown and specified.

All electrical installation work shall be performed by qualified tradesmen experienced in such work.

The Contractor shall obtain all permits and approvals and pay all related fees required for the work and submit a copy of all permits and associated documents to the Design Engineer and the Department.

At locations where new power supply or power supply modifications are necessary, application to the power company will be carried out by the Contractor. A specific service point for the power supply by others will be as indicated in the Detailed Designs. The Contractor shall provide all facilities to the service point. The power company will make the final connection.

400.2.17.1.1 Abbreviations and Definitions

Wherever in these specifications the following abbreviations are used, the intent and meaning shall be as follows:

CSA: Canadian Standards Association
NEMA: National Electrical Manufacturers Association
EEMAC: Electrical and Electronic Manufacturer's Association of Canada

400.2.17.2 Materials And Procedures

The Contractor shall supply all materials required for the installation of the highway lighting including associated electrical components.

All material supplied shall be new and built in accordance with EEMAC standards and shall be CSA approved. The Contractor shall obtain approval of the local inspection authority and shall bear all inspection charges levied and any modification costs required for any materials not CSA approved.

Material shall also comply with the Detailed Designs and as required by the "Canadian Electrical Code". The materials shall comply with the Detailed Designs, or as specified by the Design Engineer and as accepted by the Department.

When the work necessitates the removal, salvage and reinstallation of lighting structures, only materials from existing installations shall be used. Contractor stockpiles of used material from other sources will not be acceptable.

400.2.17.2.1 Conduit

The Contractor shall supply 50mm or 100mm underground electrical conduit, complete with all necessary incidentals, as indicated in the Detailed Designs.

Underground electrical conduit shall be either Polyvinyl Chloride (PVC), type DB2 or Reinforced Thermosetting Resin Conduit (RTRC) conforming to CSA Standards C22.2 No.211.1 and C22.2 No. 211.3, respectively.

400.2.17.2.2 Wiring

All wiring within the poles to the luminaires shall be #12 Cu. RW90 X-Link. All conductors shall be copper.

The Contractor shall supply secondary electrical cable as shown on the drawings. All teck cables shall be copper and have 1000 V cross link insulation. Teck cable shall be HL rated.

400.2.17.2.3 Luminaires and Standards (Poles)

The Contractor shall supply new luminaires complete with lamps, davit or high mast standards, and bases as indicated in the Detailed Designs.

Only new materials shall be used.

The poles shall be continuously tapered of polygonal cross sections presenting good visual appearance. With the anchor base mounted in a horizontal plane, the upright pole section shall be in a true vertical position. All materials used shall conform to the latest edition of CSA Standard G40.21M 300W, ASTM Standard A570 Grade D or ASTM Standard A36 as a minimum requirement. Silicon content of the steel shall be less than 0.04 percent for the shafts, whereas for base plates the silicon content shall be either less than 0.04 percent or between 0.15 to 0.25 percent.

All standards shall be hot dip galvanized in accordance with CSA standard G164-M. Double dipping will not be permitted. Where two or more galvanized sections will be placed in close proximity; the finished appearance each section shall be similar to the adjacent galvanized section(s). The Design Engineer will determine the suitability of repair methods subject to acceptance by the Department.

400.2.17.2.4 Sand Bedding and Backfill

All bedding sand shall be supplied by the Contractor and shall be free of clay, rocks and organic materials. The sand shall be a Designation 5 Class 10A in accordance with Section 400.2.20 (Aggregate Production and Stockpiling) or as accepted by the Design Engineer and as accepted by the Department.

When native material excavated from a ditch or trench is unacceptable as backfill, the Contractor shall supply sand or other approved backfill material. At no time shall backfill material containing ice, snow, organic or frozen material be used. All backfill material will be subject to acceptance by the Design Engineer and as accepted by the Department.

400.2.17.2.5 Concrete Bases

The Contractor shall supply all materials for the construction of pole and cabinet bases and the bases shall be constructed of concrete in accordance with CAN3-A23.1-M90. Concrete shall be Type 50, Class C in accordance with Section 400.2.32 (Supply of Portland Cement Concrete). Reinforcing shall be Grade 400, deformed bars in accordance with CSA G30.12-M77 complete with 10M ties as shown on the Detailed Designs.

Anchor bolts shall be supplied in accordance with the requirements of the pole or base manufacturer. Generally the top 300mm of the anchor bolts shall be hot dipped galvanized unless otherwise specified.

400.2.17.2.6 Frangible Bases (Breakaway Couplings)

The Contractor shall supply all required frangible bases for light standards as indicated on the Detailed Designs.

400.2.17.2.7 Site Lighting Distribution Enclosure and Components

The Contractor shall supply the required distribution enclosure in accordance with the Detailed Designs and as determined by the Design Engineer and accepted by the Department.

The enclosure shall be a weatherproof NEMA 4 design complete with padlockable door, hinged on one side. The enclosure shall be of sufficient size to house panel boards, disconnects, breakers, lighting contactors, control transformers, splitters, controls and an externally mounted power supply meter socket, as shown on the Detailed Designs. The enclosure shall be CSA approved with components installed. The entire system in the enclosure shall be concealed in conduit or other acceptable means. Exposed wiring will not be accepted. The Contractor shall provide all wiring schematics for future reference.

Panel boards shall be commercial or industrial grade complete with breaker. Rating of panel boards and number and type of breakers shall be as indicated on the Detailed Designs. Breakers shall be bolt in style only to match panels. Acceptable manufacturers are Westinghouse, Square D, FPE or approved equal.

Main disconnect shall be commercial or industrial grade NEMA 1 breaker enclosure suitable for service entrance. Rating and phases shall be as indicated on the Detailed Designs. Acceptable manufacturers shall be Westinghouse, Square D, FPE or approved equal.

Lighting contacts shall have a minimum of 600 volt rated contacts and 120 volt operating coil. The contact shall be mounted in a NEMA 1 enclosure and have a rating and number of phases as indicated on the Detailed Designs. Acceptable manufacturers shall be Westinghouse, Allen Bradley, Square D or approved equal.

Control transformer (if required) shall be 2000 VA rated and mounted in NEMA 1 enclosure. The transformer shall have voltage ratings and phases as indicated on the Detailed Designs.

Control circuit disconnect (if required) shall be rated at 15 amp and shall be mounted in a NEMA 1 enclosure. Voltage ratings and phases shall be as indicated on the Detailed Designs. Acceptable manufacturers shall be Westinghouse, Square D, FPE or approved equal.

Hand-Off-Auto switch shall be a 3-position selector switch with capabilities to override photocell and shall be mounted in a NEMA 1 enclosure.

Photocell shall be rated 1500 watt, 120 volt, drift free minimum "turn on level" of 1.5-foot candles. It shall be integrally wired into distribution enclosure and shall be of vandal proof design.

400.2.17.2.8 Drawing Submission

The Contractor shall submit four copies of shop drawings of electrical work, including poles, luminaires, distribution enclosures and frangible bases to the Design Engineer and the Department for review, a minimum of 14-days before the scheduled start of the work. Shop drawings shall be stamped and signed by a Professional Engineer. Work shall not commence until all shop drawings have been reviewed and accepted by the Design Engineer and the Department.

400.2.17.3 Quality Management Sampling And Testing

Sampling and Testing of the cast-in-place Concrete shall meet the requirements of Section 400.2.32 (Supply of Portland Cement Concrete).

400.2.17.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.17.5 Construction

400.2.17.5.1 Existing Underground Utilities

The Contractor shall hand expose all underground utilities in all areas of excavation. Hand exposure shall be as specified by the utility owner. The exposure and backfilling of the utilities shall be undertaken by the Contractor under the direct supervision of the utility owner's representative.

400.2.17.5.2 Removal and Salvage of Existing Standards

Where required as indicated in the Detailed Designs, the Contractor shall remove, salvage and store existing light standards. Existing pre-cast bases and all other components shall be removed and disposed of in a manner acceptable to the Design Engineer and as accepted by the Department. The Contractor shall backfill and compact holes left from pole removal before nightfall. Material damaged by the Contractor during the removal shall be replaced with new material by the Contractor.

When standards are salvaged for reuse, the existing galvanizing shall be repaired to the satisfaction of the Design Engineer and as accepted by the Department prior to installation.

When painted standards are designated to be salvaged and reinstalled, they shall be hauled to a plant equipped to do the work, stripped of all paint and rust and hot dip galvanized in accordance with CSA Standard G164-M.

400.2.17.5.3 Removal and Disposal of Existing Lighting Fixtures

Where required as indicated in the Detailed Designs, the Contractor shall remove and dispose of existing light fixtures including standards, bases and luminaires in a manner and location as acceptable to the Design Engineer and as accepted by the Department. Unless otherwise stated in Section 200 (Project Specifies), all materials shall become the property of the Contractor.

The Contractor shall backfill and compact the disturbed areas prior to nightfall.

400.2.17.5.4 Cutting of Pavement

When required, saw cutting shall be in accordance with Section 400.2.26 (Cutting of Pavement).

400.2.17.5.5 Excavation and Backfill

No trenching or excavation work will be permitted over existing power, communication cable, pipeline or other underground utilities without the supervision of the appropriate authority. The Contractor shall call Alberta First Call and the respective utilities to locate and mark existing underground utilities. Damage to any utilities is the responsibility of the Contractor.

Trench digging machinery will be permitted except where its operation will cause damage to trees, buildings, or existing structures above or below ground. At such locations, alternative methods shall be used subject to the approval of the Design Engineer and as accepted by the Department.

Excavation and backfill shall be executed where required for electrical installation unless otherwise stated in the Detailed Designs. Trenches shall be a minimum of 150mm wide along alignments. Trenches shall be a minimum of 0.9 metres to a maximum of 1.1 metres below finished grade level. The trench bottom shall be free of stones, loose material and sharp objects. In backfilled areas, the trench bottom shall be kept level to facilitate laying-in of the cable. The excavation shall be performed in such a manner as to cause the least possible damage to the adjacent embankment surface and other improvements.

No deviation shall be made from the required line or grade except with written approval of the Design Engineer and as accepted by the Department.

Trenches shall not be left open unattended or unprotected without written permission from the Design Engineer and as accepted by the Department. In such cases, the open trench shall be properly marked and barricaded with flashers. In locations where flooding may occur or public hazard is created by open trench, the Design Engineer and as accepted by the Department may require that the excavation be appropriately covered.

Temporary support, adequate protection, and maintenance of all underground and surface utilities structures, drains, sewers, and other obstructions encountered in the progress of the work shall be provided by the Contractor.

Backfill material shall be mechanically compacted in maximum lifts of 150mm to a minimum of 95 percent of Standard Proctor Density for the full depth of the excavation. Compaction tests shall be on a minimum of one density test per 150 metres of trench for compacted vertical backfill. Additional tests may be required at the discretion of the Department.

All disturbed areas shall be restored to the conditions existing prior to the disturbance or a condition satisfactory to the Design Engineer and as accepted by the Department.

Disposal of all excess material shall be the responsibility of the Contractor.

400.2.17.5.6 Sand Bedding

Sand used as bedding or backfill in excavated areas beneath roadway, driveways, and sidewalks shall be compacted to a minimum of 100 percent of Standard Proctor Density and provide a minimum of 50mm covering on all sides of the conduit. In all other cases, unless otherwise specified by the Design Engineer and as accepted by the Department, sand shall be compacted to a minimum of 95 percent of Standard Proctor Density.

400.2.17.5.7 Street Light Bases

When the type of street light base is not stated in the Technical Requirements, the Contractor shall have the option of supplying and installing either cast-in-place concrete bases, steel screw-in bases, or pre-cast concrete bases. Contractor optional bases shall be designed, fabricated, and installed in accordance with Section E6.2.2 of the Highway Lighting Guide 2003 and shall be acceptable to the Design Engineer and as accepted by the Department.

Cast-in-place bases shall be constructed a minimum of 21 days prior to installing the poles, unless braces, acceptable to the Design Engineer and as accepted by the Department, are provided.

The Contractor is advised to assess the nature of the existing soil types and conditions prior to the deadline for submission of the Price Proposal (as defined in the RFP). The Contractor shall have no claim against the Department for difficulties in the constructability of the bases and footings due to soil types and conditions.

400.2.17.5.8 Luminaires and Standards (Poles)

The Contractor shall install all davit and high mast standards (to the height specified), luminaires, lamps and frangible bases according to the Detailed Designs.

Standards shall be installed plumb and level. Shims may be used for levelling, however any gaps between standards and bases shall be appropriately filled with grout.

Each luminaire shall be aligned and aimed correctly as indicated on the Detailed Designs.

The Contractor shall complete all associated wiring, fusing and galvanizing in accordance with CSA standard G164-M for the installation of the unit.

Terminations in the pole base shall be completed using insulated crimping connectors, not wire nuts (amp type or approved equal). All aluminum to aluminum or aluminum to copper connections shall be made using PENETROX, or an approved equivalent, in an approved manner.

The Contractor shall furnish such aerial lift devices, with qualified operators and associated traffic control, as may be required for the Design Engineer and the Department to inspect any and all luminaires on the Project throughout construction activities, and prior to the expiration of the Contractor's warranty.

400.2.17.5.9 Underground Electrical Conduit

Conduit shall be installed beneath all roadway, walkways, driveway crossings and other locations as indicated in the Detailed Designs. The installation shall be for the entire length of the crossing plus an additional metre on each side. Installation shall be in accordance with the Detailed Designs.

Pushed or trenched underground electrical conduit shall be installed in accordance with Section 400.2.6 (Underground Electrical Conduits) and the applicable drawings.

400.2.17.5.10 Site Lighting Distribution Enclosure

The Contractor shall install the required distribution enclosure in accordance with the Detailed Designs and as determined by the Design Engineer and as accepted by the Department. The sand bedding for the enclosure shall be compacted to a minimum of 100 percent of Standard Proctor Density.

A concrete base shall be constructed to the dimensions shown on the Detailed Designs. All connections to the enclosure shall run through the concrete base.

The Contractor shall situate the base and cabinet to ensure that the photocell operation is not effected by outside light sources.

400.2.17.5.11 Secondary Electrical Cable

Secondary electrical cable shall be placed in trenches in random separation with great care to ensure no kinking or damage to the sheath (splices are unacceptable). Cable shall be installed with sufficient slack and snaking to ensure cable is not damaged during backfilling operations, or from ground movements due to frost heave.

All cables crossing roadways shall be placed in a 50 or 100mm conduit as specified, one duct for each cable.

Secondary electrical cable shall be installed as shown on the Detailed Designs.

400.2.17.6 Product Acceptance

The electrical installation shall be completely tested, including but not limited to megger and ground testing, and certified by a qualified licensed electrician demonstrating to the satisfaction of the Design Engineer and as accepted by the Department that the equipment and system installed perform in the manner intended. The Design Engineer and the Department shall be notified 24 hours in advance of the certification testing.

400.2.17.7 Measurement

400.2.17.7.1 Trench and Backfilling

Trenching and backfilling for wiring installation placed outside of conduits will be measured by the lineal metre along the centreline of the trench.

400.2.17.7.2 Underground Electrical Conduit

Measurement for conduit installation will be in accordance with Section 400.2.6 (Underground Electrical Conduit) Trench Excavation or Pushed Conduit, as applicable.

400.2.17.7.3 Secondary Cable

Secondary will be measured by length in metres of trench excavated for the installation of underground wiring as measured along the centreline of the trench. No additional allowance will be made for the requirement for extra connecting cable at run terminations or for cable wiring installed at variance with a straight line.

400.2.17.7.4 Street Light Bases

Measurement of street light bases will be per unit.

400.2.17.7.5 Davit and High Mast Standards

Measurement of the installation of davit or high mast standards will be per unit.

400.2.17.7.6 Reinstallation of Salvaged Standards (Poles)

Measurement of reinstalling poles will be per unit.

400.2.17.8 Payment Adjustment

Intentionally Deleted

400.2.18 TRAFFIC SIGNALS

400.2.18.1 General

400.2.18.1.1 Abbreviations and Definitions

This work shall consist of the supply and installation of traffic signals and all associated electrical work in accordance with these specifications, and in conformity with the Detailed Designs. In cases of conflict with existing underground utilities, the Contractor shall contact the Design Engineer and the Department for approval of revisions prior to completing the work.

The electrical installation shall be in accordance with the current edition of the Canadian Electrical Code, the *Safety Codes Act* (Alberta) and regulations thereunder, the regulations of the Electrical Inspection Department having jurisdiction. Any work, even if not shown or specified, which is obviously necessary or reasonably implied to complete the work, shall be done as if it were both shown and specified.

All electrical installation work shall be performed by qualified tradesmen experienced in such work.

Cabinet bench testing, cabinet wiring, termination of cables, testing of signals, and activation of signals shall only be performed by personnel possessing the following qualifications:

- Journeyman Power Systems Electrician, or a Journeyman Power Lineman, or a Journeyman Electrician certificate;
- Successfully completed Traffic Signals Level I and Level II courses offered by IMSA;
- Five years experience with traffic signal installation, maintenance and troubleshooting.

The Contractor shall obtain all permits and approvals and pay all related fees required for the work and submit a copy of all permits and associated documents to the Design Engineer and the Department. After completion of the work, the Contractor shall provide the Department a "Certificate of Final Inspection and Approval" from the electrical inspection authority. The Contractor shall be responsible for all costs associated with the testing inspection done by the electrical inspecting authority.

At locations where new power supply or power supply modifications are needed, application to the power company will be carried out by the Contractor. A specific service point for the power requirements will be provided by the power company and will be as indicated in the Detailed Designs.

The Contractor shall provide all facilities to the service point. The power company shall make the final connection.

400.2.18.2 Materials and Procedures

400.2.18.2.1 General

The Contractor shall supply all materials required for the installation of traffic signals including associated electrical components.

All material supplied shall be new and CSA approved. The Contractor shall obtain approval of the local inspection authority and shall bear all inspection charges levied.

Material shall also comply with the Detailed Designs and as required by the "Canadian Electrical Code". The materials shall comply with the Technical Requirements, or as specified by the Design Engineer and as accepted by the Department.

When the work necessitates the removal, salvage and reinstallation of existing structures, only materials from the existing installations shall be used. Contractor stockpiles of used material from other sources will not be acceptable.

400.2.18.2.2 Abbreviations and Definitions

Wherever in these specifications the following abbreviations are used, the intent and meaning shall be as follows:

AISC:	American Institute of Steel Construction
ASA:	American Standards Association
ATSSA:	American Traffic Safety Services Association
CEMA:	Canadian Electrical Manufacturers Association
CSA:	The Canadian Standards Association
IMSA:	International Municipal Signal Association
NEMA:	National Electrical Manufacturers Association
EEMAC:	Electrical and Electronic Manufacturer's Association of Canada

400.2.18.2.3 Wire and Cable

General

Wire shall be stranded copper RWU90 cross-link conforming to CSA C22.2 No.38, 'Thermoset Insulated Wires and Cables' or equivalent, unless otherwise specified below or specified in the Detailed Designs. Wire and cable shall meet CSA standards for installation in wet environments.

Signal Control Cable

Signal control cable shall be 600 volt rated, consisting of #14 AWG solid copper conductors, individually polyethylene insulated, covered with a black polyvinyl chloride outer jacket, conforming to IMSA Spec. No. 19-1. Signal cable for exposed installations shall conform to IMSA Spec. No. 20-1. The Contractor shall follow the Plans and Standard Drawing TCS-F-101 for selecting the type and quantity of signal control cables (7 or 16 conductor cable) for the work.

Loop Detector Wire

Loop detector wire shall be 600 volt rated #14 or #16 XHHW stranded copper conductor or equivalent with cross-linked polyethylene insulation conforming to IMSA Spec. No. 51-3.

Loop Detector Lead-In Cable

Loop detector lead-in cable shall be 600 volt rated, composed of two #16 AWG stranded tinned copper conductors individually insulated with polyethylene material, twisted together, and shielded with aluminum backed mylar. The cable shall conform to IMSA Spec. No. 50-2.

Microwave Detector Lead-In Cable

Microwave detector lead-in cable shall be 600 volt rated, unshielded, and composed of four #16 AWG stranded bare copper conductors. Belden 27338A or an equivalent cable are acceptable.

Communication Cable

Traffic signal communication cable shall consist of 4 twisted pairs of #16 AWG stranded copper polyethylene insulated conductor with electrical shielding and a polyvinyl chloride jacket, and shall conform with IMSA Spec. No. 19-2.

Advance Warning Cable

Advance warning signal cable shall be 600 volt rated, unshielded, composed of three #10 AWG RW90 cross-link conductor, suitable for installation in wet environments.

Streetlight Cable

The cable feeding streetlights on combination traffic poles shall be 600 volt rated, polyvinyl chloride jacketed, comprised of two #10 insulated conductors with a concentric neutral. USEB90 or equivalent cable is acceptable.

Power Supply

Power supply conductor shall be #8 AWG RWU90 cross-link.

400.2.18.2.4 Grounding and Bonding

General

Grounding and bonding materials shall conform to CSA C22.2 No.41, 'Grounding and Bonding

Equipment'.

Ground and Bond Conductors

Ground and bond conductors shall be stranded copper RWU90 cross-link, insulation color green, and shall conform to CSA C22.2 No.38-M, type RWU90 cross-link.

Ground/Lightning Electrodes

Ground/Lightning Electrodes shall be copperclad steel rods, 21mm diameter by 3.0m in length.

Ground/Lightning Electrode Connectors

Moulded type connectors shall be used on all wire-to-rod connections. Moulded connectors shall consist of metallic alloys and fusible powder mixtures held in place by a suitable mould and connected using an exothermic type welding process.

400.2.18.2.5 Conduits

General

Supply and Installation of conduits shall be in accordance with Section 400.2.6 (Underground Electrical Conduits) and as specified herein.

Fittings for DB2 Conduits
Only factory bends are acceptable for Type DB2 PVC conduits. Field fabrication of couplings, adapters, bends, and fittings for DB2 conduits will not be accepted.

Trench Marker Tape

Trench marker tape shall be 250mm wide yellow plastic tape, labelled "CAUTION - ELECTRICAL WIRE BURIED BELOW" at minimum 0.5m intervals.

400.2.18.2.6 Junction Boxes

Junction boxes shall be precast of non-ferrous metal or approved plastic material and shall be of suitable sizes. The boxes shall have a removable metal cover equipped with cap screws and threaded holes in the cover to facilitate removal of the cover after sealing. The metal cover shall be grounded.

400.2.18.2.7 Foundations

General

The Contractor shall supply Portland Cement Concrete required for foundations in accordance with Section 400.2.32 (Supply of Portland Cement Concrete), and as specified herein.

Precast Cabinet Base

Precast concrete base for Type "M1" signal control cabinet and the power supply cabinet shall be constructed in accordance with Standard Drawing TEB 4.39.

Precast Pole Base

Concrete for the precast pole bases shall have minimum 28-day strength of 30 MPa concrete in accordance with CAN3-A23.1-M90. Concrete shall be Type HS, Class C. The Contractor shall supply galvanized steel anchor bolts with nuts, washers and nut covers.

Precast pole bases for pedestal poles shall be constructed in accordance with Standard Drawing TCS-F-301.

Precast pole base for traffic poles with an arm span of 9 metres or less shall be constructed in accordance with Standard Drawing TCS-F-305.

Concrete bases for advance warning signal poles or traffic poles with an arm span greater than 9 metres must be cast-in-place.

Cast-In-Place Pole Base

Cast-in-place pole bases shall be constructed of concrete using Type HS sulphate resistant cement to give minimum compressive cylinder strength of 30 MPa in 28-days for Class C exposure with 20mm nominal size coarse aggregate, slump at point at time of discharge maximum 100mm and minimum 50mm. Air content shall be between 4 percent and 7 percent. Maximum water cement ratio shall be 0.45 by mass.

Cast-in-place concrete pole bases for pedestal poles shall be constructed in accordance with Standard Drawing TCS-F-301.1.

Cast-in-place concrete pole bases for advance warning signal poles with an arm span up to 9m and for traffic poles with an arm span up to 11m shall be constructed in accordance with Standard Drawing TCS-F-305.1.

Cast-in-place concrete pole bases for advance warning signal poles with an arm span up to 11m and for traffic poles with an arm span up to 15m shall be constructed in accordance with Standard Drawing TCS-F-310.

The Contractor shall submit the concrete truck tickets to the Design Engineer and the Department to demonstrate that the correct type of concrete is used.

Galvanized Steel Helix Pedestal Pole Base

Shop drawings for the galvanized steel helix pedestal pole bases shall be submitted by the Contractor to the Design Engineer and the Department for review and acceptance. Steel helix pedestal pole bases shall be fabricated to fit a bolt circle diameter (B.C.D.) of 280mm and for four 25mm anchor bolts. The steel helix pole base shall be designed to support a loading which corresponds to a 5m tall pedestal pole with 2 four-section signal head unit side-mounted at the upper section of the pole. Additional loadings are a 60cm x 75cm sign and a 60cm x 60cm sign mounted below the four-section signal heads.

Galvanized Steel Rotatable Base

Rotatable bases for traffic poles and advance warning signal poles shall be hot dip galvanized in accordance with CSA standard G164-M. Shop drawings for the rotatable pole base shall be submitted by the Contractor to the Design Engineer and the Department for review and acceptance.

Rotatable pole bases shall be fabricated to fit a B.C.D. of 400mm and for four 35mm anchor bolts. The maximum height for the rotatable pole base shall be 800mm. A centre hole with a minimum diameter of 150mm shall be provided through the base. The rotatable base shall be designed so that a maximum rotating angle of 90 degrees is allowed. This can be achieved by fabricating a stop-end anchor at the underside of the top plate and on the side of the main rotatable base exterior wall tubing. A 40mm diameter hole should be provided on both stop-end anchors to allow the top plate to be locked in place after it is rotated.

The rotatable base shall be designed to support the loading outlined in Section 400.2.18.2.8 (Signal Supports) based on the following arm mounting heights with the rotatable base attached: traffic sign poles - 6.7m above top of concrete pole base; traffic signal poles - 6.5m above top of concrete pole base.

Loading calculation shall be based on a wind speed of 160 km/h and a 12.7mm layer of ice load on one side of the structure / sign surfaces.

Welding for the rotatable base shall be done by a CWB certified company. All welding shall conform to CSA Standard W59 and shall be performed by welders or welding operators qualified under CSA Standard W47.1. SMAW process shall use E48018 or E48018-1 classification electrode. FMAW process shall use E480XT-X classification electrode. GMAW process shall use E480S-X classification electrode. All welding shall be completed prior to galvanizing. Welding activities shall not be permitted in the field without adequate protection from public viewing.

400.2.18.2.8 Signal Supports

General

The pole support structures shall be continuously tapered of polygonal cross sections presenting good visual appearance. With the anchor base mounted in a horizontal plane, the upright pole section shall be in a true vertical position. All materials used shall conform to the latest edition of C.S.A Standard G40.21M 300W, ASTM Standard A570 Grade D or ASTM Standard A36 as a minimum requirement. Silicon content of the steel shall be less than 0.04 percent for the shafts, whereas for base plates the silicon content shall be either less than 0.04 percent or between 0.15 to 0.25 percent.

Only new materials shall be used in its construction.

Shop Drawings

The Contractor shall submit to the Design Engineer and as accepted by the Department shop drawings in triplicate (three copies) for review prior to any fabrication. Shop drawings shall be complete and shall include all information such as material specifications, weld sizes, welding procedures, design criteria, and design loading. Shop drawings shall be stamped and signed by a Professional Engineer.

Review of shop drawings by the Design Engineer and the Department will be for general arrangement only and in no case will the Contractor be relieved of the responsibility for completeness or adequacy of fabrication materials and procedures for the structures. Any costs resulting from changes made necessary by errors in fabrication, or due to failure to have shop drawings so accepted shall be the responsibility of the Contractor. Work shall not commence until all shop drawings have been reviewed and accepted by the Design Engineer and the Department.

400.2.18.2.9 Structural Design Criteria

General

The mast arm mounting height for advance warning signal poles or pedestrian corridor poles shall be 6.7m above the base plate. The mast arm mounting height for traffic shall be 6.5m above base plate. The arm reach of signal/overhead sign pole mast arm shall follow the pole schedule on the Detailed Designs. In situations where rotatable bases are needed, the signal supports shall be fabricated so that shorter pole shafts will be used to achieve the same mast arm mounting heights as specified above.

Live Loads

The wind drag coefficient of the latest National Building Code of Canada for either octagonal section or round section shafts and where other cross sectional shapes are employed shall be utilized in the design. All safety factors shall be in accordance with AISC Steel Construction Manual for wind and seismic stresses, or a minimum of 1.25:1 based on the published yield strength of the material.

The structural design criteria shall be for wind velocities up to and including 160 km/h upon the total effective area of the signal structures and fittings. The loading shall include ice load based on 12.7mm ice thickness on all faces of structure members and on one face of the sign load.

Dead Loads

For Pedestal Poles

1. Two four-section signal heads mounted back to back on the pole. Each signal head has a weight of 20 kg, and
2. Any combination of signal heads or signs of which the projected area is not to exceed 2.0 square metres.

For Combination Cantilever Signal Poles

1. Three traffic signal heads each with maximum projected area of one square metre and weight of 20 kg each on the mast arm. The three signals on the traffic arm are to be located 0.5m, 3.8m, and 7.5m inward from the end of the arm, and

2. Three 75cm x 75cm aluminum signs mounted at 0.2m, 3.5m, and 7.2m inward from the end of the arm, and
3. Two pedestrian signals with a maximum projected area of one square metre and weight of 20 kg, to be mounted on the pole shaft along with a side mounted traffic signal with weight of 20 kg and projected area of one square metre.
4. A streetlight extension section 5.7m in height (total structure height of combination pole shall be 12.2m) and reaching 1.8m towards the road.
5. Pole shafts for signal poles with arm span of 11m or less shall be designed to support the loading of an 11m arm with the above-mentioned loadings.
6. Pole shafts for signal poles with arm span of 15m or less shall be designed to support the loading of a 15m arm with the above mentioned loadings.

For Cantilever Sign Poles

1. One sign 1.8m x 2.4m in dimensions on 20mm thick marine plywood c/w high intensity retro-reflective sheeting for the sign face (weight - 65 kg), and
2. Two 20cm diameter amber beacons (weight - 10 kg), and
3. Angle irons to mount sign (weight - 45 kg).
4. Pole shafts for sign poles with arm span of 9m or less shall be designed to support the loading of a 9m arm with the above-mentioned loadings.
5. Pole shafts for sign poles with arm span of 11m or less shall be designed to support the loading of an 11m arm with the above mentioned loadings.

<u>Pole Setting Features (Anchorage)</u>

The Detailed Designs may be such that the vertical shaft is inserted into the base plate and attached with two circumferential welds.

The signal/sign pole shall meet the following requirements:

1. Each base plate shall have 4 bolt holes equally spaced around the bolt circle. The rectangular centres of the two bolt holes shall be parallel with the neutral plane of the pole shaft. The bolt holes shall be elongated so that it can be fitted onto pole bases with B.C.D. of either 395mm (15.5") or 405mm (16"). Width of bolt hole slot shall be 45mm (1¾") plus/minus 1.6mm (1/16")
2. The base plate shall be designed for accommodating a single nut cover. Nut covers shall be attached to the poles by means of brass cap screws or other approved methods.
3. The pedestal pole shall be 120mm across flats at the top with a 115mm O.D. x 100mm long tenon. The pole shall come with an end cap.
4. B.C.D. dimensions and anchor bolt sizes shall meet the requirements outlined on Standard Drawings TCS-F-301, 301.1, 305, 305.1, and 310.

<u>Mast Arm Attachment Features</u>

The mast arm shall be designed to meet structural design criteria. The steel plates (flange) shall have 8 bolt holes equally spaced. A 100mm (4") diameter hole in flange and pole shaft shall be provided for electrical cable access, and centered in the flange. The 8 bolt holes in the flange shall be 28.5mm (1 1/8") in diameter. The 8 bolts supplied shall include washers and nuts sized to meet design criteria.

Surface Finish

The surface finish for the traffic/sign poles shall be hot dip galvanized and shall meet all the requirements outlined in CSA Standard G164-M. Pole refinishing materials shall be a cold galvanizing compound such as "Galvicon" or approved equivalent.

Where two or more galvanized sections will be placed in close proximity; the finished appearance each section shall be similar to the adjacent galvanized section(s). The Design Engineer will determine the suitability of repair methods subject to review and acceptance by the Department.

Workmanship and Fabrication

Fabrication and workmanship shall be in accordance with the latest edition of CSA Specification S16, and all workmanship shall be equal to the best practice in modern construction steel shops. The structure inside and outside shall be clear of any obstructions which will hamper the wiring of the traffic signal after erection.

Welding shall be undertaken only by a fabricator fully approved by the Canadian Welding Bureau to the requirements of CSA. Standard W47. Any circumferential welds shall develop 100 percent penetration of the material thickness. All welds shall be cleared of all slags and spatter. If future welding is done after cleaning, the weld metal and adjacent areas shall be cleaned and all spatter removed.

Electrical Connections

Each pole shall include provision for electrical constructions in the form of hand holes of adequate size positioned 0.5m above the base plate and at the mast arm mounting level. The hand holes shall be adequately reinforced with a collar with covers secured in place by a 9.5mm (3/8") galvanized standard N.C. Hex bolt with anti-tampering cup washer.

Each pole shall be provided with 9.5mm x 38.1mm (3/8" x 1 1/2") N.C. galvanized bolt which shall be welded to the inside of the pole directly opposite the bottom hand hole. This stud shall be fitted with grounding lug, two washers, and a brass nut suitable for connecting the ground wire.

Wire access on the pole section: Four (4) only, 25mm (1") with 1360 kg (3,000 lbs) couplings complete with square recessed head plugs and spaced 90 degrees to each other at 3 m above the base plate shall be provided. Recessed head plugs must have a lubricant on the threads to allow easy removal.

Wire access on the mast arm section: Three or four 25mm (1") diameter rubber grommets shall be provided at the following locations on the mast arm: 0.5m from the end, and every 3.7m, thereafter.

Inspection and Testing

The Contractor shall obtain an independent testing firm to carry out ultrasonic testing on welds.

Weld testing reports for all poles shall be submitted to the Design Engineer and the Department for review and acceptance before the poles are shipped to the work site. Costs associated with testing shall be the responsibility of the Contractor.

Should such tests show the pole structures are not in accordance with the specifications, they shall be repaired or replaced by the Contractor. The Department reserves the right to reject any portion of the shipment of pole structures that does not comply with the Detailed Designs and Technical Requirements,

In particular:

a) Pole structures which do not comply with the physical dimensions or B.C.D. specified in the Technical Requirements or Detailed Designs shall be rejected.

b) Pole structures which do not pass visual inspection at delivery shall be rejected.

c) Pole structures which have been damaged during delivery shall be rejected. The Contractor shall replace or repair rejected structures.

Pole Identifications

Each structure supplied shall be fully identified by permanent markings on the walls of the structure (arm and trunk). The permanent markings are to be stamped or welded on the structures and shall include the following information:

- Name of manufacturer
- Year of manufacturing
- Type of pole
- Dimension / span / height of pole

400.2.18.2.10 Luminaries and Photocells

Luminaries shall be High Pressure Sodium complete with polycarbonate refractors and have integral 120/240 VAC regulated output constant wattage iso-lead (CWI) high power factor ballasts.

Photocell units shall be cadmium sulphide thermal delay type with built in surge and lightning protection. The photocell shall be load rated at a minimum of 1000 volt-amp.

400.2.18.2.11 Pole Mounted Traffic Control Fixtures

Traffic and Pedestrian Signal Heads and Accessories

Traffic and pedestrian signal heads optical system shall conform to the Institute of Transportation Engineer specifications, the American Standards Association (ASA) specifications, and the specifications contained herein. The traffic and pedestrian signal heads shall be polycarbonate in design unless otherwise indicated. The fixture body of the traffic and pedestrian signals shall be traffic yellow. The doors and visors shall be dull black. Refer to

Standard Drawings TCS-F-501, 505, 510, 515, 520 and 525 for mounting hardware requirements for traffic control fixtures on signal poles.

General

All wiring and terminal blocks shall meet the requirements of Section 13.02 of the ITE Vehicle Traffic Signal Heads (VTCSH) standard. Two secured, colour coded, 914mm (36 in) long 600 V, 20 AWG minimum, jacketed wires, conforming to the National Electrical Code, rated for service at +105ºC, are to be provided for electrical connection.

Voltage Range

LED signal modules shall operate from a 60±3 cycle AC line power over a voltage range from 80 VAC RMS to 135 VAC RMS. The current draw shall be sufficient to ensure compatibility and proper triggering and operation of load current switches and conflict monitors in signal controller units the procuring agency has in use.

Nominal operating voltage for all measurements shall be 120±3 volts RMS.

Fluctuations in line voltage over the range of 80VAC to 135VAC shall not affect luminous intensity by more than ±10 percent.

The LED circuitry shall prevent flicker at less than 100 Hz over the voltage range. It must be ensured that the product will not show illumination for input voltages below 45 volts.

Transient Voltage Protection

The signal module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients and low-repetition, high-energy transients as stated in section 2.1.6, of NEMA Standard TS-2, 1992.

LED Drive Circuitry

The individual LED light sources shall be wired so that a catastrophic failure of one LED light source shall result in the loss of not more than 20 percent of the signal module light output.

Electronic Noise

The LED signal and associated on-board circuitry shall meet Federal Communications Commission (FCC) Title 47, SubPart B, Section 15 regulations concerning the emission of electronic noise.

Power Factor (PF) and AC Harmonics

LED signal modules shall provide a power factor of 0.90 or greater when operated at nominal operating voltage, and 25ºC (77ºF).

Total harmonic distortion induced into an AC power line by an LED signal module, operated at nominal operating voltage, with a power consumption equal to or greater than 15 watts at 25ºC (77ºF) shall not exceed 20 percent. Total harmonic distortion induced into an AC power line by an LED signal module, operated at nominal operating voltage, with a power consumption less than 15 watts at 25ºC (77ºF) shall not exceed 40 percent.

Traffic Signal Head

All traffic signal heads shall be 300mm in diameter with Standard Full Matte Black Visors (tunnel visors). The signals shall come with 300mm signal backboards and all mounting hardware. Backboards, doors, and visors shall be flat black. The design of the traffic signal head shall be such that the reflector assembly is hinged separately from the door assembly.

The signal head shall be secured by a minimum of 2 latching bolts for the door assembly.

Pedestrian Signal Head

All pedestrian signal heads shall be of the standardized square head of 300mm size or as specified, and shall be designed to retain optical efficiency.

The background of all message and indication type lenses shall be an opaque grey ceramic, fired directly on the lens. The lens shall be made of impact resistant polycarbonate.

WALK and DON'T WALK message shall be symbolized to the standards outlined in the Manual of Uniform Traffic Control Devices for Canada.

Standard cowl/cutaway style visors shall be included. The colour shall be flat black.

Pedestrian Pushbutton and Sign

Pushbutton and pushbutton housing shall be cast using aluminum alloy. The pushbutton shall be controlled by low voltage relay switching, operating from 24 VAC supply from the controller cabinet.

Pushbuttons shall have an isolator/LED latch module to enable a LED indicator light to come on once pressed. Each pushbutton requires a switch circuit module to operate the 3 volt LED. A 4-channel isolator/latch module is needed to operate up to 4 pushbuttons, for a total of 16 pushbuttons per isolator/latch module. Each pedestrian movement at the intersection requires at least one unlatch module. An intersection with 2 pedestrian movements will require 2 unlatch modules.

Microwave Detectors

Microwave detectors shall be controlled by a microprocessor. They shall be designed to allow a minimum detection range of 50m and to trigger the operation of a traffic controller.

The microwave detector shall only respond to motion in one direction (approach or depart only - selectable). The detector shall generate a microwave beam aim to cover the same area normally covered by a loop detector system. The microwave detector shall have an operating voltage of 24 VAC.

Special Crosswalk

Special crosswalk sign shall consist of a 75cm x 240cm sign with RA-102 sign message and the following colour scheme - White Background, Black Border, Black Message/Symbol. The sign board material shall comply with the requirements in Section 400.2.38 (Supply of Permanent Highway Signing). Two 200mm amber beacons shall be mounted on the sign. Mounting hardware for the special crosswalk sign shall be provided in accordance with Standard Drawing TCS-F-520.

Advance Warning Signal

Advance warning signal sign shall consist of a 150cm x 240cm sign with WB-5 sign message and colour scheme. The sign board material shall comply with the requirements of Section 400.2.38 (Supply of Permanent Highway Signs, Posts and Bases). Two 200mm amber beacons shall be mounted on the sign. Mounting hardware for the advance warning signal sign shall be provided in accordance with Standard Drawing TCS-F-525.

400.2.18.2.12 Traffic Signal Controller Unit and Cabinet

General

This specification is applicable for TS2 Type 2 Traffic Signal Control Cabinet for application in Alberta. TS2 Type 1 Cabinet is also accepted as an alternative. TS2 Type 1 Cabinets, if used, shall comply with the requirements of NEMA TS2-1998.

The Contractor shall demonstrate to the Design Engineer and the Department, in the Contractor's own signal shop, the ability of the controller cabinet to provide the expected traffic operations as specified on the Detailed Designs.

Manufacturer's Identification

The manufacturers' identification shall be on all major equipment supplied with this specification including the cabinet assemblies. The date on which the controller cabinet is manufactured shall also be marked on the inside cabinet door.

Software Changes and Updates

All applicable software changes and updates shall be supplied and installed in the equipment at no extra cost to the Department for the duration of the warranty period.

Traffic Signal Cabinet Configurations

Traffic signal controller cabinets shall be configured to provide a minimum of 8-phase signal operations, with the following minimum configuration:

Controller Unit

- TS2 - Type 2 - Type A2 (TS2 Type 1 is an acceptable alternative) MMU
- Type 12 Terminal and Facilities
- 16 Channel Detector Rack (Rack mounted. Shelf-mounted detector shall not be used)
- 8 veh/4 Ped Test Switch Panel

- Police Panel on Main Door

Auxiliary Devices

- 12 Load Switches
- 1 - 2 cct Solid State Flasher
- 4 Flash Transfer Relays
- As per Detector Schedule in the Detailed Designs

Cabinet

- Type M1 (82cm x 46cm x 152cm) with Corbin No. 2 Key (three sets of keys)
- Bus Interface Unit
- 1 for Detector Rack, Controller, and MMU SDLC Interface

NEMA TS 2-1998 Exceptions

Controller Unit (CU)

The controller supplied by the Contractor shall be one of the Controllers listed on the Alberta Transportation Products List. Other Controllers configured for Dual Ring operations and conforming to the applicable standards of the National Electrical Manufacturers' Association (NEMA) TS 2-1998 edition for Type 2 configuration Type A2 - Controller Units in all material respects will be allowed with the prior acceptance by the Design Engineer and the Department.

Malfunction Management Unit (MMU)

The MMU shall be capable of operation in a cabinet designed to TS 1 specification with no loss of TS 1 functionality.

If a TS-1 type controller is used, all electrical connections with the monitor shall be through approved quick disconnect MS type connectors and harnesses such that it is directly pin plug interchangeable with other conflict monitors of like manufacture and NEMA series. If a TS-2 type controller is used, communication with the MMU shall be either as above or via a serial data bus.

MMU shall be provided complete with a "Programming Card".

Terminal and Facilities (TF)

The TF interface shall be as defined for TS 2 - Type 2 Controller Units and the use of a BIU for communication with the MMU and vehicle detectors.

AC Neutral Bus shall have minimum 14 positions. Earth Ground (Bond) Bus shall have minimum 14 positions. Main Breaker shall be 40 amp for the traffic signal equipment. Auxiliary Breaker shall be 15 amp for auxiliary equipment. As an integral part of the power assembly a ground fault equipment receptacle, controller ON/OFF switch and cabinet light switch shall be provided. The power distribution assembly shall be integral to the entire load bay assembly and shall be located in the center of the panel. All components of the power panel shall be protected by a front panel that isolates and protects all parts of the power assembly. This panel shall be clearly marked as to the functions for both the power assembly and output load bay.

Where any harnesses are exposed to damage or handled frequently, the harness shall be covered by a protective nylon cover. Changing flash programming, from red to amber flash, shall be accomplished by easily moving jumpers on a separate terminal block located on the front of the load bay or by means of toggle switches from a control panel. All wires used in the cabinet shall be of the low temperature type and be rated for -40ºC to +105ºC.

A bracket shall be used to support all load switches and flashers and prevent them from vibrating out of position.

A small recessed police panel with a separate access door shall be contained within the front of the cabinet, with the following switches: "Signal AUTO/FLASH", "Signal AUTO/MANUAL". A maintenance panel located on the inside of the front door, with the following switches: "Signal ON/OFF", "Signal AUTO/FLASH", "Signal AUTO/MANUAL".

Auxiliary Devices

Auxiliary Devices including: Load Switches; Solid State Flashers; Flash Transfer Relays; and Inductive Loop Detector Units.

No Exceptions to be noted.

Cabinet

The cabinet shall be a Canadian Electrical Manufacturer Association (CEMA) Type 3 enclosure, fabricated from sheet aluminum with a thickness of 3.18mm (0.125 inches), type 5052 - H32 or equivalent. It shall provide weather and dust protection, with adequate strength to withstand reasonable vandalism protection to the control equipment.

The interior and exterior of the cabinet shall be properly cleaned and prepared for coating. The coating shall be a high quality ultra violet ray stable polyester powder paint (ASA 61 Grey), applied with a minimum thickness of 3 mil.

The cabinet shall include two (2) shelves with strong supports for placement of supplied signal controller and auxiliary equipment.

The main door of the cabinet shall include a police door. Both the main door and the police door shall be supported by continuous hinge. Included in the main door shall be ventilation louvers and an air filter (that fits tightly to the door) c/w sheet metal removable winter frost cover.

The cabinet shall be designed for base mounting on a Standard M or M1 signal cabinet concrete foundation.

The cabinet shall be equipped with a separately fused electric exhaust fan assembly for summer operations. The fan shall be thermostatically controlled and manually adjustable to turn on between +20ºC and +65ºC in increments of 10ºC or less. The cabinet shall also be equipped with a separately fused 350 watt finned (Fast Heat RV0200D1 or equal) heater assembly for winter operations. The heater shall be thermostatically controlled and manually adjustable to turn on between -20ºC and +10ºC in increments of 10ºC or less. The thermostats for the heater and exhaust fan shall be calibrated, labelled and installed on an easily accessible separate panel in the cabinet.

The cabinet shall be equipped with a switch and a fused lamp to illuminate the inside of the cabinet. Lamp shall be incandescent type.

Bus Interface Unit (BIU)

No Exceptions to be noted.

Documentation

Two sets of the following documentation shall be supplied:

- operation manual for the controller and MMU
- detailed controller programming chart
- cabinet wiring diagram
- MMU programming schematic
- any logic wiring diagrams that are applicable

One set of the documentation shall be placed in the controller cabinet inside a durable print pouch, which hangs in a convenient location not interfering with other equipment. The other set of the documentation shall be supplied to the Department directly.

400.2.18.2.13 Pedestrian Actuated Flashing Signal Control Unit

Control Unit Cabinet

The units shall be housed in a cast aluminum weatherproof cabinet. The cabinet shall be latched by a standard traffic control lock (three sets of keys to be supplied). It shall be supplied with mounting brackets capable of being used for mounting the cabinet on any size of conventional type of traffic pole.

Inspection and Testing

Approval from the electrical inspection authority must be obtained by the Contractor before the unit is installed in the field for full operations.

Manufacturer's Identification

The manufacturer's identification shall be on all major equipment supplied with this specification including the control unit assemblies.

Instruction and Wiring Diagrams

The Control Unit shall be supplied with complete installation instructions including a complete chart for field connections. Installation hardware and instruction, including limits of operation, along with service manual shall be provided. Two set of the documentation shall be supplied. One set of the documentation shall be placed in the controller cabinet inside a durable print pouch, which hangs in a convenient location not interfering with other equipment. The other set of the documentation shall be supplied to the Department directly.

Functional Specifications

The pedestrian actuated flashing signal control unit shall function as follows:

Upon actuation of the crosswalk sign/signals by a pedestrian pushbutton, the pedestrian indicator lights will come on approximately 5 seconds (adjustable in increments of one second from 0 - 180 seconds) after the crosswalk sign/signals starts operating and will terminate 10 seconds (adjustable in increments of one second from 0 - 180 seconds) before the crosswalk sign/signals stop.

The timer relays shall disengage the flash conditions of the crosswalk signals and indicator lights after all of the preset time periods and rest itself automatically. Successive pushbutton actuation shall not cause extension of the timer relays.

Standard Drawing TCS-F-701 illustrates a typical wiring scheme and a functional scheme for the pedestrian actuated flashing signal control unit. Other design methods and wiring configurations are acceptable as long as the functional requirements are produced by the Control Unit.

Reset Timers

Rest timers shall be capable of performing a single timed interval for a preset time when initiated by an external signal (pedestrian pushbutton). The reset timers shall function as follows:

a) Crosswalk Signals Flash Time - sets the length of crosswalk signals flash time
b) Pedestrian Indicator Lights Start Time - sets the start time for the indicator lights flashing (delay start in relation to crosswalk signals)
c) Pedestrian Indicator Lights Flash Time - sets the length of indicator flash time.

Wiring

The units shall be wired in such a manner as to be able to accept #14 awg wires for the signal lamp connections, #8 awg wires for the a.c. feed connections, and #14 awg wires for the pedestrian pushbutton connections. These connections shall be made at a suitable termination strip. All 116 VAC connections shall be fused.

Flasher

The flasher used to generate alternate power on and off cycles between the two output terminals shall be of the Solid-State type. It shall be a plug in module easily replaceable without any tools. It shall be supplied with a radio interference suppressor and two 116 VAC power outputs. The output alternating rate shall be adjustable from 60 to 120 cycles per minute. The outputs shall be capable of handling at least 10 amps of current draw.

Timer

The timers used to time the preset time periods shall be adjustable from 0 to 180 seconds in one second intervals.

Pushbutton Field Circuit

The field circuit to be used for the pedestrian pushbuttons shall not exceed 12 volts A.C. or D.C.

Service Entrance

The unit supplied shall be approved for service entrance by the electrical inspection authority.

400.2.18.2.14 Detector Loops

Loop Detector Conductor

In-road loop detectors shall be insulated single conductor No. 14 or No.16 RW90 XLPE stranded copper conductors.

Lead-In Cable

Lead-in cable shall be similar to Beldon 8720 shielded audio broadcast cable, consisting of two continuous unspliced #14 or #16 stranded tinned copper conductors. Exterior insulation shall be polyethylene or other material suitable for direct burial in wet ground conditions.

Loop Sealant

Loop sealant shall be "3M" detector loop sealant or equivalent.

400.2.18.2.15 Power Supply

The Contractor shall supply and install a power supply cabinet to house a loadcentre and an externally mounted power supply meter socket. The enclosure shall be CSA approved and consist of a CEMA 3 enclosure complete with a vandal resistant padlocked door, with ASA 61 gray enamel finish over rust resistant primer. The loadcenter shall include a 60 ampere main breaker, and an eight position branch circuit panel to service the traffic control cabinet, street lighting on the combination traffic poles, median flashers, etc.

Shop drawings shall be submitted for the Design Engineer and the Department for review and acceptance prior to fabricating the cabinet.

400.2.18.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.18.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.18.5 Construction

400.2.18.5.1 Wire, Cable and Grounding/Bonding

Wire and Cable

All installations of wire and cable shall comply with the Canadian Electric Code and the *Safety Codes Act* (Alberta) and regulations thereunder.

Cable runs must be separated by function. Traffic signal cables and any other 120V wires and cables shall be grouped together into one or more conduits with a #8 AWG bonding conductor. If spare conduits are available, low voltage detector cables should be grouped together in separate conduit(s). Communication cable shall be run in a conduit and junction box system that is completely separate from the system for 120V wires/cables.

Routing of bonding conductor, signal cable, and streetlight cable shall be carried out in accordance with Standard Drawing TCS-F-105, and as per the Conduit Schedule on the Detailed Designs. Where wires and cable pass through junction boxes, there shall be a minimum 300mm of slack left in each junction box, and also in pole handholes. Wire and cable shall be run continuous from the controller cabinet to the pole handhole - no splices are permitted underground in conduit or in junction boxes. In the case of detector loop wiring, splices between the loop conductors and the lead-in cable shall be made in the junction box in accordance with the installation procedures and requirements outlined in Section 400.2.18.5.7 (Detector Loops).

Wires and cables shall be labelled at each junction box and at the traffic cabinet with tags of a permanent nature. Labelling shall identify the purpose/destination of the cable using the following convention:

Cable Labelling Requirements:

Traffic signal cable	Pole ID - TS (e.g. Pole A - TS)
Streetlight cable	Pole ID - SL (e.g. Pole A - SL)
Microwave cable	Pole ID - MWD No. (e.g. Pole A - MWD2)
Loop Lead-In Cable	Loop No. - Traffic Movement (e.g. Loop 3-EBLT) (LT - Left Turn, RT - Right Turn, TH - Through) (Loop No. denotes signal phasing)

Signal Control Cable

Standard colour coding for the IMSA signal control cable is shown on Standard Drawing TCS-F-101. The size and number of signal cables pulled to each traffic pole shall be as per the Conduit Schedule on the Detailed Designs.

Traffic Signal Poles

Each traffic signal and pedestrian head shall be separately wired to the base of the pole utilizing a #14 AWG stranded signal cable and a #14 AWG fixture bonding conductor. All common connections shall be made accessible from the handhole at the base of the pole. Cable and wires from the mast arm hanger to cable entrances shall be bundled/taped together.

Where the Contractor is required to drill and tap the steel poles for wire outlets, rubber grommets shall be used to prevent abrasion to the signal cables. If requested by the Design Engineer and the Department, the Contractor shall drill additional cable entrances on the steel poles for future signal head mounting locations. The drilled holes shall be touched up with a cold galvanizing compound and plugged to minimize entrance of moisture.

Traffic Cabinet

Field wiring shall be dressed and routed in corners of the cabinet to the various terminal boards or blocks, secured by plastic locking cable ties, lacing or preformed plastic spiral wrapping harness and fanned out neatly from the harness to each terminal. Individual leads shall be long enough to permit re-routing to different terminals at a later date should this be required or as specified in the Detailed Designs. All conductors shall be stripped such that the amount of exposed conductor protruding from the terminal block does not exceed 3mm.

Splices

Splices in both aerial and underground cable must be electrically sound and waterproof. Splices shall be located in pole handholes. Splices are not permitted in conduit runs or within signal fixtures or within a pole base if not readily accessible through a handhole. No splices or joints of cable shall be drawn inside conduit.

Grounding

Service Ground

The intersection service ground will be connected to the power supply cabinet, and NOT to the traffic cabinet. The service ground shall consist of a minimum three 21mm diameter x 3.0m long copperclad ground rods on a #6 AWG bare copper ground conductor. The three ground electrodes shall be spaced 3.0 metres apart, forming an equilateral triangle (3m x 3m x 3m), and located at least 5.5 metres from either the traffic controller or the power supply cabinets. The service ground shall be bonded to the neutral side of the main power disconnect breaker with one #6 AWG conductor in a single circuit.

Fixture Bond

A #8 AWG insulated bonding conductor shall be installed throughout all conduits containing live 120 AC conductors and shall connect all poles, pole fixtures, luminaries, steel junction box lids, and metal conduit to the grounded or neutral side of the AC power supply.

Lightning Attenuation

The Contractor shall install a 21mm diameter x 3.0m long copperclad lightning electrode in the junction box adjacent to all main traffic poles (i.e. cantilever poles, cantilever combination poles, and signal bridges. Pedestal poles, in most cases, can be installed without lighting electrodes located immediately adjacent to them), and connect the lightning electrode to the pole bonding stud with a #6 AWG conductor.

400.2.18.5.2 Conduits and Junction Boxes

Conduits

Refer to Section 400.2.6 (Underground Electrical Conduits), for general requirements related to conduit installations. Additional requirements related to conduit works in a traffic signals project are provided in this Section 400.2.18.5.2 (Conduits and Junction Boxes).

The Contractor shall install the conduits in accordance with the size, quantity, location, and installation method as specified on the Conduit Schedule and Underground Installations plan on the Detailed Designs. If the installation method is not specified on the Detailed Designs, acceptance from the Design Engineer and the Department shall be obtained prior to conduit installation. Any deviation from the design on the Detailed Designs shall be pre-approved by the Design Engineer and the Department.

For traffic signal work, all underground conduit that runs underneath a roadway surface shall typically be installed at a minimum depth of 1.2m. Where it is necessary for conduits to cross over other conduits, a minimum separation of 150mm shall be provided between the crossing conduits. Where it is necessary for conduits to cross over utilities, a minimum separation of 300mm shall be maintained. Where local authorities have different separation requirements from their underground utilities, the more stringent (i.e. farther apart) requirements will govern unless otherwise authorized by the Design Engineer, the Department or representative of the Local Authority. Where conduits are installed prior to placing roadbed granular materials, the conduits shall be protected with a minimum cover of 300mm of compacted materials.

All conduits shall be installed free from dents and bruises and, as soon as installed, shall have the ends plugged to prevent the entrance of dirt or moisture. All conduits shall be thoroughly cleaned out before installation of conductors. All unused conduits shall be capped. Multiple bends in opposing directions are not permitted.

Conduit entrances into junction boxes designated for fibre optic cable installation shall be installed so that conduit designated for communication is capable of accommodating a minimum of 230mm bend radius and a minimum of 300mm clearance from the top of the cable bend to the top of the junction box.

The Contractor shall demonstrate to the Design Engineer and the Department the conditions of conduit connections by using an air compressor to blow a suitably sized Styrofoam ball through the conduit system. The Contractor shall use a red pen to record the location, alignment, quantity, size, installed depth, and installation method of all conduits on the Detailed Designs. Any deviation from the Detailed Designs shall be clearly marked.

Junction Boxes

The Contractor shall install junction boxes in accordance with the size and location as specified on the Underground Installations plan on the Detailed Designs. Any deviation from the design on the Detailed Designs shall be pre-approved by the Design Engineer and the Department. Field location of all junction boxes shall be accepted by the Design Engineer and the Department.

Junction boxes shall be rested on a 100mm layer of compacted gravel. The cover of the junction boxes shall be level with the surrounding surface. Ground surface adjacent to a junction box should provide slope to direct surface runoff away from the junction box.

The Contractor shall use a red pen to record the location, quantity, and size of all junction boxes on the Detailed Designs. Any deviation from the Detailed Designs shall be clearly marked.

Backfilling

Conduits installed by trench excavation must be backfilled with a trench marker tape placed 300mm below ground level, or provide at least 300mm separation above the installed conduit. The Design Engineer and the Department shall be notified prior to backfilling over any electrical conduits. Trenches shall not be excessively wet and shall not contain pools of water during backfilling.

400.2.18.5.3 Foundations

The locations of the traffic pole bases and cabinet bases shall be as specified on the Detailed Designs, and will be subject to field confirmation by the Design Engineer and as accepted by the Department. If obstructions or other existing conditions cause problems with the placement of the traffic pole bases or cabinet bases, the Design Engineer and as accepted by the Department may direct that a different location be used. Any deviation from the design on the Detailed Designs must be pre-approved by the Design Engineer and the Department.

The Contractor shall use a red pen to record the approved as-built location, quantity and size of all pole bases on the Detailed Designs.

Precast Cabinet Base and Pole Base

Excavation required for the installation of the precast cabinet base and the precast pole bases shall be performed in such a manner as to avoid any unnecessary damage to streets, sidewalks, landscaping and other improvements. Excavation shall not be performed until immediately before installation of the precast concrete bases. At the end of each working period, all excavations shall be barricaded or covered, or both, to provide safe passage for pedestrian and vehicular traffic.

The precast cabinet bases shall be installed with the top of the base mounted at 600mm above the surrounding ground surface. The controller cabinet base shall be placed on a minimum 100mm layer of compacted granular material.

Precast concrete pole bases shall rest directly and solidly on the bottom of the hole. The top of the pole bases shall be up to 25mm above the existing or new curb and sidewalk, or up to 100mm above finished grade where there is no curb or sidewalk, except in sloped areas where they shall be up to 300mm above finished grade or as per requirements shown on the Detailed Designs, whichever is less.

A 900mm diameter hole shall be excavated either by auger or hydrovac for precast concrete pole bases for cantilever or cantilever combination poles. A 600mm diameter hole shall be excavated for precast pole bases for pedestal poles. The Contractor shall thoroughly compact the bottom of the hole. Unsuitable material at the bottom of the holes shall be replaced with granular material. All surplus excavated materials shall be properly disposed of by the Contractor.

Excavated material from augering the foundation holes shall not be used for backfilling around a precast concrete pole base. Lean mix concrete with a minimum 15 MPa 28 day compressive strength shall be used for backfilling. Alternatively, cold mix asphalt can be used, with compaction, for backfilling.
Allowable tolerances for precast concrete cabinet bases and pole bases are as follows:

Tolerance Limits:

Cabinet Bases:	Horizontal location (base centre)	+/- 100 mm
	Vertical location (top of base)	+/- 50 mm
Pole Bases:	Horizontal location (pole base centre)	+/- 50 mm
	Vertical location (top of pole base)	+/- 25 mm
Anchor Bolts:	Horizontal location (relative to centre of pole base)	+/- 25 mm
	Bolt circle diameter (B.C.D.)	+/- 10 mm
	Vertical location (from top of pole base)	+/- 15 mm

Situations where more stringent tolerance limits are required will be indicated in the Technical Requirements or on the Detailed Designs. The more stringent tolerance limits shall be adhered to.

Cast-In-Place Pole Base

The Contractor shall install casing for pole bases as per dimensions specified on the Pole Schedule on the Detailed Designs.

Steel cage for the cast-in-place pole base must be constructed as per the reinforcement quantities, lengths and dimensions as per Standard Drawings TCS-F-301.1, 305.1, and 310. The anchor rods for the signal supports shall be physically bonded to the steel cage by either spot welds or reinforcements ties. The anchor rod assembly shall be centred on the pole base. The Contractor shall use 50mm concrete spacer blocks at the perimeter of the steel cage assembly and the sonar tube shall be erected to plumb. If the sonar tube is not positioned to plumb, it must be extracted and the drill hole or hydrovac hole be enlarged so that the sonar tube can be positioned vertically.

The anchor rod shall be positioned so that the erected mast arm on the signal support shall be perpendicular to the approaching travel lanes, unless specified otherwise on the Detailed Designs. Before the concrete is poured, the steel cage and the sonar tube must be ready and in position, and the anchor rod assembly must be secured to the steel cage and wrapped to protect the anchor bolt assembly from the concrete pour.

A 25mm chamfer shall be provided by using preformed formwork around the inside ring of the sonar tube for the purpose of establishing the top level of the pole base, provide a reference point for finishing the top of pole base, and to form a 25mm chamfer around the perimeter of the top of the finished pole base. The length of anchor rod protruding from the top of the pole base shall be as per Standard Drawings TCS-F-301.1, 305.1, and 310.

Place concrete in accordance with CAN3-A23.1. Use Hot Weather Concrete protection procedures when air temperature is at or above 25ºC. Use Cold Weather Concrete protection procedures when air temperature is at or below 5ºC. Concrete shall not be placed on frozen subgrade or subbase. Water shall not be added to the concrete after the concrete truck arrives at the work site.

Obtain acceptance from the Design Engineer and the Department before placing concrete. Steel cage for pole base shall be checked before concreting for cleanliness, secure connection to anchor bolts, and a minimum 50mm cover between steel cage and the sonar tube casing or the drilled hole. Copies of the concrete tickets shall be submitted to the Department after concreting as a record of the type of concrete used and the ambient conditions during concreting.

Ensure pile casing and anchor bolts are not disturbed during concrete placement. The allowable tolerances for the cast-in-place concrete pole bases are as follows:

Tolerance Limits:

Pole Bases:	Horizontal location (pole base centre)	+/- 50mm
	Vertical location (top of pole base)	+/- 25mm
	Vertical plumb (side of pole base)	+/- 5 degrees
Anchor Bolts:	Horizontal location (relative to centre of pole base)	+/- 25mm
	Orientation of the anchor bolt	+/- 10 degrees
	Vertical location (from top of pole base)	+/- 15mm

The above tolerances shall be measured and checked by the Design Engineer and the Department after the concrete is set and the concrete form tube casing is stripped from the pole base.

Situations where more stringent tolerance limits are required will be indicated in the Technical Requirements or on the Detailed Designs. The more stringent tolerance limits shall be adhered to.

<u>Galvanized Steel Helix Pole Base</u>

The allowable tolerances for the helix pole bases are as follows:

Tolerance Limits:

Pole Bases:	Horizontal location (pole base centre)	+/- 50mm
	Vertical location (top of pole base)	+/- 25mm
Anchor Bolts:	Horizontal location (relative to centre of pole base)	+/- 25mm

Bolt circle diameter (B.C.D.)	+/- 10mm
Vertical location (from top of pole base)	+/- 15mm

Situations where more stringent tolerance limits are required will be indicated in the Technical Requirements or on the Detailed Designs. The more stringent tolerance limits shall be adhered to.

Salvaged Pole Base

Precast pole base to be salvaged shall be cleaned by the Contractor prior to delivery to the destination specified on the Detailed Designs.

400.2.18.5.4 Signal Supports

Refinishing Poles

Any spots where the galvanizing of the signal poles is damaged due to drilling, tapping, reaming, welding or surface damage during transportation and erection shall be refinished with an approved cold galvanizing compound. The application of the cold galvanizing compound shall be in accordance with the following:

a) The surface preparation and application of the compound shall be performed under the supervision or authorization of the Design Engineer and as accepted by the Department. Any unsupervised or unauthorized application shall be completely removed and redone under proper supervision.

b) The surface must be mechanically cleaned with a wire brush or grinder and chemically cleaned to remove all welding flux, grease, oil, rust, scale and other dirt.

c) The surface shall be absolutely dry and the ambient temperature shall be over 10ºC.

d) The cold galvanizing compound shall be thoroughly stirred before using until it has a completely uniform appearance. No thinning agent shall be added unless the Contractor is instructed to do so by the Design Engineer and as accepted by the Department.

e) A single brush coat shall be applied. This coat shall be as thick as possible without causing runs in the finished surface.

f) The brush shall be dipped to the bottom of the can each time. Periodic stirring of the can during painting is required.

g) Complete drying time can be as long as 48 hours so the application shall be timed so that the treated surface is not subject to damage or abrasion to other work within 48 hours of the time of application.

Signal / Sign Poles

The signal/sign poles shall be plumbed by the Contractor so that they are vertical when viewed from all directions. The plumb will be checked by the Design Engineer and the Department and the Contractor shall make any adjustments which are necessary by installing levelling shims as required around the anchor bolts. If requested by the Design Engineer and as accepted by the Department, the Contractor shall grout underneath the shimmed pole base plate with a flowable and expansive high-strength grout compound, such as Sika 232, designed for such purposes. The Contractor shall obtain approval from the Design Engineer and as accepted by the Department prior to using a selected grout compound.

The signal poles shall be oriented so that the mast arms are perpendicular to the approaching travel lanes, unless specified otherwise on the Detailed Designs. Where practical, the signal poles shall be positioned with the handhole in the back of the pole or, if not possible, on the downstream traffic side of the pole.

Flange connections between all signal pole pieces shall be secured by means of bolts, washers and double nuts on each bolt in accordance with the torque recommended on the support structure shop drawings.

400.2.18.5.5 Pole Mounted Traffic Control Fixtures

The Contractor shall install traffic signal heads and other traffic control fixtures including signs, microwave detectors, and pushbuttons on the signal support as per the Pole Schedule on the Detailed Designs. The Contractor shall be required to drill and tap the steel poles as required. All drill holes shall be further protected by a rubber grommet.

Standard mounting height and location of the pole mounted traffic signals, pedestrian signals, and pushbuttons shall be in accordance with Standard Drawing TCS-F-501.

Standard mounting hardware arrangement for traffic and pedestrian signals on pedestal poles shall be in accordance with Standard Drawing TCS-F-505.

Standard mounting hardware arrangement for traffic and pedestrian signals on the side of the signal pole (such as secondary heads) shall be in accordance with Standard Drawing TCS-F-510.

Standard mounting hardware arrangement for traffic signals, either horizontally or vertically, on the mast arm of a cantilever or combination pole shall be in accordance with Standard Drawing TCS-F-515. A minimum vertical clearance of 5.8m shall be provided between the bottom of the fixtures on the mast arm and the final pavement surface. This vertical clearance requirement is also applicable to large overhead signs such as special crosswalk sign and advance warning signal sign. The location and position of all pole mounted fixtures including traffic signal heads and pedestrian signal heads, pushbuttons, signs, and microwave detectors shall be checked with the Design Engineer and the Department in the field prior to final mounting.

All conductors from mast hangers to cable entrances shall be taped together.

The Contractor shall completely covered the signal heads, pedestrian signal heads, pushbuttons, and all signs that provide conflicting messages to the current traffic operating arrangements, from the time they are installed until the system is turned on for full operation.

Installation of microwave detectors shall include aiming and positioning of the detector to provide a desirable detection zone as per the Detailed Designs.

The following items shall be inspected by the Design Engineer and the Department after all traffic control fixtures are mounted and secured on the support structures:

- Position and quantity of overhead signs, signal heads and other traffic control fixtures shall be checked for compliance with the Above Ground Installation Plan and Pole Schedule on the Detailed Designs.
- Alignment of signal head and overhead signs to travel lane shall be checked with reference to the Above Ground Installation Plan on the Detailed Designs.
- Type and detailed configuration of signal head mounting hardware shall be checked for compliance with the Above Ground Installation Plan and Pole Schedule on the Detailed Designs, Standard Drawings TCS-F-501, 505, 515, 520, and 525.
- Alignment of pedestrian signal heads shall be checked for visibility from pushbutton location across the street.
- Mark on traffic signal head lens covers shall be checked for signal lenses alignment.
- Vertical clearance for traffic control fixtures mounted on the mast arm shall be checked if the 5.8m minimum value is provided.
- All exposed cables shall be checked for presence of jacket insulation
- All unused signal cable wires shall be checked to ensure that they are taped off or grounded.

400.2.18.5.6 Traffic Signal Controller Unit and Cabinet

Controller Timing Programming

The Contractor is responsible for programming the controller, verifying proper/expected operation through testing, and final turn-on verification of the provided timings. The Contractor shall develop the signal timing plans, in a generic format, for the traffic controller at least 4 weeks before the expected traffic signal start-up date so that the Contractor can arrange for proper bench testing of the controller cabinet.

Bench Testing

Cabinets shall be pre-wired at the Contractor's shop to simulate all field operations as per the traffic signal design on the Detailed Designs. The cabinet shall be configured to operate as per the designs provided, including timing, phasing and any additional control logic. When full compliance with the designs has been confirmed, the cabinet shall be bench tested for a period of 48 hours to verify proper operation. All timing plans and time-of-day plans must be tested. Prior to and after all bench testing, a full MMU test must be performed.

At the end of the bench testing process, the Contractor shall arrange for an inspection by the Design Engineer and the Department. The Contractor shall demonstrate to the Design Engineer and the Department during this inspection that the Controller Cabinet is wired and operating as per the design illustrated on the Detailed Designs, using the preliminary traffic signal timings provided by the Design Engineer.

The following reports shall be submitted to the Design Engineer and the Department at the time of the inspection at the Contractor's shop:

- A printed report of the conflict monitor test results
- Bench test and flash test reports
- A copy of the controller cabinet wiring drawing

Delivery to the Field

All equipment shall be delivered to the site free from any scratches or dents. Equipment will be rejected if noted that it has signs of any damage at time of the Construction Completion inspection.

Field Wiring

Field wiring shall be terminated as indicated on the cabinet wiring drawing and shall be dressed and routed in corners of the cabinet to the various terminal boards or blocks, secured by lacing, cable ties, or preformed plastic spiral wrapping harness and fanned out neatly from the harness to each terminal. Individual leads shall be long enough to permit re-routing to different terminals at a later date should this be required or specified in the Technical Requirements.

Wires and cables entering the traffic cabinet shall be labelled with tags of a permanent nature. Labelling shall identify the purpose of the cable (i.e.: Pole A-TS for traffic signal cable to Pole A). Refer to Section 400.2.18.5.1 (Wire, Cable and Grounding/Bonding) for cable labelling requirements. Colour coding of the traffic signal cable and conductors shall be in accordance with the requirements outlined in Section 400.2.18.5.1 (Wire, Cable and Grounding/Bonding). The load switches and detector racks shall be labelled with a thick, black permanent marker the corresponding signal phasing the component is serving.

Any field modification to the wiring of the cabinet must be documented by marking up the controller cabinet wiring diagram. A copy of the marked-up drawing shall be submitted to the Design Engineer and the Department for records as part of the record drawing package.

The following items will be tested by the Design Engineer and the Department as part of the Construction Completion inspection of the Controller Cabinet Installation:

- Check for number of conduits entering the cabinet
- Check ground connection
- Check signal timing values
- Check signal phasing and detector phasing are as per Phasing Diagram and Above Ground Installations Plan on the Detailed Designs, and as per the Wiring Diagram accompanying the Controller Cabinet
- Cleanliness
- Labelling of cables and auxiliary components in the controller cabinet such as load switches, and detector amplifiers.

Cabinet Sealing

The bottom of the controller cabinet contact with the concrete pedestal shall be sealed with a silicon base compound to prevent infiltration of dust and moisture.

400.2.18.5.7 Detector Loops

The Contractor is responsible for roadway cutting and patching for detector loop installation at locations indicated on the Underground Installation plan on the Detailed Designs.

Wire Loop Assembly

Diamond detector loops shall be installed as per the dimensions and methods as shown on Standard Drawing TCS-F-801.

Rectangular detector loops shall be installed as per the dimensions and methods as shown on Standard Drawing TCS-F-805.

Quad detector loops shall be installed as per the dimensions and methods as shown on Standard Drawing TCS-F-810.

For total lead-in length is more than 100m, the number of windings should be increased by one.

When multiple loops are used, they should always be connected in series for maximum efficiency and greater reliability.

Conductor feeder pairs from loop to junction box shall be taped together every 0.3m and twisted to provide a minimum of 15 turns per metre.

Adjacent loops serving a similar purpose shall be wired to provide current flow in the same direction (all clockwise or counter-clockwise). Adjacent loops serving separate traffic phases shall be wired to provide current flow in different directions (one clockwise and once counterclockwise).

Pavement Slot Cutting

The locations of the detector loops shall be marked on the pavement as per the Detailed Designs. To minimize cross-talking between detector loops, the home runs of the detector conductor towards the roadside shall be located a minimum of 300mm apart. At roadside where the home run enters the loop conduit connecting to the junction box, a minimum of 75mm separation should be provided between home run slots. Maintain minimum 300mm separation between loop conduits.

The depth of the saw cut and the saw cut width shall meet the requirements outlined on Standard Drawings TCS-F-801, 805, and 810. Saw cut shall be straight and be overlapped at corners to ensure that the full depth is cut. Diagonal saw cut of 45 degrees shall be used in all 90 degree corners of the detector loop.

Loop Installation

Remove all jagged edges and protrusions along the slot. The saw cut slots shall be cleaned by flushing with water and dried by blowing with oil free compressed air.

Place a small amount (5 to 10mm) of loop sealant as a base. Carefully lay loop wire in the slot avoiding any kinking or stretching of the insulation and seat each turn using a blunt tool such as a wooden paint stirrer, but not a screwdriver or other such sharp object. Hold wire in place (minimum 35mm below the surface of the roadway) with a backer rod. Push backer rod tight against conductors.

One continuous, unbroken length of wire shall be used to form a loop of the number of windings required from the loop to the junction box in accordance to Standard Drawings TCS-F-801, 805, and 810. Conduit connection at the roadside shall be installed in accordance with Standard Drawings TCS-F-815 and 815.1. Seal both ends of the flexible conduit with electrical cable sealant compound to prevent water from entering the conduit.

<u>Sealing of Pavement Slot Cuts</u>

Install detector loops and seal pavement slot cuts in the same day. Immediately prior to the application of loop sealant, saw cut slots must be thoroughly blown dried by using a high pressure air compressor.

Apply sealant in accordance with manufacturer's instructions. Apply the sealant in multiple (minimum 2) passes to prevent loop wire insulation damage and allowed to set prior to allowing vehicles to cross the loop.

Ensure that sealant completely surrounds detector loops and all hold down materials. Air bubbles which will leave voids must be removed and excess material smoothed out. Ensure that the slot is completely filled with sealant to 2 mm below the surface of the pavement. Any excess sealant or spillage shall be removed. The sealant shall be covered with dry cement powder or fine sand.

<u>Splice between Loop Conductor and Lead-In Cable</u>

Splices into the lead-in cable at the junction box shall be twisted, soldered and sealed using heat shrink connectors as per Standard Drawing TCS-F-820. All pair splices shall be sealed separately. Coil 1.0m of the lead-in cable in the junction box. No other splices to the lead-in cable are allowed. The splicing arrangement shall be done in accordance with the Detector Schedule on the Detailed Designs. Lead-in cable run back to the controller cabinet shall be installed in accordance with the Conduit Schedule on the Detailed Designs. Lead-in cable shall be grounded at the controller cabinet only. At the twisted feeder cable end, the ground wire of the lead-in cable shall be cut off flush and not connected to the ground.

<u>Identification</u>

Shielded cables shall be identified by labelling mechanically using identification tags by loop numbers and signal phases. Labelling shall be done with indelible marking pen. Label the shielded cables at the junction box and at the controller cabinet.

<u>Tests</u>

All splices shall be carefully made to ensure constant low resistance and be insulated in such a manner that, under the prevailing environmental conditions, the installation maintains resistance to ground of not less than 10 megohms. To ensure that the loop installation is correct, a continuity check on the loop wiring and a resistance check on the loop to ground using a "megger" or other suitable insulation tester shall be performed.

All tests shall be performed by the Contractor in the presence of the Design Engineer and the Department. The Contractor shall arrange for a field inspection by the Design Engineer and the Department. A minimum of two (2) Business Days notice is required to arrange for the inspection. Replace any loop or lead-in cable that fails the tests. Repeat test after completion of detector loop installation.

400.2.18.5.8 Power Supply Cabinet

Power Supply Cabinet

The power supply cabinet shall be pole mounted or concrete base mounted as indicated on the Detailed Designs. When mounted on a pole, the power supply cabinet shall be mounted securely using stainless steel straps. Rigid PVC conduit and fittings shall be installed on the pole using PVC conduit straps and galvanized lag screws at 1.5m maximum centers. When mounted on a concrete base, the bottom of the power supply cabinet that is in contact with the concrete base shall be sealed with proper weatherproof compound to prevent infiltration of dust and moisture.

The power supply cabinet shall be installed at least 11m away from the traffic controller cabinet.

Grounding and Bonding

Service Ground

When a power supply cabinet is included on the Detailed Designs, the intersection service ground will be connected to the power supply cabinet and shall consist of a minimum three 20 mm diameter x 3.0m long copperclad ground electrodes, spaced 3.0m apart on a #6 AWG bare copper ground conductor, and arranged in a equilateral triangle formation. The service ground shall be bonded to the neutral side of the main power disconnect breaker with one continuous #6 AWG conductor. The intersection service ground electrodes shall be installed at a minimum of 5.5m from both the traffic control cabinet and the power supply cabinet.

Bonding

A #8 AWG green bonding conductor shall be installed from the power supply service cabinet to the traffic control cabinet and to each traffic signal pole and street light pole supplied by the power supply service cabinet.

Where bonding conductors are spliced in a junction box, a copper split bolt connector shall be used to join the associated conductors together.

From each pole fixture, a bonding conductor shall be installed to the bonding stud at the base of each pole.

Lightning electrodes are to be connected to the bonding stud at the base of each pole.

400.2.18.6 Product Acceptance

A Signals Completion Inspection is required to demonstrate and determine that all parts of the traffic signal system function as per design prior to the signal actually being turned on for public traffic.

When the Contractor has finished all necessary wiring, obtained approval from the electrical inspection authority, entered into the traffic controller the traffic signal timings, and is confident that the signal system will operate satisfactorily; he shall inform the Design Engineer and the Department and request for a Signals Completion Inspection of the signal system. The Contractor shall submit a set of as-built drawings to the Desing Engineer and the Department as part of the Signals Completion Inspection. The as-built drawings shall indicate (in red) the location and accurate alignments of all junction boxes, conduits, poles, detector loops, and other equipment or fixtures installed, as well as all changes, additions, deletions, or any other modifications made to the original design. A minimum of two (2) Business Days notice is required for scheduling the inspection.

In preparing for Signals Completion Inspection, the Contractor shall carry its own inspection to verify that all materials and equipment are in place and secure, and the traffic signal equipment and detectors are functioning. The results of such tests shall conform to the requirements of the Canadian Electrical Code and shall be to the satisfaction of the electrical inspection authority, the Design Engineer and the Department.

(a) If the Design Engineer or the Department decides that the results of the Signals Completion Inspection are unsatisfactory, a subsequent Signals Completion Inspection shall be arranged. The signal heads shall be either bagged or turned down if the traffic signal is not ready to go into a flashing mode.

(b) If the test results are satisfactory to the Design Engineer and the Department, the signal system will be left in a flashing mode. A date for Signal-Turn-On, usually 3 to 7 days later, will be selected by the Department for switching the traffic signal from a flashing mode to a fully operational mode. The Design Engineer or the Department may identify a list of deficiencies which must be rectified by the Contractor prior to the Signal-Turn-On Date.

(c) During both Signals Completion Inspection and Signal-Turn-On, the Contractor shall ensure that a qualified representative of the company, familiar with the equipment installed, is on site until it has been demonstrated that all equipment functions as intended on the Detailed Designs and in the Technical Requirements, and to the satisfaction of the Design Engineer and the Department.

A Signals Completion Certificate will be issued to the Contractor if the traffic signal system has been operating satisfactorily for a pre-specified burn-in period after Signal-Turn-On. For traffic signal installations located near an urban centre or is close to a local Alberta Transportation Maintenance Contract Inspector (MCI) office, a 7-day burn-in period is required. For traffic signal installations located outside an urban centre, or more than 100km from a local Alberta Transportation MCI office, a 14-day burn-in period is required.

400.2.18.6.1 Warranty

Notwithstanding the DB Agreement and the Technical Requirements, the two year warranty period in respect of the work on the Project required in this Section 400.2.18 (Traffic Signals) will commence on the later of: the date following the successful completion of the burn-in period; or upon the date of issuance of the Construction Completion Certificate.

400.2.18.7 Measurement

400.2.18.7.1 Underground Electrical Conduit

Measurement for conduit installation will be in accordance with Section 400.2.6 (Underground Electrical Conduits) - Trench Excavation or (Underground Electrical Conduits) - Pushed Conduit as applicable.

400.2.18.7.2 Secondary Cable

The quantity of secondary cable will be based on the length in metres of trench excavated for the installation of underground wiring as measured along the centreline of the trench. No additional measurement will be made for the requirement for extra connecting cable at run terminations or for cable wiring installed at variance with a straight line.

400.2.18.7.3 Removal and Salvage of Existing Standards

Measurement for the removal and salvage of existing standards will be made per unit.

400.2.18.8 Payment Adjustment

Intentionally Deleted

400.2.19 SUBGRADE PREPARATION

400.2.19.1 General

Subgrade shall be considered as the soil surface on which a subsequent layer or layers of granular base course, granular fill, gravel surfacing, surface treatment, pavement or other material is to be placed.

400.2.19.2 Materials And Procedures

In addition to the specific requirements included in the Technical Requirements, the conditions requisite for suitable and completed work will be a subgrade which is smooth and compacted over the entire surface area and with an in-place, long-term, subgrade support value that meets or exceeds the value indicated in Section 200 (Project Specifics).

400.2.19.3 Quality Management Sampling And Testing

400.2.19.3.1 General

Quality management testing is the responsibility of the Contractor. Tests performed by the Department will not be considered to be quality management tests.

The Contractor shall use Professional Engineering services and a qualified testing laboratory, licensed to practice in the Province of Alberta, to assess and where necessary, modify the materials/procedure to ensure the end use meets the Technical Requirements.

The Contractor shall provide and maintain equipment and qualified personnel to perform all field testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the work.

The Contractor shall be responsible for the cost of quality management and shall be responsible for the cost of all consulting services retained by him.

All quality management sampling and testing will be carried out in accordance with the Contractor's "Quality Management System (QMS)", Table 400.2.19.4.2.1, and the Technical Requirements.

Copies of all quality management tests shall be submitted to the Department within 24 hours of the completion of each test.

400.2.19.3.2 Test Methods

Inspection, sampling, and testing to follow requirements of Table 400.2.19.4.2.1. Alternative or supplemental test methods may be used but shall be outlined in the QMS.

400.2.19.4 Acceptance Sampling And Testing

400.2.19.4.1 General

Acceptance sampling and testing of the work will be undertaken by the Department.

The Department will, from time to time, take samples and carry out testing and inspection of the workmanship and materials incorporated or being incorporated into the work in order to ensure compliance with the Technical Requirements. The Contractor shall cooperate with the Department for such sampling, testing, and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the work strictly in accordance with the requirements of the Technical Requirements.

The Department is under no obligation to provide the Contractor with test results.

400.2.19.4.2 Test Methods

Various alternative test methods may be used by the Department to confirm that the Technical Requirements are being met.

In cases of dispute regarding the degree of compaction and/or moisture contents, all testing to confirm compliance with the Technical Requirements will be carried out by the Department, using the most recent edition of the following standard test methods indicated in Table 400.2.19.4.2.1.

TABLE 400.2.19.4.2.1
SAMPLING and TESTING METHODS

	Test Descriptions	Method No.
1.	Classification of Soils for Engineering Purposes	ASTM Designation D2487 (1)
	a) Determining the Liquid Limit of Soils	AASHTO Designation T 89
	b) Determining the Plastic limit and Plasticity Index of Soils	AASHTO Designation T 90
	c) Particle Size Analysis of Soils	AASHTO Designation T 88
2.	Soils Identification, Hand Method	ATT-29
3.	Moisture-Density Relation	
	a) Standard Compaction, - 5 000 μm Material	ATT-23
	b) Standard Compaction, + 5 000 μm Material	ATT-19
	c) One-Point	ATT-20
4.	Density	
	a) In-Place, Sand Method	ATT-9
	b) In-Place, Balloon Method	ATT-8
	c) In-Place, Nuclear Method	ATT-11
5.	Moisture Content	
	a) Oven Method, Soil and Gravel	ATT-15, Part I
	b) Microwave Oven Method	ATT-15, Part IV
	c) Speedy Moisture Teller	ATT-44
	d) In-Place, Nuclear Method	ATT-11
6.	Correction Factors, Nuclear Moisture-Density Measurements	ATT-48

Notes:

(1) As modified by the Prairie Farm Rehabilitation Administration (PFRA) to include medium plastic clay with the symbol CI.

(2) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specifications 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Section 400.2.20 (Aggregate Production and Stockpiling).

400.2.19.5 Construction

400.2.19.5.1 Subgrade Excavation

Subgrade soil or previously existing, failed surfacing materials, designated as undesirable by the Design Engineer or the Department, shall be excavated, removed, and disposed of.

Existing topsoil that may be disturbed by the excavation work shall be stripped and stockpiled prior to the subgrade excavation work. All disturbed areas shall be covered with the stockpiled topsoil in accordance with Section 400.2.5 (Topsoil Placement), and seeded in accordance with Section 400.2.14 (Seeding).

The Contractor shall assume ownership of the excavated material and shall remove it from the roadway to its own storage or disposal site; or otherwise dispose of the material to the satisfaction of the Design Engineer and the Department. Written approval from the landowner of the disposal site, including proof of the disposal site cleanup shall be submitted to the Design Engineer and the Department before payment for the work will be made.

400.2.19.5.2 Preparing Subgrade Surface

The subgrade shall be scarified to a depth of 150mm, unless otherwise specified. The loosened material shall be windrowed to the side and the exposed surface shall be thoroughly compacted. The windrowed material shall then be uniformly mixed, shaped to conform to the dimensions, lines, grades, and cross-section as established by the Detailed Designs. The subgrade shall be compacted to obtain an average of 100 percent, with no test results being less than 97 percent, of the maximum dry density at optimum moisture content established by the Moisture-Density Relation tests using standard compaction. Approved material shall be added or removed to restore true grade and cross-section as directed by the Design Engineer and as accepted by the Department.

When material varies from optimum moisture content, it shall be treated in the following manner. When a deficiency in moisture content exists, the material shall be watered and thoroughly mixed until optimum moisture content is attained. When an excess in moisture content exists, the material shall be worked and aerated until optimum moisture content is attained. The incorporation/use of lime or any other material to assist in drying material shall be entirely at the Contractor's discretion.

Where required, the subgrade shall be prepared to a depth exceeding 150mm on sections of the roadway as designated by the Design Engineer and as accepted by the Department. When such work is required, it shall be carried out in layers, each of which do not exceed 150mm in depth, and requirements for density and optimum moisture as specified above shall apply for each layer.

Subgrade ramps of whatever nature at approaches to railway crossings, bridge structures or adjacent to fixed obstructions, shall be removed to the lines and grades indicated in the Detailed Designs or as directed by the Design Engineer and as accepted by the Department. When the surplus material has been removed, the subgrade shall then be prepared in accordance with the Technical Requirements.

The Contractor shall repair any damages to a prepared subgrade surface, as well as, repair damages done to culverts by his equipment and shall remove any obstructions he may have placed which will interfere with the normal function of a drainage system.

400.2.19.5.3 Preparing Subgrade Surface on Combined Grading and Surfacing Projects

Where the Detailed Designs specifies grading and subsequent base course and/or paving work on the same area, subgrade preparation shall be performed as required between the separate phases as determined and directed by the Design Engineer and as accepted by the Department. Subgrade preparation work, when so ordered by the Design Engineer and as accepted by the Department, will be performed according to the specified requirements of Section 400.2.19.5.2 (Preparing Subgrade Surface).

Subgrade preparation for combined projects shall not relieve the Contractor of completing the initial grading construction totally to the specified profile, cross-section, moisture content, and compaction standards indicated in the Detailed Designs.

400.2.19.5.4 Granular Fill

Where designated by the Design Engineer and as accepted by the Department, the Contractor shall place and compact granular fill on the prepared subgrade.

This work shall be done in accordance with the provisions of Section 400.2.22 (Granular Fill), and in general accordance with Section 400.2.27.5.2 of Section 400.2.27 (Asphalt Concrete Pavement).

400.2.19.6 Product Acceptance

400.2.19.6.1 General

The finished subgrade surface shall be firm and uniform, true to grade and cross-section, in accordance with the provisions hereinafter specified and with Section 400.2.23 (Tolerance for Surface Finish), and shall be approved by the Design Engineer and as accepted by the Department before placing subsequent material thereon. Subgrade that does not conform to the requirements as to grade, cross-section, moisture content, surface tolerance or degree of compaction shall be reworked until such requirements are met.

Any large rocks encountered during the subgrade preparation process, which constitute a hazard to traffic due to size or protrusion from the finished subgrade shall be removed and disposed of as directed by the Design Engineer and as accepted by the Department.

400.2.19.6.2 End Product Acceptance or Rejection

Subgrade materials shall be compacted to obtain an average of 100 percent, with no test results being less than 97 percent, of the maximum dry density at the optimum moisture content established by the Moisture-Density Relation tests using standard compaction.

After compaction, to the minimum required, the subgrade must meet or exceed the in-place, long-term, subgrade support value indicated in Section 200 (Project Specifics).

400.2.19.7 Measurement

Intentionally Deleted

400.2.19.8 Payment Adjustment

Intentionally Deleted

400.2.20 AGGREGATE PRODUCTION AND STOCKPILING

400.2.20.1 General

This specification covers the general requirements for production, gradation, and stockpiling operations for specified aggregate materials.

400.2.20.2 Materials And Procedures

The Contractor shall supply aggregate materials in accordance with Section 400.2.31 (Supply of Aggregate).

Aggregate produced from all sources shall comply fully with the specification requirements. The Contractor shall recognize and satisfy itself as to the type and amount of work that may be necessary to produce the material required. The aggregate shall meet the specified requirements as shown on Table 400.2.20.2.1 for the material specified. The Contractor shall adjust and modify aggregates as required in order to meet specification requirements.

The crushed aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock, and shall be free from elongated particles, injurious quantities of flaky particles, soft shale, organic matter, clay lumps, and other foreign matter.

All material up to and including 300mm diameter in Designated Sources and Department Sources identified in Technical Requirements shall be crushed.

For Designation 1 aggregates used for wearing surfaces (top lift), the Contractor shall produce aggregates such that material retained on the 5,000 micron sieve shall not contain more than 3 percent detrimental matter based on the total mass of the combined aggregates in the final product.

Before the production of any aggregate for use as a wearing surface, the Contractor shall submit a proposal to the Design Engineer and as accepted by the Department detailing the action to be taken in the event the specification requirement for detrimental matter cannot be achieved. Production of aggregates, for use as a wearing surface, shall not proceed until such an action plan has been approved by the Design Engineer and as accepted by the Department.

There will be no separate payment made for any additional work associated with the Contractor's proposal in achieving the specification requirements for detrimental matter.

TABLE 400.2.20.2.1 - Specifications for Aggregate

DESIGNATION		1				2				3				4			5		6		7	8	9
Class (mm)		**10**	**12.5**	**16**	**25**	***16(N2)**	**20**	**25**	**40**	**12.5AW**	**12.5BW**	**12.5C**	**16**	**20**	**25**	**40**	**10A**	**10B**	**80**	**125**	**40**	**25**	**8**
Percent Passing Metric Sieve (CGSB 8-GP-2M) micron	125 000																			100			
	80 000																		100				
	50 000																		55-100	55-100			
	40 000								100							100					100		
	25 000				100			100	70-94						100				38-100	38-100		100	
	20 000				85-95		100	82-97						100		55-90							
	16 000			100	77-87	100	84-94	70-94	55-85				100						32-85	32-85		90-100	
	12 500		100	80-92	67-80	89-100				100	100	100	72-95										
	10 000	100	83-92	70-84	59-73	78-94	63-86	52-79	44-74	35-65	55-75	70-93	53-82	35-77	30-77	25-72	100	100			85-100	45-75	
	8 000																						100
	5 000	60-75	55-70	50-65	40-58	55-70	40-67	35-64	32-62	0-15	0-15	30-60	27-54	15-55	15-55	8-55	70-90	45-70	20-65	20-65		0-15	85-100
	1 250	26-45	26-45	26-45	22-38	26-45	20-43	18-43	17-43	0-3	0-3	9-28	9-28	0-30	0-30	0-30	20-45	20-45			40-100	0-5	45-75
	630	18-38	18-38	18-38	15-31	18-38	14-34	12-34	12-34														30-50
	315	12-30	12-30	12-30	10-25	12-30	9-26	8-26	8-26			0-15	0-15				9-22	9-22	6-30	6-30	17-100		18-30
	160	8-20	8-20	8-20	6-16	8-20	5-18	5-18	5-18			0-11	0-11				5-15	5-15					10-21
	80	4-10	4-10	4-10	4-10	4-10	2-10	2-10	2-10	0-0.3	0-0.3	0-8	0-8	0-12	0-12	0-12	0-10	0-10	2-10	2-15	6-30		5-15
% FRACTURE BY WEIGHT (2 FACES)	ALL +5000	*See Note (N1)				60+	60+	60+	50+	75+ (100% 1 Face)	75+ (100% 1 Face)	60+	60+	40+	40+	25+	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PLASTICITY INDEX (PI)		NP	NP	NP	NP	NP	NP-6	NP-6	NP-6	N/A	N/A	NP-4	NP-4	NP-8	NP-8	NP-8	NP-6	NP-6	NP-8	NP-8	NP-5	NP-5	NP
L.A. ABRASION LOSS PERCENT MAX.		40	40	40	40	50	50	50	50	35	35	35	35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	35
FLAKINESS INDEX		N/A								MAX 15		N/A											
COEFFICIENT OF UNIFORMITY (CU)		N/A																			3+	N/A	

Designations:
Designation 1 - Asphalt Concrete Pavement
Designation 2 - Base Course Aggregate
Designation 3 - Seal Coat Aggregate
Designation 4 - Gravel Surfacing Aggregate
Designation 5 - Sanding Material
Designation 6 - Gravel Fill
Designation 7 - Cement Stabilized Base Course Aggregate
Designation 8 - Granular Filter Aggregate
Designation 9 - Slurry Seal Aggregate

* Notes:

N1. According to Specification 400.2.27 Asphalt Concrete Pavement and Mix Type Specified.

N2. Designation 2 Class 16 Material is for Asphalt Stabilized Base Course

N3. For crushed aggregates other than all Designation 5 and Designation 9 materials, a tolerance of three percent in the amount passing the maximum size sieve will be permitted provided all oversize material passes the next larger standard sieve size.

N4. Unless otherwise specified, Pit-Run Aggregate will be defined as unprocessed granular material, with no specified gradation requirement, that is extracted from an aggregate deposit

400.2.20.3 Quality Management Sampling And Testing

400.2.20.3.1 General

For all aggregate sources, quality management testing is the responsibility of the Contractor. Tests performed by the Department will not be considered to be quality management tests.

The Contractor shall use Professional Engineering services and a qualified testing laboratory, licensed to practice in the Province of Alberta to assess and where necessary, modify the aggregate materials being produced to ensure their end use meets the Technical Requirements.

The Contractor shall provide and maintain equipment and qualified personnel to perform all field-testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the work.

The Contractor shall be responsible for the cost of quality management and shall be responsible for the cost of all consulting services retained by him.

The Contractor shall provide safe and convenient means for accurately and representatively sampling each aggregate stream being produced during all screening, splitting, and crushing processes.

All quality management sampling and testing will be carried out in accordance with the Contractor's "Quality Management System (QMS)", Table 400.2.20.3.1.1, and the Technical Requirements.

Copies of all quality management tests shall be submitted to the Department within 24 hours of the completion of each test.

TABLE 400.2.20.3.1.1
Quality Management Testing of Aggregates

TESTS	STANDARD	MINIMUM FREQUENCY
SIEVE ANALYSIS		
Crushed Aggregate		
1 Des. 1 and 2	ATT-25 or ATT-26	Minimum Frequency per MQS
Des. 3 (Class 12.5 & 16) 4 and 5 and 9		One per 1,000 tonnes production
2 Determining Pit-Run Contamination of Des. 1 (coarse fraction of Mix Types H1 & H2) and Extra Manufactured Fines aggregates.	ATT-25, Part II	One per 12 hours of plant production.
3 Blend Sand	ATT-26	Minimum Frequency per MQS
4 Extra Manufactured Fines	ATT-26	Minimum Frequency per MQS
5 Chips (Des. 3 Class 12.5AW & 12.5BW)	ATT-26	One per 8 hours of wash plant production
6 Uncrushed Fine Fraction(s)		
Contractor Supply of Aggregate	ATT-26	Minimum Frequency per MQS
Department Controlled Source	ATT-26	One for first 5,000 tonnes plus one for each additional 10,000 tonnes.
7 Sampling, Gravel and Sand	ATT-38	
DRY STRENGTH	ATT-54	Des. 2-one per 20,000 tonnes
PLASTICITY INDEX	AASHTO T 90	Des. 1-minimum frequency per MQS Des. 2-one per Source and one per 20,000 tonnes when ATT-54 indicates a non-plastic high result. Other Des.-when requested by the Design Engineer or the Department
PERCENT FRACTURE	ATT-50	One per 5,000 tonnes.
L.A. ABRASION	AASHTO T 96	When requested by the Design Engineer or the Department
FLAKINESS INDEX (DES. 3 CLASS 12.5AW & 12.5BW)	ATT-49	One per source
DETRIMENTAL MATTER IN COARSE AGGREGATE (Paving Aggregates, Coarse Fraction, +5 000 micron material)	TLT-107	Minimum of one for first 5,000 tonnes. (Note 1)
The Design Engineer or the Department may require an increase in the frequency of any quality management test, which has a specified minimum frequency. The Contractor shall arrange and pay for any additional tests required by the Design Engineer or the Department.		

Note 1: Additional tests, at rate of one per 10,000 tonnes, if first test indicates deleterious material is ≥ 4 percent. (Reported on line E of Form MAT 5-730/94)

2: In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Table 400.2.20.4.1.3.

400.2.20.3.2 Test Methods

Inspection, sampling, and testing to follow requirements of Table 400.2.20.3.1.1. Alternative or supplemental test methods may be used but shall be outlined in the QMS.

400.2.20.4 Acceptance Sampling And Testing

The Department may assess the aggregate production process and test and/or monitor the workmanship and quality of the material being produced by the Contractor at any time and as often as it deems necessary in order to ensure compliance with the Technical Requirements. Such assessment or testing shall not in any way relieve the Contractor of the responsibility for producing aggregates that meet the Technical Requirements in all respects.

The Department will carry out all acceptance sampling and testing.

The Department is under no obligation to provide the Contractor with test results.

400.2.20.4.1 Test Methods

The terms "ATT" and "TLT" refer to Alberta Transportation Test and Transportation Laboratory Test methods, respectively.

Unless otherwise specified, the latest edition of the test methods shown in Table 400.2.20.4.1.2 will be used for acceptance sampling and testing.

TABLE 400.2.20.4.1.2
Test Methods Used to Determine Material Characteristics

TESTS	STANDARD
Sampling, Gravel and Sand	ATT-38
Sieve Analysis	ATT-25 or 26
Sieve Analysis, 80,000 micron Minus, Part II - Pit-Run Contamination, - 5,000 micron Sieve Analysis	ATT-25, Part II
Determining the Liquid Limit of Soils	AASHTO T 89
Dry Strength, Non-Plastic Aggregates	ATT-54
Determining the Plastic Limit and Plasticity Index of Soils	AASHTO T 90
Percent Fracture	ATT-50
Classification of Soils for Engineering Purposes (for definition of Coefficient of Uniformity, Cu)	ASTM D2487
L.A. Abrasion	AASHTO T 96
Flakiness Index	ATT-49
Detrimental Matter in Coarse Aggregate	TLT-107

Note:

(1) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Table 400.2.20.4.1.3.

TABLE 400.2.20.4.1.3
Sieve Size(s)

SIEVES IN ACCORDANCE WITH: AASHTO DESIGNATION: M 92 ASTM DESIGNATION: E 11			**METRIC SIEVES IN ACCORDANCE WITH: CGSB SPEC. 8-GP-2M**
(U.S. STANDARD SERIES) (OPENING AND DESIGNATION)			
125.0	mm	5"	125,000
75.0	mm	3"	80,000
63.0	mm	2-1/2"	63,000
50.0	mm	2"	50,000
37.5	mm	1-1/2"	40,000
25.0	mm	1"	25,000
19.0	mm	3/4"	20,000
16.0	mm	5/8"	16,000
12.5	mm	1/2"	12,500
9.5	mm	3/8"	10,000
8.0	mm	5/16”	8,000
4.75	mm	#4	5,000
2.36	mm	#8	2,500
2.00	mm	#10	2,000
1.70	mm	#12	1,600
1.18	mm	#16	1,250
0.850	mm	#20	800
0.600	mm	#30	630
0.425	mm	#40	400
0.300	mm	#50	315
0.150	mm	#100	160
0.075	mm	#200	80
0.045	mm	#325	45

400.2.20.5 Construction

400.2.20.5.1 General

The Contractor shall produce aggregates conforming to the Technical Requirements for the Designations and Classes called for in the Detailed Designs.

Prior to any aggregate production, the Contractor shall submit a written proposal to the Design Engineer and as accepted by the Department detailing aggregate processing procedures intended to be used. These proposed procedures will require the consent of the Department. Aggregates produced prior to this consent will not be accepted.

The Contractor shall notify the Design Engineer and the Department a minimum of 48 hours in advance of the start of aggregate production to allow the visual inspection of the process and testing of the production, as deemed necessary by the Department.

Any recombining of aggregates or addition of blend materials shall be performed so that a uniform mix of the various sizes is achieved.

Unless otherwise specified, the Contractor shall ensure that manufactured fines are retained in the crushed aggregate stockpile.

400.2.20.5.2 Production of Designation 1 Aggregates

The Contractor shall split aggregates for Designation 1 material into coarse and fine fractions prior to crushing of the coarse fraction. The crushed coarse and the fine fractions shall be stockpiled separately.

The Contractor shall select a screen size at which splitting will take place. Splitting of aggregates shall be controlled such that the coarse aggregate fraction, before crushing, shall contain no more than 5 percent passing the 5,000 micron sieve for all mix types.

In Department sources, all uncrushed fine fraction(s) shall contain no more than 20 percent of material retained on the 5,000 micron sieve size.

Further splitting of the crushed coarse aggregate into separate stockpiles may be performed at the Contractor’s option and cost.

400.2.20.5.3 Production and Addition of Blend Sand

When the aggregate being produced is destined for further processing through a mixing plant, the addition of any required blend sand shall take place at the mixing plant.

Prior to the mix production, blend sand shall be separately stockpiled so that a representative sample can be obtained in order to establish a mix design.

All blend sand shall be screened before being incorporated into the mix, to remove clay lumps, roots and other deleterious materials. All blend sand so screened shall pass the 5,000 micron sieve.

Blend sand shall be dried if necessary to ensure a uniform feed.

All other aggregates requiring an addition of blend sand to meet the gradation requirements shall be adjusted at the crushing stage by means of a separate conveyor or other approved device capable of metering the blend sand at a specified uniform rate. The blend sand shall be added prior to or onto the crusher screen deck.

400.2.20.5.4 Production of Extra Manufactured Fines

Manufactured fines are defined as that portion of the material passing the 5,000 micron sieve size, which is produced by the crushing process.

In the event the manufactured fines in the total combined aggregate do not meet the requirement for the specified Asphalt Concrete Mix Type, extra manufactured fines shall be produced by screening the pit-run material so that the screened material contains no more than 5 percent material passing a 5,000 micron sieve. This material shall be crushed and all material produced by this crushing process shall be placed in a separate stockpile and designated as Extra Manufactured Fines.

400.2.20.5.5 Stockpiling

When aggregate stockpiles are specified or used as part of construction operations, the following shall apply:

i.) When stockpiling is specified in Technical Requirements, the stockpile sites shall be located as shown on the Detailed Design or as directed by the Design Engineer and as accepted by the Department.

ii.) If, in order to expedite its construction operation, the Contractor constructs temporary stockpiles at sites of its own choosing, it shall arrange for such sites and be responsible for them in all respects, including all costs for clearing, removal and salvage of overburden and other site preparation and reclamation. The Contractor shall also obtain permit approvals and clearances from Alberta Environment and Alberta Culture and Community Spirit (Historic Resources Management) for these sites prior to commencement of the work.

iii.) Stockpiles shall not be constructed at locations or by methods that will interfere with or damage any utilities such as power lines, telephone lines, pipelines, and underground utilities.

iv.) Sites shall be cleared to the required dimensions. Topsoil and subsoil shall be separately excavated to the full depth or 300mm, whichever is greater, and stockpiled separately. Stockpile sites shall be shaped to a uniform smooth surface and graded to ensure positive drainage.

v.) Stockpiles shall be constructed by first distributing material uniformly over the entire base, and building upwards in successive layers not exceeding a thickness of 2m.

vi.) Construction operations shall be controlled to prevent segregation of the various particle sizes.

vii.) Crushed aggregate or gravel fill shall not be pushed or dumped over the edges or down the faces of stockpiles.

viii.) For blend sand, newly processed material shall be blended into the stockpile.

ix.) Completed stockpiles shall be neat and regular in form and shall be constructed to occupy the smallest feasible area taking into consideration the bearing capacity of the foundation soils and the requirements of the *Occupational Health and Safety Act* (Alberta).

x.) If different types of material are to be stockpiled, the piles shall be located and constructed so that no intermixing of material will occur.

400.2.20.6 Product Acceptance

400.2.20.6.1 General

Aggregate produced from all sources shall comply fully with the specified requirements as shown on Table 400.2.20.2.1, for the material specified.

The crushed aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock, and shall be free from elongated particles, injurious quantities of flaky particles, soft shale, organic matter, clay lumps and other foreign matter.

Testing by the Department to verify aggregate quality will be undertaken on the following sources:

i.) any unproven source in which there is no history as being used on a Department project, or
ii.) any source for which the Department has concerns about the aggregate quality.

The Contractor is to assist the Department in obtaining representative samples. Aggregate sampled for acceptance testing shall be obtained from the stockpile containing crushed aggregate or the coarse fraction for Designation 1 applications. A minimum sample size of 120 kg shall be obtained according to the procedures outlined in ATT-38 except that a front-end loader may be used in place of a back hoe for sampling the stockpile. Sampling should occur shortly after 5,000 tonnes have been stockpiled or at a time mutually agreed upon between the Contractor and Department. The Department is to be present during sampling. The Department will split the sample into 3 samples of approximately equal weight. One sample will be given to the Contractor, one will be tested by the Department, and the third will be retained by the Department for potential appeal testing.

All acceptance and appeal testing for aggregate quality will be completed by firms that are pre-qualified by the Department in the category of Mix Design Services - Marshall. Acceptance testing to verify aggregate quality will include some or all of the following tests: Sieve Analysis, Detrimental Matter in Coarse Aggregate (Coarse Fraction, +5,000 micron material) and L.A. Abrasion. The results of this testing will be used by the Department to verify specification compliance for the requirements of L.A Abrasion and/or detrimental matter.

If the Department's test results for detrimental matter content exceeds 3 percent, the Contractor will not be allowed to use this material for top lift production unless the proportion of coarse fraction used in the asphalt mix results in a detrimental matter content of 3 percent or less based upon the total mass of the combined aggregates.

400.2.20.6.2 End Product Acceptance or Rejection

Acceptance of processed aggregates shall take place when they are in their final position and have met all the requirements of the Detailed Designs and the Technical Requirements.

Aggregate that does not meet specification requirements shall not be incorporated into the work.

The Department may sample and test at any time and reject material that does not meet the Technical Requirements.

400.2.20.6.3 Appeal of Acceptance Test Results and Appeal Testing

The Contractor may appeal the results of the verification testing for aggregate quality if the test value indicates the aggregate material is not acceptable to be incorporated into the work at the anticipated aggregate proportions to be used. The Contractor shall serve notice of appeal to the Department, in writing, within 48 hours of receipt of the test results.

The Department will request that cause be shown for the appeal, including the results of the Contractor's quality management testing.

The Department will arrange and pay for an independent testing laboratory to perform the appeal testing. The Department will arrange to have the remaining split of aggregate material delivered to the appeal laboratory.

The reported appeal value will be combined with the original verification value and averaged. The mean value will be used to determine whether the aggregate material is suitable to be incorporated into the work.

If the new mean value indicates that the aggregate material is acceptable then appeal testing costs will be the responsibility of the Department.

If the new mean value indicates that the aggregate material is not acceptable then the Contractor will be invoiced by the Department for the testing costs at the following rates:

L.A. Abrasion - $300.00 per appeal,

Detrimental Matter Content - $500.00 per appeal.

400.2.20.7 Measurement

In all sources, the production of aggregates including the processing, hauling, and addition of blend sand, the production and addition of extra manufactured fines, and any other aggregate gradation adjustments and modifications will not be paid for separately.

All aggregates provided will be measured in tonnes.
When required, a conversion factor of $1m^3 = 1.632$ tonne will be used.

400.2.20.8 Payment Adjustment

Acceptance of aggregates shall take place when they are in their final position and Payment Adjustments, if applicable, are contained within the Technical Requirements that govern the final position of the aggregates.

400.2.21 GRANULAR BASE COURSE

400.2.21.1 General

400.2.21.1.1 Description

Granular Base Course shall consist of a uniform mixture of crushed aggregate and water that is placed in layers upon a prepared surface, compacted, and finished, as specified herein.

400.2.21.1.2 Definitions

A "Control Strip" is a lift of Granular Base Course constructed using the equipment and method of compaction as prescribed herein, normally on a 400m section of prepared surface selected by the Design Engineer and as accepted by the Department.

The "Control Density" is the maximum dry density attained on a "Control Strip."

A "Density Test Section" is a randomly established area of approximately 1,000 lineal metres for each lift of Granular Base Course in which the Design Engineer and as accepted by the Department will undertake field density testing for the purposes of determining the acceptance of the work.

A "Pass" is one complete coverage of the Control Strip area with at least the minimum compaction equipment specified herein.

A "Lot" is normally defined as the quantity of Granular Base Course placed in one day's production. For work on the Project involving with small quantities of Granular Base Course, generally less than 3,000 tonnes, the entire quantity of Granular Base Course will be considered as one Lot. If the Design Engineer and as accepted by the Department suspects a portion of a Lot is substandard, the Design Engineer and as accepted by the Department will undertake extra testing to define the area and severity of the deficiency. A new Lot will be designated for this portion of the work, if this extra testing indicates the Granular Base Course is subject to rejection or a Payment Adjustment.

A "Visually Failed Area" is an area of any subgrade or Granular Base Course identified by the Design Engineer or the Department, which in the sole opinion of the Department fails, loses specified density, becomes too wet or too dry or becomes rutted, distorted, loose or rough.

400.2.21.2 Materials And Procedures

400.2.21.2.1 Aggregate

The Contractor shall produce crushed aggregate in accordance with Section 400.2.20 (Aggregate Production and Stockpiling), for the Designation and Class of materials required in the Detailed Designs and Technical Requirements. The Contractor shall supply materials in accordance with Section 400.2.31 (Supply of Aggregate).

When the use of Designation 2 Class 25 (D2-C25) material is specified in the Detailed Designs or Technical Requirements, the Contractor shall have the option of supplying either Designation 2 Class 20 (D2-C20) material or Designation 2 Class 40 (D2-C40) material providing it meets the requirements of the Detailed Designs.

The Contractor shall advise the Department which material (D2-C20, D2-C25, D2-C40) will be produced before commencing crushing operations. If the Contractor decides to change materials at any time during the crushing operations, the Contractor shall immediately advise the Design Engineer and the Department and stockpile the new material separately from any previously crushed material. In cases where the Contractor elects to use more than one material the Contractor shall, prior to hauling, keep the Design Engineer and the Department informed which material is being hauled on a daily basis. No intermixing of materials will be allowed at any time.

400.2.21.2.2 Water

The Contractor shall supply and haul all water required for the construction and maintenance of this work.

The water shall be free from substances that, in the sole opinion of the Department, render it unfit for use.

400.2.21.2.3 Asphalt

The Contractor shall supply asphalt material for prime coat in accordance with Section 400.2.33 (Supply of Asphalt).

400.2.21.2.4 Interim Lane Markings

The Contractor shall supply interim lane marking paint and glass beads from the list of approved products, which are shown on the Department's Products List.

As an alternative to paint and glass beads, the Contractor has the option of supplying reflectorized temporary pavement markers or self-adhesive reflectorized pavement marking tape, which are shown on the Department's Products List.

400.2.21.3 Quality Management Sampling And Testing

Quality management testing is the responsibility of the Contractor. Tests performed by the Department will not be considered to be quality management tests.

The Contractor shall use Professional Engineering services and a qualified testing laboratory, licensed to practice in the Province of Alberta to assess and where necessary, modify the materials to ensure their end use meets all the Technical Requirements.

The Contractor shall provide and maintain equipment and qualified personnel to perform all field-testing necessary to determine and monitor the characteristics of the materials being incorporated into the work.

The Contractor shall be responsible for the cost of quality management and shall be responsible for the cost of all consulting services retained by it.

All quality management sampling and testing will be carried out in accordance with the Contractor's "Quality Management System (QMS)", Table 400.2.21.4.1.1, and the Technical Requirements.

Copies of all quality management tests shall be submitted to the Department within 24 hours of the completion of each test.

400.2.21.3.1 Test Methods

Inspection, sampling, and testing to follow requirements of Table 400.2.21.4.1.1. Alternative or supplemental test methods may be used but shall be outlined in the QMS.

400.2.21.4 Acceptance Sampling And Testing

The Department will from time to time take samples and carry out testing and inspection of the materials incorporated or being incorporated into the work. The Contractor shall cooperate with the Department for such sampling, testing, and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the work strictly in accordance with the Technical Requirements.

Various alternative test methods may be used by the Department to confirm that the Technical Requirements are being met.

In cases of dispute regarding the degree of compaction and/or moisture contents, all testing to confirm compliance with the Technical Requirements will be carried out by the Department, using the most recent edition of the following standard test methods indicated in Table 400.2.21.4.1.1.

400.2.21.4.1 Test Methods

Unless otherwise specified, the following standard ATT methods shown in Table 400.2.21.4.1.1 will be used for sampling and testing.

TABLE 400.2.21.4.1.1
Sampling and Testing Methods

TEST	STANDARD	FREQUENCY (Minimum)
SAMPLING, Gravel and Sand	ATT- 38	As Required
SIEVE ANALYSIS (1)	ATT-25 or 26	As required in ATT-38
PERCENT FRACTURE	ATT-50	As required in ATT-38
DENSITY, Control Strip Method	ATT-58	Control & Test Sections (2)
RANDOM TEST SITE LOCATIONS	ATT-56	Each Test Sections
DENSITY, In-Place Nuclear Method	ATT-11	As required (2)
MOISTURE CONTENT, Oven Method, Soil and Gravel	ATT-15	As required (2)

Notes: (1) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Section 400.2.20 (Aggregate Production and Stockpiling).

(2) Control Strips are established as specified herein. Density Test Sections are randomly established every 1,000 lineal metres on all lifts.

400.2.21.4.2 Control Strip

The nominal lift thickness of a Granular Base Course shall be determined by the Contractor but shall not be less than 100mm or exceed 200mm when compacted. The total design Granular Base Course thickness may require that more than one lift be constructed, in which case, a new Control Strip is required for each lift; for a change in aggregate designation, aggregate class or source of aggregate; or when called for by the Design Engineer or the Department.

Control Strips shall not be constructed during freezing ambient temperatures, with frozen aggregate or on frozen subgrade.

Aggregate for construction of a Control Strip shall be spread by means of a motor grader or paver.

The Control Strip moisture content shall be adjusted as directed by the Design Engineer and as accepted by the Department during spreading of the aggregate. The surface of the Granular Base Course shall be kept moist until testing is completed.

Once the aggregate for the Control Strip lift has been completely spread, the moisture, and density measurements for determining the Control Density will commence and will continue during repeated passes of the specified compaction equipment until the maximum dry density is attained. The Design Engineer and as accepted by the Department will take these measurements using nuclear testing equipment in accordance with ATT 11 Density, In-Place Nuclear Method.

400.2.21.4.3 Control Strip Minimum Compaction Equipment

The Control Strip lift shall be compacted using at least the following equipment:

Two vibratory steel rollers weighing not less than 10 tonne each and having a vibratory capacity of at least 1,500 Vibrations per Minute (VPM) with a minimum dynamic or centrifugal force of 78,500 Newtons, operated in the vibratory mode and at a speed not exceeding 8 km/h; plus one of the following:

(i) Six wobbly tired rollers with tires inflated to a pressure of 200 kPa plus or minus 35 kPa, ballasted with at least a level load of gravel, and towed at a speed not exceeding 8 km/h; or

(ii) Two self-propelled pneumatic rollers, each ballasted to its maximum capacity, weighing not less than 10 tonne each, having a minimum tire pressure of 400 kPa plus or minus 35 kPa, and traveling at a speed not exceeding 8 km/h; or

(iii) A combination of four wobbly tired rollers and one self-propelled pneumatic roller each of which meets the appropriate criteria described above.

For work on the Project where Control Strips are being established on small areas such as acceleration and deceleration lanes, culvert backfills, etc., other minimum Control Strip compaction equipment proposed by the Contractor may be accepted by the Design Engineer and as accepted by the Department.

400.2.21.4.4 Control Strip Compaction

If portions of the lift are being spread using a motor grader, the aggregate shall be compacted so that when the entire lift has been spread, a minimum of 4 complete passes with the specified compaction equipment shall have been completed over all the Control Strip area.

If the aggregate has been spread by means of a motor grader and vibratory compaction causes a loss of density during base course construction, vibratory compactors shall operate in the static mode supplemented with the specified pneumatic rollers. Whenever a Granular Base Course lift is spread by a paver, a vibratory compactor operating in the vibratory mode shall be utilized.

When pneumatic self-propelled rollers or wobbly type rollers are used for compaction, the pneumatic self-propelled rollers or wobbly type rollers shall lead the steel vibratory compactor.

400.2.21.5 Construction

400.2.21.5.1 General

Once the Control Density has been established, the Contractor may use any combination of compaction equipment.

The Granular Base Course shall be uniformly placed at the same lift thickness as the corresponding Control Strip lift thickness.

Each lift of Granular Base Course shall be constructed true to grade and cross-section, the finished surface shall be smooth and free of loose material, and be in accordance with Section 400.2.23 (Tolerance for Surface Finish).

The Contractor shall compact areas with restricted access, using a vibratory steel-wheeled roller as specified in Section 400.2.21.4.3 (Control Strip Minimum Compaction Equipment) to the satisfaction of the Design Engineer and as accepted by the Department or until 95.0 percent of the Control Density has been achieved.

The Design Engineer or the Department may direct the Contractor not to use the vibratory compaction mode within certain areas located near utilities or other restricted areas, as determined by the Design Engineer and as accepted by the Department.

Water shall not be added in such quantities that it seeps into the underlying subgrade.

Materials shall be handled so that segregation of the coarser and finer fractions does not occur and the Contractor shall take all necessary precautions to prevent aggregate segregation for each lift of Granular Base Course.

Granular Base Course shall not be spread on frozen subgrade and compaction shall be completed before freezing.

400.2.21.5.2 Finishing Work

Subgrade slopes shall be neatly trimmed and loose or waste material, from the side slopes, shall be either neatly bladed against the edge of the Granular Base Course or spread neatly over the side slope and ditches to the satisfaction of the Design Engineer and as accepted by the Department.

In addition, the finished Granular Base Course surfaces shall be in compliance with the tolerances specified in Section 400.2.23 (Tolerance for Surface Finish).

All rocks larger than 75mm in diameter shall be removed from the side slopes and ditches and be disposed of in a manner satisfactory to the Design Engineer and as accepted by the Department.

Prime coat shall be placed on the finished final lift of Granular Base Course in accordance with Section 400.2.25 (Prime, Tack and Fog Coats).

400.2.21.5.3 Interim Lane Markings

The Contractor shall provide interim lane markings on all newly primed surfaces that are to be exposed to traffic overnight. The Contractor has the option of using paint and glass beads or reflectorized temporary pavement markers.

When paint is used, all paint spots shall be 100mm wide and 300mm long, shall be applied lengthwise to the road surface, shall be spaced 15m apart on centre in tangent sections and 7.5m apart on curves, shall employ the same paint colour as the permanent marking to come, and shall be completely covered with glass beads at the time of painting.

When reflectorized temporary pavement markers are used, they shall be placed at 25m intervals on tangent sections and at 15m intervals on curves and shall be removed immediately before being overlaid.

400.2.21.6 Product Acceptance

400.2.21.6.1 General

The Contractor shall repair and/or restore to the specified condition, any visually failed areas or areas of aggregate segregation, as directed by the Design Engineer and as accepted by the Department.

Each lift shall be compacted to an average of 98.0 percent of the applicable Control Density with no single test less than 95 percent of the applicable Control Density. The frequency of testing is outlined in Table 400.2.21.4.1.1.

As specified for the Control Strip construction, the surface of the Granular Base Course shall be kept moist until testing is completed.

400.2.21.6.2 End Product Acceptance or Rejection

For Granular Base Course aggregates placed in all lifts, acceptance will be subject to all compliance requirements of Section 400.2.21.6.1 (General) and the following requirements for the Lot aggregate Gradation and Fracture count.

Payment Adjustment for aggregate Gradation for each sieve size will be based on the variation of the Lot Mean Gradation from the limits of the Designation and Class outlined in Table 400.2.20.2.1 of Section 400.2.20 (Aggregate Production and Stockpiling). The corresponding adjustment points are shown in Table 400.2.21.8.1.

When the Lot Mean Gradation is outside the gradation limits of Table 400.2.20.2, the Payment Adjustment will be $0.02 for each Mean Adjustment Point outside those limits. If the maximum deviation shown in Table 400.2.21.8.1 is exceeded, the Lot is rejected.

Payment Adjustment for Fractures will be based on the Mean Fracture deviation below the specification minimum shown in Table 400.2.20.2.1 of Section 400.2.20 (Aggregate Production and Stockpiling), one adjustment point for each 1 percent below the specification minimum will occur up to a maximum of 10 percent. If the maximum deviation is exceeded, the Lot is rejected.

Payment Adjustment for Lot Mean Gradation and Fractures will be based on a minimum of 3 tests each per Lot sampled under a Full Testing Program in accordance with ATT 38, Sampling, Gravel and Sand.

At the discretion of the Design Engineer and as accepted by the Department, a Partial Testing Program in accordance with ATT 38 may be used in determining End Product acceptance subject to other compliance testing. Payment Adjustment will not apply in cases where the Partial Testing Program is used.

400.2.21.6.3 Rejected Areas

All rejected areas shall be repaired by the Contractor to the satisfaction of the Design Engineer and as accepted by the Department.

For areas rejected due to Lot Mean Gradation and/or Fractures, the following methods of repair are generally acceptable but are subject to the acceptance of the Design Engineer and as accepted by the Department:

- Remove and replace entire depth of rejected lift in failed area.

- Place a remedial lift equal to 30 percent of the depth of the rejected lift thickness or 50mm, whichever is greater. When remedial lifts are used as a repair method, the surrounding areas/lanes also require additional material to create smooth transitions and acceptable elevation changes between the repaired and approved areas. When a lower lift is repaired using a remedial lift, the repair material will not be considered to take the place of any portion of subsequent lifts (i.e. the completed structure will be the design depth plus the depth of repair lift)

- Correct aggregate requirements by adding, blending, and reworking appropriate materials.

All repairs shall be regular in shape and finished using good workmanship practices to provide an appearance suitable to the Design Engineer and as accepted by the Department.

Any aggregate segregation shall be corrected by re-blending, as necessary.

All repairs shall be carried out by the Contractor to the satisfaction of the Design Engineer and as accepted by the Department.

400.2.21.6.4 Rejected Work Made Acceptable

All repaired areas will be retested by the Department and the results of the retest will be used for determining Payment Adjustments.

When the method of repair is a remedial lift, the remedial lift will be tested and any Payment Adjustment, as determined, will be applied to the rejected underlying lift.

When the method of repair is adding, blending, and reworking materials the remedial lift will be tested and any Payment Adjustment, as determined, will be applied to the rejected lift.

Payment for the additional testing will be charged to the Contractor in accordance with the rates as shown in Section 400.2.21.6.5 (Appeal of Acceptance Test Results and Appeal Testing) – Payment of Appeal Testing Costs.

400.2.21.6.5 Appeal of Acceptance Test Results and Appeal Testing

Gradation and Fractures

Appeal testing will be done using appeal sampling method described in ATT 38. The Contractor may appeal the results of acceptance testing of Gradation or Fractures for any rejected or penalized Lot only once. The Department will request that cause be shown for the appeal. The appeal shall be for all tests within the Lot and there will be no appeal allowed for single tests within a Lot. Priming or placing of additional lifts on the appealed Lot will void any appeal.

The following procedures will apply for an appeal:

(i) The Contractor shall serve notice of the appeal for Gradation, Fractures or both to the Design Engineer and the Department, in writing, within 24 hours of receipt of the test results.

(ii) The Department will arrange and pay for an independent testing laboratory certified to operate in the Province of Alberta, to perform the appeal testing. The personnel employed or testing laboratory retained by the Contractor for quality management testing on the project will not be used for appeal testing.

(iii) The Department will sample the compacted Granular Base Course and provide the samples to the independent testing laboratory. The Contractor may observe the sampling process. The number of the new tests, for the appeal, shall be the same as the number used to determine the Lot Mean, and

(iv) All test results from the old Lot will be retained and averaged with the new appeal test results. A new mean for all test results will be determined and used for acceptance and Payment Adjustment.

The new mean, thus determined, in all cases, will be binding on the Contractor and the Department.

Payment of Appeal Testing Costs

If the new results show that a penalty no longer applies sampling and testing costs, incurred during the appeal procedures for that Lot, will be borne by the Department.

If the new results verify that any Payment Adjustment reduction or rejection remains valid for that Lot, the Contractor will be invoiced by the Department for the sampling and testing costs for the appeal procedures, at the following rates:

Gradation:	$500.00
Fracture Count:	$300.00

400.2.21.7 Measurement

Measurement of Granular Base Course will be in tonnes per Lot.

400.2.21.8 Payment Adjustment

Total Lot Adjustment points will be calculated for each Lot. A Lot Gradation and Fracture Payment Adjustment per tonne will be applied based on the following formula, providing the Lot Mean does not exceed the requirements in Table 400.2.21.8.1 or the maximum deviation for Fractures is not exceeded.

PAgf = (PAg + PAf) x $ 0.02

Where:

PAgf = Payment Adjustment for Gradation and Fractures
PAg = Adjustment Points for Gradation
PAf = Adjustment Points for Fractures

TABLE 400.2.21.8.1
MEAN ADJUSTMENT POINTS FOR DEVIATIONS FROM GRADATION LIMITS AND MAXIMUM DEVIATIONS ALLOWABLE

LOT MEAN REQUIREMENTS	SIEVE SIZE micron			
	(1)25,000 20,000 16,000 10,000	5,000 1,250 630 315	160	80
Mean Adjustment Points for Deviations from limits of Table 400.2.3.2.2.1	2 for each 1% Deviation	5 for each 1% Deviation	0.5 for each 0.1% Deviation	5 for each 0.1% Deviation
Maximum Allowable Deviation from limits of Table 400.2.3.2.3.1	2	3	3	1.5

Note: (1) Include all applicable sieves up to one size smaller than top size.

400.2.22 GRANULAR FILL

400.2.22.1 General

Granular fill shall consist of pit-run gravel, gravel fill, sand or crushed gravel placed upon the prepared areas and in excavations, at locations and to thicknesses specified in the Detailed Designs, the Technical Requirements or as directed by the Design Engineer and as accepted by the Department.

400.2.22.2 Materials And Procedures

400.2.22.2.1 Aggregate

The Contractor shall produce processed aggregates in accordance with Section 400.2.20 (Aggregate Production and Stockpiling), for the designation and class of material specified in the Detailed Designs. The Contractor shall supply aggregate materials in accordance with Section 400.2.31 (Supply of Aggregate) and haul aggregate materials in accordance with Section 400.2.30 (Hauling).

400.2.22.2.2 Water

When required, the Contractor shall supply suitable water.

400.2.22.3 Quality Management Sampling And Testing

400.2.22.3.1 General

Quality management testing is the responsibility of the Contractor. Tests performed by the Department will not be considered to be quality management tests.

The Contractor shall use Professional Engineering services and a qualified testing laboratory, licensed to practice in the Province of Alberta to assess and where necessary, modify the materials to ensure their end use meets all the Technical Requirements.

The Contractor shall provide and maintain equipment and qualified personnel to perform all field-testing necessary to determine and monitor the characteristics of the materials being incorporated into the work.

The Contractor shall be responsible for the cost of quality management and shall be responsible for the cost of all consulting services retained by it.

All quality management sampling and testing will be carried out in accordance with the Contractor's "Quality Management System (QMS)", Table 400.2.22.4.2.1, and the Technical Requirements.

Copies of all quality management tests shall be submitted to the Department within 24 hours of the completion of each test.

400.2.22.3.2 Test Methods

Inspection, sampling, and testing to follow requirements of Table 400.2.22.4.2.1. Alternative or supplemental test methods may be used but shall be outlined in the QMS.

400.2.22.4 Acceptance Sampling And Testing

400.2.22.4.1 General

The Department will from time to time take samples and carry out testing and inspection of the materials incorporated or being incorporated into the work. The Contractor shall cooperate with the Department for such sampling, testing, and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the work strictly in accordance with the Technical Requirements.

Various alternative test methods may be used by the Department to confirm that the Technical Requirements are being met.

In cases of dispute regarding the degree of compaction and/or moisture contents, all testing to confirm compliance with the Technical Requirements will be carried out by the Department, using the most recent edition of the following standard test methods indicated in Table 400.2.22.4.2.1**.**

400.2.22.4.2 Test Methods

Various test methods may be used by the Department to confirm that specification requirements are being met.

Unless otherwise specified, the latest edition of the test methods shown in Table 400.2.22.4.2.1 will be used to determine material characteristics.

The terms "ATT" and "TLT" refer to Alberta Transportation Test and Transportation Laboratory Test methods, respectively.

TABLE 400.2.22.4.2.1
Test Methods Used To Determine Material Characteristics

Test Description	Method No.
Sampling, Gravel and Sand	ATT-38
Sieve Analysis	ATT-25 or 26
Determining the Liquid Limit of Soils	AASHTO T 89
Dry Strength, Non-Plastic Aggregates	ATT-54
Determining the Plastic Limit and Plasticity Index of Soils	AASHTO T 90
Density, Control Strip Method	ATT-58
Moisture Content, Open Pan Method	ATT-14

Notes: (1) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board Specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Specification 400.2.20, Aggregate Production and Stockpiling.

400.2.22.5 Construction

400.2.22.5.1 Granular Fill

The granular fill shall be deposited on the prepared area or in an excavation in a uniform manner and quantity, which will produce the required compacted thickness and width indicated in the Detailed Designs, the Technical Requirements or as designated by the Design Engineer and as accepted by the Department. Any coarse material segregated during dumping operations shall be blended with fines and shaped to the required depth, grade, and cross-section and to the satisfaction of the Design Engineer and as accepted by the Department.

The granular fill shall be watered or dried and compacted. Compaction shall continue in conjunction with light blading and water spraying where necessary to maintain cross-section and designated moisture content until the required density is reached.

400.2.22.5.2 Fine Grading Gravel Course

When required by the Design Engineer and as accepted by the Department, a light application of crushed gravel material "fine grading gravel course" of the designation and class specified in the Detailed Designs, the Technical Requirements or as directed by the Design Engineer and as accepted by the Department, shall be placed in a single layer on the granular fill for fine grading purposes.

The fine grading gravel course shall be windrowed uniformly upon the designated area and spread to the required cross-section and depth. The surface shall be compacted to the required density. If necessary, water shall be added to the material during compaction to maintain the required uniform moisture content.

The moisture content of any layer shall not exceed the designated moisture content prior to any subsequent operations.

400.2.22.6 Product Acceptance

The finished granular fill or fine grading gravel course shall be firm and uniform, true to grade and cross-section, in accordance with the provisions hereinafter specified, and shall be accepted by the Design Engineer and as accepted by the Department before placing subsequent material thereon.

Granular fill or fine grading gravel course that does not conform to the requirements as to grade, cross-section, moisture content or degree of compaction shall be reworked until such requirements are met.

400.2.22.6.1 End Product Acceptance or Rejection

Granular fill and fine grading gravel course materials shall be compacted to obtain an average of 100 percent, with no test results being less than 97 percent, of the maximum dry density at the optimum moisture content established by the Moisture-Density Relation tests using standard compaction.

400.2.22.7 Measurement

Measurement of granular fill and fine grading gravel course will be in tonnes.

400.2.22.8 Payment Adjustment

Intentionally Deleted

400.2.23 TOLERANCE FOR SURFACE FINISH

400.2.23.1 General

The finished surfaces constructed for the Project are subject to tolerances for elevation, slope and width. These tolerances shall apply to the following:

(i) the finished subgrade surface;
(ii) the finished surface of Granular Base Course; and
(iii) embankment sideslope and ditches.

All surfaces shall be built true to grade, cross-section and alignment as shown on the Detailed Designs with consistent, uniformly contoured surfaces. Furthermore, the finished roadway grade, alignment and widths shall tie neatly into fixed control points such as bridge abutments, railway crossings, grade intersections, etc. to the satisfaction of the Design Engineer and as accepted by the Department.

400.2.23.2 Materials And Procedures

Intentionally Deleted

400.2.23.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.23.4 Acceptance Sampling And Testing

The Department will take as many measurements as the Department thinks necessary to establish compliance with this specification and may vary the general interval, particularly where the finished surface is evidently not plane between stations or across the travel lanes. Where compliance with surface tolerance requirements is not initially achieved, reworking will be required.

400.2.23.5 Construction

Intentionally Deleted

400.2.23.6 Product Acceptance

The Contractor shall produce all finished surfaces to achieve or exceed the grade, slope and width tolerance limits as follows:

400.2.23.6.1 Surface Tolerance at Base Line Stations

The deviation of the finished surface from the corresponding design elevation will be determined by the Department at each station. The maximum allowable deviation from the design elevation at any point will be ± 30mm for subgrade surfaces and ± 20mm for base course surfaces.

Furthermore, the maximum difference in deviation between consecutive stations at the same offset, shall not be more than 30mm for subgrade surfaces and 20mm for any type of base course surface.

400.2.23.6.2 Slope Tolerance Limits

The Department will determine the roadway slope using the elevations at centreline and edge of shoulder at any location on the finished surface that he determines necessary. These measured slopes shall be considered Slope Reference Lines.

For projects consisting of combined Grading/Granular Base Course Work or Base Course Work only, the Slope Reference Line at any location on a finished surface shall not deviate from the design slope by more than 0.25 percent.

Furthermore, for all types of work, no point on the surface shall deviate in elevation by more than 15mm from the Slope Reference Line as determined.

400.2.23.6.3 Surface Width Tolerance Limits

The finished surface, as measured from shoulder edge to shoulder edge, shall not be wider by more than 0.1m or narrower by more than 0.05m from the design width as determined by the Department.

400.2.23.6.4 Road Side Slope Tolerance Limits

At any location, no part of any finished side slope shall deviate from the design side slope by more than ± 0.2m/m.

400.2.23.6.5 Road Ditch Width Tolerance Limits

At any location, the ditch width shall not deviate by more than 0.2m from the design or as approved by the Department.

The tolerance limits for Road Side Slope and Road Ditch Width only apply when the Technical Requirements calls for Grading Work.

400.2.23.7 Measurement

The Department will make no charge for initial survey measurements. After the surfaces are reworked, the Department will determine if re-measuring to confirm compliance is required. If the Department performs re-measure and the surfaces are not in compliance, the Contractor will be charged an amount of $500.00 per occurrence and further reworking shall be required. An "occurrence" will be considered a day or portion of a day in which re-measuring to verify compliance is performed. If the Department performs re-measure and the reworked surfaces are in compliance, no charge will be made for the re-measure.

400.2.23.8 Payment Adjustment

Intentionally Deleted

400.2.24 COLD MILLING ASPHALT PAVEMENT

400.2.24.1 General

400.2.24.1.1 Description

Cold milling asphalt pavement is the process of removing existing pavement from the roadway to the lines and dimensions shown on the Detailed Designs or as directed by the Design Engineer and as accepted by the Department.

400.2.24.2 Materials And Procedures

400.2.24.2.1 Reclaimed Asphalt Pavement (RAP)

The material produced as a result of cold milling shall be defined as Reclaimed Asphalt Pavement (RAP).

Ownership of the RAP will be specified in the Technical Requirements and shall be one of or a combination of the following:

(a) Department Ownership of the RAP

The Department will retain ownership of the RAP material, and the Contractor shall haul it to a designated location.

(b) Contractor Ownership of the RAP

The Contractor will assume ownership of the RAP material and shall haul it from the roadway to his own storage site or otherwise dispose of it.

400.2.24.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.24.3.1 General

Sampling and testing will only be required if RAP is to be used for the production of asphalt concrete pavement or stockpiled for the Department.

The Department shall have access to the work at all times for taking samples. The Contractor shall provide sampling stands, sampling devices and other facilities which the Department may require to safely obtain representative samples of the item being produced.

400.2.24.3.2 Test Methods

Unless otherwise specified, the latest edition of the following standard Alberta Transportation test methods (ATT) shown in Table 400.2.24.3.2 1 will be used to determine material characteristics of the RAP.

Table 400.2.24.3.2 1

RAP TEST METHODS

TEST DESCRIPTION	TEST METHOD
1. Sampling Mixes	ATT - 37
2. Sieve Analysis, RAP	ATT - 53
3. Extraction	ATT - 12
4. Sieve Analysis, 20 000 Φm Minus	ATT - 26

NOTES:

(1) In all test methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board Specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Section 400.2.20 (Aggregate Production and Stockpiling).

(2) In all cases the latest amendment or revision current at the closing date of the tender is implied when reference is made to one of the above standards in the specification.

400.2.24.3.3 Quality Control Testing

Quality control testing is the responsibility of the Contractor. Tests performed by the Department will not be considered to be quality control tests. The Contractor shall provide and pay for equipment and qualified personnel to perform all quality control testing necessary to determine and monitor the characteristics of the RAP and to ensure that it meets specification requirements.

Test methods, sampling and minimum frequency of testing are described in Section 400.2.24.3.2 (Test Methods) and Table 400.2.24.3.3.1 Quality Management Testing Requirements.

Results of all quality control tests shall be submitted to the Department on a daily basis.

Table 400.2.24.3.3.1

QUALITY MANAGEMENT TESTING REQUIREMENTS

TEST	STANDARD	MINIMUM FREQUENCY
Sampling Mixes	ATT - 37	One per 1000 tonnes
RAP Sieve Analysis	ATT - 53	One per 1000 tonnes
RAP Asphalt Content (Extraction)	ATT - 12	One per 1000 tonnes
Extraction Sieve Analysis	ATT - 26	One per extraction test

400.2.24.4 Acceptance Sampling And Testing

Within this specification certain requirements, limits, and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements where so specified, shall be measured and accepted based on the Department's quality acceptance test results.

400.2.24.5 Construction

400.2.24.5.1 Cold Milling Equipment

The Contractor shall use equipment with automatic grade and slope controls, capable of cold milling existing asphalt pavement to an accurate depth of cut, profile and cross slope and shall be capable of loading the milled material directly into trucks.

400.2.24.5.2 Cold Milling Asphalt Pavement

Cold milling asphalt pavement shall be performed in a manner which prevents the tearing and breaking of underlying and adjacent pavement and the contamination of the RAP with granular, subgrade or deleterious materials. All RAP shall be loaded directly to trucks from the milling machine and hauled to stockpile or disposed of.

The milled roadway surface shall be swept clean prior to opening to traffic. At locations including but not limited to urban areas and bridge decks, the Contractor shall sweep the surface in a manner which minimizes dust.

The Contractor shall promptly repair any localized areas of distress in the milled surface that may present a hazard to traffic.

At the point of daily termination of cold milling operations, changes in roadway surface profile or cross-section shall be limited to 50mm and longitudinal transitions shall be a maximum of 25mm vertically per metre.

In the event of rain or other inclement weather, the Contractor shall suspend cold milling operations. The Contractor shall make necessary allowances for drainage of water that may pond in areas where the milled sections have not been paved.

400.2.24.5.3 Stockpiling Reclaimed Asphalt Pavement

- Department Ownership

When stockpiling of RAP for Department ownership is specified, it shall be performed in accordance with Section 400.2.20 (Aggregate Production and Stockpiling) and the following:

(i) A granular stockpile base layer shall be constructed upon the prepared stockpile site to a compacted thickness of at least 150mm, using granular material containing 100 percent passing the 16 000 micron sieve, and no more than 10 percent passing the 80 sieve. The stockpile base layer shall be of such dimensions as to accommodate the maximum quantity of RAP which will exist in the stockpile.

(ii) No equipment shall operate on the stockpile at anytime.

- Contractor Ownership

When it is specified that the Contractor shall assume ownership of the RAP and it elects to use this material in the production of Asphalt Concrete Pavement, stockpiling of the RAP shall be performed in a manner which prevents contamination and consolidation of the RAP material being used.

400.2.24.5.4 Gradation of Reclaimed Asphalt Pavement

Reclaimed asphalt pavement to be used in the production of Asphalt Concrete Pavement shall meet the gradation requirements specified in Table 400.2.24.5.4.1.

Table 400.2.24.5.4.1

GRADATION SPECIFICATIONS FOR RECLAIMED ASPHALT PAVEMENT

Percent Passing Metric Sieve (CGSB 8-GP-2M) Φm	125 000	100
	80 000	99 - 100
	40 000	95 - 100

400.2.24.5.5 Hauling

Haul of RAP shall be carried out in accordance with Section 400.2.30 (Hauling).

400.2.24.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.24.7 Measurement

400.2.24.7.1 Cold Milling Asphalt Pavement

Measurement of cold milling asphalt pavement will be made in square metres of roadway milled, or tonnes or cubic metres (truck box measurement), whichever is specified in Section 200 (Project Specifics), of RAP produced.

400.2.24.7.2 Granular Stockpile Base Layer

When RAP is stockpiled for Department ownership, a granular stockpile base layer will be required.

Measurement of the granular stockpile base layer will be in tonnes or cubic metres (truck box measurement), whichever is specified in Section 200 (Project Specifics).

400.2.24.8 Payment Adjustment

Intentionally Deleted

400.2.25 PRIME, TACK AND FOG COATS

400.2.25.1 General

400.2.25.1.1 Description

The work shall consist of placing an asphalt material on a prepared surface at locations shown in the Detailed Designs.

400.2.25.1.2 Definitions

Prime Coat:

An application of a liquid asphalt to an absorbent surface to waterproof and promote bonding between the surface being primed and the next course.

Tack Coat:

An application of a liquid asphalt to ensure a bond between the surface being paved and the next course.

Fog Coat:

An application of a liquid asphalt to seal small cracks and surface voids.

400.2.25.2 Materials And Procedures

The Contractor shall supply the asphalt material in accordance with Section 400.2.33 (Supply of Asphalt).

The types and grades of liquid asphalts for Prime Coat, Tack Coat, Curing Fog Coat for Cement Stabilized Base Course, and Fog Coat shall be as follows:

Prime Coat:

The Contractor's choice of SEP-1, SEP-2 or SS-1 for application through August 31 each season. The Contractor's choice of MC-30, SEP-1, SEP-2 or SS-1 for application after August 31 each season.

Sand used for the blotting of excess asphalt due to prime shall be supplied by the Contractor.

Fog Coat:

SS-1 for application through August 31 each season. The Contractor's choice of MC-30 or SS-1 for application after August 31 each season.

The estimated range in application rates for Fog Coat to a pavement surface is from 0.4 to 0.7 kilograms per square metre of undiluted SS-1 or 0.2 to 0.5 kilograms per square metre of MC-30. The actual application rate is to be chosen by the Contractor in consultation with the Design Engineer and as accepted by the Department at the beginning of the project to ensure that complete and uniform coverage is achieved without streaking.

400.2.25.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.25.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.25.5 Construction

Asphalt material for Tack Coat and Fog Coat shall be applied only when the surface to be treated is dry, when the weather is not foggy or rainy, and when the surface temperature is above zero degrees Celsius for application of cutback asphalts and 5ºC for emulsions, or as otherwise approved by the Design Engineer and as accepted by the Department.

The asphalt material shall be applied by means of a self-powered pressure distributor equipped with the following control devices.

(1) Tachometer.
(2) Pressure gauge.
(3) Adjustable length spray bar.
(4) Positive displacement asphalt pump with separate power unit.
(5) Heating coils and burner capable of applying even heat to the asphalt material.
(6) Thermometer well and accurate thermometer.

Before applying asphalt material, the Contractor shall ensure that the distributor meets the following adjustments and requirements:

(1) The distributor vehicle will maintain a constant height of the spray bar as the tank is unloaded.
(2) All spray bar nozzles are of the same manufacture, type, and size.
(3) Clogged nozzles have been removed and cleaned with solvent.
(4) All nozzles have been set in the spray bar so that the nozzle slots make the same angle (15º to 30º) with the longitudinal axis of the spray bar.
(5) The spray bar has been adjusted to the correct height to ensure uniform application without streaking.
(6) The spray bar has been provided with a positive shut-off to prevent dribbling.
(7) The distributor is capable of maintaining a uniform speed.

The distributor may be checked for calibration by the Design Engineer and as accepted by the Department before being used on the work.

Before applying the asphalt material, loose dirt or other objectionable material shall be removed from the prepared surface by brooming or by other methods acceptable to the Design Engineer and as accepted by the Department. Where base courses become ravelled, the loose material shall be moistened and recompacted to achieve a tight, uniform surface.

The asphalt shall be uniformly applied without streaking.

Joints and seams shall not be excessively overlapped. Structures, wheel guards, guardrail, and other roadway appurtenances shall not be spattered by the asphalt material. The Contractor shall remove any spattering caused by his operation.

Areas missed by the distributor or inaccessible to the distributor shall be treated using a hand spray or pouring pot.

Traffic shall not to be permitted to travel on Tack Coat until it has cured.

Traffic shall not to be permitted to travel on Prime Coat until 6 hours after application or until it has cured. After this period of time, excess asphalt material remaining on the surface shall be blotted by sand before traffic is permitted to travel on the surface. The "blotter sand" can be any clean sand.

Where traffic must be accommodated, the Contractor shall apply the Prime, Tack or Fog Coat covering up to only one-half of the roadway surface at a time. Other portions across the roadway shall not be sprayed until previous applications have properly cured and in the case of Prime Coat, all puddles and excess free asphalt has been blotted.

In all situations, Prime Coat and Tack Coat shall be maintained by the Contractor. Any area of Prime Coat or Tack Coat that has become fouled shall be repaired before Asphalt Concrete Pavement is placed.

400.2.25.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.25.7 Measurement

400.2.25.7.1 Prime Coat

Measurement for supplying and applying Prime Coat will be by the square metre of area placed.

400.2.25.7.2 Tack Coat

Measurement for supplying and applying Tack Coat will be by the square metre of area placed.

400.2.25.8 Payment Adjustment

Intentionally Deleted

400.2.26 <u>CUTTING OF PAVEMENT</u>

400.2.26.1 General

This specification covers the cutting of existing concrete curbs, sidewalks, driveways, asphalt concrete pavement, and base course materials where new surfacing materials are to be placed abutting the existing structure. The location of pavement cuts will be shown on the Detailed Designs, or as specified in the Technical Requirements.

400.2.26.2 Materials And Procedures

Intentionally Deleted

400.2.26.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.26.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.26.5 Construction

Wherever specified, the Contractor shall cut concrete curbs, sidewalks, driveways, and existing pavement to the full thickness of the structure so that a smooth vertical edge results, against which new materials can be effectively placed and compacted. Rough, jagged edges will not be acceptable.

Unless otherwise specified in the Technical Requirements, the Contractor may utilize any cutting methodology, provided the methods and equipment result in a clean and straight vertical cut. All proposed methods and equipment employed by the Contractor shall be reviewed and accepted by the Design Engineer and as accepted by the Department prior to the start of work.

When trench excavation across an existing structure is required, the Contractor shall cut the existing pavement on both sides of the trench to the full depth of the structure. The trench cuts shall result in a trench that is no wider than necessary to permit satisfactory installation of the works, and to thoroughly compact the backfill material.

When the Contractor cuts a trench across existing curb, sidewalk, driveway or roadway, the Contractor shall the backfill the trench with similar or better materials than those excavated. The backfill work shall be performed in accordance with the applicable sections of the Technical Requirements.

All concrete, asphalt concrete pavement, and base course material that is cut-away shall be excavated, loaded, hauled and disposed of at a suitable disposal site provided by the Contractor.

400.2.26.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.26.7 Measurement

Cutting of pavement will be measured in lineal metres of structure cut.

400.2.26.8 Payment Adjustment

Intentionally Deleted

400.2.27 ASPHALT CONCRETE PAVEMENT

400.2.27.1 General

400.2.27.1.1 Description

Asphalt Concrete Pavement (ACP) shall consist of crushed aggregates, or a combination of crushed aggregates and where permitted in Section 200 (Project Specifics) Reclaimed Asphalt Pavement (RAP), blend sand material, as required, and asphalt cement, combined in a hot mix plant, placed and compacted on a prepared surface in conformity to the lines, grades, dimensions and cross-sections as shown in the Detailed Designs or as directed by the Design Engineer and as accepted by the Department.

400.2.27.1.2 Definitions

For purposes of this specification, the following definitions will apply:

Acceptance Limits

(i) Density and Actual Asphalt Content - Acceptance Limits for Density and Actual Asphalt Content are the limiting values of the Lot Mean within which the Lot will be accepted at full, increased, or reduced payment for Density, as shown in Table 400.2.27 A, or full or reduced payment for Actual Asphalt Content as shown in Table 400.2.27 B.

(ii) Smoothness - Acceptance Limit for Smoothness is the limiting value of the Profile Index (PrI) within which a Sublot will be accepted with or without Payment Adjustment as shown in Table 400.2.27 C.

(iii) Gradation - Acceptance Limit for Gradation is the limiting value of the Lot Mean within which the Lot will be accepted as shown in Table 400.2.27 E.

(iv) Thickness – Acceptance Limit for Thickness is the limiting value of the Sublot Mean within which the Sublot will be accepted as shown in Table 400.2.27 G1 and G2.

Asphalt Content

(i) Design Asphalt Content - The Asphalt Content established by the accepted mix design.

(ii) Accepted Asphalt Content - The Design Asphalt Content or subsequent adjustments to it. Such adjustments must be accepted in writing by the Design Engineer and as accepted by the Department.

(iii) Actual Asphalt Content - The amount of asphalt binder in the mix as determined by ATT-12, ATT-74 and includes an amount to correct for the asphalt binder lost due to absorption by the aggregate or aggregate loss.

This correction may be determined for each change in aggregate or asphalt binder.

Job Mix Formula

The Job Mix Formula establishes the aggregate proportioning, target aggregate gradation, and Accepted Asphalt Content to be used for production of asphalt mix and requires the approval of the Design Engineer and the Department on the basis of a mix design.

Lot

A Lot is a portion of the work being considered for acceptance and is defined as the following:

(i) One day's plant production of more than 4 hours where accepted changes to the following criteria have not occurred:

   (a) Job Mix Formula

   (b) Pavement Density Requirement

   A change in any one of the above may require a new Lot designation.

(ii) One day's plant production of less than 4 hours will be dealt with at the Department's option, as follows:

   (a) The material will be added to the previous day's Lot if the criteria specified in (i) remains the same or,

   (b) The material will be added to the next day's Lot with the same criteria specified in (i) or,

   (c) If it is the last time the mix is produced with these criteria then the production will be designated as a Lot.

(iii) If the Department suspects a portion of a Lot is substandard, extra testing to define the area and severity of the deficiency, may be undertaken. A new Lot will be designated for this portion if this extra testing indicates the mix is subject to a Payment Adjustment or rejection.

Rejection Limit

(i) Density and Actual Asphalt Content - Rejection Limit for Density and Actual Asphalt Content is the limiting value of the Lot Mean beyond which a Lot is rejected as shown in Tables 400.2.27 A, and 400.2.27 B.

(ii) Smoothness - Rejection Limit for Smoothness is the limiting value of the PrI beyond which a Sublot is rejected as shown in Table 400.2.27 C.

(iii) Gradation - Rejection limit for Gradation is the limiting value of the Lot Mean beyond which a Lot is rejected as shown in Table 400.2.27 E.

Lot Mean and Range

The Lot Mean is the arithmetic mean of a set of 5 or more test results constituting the sample for the Lot. The Range represents the difference between the highest and lowest values within a set of test results.

Stratified Random Sample

A Stratified Random Sample is a set of test measurements taken 1 each from 5 or more separate (stratified) areas or segments within a Lot in an unbiased way.

Sublot

A Sublot is a portion of a Lot that is 1 paver width wide and 100m long on which the calculation for Smoothness, Thickness, and assessment of Workmanship and Obvious Defects are based.

Alberta Transportation Test Procedures

Test methods designated in these specifications as "ATT" or "TLT" refer to Alberta Transportation Tests.

400.2.27.2 Materials And Procedures

400.2.27.2.1 Asphalt

The Contractor shall supply asphalt material in accordance with Section 400.2.33 (Supply of Asphalt) and Section 200 (Project Specifics). The types and grades of asphalt shall be as specified in the Technical Requirements.

For ACP mixtures containing RAP and specified to use penetration grade asphalts, the procedures outlined in TLT-300, Recycling of Asphalt Concrete Pavement, shall be used to determine the rheology of the RAP and the grade of virgin asphalt to be used. For ACP mixtures containing RAP and specified to use Performance Graded (PG) asphalts, the RAP rheology and the grade of virgin asphalt to be used shall be determined according to Appendix A of AASHTO M323.

Rheological testing of the RAP is not required for ACP mixtures using a maximum RAP to virgin aggregate ratio of 10/90 and penetration grade asphalts. Rheological testing of the RAP is required for ACP mixtures using PG asphalts..

400.2.27.2.2 Aggregate

The Contractor shall produce crushed aggregates in accordance with Section 400.2.20 (Aggregate Production and Stockpiling), for the designation and class of material specified in the Detailed Designs. The Contractor shall supply aggregate materials in accordance with Section 400.2.31 (Supply of Aggregate), and haul materials in accordance with Section 400.2.30 (Hauling).

400.2.27.2.3 Interim Lane Markings

The Contractor shall supply interim lane marking paint and glass beads from the list of products shown in the Department's Products List.

The Contractor has the option of supplying reflectorized temporary pavement markers or self-adhesive reflectorized pavement marking tape. Acceptable temporary pavement markers are shown on the Department's Products List.

400.2.27.2.4 Reclaimed Asphalt Pavement

Unless specified otherwise, the Contractor may elect to use suitable RAP in the ACP mixture to a maximum RAP to virgin aggregate ratio of 30/70 for penetration grade asphalts. For ACP with PG asphalt at -37 or lower shall not use RAP without rheological testing to ensure that the specified PG low temperature criteria is meet at the RAP to virgin aggregate ratio proposed. ACP mixes with PG asphalt and RAP will need to be accepted by the Department before they are used. Suitable RAP shall not contain any other additives including, but not limited to: sulphur, crumb rubber, asphalt rubber, asbestos, produced sand, paving fabrics, and reinforcement grids. The handling, stockpiling, storage, and hauling of all RAP shall be in accordance with Section 400.2.24 (Cold Milling Asphalt Pavement). The Contractor shall prevent the contamination and consolidation of the RAP material.

400.2.27.2.5 Asphalt Mix Design and Job Mix Formula

Responsibility for Mix Design

Preparation and submission of asphalt mix design(s) for Design Engineer and Department verification and acceptance are the responsibility of the Contractor. The Contractor shall use Professional Engineering services and a qualified testing laboratory licensed to practice in the Province of Alberta, to assess the aggregate materials proposed for use and to carry out the design of the asphalt mixture. The design testing laboratory shall have obtained pre-qualification status from the Department in the category of Asphalt Concrete Mix Design - Marshall.

All costs incurred in mix design formulation are the responsibility of the Contractor. Shipping costs for samples sent to the Design Engineer and the Department for verification and approval are the responsibility of the Contractor.

Requirements for Mix Design

The asphalt mix design shall follow the Marshall method of Mix Design as outlined in design procedure TLT-301. The mix design, at the Design Asphalt Content, shall meet the requirements in Table 400.2.27.2.5.1 for the Asphalt Concrete Mix Type specified in the Technical Requirements.

TABLE 400.2.27.2.5.1, ASPHALT CONCRETE MIX TYPES AND CHARACTERISTICS

Mix Type	Aggregate Criteria			Marshall Mix Design Criteria							
	Top Size (mm) (Class for Des. 1 Aggregate)	Percent MF. -5,000 (min) Note 1	Percent Fractures +5,000 (2 faces) (min)	Marshall Stability N (min)	No. of Blows	Flow (mm)	Air Voids (%)	VMA (min) by Air Voids (%)		Voids Filled with Asphalt (%)	Retained Stability (min) (%)
								3.5	4.0		
H1	16.0	75	98 (1 face) 90	12,000	75	2.0 to 3.5	Note 3	13.0	13.5	65-75	70
H2	12.5	70	80	11,500	75	2.0 to 3.5	Note 3	13.5	14.0	65-75	70
M1	12.5	50	60	8,000	75	2.0 to 3.5	Note 3	13.5	14.0	65-75	70
L1	12.5	Note 5	60	5,300	50	2.0 to 4.0	Note 3, 4	13.5	14.0	65-78	70
S1	10.0	Note 5	70	5,300	Note 2	2.0 to 4.0	Note 3	14.5	15.0	65-78	70
S2	10.0	75	90	10,000	75	2.0 to 3.5	Note 3	14.5	15.0	65-78	70
S3	25.0	Note 5	70	10,000	75	2.0 to 4.0	Note 3	11.5	12.0	65-78	70

Design Air Voids	Minimum Theoretical Film Thickness Requirements (microns)	
	Mix Types H1, H2, M1	**Mix Type L1, S2, S1** (note 7)
4.0 and 3.9	6.0	6.5
3.7 and 3.8	6.1	6.6
3.5 and 3.6	6.2	6.7
3.3 and 3.4 (L1 for Community Airports only)	-	6.8
3.0, 3.1 and 3.2	-	6.9

Note 1 - The Percentage of Manufactured Fines in the -5,000 micron portion of the combined aggregate.

Note 2 - Use the same number of blows as for the surface course or 50 blows if used as a surface course.

Note 3 - The Design Air Voids shall be chosen as the lowest value, within the range of 3.5 to 4.0 percent inclusive, such that all other mix design criteria are met.

Note 4 - Air Void limits listed in Note 3 shall be reduced by 0.5 percent for community airports. VMA at 3.0 percent Air Voids shall be a minimum of 13.0 percent. A 300-400A asphalt is normally used for community airports.

Note 5 - All fines manufactured by the process of crushing shall be incorporated into the mix.

Note 6- Theoretical Film Thickness shall be as follows, depending on the specified Mix Type and Design Air Voids. The Theoretical Film Thickness value shall be established in accordance with TLT-311.

Note 7 - S1 requirement only for a surface course

Acceptance of Mix Design

The Contractor shall submit the mix design to the Department for acceptance. The Contractor's submission shall include the following information:

(i) Aggregate source name(s) and location(s).

(ii) The gradation of each aggregate to be used in the mixture.

(iii) The percentage by mass of each aggregate to be used in the mixture.

(iv) The mix design gradation of the combined aggregate.

(v) Other characteristics of the combined aggregate specified in Section 400.2.20 (Aggregate Production and Stockpiling).

(vi) All Marshall Mix Design characteristics, including graphs used in arriving at the final mix design, the bulk specific gravity of the combined aggregates, theoretical maximum specific gravities, and the asphalt absorption of the combined aggregates.

(vii) Identification of each asphalt supplier by name, location, and types and grades of asphalt to be supplied.

(viii) Percent uncompacted voids (Fine Aggregate Angularity) of loosely compacted minus 2,500 micron portion of the combined aggregate in accordance with TLT-125. No minimum value specified.

(ix) For each asphalt supplied, asphalt specific gravity, and recommended mixing and compaction temperatures for the preparation of design specimens.

(x) Voids table to include Air Voids, VMA, and Voids Filled with Asphalt for various asphalt contents (0.1 percent increments) and bulk densities (increments of 5 kg/m^3).

(xi) Mix design submissions using RAP shall include the RAP source name(s) and location(s), all RAP asphalt content and gradation test results, the bulk specific gravity of the RAP aggregate, the percentage by weight of RAP to be used in the mixture, and, when required, all RAP rheological test results, the design rheology, and all blending charts used.

Where required by the Design Engineer or the Department for any change in the nature or sources of the aggregates or RAP, or where a new mix design is desired by the Contractor, the Contractor shall provide a separate and complete mix design. This new mix design shall be subject to acceptance by the Design Engineer and the Department.

The Department may, at any time, require the Contractor to provide representative samples of each of the aggregate components, asphalt cement, and RAP for verification purposes. A sufficient quantity of each component shall be provided to result in a 100 kg sample of combined aggregate at design proportions.

The Department will require up to 5 working days from the time of receipt of the mix design or the samples, if they are required, to accept the mix design.

The cost of such mix design verification will be borne by the Department.

The Contractor shall not produce any asphalt mix prior to receiving the Design Engineer and the Department's written notice that the mix design has been accepted. Any mix produced prior to receiving such notice will not be accepted.

The aggregate proportioning, target gradation, and asphalt content for the accepted mix design will then be the Design Mix Formula and will become the Job Mix Formula for the start in production of asphalt mix.

Variation from Accepted Job Mix Formula

Once the Job Mix Formula has been established and accepted, no alteration will be permitted unless reviewed and accepted by the Design Engineer and the Department.

The Lot Mean Marshall Air Voids, as determined by the Design Engineer and the Department, shall not vary from the air voids in the accepted mix design by more than 0.5 percent.

If the sum of any accepted alterations to the Job Mix Formula is in excess of any one of the following limits away from the Design Mix Formula, a new mix design is required.

- ± 5.0 percent passing the 5,000 micron sieve.
- ± 1.0 percent passing the 80 micron sieve.
- ± 0.3 percent asphalt content.
- ± 2.0 percent in target proportion of RAP.

Unless otherwise accepted by the Design Engineer and the Department, the Contractor may not request more than 3 alterations to the Job Mix Formula without the provision of a new mix design.

Any change to the accepted Job Mix Formula shall not result in a Theoretical Film Thickness value less than that specified in Table 400.2.27.2.5.1 Asphalt Concrete Mix Types and Characteristics, for the applicable Design Air Voids.

Any change in the target proportion for RAP shall meet the requirements of Section 400.2.27.2.1 (Asphalt), for rheological testing of the blended asphalt and maximum RAP to virgin aggregate ratio.

400.2.27.3 Quality Management Sampling And Testing

400.2.27.3.1 General

The Contractor shall use Professional Engineering services and a qualified testing laboratory, licensed to practice in the Province of Alberta, to assess and where necessary, modify the materials/procedure to ensure the end use meets all Technical Requirements.

Quality management testing is the responsibility of the Contractor throughout every stage of the work from the crushing and production of aggregates to the final accepted product. Tests performed by the Department will not be considered to be quality management tests. The Contractor shall provide and pay for equipment and qualified personnel, including all consulting services retained by it, to obtain all acceptance core samples and perform all quality management testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the work, and the final product produced.

If the Contractor elects to use RAP, the asphalt content and gradation of the RAP shall be determined according to and at the frequencies specified in Section 400.2.24 (Cold Milling Asphalt Pavement). When required, the RAP rheology shall be determined at a minimum frequency of 1 per 1,000 tonnes of RAP and a minimum of 3 samples shall be tested for each RAP source.

All quality management sampling and testing will be carried out in accordance with the Contractor's "Quality Management System (QMS)" and the Technical Requirements.

The Design Engineer or the Department may require an increase in the frequency of any quality management test, which has a specified minimum frequency in the Quality Management Plan. The Contractor shall arrange and pay for any additional tests required by the Design Engineer or the Department.

Results of all quality management tests shall be submitted to the Design Engineer and the Department as they become available. In addition, the quality management test results for mix asphalt content and aggregate gradation shall be provided to the Design Engineer and the Department no later than 12:00 noon of the day following placement.

All costs associated with pavement coring for both quality management and acceptance testing shall be the responsibility of the Contractor.

Initial acceptance testing will be performed free of cost to the Contractor. The Contractor shall be responsible for the costs of all acceptance testing performed on material that is used to replace or overlay material that has been previously rejected.

The Contractor shall repair using fresh asphaltic material all core holes or other sampling disturbances, as required for either quality management or acceptance testing to a uniform smooth surface condition.

The Contractor shall be responsible for all acceptance retesting performed following attempts to improve smoothness or to remove bumps or dips.

After all quality management tests for the Lot are reported to the Department, the Department may provide the Contractor with a copy of the results of acceptance tests within 1 working day of their availability.

Quality management measures, as outlined in the QMS, shall be followed to ensure pavement design lift thickness values are being achieved.

400.2.27.3.2 Test Methods

Inspection, sampling, and testing to follow requirements of Table 400.2.27.4.3. Alternative or supplemental test methods may be used but shall be outlined in the QMS.

400.2.27.4 Acceptance Sampling And Testing

400.2.27.4.1 General

The Department will, from time to time, take samples and carry out acceptance testing and inspection of the workmanship and materials incorporated or being incorporated into the work in order to ensure compliance with the Technical Requirements. The Contractor shall cooperate with the Department for such sampling, testing, and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the work strictly in accordance with the Technical Requirements.

Where it is required in the specifications that the Contractor submits samples of materials or mixtures to the Department for acceptance, these samples shall be submitted in sufficient time for proper testing.

Where specified, random sampling procedures shall be followed, and where no specific random sampling procedure is specified, the sampling procedure shall be as identified by the Department in the case of acceptance testing and by the Contractor in the case of quality management testing.

The Department shall have access to the work at all times for taking samples. The Contractor shall provide any assistance necessary for taking samples and shall reinstate pavement layers or other structures to the satisfaction of the Department at the positions where samples have been taken. No separate compensation for providing assistance with sampling and for reinstatement where samples are taken will be made.

The Contractor shall provide sampling stands, sampling devices, and other facilities, which the Department may require to safely obtain representative samples of the item being produced.

When required, the Contractor shall provide and prepare, to the satisfaction of the Department, a suitable site for the parking of a mobile laboratory trailer. The Contractor shall provide power to the mobile laboratory trailer.

400.2.27.4.2 Test Methods

Various test methods may be used by the Department to confirm that specification requirements are being met.

Unless otherwise specified, the following standard test methods shown in Table 400.2.27.4.2 will be used to determine material characteristics.

TABLE 400.2.27.4.2
Acceptance Sampling and Testing Methods

	TEST DESCRIPTION	TEST METHOD
1	Sampling Mixes	ATT-37
2	Coring	ATT-5
3	Extraction	ATT-12
4	Correction Factor, Extracted Asphalt Content	ATT-12 Part III
5	Percent Fracture	ATT-50
6	Sieve Analysis	ATT-26
7	Density, Immersion Method, Waxed Asphalt Concrete Specimens	ATT-6
8	Density, Immersion Method, Saturated Surface Dry Asphalt Concrete Specimens	ATT-7
9	Voids Calculations, Asphalt Concrete Specimens	ATT-36
10	Percent Compaction, Asphalt Concrete Pavement	ATT-67
11	Forming Marshall Specimens, Field Method	ATT-13
12	Moisture Content, Oven Method Asphalt Concrete Mixes	ATT-15
13	Smoothness of Pavements, Profilograph Method	ATT-59
14	Stratified Random Test Sites for ACP Projects	ATT-56
15	Appeal Testing, Asphalt Content, Density and Gradation	ATT-68
16	Asphalt Content, Ignition Method	ATT-74
17	Correction Factor, Ignition Asphalt Content	ATT-74 Part II
ADDITIONAL TEST METHODS FOR QUALITY MANAGEMENT TESTING		
18	Asphalt Content	AASHTO T164, T287 or ATT-74

Notes:

(1) In all test methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board Specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Section 400.2.20 (Aggregate Production and Stockpiling).

Table 400.2.27.4.3
QUALITY MANAGEMENT TESTING REQUIREMENTS - ACP PROJECTS

TEST	STANDARD	MINIMUM FREQUENCY
AGGREGATE PRODUCTION		See Section 400.2.20
ASPHALT MIX PLANT		
Calibration	ATT-17	Once and additionally as outlined in the QMS. Inspection as per outlined in the QMS.
Inspection	ATT-16	
SAMPLES FOR ACCEPTANCE TESTING		
Asphalt Cement	ATT-42	See Section 400.2.33
Tack, Prime and Fog Materials	ATT-42	See Section 400.2.33
Cores - Stratified Random Test Sites Chosen By the Department.	ATT-5, ATT-56	1 per segment for each Lot.
INSPECTION, SAMPLING AND TESTS		Inspection, sampling, and testing as outlined in the Contractor's QMS
Cold Feed Aggregate	ATT-38	
Mix	ATT-37	
Mix Asphalt Content	AASHTO T-164, T287 or ATT-12 or ATT-74	
Correction Factors	ATT-12, Part III or ATT-74, Part II	
Mix Moisture Content	ATT-15	
Aggregate Sieve Analysis	ATT-26	
Pavement Segregation	Segregation Rating Manual	
Field Formed Marshall Briquettes	ATT-13	
Density Immersion Method, Saturated Surface Dry	ATT-7	
Void Calculations, Cores or Formed Specimens	ATT-36	
Temperatures	ATT-30	
Percent Compaction, Cores or Nuclear Density	ATT-67, ATT-5 or ATT-11	
Random Test Site Locations	ATT-56	
Correction Factors, Nuclear Moisture-Density Measurement	ATT-48	
Pavement Smoothness	ATT-59	

Notes:

(1) In all test methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board Specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Section 400.2.20 (Aggregate Production and Stockpiling).

400.2.27.5 Construction

400.2.27.5.1 Equipment

General

Equipment shall be designed and operated to produce an ACP end product complying with the requirements of this specification and the Technical Requirements.

Mixing Plant

Mixing plants shall be operated in accordance with the manufacturer's recommendations and shall be calibrated prior to commencing production of the specified mix. The Contractor shall provide the Design Engineer and the Department with a certificate of calibration, which certifies that the plant has been calibrated to produce a uniform mixture in accordance with the Job Mix Formula.

When ACP contains RAP, the mixing plant shall be capable of thoroughly separating and heating the RAP particles and blending the RAP with virgin aggregate and any required asphalt cement, to create a homogeneous mix at the plant discharge. The plant shall also contain specialized mixing equipment that will prevent the RAP from coming into direct contact with the flame, thus minimizing "blue smoke" and oxidation of the asphalt in the RAP.

Mix Production

Aggregate and asphalt shall be combined to produce a uniform mixture of specified gradation at an asphalt content in accordance with the accepted Job Mix Formula and in which all particles of aggregate are uniformly coated.

Unless otherwise specified, the maximum mixing temperature for all grades of asphalt shall be 155ºC or for Performance Grade specified asphalts, as recommended in writing by the asphalt supplier.

Plant emissions shall not exceed the limits set by Alberta Environment.

400.2.27.5.2 Preparation of Existing Surface

General

Failed areas in existing surfaces shall be repaired in accordance with Section 400.2.19 (Subgrade Preparation) or as directed by the Design Engineer or the Department. The Design Engineer and the Department in consultation with the Contractor will identify areas requiring repair.

Before the asphalt mix is placed, dirt and other objectionable material shall be removed from the surface to be paved, by brooming or other methods, and a tack coat or prime coat shall be applied in accordance with Section 400.2.25 (Prime, Tack and Fog Coats).

Existing fillets and ramps at approaches to railway crossings and bridge structures, or adjacent to paved surfaces or other structures, shall be removed to the depths indicated in the Detailed

Designs or as directed by the Design Engineer and as accepted by the Department. The removed material shall be disposed of and the exposed surfaces shall be prepared as directed by the Design Engineer and as accepted by the Department.

Contact edges of existing mats and contact faces of curbs, gutters, manholes, sidewalks, and bridge structures shall be coated with a thin film of liquid asphalt material, to the satisfaction of the Design Engineer and as accepted by the Department, before placing the asphalt mix.

Preliminary Levelling

Areas that require preliminary levelling will be indicated in the Technical Requirements or as identified in the field by the Design Engineer and as accepted by the Department. Generally, areas that show depressions, rutting or other deformations to a depth of 15mm or greater will be designated by the Design Engineer and as accepted by the Department for preliminary levelling.

Pavement lifts that are specified, or indicated in the Technical Requirements, with designated lift thickness less than 20mm shall be considered as preliminary levelling and shall be placed using a paver. Preliminary levelling not specified to be placed using a paver lift shall be spread using a motor grader or other methods accepted by the Design Engineer and as accepted by the Department. All of the following shall apply for acceptance:

(i) if the material type for preliminary levelling is not specified or indicated in the Technical Requirements, it shall be the same designation and class as specified for the subsequent lift of asphalt concrete pavement;

(ii) regardless of how the asphalt mix is spread, a minimum of 1 pneumatic tired roller shall be used for compaction, and a minimum density of 91.0 percent of the Marshall density, as determined by the Department, is required;

(iii) preliminary levelling is intended to be a separate operation and shall not be done as part of the construction of the subsequent lift of ACP.

For the purposes of determining the Payment Adjustments listed in Table 400.2.27 A and lump sum Sublot assessments listed in Table 400.2.27 C, preliminary levelling is not considered to be a lift.

Transverse Pavement Joints

Transverse joints between existing pavement and ACP placed on the Project shall be of a vertical butt type, well bonded, sealed, and finished to provide a continuous, smooth profile across the joint, to the satisfaction of the Design Engineer and as accepted by the Department. This shall include tie-ins to all paved road allowances, median cross overs, and approaches to bridges and railway crossings. Tie-ins to streets, parking lots and other urban approaches shall be as specified in the Detailed Designs. To accomplish this, the existing pavement shall be cold-milled to expose a vertical surface, of a depth equal to the thickness of the final lift, against which new ACP may be placed. In longitudinal section the minimum slope of the milled area shall be 200 horizontal to 1 vertical, all in general conformance with Alberta Transportation Drawing CB6-3.50 M16. In plan, the Contractor shall have the option of cutting the joint in any of the three ways following:

(i) The joint shall be cut at 45º to the centreline of the roadway across the full width of each mat; or

(ii) The joint shall be cut at 45º to the roadway centreline across the travel lanes and contiguously at 90º to the roadway centreline elsewhere; or

(iii) For median cross overs, bridges and railway crossings the joint shall be cut parallel to the crossing.

When the existing pavement has been removed in advance of paving the joint area, the Contractor shall construct a smooth taper at the joint area to a slope of at least 50 horizontal to 1 vertical. The taper may be placed on tar paper and shall be removed when paving is resumed as directed by the Design Engineer and as accepted by the Department. The transverse joint shall be straight and have a vertical face when the taper is removed.

400.2.27.5.3 Transporting the Asphalt Mix

The mix shall be transported in accordance with Section 400.2.30 (Hauling). Trucks used for transportation of the mix shall be compatible with the size and capacity of the spreading equipment.

Truck boxes shall be clean, free from accumulations of asphalt mix, and foreign material. Excess truck box lubricants such as detergent or lime solutions shall not be allowed to contaminate the mix, and shall be disposed of in an environmentally acceptable manner. Petroleum based truck box lubricants shall not be used.

During transport, the mix shall be completely covered to protect it from precipitation and excessive heat loss by securely fastened waterproofed tarpaulins, unless otherwise accepted by the Design Engineer and the Department.

400.2.27.5.4 Placing the Mix

Asphalt mix shall be placed only on dry surfaces.

The Contractor shall manage his paving operations such that the actual compacted thicknesses meet or exceed the values shown on the Detailed Designs for all lifts placed.

Unless otherwise shown in the Detailed Designs, the asphalt mix shall be placed in the following lift thicknesses:

(i) in a single lift when the design compacted total thickness is 70mm or less.

(ii) in 2 or more lifts when the design compacted total thickness is greater than 70mm. The lift thickness selection shall be determined by the Contractor except that:

  (a) the maximum thickness of any lift shall be 100mm.

  (b) the minimum thickness of a top lift shall be 50mm, unless it is placed directly over a Mix Type S3, in which case the minimum thickness shall be 60mm.

  (c) When a total ACP thickness of 80mm is specified, the thickness of the first lift shall be 30mm and the final lift shall be 50mm.

(d) When a total ACP thickness of 90mm or more is specified, the minimum thickness of all lifts except the top lift shall be 40mm or greater.

(e) The minimum lift thickness for any lift using a Mix type S3 shall be 80mm.

Lift thickness will normally be designed and expressed in increments of 10mm.

Longitudinal joints will not be permitted within driving lanes, in the final lift of ACP. Longitudinal joints shall be offset a minimum of 150mm from one lift to the next.

Longitudinal and transverse joints shall be vertical butt type, well bonded and sealed, and finished to provide a continuous, smooth profile across the joints. Surplus material at longitudinal joints shall be disposed of in a manner acceptable to the Design Engineer and as accepted by the Department. Broadcasting surplus material across the mat will not be permitted.

All longitudinal joints shall be straight and uniform with no lateral waviness. Any mat contact that is not straight or uniform as determined by the Design Engineer and as accepted by the Department shall be trimmed by saw-cutting or using some other method acceptable to the Design Engineer and as accepted by the Department prior to placing the adjacent mat. The material removed shall be disposed of to the satisfaction of the Design Engineer and as accepted by the Department.

Any mat with a contact edge that has deteriorated, cracked or slumped due to improper rolling or vehicle traffic shall be trimmed by saw-cutting or some other method acceptable to the Design Engineer and as accepted by the Department prior to placing the adjacent mat. The length of contact edge to be trimmed, removed and disposed of will be as determined by the Design Engineer and as accepted by the Department.

If required by the Design Engineer and as accepted by the Department, the contact edge of any mat placed by the Contractor shall be coated with a thin film of liquid asphalt before placing the adjacent mat.

When paving is discontinued in any lane or in any lift, the mat shall be tapered to a slope of 10 horizontal to 1 vertical. The taper may be placed on tar paper and shall be removed when paving is resumed. The transverse joint shall be straight and have a vertical face when the taper is removed.

Transverse construction joints from one lift to the next shall be separated by at least 2m.

Where the construction of a top lift of pavement next to a concrete curb section or curb and gutter section will be delayed, the Contractor shall construct a temporary ACP fillet next to the concrete section in accordance with the Detailed Designs or as directed by the Design Engineer and as accepted by the Department. These fillets shall be removed when paving is resumed.

Placement of ACP adjacent to guardrail shall be in accordance with Alberta Transportation's Typical Barrier Drawing No. TEB 3.56a.

400.2.27.5.5 Road Intersections and Entrances

Road intersections and entrances shall be paved in accordance with the Technical Requirements or as herein described in these specifications.

On all road intersections, median cross overs, and residential farm entrances, the asphalt mix shall be spread by means of a paver. No grader laying will be permitted except for preliminary levelling.

On all other entrances, the asphalt mix shall be spread by means determined by the Contractor and in a manner acceptable to the Design Engineer and the Department.

400.2.27.5.6 Compacting the Mix

All asphalt mix, including those areas of the mat which are excluded from testing as noted in Section 400.2.27.6.5 (Exclusions from Random Sampling), shall be thoroughly compacted, and after final rolling the finished surface of the mat shall be free from segregation, waves, hairline cracks, and other obvious defects.

The rollers or drums shall be kept moist with water or non-petroleum based release agents to prevent adhesion. Excess water or release agents shall not be used.

After final rolling is complete, the Contractor shall ensure that the finished mat has cooled for a minimum period of 2 hours before opening the section to traffic.

400.2.27.5.7 Interim Lane Markings

The Contractor shall provide interim lane markings on all newly constructed ACP surfaces, or on tacked surfaces that are to be exposed to traffic overnight.

When paint is used, the paint shall be the same colour as the permanent markings designed for the work.

All paint spots shall be 100mm wide and 300mm long, shall be applied lengthwise to the road surface, shall be spaced 15m apart on centre in tangent sections and 7.5m apart on curves and shall be completely covered with glass beads at the time of painting.

When self-adhesive, reflectorized pavement marking tape is used, the spacing shall be the same as is used for paint spots. Tape on lower lifts does not need to be removed prior to placement of the next lift of pavement. If tape is used on the upper lift, it shall be removed immediately prior to painting the permanent lane markings.

When temporary pavement markers are used, they shall be placed at 25m intervals on tangent sections and at 15m intervals on curves. Markers used on the upper lift must remain in place until the permanent markings are applied. Markers used on lower lifts, shall be removed immediately prior to placement of the next lift of pavement.

400.2.27.5.8 Grooved Rumble Strips

Grooved rumble strips will be required only as indicated in the Technical Requirements.

400.2.27.6 Product Acceptance

400.2.27.6.1 General

Within this specification, certain requirements, limits, and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements where so specified, shall be determined by statistical testing as described in this section.

The Contractor shall be totally responsible for production of aggregate and mixes that meet all the specified requirements.

The Department's acceptance of any materials or mixture shall in no way relieve the Contractor from his obligation to provide materials, mixtures, and workmanship in accordance with the Technical Requirements.

Pavement sampling will be done using stratified random sampling procedures.

The Contractor shall provide to the Department all acceptance testing density cores and any additional cores requested by the Department for acceptance testing for asphalt content and gradation by 12:00 noon of the day following placement, unless otherwise permitted by the Department.

Prior to the Contractor obtaining the cores, the Department may provide the Contractor with new or different random sample locations. The Department may have the Contractor obtain cores for acceptance testing at any time throughout the work for any Lot. All cores provided to the Department shall be in their original condition. The Department shall do core preparation or sawing.

Cores for acceptance Thickness testing shall be obtained by the Contractor at locations chosen by the Department. The Contractor will be reimbursed coring costs for acceptance Thickness testing at a rate of $100.00 per location provided the Sublot is accepted and no Payment Adjustments are applied. No reimbursement of coring costs will be provided for Sublots that are rejected or are subject to Payment Adjustments for Thickness.

If the Department determines that certain test results are faulty due to testing equipment malfunction, improper testing procedures, or calculations, the Department will replace the faulty tests with new tests.

400.2.27.6.2 Pavement Density, Asphalt Content, and Gradation

A minimum of 5 tests per Lot will be selected as follows:

(i) The Lot will be divided into 5 or more segments of approximately equal quantity.

(ii) In each segment, a test site will be located by using random numbers to determine the longitudinal distance from the end of the segment and the lateral distance from the edge of the segment. In no case will a lateral distance be less than 0.5m from the shoulder or 0.3m from any other edge of a mat except when matching mats, in which case the test site may be within 0.3m of the joint.

For lifts of 20mm or less, samples for asphalt content and gradation may be obtained by the Department using the Sampling Mix Behind Paver method described in ATT-37. If sufficient numbers of mix samples cannot be obtained in this manner, stratified random core samples shall be taken by the Contractor, as determined by the Department, in order to perform the minimum 5 tests per Lot.

400.2.27.6.3 Pavement Sampling for Smoothness

The surface of the Sublots in the final lift of asphalt concrete pavement will be profiled by the Department in accordance with ATT-59 using a California Cox Model Profilograph. Other makes of Profilograph machines may be used if they have been individually accepted by the Department. Profiles will be made approximately at the traffic wheel paths.

Smoothness testing will also be undertaken on all passing, climbing, deceleration and acceleration lanes that are greater than 100m in length, and on all interchange ramps.

The following pavement surfaces will be excluded from Profilograph smoothness testing.

i.) Main alignment portions, interchange ramps and all other lanes where the regular posted speed (i.e. without construction activities) is less than 70 km per hour.

ii.) Turn lanes and storage lanes.

iii.) Tapers.

iv.) Portions of pavement, which, as determined by the Department, are influenced by manholes, water valves or other embedded hardware.

All pavement surfaces within the driving lanes of the above exclusions shall show no variation greater than 6mm from the edge of a 3m straightedge placed in any direction, excluding deviations due to crown breaks as outlined in the Technical Requirements. Locations for testing and the need for testing of straightedge deviation will be as determined by the Department.

Smoothness testing will extend completely across all transverse joints between existing pavement and ACP placed as part of the Project. Payment Adjustments and acceptance/rejection criteria will apply to all such bumps and dips identified. PrI assessment for Smoothness will be determined starting at the location where all wheels of the Profilograph are on ACP placed as part of the Project.

Weather permitting, acceptance testing for Smoothness will normally be completed within 2 weeks following the completion of all paving work subject to Smoothness testing. All Smoothness acceptance criteria will apply regardless of the year that the pavement is placed and the year that it is tested. Requests by the Contractor to have portions of the work tested prior to the completion of all paving will be considered subject to the availability of the Department's

Profilograph testing crew and seasonal weather conditions. In such cases, the Contractor will be invoiced by the Department at a rate of $750.00 to cover the extra mobilization and travel costs associated with each occurrence.

400.2.27.6.4 Asphalt Mix Sampling

Sampling of the asphalt mixture for Marshall compaction comparison will be done by the Department using the procedures identified in ATT-37.

400.2.27.6.5 Exclusions to Random Sampling

Random sampling methods will not be applied when the Department samples mix behind the paver on lifts of 20mm or less; nor to small areas such as tapers, approaches, areas of handwork, gores; nor for asphalt mix used for isolated levelling and repair of failed areas.

400.2.27.6.6 Retesting Following Attempts to Improve Smoothness

When the test results on a Sublot of ACP indicate a penalty or rejection because of Smoothness, the Contractor may make 1 attempt to improve the Smoothness on the Sublot by additional work; in which case the following shall apply:

(i) the Contractor shall notify the Department in writing that he will make 1 attempt to improve Smoothness.

(ii) additional work on a Sublot to improve Smoothness shall be completed within 10 calendar days from the time the Contractor receives written notification from the Department indicating the smoothness test results for that Sublot.

(iii) additional work to improve Smoothness will only be allowed on Sublots that are in penalty or reject according to the criteria contained in Table 400.2.27 C, except for removal of bumps and dips over 8mm.

The Contractor shall not undertake any method of repair that is detrimental to the quality of the pavement. Any method of heating that has a detrimental effect on the pavement in the opinion of the Department, will not be allowed.

The Department will re-test any Sublots in which the Contractor has made 1 attempt to improve Smoothness. The Sublot assessment for Smoothness will be based upon the re-tested values.

400.2.27.6.7 Aggregate Gradation Requirements

The following requirements apply to ACP material in all lifts except preliminary levelling Lots.

Payment Adjustments for aggregate gradation variation will be based on the variation of the Lot Mean Gradation from the Job Mix Formula tolerance, for each sieve size, as shown in Tables 400.2.27 D and 400.2.27 E and the corresponding adjustment points as shown in Table 400.2.27 F.

For lifts greater than 20mm in thickness, the Lot Mean Gradation will be determined using the sieve analysis of core samples. For lifts 20mm or less, the Lot Mean Gradation will be determined using the sieve analysis of mix and/or core samples.

400.2.27.6.8 Pavement Segregation Requirements

General

The finished surface of the top lift of ACP shall have a uniform texture and be free of segregated areas.

Classifying Pavement Segregation

A segregated area is defined as an area of the pavement where the texture differs visually from the texture of the surrounding pavement. For the purposes of classifying pavement segregation, only segregated areas greater than $0.1m^2$ and centre-of-paver streaks greater than 1m in length will be considered. Moderate or severe segregated areas, which do not meet these size parameters, will be considered obvious defects. Pavement segregation will be classified as follows:

Slight - The matrix, asphalt cement and fine aggregate is in place between the coarse aggregate. However, there is more stone in comparison to the surrounding acceptable mix.

Moderate - Significantly more stone than the surrounding mix; moderately segregated areas usually exhibit a lack of surrounding matrix.

Severe - Appears as an area of very stony mix, stone against stone, with very little or no matrix.

Centre-of-Paver Streak - Appears as a continuous or semi-continuous longitudinal "streak" typically located in the middle of the paver "mat".

Inspections for Pavement Segregation

(i) Inspections During Construction

The Department shall inspect the lower lifts of pavement to identify any instances of pavement segregation. If segregation is evident, the Department shall immediately notify the Contractor so that corrective action can be taken to prevent further occurrence of segregation.

The Department shall also inspect the top lift of pavement. Typically, each pavement Lot would be inspected, as soon as possible after the Lot is placed. During the inspection(s) of the top lift, the Department will identify and record any areas of moderate and severe segregation and any areas of centre-of-paver streak. Areas requiring repair in accordance with Section 400.2.27.6.8 (Pavement Segregation Requirements) - Repairing Pavement Segregation, shall be marked. The Department will provide the Contractor with a written assessment (location and severity) of the segregated areas as soon as possible following each inspection.

(ii) Inspection Following Construction

The Department shall conduct a second inspection of the top lift, normally 2 weeks after the completion of all paving work. During this inspection, the Department will identify and record any areas of slight, moderate, and severe segregation and any areas of centre-of-paver streak, which were not identified in the inspections during construction. The Department will provide the Contractor with a written assessment (location and severity) of the segregated areas as soon as possible following this inspection.

Requests by the Contractor to have the second inspection conducted on portions of the work prior to the completion of all paving work will be considered subject to the availability of the Department's engineering staff and seasonal weather conditions. This is meant to apply for projects that are not anticipated to be completed prior to winter shut down or where the Contractor has moved his paving operations offsite for an extended period of time. For such inspections, the Contractor will be invoiced by the Department at a rate of $750.00 per inspection to cover the extra mobilization and travel costs associated with each occurrence.

Repairing Pavement Segregation

Pavement segregation identified during the inspection performed two weeks after the completion of paving operations will not require repair. However, this shall not relieve the Contractor from its responsibility to repair any obvious defects, deteriorated repairs or failures, which become evident within the warranty period.

The Contractor, in accordance with the following, shall repair pavement segregation identified in the inspections performed during construction:

- Moderate and severe segregation in the top lift of pavement and on entrances and intersections shall require repair.
- For entrances and the portion of intersections outside the through travel lanes and shoulders, areas of moderate and severe segregation shall be repaired in accordance with the methods of repair listed for moderate segregation. Intersections and entrances shall also be neatly shaped, smooth, and free of surface defects and depressions.
- Slight segregation on any lift of pavement will not require repair.
- Moderate segregation on lower lifts will not require repair.
- Severe segregation on lower lifts will only require repair in instances where, in the opinion of the Department, the segregated area will affect the long-term structural integrity of the pavement structure. Such repair will not be required in instances where the Department determines that the paver screed is "dragging" due to distortion of the existing surface.
- Only moderate and severely segregated centre-of-paver streak on the top lift of pavement will require repair.

The following methods of repair are pre-approved:

- Moderate Segregation - The Contractor has the option of using a slurry patch or a hot mix patch.
- Severe Segregation - The Contractor has the option of removal and replacement or overlay.

Any other methods of repair proposed by the Contractor will be subject to the approval of the Department with the exception that the application of asphalt (by distributor, hand spraying, squeegeeing, etc.) will not be permitted as a method of repair under any circumstances.

Repairs for segregation using an overlay shall be for the entire pavement width. Repairs for segregation using removal and replacement shall be for the full lane width, full lane width and shoulder or the shoulder only as applicable, depending on the extent of the segregated area. The full depth of the asphalt lift shall be removed and replaced with new ACP using an appropriate paver and cold milling equipment. All ACP material used for overlay and removal and replacement repairs shall have a tack coat applied prior to placement and will be subject to the requirements of Section 400.2.27.6.9 (End Product Acceptance or Rejection) - End Product Rejection.

The Department will mark out the area of repair. The "marked area" shall extend a minimum of 0.5m beyond the segregated area. For centre-of-paver streak, the "marked area" shall extend a minimum of 100mm laterally and 0.5m longitudinally beyond the streak.

All repairs shall be regular in shape and finished using good workmanship practices to provide an appearance suitable to the Department. Traffic shall be kept off all repairs for a sufficient period of time to ensure that tracking does not occur.

All hot mix and other repairs for which compaction is normally required shall be properly compacted.

In the event repairs cover existing roadway lines or markings, the Contractor shall reinstate the lines and markings to the satisfaction of the Department.

Repairing pavement segregation will not affect the assessment of segregation Payment Adjustments.

Repairs shall be completed during construction or shortly after construction, except when prevented by inclement weather or seasonal shutdown. In these cases, the Contractor shall complete the repairs prior to June 15 of the following year.

<u>Inspections for Pavement Thickness</u>

The Department may choose to check and verify that the actual placement thickness of the ACP is equal to or greater than design values using the cores obtained for other acceptance testing or other unspecified procedures.

In addition, the Department may also undertake acceptance Thickness testing on selected Sublots of completed pavement where all specified lifts have been placed. Acceptance Thickness testing may be undertaken by the Department at any time throughout the work and may or may not be completed at the same time as coring for regular acceptance testing.

For each Sublot selected for testing the Contractor shall obtain 3 single cores of either 100mm or 150mm diameter at random locations, as selected by the Department, and in the presence of the Department. The Contractor shall core through all lifts of pavement to the underlying base or existing pavement. The cores shall be provided to the Department for thickness measuring.

Measurements will be taken by the Department at 3 circumference locations and the mean core thickness value determined to the nearest mm. Measurements shall be taken prior to saw cutting, however any primed granular base material that is attached will removed with moderate hand pressure prior to measuring.

The mean Sublot thickness value will be the average of all Sublot acceptance thickness cores determined to the nearest mm and will be compared to the corresponding design thickness value. Sublots with a varying design thickness shall use a prorated design thickness value based upon the location for each core.

Inspections for Pavement Width

The Department will measure the width of top lift pavement, from edge of pavement to edge of pavement, to verify that the actual pavement widths are not narrower than design values. The minimum length of roadway to be measured for compliance shall be 50m. A minimum of five locations or one measurement per 100m, whichever is the higher frequency for a section of roadway, will be taken at locations chosen by the Department and a mean pavement width value will be determined.

400.2.27.6.9 End Product Acceptance or Rejection

General

The following end product properties of ACP will be measured for acceptance in accordance with the previous section:

(i) Density
(ii) Actual Asphalt Content
(iii) Aggregate Gradation
(iv) Smoothness
(v) Thickness
(vi) Width

For the Density, Actual Asphalt Content, and Gradation of a Lot to be acceptable, the Lot Means must be within the acceptance limits shown in Tables 400.2.27 A, 400.2.27 B and 400.2.27 E, respectively.

For Smoothness, of a Lot to be acceptable, the PrI of all Sublots in the Lot in the top lift of pavement are not in penalty or reject according to the criteria outlined in Table 400.2.27 C.

For Width to be acceptable the mean pavement width must be equal to or greater than the design pavement width.

If the mean pavement width is narrower than the design width, but not greater than 0.35m narrower than the design width, then a Payment Adjustment is applied equal to the length of nonconforming roadway, rounded to the next highest kilometre, multiplied by $108,000/km.

The Contractor shall provide an end product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the Technical Requirements. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice.

End Product Acceptance

Acceptance at Full or Increased Payment

Acceptance of any Lot at full or increased payment will occur if it contains no obvious defects and if:

(i) the Lot Mean for Density of the compacted mix in the Lot is not in penalty or reject according to the criteria outlined in Table 400.2.27 A.

(ii) the Lot Mean for Actual Asphalt Content of the mix is within 0.3 of the Accepted Asphalt Content.

(iii) for Smoothness, full payment will occur if the PrI of all Sublots in the Lot in the top lift of pavement are not in penalty or reject according to the criteria outlined in Table 400.2.27 C.

Increased payment will occur if the PrI of all Sublots in the Lot in the top lift of pavement is 0.

(iv) individual bumps and dips in the top lift of pavement do not exceed 8 mm.

(v) for Gradation full payment will occur if there are no Lot Mean Adjustments for Gradation and increased payment will occur if there are no Lot Mean Adjustments and the Maximum Range as shown in Table 400.2.27 D is not exceeded for any sieve size in the Lot.

(vi) for Thickness full payment will occur if all Sublots meet the acceptance thickness criteria outlined in Tables 400.2.27 G1 and G2.

(vii) for Width full payment will occur if the mean pavement width is equal to or greater than the design pavement width for all sections of roadway.

Acceptance with Payment Adjustment

Acceptance of any Lot with a Payment Adjustment will occur if it contains no obvious defects and if;

(i) the acceptance test results are such that the Lot or Sublot or section of roadway meets with requirements for acceptance with a Payment Adjustment.

(ii) the Lot or Sublot or section of roadway is accepted in respect of all other requirements.

(iii) the Contractor has not notified the Department in writing that it will exercise its option to repair or remove and replace the work with work meeting the requirements for acceptance at full or increased payment.

(iv) individual bumps and dips measuring 12mm or greater have been repaired.

(v) individual bumps and dips exceeding 8mm and less than 12mm which have been designated by the Department as unacceptable, have been repaired.

End Product Rejection

If the Lot Mean for Density, Actual Asphalt Content or Gradation are outside the applicable acceptance limits, then the Lot is rejected automatically, regardless of the values of the other control characteristics.

If the Smoothness of the top lift of any Sublot is outside the acceptance limit, then the Sublot is rejected automatically, regardless of the values of the other control characteristics.

If the Thickness of any Sublot is outside the acceptance limit, then the Sublot is rejected automatically, regardless of the values of the other control characteristics.

If the Width of the completed pavement is determined to be greater than 0.35m narrower than the design width then the non-conforming section of roadway is rejected automatically regardless of the values of the other control characteristics.

The finished surface of any lift shall have a uniform close texture and be free of visible signs of poor workmanship. Any obvious defects, as determined by the Department such as, but not limited to the following, will be cause for automatic rejection of ACP regardless of the values of any other control characteristic:

(i) individual bumps and dips 12mm or greater. The Department may reject ACP with individual bumps and dips exceeding 8mm and less than 12mm.

(ii) segregated areas not already covered in Section 400.2.27.6.8 (Pavement Segregation Requirements).

(iii) areas of excess or insufficient asphalt.

(iv) improper matching of longitudinal and transverse joints.

(v) roller marks.

(vi) tire marks.

(vii) cracking or tearing.

(viii) sampling locations not properly reinstated.

(ix) improperly constructed patches.

(x) top lift surfaces, which are torn due to the dragging of the paver screed.

(xi) any final lift surface with a variation greater than 6mm from the edge of a 3m straightedge placed in any direction on the surface.

When ACP is rejected by reason of obvious defects, the minimum area of rejection will be Sublot size as defined in Section 400.2.27.1.2 (Definitions) - Sublot.

Rejected work shall be promptly repaired, remedied, overlaid, or removed and replaced all in a manner acceptable to the Department.

If an ACP overlay is used as a corrective measure on a defective Lot or Sublot, the ACP overlay thickness will be subject to acceptance by the Department. Where an ACP overlay is used as a corrective measure in any lane, adjacent lanes shall also be overlaid to the same thickness and length, regardless of whether the adjacent lanes were acceptable or not. The ACP overlay will be subject to the same specifications as the original pavement, except that the minimum thickness of an ACP overlay shall be the lesser of 40 mm or the design lift thickness of the defective material.

400.2.27.6.10 Appeal of Acceptance Test Results and Appeal Testing

Density, Asphalt Content, and Gradation

Appeal testing will be done using ATT-68. The Contractor may appeal the results of acceptance testing of Density, Asphalt Content or Gradation for any rejected or penalized Lot only once.

Appeals will only be considered if cause can be shown. Quality management test results for Density that are provided to the Department subsequent to the Contractor's receipt of the acceptance test results for that Lot will not be considered when evaluating cause for an appeal.

The appeal shall be for all tests within the Lot and there will be no appeal allowed for single tests within a Lot.

Any attempt to improve Density on the appealed Lot after the Department has tested the Lot for acceptance shall void the appeal and the original test results will apply.

The following procedures will apply for an appeal:

(i) For Gradation and Asphalt Content appeals, the Contractor shall serve notice of appeal to the Department, in writing, within 48 hours of receipt of the test results.

For all other appeals, notice shall be served to the Department, in writing, within 24 hours of receipt of the test results.

(ii) The Department will arrange and pay for an independent testing laboratory certified to operate in the Province of Alberta, to perform the appeal testing. The personnel employed or testing laboratory retained by the Contractor for quality management testing on the work will not be used for appeal testing.

(iii) The Department will determine the number and location of the new tests for each segment in accordance with Section 400.2.27.6 (Product Acceptance). The Contractor shall sample the pavement at such locations and provide the samples to the Department.

(iv) For appeals other than Gradation appeals, the single high and single low test results from the old Lot will be rejected and the remaining test results will be added to the results of the new tests. A new Lot Mean for the test results will be determined and used for acceptance and Payment Adjustments.

For Gradation appeals, all tests from the old Lot will be retained and averaged with the new appeal tests. A new Lot Mean and Range for all tests will be determined and used for acceptance and Payment Adjustments.

The new values, thus determined, in all cases, will be binding on the Contractor and the Department.

Smoothness

The Contractor may appeal acceptance test results of Smoothness of any rejected or penalized Sublot once. The appeal shall be in writing and submitted within 24 hours of receipt of the test results.

Any attempt to improve Smoothness on the appealed Sublot after the Department has tested the Lot for acceptance shall void the appeal and the original test results will apply.

A firm that is pre-qualified by the Department for smoothness testing will perform the appeal testing. The new results will be binding on the Contractor and the Department.

Segregation Rating

The Contractor may appeal the Segregation Rating in any portion of the work for lane•km(s) that are not in bonus.

The following procedures will apply for an appeal:

(i) The Contractor must serve written notice of the appeal to the Department within 7 days of receipt of a written segregation assessment. The written notice shall detail the lane•km(s) and nature of the appeal.

(ii) The Department will determine a representative sample of the portion of the work appealed, and will reassess this area. Generally, this reassessment will be completed within 1 week of the Department's receipt of the written notice of appeal.

Based on the reassessment of the representative sample, the Department will determine whether or not a reassessment of the entire appealed work is necessary.

Thickness and Width

The Contractor may appeal the results of acceptance testing of Thickness for any rejected or penalized Sublot only once.

Appeals will only be considered if cause can be shown.

The appeal shall be for all tests within the Lot, and there will be no appeal allowed for single tests within a Sublot.

The following procedures will apply for an appeal:

(i) The Contractor shall serve notice of appeal to the Department, in writing, within 48 hours of receipt of the test results.

(ii) The Department will determine the location of the new cores for each Sublot. The Contractor shall sample the pavement at such locations, in the presence of the Department, and provide the samples to the Department.

(iii) The Department will determine the mean thickness for each core. All tests from the old Sublot will be retained and averaged with the new appeal tests.

A new Sublot Thickness mean will be determined and used for acceptance and Payment Adjustments.

The new values, thus determined, in all cases, will be binding on the Contractor and the Department.

Sections of roadway subject to Payment Adjustments or reject for width may be appealed only once. Remeasurement of the appeal section will consist of an additional 5 measurements or one every 100m, whichever is the highest frequency, at new locations to be chosen by the Department. All original width measurements will be retained and averaged with the new appeal measurements.

A new Pavement Width mean will be determined and used for acceptance and Payment Adjustments. The new values, thus determined, in all cases, will be binding on the Contractor and the Department.

Payment of Appeal Testing Costs for Asphalt Content, Smoothness or Gradation

If the new results show that a Payment Adjustment no longer applies, then sampling and testing costs for the appeal procedures for that Lot will be the responsibility of the Department.

If the new results verify that any Payment Adjustment or rejection remains valid for that Lot, then the Contractor will be invoiced by the Department for the testing costs for the appeal procedures at the following rates:

Asphalt Content:	$2,000.00 for the first appeal Lot, $1,000.00 for all subsequent Lots, if an asphalt correction factor is not required.
Gradation:	$1,000.00 per appeal.
Smoothness:	$150.00 per hour for Profilograph (travel time, testing time and standby time).

Payment of Appeal Testing Costs for Density

If the new results indicate that the new Lot Mean for Density is no longer in a Payment Adjustment situation and that the Lot Mean has increased by more than 0.8 percent, then the costs of sampling and testing for the appeal procedures shall be the responsibility of the Department.

If the new results indicate that the Lot Mean for Density is either in a Payment Adjustment situation or has not increased by more than 0.8 percent, then the Contractor shall be invoiced by the Department for the sampling and testing costs for the appeal procedures at a rate of $250.00 per Lot appealed.

Payment of Appeal Testing Costs for Segregation Rating

If a reassessment of the appealed work results in a change in the original rating, the revised rating will apply. If the overall Payment Adjustment for the appealed work is reduced by an amount of $1,000.00 or greater, the cost of the reassessment will be borne by the Department.

If there is no change to the overall Payment Adjustment or if the overall payment is decreased by an amount less than $1,000.00 or if the overall Payment Adjustment is increased, the Contractor will be charged an amount of $3,500.00 for the appeal.

Payment of Appeal Testing Costs for Thickness and Width

If the new results show that a Payment Adjustment no longer applies, then sampling and testing costs for the appeal procedures for that Sublot will be the responsibility of the Department. Furthermore, the Contractor shall be reimbursed sampling costs at the rate of $100.00 per old and new Sublot core.

If the new results verify that any Payment Adjustment or rejection remains valid for that Sublot or section of roadway, then the Contractor will be invoiced by the Department for the testing costs for the appeal procedures at the following rate:

Thickness: $50.00 per appeal core.
Width: $50.00 per appeal measurement.

400.2.27.7 Measurement

Accepted ACP will be measured in tonnes per Lot or Sublot.

400.2.27.8 Payment Adjustments

No payment will be made for work in any Lot or Sublot, which has been rejected, until the defects have been remedied.

400.2.27.8.1 Payment Adjustments For Accepted Work

The following end product properties for ACP will be measured for acceptance in accordance with Section 400.2.27.6.9 (End Product Acceptance or Rejection).

(i) Density
(ii) Actual Asphalt Content
(iii) Aggregate Gradation
(iv) Smoothness
(v) Thickness

For the Density, Actual Asphalt Content, and Gradation of a Lot to be accepted, the Lot Means must be within the acceptance limits shown in Tables 400.2.27 A, 400.2.27 B, and 400.2.27 E, respectively.

For each Lot, the Payment Adjustments for Density and Actual Asphalt Content will be the amounts shown in Tables 400.2.27 A and 400.2.27 B for the Sample Mean of the test results for that Lot.

For each Lot, the Payment Adjustment for Gradation will be as follows:

(i) When the Lot Mean Gradation is outside the Job Mix Formula tolerance, the Payment Adjustment will be $0.04 per tonne for each Mean Adjustment Point, up to the limits shown in Table 400.2.20.2.1 of Section 400.2.20 (Aggregate Production and Stockpiling).

(ii) When the Lot Mean Gradation is outside the limits of Table 400.2.20.2.1, the Payment Adjustment will be $0.40 per tonne for each Mean Adjustment Point outside those limits, regardless of the Job Mix Formula tolerance.

(iii) If the maximum deviation shown in Table 400.2.27 E is exceeded, the Lot is rejected.

(iv) When the Lot Mean Gradation for all sieve sizes is within the Job Mix Formula tolerance and within the limits of Table 400.2.20.2.1 and individual test results for each sieve size are within the allowable range shown in Table 400.2.27 D, a bonus of $0.20 per tonne will be applied.

The Payment Adjustment applicable to each Lot quantity of ACP will be calculated as follows:

Lot Payment Adjustment Per Tonne	=	the sum of the Payment Adjustment for **PAd**, **PAa,** & **PAg**

where:

PAd = Payment Adjustment for Density (bonus or penalty)

PAa = Payment Adjustment for Asphalt Content (penalty only)

PAg = Payment Adjustment for Gradation (bonus or penalty)

If the Lot Mean for Density, Actual Asphalt Content or Gradation for any Lot is outside the acceptance limit, the Lot is rejected, and no payment will be made for the quantity of ACP in that Lot, until the defect has been remedied.

For the Smoothness of any Sublot in the top lift of ACP to be acceptable, the PrI must be within the limits shown in Table 400.2.27 C. For each Sublot in the top lift of ACP, the Payment Adjustment for Smoothness will be the amounts shown in Table 400.2.27 C for the PrI of that Sublot.

All of these Payment Adjustments, so determined, will be deducted from the payment made for ACP in each Lot based on the tonnage of the Lot.

Every Sublot in the top lift of ACP that is outside the acceptance limit for Smoothness will be rejected and payment will not be made for the quantity of ACP in these Sublots until they have been made acceptable. Payment Adjustments for the remainder of the Lot will be made in accordance with the above formula using PAd, PAa, and PAg as determined for the Lot from which will be subtracted any Payment Adjustment for Smoothness.

Sublots in which the mean Thickness value is less than the design value shall be either accepted, accepted with Payment Adjustments or rejected as outlined in Tables 400.2.27 G1 and G2.

Sublots eligible for waiving of Payment Adjustment are identified as "Grace Sublots" in Tables 400.2.27 G1 and G2. A combined total of 5 Grace Sublots will allowed for the work. Sublots, which are not identified as Grace Sublots, will be subject to Payment Adjustments regardless of the number of Grace Sublots used.

400.2.27.8.2 Segregation Payment Adjustments

Payment Adjustments for pavement segregation shall apply to the top lift of ACP only and in accordance with the following:

- Segregated areas, centre-of-paver streak, and any repaired segregated areas identified by the Department either during construction or during the inspection conducted two weeks after the completion of paving work, will be used to determine Payment Adjustments. Payment Adjustments will not apply to segregated areas $0.1m^2$ or less or on centre-of-paver streaks 1 m or less in length.
- Segregated areas (excluding centre-of-paver streaks) separated by less than 3m shall be considered a single area for the determination of Payment Adjustments. For centre-of-paver streaks, each area will be measured separately for Payment Adjustments.
- Payment Adjustments for Segregation will not apply to entrances or the portion of an intersection outside the through travel lanes and shoulders.
- Payment Adjustments will not apply to instances where the Department determines that the paver screed is "dragging".
- If a Segregated area is identified by the Contractor and repaired prior to inspection by the Department, it will be classified as "moderate" for the purpose of determining Payment Adjustments.
- Payment Adjustments will apply regardless of the year the pavement is placed and the year the pavement is inspected.

The total Payment Adjustment for Segregation is determined as follows:

- The Department will inspect each lane•km of the completed pavement separately. A "lane" includes the adjoining shoulder. Measurement of lane•kms will be made in 1 km (or partial km) long segments, 1 lane wide as shown in the Technical Requirements. Acceleration and deceleration lanes and interchange ramps are considered separate lanes.

For each lane•km, the Department will determine the following:

(i) the total number of slight Segregated areas, and

(ii) the total number of moderate and severe Segregated areas, and

(iii) the total length of centre-of-paver streak (determined by adding each instance of streak that is in excess of 1m in length).

These values will be used for the "segregation frequencies" and "length of centre-of-paver streak" in Tables A, B & C as applicable, with the exception that for partial lane•kms, the segregation frequency for slight Segregation will be calculated by dividing the actual number of slight Segregated areas by length of the segment assessed (expressed in kms) and rounding to the nearest whole number.

Table A, Payment Adjustment for Slight Segregation

Segregation Frequency of Slight Areas (per lane•km)	Payment Adjustment $ per lane•km
0	Note 3
1 or 2	Note 4
Greater than 2	- (number of areas - 2) x $100.00

Table B, Payment Adjustment for Moderate and Severe Segregation

Segregation Frequency of Moderate and Severe Areas (per lane•km)	Payment Adjustment $ per lane•km
0	Note 3
Greater than 0	- (number of areas) x $500.00

Table C, Payment Adjustment for Centre-of-Paver Streak

Length of Centre-of-Paver Streak (per lane•km)	Payment Adjustment $ per lane•km
1 m or less	Note 3
Greater than 1 m	- $1.50 per linear m

Notes:

1. Total Payment Adjustment per lane•km for Segregation will be the sum of Tables A, B, and C.
2. For partial lane•km, the Payment Adjustments for Table A will be prorated based upon the actual length of segment assessed.
3. Lane•km with no areas of Segregation of any type or severity, or any centre-of-paver streaks will be assigned a bonus payment of $1,000.00 per lane•km.

   (For partial lane•kms the bonus will be prorated based upon the actual length of the segment assessed.)
4. Lane•km with 1 or 2 areas of slight Segregation, no moderate or severely segregated areas and no centre-of-paver streak will be assigned a bonus payment of $500.00 per lane•km.

   (For partial lane•kms the bonus will be prorated based upon the actual length of the segment assessed.)
5. The maximum penalty adjustment for Segregation shall be limited to $2,000.00 per lane•km. For partial lane•kms, this adjustment will be prorated based upon the actual length of segment assessed.

400.2.27.8.3 Payment Adjustments For Work That Had Been Rejected, But Was Made Acceptable

When defects have been remedied in Lots or Sublots, which had been rejected, Payment Adjustments for the original quantity of material in those Lots or Sublots will be made subject to the follows:

(i) Payment Adjustments will be made for Smoothness as follows:

Payment Adjustment for PrI will be the amounts shown in the applicable section of Table 400.2.27 C and will be based on Profilograph tests following any corrective action taken by the Contractor.

The Payment Adjustment for each bump or dip over 8mm will be $300.00 for multi-lift pavements and $100.00 for single-lift or curb and gutter applications. Payment Adjustments for bumps and dips will be based on initial Profilograph testing conducted by the Department. Repairs carried out by the Contractor will not affect the Payment Adjustment for bumps and dips.

If bumps or dips are treated by the Contractor prior to Profilograph tests by the Department, such defects will be considered greater than 8mm and will be assessed at the applicable Payment Adjustment.

(ii) The Payment Adjustment for Asphalt Content, Density, and Gradation will be based on testing of the replacement or overlay material where applicable. Where replacement or overlay material does not cover the entire Lot or Sublot, prior tests on the uncovered area will be averaged with new tests on the corrective work.

The Payment Adjustment determined through retesting of the corrective work will be applied to that quantity of material in the Lot or Sublot, which was originally rejected.

No payment will be made for any material used to replace, repair or overlay rejected work and all corrective work shall be performed by the Contractor.

TABLE 400.2.27 A PAYMENT ADJUSTMENT FOR DENSITY					
PERCENT OF MARSHALL DENSITY	PAYMENT ADJUSTMENT - DOLLARS PER TONNE				
	DESIGN LIFT THICKNESS				
Lot Mean	35 MM OR GREATER LOWER LIFTS	LESS THAN 35 MM AND GREATER THAN 20 MM LOWER LIFTS	20 MM LOWER LIFTS	35 MM OR GREATER TOP LIFT ONLY	LESS THAN 35 MM AND GREATER THAN 20 MM TOP LIFT ONLY
≥ 98.0	+ 1.00	+1.00	+ 1.00	+ 1.00	+ 1.00
97.9	+ 0.90	+ 0.90	+ 0.90	+ 0.90	+ 0.90
97.8	+ 0.80	+ 0.80	+ 0.80	+ 0.80	+ 0.80
97.7	+ 0.70	+ 0.70	+ 0.70	+ 0.70	+ 0.70
97.6	+ 0.60	+ 0.60	+ 0.60	+ 0.60	+ 0.60
97.5	+ 0.50	+ 0.50	+ 0.50	+ 0.50	+ 0.50
97.4	+ 0.40	+ 0.40	+ 0.40	+ 0.40	+ 0.40
97.3	+ 0.30	+ 0.30	+ 0.30	+ 0.30	+ 0.30

TABLE 400.2.27 A PAYMENT ADJUSTMENT FOR DENSITY					
PERCENT OF MARSHALL DENSITY	PAYMENT ADJUSTMENT - DOLLARS PER TONNE				
	DESIGN LIFT THICKNESS				
Lot Mean	35 MM OR GREATER LOWER LIFTS	LESS THAN 35 MM AND GREATER THAN 20 MM LOWER LIFTS	20 MM LOWER LIFTS	35 MM OR GREATER TOP LIFT ONLY	LESS THAN 35 MM AND GREATER THAN 20 MM TOP LIFT ONLY
97.2	+ 0.20	+ 0.20	+ 0.20	+ 0.20	+ 0.20
97.1	+ 0.10	+ 0.10	+ 0.10	+ 0.10	+ 0.10
97.0	0.00	0.00	0.00	0.00	0.00
96.9	-0.20	0.00	0.00	-0.20	0.00
96.8	-0.40	0.00	0.00	-0.40	0.00
96.7	-0.60	0.00	0.00	-0.60	0.00
96.6	-0.80	0.00	0.00	-0.80	0.00
96.5	-1.00	0.00	0.00	-1.00	0.00
96.4	-1.20	0.00	0.00	-1.20	0.00
96.3	-1.40	0.00	0.00	-1.40	0.00
96.2	-1.60	0.00	0.00	-1.60	0.00
96.1	-1.80	0.00	0.00	-1.80	0.00
96.0	-2.00	0.00	0.00	-2.00	0.00
95.9	-2.20	0.00	0.00	-2.20	-0.20
95.8	-2.40	0.00	0.00	-2.40	-0.40
95.7	-2.60	0.00	0.00	-2.60	-0.60
95.6	-2.80	0.00	0.00	-2.80	-0.80
95.5	-3.00	0.00	0.00	-3.00	-1.00
95.4	-3.20	0.00	0.00	-3.20	-1.20
95.3	-3.40	0.00	0.00	-3.40	-1.40
95.2	-3.60	0.00	0.00	-3.60	-1.60
95.1	-3.80	0.00	0.00	-3.80	-1.80
95.0	-4.00	0.00	0.00	-4.00	-2.00
94.9	-4.40	0.00	0.00	-4.40	-2.20
94.8	-4.80	0.00	0.00	-4.80	-2.40
94.7	-5.20	0.00	0.00	-5.20	-2.60
94.6	-5.60	0.00	0.00	-5.60	-2.80
94.5	-6.00	0.00	0.00	-6.00	-3.00
94.4	-6.40	0.00	0.00	-6.40	-3.20
94.3	-6.80	0.00	0.00	-6.80	-3.40
94.2	-7.20	0.00	0.00	-7.20	-3.60
94.1	-7.60	0.00	0.00	-7.60	-3.80
94.0	-8.00	0.00	0.00	-8.00	-4.00
93.9	**DEPARTMENT EVAL.**	-0.20	0.00	**OVERLAY OR RM.&RP.**	-4.40
93.8	DEPARTMENT EVAL.	-0.40	0.00	OVERLAY OR RM.&RP.	-4.80
93.7	DEPARTMENT EVAL.	-0.60	0.00	OVERLAY OR RM.&RP.	-5.20
93.6	DEPARTMENT EVAL.	-0.80	0.00	OVERLAY OR RM.&RP.	-5.60
93.5	DEPARTMENT EVAL.	-1.00	0.00	OVERLAY OR RM.&RP.	-6.00
93.4	DEPARTMENT EVAL.	-1.20	0.00	OVERLAY OR RM.&RP.	-6.40
93.3	DEPARTMENT EVAL.	-1.40	0.00	OVERLAY OR RM.&RP.	-6.80
93.2	DEPARTMENT EVAL.	-1.60	0.00	OVERLAY OR RM.&RP.	-7.20
93.1	DEPARTMENT EVAL.	-1.80	0.00	OVERLAY OR RM.&RP.	-7.60

TABLE 400.2.27 A PAYMENT ADJUSTMENT FOR DENSITY					
PERCENT OF MARSHALL DENSITY	PAYMENT ADJUSTMENT - DOLLARS PER TONNE				
	DESIGN LIFT THICKNESS				
Lot Mean	35 MM OR GREATER LOWER LIFTS	LESS THAN 35 MM AND GREATER THAN 20 MM LOWER LIFTS	20 MM LOWER LIFTS	35 MM OR GREATER TOP LIFT ONLY	LESS THAN 35 MM AND GREATER THAN 20 MM TOP LIFT ONLY
93.0	DEPARTMENT EVAL.	-2.00	0.00	OVERLAY OR RM.&RP.	-8.00
92.9	DEPARTMENT EVAL.	-2.20	-0.20	OVERLAY OR RM.&RP.	-8.40
92.8	DEPARTMENT EVAL.	-2.40	-0.40	OVERLAY OR RM.&RP.	-8.80
92.5	DEPARTMENT EVAL.	-3.00	-1.00	OVERLAY OR RM.&RP.	-10.00
92.4	DEPARTMENT EVAL.	-3.20	-1.20	OVERLAY OR RM.&RP.	-10.40
92.3	DEPARTMENT EVAL.	-3.40	-1.40	OVERLAY OR RM.&RP.	-10.80
92.2	DEPARTMENT EVAL.	-3.60	-1.60	OVERLAY OR RM.&RP.	-11.20
92.1	DEPARTMENT EVAL.	-3.80	-1.80	OVERLAY OR RM.&RP.	-11.60
92.0	DEPARTMENT EVAL.	-4.00	-2.00	OVERLAY OR RM.&RP.	-12.00
91.9	DEPARTMENT EVAL.	-4.40	-2.20	**REMOVE & REPLACE**	-12.40
91.8	DEPARTMENT EVAL.	-4.80	-2.40	REMOVE & REPLACE	-12.80
91.7	DEPARTMENT EVAL.	-5.20	-2.60	REMOVE & REPLACE	-13.20
91.6	DEPARTMENT EVAL.	-5.60	-2.80	REMOVE & REPLACE	-13.60
91.5	DEPARTMENT EVAL.	-6.00	-3.00	REMOVE & REPLACE	-14.00
91.4	DEPARTMENT EVAL.	-6.40	-3.20	REMOVE & REPLACE	-14.40
91.3	DEPARTMENT EVAL.	-6.80	-3.40	REMOVE & REPLACE	-14.80
91.2	DEPARTMENT EVAL.	-7.20	-3.60	REMOVE & REPLACE	-15.20
91.1	DEPARTMENT EVAL.	-7.60	-3.80	REMOVE & REPLACE	-15.60
91.0	DEPARTMENT EVAL.	-8.00	-4.00	REMOVE & REPLACE	-16.00
90.9	**REMOVE & REPLACE**	**DEPARTMENT EVAL.**	-4.40	REMOVE & REPLACE	**DEPARTMENT EVAL.**
90.8	REMOVE & REPLACE	DEPARTMENT EVAL.	-4.80	REMOVE & REPLACE	DEPARTMENT EVAL.
90.7	REMOVE & REPLACE	DEPARTMENT EVAL.	-5.20	REMOVE & REPLACE	DEPARTMENT EVAL.
90.6	REMOVE & REPLACE	DEPARTMENT EVAL.	-5.60	REMOVE & REPLACE	DEPARTMENT EVAL.
90.5	REMOVE & REPLACE	DEPARTMENT EVAL.	-6.00	REMOVE & REPLACE	DEPARTMENT EVAL.
90.4	REMOVE & REPLACE	DEPARTMENT EVAL.	-6.40	REMOVE & REPLACE	DEPARTMENT EVAL.
90.3	REMOVE & REPLACE	DEPARTMENT EVAL.	-6.80	REMOVE & REPLACE	DEPARTMENT EVAL.
90.2	REMOVE & REPLACE	DEPARTMENT EVAL.	-7.20	REMOVE & REPLACE	DEPARTMENT EVAL.
90.1	REMOVE & REPLACE	DEPARTMENT EVAL.	-7.60	REMOVE & REPLACE	DEPARTMENT EVAL.
90.0	REMOVE & REPLACE	DEPARTMENT EVAL.	-8.00	REMOVE & REPLACE	DEPARTMENT EVAL.
89.9	REMOVE & REPLACE	**REMOVE & REPLACE**	**DEPARTMENT EVAL.**	REMOVE & REPLACE	**OVERLAY OR RM. & RP.**
89.8	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.7	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.6	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.5	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.4	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.3	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.2	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.1	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.0	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.9	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.8	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.7	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.

TABLE 400.2.27 A PAYMENT ADJUSTMENT FOR DENSITY					
PERCENT OF MARSHALL DENSITY	PAYMENT ADJUSTMENT - DOLLARS PER TONNE				
	DESIGN LIFT THICKNESS				
Lot Mean	35 MM OR GREATER LOWER LIFTS	LESS THAN 35 MM AND GREATER THAN 20 MM LOWER LIFTS	20 MM LOWER LIFTS	35 MM OR GREATER TOP LIFT ONLY	LESS THAN 35 MM AND GREATER THAN 20 MM TOP LIFT ONLY
88.6	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.5	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.4	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.3	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.2	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.1	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.0	REMOVE & REPLACE	REMOVE & REPLACE	DEPARTMENT EVAL.	REMOVE & REPLACE	OVERLAY OR RM.&RP.
≤ 87.9	REMOVE & REPLACE	REMOVE & REPLACE	**REMOVE & REPLACE**	REMOVE & REPLACE	OVERLAY OR RM.&RP.

Notes: 1 - Single Lifts only are considered as a Top Lift;
2 - Preliminary Levelling is not considered as a Lift.
3 - Lots identified as "Department Eval." shall be evaluated by the Department to determine whether removal and replacement is necessary. "Department Eval." Lots accepted by the Department shall be assigned a Payment Adjustment of $50.00 per tonne.

TABLE 400.2.27 B
PAYMENT ADJUSTMENT FOR ASPHALT CONTENT

Deviation of the Actual Asphalt Content from the Accepted Asphalt Content	Payment Adjustment for Asphalt Content PAa $ per tonne			
	Top Lift		Lower Lift	
	Below	Above	Below	Above
From 0 to 0.30	0.0	0.0	0.0	0.0
From 0.31 to 0.35	-2.6	-0.9	-2.6	-0.9
From 0.36 to 0.40	-3.8	-1.8	-3.8	-1.8
From 0.41 to 0.45	-5.0	-2.7	-5.0	-2.7
From 0.46 to 0.50	-6.1	-3.6	-6.1	-3.6
From 0.51 to 0.55			-7.2	-4.5
From 0.56 to 0.60			-8.4	-5.4
From 0.61 to 0.65			-9.5	-6.3

Notes: 1 - For top lift deviations of more than 0.50 percent the Contractor shall either overlay or remove and replace the previously placed mix.

2 - For lower lift deviations of more than 0.65 percent, the Department will determine whether removal and replacement is necessary. For material that is allowed to stay in place, a Payment Adjustment of $50.00 per tonne will be applied.

TABLE 400.2.27 C
LUMP SUM SUBLOT PAYMENT ADJUSTMENTS FOR SMOOTHNESS

PrI	Payment Adjustments for Smoothness of Top Lift $ per Sublot Lump Sum		
	C1	C2	C3
0	30.00	30.00	30.00
>0 and 10 or less	0.00	0.00	0.00
11	-40.00	0.00	0.00
12	-70.00	0.00	0.00
13	-100.00	0.00	0.00
14	-130.00	0.00	0.00
15	-170.00	0.00	0.00
16	-200.00	-40.00	0.00
17	-230.00	-80.00	0.00
18	-260.00	-120.00	0.00
19	-290.00	-160.00	0.00
20	-320.00	-200.00	0.00
21	-350.00	-240.00	0.00
22	-380.00	-280.00	0.00
23	-410.00	-320.00	-10.00
24	**REJECT**	**REJECT**[1]	-40.00
25	"	"	-70.00
26	"	"	-100.00
27	"	"	-130.00
28	"	"	-160.00
29	"	"	-190.00
30	"	"	-220.00
Greater than 30	"	"	**REJECT**[1]

Pavement smoothness will be assessed based upon the type of construction as follows.

Type of Construction	Table 400.2.27 C Payment Adjustment Column
2 or more paver laid lifts, minimum design lift thickness of 20 mm.	C1
Single lift with design lift thickness greater than or equal to 45 mm	C2
Hot In-Place Recycling or Mill and Inlay	C2
Curb and Gutter	C3
Single Lift with design lift thickness less than 45 mm.	C3

Payment Adjustments for bumps and dips will be applied to all applicable top lifts of pavements

Note 1 - Sublot may be accepted, subject to approval of the Department, with an assessment of -$400.00.

TABLE 400.2.27 D
GRADATION TOLERANCES FOR THE LOT MEAN FROM THE JOB MIX FORMULA AND MAXIMUM RANGE BETWEEN INDIVIDUAL TEST RESULTS IN A LOT

CHARACTERISTICS	SIEVE SIZE, micron					
	(1) 20,000, 16,000, 12,500 10,000, 5,000	1,250	630	315	160	80
Tolerances for the Lot Mean from the Job Mix Formula	+/-5	+/-3	+/-2	+/-2	+/-1.5	+/-1.5
Maximum Range Between Individual Test Results in a Lot	10	6	5	4	3	3

(1) Note: Include all sieves up to 1 size smaller than top size.

TABLE 400.2.27 E
MAXIMUM DEVIATION FOR THE LOT MEAN FROM THE GRADATION LIMITS SPECIFIED IN TABLE 400.2.20.2.1 OF SPECIFICATION 400.2.20, AGGREGATE PRODUCTION AND STOCKPILING

CHARACTERISTIC	SIEVE SIZE, micron		
	(1) 20,000, 16,000, 12500, 10,000	5,000, 1,250, 630, 315	160, 80
Maximum Deviation for the Lot Mean from Section 400.2.20 (Aggregate Production and Stockpiling)	2.0	1.0	0.5

(1) Note: Include all sieves up to 1 size smaller than top size.

TABLE 400.2.27 F
"A" AND "B" ADJUSTMENT POINTS FOR DEVIATION IN GRADATION

SIEVE SIZE, micron	MEAN
(1) 20,000, 16,000, 12,500, 10,000, 5,000	5 for each 1 percent Deviation
1,250	1 for each 1 percent Deviation
630	2 for each 1 percent Deviation
315	2 for each 1 percent Deviation
160	0.2 for each 0.1 percent Deviation
80 Deviation ≤ 1.0 percent 80 Deviation > 1.0 percent	1.0 for each 0.1 percent Deviation 2.0 for each additional 0.1 percent Deviation

(1) Note: Include all sieve sizes up to 1 size smaller than top size.

Lot Mean Adjustment points will be calculated for each Lot. If the Lot Mean does not exceed the requirements in Table 400.2.27 E**,** a Lot Gradation Payment Adjustment per tonne will be applied based on the following formula:

$$\boxed{\textbf{PAg = (A x -\$0.04) + (B x -\$0.40) + Bonus}}$$

Where:

PAg = Payment Adjustment for Gradation (bonus or penalty)

A = Mean Adjustment Points assessed within the gradation limits specified in Section 400.2.20 (Aggregate Production and Stockpiling), but beyond the Job Mix Formula tolerance requirements in Table 400.2.27 D.

B = Mean Adjustment Points assessed outside the gradation limits specified in Section 400.2.20 (Aggregate Production and Stockpiling) regardless of the Job Mix Formula tolerance.

Bonus = +$0.20 when there are no Mean Adjustment Points and the maximum range as shown in Table 400.2.27 D, is not exceeded for any sieve size in the Lot.

Table 400.2.27 G1
Payment Adjustment for Sublot Core Thickness – Design Thickness Less than 110 mm

Sublot Mean Thickness			Payment Adjustment $/m²
(mm)	(mm)	(mm)	
	t	> d	0.00
d =	t	= d - 5	0.00
d – 6 =	t	= d - 8	- 1.36 (Note 1)
d – 9 =	t	= d - 11	- 2.53
d – 12 =	t	= d - 14	- 3.70
d – 15 =	t	= d - 17	- 4.86
d – 18 =	t	= d - 20	- 6.03 (Note 2)
	t	< d - 20	**Reject**

t = Sublot Mean Thickness
d = Design Specified Thickness
Note 1 – Eligible to be used as a Grace Sublot
Note 2 – Reject if Design Specified Thickness is 60mm or less.

Table 400.2.27 G2
Payment Adjustment for Sublot Core Thickness – Design Thickness Greater Than or Equal to 110mm

Sublot Mean Thickness			Payment Adjustment
(mm)	(mm)	(mm)	$\$/m^2$
	t	> d	0.00
d =	t	= d - 10	0.00
d – 11 =	t	= d - 14	- 3.50 (Note 1)
d – 15 =	t	= d - 18	- 5.05
d – 19 =	t	= d - 22	- 6.61
d – 23 =	t	= d - 26	- 8.17
d – 27 =	t	= d - 30	- 9.73 (Note 2)
	t	< d - 30	**Reject**

t = Sublot Mean Thickness
d = Design Specified Thickness
Note 1 – Eligible to be used as a Grace Sublot.
Note 2 – Reject if Design Specified Thickness is 120 mm or less.

400.2.28 ASPHALT CURB, MEDIANS, TRAFFIC ISLANDS AND FLUMES

400.2.28.1 General

400.2.28.1.1 Description

This work shall consist of the construction of asphalt curbs, medians, traffic islands and flumes, using well graded crushed aggregate, and asphalt cement, combined as hereinafter specified, placed and compacted on a prepared base, in conformity with lines, grade and cross-section as indicated on the Detailed Designs, in the Technical Requirements, or as directed by the Design Engineer and as accepted by the Department.

400.2.28.2 Materials And Procedures

400.2.28.2.1 General

All materials necessary for the construction of the works described herein shall be supplied by the Contractor.

400.2.28.2.2 Aggregate

The Contractor shall produce crushed aggregate in accordance with Section 400.2.20 (Aggregate Production and Stockpiling). Unless otherwise specified or directed by the Department, aggregate shall meet the requirements for Designation 1 Class 12.5 material. The Contractor shall supply aggregate in accordance with Section 400.2.31 (Supply of Aggregate) and haul aggregate in accordance with Section 400.2.30 (Hauling).

400.2.28.2.3 Asphalt

The Contractor shall supply asphalt in accordance with Section 400.2.33 (Supply of Asphalt). The type and grade of asphalt shall be as specified in Section 400.2.28.2.4 (Asphalt Mix Design).

Asphalt used for tack coats shall be of the type and grade designated by the Design Engineer and as accepted by the Department.

400.2.28.2.4 Asphalt Mix Design

The asphalt mix design shall be prepared and submitted according to the requirements of Section 400.2.27.2.5 (Asphalt Mix Design and Job Mix Formula). Unless otherwise specified, a Mix Type L1 shall be used in accordance with the following design requirements:

(i) Asphalt cement grade shall be either 120-150A, 150-200A or 200-300A (the stiffest asphalt cement grade shall be used on projects that specify more than one grade).

(ii) Design Air Voids shall be 3 percent.

400.2.28.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management Plan.

400.2.28.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.28.5 Construction

400.2.28.5.1 Preparation of Surface for Asphalt Curbs

Before placing asphalt curbs, the existing surface in the curb locations shall be cleaned of all foreign, loose or deleterious material. All broken or defective areas in the locations shall be repaired by removing the broken and defective material and replacing it with asphalt concrete patching material as directed by the Design Engineer and as accepted by the Department.

An asphalt tack coat shall be uniformly applied at the location, rate, temperature, and to the dimensions as approved by the Design Engineer and as accepted by the Department. The surface to be tacked shall be dry and free from loose or deleterious material when the tack coat is applied.

Following the curing of the asphalt tack coat, depressions shall be eliminated by placing asphalt concrete levelling patches at the locations and to the dimensions designated by the Design Engineer and as accepted by the Department.

The asphalt concrete material used for patching and levelling shall conform to, and be placed in accordance with, the requirements of Section 400.2.27 (Asphalt Concrete Pavement), using the designation and class of aggregate specified or directed by the Design Engineer and as accepted by the Department. The patching and levelling shall be performed in such a way as to result in a surface which is tight, neat, uniform, and well bonded to the underlying surface. The patched and levelled areas shall be fully compacted so that the final surface is flush with the surrounding surface, and does not pond water when asphalt curb construction is complete.

An asphalt tack coat shall be applied to levelled and patched areas as directed by the Design Engineer and as accepted by the Department.

400.2.28.5.2 Mixing and Placing Asphalt Curb Material

The bituminous mixture shall be produced, transported, and placed in accordance with the requirements of Section 400.2.27 (Asphalt Concrete Pavement).

Mix temperatures shall be sufficiently high to enable adequate mixing and compaction, but shall not be so high as to cause asphalt damage or curb instability.

The placing, compacting and finishing of asphalt curbs shall be accomplished by use of a mechanical curb machine of a type acceptable to the Design Engineer and as accepted by the Department. The bituminous mixture shall be laid only upon a dry, clean surface, on which the tack coat has fully cured and under weather conditions acceptable to the Design Engineer and as accepted by the Department.

Curb shall be placed in a continuous, one step operation, in one direction, with a minimum number of joints. Where joints are absolutely necessary, they shall be constructed so that they are virtually indistinguishable from the adjacent curb. Cold joints shall be tacked before new material is placed against them.

The finished asphalt curb shall be true to alignment and cross-section, thoroughly compacted, and shall have a smooth, tight, uniform surface texture which is free from segregation, defects, blemishes or other irregularities.

400.2.28.5.3 Gravel Fill for Asphalt Curb, Medians and Traffic Islands

Median fill gravel shall be placed within the asphalt curbs forming the outside perimeter of medians and traffic islands, and shall be thoroughly compacted in layers not exceeding 150mm in depth, to a tight, smooth surface within 50mm of the top of the curbs, or as otherwise specified in the Technical Requirements.

400.2.28.5.4 Median Surfacing

The compacted gravel fill within medians and traffic islands shall be surfaced with asphalt concrete material in accordance with the requirements of Section 400.2.27 (Asphalt Concrete Pavement), using the designation and class of aggregate specified or directed by the Design

Engineer and as accepted by the Department. The finished surface shall be true to cross-section and grade, thoroughly compacted, and shall have a smooth, tight, uniform surface texture.

400.2.28.5.5 Asphalt Flumes

Where asphalt flume outlet drains are specified, they shall be constructed in accordance with the typical plans and the requirements of Section 400.2.27 (Asphalt Concrete Pavement), using the designation and class of aggregate specified or directed by the Design Engineer and as accepted by the Department. The finished surface shall be true to the lines, grades and cross-sections established by the Design Engineer, and shall be smooth, tight, and compact over its entire length. The excavated material from the flume trench shall be spread uniformly over the adjacent sideslope as directed by the Design Engineer and as accepted by the Department.

The flume bedding material shall be select pit-run gravel, or crushed aggregate of the Designation and Class specified, or as otherwise directed by the Design Engineer and as accepted by the Department. Bedding material shall be placed and thoroughly compacted to the depths and widths specified or as directed by the Design Engineer and as accepted by the Department.

Hand laid rock forms shall be produced and placed in a neat manner, in accordance with the typical plans.

400.2.28.5.6 Protection

Care shall be taken to prevent damage to the work during subsequent construction operations forming part of the Project. All means and materials required to protect the work from damage shall be provided by the Contractor.

400.2.28.5.7 Cleanup

All construction materials and other debris, resulting from the execution of the work covered by these specifications, shall be removed and disposed of to the satisfaction of the Design Engineer and as accepted by the Department.

400.2.28.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.28.7 Measurement

400.2.28.7.1 Repair and Levelling Patches

Measurement for asphalt concrete material for repair and levelling patches will be made in accordance with Section 400.2.27 (Asphalt Concrete Pavement).

400.2.28.7.2 Asphalt Curbs

Measurement of asphalt curbs will be by the length in metres, along the centreline of the curb.

400.2.28.7.3 Gravel for Median Fill

Measurement of gravel fill material for medians and traffic islands will be in tonnes.

400.2.28.7.4 Median Surfacing

Measurement of median surfacing will be in tonnes.

400.2.28.7.5 Asphalt Flume Outlet Drains

Measurement of asphalt flume outlet drains will be by length in metres, along the flow line of the flume.

400.2.28.8 Payment Adjustment

Intentionally Deleted

400.2.29 CONCRETE CURBS, GUTTERS, SIDEWALKS, MEDIANS AND TRAFFIC ISLANDS

400.2.29.1 General

The work shall include construction of the following items:

(a) Curbs, gutters and combination curb and gutter sections,
(b) Curbs for medians and traffic islands which have concrete, asphalt or topsoil surfacing,
(c) Solid concrete medians, traffic islands and sign islands,
(d) Separate sidewalks,
(e) Monolithic sidewalk curb and gutter sections,
(f) Concrete swales,
(g) Outlet gutters, and
(h) Concrete barriers.

These cast in place, extruded or precast structures shall consist of air entrained Portland cement concrete with or without reinforcing steel, prepared in accordance with the specifications and to the lines, grades and typical cross-sections as shown on the Detailed Designs or as designated by the Design Engineer and as accepted by the Department.

Curbs shall include mountable, semi-mountable and barrier types.

400.2.29.2 Materials And Procedures

400.2.29.2.1 General

The Contractor shall supply all materials, including forms for the construction of the work.

400.2.29.2.2 Aggregate

The Contractor shall produce aggregate materials in accordance with Section 400.2.20 (Aggregate Production and Stockpiling). Gravel or sand bedding material shall be select and shall consist of well graded sand or a well graded mixture of natural sand, gravel and/or crushed rock, all of which shall pass a 40mm sieve opening. Any processing required to meet this gradation requirement shall be the responsibility of the Contractor. The Contractor shall supply aggregate in accordance with Section 400.2.31 (Supply of Aggregate) and haul aggregate in accordance with Section 400.2.30 (Hauling).

400.2.29.2.3 Portland Cement Concrete

Portland cement concrete shall comply with the requirements of Section 400.2.32 (Supply of Portland Cement Concrete) for concrete class C. For precast F-type barrier curbs the compressive strength of the concrete at 28 days shall be 40 MPa.

400.2.29.2.4 Expansion Joint Fillers

Preformed expansion joint fillers shall conform to the requirements in the most recent edition of ASTM Designation D1751 and shall be of adequate dimensions to fill the joint fully and continuously throughout its entire depth.

400.2.29.2.5 Curing and Sealing Compounds

Curing compound shall conform to the most recent edition of ASTM Designation C309 and shall contain white fugitive dye. The Contractor shall not add any material to the curing compound as delivered by the manufacturer.

Sealing compounds are not normally required for this work. When use of a sealer is specified, the Contractor shall select one of the approved Type 1b Bridge Concrete Sealers identified on the Department’s Products List.

400.2.29.2.6 Reinforcing Bars and Wires

Steel reinforcing bars shall be deformed bars in accordance with the most recent edition of CSA G30.12 - M "Billet Steel Bars for Concrete Reinforcement". For F type barrier curbs the bars shall also be epoxy coated.

Cold drawn wire or welded wire fabric for concrete reinforcement shall conform to the requirements of the latest edition of CSA G30.5.

400.2.29.2.7 Median Fill Materials

Fill material for medians to be surfaced with Portland Cement Concrete or Asphalt Concrete shall be crushed aggregate of the Designation and Class specified in the Detailed Designs. The Contractor shall process the material by crushing if required to meet the specifications.

Fill material for medians to be topsoiled shall be clayey soil free of stones, clods, sticks, roots, concrete and other debris.

Asphalt concrete for median surfacing shall be supplied, produced and placed in accordance with the requirements of Section 400.2.27 (Asphalt Concrete Pavement). Unless otherwise specified in the special provisions, the Mix Type shall be as used elsewhere on the project. Gradation of the median surfacing asphalt concrete aggregate shall be in accordance with the requirements for the Designation and Class specified or directed by the Design Engineer and as accepted by the Department.

Topsoil for medians shall meet the requirements of Section 400.2.5 (Topsoil Placement).

400.2.29.3 Quality Management Sampling And Testing

Sampling and Testing shall meet the requirements of Section 400.2.32 (Supply of Portland Cement Concrete).

400.2.29.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.29.5 Construction

400.2.29.5.1 General

The Contractor shall be responsible for the proper adjustment and calibration of its equipment.

400.2.29.5.2 Preparation of Base and Bedding

Soft, yielding or unsuitable base material shall be removed and disposed of, as directed by the Design Engineer or Department, and replaced with approved material. The base material shall be thoroughly compacted to 95 percent of Standard Proctor Density at optimum moisture to a depth of 150mm and finished to a smooth, uniform surface, true to established line and grade. Base preparation shall extend sufficiently beyond the edges of the structure to enable forming and construction of the work.

The Contractor shall place and compact gravel or sand bedding course upon the prepared base to a minimum compacted depth of 50mm, or as otherwise specified or directed by the Design Engineer and as accepted by the Department. Gravel or sand bedding shall be placed to the widths as specified or as directed by the Design Engineer and as acceptance by the Department, and shall be thoroughly compacted to a smooth, uniform surface, true to established lines and grade. Bedding material shall extend sufficiently beyond the edges of the structure to enable support, forming and construction of the work.

400.2.29.5.3 Adjusting Catch Basins and Manholes

Raising or lowering catch basin or manhole frames, when necessary, to match sidewalk or curb and gutter grades shall be in accordance with Section 400.2.9 (Manholes, Inlets and Catch Basins).

400.2.29.5.4 Forms

Steel or wood forms shall conform to the shape, lines and dimensions of the concrete shown on the Detailed Designs. Lumber used in forms for exposed surfaces shall be dressed to a uniform thickness and shall be free from loose knots or other defects. Forms shall extend the full depth of the section being formed, and shall be secure and sufficiently tight to prevent leakage of mortar. Forms shall be properly braced or tied together to maintain position and shape, and shall be thoroughly cleaned and coated with a non-staining form-release oil, before concrete is placed therein. Forms shall not be disturbed until the concrete has hardened sufficiently to prevent damage.

Where form ties are used they shall be cut off inside the surface of the concrete and the holes shall be patched.

400.2.29.5.5 Extrusion

Where slip-form paving machines or concrete extruding machines are used for placing concrete, they shall meet the following requirements:

(a) The machines shall be accepted by the Design Engineer and the Department prior to commencement of the work.

(b) The vibrators on the equipment shall be adequate to produce a dense mass free of voids with a smooth surface free of honeycombing.

(c) The equipment shall have automatic grade and line control.

(d) The equipment shall, in a single pass, provide the specified shape and cross-section for the concrete items to be constructed.

400.2.29.5.6 Steel Reinforcement

Steel reinforcement, dowels or tie bars, when specified, shall be properly spaced, aligned, and held in correct position during the placement of the concrete by the use of bar chairs or other approved devices. Longitudinal bars shall extend through all contraction joints, and shall terminate a minimum of 50mm from any expansion or construction joint. Bars shall overlap at splices by at least 300mm.

400.2.29.5.7 Wire Mesh Reinforcement

Wire mesh reinforcement, when specified, shall be properly placed and held in position during the placement of the concrete by use of chairs or other approved devices. Joints in the wire mesh shall be overlapped 100mm. Wire mesh reinforcement shall terminate a minimum of 50mm from any expansion or construction joint.

400.2.29.5.8 Placing Concrete

The bedding shall be in a moist condition immediately prior to the time the concrete is placed. The concrete shall be spread uniformly to the required cross-section, without segregation, and thoroughly consolidated to eliminate excess air voids and to bring sufficient mortar to the surface for proper finishing. Before final finishing, surfaces shall be tested with a 3m straightedge, and any irregularities of more than 6mm in 3m shall be corrected.

Concrete placement between construction joints shall be continuous. Where there is a delay of more than 30 minutes in the placement of concrete a construction joint shall be formed.

Concrete shall not be placed during rain or during other adverse weather conditions.

Concrete shall not be placed on frozen base or frozen bedding.

400.2.29.5.9 Crossings

Lane, commercial and private crossings shall be constructed on prepared bases at locations and to the depths and widths as indicated on the Detailed Designs and as directed by the Design Engineer and the Department. When specified, crossings shall be reinforced with steel wire mesh.

400.2.29.5.10 Precast Sections

Precast sections shall be placed on a prepared base, to the line and grade specified, as indicated on the Detailed Designs or as directed by the Design Engineer and the Department.

400.2.29.5.11 Joints

General

Joints shall be perpendicular to the subgrade and at right angles to the longitudinal axis of the structure. Joints shall be formed and edged with a 6mm radius so as to leave a neat finished appearance.

Contraction Joints

For barriers, curbs, combination curb and gutter sections, separate sidewalks, and monolithic sidewalk, curb and gutter sections, contraction joints shall be formed every 3m except where shorter spacing is necessary for closures, but no section shall be less than 1m in length. Contraction joints shall be made by the use of one of the following methods:

(i) Sawing a joint 50mm deep with a concrete saw early enough after the concrete has set to prevent uncontrolled cracking, but not so soon as to displace the aggregate from the edges of the cut. The timing of sawing shall be the Contractor's responsibility.

(ii) Forming a joint 50mm deep by inserting into the plastic concrete a metal or fibre strip or a polyethylene film, finishing the edges to a 6mm radius, and removing the insert as soon as initial set of the concrete has taken place.

(iii) Forming a joint 50mm deep with a jointing tool with a thin metal blade to impress a permanent plane of weakness into the plastic concrete.

For sidewalk construction a surface joint 15mm in depth shall be constructed alternating with and halfway between contraction joints. This joint shall not extend into the curb and gutter section.

An additional surface joint 15mm in depth shall be constructed longitudinally in monolithic curb, gutter and sidewalk for the purposes of delineating the back of the curb. This joint shall be located at the distance from the back of sidewalk as indicated on the Detailed Designs and shall be continuous for the entire length of the structure including driveway and lane crossings.

<u>Expansion Joints</u>

Expansion joints shall be constructed with a preformed expansion joint filler to the full depth of the concrete at the following locations:

(i) where the concrete structure abuts a building, pole or other permanent structure;

(ii) at construction joints;

(iii) where shown on the Detailed Designs; and

(iv) where directed by the Design Engineer and the Department.

<u>Construction Joints</u>

Construction joints shall be formed using steel divider plates, at locations specified by the Design Engineer, or as otherwise designated by the Department. Should concrete placing operations be unavoidably interrupted, construction joints shall be formed at the last fully completed panel.

Construction joint divider plates shall be left in place until the concrete has set sufficiently to hold its shape, and shall be removed without damaging the concrete.

Steel dowels, greased on one end, shall be incorporated into construction joints where specified by the Design Engineer or as directed by the Department.

400.2.29.5.12 Finishing

Exposed concrete surfaces shall have a brush finish. The brush grooves shall be transverse on the sidewalk and longitudinal on the curb and gutter.

Exposed edges on sidewalks including contraction and surface joints, shall be tooled for a width of 50mm and rounded to a radius of 6mm, or as otherwise specified in the Technical Requirements.

The finished concrete shall be true to cross-section, line and grade, and the surface shall be tight, smooth and free of honeycombing and irregularities. Concrete with honeycombing or other irregularities shall be removed and replaced as directed by the Department.

400.2.29.5.13 Identification of Work

Identification marks showing the name of the Contractor and the year constructed, shall be placed at the end of each block or at the terminal points of the work in each block, in a neat, easily legible form, as accepted by the Design Engineer and the Department.

400.2.29.5.14 Curing, Sealing and Protection

Curing

Immediately after finishing, the concrete shall be protected against moisture loss by the application of an approved curing compound. The application rate and method of application shall be in accordance with the manufacturer's recommendations.

Curing compounds shall be applied by spraying with pressure equipment. To ensure complete coverage, approximately one-half the quantity for a given area shall be applied in one direction and the remainder applied at right angles to this direction.

Curing compounds shall not be used on a surface where a bond is required with additional concrete to be placed later, or where a sealing compound is specified to be used. In such cases the concrete surface shall be moist cured by using wet burlap or polyethylene film.

Sealing

When sealing is specified, sealing compounds shall not be applied until a minimum of 14 days following placement of the concrete. The concrete shall be dry and swept clean prior to application of sealing solution as directed by the Design Engineer and as accepted by the Department.

The minimum application rate and method of application shall be in accordance with the manufacturer's recommendations.

Protection

Concrete shall be protected against damage in accordance with Section 400.2.32 (Supply of Portland Cement Concrete).

400.2.29.5.15 Backfill

For outlet gutters, sidewalks and monolithic curb, gutter and sidewalks, the Contractor shall backfill as soon as possible after the removal of forms. The backfill shall be mechanically tamped and trimmed.

For curb and gutter the Contractor shall backfill behind the curb with suitable material after the seven day curing and protection period has elapsed. The backfill shall extend to at least 600mm behind the curb and shall be compacted in two lifts. The densities shall be obtained by means of a hand operated mechanical tamper or other equipment acceptable to the Design Engineer and as accepted by the Department.

Organic soils shall not be permitted for backfilling, except where topsoil is specified for the top 100mm of fill.

400.2.29.5.16 Fill for Medians, Sign Islands and Traffic Islands

Topsoiled Medians

Fill for medians to be topsoiled shall be placed and moderately compacted to a smooth surface 150 mm below the top of the median curb. The material shall be classified in accordance with Section 400.2.2 (Grading).

Other Medians

Fill for medians to be asphalt concrete surfaced or concrete surfaced shall be crushed aggregate placed and compacted as indicated in the Detailed Designs, and as directed by the Design Engineer and as accepted by the Department.

400.2.29.5.17 Median Surfacing

Topsoil Surfacing

Topsoil surfacing of medians shall be placed in accordance with Section 400.2.5 (Topsoil Placement).

Asphalt Concrete Surfacing

Asphalt concrete material for median surfacing shall be supplied and placed in accordance with Section 400.2.27 (Asphalt Concrete Pavement) except that the density requirements will not apply. The finished surface shall be true to cross-section and grade, shall be compacted and shall have a smooth, tight, uniform surface.

Concrete Surfacing

Concrete material for median surfacing shall be supplied in accordance with the requirements of Section 400.2.32 (Supply of Portland Cement Concrete) and placed, finished, cured and sealed in accordance with the appropriate sections of this specification.

400.2.29.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.29.7 Measurement

400.2.29.7.1 Concrete Structures

Solid Concrete Medians and Islands

Solid concrete medians and solid concrete islands will be measured in square metres of completed top surface area

Curbs, Gutters, Combination Curb and Gutter Sections, Sidewalks, Monolithic Sidewalk Curb and Gutter Sections, Concrete Barriers, and Swales or combinations thereof

Measurement will be made in linear metres to the nearest 0.1 metre with measurements taken as follows:

(i) "Concrete Curb", measured along the length of the curb, for each type of curb.

(ii) "Gutters", and "Outlet Gutter", measured along the length of the gutter.

(iii) "Curb and Gutter", measured along the length of the curb face.

(iv) "Concrete Sidewalk", measured along the length, for each specified width.

(v) "Monolithic sidewalk, Curb and Gutter", measured along the length, for each specified width.

(vi) "Concrete Swale", measured along the flow line.

(vii) "Concrete Barrier", measured along the length.

Rip-Rap for Outlet Gutters

Contrary to Section 400.2.4 (RIPRAP), RIPRAP for outlet gutters will be measured in square metres.

400.2.29.7.2 Median Fill

Granular fill material for asphalt concrete or Portland Cement Concrete surfaced medians will be measured in tonnes.

Earth fill material will be measured in accordance with Section 400.2.2 (Grading).

400.2.29.7.3 Median Surfacing

Median asphalt concrete surfacing will be measured in tonnes.

Median Portland Cement Concrete surfacing will be measured in square metres based on the width excluding the curbs

Median topsoiling will measured as specified in Section 400.2.5 (Topsoil Placement).

400.2.29.8 Payment Adjustment

Intentionally Deleted

400.2.30 HAULING

400.2.30.1 General

400.2.30.1.1 Description

This specification applies to the hauling of all granular materials produced under Section 400.2.20 (Aggregate Production and Stockpiling) including blend sand, and the hauling of all mixtures of granular material with asphalt or cement produced under the applicable specification as required by the Technical Requirements. This specification covers the following:

(a) The administration of haul roads from all aggregate sources;

(b) Hauling granular materials and mixtures of granular material with asphalt or cement;

(c) Hauling granular materials and mixtures of granular material with asphalt or cement "In-Place".

400.2.30.1.2 Definitions

For purposes of this specification, the following definitions will apply:

Aggregate Sources

The categories of aggregate sources are as specified in Section 400.2.31 (Supply of Aggregate).

Hauling

The process of transporting material from its point of loading to its designated delivery point.

Haul Road

A route over which materials are hauled for the Project with the exception of any portion of the highway or road within the Project Limits.

Conversion Factors

Where the application of conversion factors is necessary, the following standard values shall be used:

- 1.63 t/m^3 for gravel (pit-run and crushed, regardless of class), and
- 1.36 t/m^3 for sand.

400.2.30.2 Materials And Procedures

400.2.30.2.1 Identification of Haul Routes

At the time of the DB Agreement execution, the Contractor shall provide land title or public land standing reports, and shall state the location of its proposed aggregate sources and haul routes. The Contractor shall be responsible for obtaining authority to haul over the proposed haul routes from the agency having jurisdiction. The use of provincial highways as haul routes is subject to prior approval by the Department.

The Contractor shall abide by all road restrictions established by the road or bridge authority having jurisdiction, including all roads and portions of the highway or road within the Project Limits.

400.2.30.2.2 Hauling

Vehicle Requirements

Haul vehicles shall comply with the Alberta *Traffic Safety Act* and have Alberta Class 1 registration.

Each truck used for hauling shall have current registration with the Alberta Sand and Gravel Association (ASGA) Registry, or equivalent registry system designed to allow the public to lodge haul related complaints.

Each haul truck shall display signs on three sides of the vehicle indicating the name of the registry system, and displaying a clearly visible toll-free telephone contact number and unique truck identifier. The truck identifier shall have no more than 8 characters, with a minimum height of 150mm per character.

The registry system used shall forward all complaints received to the Contractor; shall record the nature of the complaint; and shall be able to provide the Department with summary statistics when requested.

All complaints received shall be handled by the Contractor.

Prior to a haul truck being used, the Contractor shall provide the Department with identification information including the haul truck number, truck registration identifier, allowable gross vehicle weight and tare vehicle weight.

For vehicles hauling on a cubic metre basis the approved capacity will be the struck measure of the box as calculated by the Design Engineer and as accepted by the Department to the closest 0.1 cubic metres.

Hauling Restrictions

The Department may direct that hauling operations will not be permitted if excessive damage to highways or public roads will occur or when hauling operations cause serious hazards or difficulties to the traveling public.

The conditions when this may occur will generally be:

(a) When spring thaw is taking place;

(b) During or after heavy rainfall;

(c) During periods of exceptionally heavy traffic.

The Contractor shall abide by all load restrictions established by the road or bridge authority having jurisdiction.

If work must be carried over from one construction season to the next, the Department may order that when work closes down for the season, the Contractor shall repair any damage to public roads caused by his hauling operations.

Construction, Initial Conditioning and Maintenance of Haul Roads

The Contractor shall initially condition, maintain and restore roads used as haul roads to the satisfaction of the agency having jurisdiction and in the case of provincially owned or controlled roads, to the satisfaction of the Design Engineer and the Department. The Contractor shall also be responsible for construction of new haul roads where necessary.

400.2.30.3 Quality Management Sampling And Testing

Intentionally Deleted

400.2.30.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.30.5 Construction

Intentionally Deleted

400.2.30.6 Product Acceptance

Intentionally Deleted

400.2.30.7 Measurement

Intentionally Deleted

400.2.30.8 Payment Adjustment

Intentionally Deleted

400.2.31 SUPPLY OF AGGREGATE

400.2.31.1 General

This specification covers the general requirements for the supply of aggregate materials by the Contractor. Aggregate materials are considered the total of the granular portion of construction materials consisting of the coarse and fine gravel splits, blend sand and manufactured fines when required.

400.2.31.2 Materials And Procedures

400.2.31.2.1 Aggregate Categories

Aggregate sources are categorized as follows:

Aggregate Sources Controlled by the Department

The following are deemed as aggregate sources controlled by the Department:

(i) a source owned by the Department, or

(ii) a Crown source for which the Department has a reservation, or

(iii) a private source for which the Department has a royalty agreement, and holds an approval under the *Environmental Protection and Enhancement Act* (Alberta).

Designated Sources

When it is specified in the Technical Requirements that the Contractor shall only use the Department sources (pits, stockpiles or quarry sites) for the production of crushed or uncrushed aggregate, these sources shall be termed "Designated Sources".

Aggregate Sources Not Controlled by the Department

The following are deemed as aggregate sources not controlled by the Department:

(i) a Crown source on undeeded land, operated primarily under lease or license and for which the Department does not have a reservation.

(ii) a private source for which the Department does not have a royalty agreement, and does not hold an approval under the *Environmental Protection and Enhancement Act* (Alberta).

400.2.31.2.2 General Requirements for the Use of All Aggregate Sources

When supplying aggregate from any source, the Contractor shall:

(i) ensure a Conservation and Reclamation Approval or Registration from Alberta Environment, or a lease or license to extract from Alberta Sustainable Resource Development, and a clearance from the Archaeological Survey of Alberta are in place prior to commencement of the work;

(ii) assume full responsibility for the quantity and quality of the material in the aggregate source;

(iii) specify the location of the proposed aggregate source(s) and haul routes;

(iv) acquire the necessary rights to remove materials from all aggregate sources except sources controlled by the Department;

(v) explore and develop the aggregate sources; and

(vi) save the Department harmless from any and all claims resulting from the use of the aggregate sources.

The Department will not consider the use of aggregates from existing stockpiles unless the Contractor can satisfy the Design Engineer and the Department that the aggregate in question meets all required specifications. Agreement by the Department that such pre-prepared aggregates can be used will not constitute acceptance of the material in stockpile. Acceptance of such material will be based on testing done by the Department as the material is incorporated into the work.

400.2.31.2.3 Pit Operations

<u>General</u>

In all aggregate sources, the Contractor shall comply with the conditions set by Alberta Environment or Alberta Sustainable Resource Development when removing topsoil, subsoil and inorganic overburden, including if in a frozen condition. The standards and conditions for appropriate development and reclamation as required by Alberta Environment or Alberta Sustainable Resource Development shall apply to all sources.

<u>Pit Operations in Aggregate Sources Controlled by the Department</u>

Unless modified by a pit operation plan provided to the Contractor by the Department or the Technical Requirements or as directed by the Department, pit operations in an aggregate source controlled by the Department shall comply with the requirements detailed in this section.

All reject material produced in an aggregate source controlled by the Department shall be disposed of as directed by the Department and the Contractor shall have no claim to the material.

When aggregate is to be produced from a source which has been partially excavated previously, the new excavation shall proceed as an extension of the previous excavation provided that suitable material is obtainable. If required, stockpiled materials from previous operations shall be removed and deposited, as indicated in the Technical Requirements unless otherwise directed by the Design Engineer and as accepted by the Department. The aggregate exposed shall be processed and used.

Normally, the cleared area shall extend beyond the final position of an open face by a minimum distance of four times the expected depth of excavation. Clearing and timber salvage shall be performed in accordance with Section 400.2.1 (Clearing).

The Contractor shall erect and maintain such temporary fences and livestock guards as may be required to prevent livestock from straying into the aggregate source.

The Contractor shall be responsible for signing Department controlled pits in accordance with Drawing TEB 1.59. The Contractor shall be responsible for the removal and re-installation of any existing signs. If the pit is not signed in accordance with Drawing TEB 1.59, or if in the opinion of the Department, the existing signs are damaged, the Contractor shall supply and install new warning signs in accordance with Section 400.2.38 (Supply of Permanent Highway Signs, Posts and Bases) and TEB 1.59. All warning signs shall be promptly installed, and/or re-installed in the proper location immediately after removal.

Inorganic overburden shall be removed to a minimum 10 metres beyond the top of the backsloped aggregate face. Topsoil and subsoil shall be stripped to a minimum distance of 5 metres beyond the top of the backsloped overburden face. The stripped buffers shall be maintained throughout the Project.

Prior to the placement of excavated inorganic overburden, the Contractor shall remove the full depth of both topsoil and subsoil layers and stockpile the materials in separate stockpiles. In addition, unless otherwise directed by the Department, the Contractor shall remove and separately stockpile the full depth of both topsoil and subsoil layers from all temporary work sites including but not limited to, the crusher, plant, camp, parking areas and all access roads.

Prior to the placement of excavated subsoil, the Contractor shall remove and stockpile the full depth of topsoil layer.

The aggregate area to be used shall be stripped in stages as follows. The first stage shall be the removal and stockpiling of topsoil. The second stage shall be the removal and stockpiling of the subsoil. The final stage shall be the removal and deposition of the inorganic overburden, as indicated in the Technical Requirements, or as directed by the Department. The Contractor shall remove all materials in a manner that prevents contamination of one material with another. Dozers shall not be used for the removal topsoil or subsoil unless specifically authorized by the Department in writing. Topsoil, subsoil, and inorganic overburden shall be stockpiled uniformly and compactly in separate piles in the area(s) designated by the Department. Stockpiling of all stripped materials shall be completed in a manner that will minimize surface damage and interruption of natural drainage.

Unless otherwise directed by the Department, where stockpiles of topsoil, subsoil and inorganic overburden exist from previous pit operations, the Contractor shall utilize the same stockpile locations for the deposit of excavated topsoil, subsoil and inorganic overburden.

During the Project, the Contractor shall prevent erosion of all topsoil, subsoil, and inorganic overburden stockpiles resulting from his operations. In the event such piles remain at the completion of construction, they shall be seeded by the Contractor.

All materials required for seeding shall be supplied by the Contractor. Grass seed shall conform to Section 400.2.14 (Seeding). The composition and application rate of the grass seed mixture will be determined by the Department at the time of construction.

The excavation of aggregate shall advance uniformly to obtain maximum yield from the deposit. Under no circumstances will waste of useable material be permitted, and excavations shall be continued to depths below water level if suitable material is available.

The Contractor shall clean-up the areas of pits affected by operations performed for the Project in accordance with the following:

(i) All faces with potential future use for the removal of aggregate shall be sloped at a ratio of at least two horizontal to one vertical.

(ii) Faces designated to be abandoned in a deposit shall be sloped at a ratio of at least four horizontal to one vertical.

(iii) At boundaries of authorization or property lines, sloping shall be at a ratio of at least four horizontal to one vertical with the top of slopes terminating at a minimum distance of three metres from the boundary.

(iv) Upon completion of the work, the site shall be left in a neat and presentable condition. All fences removed for purposes of entry shall be replaced in a condition equal to or better than they were before being removed, and all debris, including construction materials and garbage, resulting from the Contractor's operations shall be removed and disposed of as required by the Department. The Contractor shall not drain, spill or bury at this site any garbage, sewage, outhouse waste, fluids, oils, fuels, mechanical parts or equipment.

(v) All asphalt material produced by the Contractor shall be removed from the site, unless otherwise outlined in the Technical Requirements. All reject asphalt material produced by the Contractor shall be disposed of in accordance with all applicable environmental laws.

In addition to the foregoing sloping operations, where practical, the Department may order that flatter slopes be constructed on selected areas using stockpiled overburden material. The quantity of overburden material available will determine the amount of sloping to be done. This operation may require some site preparation such as ripping of the compacted earth floor.

<u>Pit Operations in Aggregate Sources Not Controlled by the Department</u>

All aspects of clearing, removal of overburden, protection and safety of livestock, general pit management and clean up shall be the responsibility of the Contractor.

400.2.31.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.31.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.31.5 Construction

Intentionally Deleted

400.2.31.6 Product Acceptance

Intentionally Deleted

400.2.31.7 Measurement

When the material measurement is by volume, a conversion factor of 1.632 tonnes per cubic metre will be used to determine the weight of a gravel component and 1.365 tonnes per cubic metre will be used for a blend sand component.

400.2.31.8 Payment Adjustment

Intentionally Deleted

400.2.32 SUPPLY OF PORTLAND CEMENT CONCRETE

400.2.32.1 General

Portland Cement Concrete shall consist of a mixture of Portland Cement, fine aggregate, coarse aggregate, water, and admixtures where required, combined in proportions to meet the specifications herein.

400.2.32.1.1 Class of Concrete

The Contractor shall supply Portland Cement Concrete in accordance with the following requirements for the class of concrete specified in the Detailed Designs:

Class of Concrete	Minimum Compressive Strength @ 28 Days MPa	Size of Coarse Aggregate mm	Range of Slump mm	Entrained Air Cont. %	Maximum Water/ Cement Ratio
*A	25	40 to 5	50 to 70	4 - 7	0.45
B	25	28 to 5	50 to 70	4 - 7	0.45
C	30	20 to 5	60 to 80	5 - 8	0.42
D	30	14 to 5	50 to 70	5 - 8	0.42
Pile	25	28 to 5	100 to 140	4 - 7	0.45

NOTE:

* The Contractor will be permitted to supply Class "B" concrete where Class "A" has been specified.

All properties shall be determined in accordance with the requirements of the latest version of CSA Standards A23.1, Concrete Materials and Methods of Concrete Construction, and A23.2, Methods of Test and Standard Practices for Concrete.

400.2.32.2 Materials And Procedures

400.2.32.2.1 Portland Cement

The Contractor shall supply Portland Cement conforming to the requirements of Section 400.2.32 (Supply of Portland Cement Concrete) and concrete products in accordance with A23.1

Unless otherwise specified, directed or accepted by the Department, Normal Type GU Portland Cement shall be used.

400.2.32.2.2 Water

Mixing and curing water shall be supplied by the Contractor.

Water shall conform to the requirements of the latest version of CSA Standard A23.1. Water used in Portland Cement Concrete construction shall be subject to the prior acceptance by the Design Engineer and as accepted by the Department.

400.2.32.2.3 Aggregates

The Contractor shall supply aggregates conforming to the requirements of the latest version of CSA Standard A23.1. Aggregates used in Portland Cement Concrete shall be subject to the prior acceptance by the Design Engineer and the Department.

400.2.32.2.4 Air-Entraining Admixtures

Air-entraining admixtures shall be supplied by the Contractor.

Air-entraining admixtures shall conform to the requirements ASTM C260.

400.2.32.2.5 Other Admixtures

All accepted admixtures, such as water reducing agents, and superplasticizers shall conform to ASTM C494 and be compatible with all other constituents. The addition of calcium chloride, accelerators and air-reducing agents, will not be permitted, except when accepted by the Department. Retarders or set controlling admixtures may be used for concrete specified with corrosion inhibitor.

400.2.32.2.6 Fly Ash

Fly ash may only be used in concrete mixes where the aggregate is assessed to be potentially alkali-silica reactive.

Fly ash, when accepted by the Department, shall not exceed 30 percent by mass of cementing materials. All fly ash shall conform to the requirements of CSA-A3000-03 Cementitious Material Compendium for Type “F” or “CI” fly ash. Characteristic data for fly ash is required to assure conformance to the standards and is to be provided to the Design Engineer and the Department prior to its use.

Only acceptable compatible superplasticizing admixtures and air entraining agents shall be used with fly ash.

400.2.32.3 Quality Management Sampling And Testing

Quality management testing will be the responsibility of the Contractor. The Contractor shall determine the type and frequency of testing required and shall provide and pay for all equipment and personnel necessary to complete such testing. Results of all quality management testing shall be submitted to the Department as they become available.

400.2.32.4 Acceptance Sampling And Testing

Acceptance testing is the responsibility of the Department. The Department will take samples, and carry out acceptance testing and auditing of materials incorporated or being incorporated into the work. The Contractor shall cooperate with the Department during the sampling, testing and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the work strictly in accordance with the Technical Requirements.

Locations for routine acceptance testing shall be randomly selected as far as it is practical to do so. This will not limit the Department from testing at any additional locations as it deems necessary.

Results of the acceptance tests will be made available to the Contractor for its information. The Contractor shall be responsible for interpretation of test results and alter its operation if necessary, so that the product meets the Technical Requirements.

400.2.32.4.1 Test Methods

Unless otherwise specified, the most recent editions of the following standard test methods and frequencies will be used to determine the material characteristics.

Test Description	Method No.	Frequency
Sampling Concrete	CSA A23.2-1C	1. Minimum of one per day
Slump	CSA-A23.2-5C	2. Minimum of one per day
Entrained Air	CSA-A23.2-4C	2. Minimum of one per day

Test Description	Method No.	Frequency
Making and Curing Compressive Strength Specimens	CSA-A23.2-3C	[1.]Minimum of one per day
Compressive Strength	CSA-A23.2-9C	[1.]Minimum of one per day

Notes 1: On larger pours a strength test will be taken on approximately each 30m^3 portion of the concrete pour. A compressive strength test will consist of four standard test specimens. One cylinder will be tested at seven days. The 28 day test result will be the average of the remaining three specimens.

2. For each compressive strength test a slump test will be performed and the amount of entrained air measured.

400.2.32.4.2 Slump and Air Content

In the event that slump and/or air content test results are outside the specified tolerance range as determined by the Department's testing, the Department may accept adjustments of the deficient condition as an alternate to rejection provided adjustments are made within 90 minutes from batching of the concrete. Concrete that does not meet this requirement is subject to rejection.

On-site addition of water to a concrete batch will only be permitted by the Design Engineer and as accepted by the Department provided the specified water-to-cement ratio is not exceeded. The Department reserves the right to reject any batch in the event of confirmed unacceptability, and to require immediate removal of any concrete from this batch that may have already been placed.

Placed concrete that does not meet the specified air content criteria will not be accepted by the Department unless core sample testing conducted by the Contractor indicates that the air content and air-void system parameters of the suspect material is considered satisfactory in accordance with the latest version of CSA-A23.1 clauses 4.3.3.2 and 4.3.3.3. Sampling and testing costs associated with verifying the suitability of suspect concrete will be the responsibility of the Contractor.

400.2.32.5 Construction

400.2.32.5.1 Care and Storage of Materials

All Portland Cement Concrete materials shall be handled and protected in such a way as to prevent segregation, damage and contamination.

All cement, aggregate and other concrete construction materials shall be stored in accordance with the requirements of the latest version of CSA Standards A5, A3001 Cementitious Materials for Use in Concrete and A23.1. Any segregated, damaged, or contaminated materials shall be rejected.

400.2.32.5.2 Aggregate Tests and Concrete Mix Design

The Contractor shall be responsible for providing the concrete mix designs, and shall submit the mix design for class of concrete to the Design Engineer and the Department for review and acceptance a minimum of one week prior to the scheduled placing of concrete.

For each concrete mix design, the following aggregate analysis shall be provided:

- "Fine and Coarse Aggregate Sieve" (CSA A23.2-2A)
- Amount of material finer than 80 micron in aggregate (CSA A23.2-5A)
- "Organic Impurities in Sands for Concrete"
- "Assessment of Potential for Deleterious Alkali-Aggregate Reactivity (AAR)" (CSA A23.2-27A)
- "Sources of proposed aggregate"

The analysis of the aggregates shall fully represent the material to be used in production.

If the fine aggregate consists of a blend from more than one source, the "Fine Aggregate Sieve" analysis shall show the gradation of the blended fine aggregates. Similarly in the case of blended coarse aggregates, the "Coarse Aggregate Sieve" analysis shall indicate the gradation of the blended coarse aggregates. Aggregate gradations for the coarse and fine aggregate shall meet the criteria outlined in Tables 10 and 11 of CSA A23.1-04.

Fine aggregate, tested in accordance with CSA Test Method A23.2-7A, "Organic Impurities in Sands for Concrete", shall produce a colour not darker than the Standard colour (Organic Plate Number 3). Aggregate producing a colour darker than the Standard colour will be rejected in the absence of a satisfactory record of performance of a similar class of concrete (minimum 30 tests over the last 12 months); provisions 4.2.3.3.3.2 (a) & (b) of CSA Standard CAN3-A23.1-04 shall not apply.

The potential for deleterious alkali-aggregate reactivity shall be assessed in accordance with CSA A23.2-27A. This assessment shall include the risk level associated with structure size and environment, the level of prevention related to service life requirements and the determination of the appropriate preventative measures. Unless otherwise indicated the service life is considered to be 50 years. Test data, less than 18-months old, evaluating the potential alkali-silica reactivity of aggregates tested in accordance with CSA A23.2-14A or CSA A23.2-25A shall be provided by the Contractor for the Design Engineer's and the Department's review. In the absence of current test data and outside of areas of known highly reactive aggregate, the aggregate shall be presumed to be moderately reactive.

For all concrete mixes the minimum cement content, excluding supplementary cementing materials, shall be 300 kg/m^3.

Concrete mixes that will be placed by concrete pump shall be designed for pumping.

The sampling and testing of aggregates, and the concrete mix design shall be completed by a CSA certified and qualified concrete testing laboratory that has a permit to practice in the Province of Alberta. The testing laboratory shall provide an engineering opinion that concrete aggregate and mix designs are suitable for the intended use and are expected to perform to specified standards.

If, during the progress of the work, it is determined that the concrete has inadequate workability, or does not meet the Technical Requirements , the Contractor shall provide a new mix design for the Design Engineer's approval and the Department's acceptance, in accordance with the foregoing requirements.

All concrete shall be proportioned in accordance with the accepted mix designs.

All costs associated with aggregate testing and providing the mix designs shall be the responsibility of the Contractor.

400.2.32.5.3 Consistency

The slump shall be in accordance with the specifications herein, however, the slump for slip-formed concrete shall be limited to a maximum of 50mm, or to such other value as may be necessary to enable the material to be slip-formed without subsequent distortion.

Generally, mass and mechanically vibrated concrete shall have slumps in the lower portion of the specified range, and heavily reinforced and/or inaccessible sections shall have slumps in the higher end of the range.

400.2.32.5.4 Concrete Production

Portland Cement Concrete shall be produced in accordance with the requirements of the latest version of CSA Standard A23.1, unless otherwise accepted by the Design Engineer and the Department.

400.2.32.5.5 Delivery

Delivery of Portland Cement Concrete shall be regulated so as to enable continuous deposition until the placement of each concrete section is completed.

400.2.32.5.6 Protection

Curing and protection of the placed concrete shall be in accordance with section 7.4, Curing and Protection, of CSA A23.1-04 for a Curing Type 2 concrete surface.

Concrete shall be protected against damage from freezing, rain, dust, rapid temperature change or other adverse weather effects.

For at least 7-days after finishing, or until the concrete has attained 70 percent of the specified concrete strength, whichever is greater; concrete shall be protected against damage by any form of traffic. The Contractor may block off areas containing fresh concrete to safeguard the work from traffic.

Hot-weather curing requirements shall apply when the concrete is placed with an air temperature of 27ºC or higher, or when the air temperature is forecast to exceed this value during the 7-day curing period. During periods of hot-weather curing, the Contractor shall use a water spray or saturated absorptive fabric to achieve cooling by evaporation.

Methods and materials used for protecting concrete from damage shall be the responsibility of the Contractor, and will be subject to prior acceptance by the Design Engineer and the Department.

Concrete damaged by moisture loss, freezing, rain, traffic, construction operations, or any other cause shall be repaired, or removed and replaced to the satisfaction of the Design Engineer and as accepted by the Department.

400.2.32.6 Product Acceptance

400.2.32.6.1 General

The Department reserves the right to reject any concrete whatsoever that does not meet all the requirements for the specified class of concrete. The Department may however, accept concrete the strength of which falls below the specified strength requirements. Section 400.2.32.8.1 (Payment Scales) includes minimum acceptable compressive strength requirements measured at 28 days.

Removing and replacing of rejected concrete construction shall be done by the Contractor. Any work deemed by the Department as defective or damaged by weather, traffic or other causes, shall be repaired or removed and replaced by the Contractor.

400.2.32.7 Measurement

400.2.32.7.1 Portland Cement Concrete

Measurement of Portland Cement Concrete will be done by the cubic metre placed.

400.2.32.8 Payment Adjustment

In cases where the Department accepts concrete for which the strength falls below the specified strength requirements, the Payment Adjustments in Section 400.2.32.8.1 (Payment Scales) shall apply.

400.2.32.8.1 Payment Scales

Strength Test Result	Minimum Compressive Strength Requirement @ 28 Days MPa			
	20	25	30	35
35 MPa and over	Acceptable	Acceptable	Acceptable	Acceptable
34 MPa to 35 MPa	Acceptable	Acceptable	Acceptable	\$10 /m^3 Penalty
33 MPa to 34 MPa	Acceptable	Acceptable	Acceptable	\$20 /m^3 Penalty
32 MPa to 33 MPa	Acceptable	Acceptable	Acceptable	\$30 /m^3 Penalty
31 MPa to 32 MPa	Acceptable	Acceptable	Acceptable	\$40 /m^3 Penalty

Strength Test Result	Minimum Compressive Strength Requirement @ 28 Days MPa			
	20	**25**	**30**	**35**
30 MPa to 31 MPa	Acceptable	Acceptable	Acceptable	\$50 /m^3 Penalty
29 MPa to 30 MPa	Acceptable	Acceptable	\$10 /m^3 Penalty	\$60 /m^3 Penalty
28 MPa to 29 MPa	Acceptable	Acceptable	\$20 /m^3 Penalty	\$70 /m^3 Penalty
27 MPa to 28 MPa	Acceptable	Acceptable	\$30 /m^3 Penalty	Reject
26 MPa to 27 MPa	Acceptable	Acceptable	\$40 /m^3 Penalty	Reject
25 MPa to 26 MPa	Acceptable	Acceptable	\$50 /m^3 Penalty	Reject
24 MPa to 25 MPa	Acceptable	\$10 /m^3 Penalty	Reject	Reject
23 MPa to 24 MPa	Acceptable	\$20 /m^3 Penalty	Reject	Reject
22 MPa to 23 MPa	Acceptable	\$30 /m^3 Penalty	Reject	Reject
21 MPa to 22 MPa	Acceptable	\$40 /m^3 Penalty	Reject	Reject
20 MPa to 21 MPa	Acceptable	\$50 /m^3 Penalty	Reject	Reject
19 MPa to 20 MPa	\$10 /m^3 Penalty	Reject	Reject	Reject
18 MPa to 19 MPa	\$20 /m^3 Penalty	Reject	Reject	Reject
17 MPa to 18 MPa	\$30 /m^3 Penalty	Reject	Reject	Reject
16 MPa to 17 MPa	\$40 /m^3 Penalty	Reject	Reject	Reject
15 MPa to 16 MPa	\$50 /m^3 Penalty	Reject	Reject	Reject
Less than 15 MPa	Reject	Reject	Reject	Reject

400.2.33 SUPPLY OF ASPHALT

400.2.33.1 General

The work consists of supplying asphalt materials including ordering, scheduling, delivering, supplying storage facilities, handling, storing, sampling, testing and other related work.

For purposes of this specification, the term "Asphalt Supplier" shall mean the party awarded an order by the Contractor for the supply of asphalt.

400.2.33.2 Materials And Procedures

400.2.33.2.1 General

The Contractor shall supply the types and grades of asphalt specified in the Detailed Designs. Asphalt suppliers' materials must be pre-qualified by the Department. Pre-qualified suppliers are listed in the Alberta Transportation Products List.

All asphalt binders shall be prepared from petroleum oils. They shall be free from impurities. Solvents used in the manufacture of cut-back asphalts shall be derived from petroleum oils.

Emulsifiers used to stabilize asphalt emulsions shall not be harmful to the performance of the asphalt in service.

The Contractor shall ensure that the asphalt supplied meets all requirements for the types and grades specified. The Contractor may be required to use more than one type or grade of asphalt for a particular purpose. Any change in asphalt type or grade must be reviewed and accepted by the Design Engineer and the Department. The Contractor shall notify the Design Engineer and the Department of any changes in asphalt material suppliers.

Performance grade (PG) asphalt cements (PGAC) shall meet the requirements of AASHTO M320 Standard Specification for Performance Graded Asphalt Binder. For asphalts designated as a PG 58-37, Table 1, Performance Graded Asphalt Binder Specification contained in AASHTO M320 shall be modified in accordance with the following criteria:

- The test temperature for creep stiffness and direct tension shall be -27°C;
- The test temperature for the Dynamic Shear on PAV residue shall be 15°C.

The Department reserves the right to discontinue the use of any asphalt product that fails to handle or perform to expectation or satisfaction, regardless of its compliance with the Technical Requirements.

400.2.33.2.2 Delivery, Handling and Storage

When requested by the Department, the Contractor shall supply the Department with the asphalt suppliers' weigh-bills and records of all asphalt received and/or returned on a daily basis. On projects where PGAC is supplied, the Contractor shall supply the Department with all asphalt suppliers' weigh-bills and records of all asphalt received and/or returned on a daily basis.

The Contractor shall provide, maintain and reclaim asphalt storage facilities.

Storage facilities for asphalt cement shall be capable of heating the material under effective and positive control at all times and shall contain provision for measuring and sampling.

For PGAC, the Contractor shall follow the suppliers' specified handling and storage requirements for each grade of PGAC.

No asphalt type or grade shall be diluted or mixed with a different type or grade, or with any other material, without the specific acceptance by the Design Engineer and the Department. PG asphalts from different suppliers shall not be mixed, regardless of grade.

The Contractor shall prevent contamination of the asphalt, by asphalt of another type or grade, by solvent, or by any other material. Asphalt storage tanks shall be emptied of one type or grade of asphalt, and cleaned as necessary to prevent detrimental contamination of the asphalt, before placing another type or grade of asphalt therein. Asphalt emulsions shall be protected from freezing.

400.2.33.3 Quality Management Sampling And Testing

400.2.33.3.1 Quality Management

Quality management and quality management testing is the responsibility of the Contractor. Quality management testing shall be carried out by a qualified Supplier's laboratory or a qualified testing laboratory licensed to practice in the Province of Alberta.

<u>Quality Management Plan - Performance Grade Asphalt Cements</u>

The Contractor shall provide a Quality Management Plan jointly prepared with the asphalt supplier detailing the quality management activities related to the use of the PGAC. The Plan shall be submitted at least 14 calendar days prior to the use of any PGAC product on the Project.

Hot mix production shall not commence until the Quality Management Plan has been accepted, in writing, by the Department. The requirement for the Contractor to provide a Quality Management Plan may be waived if the current Quality Management Plan used by the asphalt supplier has been previously accepted in writing by the Department.

As a minimum, the Quality Management Plan shall provide the following information:

(i) The type of facility from which the material(s) will be supplied (refinery, terminal) and its location.

(ii) Name and telephone number of the person responsible for quality management at the facility.

(iii) The method and frequency for initial testing, specification compliance testing and any other testing employed to either guide the manufacturing process of the PGAC or to ensure the on-going compliance of the material to contract specifications.

(iv) Specification compliance testing shall be carried out prior to shipping the materials from the supplier's facility to the hot mix plant. The Quality Management Plan shall provide an outline of the procedures to be followed for checking transport vehicles before loading to prevent contamination of shipments. The outline shall include a statement that the transport vehicles inspection report, signed by the responsible inspector, shall be maintained in the supplier's records and shall be made available to the Department upon request.

(v) The Quality Management Plan shall identify the quality management laboratory and detail control charting or any such statistical procedures which will be used to track the quality of the material(s). The Quality Management Plan shall indicate which accreditation programs, proficiency sample testing programs or other correlation programs that the quality management laboratory has or is currently participating in. Proof of good standing in such programs is required.

(vi) The Quality Management Plan shall detail the methods to be used to identify and provide for the exclusion of materials which do not conform to specifications, prior to incorporating them into the hot mix.

400.2.33.4 Acceptance Sampling And Testing

400.2.33.4.1 General

The Contractor shall obtain representative, uncontaminated samples of all asphalt materials delivered to the project for acceptance testing in accordance with ATT-42, Sampling Asphalt and Table 400.2.33.4.1.1. The Department may require increases in the minimum frequencies specified for acceptance sampling. In addition, all asphalt shall be subject to inspection, sampling and testing by the Department. The Contractor shall provide safe, convenient access, acceptable to the Department, for inspection and sampling of the asphalt, and shall cooperate in the inspection and sampling process when requested to do so.

The Contractor shall ensure that all asphalt delivery tanks are equipped with sampling valves maintained in good operating condition which are designed and located to enable safe, representative sampling into the appropriate one- or two-litre containers.

The Contractor shall deliver all acceptance samples to the Department on the day they were sampled. The Department will forward the samples to the Department's designated laboratory for testing and will accept or reject asphalt material based on the test results.

TABLE 400.2.33.4.1.1
SAMPLING FREQUENCY FOR QUALITY ACCEPTANCE

MATERIAL	MINIMUM FREQUENCY (1) (FOR EACH ASPHALT TYPE)
Asphalt Cement - Penetration grades	One per five Lots
Asphalt Cement - Performance Grade	One per three Lots
Liquid Asphalt (ASBC)	One per day
Prime, Tack, Curing Seal, and Fog Coat	One for each 100 tonnes
Seal Coats, Slurry Seals	One per day

Note 1: Minimum of one sample for each asphalt type or as listed above, whichever is greater.

400.2.33.5 Construction

Intentionally Deleted

400.2.33.6 Product Acceptance

Asphalt materials supplied and incorporated into the work will be considered for acceptance provided the specified quality acceptance samples have been provided to the Department within the time frame specified and where both the work and the asphalt material meet Technical Requirements.

400.2.33.7 Measurement

Measurement will be based on the suppliers' weigh bills however, the Department may check quantities delivered by weighing the delivery vehicles before and after unloading.

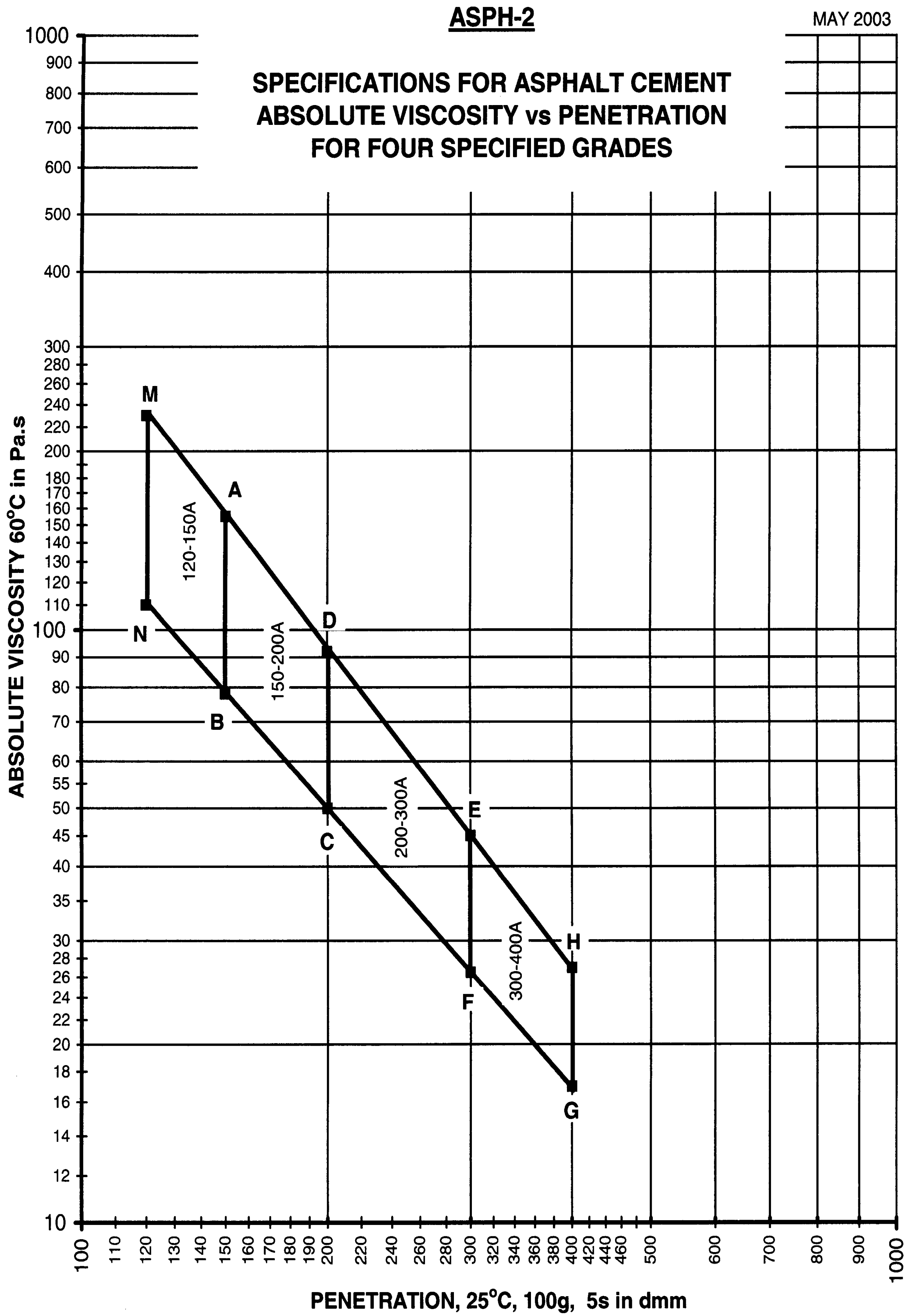
400.2.33.8 Payment Adjustment

Intentionally deleted

ASPH-1 SPECIFICATIONS FOR ASPHALT CEMENTS: Asphalt cements shall conform to the requirements specified in the following table:

TEST CHARACTERISTICS	A.S.T.M. TEST METHODS	PREMIUM GRADES OF ASPHALT CEMENTS			
		120-150(A)	150-200(A)	200-300(A)	300-400(A)
Absolute Viscosity, 60ºC, Pa.s Penetration, 25ºC , 100 g, 5 s, dmm	D2171 D5	The viscosity and penetration values must fall within the area bounded by M-N-B-A-M, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: Pt. / Abs. Visc. / Pen. M / 230 / 120 N / 110 / 120 B / 78 / 150 A / 155 / 150	The viscosity and penetration values must fall within the area bounded by A-B-C-D-A, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: Pt. / Abs. Visc. / Pen. A / 155 / 150 B / 78 / 150 C / 50 / 200 D / 92 / 200	The viscosity and penetration values must fall within the area bounded by C-D-E-F-C, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: Pt. / Abs.Visc. / Pen. C / 50 / 200 D / 92 / 200 E / 45 / 300 F / 26.5 / 300	The viscosity and penetration values must fall within the area bounded by E-F-G-H-E, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: Pt. / Abs. Visc. / Pen. E / 45 / 300 F / 26.5 / 300 G / 17 / 400 H / 27 / 400
Kinematic Viscosity, 135ºC, mm^2/s Penetration, 25ºC, 100g, 5s, dmm	D2170 D5	The viscosity and penetration values must fall within the area bounded by M-N-B-A-M, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: Pt. / Kin.Visc. / Pen M / 435 / 120 N / 300 / 120 B / 255 / 150 A / 360 / 150	The viscosity and penetration values must fall within the area bounded by A-B-C-D-A, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: Pt. / kin.Visc. / Pen. A / 360 / 150 B / 255 / 150 C / 205 / 200 D / 285 / 200	The viscosity and penetration values must fall within the area bounded by C-D-E-F-C, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: Pt. / Kin.Visc / Pen. C / 205 / 200 D / 285 / 200 E / 205 / 300 F / 150 / 300	The viscosity and penetration values must fall within the area bounded by E-F-G-H-E, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: Pt. / Kin.Visc. / Pen. E / 205 / 300 F / 150 / 300 G / 120 / 400 H / 165 / 400
Flash Point, Cleveland Open Cup, ºC minimum	D92	220	205	175	175
Solubility in Trichloroethylene, % minimum	D2042	99.5	99.5	99.5	99.5
Tests on Residue from Thin-Film Oven Test: Ratio of Absolute Viscosity of Residue from Thin-Film Oven Test to Original Absolute Viscosity, maximum	D1754 D2171	4.0	4.0	4.0	4.0
Ductility, 25ºC, cm, minimum	D113	100	100	---	---
Ductility, 15.6ºC, cm, min.		---	---	100	100

General Requirement - The asphalt shall be prepared by the refining of petroleum. It shall be uniform in character and shall not foam when heated to 175ºC.
- The temperature at delivery to the site shall be between 135ºC and 175ºC.


ASPH-2
MAY 2003
SPECIFICATIONS FOR ASPHALT CEMENT
ABSOLUTE VISCOSITY vs PENETRATION
FOR FOUR SPECIFIED GRADES
ABSOLUTE VISCOSITY 60°C in Pa.s
PENETRATION, 25°C, 100g, 5s in dmm
M
N
A
B
D
C
E
F
H
G
120-150A
150-200A
200-300A
300-400A
1000
900
800
700
600
500
400
300
280
260
240
220
200
180
170
160
150
140
130
120
110
100
90
80
70
60
55
50
45
40
35
30
28
26
24
22
20
18
16
14
12
10
100
110
120
130
140
150
160
170
180
190
200
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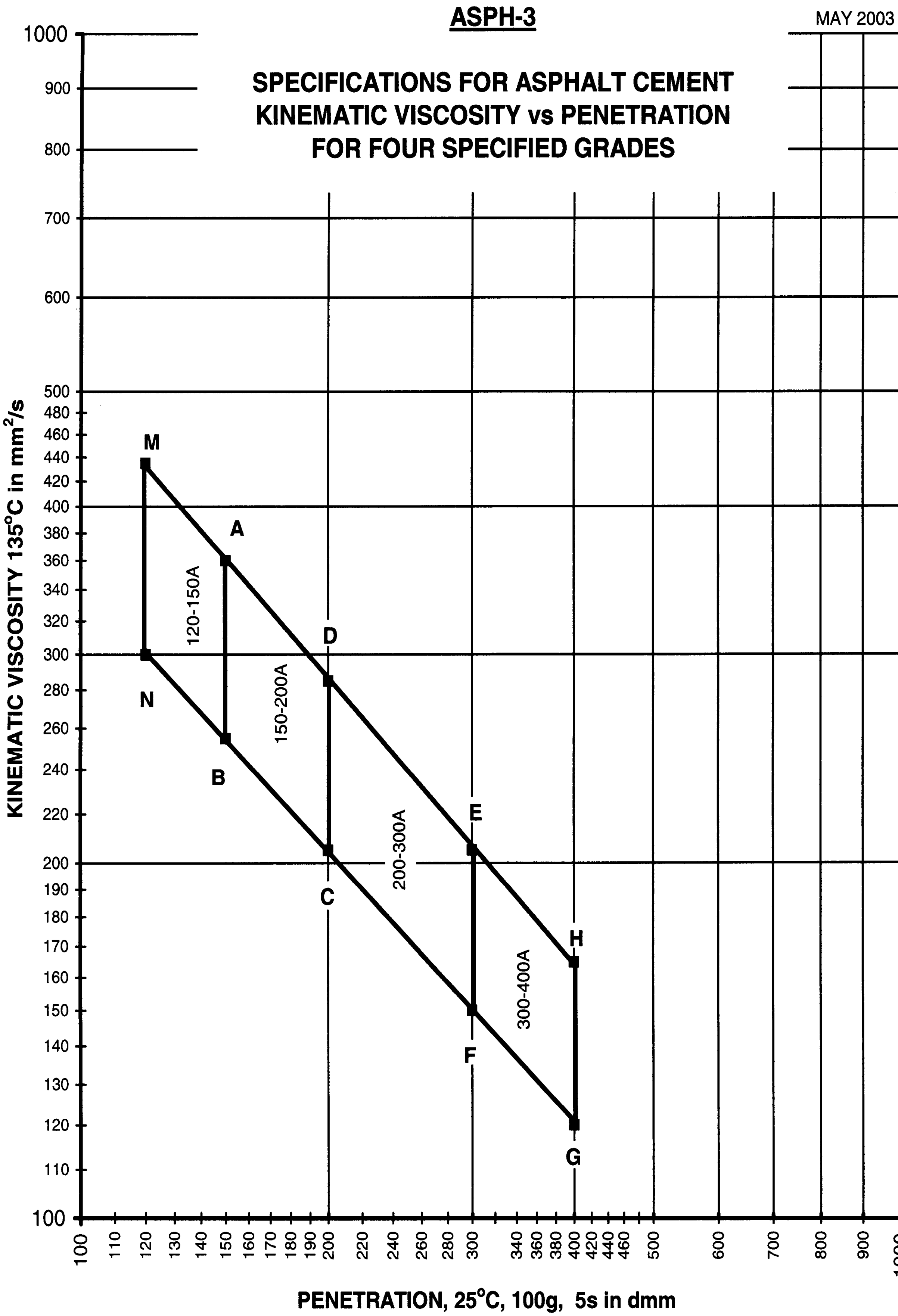
700
800
900
1000


ASPH-3
MAY 2003
SPECIFICATIONS FOR ASPHALT CEMENT
KINEMATIC VISCOSITY vs PENETRATION
FOR FOUR SPECIFIED GRADES
KINEMATIC VISCOSITY 135°C in mm²/s
PENETRATION, 25°C, 100g, 5s in dmm
M
A
N
B
D
C
E
F
H
G
120-150A
150-200A
200-300A
300-400A
1000
900
800
700
600
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
190
180
170
160
150
140
130
120
110
100
100 110 120 130 140 150 160 170 180 190 200 220 240 260 280 300 340 360 380 400 420 440 460 500 600 700 800 900 1000

ASPH-4

SPECIFICATIONS FOR SLOW CURING LIQUID ASPHALTS: Slow curing liquid asphalts shall conform to the requirements specified in the following table, for the grade designated by the Department:

ASPHALT GRADE	SC-70		SC-250		SC-800		SC-3000		A.S.T.M. TEST METHOD
REQUIREMENTS	min.	max.	min.	max.	min.	max.	min.	max.	
Flash Point, Cleveland Open Cup, ºC	65	-	80	-	90	-	105	-	D92
Kinematic Viscosity at 60EC, mm^2 /s	70	180	250	500	800	1 600	3 000	6 000	D2170
Distillation Test: Total distillate to 360ºC; % by volume	10	30	4	20	2	12	-	5	(2) TLT-214
Distillation Residue; Kinematic Viscosity at 60ºC, mm^2/s	400	7 000	800	10 000	2 000	16 000	4 000	35 000	D2170
Asphalt Residue; Residue of 100 penetration, % by mass	50	-	60	-	70	-	80	-	D243
Ductility of 100 penetration residue at 25ºC, cm(1)	100	-	100	-	100	-	100	-	D113
Solubility of Distillation Residue to 360ºC, in Trichloroethylene, % by mass	99.0	-	99.0	-	99.0	-	99.0	-	D2042
Water, % by mass or volume	-	0.5	-	0.5	-	0.5	-	0.5	D95
Delivery Temperature, ºC	55	75	75	95	90	110	110	130	

NOTE: (1) If the ductility at 25ºC is less than 100, the material will be acceptable if its ductility at 15ºC is more than 100.

(2) Alberta Transportation Laboratory Test

General Requirements: -The asphalt shall not foam when heated to the application temperature range recommended by the Asphalt Institute.

-The asphalt shall be uniform in character.

ASPH-5

SPECIFICATIONS FOR MEDIUM-CURING LIQUID ASPHALTS: Medium curing liquid asphalts shall conform to the requirements specified in the following table, for the grade designated by the Department:

ASPHALT GRADE	MC-30		MC-70		MC-250		MC-800		A.S.T.M. TEST METHOD
REQUIREMENTS	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	
Flash Point, Open Tag, ºC	38	-	38	-	65	-	65	-	D1310
Kinematic Viscosity at 60ºC, mm^2 /s	30	60	70	140	250	500	800	1 600	D2170
Distillation Test: % by volume of total distillate to 360ºC, -to 225ºC -to 260ºC -to 315ºC	 - 40 75	 25 70 93	 - 20 65	 20 60 90	 - 15 60	 10 55 87	 - - 45	 - 35 80	(2) TLT-214
Residue from distillation to 360ºC, Volume % by difference	50	-	55	-	67	-	75	-	
Test on Residue from Distillation: a) Penetration at 25ºC, 100 g, 5 s, dmm b) Ductility at 25ºC, cm (1) c) Solubility in Trichloroethylene, % by mass	 120 100 99.5	 250 - -	 120 100 99.5	 250 - -	 120 100 99.5	 250 - -	 120 100 99.5	 250 - -	 D5 D113 D2042
Water, % by mass or volume	-	0.2	-	0.2	-	0.2	-	0.2	D95
Delivery Temperature, ºC	35	55	55	75	75	95	90	110	

NOTE: (1) If the ductility at 25ºC is less than 100, the material will be acceptable if its ductility at 15ºC is more than 100.

(2) Alberta Transportation Laboratory Test

General Requirements: -The asphalt shall not foam when heated to the application temperature range recommended by the Asphalt Institute.

-The asphalt shall be produced by the refining of petroleum and shall be uniform in character.

ASPH-6

SPECIFICATIONS FOR RAPID-CURING LIQUID ASPHALTS: Rapid curing liquid asphalts shall conform to the requirements specified in the following table, for the grade designated by Department:

ASPHALT GRADE	RC-30		RC-70		RC-250		A.S.T.M. TEST METHOD
REQUIREMENTS	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	
Flash Point, Open Tag, ºC	-	-	-	-	27	-	D1310
Kinematic Viscosity at 60ºC, mm^2 /s	30	60	70	140	250	500	D2170
Distillation Test: % by volume of total distillate to 360ºC, -to 190ºC -to 225ºC -to 260ºC -to 315ºC Residue from distillation to 360ºC, Volume % by difference	 15 55 75 90 50	 - - - - -	 10 50 70 85 55	 - - - - -	 - 35 60 80 65	 - - - - -	(2) TLT-214
Tests on Residue from Distillation: a) Penetration at 25ºC, 100 g, 5 s, dmm b) Ductility at 25ºC, cm (1) c) Solubility in Trichloroethylene, % by mass	 80 100 99.5	 120 - -	 80 100 99.5	 120 - -	 80 100 99.5	 120 - -	 D5 D113 D2042
Water, % by mass or volume	-	0.2	-	0.2	-	0.2	D95
Delivery Temperature, ºC	35	55	55	75	75	95	

NOTE: (1) If the ductility at 25ºC is less than 100, the material will be acceptable if its ductility at 15ºC is more than 100.

(2) Alberta Transportation Laboratory Test

General Requirements: -The asphalt shall not foam when heated to the application temperature range recommended by the Asphalt Institute.

-The asphalt shall be produced by the refining of petroleum and shall be uniform in character.

ASPH-7

SPECIFICATIONS FOR ANIONIC EMULSIFIED ASPHALTS: Anionic emulsified asphalts shall conform to the requirements specified in the following table, for the grade designated by the Department:

ASPHALT TYPE	**RAPID SETTING (RS)**				**MEDIUM SETTING (MS)**		**SLOW SETTING (SS)**				**A.S.T.M. TEST METHOD**
ASPHALT GRADE	**RS-1**		**RS-2**		**MS-1**		**SS-1**		**SS-1H**		
REQUIREMENTS	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	
Viscosity at 25ºC, SF s Viscosity at 50ºC, SF s	20 -	100 -	- 50	- 300	20 -	100 -	20 -	60 -	20 -	60 -	D244
Residue by Distillation, % by mass	55	(1)	60	(1)	55	(1)	55	(1)	55	(1)	D6997
Settlement in 5 d, % difference by mass (2)	-	3	-	3	-	5	-	5	-	5	D6930
Storage Stability Test, 24 h, % by mass (3)	-	1	-	1	-	1	-	1	-	1	D6930
Sieve Test, % retained on a No. 1000 Sieve, % by mass (4)	-	0.10	-	0.10	-	0.10		0.10	-	0.10	D6933
Demulsibility, 35 ml of 1.11 g/l $CaCl_2$, % by mass	60	-	60	-	-	-	-	-	-	-	D6936
Cement Mixing Test, % by mass	-	-	-	-	-	-	-	2.0	-	2.0	D6935
Particle Charge (5)	Negative		Negative		Negative		-		-		D244
Tests on Residue from Distillation: a) Penetration at 25ºC, 100 g, 5 s, dmm b) Ductility at 25ºC, and 5 cm/min., cm c) Solubility in Trichloroethylene, % by mass	 100 60 97.5	 200 - -	 100 60 97.5	 200 - -	 100 60 97.5	 200 - -	 100 60 97.5	 200 - -	 40 60 97.5	 100 - -	 D5 D113 D2042
Delivery Temperature, ºC	35	65	45	70	40	70	40	70	40	70	

NOTES:
(1) Upper limit on % residue is governed by the consistency limits.
(2) The test requirement for settlement may be waived when the emulsified asphalt is used in less than 5 days time.
(3) The 24 hour storage stability test may be used instead of the 5 day settlement test. In case of dispute the 5 day storage settlement test shall govern.
(4) CGSB 8-GP-2M, Sieves, Testing, Woven Wire, Metric
(5) Particle Charge Test (Qualitative) - The rapid setting grades will be tested for particle charge according to the procedure described in ASTM D 244, with the modification that the asphalt deposit will, for anionic emulsions, be found on the anode (positive electrode), and shall be continuous and opaque. In the event of dispute, the test will be repeated using freshly distilled water as the wash water for the electrodes, before evaluating the asphalt deposit.

General Requirements: -All tests shall be performed within 15 days of date of delivery.
-The asphalt shall be uniform in character, and shall have a refined petroleum base.

ASPH-8

SPECIFICATIONS FOR CATIONIC EMULSIFIED ASPHALTS: Cationic emulsified asphalts shall conform to the requirements specified in the following table, for the grade designated by the Department:

ASPHALT TYPE AND GRADE	RS-1K		RS-2K		CRS-2		QS-Kh		A.S.T.M. TEST METHOD
REQUIREMENTS	min.	max.	min.	max.	min.	max.	min.	max.	
Viscosity at 25ºC, SF s Viscosity at 50ºC, SF s	- 75	- 200	- 150	- 400	- 100	- 400	20 -	100 -	D244
Residue by Distillation, % by mass	65	(1)	65	(1)	65	-	57	(1)	D6997
Settlement in 5 d, % difference by mass (2)	-	5	-	5			-	5	D6930
Storage Stability Test, 24 h, % by mass (3)	-	1	-	1	-	1.5 (8)	-	1	D6930
Demulsibility. 35 ml of 0.5 % by weight solution of sodium dioctyl sulphosuccinate, % by mass					60				D6936
Oil Portion of Distillate, % by volume of emulsion	-	3	-	3	-	3	-	-	D6997
Sieve Test, % retained on No. 1 000 Sieve (4)(5), by mass	-	0.10	-	0.10	-	0.10 (8)	-	0.10	D6933
Particle Charge (6)	Positive		Positive		Positive		Positive		D244
Tests on Residue from Distillation:									
a) Penetration at 25ºC, 100 g, 5 s, dmm	100	250	100	250	100	250	40	125	D5
b) Apparent Viscosity at 60ºC, Pa.s					See Figure 1				
c) Ductility at 25ºC,(4) and 5 cm/min., cm (7)	60	-	60	-	60	-	60	-	D113
d) Solubility in Trichloroethylene, % by mass	97.5	-	97.5	-	97.5	-	97.5	-	D2042
Delivery Temperature, ºC	60	80	60	85			-		

NOTES: (1) Upper limit on % residue is governed by the consistency limits.

(2) The test requirement for settlement may be waived when the emulsified asphalt is used in less than 5 days time.

(3) The 24 hour storage stability test may be used instead of the 5 day settlement test, however in case of dispute the 5 day storage settlement test shall govern.

(4) CGSB 8-GP-2M, Sieves, Testing, Woven Wire, Metric

(5) Replace sodium oleate solution (2%) with distilled water, use distilled water in all operations including wetting and subsequent washing of wire cloth sieves.

(6) Particle Charge Test (Qualitative)- The emulsion will be tested for particle charge according to the procedure described in ASTM D 244, and it is required that the layer of asphalt deposited be continuous and opaque. In the event of dispute, the test will be repeated using freshly distilled water as the wash water for the electrodes, before evaluating the asphalt deposit.

(7) Ductility - Ductility will be measured at 25ºC for 100-200 penetration asphalts, and at 15ºC for 200-250 penetration asphalts.

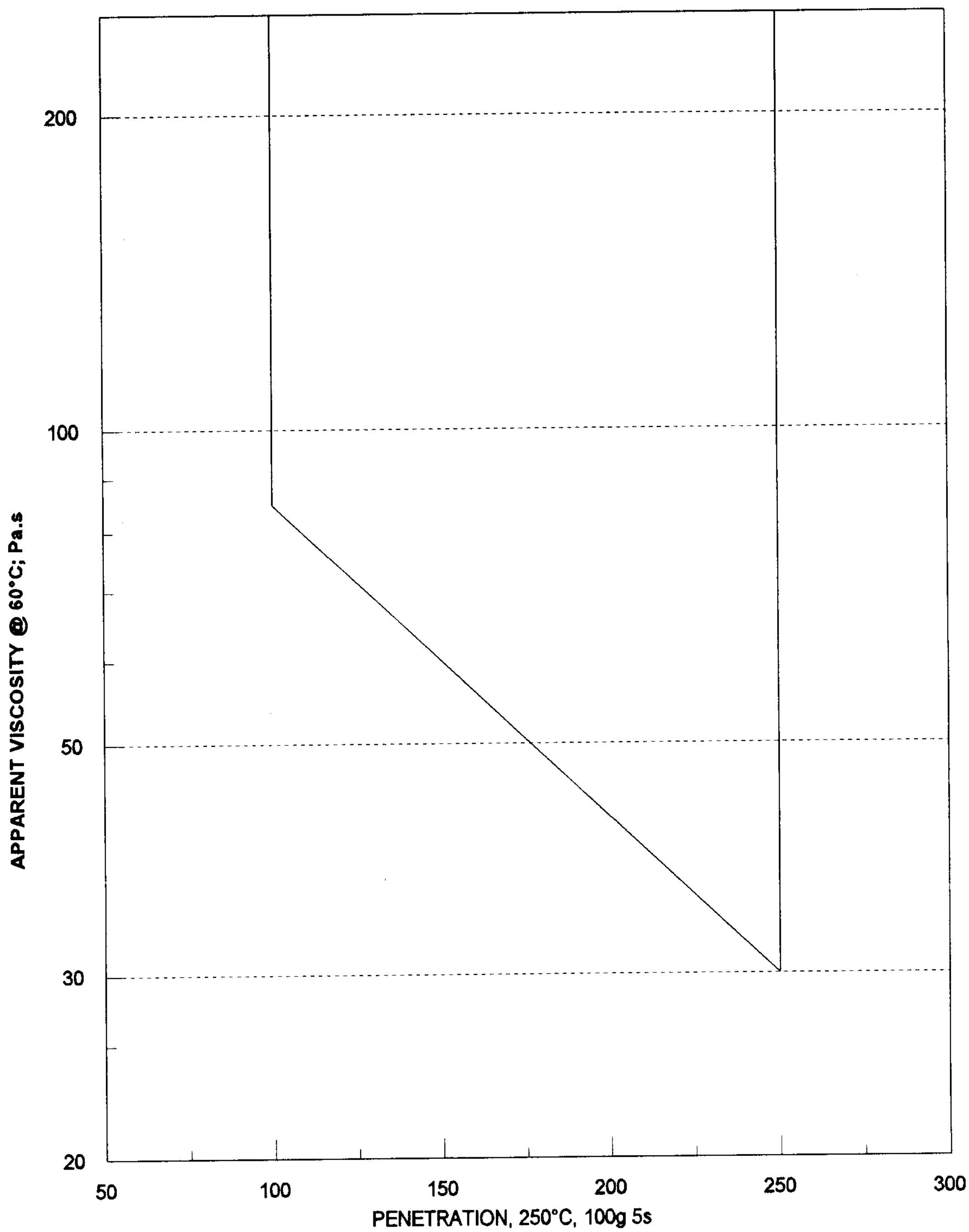
(8) Requirements for Storage Stability and Sieve Test are waived if emulsion performs satisfactorily during application.

General Requirements: -All tests shall be performed within 15 days of date of delivery;

-The asphalt shall be uniform in character, and shall have a refined petroleum base.

FIGURE 1

MINIMUM VISCOSITY FOR CRS-2 DISTILLATION RESIDUE



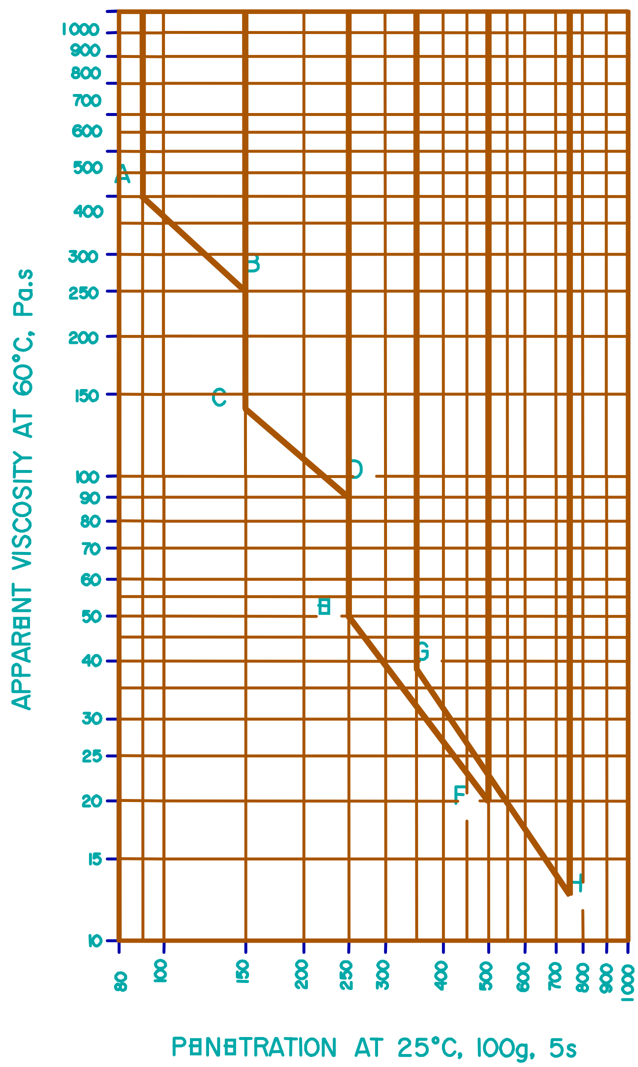
ASPH-9

SPECIFICATIONS FOR HIGH FLOAT EMULSIFIED ASPHALTS: High Float emulsified asphalt shall conform to the requirements specified in the following table, for the grade designated by the Department:

GRADE	HF-100S		HF-150S		HF-250S		HF-350S		HF-300M		HF-500M		HF-1000M		TEST (1) METHODS
REQUIREMENTS	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	**min.**	**max.**	
Residue by Distillation, % by mass	62	(2)	62	(2)	62	(2)	65	(2)	65	(2)	65	(2)	65	(2)	Par. 6.2.1
Oil Portion of Distillate, % by volume of emulsion	1	4	1	4	1	6	1.5	6	1	6	1	2	1	7	A.S.T.M. D6997 & Par. 6.2.2
Viscosity at 50ºC, SF s	30	150	30	150	35	150	75	400	50	---	50	---	50	---	ASTM D244
Sieve Test, % retained on No. 1000 sieve % by mass (3)	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10	Par. 6.2.2
Coating Test (see Notes 4 & 5)	(4)		(4)		(4)		(5)		(5)		(5)		(5)		ASTM D6998
Workability at -10ºC	---	---	---	---	---	---	---	---		---	---	---	---	Pass	Par. 6.2.3
Storage Stability Test, 24h, % by mass	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5	ASTM D6930
Demulsibility, 50 ml, 5.55 g/l $CaCl_2$, % by mass	60	---	60	---	---	---	---	---	---	---	---	---	---	---	ASTM D6936
Tests on Residue from Distillation: a) Penetration at 25ºC, 100 g, 5 s, dmm	90	150	150	250	250	500	350	750	300	---	500	---	---	---	Par. 6.2.4
b) Apparent Viscosity at 60ºC, Pa·s	Requirements outlined on the chart beneath Figure 1								10	40	8	20	2	8	Par. 6.2.5/ A
c) Float Test at 60°C, s	1200	---	1200	---	1200	---	1200	---	1200	---	1200	---	1200	---	Par./A1.6.2.6
d) Solubility in Trichloroethylene, % by mass	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	ASTM D2042
Delivery Temperature, °C	40	70	40	70	40	70	40	70	40	70	40	70	40	70	

NOTES:
(1) Test methods are as outlined in CGSB CAN2-16.5-M84.
(2) Upper limit on % residue is governed by the viscosity limits.
(3) CGSB 8-GP-2M, Sieves, Testing, Woven Wire, Metric
(4) Follow ASTM D244, except that the mixture of limestone and emulsified asphalt shall be capable of being mixed vigorously for 5 min., at the end of which period the stone shall be thoroughly and uniformly coated. The mixture shall then be completely immersed in tap water and the water poured off. The stone shall then not be less than 90% coated.
(5) Follow ASTM D244, except that the mixture of limestone and emulsified asphalt shall be mixed vigorously for 5 min., then allowed to stand for 3h, after which the mixture shall be capable of being mixed an additional 5 min. The mixture shall then be rinsed twice with approximately its own volume of tap water, without showing appreciable loss of bituminous film. After the second mixing the aggregate shall be at least 90% coated.

ASPH-9 (cont.)



Viscosity shall be within the graphic regions above the line designated by specific letters, and between penetration limits contained in vertical lines extending upwards from these points.

Viscosity value shall be reported at $0.5s^{-1}$ for grades HF-100S and HF-150S and at $1.0s^{-1}$ for grades HF-250S and HF-350S.

Grade of HF Emulsified Asphalt	HF-100S	HF-150S	HF-250S	HF-350S
	A, B	C, D	E, F	G, H

FIGURE 1

Viscosity Requirements for Distallation Residues from High-Float Emulsified Asphalts

ASPH-10

SPECIFICATIONS FOR EMULSIFIED ASPHALT PRIMER: Emulsified asphalt primers shall conform to the requirements specified in the following table, for the grade designated by the Department:

ASPHALT GRADE	SEP-1		SEP-2		A.S.T.M. TEST METHOD
REQUIREMENTS	min.	max.	min.	max.	
Viscosity at 25ºC, SF s	-	-	15	100	D88
Viscosity at 50ºC, SF s	35	200	-	-	D244
Flash point, open Tag, ºC	45	-	90	-	D3143
Residue by Distillation, % by mass	40	(1)	40	(1)	D6997
Oil Portion of Distillate, % by volume of emulsion	12	29	12	29	D6997
Settlement in 5 d	no visible separation		-	2	D6930
Miscibility with Water (2)	is not miscible with water		pass		D6999
Tests on Residue from Distillation:					
a) Penetration at 25ºC, 100 g, 5 s, dmm	100	300	100	300	D5
b) Solubility in Trichloroethylene, % by mass	97.5	-	97.5	-	D2042

NOTES: (1) Upper limit on % residue is governed by the consistency limits.
(2) Follow ASTM D6999 except add the emulsified primer to the water. After two hours the water should be clear.

ASPH-11

SPECIFICATION FOR EMULSIFIED DUST SUPPRESSANTS:

Emulsified Dust Suppressants shall conform to the requirements specified in the following table:

GRADE	EDS-1		EDS-2		ASTM Test Method
REQUIREMENTS	Minimum	Maximum	Minimum	Maximum	
Viscosity					D244
25°C, SFs	10	35			
50°C, SFs			35	100	
Residue by distillation to 260°C, % by mass	40	-	40	-	D6997
Oil portion of distillate, % by volume of emulsion	-	5	-	10	D6997
Settlement, 5 days	-		No visible separation		D6930
Storage Stability, 24 hours	No visible separation (1)		-		D6930
Workability (2)	Pass		Pass		-
Flash Point, Open Tag, °C	-	-	45	-	D3143

Miscibility with water	Pass		Pass (3)		D6999
Kinematic viscosity of residue from distillation, 60°C, mm^2/s	25	100	25	300	D2170

Notes: (1) If EDS-1 is retained in storage for an extended period of time, it should be circulated prior to use.

2) When 500 grams of sand and 50 g of emulsion are mixed for 5 minutes at ambient temperature, the sand shall be 100% coated. The mixture shall be oven dried at 120ºC to remove all the moisture. After cooling to room temperature, the mix shall be easily workable for the next 24 hours.

3) Follow ASTM D6999 except add the EDS-2 to water. After 2 hours the water should be clear.

ASPH-12

SPECIFICATION FOR COLD POUR RUBBER FILLED EMULSIFIED BITUMINOUS CRACK SEALANT:

Cold Pout Rubber Filled Emulsified Bituminous Crack Sealants shall conform to the requirements specified in the following table:

TYPE	**EC-101**		**Test Method**
REQUIREMENTS	**Minimum**	**Maximum**	
Uniformity, 24 hours	Pass		TLT-226
Stormer viscosity at 25°C, Krebs	70	90	TLT-227
Solids content, %	59	-	ASTM D244 (Residue by Evaporation Procedure A)
Ash content, %	-	2.0	TLT-229
Rate of curing, % loss	50% 24 hrs. 80% 6 days	-	TLT-230
Low temperature flexibility, -4°C, 30s	Pass (no cracks)		TLT-231
Elastic recovery, % recovered	40	-	TLT-232

Note: TLT Refers to: Alberta Transportation Laboratory Test

ASPH-13

SPECIFICATION FOR HOT POUR BITUMINOUS CRACK SEALANT:

Hot Pour Bituminous Crack Sealants shall conform to the requirements specified in the following table:

TYPE	**HC-200**		**Test Method**
REQUIREMENTS	**Minimum**	**Maximum**	
Softening Point, °C	80	95	ASTM D36
Flash Point, Cleveland Open Cup, °C	230	-	ASTM D92
Penetration 0°C, 200g, 60s, dmm 25°C, 100g, 5s, dmm 46°C, 50g, 5s, dmm	 30 55 	 65 150	ASTM D5
Ductility, 25°C, cm	45	-	ASTM D113
Solubility in Trichloroethylene, %	98	-	ASTM D2042
Kinematic viscosity at 177°C, mm^2/s	-	1500	ASTM D2170

400.2.34 SUPPLY OF PORTLAND CEMENT

400.2.34.1 General

This specification covers the supply of Portland Cement.

400.2.34.2 Materials And Procedures

The Contractor shall supply cement meeting the requirements of the latest version of Canadian Standards Association A3001 Cementitious Materials for Use in Concrete, for the type of cement specified.

Unless otherwise approved by the Department, the specification requirements shall apply to the cement in the delivery vehicle at the cement storage site.

The Contractor shall, to the satisfaction of the Department; prevent contamination of the cement, by cement of another type or by any other material; maintain records of times of receipt of cement delivery orders, cement departure from the source, arrival at the cement storage site, and start and completion of unloading, and provide this information to the Department upon request.

The Contractor shall provide the Design Engineer and the Department with a "Certificate of Compliance" acceptable to the Department, for the Portland Cement to be used in the work.

400.2.34.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.34.4 Acceptance Sampling And Testing

The Department may verify the quality of the material at any time. Sampling and testing for verification purposes will be in accordance with the latest version of Canadian Standards Association A3001.

400.2.34.5 Construction

Intentionally Deleted

400.2.34.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.34.7 Measurement

Measurement will be based on the suppliers' weigh bills however, the Department may check quantities delivered by weighing the delivery vehicles before and after unloading. If there is a variance between quantities measured by the Department and the suppliers' weigh-bills, the Department will determine the quantity on which progress will be based.

400.2.34.8 Payment Adjustment

Intentionally Deleted

400.2.35 SUPPLY OF FENCE MATERIAL

400.2.35.1 General

400.2.35.1.1 Description

The work consists of supplying all required materials for the construction of fence including but not limited to:

(a) Split Cedar Posts
(b) Pressure Treated Wood Posts and Braces
(c) Two Strand Barbed Wire
(d) Single Strand Barbed Wire
(e) Woven Wire (Paige Wire)
(f) Brace Wire
(g) Staples
(h) Metal Stays
(i) Chain Link Fence

400.2.35.1.2 Abbreviations and Definitions

Wherever in these Specifications the following abbreviations are used, the intent and meaning shall be as follows:

ASTM: The American Society for Testing Materials

CSA: The Canadian Standards Association

400.2.35.2 Materials And Procedures

400.2.35.2.1 General for Wood Posts

Posts shall be of sound quality, free from all decay, shakes, splits, multiple crooks or any other defects which would render them structurally unsuitable for the purpose intended. All posts shall comply with the minimum-maximum top diameter as specified. The top of the post shall mean the small end of the post. The ends of the posts shall be cut square and the length of individual posts shall not vary by more than plus or minus 25mm from the length required for the applicable installation.

400.2.35.2.2 Split Cedar Posts

Untreated split cedar posts shall be cut from sound timber and shall have an allowable taper from end to end not exceeding 114mm in perimeter.

400.2.35.2.3 Pressure Treated Wood Posts and Braces

Pressure treated wood posts and braces shall be fir or pine timber, as specified. Knots that are sound, well spaced, smoothly trimmed and which do not impair the strength of the posts or braces will be permitted providing they do not exceed 38mm in diameter on any face. Posts shall be naturally round and shall have all bark peeled or otherwise removed. Allowable taper from end to end of posts shall not exceed 38mm in diameter.

Braces shall be sawn square or rectangular to the standard nominal dimensions as specified.

Posts and braces shall be treated by pressure methods with 50/50 creosote-petroleum solution or a chromated copper arsenate solution. The preservative agent shall conform to the requirements of the current edition of CSA Standard 080. The minimum retention of preservative in the wood, as determined by assay, shall be as specified in the following table:

	Round Posts	**Sawn Braces**
Sample Zone for Assay (mm from surface)	0-19	0-16
Minimum Net Retention (kg/m^3) Creosote - Petroleum	96	96
Chromated Copper Arsenate (CCA)	6.4	6.4

Requirements for the preservative treatment of round posts and sawn braces shall conform to the current requirements of CSA Standard 080 with specific attention to 080.1, 080.2 and 080.5.

400.2.35.2.4 Metal Stays and Keeper Wire

Metal Stays

Metal stays shall be fabricated from high tensile steel sheet conforming to the requirements of the current "Standard Specification for Weight (mass) of Coating on Iron and Steel Articles with Zinc or Zinc Alloy Coatings", ASTM Designation A90, with additions as described in this specification.

Metal stays shall conform to the following minimum requirements:

Length 860mm

Yield Strength ....22,727 kg

High Tensile Steel Breaking Strength...........29,545 kg

Barbed Wire Slot Sized.................................4.75mm x 15.90mm

Reflective sheeting for metal stays shall meet or exceed the requirements as specified in ASTM-D4956, Performance Requirements Type III, High Intensity Retro-reflective Sheeting.

Keeper Wire

High Tensile Galvanized Keeper Wire shall conform to the requirements of the current "Standard Specification for Steel Wire, Cold-Drawn for Mechanical Springs," ASTM Designation A227, with additions as described in this specification.

Keeper wire shall conform to the following minimum requirements:

Length 860mm

Yield Strength ....35,909 kg

High Tensile Wire Breaking Strength...........41,818 kg

400.2.35.2.5 Two Strand Barbed Wire

Two strand barbed wire shall conform to the requirements of the current "Standard Specifications for Zinc-Coated (Galvanized) Steel Barbed Wire", ASTM Designation A121, (Class 1 or better) and shall consist of two strands of 2.5mm thickness wire, twisted with four-point, 2.0mm thickness round barbs spaced not more than 152mm apart.

Each spool delivered to the job site shall be legibly marked showing the mass, linear measure, thickness and name or mark and address of the Manufacturer.

400.2.35.2.6 Single Strand Barbed Wire

Single strand barbed wire shall conform to the requirements of the current edition ASTM Designation A121, "Standard Specifications for Zinc-Coated (Galvanized) Steel Barbed Wire". The requirements regarding uniform twisting of strands will be waived.

Single strand barbed wire shall conform to the following minimum requirements:

Measure of wire per spool	402 m
Minimum mass per spool	24 kg
Wire thickness	2.64 mm
Minimum tensile breaking strength of wire	500 kg
Barb spacing	125 mm
Number of points per barb	4

The barbs shall be firmly and securely fixed in position.

400.2.35.2.7 Woven Wire (Paige Wire)

Woven wire shall conform to the requirements of the current "Standard Specification for Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing", ASTM Designation A116, (Class 1 or better), except that Section 5 of the ASTM Specification shall be deleted and replaced with the requirements pertaining to size and style of the woven wire mesh as hereinafter provided.

Each roll delivered to the job site shall be legibly marked showing the length, name or mark and address of the manufacturer.

All wire of a specified class for use on the Project shall be of identical design unless otherwise specified by the Detailed Designs and Technical Requirements.

The woven wire mesh design shall conform with one of the following Classes as specified:

Class "C" Woven Wire

812mm overall height with not lighter than 3.35mm thickness top and bottom wires, and not lighter than 2.34mm thickness filler wires. Vertical stay wires shall be spaced at intervals not greater than 152mm. There shall be a minimum of eight (8) horizontal line wires forming vertical spaces graduated from 76mm at the bottom of the mesh to 152mm at the top. Joints or knots between vertical stay wires and horizontal line wires shall be of a rigid, hinge-locking design which will prevent slippage of the wires. The minimum weight of Class "C" woven wire shall be 0.60 kg per metre.

Class "D" Woven Wire

978mm overall height with not lighter than 3.35mm thickness top and bottom wires, and not lighter than 2.64mm thickness filler wires. Vertical stay wires shall be spaced at intervals not greater than 152mm. There shall be a minimum of nine (9) horizontal line wires forming vertical spaces graduated from 76mm at the bottom of the mesh and 178mm at the top. Joints or knots between vertical stay wires and horizontal line wires shall be of a rigid, hinge-locking design which will prevent slippage of the wires. The minimum weight of Class "D" woven wire shall be 0.66 kg per metre.

Class "E" Woven Wire

1064mm overall height with not lighter than 3.35mm thickness wire throughout. Vertical stay wires shall be spaced at 420mm intervals. Horizontal wires shall be spaced at 152mm intervals, top to bottom. Joints or knots between vertical stay wires and horizontal line wires shall be of a rigid, tight-lock design which will prevent slippage of the wires. The minimum weight of Class "E" woven wire shall be 0.84 kg per metre.

Class "F" Woven Wire

2134mm overall height with not lighter than 3.66mm thickness wire throughout. Vertical stay wires shall be spaced at 152mm intervals. Horizontal wires shall be spaced at 152mm intervals, top to bottom. Joints or knots between vertical stay wires and horizontal line wires shall be of a rigid, tight-lock design which will prevent slippage of the wires. The minimum weight of Class "F" woven wire shall be 2.84 kg per metre.

400.2.35.2.8 Brace Wire

Brace wire shall be 3.66mm thickness soft galvanized wire and the weight of 30.5m of wire shall not be less than 2.5 kg.

400.2.35.2.9 Staples

Wire staples shall be standard 40mm long staples, manufactured from 3.66mm thick galvanized wire. There shall be approximately 140 staples per kilogram.

400.2.35.2.10 Chain Link Fence

Pipe Material

All pipe shall be seamless steel pipe fabricated in accordance with ASTM A53 and CAN/CGSB-138.2, butt welded, hot dipped zinc coated with not less than 610g/m2 of total surface area.

- Line posts that support the fence where the fabric is continuous, shall be 60.3mm O.D. pipes with 3.91mm wall thickness
- Terminal posts, end posts, corner posts, straining posts, gate posts and posts where fencing or fabric is discontinuous shall be 88.9mm O.D. pipes with 5.49mm wall thickness
- Top rails shall be continuous, joined with couplings and shall be 42.2mm O.D. pipes with 3.56mm wall thickness
- Braces that extend from the terminal posts to the nearest line post along fabric attached to the terminal post, shall be 42.2mm O.D. pipes with 3.56mm wall thickness
- Galvanized steel or aluminum post tops that permit the passage of the top rail, with one cap for each post except where a combination post top cap and barbed wire supporting arm is required

Fence Fabric

Chain link fence fabric shall be zinc-coated steel wire fabric in accordance with ASTM A392. The fabric wire shall be 3.55mm diameter, woven into a 50mm diamond mesh.

Steel clamps, bands, clips, tension bars and bolts shall all be hot dipped galvanized in accordance with ASTM A525M and of sufficient strength to maintain the integrity of the fence.

Tension bars shall be 5mm by 20mm, with lengths equal to the height of the fabric.

Tension bands shall be 20mm in width and 3mm in thickness.

Tension wire shall be 5mm in diameter, single strand, galvanized with zinc coating of 610g/m.

Gates

Gates shall be fabricated from galvanized steel pipe in accordance with CAN/CGSB-138.4, consisting of 42.2mm O.D. pipes with 4.85mm wall thickness for the frames and 33.4mm O.D. pipes with 9.09mm wall thickness for the interior bracing.

Welded joints shall be complete with galvanizing malleable iron hinges, latch, and latch catch with provisions for a padlock that can be attached and operated from either side of the installed gate. Suitable hinges to permit a 90º swing both in and out. Double gates shall be equipped with a drop bar locking device and a hasp for locking with a padlock.

Concrete

The concrete used for anchoring posts shall be Class S Concrete supplied in accordance with Section 400.2.32 (Supply of Portland Cement Concrete).

400.2.35.3 Quality Management Sampling And Testing

At the time of shipment, the Contractor shall provide certification indicating the specification number according to which the material being supplied was produced and tested.

400.2.35.4 Acceptance Sampling And Testing

All materials shall be subject to inspection, sampling and quality acceptance testing by the Department and the Contractor shall provide safe, convenient access, acceptable to the Department, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so. The Contractor shall be responsible for any costs resulting from such inspections, including the cost of replacing any fence materials damaged by such inspection, sampling or testing.

Any material found unacceptable by the Department shall be immediately removed and replaced with acceptable material by the Contractor.

400.2.35.5 Construction

Intentionally Deleted

400.2.35.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the

completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.35.7 Measurement

Intentionally Deleted

400.2.35.8 Payment Adjustment

Intentionally Deleted

400.2.36 <u>SUPPLY OF REINFORCED CONCRETE CULVERT</u>

400.2.36.1 General

This specification covers the supply and fabrication of the following material by the Contractor:

(1) Reinforced Concrete Pipe
(2) Reinforced Concrete Box Culvert
(3) Joints and Fittings
(4) Precast Reinforced Concrete Manhole Risers and Tops
(5) Concrete Masonry Units for Construction of Catch Basins and Manhole
(6) Rubber Gasket Joints, and
(7) Cement Mortar

400.2.36.2 Materials And Procedures

400.2.36.2.1 Reinforced Concrete Pipe

<u>Round and Elliptical Pipe</u>

Reinforced concrete pipe shall conform to the material and fabrication requirements of the ASTM Specification C 76M.

The following information shall be clearly marked on each section of pipe:

(1) The pipe class
(2) The date of manufacture, and
(3) The name or trade-mark of the manufacturer.

This information shall be marked on the outside for pipe sizes up to and including 900mm diameter and on the inside for pipe sizes over 900mm diameter.

End sections shall be supplied with either square or sloped ends as required by the order. The dimensions of the sloped ends shall conform to details shown on the Detailed Designs.

Curved Pipe Sections

Curved pipe sections shall conform to all the specification requirements of round and elliptical Pipe.

The ends of the pipe sections shall be bevelled to the degree corresponding to the desired radius of curvature and shall be so formed that when the pipe sections are laid together they will form a continuous and uniform curved line.

400.2.36.2.2 Reinforced Concrete Box Culverts

Reinforced concrete box culvert shall conform to the material and fabrication requirements of ASTM Specification C 1433M.

The following information shall be clearly marked on each concrete box section:

(1) Box section span, rise, table number, maximum and minimum design earth cover
(2) The date of manufacture, and
(3) Name or trademark of the manufacturer.

Each box section shall be marked by indentation on either the inner or outer surface. In addition, the word “top” shall be lettered with waterproof paint on the inside top surface.

End sections shall be supplied either square or bevelled as required by the order. The dimensions of the bevelled ends shall conform to details shown on the Detailed Designs.

400.2.36.2.3 Joints, Fittings and Bends

The reinforced concrete box sections shall be produced with tongue and groove ends conforming to the fabrication requirements of ASTM Specification C1433M, Section 8, Joints.

Fittings shall include special sections fabricated for the purpose of connecting manholes and branch lines to the main conduit. The pipe sections utilized in forming the joint, fitting or bend shall conform to all the specification requirements of round and elliptical pipe as specified in Section 0. The sections shall be fabricated to form an integral unit, and the class of pipe shall be not less than specified on the detail drawing for the unit. The connection at the joint shall permit the utilization and development of the same degree of beam and circumferential strength as the main section of the conduit adjacent thereto.

400.2.36.2.4 Precast Reinforced Concrete Manhole Risers and Tops

Precast reinforced concrete manhole risers and tops shall conform to all the material and fabrication requirements of ASTM Specification C 478.

400.2.36.2.5 Concrete Masonry Units for Construction of Catch Basins and Manholes

Concrete masonry units for construction of catch basins and manholes shall conform to all the material and fabrication requirements of the ASTM Specification C 139.

400.2.36.2.6 Rubber Gasket Joints

Joints for circular concrete sewer and culvert pipe using flexible watertight rubber-type gaskets shall conform to all the material and fabrication requirements of ASTM Specification C 443.

400.2.36.2.7 Cement Mortar

The cement mortar mixture shall be composed of one part Portland Cement and two parts sand by volume. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. The sand shall conform to the requirements of AASHTO Specification M45, or shall be an equivalent, subject to approval by the Design Engineer and the Department. The cement shall conform to the requirements of AASHTO Specification M85.

400.2.36.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.36.4 Acceptance Sampling And Testing

All materials shall be subject to inspection, sampling and quality acceptance testing by the Department and the Contractor shall provide safe, convenient access, acceptable to the Department, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so. Inspection, sampling and testing of reinforced concrete pipe, reinforced concrete box culvert and related joints and fittings shall be in accordance with the methods prescribed in ASTM Specification C76M and C1433M. In particular, acceptance shall be on the basis of load bearing tests, material tests and inspection of the completed product.

Inspection, sampling and testing of precast reinforced concrete manhole risers and tops shall be in accordance with the methods prescribed in ASTM Specification C478.

Inspection, sampling and testing of concrete masonry units for construction of catch basins and manholes shall be in accordance with the methods prescribed in ASTM. Specification C139.

All materials which do not meet requirements of the specifications shall be rejected. No rejected material, the defects of which have subsequently been corrected, shall be used unless approval in writing has been given by the Department. Stocked materials, even though accepted in delivery, shall be subject to test and shall meet requirements of the specifications at the time they are to be used in the work.

400.2.36.5 Construction

Intentionally Deleted

400.2.36.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.36.7 Measurement

Intentionally Deleted

400.2.36.8 Payment Adjustment

Intentionally Deleted

400.2.37 SUPPLY OF POLYVINYL CHLORIDE PIPE

400.2.37.1 General

The work consists of supplying Polyvinyl Chloride Pipe of the following types:

- Type PSM Polyvinyl Chloride Drainage Pipe
- Ribbed Polyvinyl Chloride Drainage Pipe
- Polyvinyl Chloride (PVC) Pipe for Culvert Liners

Nominal sizes include:

- 100, 150, 200, 250, 300, 375, 450, 525, 600, 675, 750 and 900mm diameter.

400.2.37.1.1 Applicable Specifications

CSA B182.2	Large-diameter, Type PSM PVC Sewer Pipe and Fittings
CSA B182.4	Large-diameter, Ribbed PVC Sewer Pipe and Fittings
ASTM D883	Definition of Terms Relating to Plastics
ASTM D1784	Standard Specification for PVC and CPVC Compounds

ASTM D2122	Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D2152	Standard Test Method for Quality of Extruded PVC Pipe by Acetone Immersion
ASTM D2412	Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
ASTM D2444	Standard Test Method for Impact Resistance of Thermo-plastic Pipe and Fittings by Means of a Tup (Falling Weight)
ASTM D3034	Standard Specification for Type PSM PVC Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F412	Definition of Terms Relating to Plastic Piping Systems
ASTM F477	Standard Specification for Elastomeric Seals for Joining Plastic Pipe
ASTM F794	Standard Specification for PVC Large-diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

400.2.37.2 Materials And Procedures

All pipe and fittings shall be made of virgin PVC plastic as defined in ASTM Standard D1784.

Elastomeric Seals (gaskets) shall conform to the requirements of ASTM Standard F477.

400.2.37.2.1 Requirements

Length

Standard pipe length shall be 4 m or as indicated in the Detailed Designs. A tolerance of ± 25mm on the nominal laying length will be permitted.

Dimensions for Type PSM, PVC Drainage Pipe

Nominal Pipe Size (mm)	Average Inside Diameter (mm)	Average Outside Diameter (mm)	Minimum Wall Thickness (mm)
100	100.94	107.06	3.06
150	150.29	159.39	4.55
200	201.16	213.36	6.10
250	251.46	266.70	7.62
300	299.36	317.50	9.07
375	366.42	388.62	11.10
450	447.87	475.01	13.57
525	527.99	559.99	16.0
600	594.00	630.00	18.0
675	669.42	710.00	20.29
750	766.36	812.80	23.22
900	917.22	972.80	27.79

Dimensions for Ribbed PVC Drainage Pipe

Nominal Pipe Size (mm)	Average Inside Diameter (mm)	Average Outside Diameter (mm) (over RIBS)	Minimum Wall Thickness (mm)
200	200	224	2.03
250	251	280	2.16
300	298	333	2.54
375	374.40	399.80	3.05
450	448.31	448.44	3.05
525	527.05	570.73	3.65
600	596.90	648.20	4.34
675	673.10	728.98	4.8
750	749.30	811.28	5.35
900	901.70	976.90	6.38

400.2.37.2.2 Joints

All sizes of pipe shall be supplied with Elastomeric gasket joints providing a watertight seal meeting the requirements of the latest version of CSA B182.2 and ASTM F477. The joints shall be able to withstand 345 kPa hydrostatic pressure.

400.2.37.2.3 Hydraulics

The manufacturer will provide the tested Manning's "n" value that will be used to calculate pipe flow capacity.

400.2.37.2.4 Markings

All pipe supplied shall be clearly marked with the following information at intervals of not more than 1.5m with 5mm or larger letters.

- Manufacturer's name or trademark
- Nominal diameter
- Material designation and cell class
- The applicable specification designation
- Date of manufacture and plant designation

400.2.37.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.37.4 Acceptance Sampling And Testing

All materials shall be subject to inspection, sampling and quality acceptance testing by the Department and the Contractor shall provide safe, convenient access, acceptable to the Department, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so.

The Contractor shall contact the Department at least 72 hours prior to shipping the materials to coordinate any inspection, sampling or testing at the manufacturing location and the delivery site that the Department deems necessary.

Any material found unacceptable by the Department shall be replaced with acceptable material by the Contractor.

400.2.37.5 Construction

Intentionally Deleted

400.2.37.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.37.7 Measurement

Intentionally Deleted

400.2.37.8 Payment Adjustment

Intentionally Delete.

400.2.38 SUPPLY OF PERMANENT HIGHWAY SIGNS, POSTS AND BASES

400.2.38.1 General

The work consists of supplying concrete bases, steel breakaway posts as applicable, cluster frames, wooden posts and designated highway signs as indicated in the Technical Requirements or Detailed Designs.

400.2.38.2 Materials And Procedures

400.2.38.2.1 General

All materials shall be supplied by the Contractor.

The Contractor shall supply the Design Engeineer and the Department with certification from the supplier that the signs conform with the Technical Requirements and shall only purchase signs that are certified by the supplier to meet the specifications of the sheeting manufacturer.

400.2.38.2.2 Signs

All signs supplied by the Contractor shall be clearly marked with the following information:

- Manufacturers Name or Trade Mark
- Date of manufacture
- Type of sheeting material

The information shall be provided on a weatherproof label, or some other form of permanent marking fixed to the back of the sign near the bottom right-hand corner. The label shall be smaller than 100mm x100mm in size.

Sign patterns shall conform to the Uniform Traffic Control Devices of Canada Sign Pattern Manual or to the Alberta Transportation Sign Pattern Manual. All other signs shall be as specified by the Design Engineer and as accepted by the Department.

All lettering on signs shall conform to the series Type Highway Font from the Standard Alphabet for Highway Signs, available from the Federal Highway Administration (CHTO-20), Washington, D.C., 20590, unless otherwise specified by the Uniform Traffic Control Devices of Canada Sign Pattern Manual or the Alberta Transportation Sign Pattern Manual.

The Design Engineer will be responsible for providing the following information:

- Dimensions of the sign;
- Dimensions of the lettering;
- Colours of the sign;
- Material specifications.

400.2.38.2.3 Wooden Posts

Posts shall be pine or spruce structural framing no. 2 or better, as per NLGA 1980 Rules Par. 123 C. Posts are to be CCA (Copper, Chromate, Arsenate) pressure treated in accordance with CSA 080.14 and CSA 081.1. Material supplied shall be free from wane and shall be clean and dry.

Post sizes to be supplied shall be 100mm x 100mm, 100mm x 150mm and 150mm x 200mm dimension lumber, in lengths ranging from 365cm to 610cm.

400.2.38.2.4 Cluster Frames

The Contractor shall supply cluster frames suitable for the installation of multiple signs of up to 1.5m2 in accordance with diagram TEB 1.71A, C-Cluster Frame. The frames shall be painted with rust resistant aluminum paint or a metal primer and aluminum paint suitable to the Department.

400.2.38.2.5 Concrete Bases

The Contractor shall supply bases in accordance with drawing TEB 1.83. The Contractor shall provide the Design Engineer and the Department with the manufacturer's certification indicating that the base has been manufactured to specified requirements.

The concrete to be used for the concrete signs foundations shall be Class B - with Type HS Portland cement.

The Contractor shall supply all material necessary to install the base, including suitable backfill material. Cementitious and organic materials are not acceptable backfill.

400.2.38.2.6 Breakaway Steel Sign Posts

The Contractor shall supply steel posts as shown on drawing TEB 1.82.

The Contractor shall provide the Design Engineer and the Department with the material manufacturer's certification that the material meets the Technical Requirements.

The Contractor shall supply zinc-rich paint (i.e. galvicon or equivalent) for repairs to any damaged galvanized surfaces.

400.2.38.2.7 Tubular Steel Posts

The Contractor shall supply 60 or 90mm diameter (outside diameter) tubular steel posts for the installation of signs in accordance with the Detailed Designs. The steel posts shall be manufactured using 12 gauge aluminum steel sections. The tubular steel posts shall have a top cap that prevents any material entering the post from the top.

All fasteners and sign support brackets, shall include: frangible couplers, caps, bolts, nuts, washers and other hardware shall be cast aluminum alloy.

All tubular steel sign posts installed on concrete surfaces shall be supplied with frangible post support couplers. The Contractor shall provide a "Quickfix TM" frangible post support coupler or approved equivalent which has passed the required tests for a Test Level 3 (TL-3) for structural supports for highway signs, luminaires and traffic signals of the National Cooperative Highway Research Program (NCHRP) Report 350.

400.2.38.2.8 Mounting Hardware

The Contractor shall supply all bolts and other hardware required to mount signs to posts or to frames and the frames to the posts. All bolts and hardware shall be galvanized.

400.2.38.2.9 Material Specifications

Reflective Sheeting

Reflective Sheeting shall meet or exceed the minimum requirements as specified in ASTM-D4956, Performance Requirements Type III or Type IV, High Intensity Retroreflective Sheeting.

Reflective Sheeting for Specialized Application Permanent Highway Signs

For installations of the following signs:

- RA-1 "Stop",
- RA-2 "Yield",
- RB-22 "Wrong Way" and
- RB-23 "Do Not Enter", and
- Overhead Guide Signs without sign illumination

The reflective sheeting supplied by the Contractor shall be one of the Proven Products for Specialized Applications listed on the Alberta Transportation Products List.

Backing

Plywood - Sanded one side:

- ½" 100/100 or 120/120 Hi-Density
- ¾" 100/100 or 120/120 Hi-Density

Aluminum

- Extruded aluminum panels for major signs, shall be Alcan Shape #73247 with anodize treatment and shall conform to ASTM B221M, "Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes", Alloys 6061-T6 or 6063-T5.
- Aluminum for standard signs shall be a minimum of 2mm flat sheet tension levelled, sign grade aluminum and shall conform to the requirements of ASTM B209M, "Specification for Aluminum and Aluminum-Alloy Sheet and Plate", Alloys 6061-T6 or 5052-H38.

400.2.38.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.38.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.38.5 Construction

Intentionally Deleted

400.2.38.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.38.7 Measurement

400.2.38.7.1 Signs

Measurement for the supply of reflective sheeting and backing will be made in square metres of the actual surface area of each sign. The actual area calculations for the various types and sizes of signs are as shown in the Department's "Sign Catalogue and Images".

400.2.38.8 Payment Adjustment

Intentionally Deleted

400.2.39 SUPPLY OF LINE PAINTING MATERIALS

400.2.39.1 General

This specification applies to contracts that require the Contractor to supply line painting and pavement message marking materials.

400.2.39.2 Materials And Procedures

The Contractor shall choose the glass beads, paint, and durable paint materials to be supplied from the list of Proven Products shown in the Alberta Transportation Products List. The Contractor shall be responsible for ensuring that the quality of the paint and beads supplied meets the Technical Requirements.

The Contractor shall advise the Design Engineer and the Department of any change in paint formulation.

The Contractor shall provide the Design Engineer and the Department with the following information prior to commencing the work:

- Names and mailing addresses of the suppliers and manufacturers;
- Formulation to be supplied;
- Written confirmation from the manufacturer that the materials to be supplied meet all specified requirements.

The Contractor shall verify that all materials delivered and used in the work are the type ordered.

400.2.39.3 Quality Management Sampling And Testing

The Contractor shall supply the Design Engineer and the Department with the manufacturer's quality management test results. Quality management results shall include a minimum of Specific Gravity, Hiding Power, Dry to Traffic and Viscosity results.

400.2.39.4 Acceptance Sampling And Testing

The Contractor shall supply the Department with acceptance samples. A minimum of one acceptance sample per batch shall be taken for glass beads as per TLT-601, Sampling Glass Beads. A minimum of one acceptance sample per colour per batch shall be taken for paint as per TLT-636, Sampling Traffic Paint.

All materials shall be subject to further inspection and sampling by the Department, and the Contractor shall provide safe, convenient access, acceptable to the Department, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so.

Paint products shall be tested and shall meet the requirements as specified in the Technical Requirements.

400.2.39.5 Construction

Intentionally Deleted

400.2.39.6 Product Acceptance

The Contractor shall make all arrangements for the supply and delivery of paint and glass beads and shall provide the Department with records of all materials received and/or returned, on a daily basis.

The Contractor shall provide, maintain and reclaim all material storage sites. Storage of materials at Department facilities will not be permitted.

No paint formulation shall be diluted or mixed with a different formulation or with any other material, without the specific acceptance by the Design Engineer and the Department.

The Contractor shall take all necessary steps to prevent contamination of the materials. Paint shall be protected from freezing.

The Contractor shall be responsible for the proper clean up of waste or spilled material, and the proper disposition of containers.

400.2.39.7 Measurement

Intentionally Deleted

400.2.39.8 Payment Adjustment

Intentionally Deleted

400.2.40 SUPPLY AND INSTALL SMOOTH WALL STEEL PIPES

400.2.40.1 General

The Contractor shall supply and install smooth wall steel pipe culvert through the existing highway without disturbing the existing surfacing structure as shown in the Technical Requirements and Detailed Design.

Centerline steel pipe culvert installation shall consist of augering of the steel pipe through the existing highway embankment and installing the remainder of the steel pipe culvert by the trenched or open cut method as shown on the drawings (CB6-2.4M19).

The abbreviation for Smooth Wall Steel Pipe when indicated on the Detailed Designs or used in the Technical Requirements is SWSP.

400.2.40.2 Materials And Procedures

400.2.40.2.1 Culvert Material

Smooth Wall Steel Pipe (9.5mm wall thickness) shall be supplied by the Contractor and shall meet ASTM Specification A252 Grade2. Any variation from the specified requirements for the Smooth Wall Steel Pipe shall be subject to acceptance by the Design Engineer and the Department. The Department has the sole right to reject material that in their opinion will not adequately meet the expected longevity of this new culvert installation. The Contractor shall have no claim against the Department for all or part of material rejected and shall remove and dispose of rejected material.

400.2.40.2.2 Material for Bedding, Backfill and Sealing

The Contractor shall either use approved native material or produce granular material for bedding and backfill in trenched areas in accordance with Section 400.2.20 (Aggregate Production and Stockpiling) for the designation and class of materials specified. The Contractor shall supply aggregate in accordance with Section 400.2.31 (Supply of Aggregate).

The Contractor shall supply the required clay material for the clay seals at both ends of the installation.

400.2.40.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.40.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.40.5 Construction

400.2.40.5.1 Length of Pipe Required for Installation

The Contractor shall determine the total length of Smooth Wall Steel Pipe required for both the coring and trenched or open cut installations based on the Detailed Designs.

Prior to commencing the installation, the Design Engineer shall liaise with the Department to determine the exact length of pipe required, depending on landowner requirements and onsite inspection.

400.2.40.5.2 Welding

Welding of smooth wall steel pipe shall only be performed by journeyman welders. All Welders' qualifications shall be current and shall be available for examination by the Design Engineer and the Department.

Smooth wall steel pipe sections shall be joined together with a full strength and continuous butt weld which forms a watertight seal in accordance with CSA standard W59, Welded Steel Construction. Welding procedures shall be prepared and stamped by a Professional Engineer and shall be submitted to the Design Eningeer and the Department for review prior to welding.

When the ambient air temperature is between $0^{O}C$ and $5^{O}C$ the Contractor shall pre-heat the smooth wall steel pipe to a minimum of $100^{O}C$ for a distance of 80mm beyond the weld in each direction, and shall shelter the section being welded from the wind. When the ambient air temperature is below $0^{O}C$ the Contractor shall provide suitable hoarding and heating of the sections being welded. The Design Engineer or the Department has the right to require the Contractor to modify or cease his welding operation if, in the opinion of the Design Engineer or the Department, adequate shelter and heating is not being provided during cold weather welding.

At the discretion of the Department, Non-Destructive Examinations such as Radiography and Ultrasonic testing may be required to verify quality and strength of the welds. Non-destructive examinations shall only be done by qualified technicians and the results shall be provided to the Department for review. The Contractor shall arrange and provide non-destructive testing when required by the Department. Any defects found by such testing shall be repaired by the Contractor.

400.2.40.5.3 Coring and Pushing

The installation shall be carried out by coring and pushing a steel pipe through the highway embankment without disturbing the existing pavement structure and in a manner approved by the Design Engineer and as accepted by the Department. The invert elevations, pipe length and pipe diameter shall be as shown on the Detailed Designs or as determined in consultation with the Design Engineer and the Department. The Contractor shall cut sections and join sections with a continuous butt weld to provide the necessary overall length as part of the coring and pushing operations.

The Contractor shall be responsible for correcting and repairing any roadway slides or failures that occur as a result of activities associated with the coring operations.

The coring machine shall be capable of excavating to a diameter not greater than 25mm of the outside diameter of the pipe.

In the event that adverse soil conditions are encountered during coring operations which necessitate a change in construction methods, the method of construction for the affected portion shall be approved by the Department prior to proceeding with further construction.

400.2.40.5.4 Coring

The Design Engineer will provide line and grade at each end of the pipe from which the Contractor shall accurately control the coring. This line and grade will be subject to review and acceptance by the Department.

The Contractor shall block, shim or construct rails as required to ensure that the finished pipe meets the tolerance requirements for alignment and grade.

Line and grade shall be continuously checked by the Contractor using a laser. The laser must be sufficiently capable of shooting the entire length of each operation and have a beam deviation not greater than 6mm. If the laser does not meet the requirements of the project, the Contractor shall replace it with a unit approved by the Department.

The Department may also monitor the installation by performing acceptance testing of the line and grade. The Contractor shall co-operate by making the workings available for checking at suitable intervals during regular working hours as required by the Department.

Discrepancies found by the Department shall be corrected by the Contractor immediately. The return to established line or grade shall be at a rate not exceeding 50mm per 10m.

Such checks or lack of them shall not relieve the Contractor of full responsibility for constructing the pipe to the line and grade as specified by the Technical Requirements.

400.2.40.5.5 Installation by Trench or Open Cut Method

The pipe shall be installed on the prepared base, true to the designed lines and grades unless otherwise established by the Department. Separate sections shall be securely joined together with a continuous butt weld. The Contractor shall cut bevelled end sections (3:1 or 4:1 slope as applicable) as directed by the Department.

The Contractor shall use due care when installing pipe to avoid damaging the pipe. Damaged pipe shall be removed and replaced by the Contractor.

Bedding and Backfill

Bedding and backfill material shall be placed as shown on the Detailed Designs and shall consist of approved suitable native material or imported select gravel or soil material as directed by the Department. All bedding and backfill material shall be free from frozen lumps and organic material. Backfill within 300mm of the pipe wall shall be free from stones of diameter larger than 80mm.

400.2.40.5.6 Hand-Laid Riprap

Immediately following completion of the pipe installation, hand-laid riprap shall be placed in accordance with Section 400.2.4 (RIPRAP).

400.2.40.5.7 Cleanup

After the installation has been completed, the Contractor shall cleanup the site to a condition similar to the surrounding area or as directed by the Design Engineer and the Department. This includes but is not limited to, removal and disposal of all discarded utility lines, tracks, coring equipment, and unused construction materials and debris from the pipe and construction area.

The Contractor shall leave the pipe in a clean reasonably dry condition suitable for inspection by the Design Engineer and the Department.

400.2.40.6 Product Acceptance

The final installation shall be subject to the Department's inspection. All damages such as bent or deformed edges or undulations of the pipe shall be corrected by the Contractor.

The finished pipe culvert installation shall not deviate from grade and alignment by more than 50mm.

Any pipe placed which does not comply with these requirements shall be corrected to the satisfaction of the Department by the Contractor.

400.2.40.7 Measurement

Measurement for the supply and installation of smooth wall steel pipes will be made in metres based on the total invert length of pipe installed including sloped end sections.

400.2.40.8 Payment Adjustment

Intentionally Deleted

400.2.41 SUPPLY OF CORRUGATED METAL PIPE AND PIPE ARCHES

400.2.41.1 General

This Specification covers the requirements for the supply of corrugated metal pipe and pipe arches up to 1,400mm equivalent diameter by the Contractor.

Abbreviations for the various types of metal pipe are as follows:

- CSP - Corrugated Steel Pipe
- CSP Arch - Corrugated Steel Pipe Arch
- CAP - Corrugated Aluminum Pipe
- CAP Arch - Corrugated Aluminum Pipe Arch

400.2.41.2 Materials And Procedures

The Contractor shall ensure that the supply and fabrication of all galvanized, polymer coated and aluminum coated corrugated steel pipe (CSP) and pipe arches including couplers and appurtenances are in accordance with the latest edition of Canadian Standards Association (CSA) G401 Specification, and the supply and fabrication of corrugated aluminum pipe (CAP) and pipe arches including couplers and appurtenances are in accordance with the latest edition of AASHTO Designation M196 and M197, with the following modifications:

Previously installed pipe shall not be used. All pipe supplied shall be clearly marked with the following information at intervals of not more than 3m.

- Manufacturer's Name or Trade Mark
- Nominal Thickness and Type of Metal
- Plate/Metal Coating (for non-standard coating)
- Specification Designation
- Plant Designation Code
- Date of Manufacture

400.2.41.2.1 Sloped End Sections

Sloped end sections are required for each culvert. When 4:1 and 3:1 sloped end sections are specified, templates CB6-5.15 M1 and CB6-5.15 M2 will apply.

400.2.41.2.2 Cut Ends

All cut edges of a sloped or square end section shall be made smooth by grinding so that all of the burrs are removed. Any damaged protective coating shall be recoated with appropriate material in accordance with CSA G401.

400.2.41.2.3 Couplers

Annular corrugated couplers for pipe greater than 300mm in diameter shall be of sufficient width to cover at least two outside crest corrugations on each recorrugated end.

400.2.41.2.4 Coupler Bands

Coupler bands for pipe greater than 800mm in diameter shall have a minimum of three bolts.

400.2.41.2.5 Termination of Lock Seams

On pipes 1000mm diameter or larger, lock seams terminating at the cut edges of sloped or square ended sections shall have a 75mm length fillet weld run along the lock seam at each cut edge. The weld and surrounding area shall be recoated with the appropriate material in accordance with CSA G401.

400.2.41.2.6 Recorrugated Ends

Spirally corrugated metal pipe shall have ends recorrugated to provide annular corrugations for couplers.

400.2.41.2.7 Perforated Pipe

Perforated corrugated steel pipe shall be fabricated in accordance with the latest edition of CSA

G401.

400.2.41.2.8 Double Zinc C.S.P.

When Double Zinc CSP is specified, the zinc coating mass (total on both sides) shall be not less than 1220g/m^2 when tested by the triple spot test, or 1100g/m^2 when tested by the single spot test.

400.2.41.2.9 Polymer Coated C.S.P.

When Polymer Coated CSP is specified, the polymer coating shall be applied to both sides of the galvanized sheet prior to corrugating in accordance with classification grade 250/250 as specified in CSA G401 section 3.5.4.

Any pinholes, blisters, cracks or lack of bond shall be cause for rejection.

400.2.41.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.41.4 Acceptance Sampling And Testing

All materials shall be subject to inspection, sampling and acceptance testing by the Department and the Contractor shall provide safe, convenient access, acceptable to the Department, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so.

The Contractor shall contact the Department at least 72 hours prior to shipping the materials to coordinate any inspection, sampling or testing at the manufacturing location and the delivery site that the Department deems necessary.

Any material found unacceptable by the Department shall be replaced with acceptable material by the Contractor.

400.2.41.5 Construction

Intentionally Deleted

400.2.41.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.41.7 Measurement

Measurement for the supply and installation of corrugated metal pipe and pipe arches including couplers and appurtenances will be per metre.

400.2.41.8 Payment Adjustment

Intentionally Deleted

400.2.42 SUPPLY OF POLYETHYLENE PIPE

400.2.42.1 General

This specification covers the requirements for the supply of polyethylene pipe by the Contractor.

The work consists of supplying polyethylene pipe of the following types:

- Closed Profile Pipe: a pipe product that has an essentially smooth waterway braced circumferentially or spirally with corrugations that are joined integrally by an essentially smooth outer wall.
- Corrugated Pipe: a single walled pipe where the wall is formed into a series of alternating ridges and grooves.
- Open Profile Pipe: a pipe product that has an essentially smooth waterway braced circumferentially or spirally with outside corrugations.

400.2.42.1.1 Applicable Specifications

CAN/CSA B182.6	Profile Polyethylene Sewer Pipe and Fittings
ASTM F405	Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F667	Large Diameter Corrugated Polyethylene Tubing and Fittings
ASTM F894	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.
ASTM D3350	Specification for Polyethylene Plastic Pipe and Fittings Materials
ASTM D4976	Specification for Polyethylene Plastics Moulding and Extrusion Materials
AASHTO M252	Corrugated Polyethylene Drainage Tubing
AASHTO M294	Corrugated Polyethylene Plastic Pipe

400.2.42.1.2 Definitions

<u>Polyethylene Plastic</u>: plastic based on polymers made with ethylene as essentially the sole monomer.

<u>Profile</u>: pipe wall construction that presents an essentially smooth surface in the waterway but includes ribs or other shapes, which can be either solid or hollow, that help brace the pipe against diametrical deformation.

400.2.42.2 Materials And Procedures

The moulding and extrusion material shall be polyethylene plastic according to the requirements of CAN/CSA B182.6, ASTM F405, ASTM F667, ASTM F894, ASTM D3350, ASTM D4976, AASHTO M252 or AASHTO M294 for the appropriate type of polyethylene plastic pipe.

Previously installed pipe shall not be used.

400.2.42.2.1 Markings

Markings for corrugated, and open-end, closed-profile, polyethylene plastic pipe, tubing and fittings shall be in accordance with the appropriate standard. All pipe supplied shall be clearly marked with the following information at intervals of not more than 3m.

- Pipe Diameter
- Pipe Stiffness
- Standard Designation
- Manufacturer

400.2.42.2.2 Certificate

The Contractor shall provide a certificate of compliance from the supplier indicating that the product was produced, tested and conforms to all of the requirements of the appropriate specification to the Design Engineer and the Department prior to use on the Project.

400.2.42.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.42.4 Acceptance Sampling And Testing

All materials shall be subject to inspection, sampling and acceptance testing by the Department and the Contractor shall provide safe, convenient access, acceptable to the Department, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so.

The Contractor shall contact the Department at least 72 hours prior to shipping the materials to co-ordinate any inspection, sampling or testing at the manufacturing location and the delivery site that the Department deems necessary.

Any material found unacceptable by the Department shall be replaced with acceptable material by the Contractor.

400.2.42.5 Construction

Intentionally Deleted

400.2.42.6 Product Acceptance

The pipe stiffness for all polyethylene plastic pipe or fittings shall be no less than 210 kPa for Corrugated Pipe and 320 kPa for Closed Profile Pipe and Open Profile Pipe at 5 percent deflection.

The requirements for corrugated polyethylene plastic pipe, tubing and fittings shall be according to ASTM F405, ASTM F667, AASHTO M252 or AASHTO M294.

The requirements for open and closed profile polyethylene plastic pipe and fittings shall be according to CAN/CSA B182.6 or ASTM F894.

400.2.42.6.1 Joints

Joining systems shall be Bell and Spigot (Gasketed Type), Bell and Spigot (Extrusion Weld Type), Heat Fusion, Plain End Extrusion Weld, Integral Connectors and shall meet the requirements of the latest version of ASTM F894 and CSA B182.6.

400.2.42.6.2 Perforated Pipe

Perforated corrugated polyethylene pipe shall be fabricated in accordance with the latest edition of ASTM F405 (currently Section 6.2.4).

400.2.42.6.3 Hydraulics

The manufacturer will provide the tested Mannings "n" value that will be used to calculate pipe flow capacity.

400.2.42.7 Measurement

Measurement for the supply and installation of polyethylene pipe including joining systems and appurtenances will be per metre for the applicable type and sizes of pipe specified.

400.2.42.8 Payment Adjustment

Intentionally Deleted

400.2.43 SUPPLY OF W-BEAM GUARDRAIL AND POSTS

400.2.43.1 General

The work consists of supplying W-Beam and Thrie beam guardrail and posts for use as hazard avoidance barriers.

400.2.43.1.1 Standards of Reference

Alberta Transportation Drawings:

TEB 3.01 Wood Spacer Block and Post
TEB 3.02 Rail Detail
TEB 3.03 Wing End Section
TEB 3.04 Buried End Section
TEB 3.06 Bolt, Nut and Washer
TEB 3.53 Flex Guard Bracket
TEB 3.70 Modified Thrie Beam Guardrail

All materials supplied by the Contractor shall be in accordance with the following standards, specifications or publications. Previously installed materials may not be used.

Canadian Standards Association (CSA):

CSA G40.20 and G40.21-M87 - Structural Quality Steels
CSA G164-M - Hot Dip Galvanizing of Irregularly Shaped Articles
CSA W59-M - Welded Steel Construction (Metal Arc Welding)
CSA 080-M - Wood Preservation

American Society for Testing and Materials (ASTM):

ASTM A307 - Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM E316.3 - Magnetic gauge testing of galvanizing coating

American Association of State Highway and Transportation Officials (AASHTO):

AASHTO Standard Designation M-180 of the latest edition "Corrugated Sheet Steel Beams for Highway Guardrail"

American Road and Transportation Builders Association (ARTBA):

ARTBA Technical Bulletin No. 268-B

National Lumber Grades Authority (NLGA):

NLGA Standard Grading Rules for Canadian Lumber

Alberta Transportation

References made to TEB drawings in this Specification refer to drawings found in the manual titled "Typical Barrier Drawings", which is published by the Department.

400.2.43.2 Materials And Procedures

The Contractor shall supply all materials necessary to complete the work.

400.2.43.2.1 Rails and Terminal Elements

W-beam and thrie beam guardrail shall consist of rail sections fabricated to develop continuous beam strength with the necessary safety end feature components.

All rail sections and other components shall match the design profiles and dimensions of the AASHTO/ARTBA hardware requirements for full interchangeability of similar components regardless of the manufacturer.

The name or trademark of the manufacturer, the metal thickness and the year of production shall be clearly and permanently stamped on each component clear of the splicing overlap and on the face opposite the traffic side.

The rails and terminal elements shall be manufactured from open hearth, electric furnace or basic oxygen semi-spring steel sheet and hot dip galvanized after fabrication, all in general accordance with the AASHTO Standard Designation M180 of the latest Edition and shall conform to the relevant TEB drawings.

Rails shall be punched for splice and post bolts in strict conformity with the AASHTO Standard to the designated number and centre-to-centre spacing of posts. No punching, cutting or welding will be permitted on site except for special details in unforeseen and exceptional cases with the prior approval of the Design Engineer and the Department.

If any guardrail installation requires curved W-beam or thrie beam rails, the Contractor shall form these to the radius specified by the Detailed Designs.

The rails and terminal elements shall be manufactured according to the following standards:

- Metal properties of the base metal for the rails shall conform to the following requirements:
  - Minimum Yield Point: 345 MPa
  - Minimum Tensile Strength: 483 MPa
  - Minimum Elongation: 12 percent in 50mm length

- Sheet Thickness shall be in accordance with Table 2 (Class A, Type 2) of AASHTO Standard M180 of the latest edition with a nominal base metal thickness of 2.8mm (2.57mm minimum).
- Sheet width for the W-beam rail shall be 483mm, with a permissible tolerance of minus 3.2mm.

Welding for the fabrication of terminal elements shall conform to the requirements of CSA-W59M.

Rails and terminal elements shall be hot dip galvanized after fabrication, in accordance with CSA-G164M.

400.2.43.2.2 Bolts, Nuts and Washers

Bolts, nuts and washers shall conform to ASTM-A307, and shall be hot dip galvanized in accordance with CSA-G164M (Drawing TEB 3.06).

400.2.43.2.3 Wooden Posts

Posts and offset blocks shall be either douglas fir, hemlock, lodgepole pine or better and shall meet the requirement of the National Lumber Grades Authority (NLGA) for No. 1 Structural Posts and Timbers graded conforming to the NLGA Standard Grading Rules for Canadian Lumber.

Posts and blocks shall be rough sawn with holes drilled to the finished dimensions shown in drawing TEB 3.01. The standard length of posts shall be 1.52 metre, except at locations specified in the special provisions where 2.13 metre posts, or other length, is specified for use.

Posts shall be date stamped at the top of either side of the post not used for rail attachment with the last two digits of the year of fabrication. The stamp shall be 50mm x 50mm and have an indentation of 3mm.

Stamping and drilling shall be completed prior to treating posts. Blocks shall be pressure treated in accordance with the current requirements of CSA Standard 080, with water-borne preservative of chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA) to 8 kilograms per cubic metre.

The penetration and retention of preservatives shall conform to the requirements of CSA Standard 080.14, Table 1, Minimum Retention of Preservatives in Pressure Treated Wood for Highway Construction, under the headings "Post-Guardrail, Guide, Sign and Sight" for posts, and "Bridge Hand Rails, Guard Rails and Posts" (not in contact with ground or water).

400.2.43.2.4 Plastic Guardrail Posts

Plastic guardrail posts supplied by the Contractor shall be a product from the Alberta Transportation Products List.

Plastic posts shall be stamped at the top of the post on a surface not used for rail attachment with the following information:

- The identifying product number or code, and
- The year of manufacture.

These markings shall be legible throughout the normal service life of the post. The Contractor shall supply the Design Engineer and the Department with certification from the supplier that the plastic posts conform to the applicable specifications.

400.2.43.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.43.4 Acceptance Sampling And Testing

400.2.43.4.1 General

Prior to installing any guardrail, the Contractor shall provide the Department with a copy of the manufacturer's certificate verifying that materials supplied conform to section 16 of CSA G40.20M, for each of the mechanical and chemical tests.

400.2.43.4.2 Inspection of W-Beam and Thrie Beam Guardrail Material

Hot dip galvanized coating shall be smooth, free of beading or sharp projections at edges. Coating adherence shall prevent the peeling of any portion of the zinc coating so as to expose the base metal by cutting or prying with a stout knife under considerable pressure (bond check). A magnetic gauge will be used for checking thickness in accordance with ASTM Standard E316.3(c).

Warped or otherwise deformed rails and terminal elements will be rejected, as will those with injurious defects or excessive roughness of the zinc coating. When the rail is laid on a flat surface, the warpage shall not be greater than 5cm.

400.2.43.4.3 Inspection of Wooden Posts and Blocks

The Department may verify the penetration and retention of the preservative by the assay method.

Posts and blocks shall be subject to inspection by the Department when the bundles are opened immediately prior to use.

400.2.43.5 Construction

Intentionally Deleted

400.2.43.5.1 Compliance Requirements

Intentionally Deleted

400.2.43.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.43.7 Measurement

Intentionally Deleted

400.2.43.8 Payment Adjustment

Intentionally Deleted

400.2.44 SUPPLY OF FLEXIBLE GUIDE POST TRAFFIC DELINEATORS

400.2.44.1 General

The work consists of the supply of flexible guide post traffic delineators.

400.2.44.2 Materials And Procedures

The Contractor shall supply flexible guide posts which return to upright positions following repeated impacts and passages of vehicles over them. Such collisions shall not cause serious damage to the post or vehicle. Failure to conform to the requirements specified herein shall be cause for rejection.

400.2.44.2.1 General

The posts shall be of uniform high quality and workmanship and be free from defects.

Prior to installation, the Contractor shall provide a complete report of the physical properties of the post to the Design Engineer and the Department. This report shall include properties such as low temperature impact resistance, after-impact recoverability and weather resistance.

400.2.44.2.2 Specifications - Dimensions, Colour and Construction

The round posts shall have a minimum outer diameter of 90mm and an overall length of 1.67 metres. The semi flat fibreglass posts shall have a minimum width of 90mm and an overall length of 1.67 metre.

The top 250mm of the post length shall be black and the remainder shall be white.

The post shall be straight. Straight is defined as having no point along the length of the post any more than 6mm removed from a perfectly straight edge placed parallel to any side of the post.

Round posts shall be open at the top and bottom.

The surface of the post shall be smooth and free from irregularities or defects. The surface of the post shall not be affected by cleaning using scrapers, detergent and water, or solvent.

The black portion of the post shall accept and hold securely high-intensity reflectorized sheeting applied to its surface area with heavy-duty stainless steel staples, glue or other adhesives deemed suitable by the manufacturer.

If one piece construction is not used, then the connections between the pieces shall be at least as strong as if constructed of a single piece. The strength shall exist at temperatures ranging from -50ºC to 50ºC.

The reflective portion of round posts shall be visible from all directions and shall be of sufficient size so as to be recognizable in the dark as a guide post reflector. The reflective portion of semi flat posts shall be visible to traffic.

400.2.44.2.3 Weather Resistance and Durability

The post shall not be seriously affected by ozone, exhaust fumes, asphalt or road oils, dirt, vegetation, deicing salts or any other types of air contamination or materials likely to be encountered after installation.

The post shall withstand without serious damage all elements likely to be encountered after installation including hot (50ºC) or cold (-50ºC) temperatures, rain, snow, hail, abrasion and physical abuse.

400.2.44.2.4 Strength And Flexibility

The posts shall resist, without breaking, tearing, shattering or other serious damage, one highway vehicle impact at a speed of 100 km/h at a test temperature of -33ºC.

The post shall not bend, warp or distort when installed at temperatures up to 50ºC or installed in wind velocities up to 120 km/h.

400.2.44.2.5 High-Intensity Reflectorized Sheeting

Each post shall have a 50mm wide reflective sheeting material fastened between 100mm and 150mm from the top of the post. The reflective sheeting shall be green when the guidepost is used to mark the edges of approaches located on curves, and white in all other instances. When green is required, white sheeting shall be screen printed green using a process recommended by the sheeting manufacturer.

The reflective sheeting material shall be High-Intensity encapsulated glass bead reflective sheeting meeting or exceeding the minimum requirements as specified in ASTM-D4956, performance requirement Type III and Class I pressure sensitive adhesive backing requirements.

400.2.44.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.44.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.44.5 Construction

Intentionally Deleted

400.2.44.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.44.7 Measurement

Measurement for the supply and installation of guide posts will be per post in accordance with Section 400.2.13 (Guardrail, Energy Attenuators and Guide Posts).

400.2.44.8 Payment Adjustment

Intentionally Deleted

400.2.45 SUPPLY OF REINFORCEMENT

400.2.45.1 General

This specification is for the supply, fabrication, handling and placing of reinforcing steel. Reinforcement bars shall be supplied in the lengths and shapes, and installed as indicated on the Detailed Designs.

400.2.45.2 Materials And Procedures

All materials shall be supplied by the Contractor. Reinforcing steel shall conform to the requirements of the CSA Standard G30.18M Grade 400. All hooks and bends shall be bent using the pin diameters and dimensions as recommended in The Reinforcing Steel Institute of Canada, (RSIC), Manual of Standard Practice, 1 Sparks Ave, Willowdale, Ontario M2H 2W1, Phone: 416-499-4000, unless specified otherwise. Reinforcing bars shall conform accurately to the dimensions shown on the drawings and within the fabricating tolerance as shown in the RSIC, Manual of Standard Practice.

Epoxy coated reinforcing steel shall be prepared and coated according to the requirements of ASTM A775 and the Ontario Provincial Standard Specification OPSS 1442, Material Specification for Epoxy Coated Steel Reinforcement for Concrete. Film thickness of the coating, after curing, shall be 175 micron to 300 micron (7 to 12 mils). The epoxy coating material shall conform to the requirements of OPSS 1443, Material Specification for Organic Coatings for Steel Reinforcement.

Mesh reinforcement shall be supplied in flat sheets only.

400.2.45.2.1 Handling and Storage

The Contractor shall handle and store the reinforcement in a manner that ensures it is not damaged or contaminated with dirt or other materials.

Special care shall be taken when handling epoxy-coated reinforcing steel so that damage to the coating is minimized. Epoxy-coated reinforcing bars shall not be dropped or dragged, and shall be lifted with non-metallic slings. Bar-to-bar abrasion and excessive sagging of bundles must be prevented, and bundles shall be handled with spreaders and non-metallic slings.

On site storage of the epoxy coated reinforcing steel shall not exceed 120 days, and exposure to daylight shall not exceed 30 days. If the exposure time exceeds or is expected to exceed 30 days, the reinforcing steel shall be protected by covering with opaque polyethylene sheeting or equivalent protective material.

The Contractor shall repair all damages to the epoxy coating using epoxy patching material. If damaged areas rust before being repaired, the rust shall be completely removed before the areas are repaired.

400.2.45.2.2 Placing and Fastening

All steel reinforcement shall be accurately placed in the positions shown on the Detailed Designs, and firmly tied and chaired before placing the concrete. When placed in the work it shall be free from dirt, detrimental rust, loose scale, paint, oil or other foreign material. Bars shall be tied at all intersections, except where spacing is less than 250mm in each direction, when alternate intersections shall be tied.

Distances from the forms shall be maintained by means of stays, spacers, ties, hangers, or other approved supports. Spacers for holding reinforcement from contact with the forms shall be precast mortar blocks, or chairs of plastic or galvanized metal, of approved shape and dimensions. Any metal chairs protruding through the surface of the hardened concrete shall be cut back at least 25mm, and the holes filled in accordance with Section 400.3.5.24.2 (Class 1. Ordinary Surface Finish), unless otherwise accepted by the Department. Metal chairs shall not be used to support reinforcement on surfaces which are to be exposed or are to be finished; where possible, this reinforcement is to be supported entirely from above. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe, and wooden blocks, will not be permitted. Unless otherwise indicated in the Technical Requirements, the minimum distance between bars shall be 40mm.

All chairs or bar supports for epoxy-coated reinforcement shall be non-metallic, or epoxy coated and be accepted by the Design Engineer and the Department. Tie-wire for the coated reinforcement shall be plastic-coated.

Where field cutting of epoxy-coated reinforcing steel is necessary, and is accepted by the Design Engineer and the Department, it shall be cut by methods other than torch-cutting. All cut ends shall be patched with epoxy patching material.

400.2.45.2.3 Splicing

Splicing of bars, unless shown in the Technical Requirements, is prohibited except with the written approval of the Design Engineer and the Department. Splices, where possible, shall be staggered.

For lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the required minimum clear distance to other bars, and the required minimum distance to the surface of the concrete. In general, suitable lap lengths will be achieved by the placing of bars of the lengths as detailed. Where the lap length cannot be determined, a minimum of 35 bar diameters lap length shall be provided.

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width.

400.2.45.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.45.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.45.5 Construction

Intentionally Deleted

400.2.45.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.45.7 Measurement

Intentionally Deleted

400.2.45.8 Payment Adjustment

Intentionally Deleted

400.2.46 GEOTEXTILE

400.2.46.1 General

The work includes the supply and installation of both non-woven and woven geotextile at locations shown in the Technical Requirements and the Detailed Designs.

400.2.46.2 Materials And Procedures

400.2.46.2.1 Non-Woven Geotextile

Non-woven geotextile include:

- continuous monofilaments or staple fibres.
- random fibres that are physically entangled by punching with needles.
- random fibres that are pressed and melted together at the contact points.

The non-woven geotextile fabric shall meet the following requirements:

Property	ASTM Test	Material Specification[1] Average Roll Value		
		Type A [(2)]	Type B [(3)]	Type C [(4)]
Grab Tensile Strength (N)	D4632	400 min	650 min	875 min
Grab Tensile Elongation (%)	D4632	50 % min	50 % min	50 % min
Mullen Burst (MPa)	D3786	1.2 min	2.1 min	2.7 min
Puncture (N)	D4833	240 min	275 min	550 min
Trapezoid Tear (N)	D4533	180 min	250 min	350 min
Ultraviolet Stability (% Retained Strength)	D4355	70 % @ 150 hr.	70 % @ 150 hr	70 % @ 150 hr
Apparent Opening Size (AOS) (mm)	D4751	0.2 max	0.2 max	0.2 max
Permittivity (per sec)	D4491	2.1 min	1.5 min	1.2 min
Flow Rate (l/sec/m^2)	D4491	102 min	102 min	102 min
Minimum fabric lap shall be 300 mm				

Note 1: All numeric values except AOS represent minimum average roll value as measured in the weaker principal direction;
2: Typically used with perforated pipe and similar applications;
3: Typically used in medium duty situations such as under Class 1M, 1 & 2 riprap;
4: Typically used in heavy duty applications such as under Class 3 riprap.

400.2.46.2.2 Woven Geotextile

Woven Geotextiles consist of continuous monofilaments, staple fibres, multi-filament yearns, or slit films that are woven into a fabric.

Woven geotextiles shall have the following material properties:

Property	ASTM Test	Material Specification[1] Average Roll Value		
		Class 1	Class 2	Class 3
Elongation (%)	D 4632	<50 min	<50 min	<50 min
Grab Strength (N)	D 4632	1 400 min.	1 100 min.	800 min.
Sewn seam strength (N)	D 4632	1 260 min.	990 min.	720 min.
Tear Strength (N)	D 4533	500 min. [2]	400 min. [2]	250 min.
Puncture Strength (N)	D 4833	500 min.	400 min.	300 min
Permittivity (per sec)	D4491	0.05 min. [3]	0.02 min. [3]	0.02 min. [3]
Apparent Opening Size (AOS) (mm)	D4751	0.43 max	0.60 max	0.60 max

Ultraviolet Stability (% Retained Strength)	D4355	50% after 500 hrs of exposure	50% after 500 hrs of exposure	50% after 500 hrs of exposure

Note 1: All numeric values except AOS represent minimum average roll value as measured in the weaker principal direction

Note 2: For woven monofilament geotextiles, the required minimum average roll value for tear strength is 250 N.

Note 3: Default value. Permittivity of the geotextile should be greater than that of the soil. The Detailed Designs may also require the permeability of the geotextile to be greater than that of the soil.

400.2.46.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.46.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.46.5 Construction

Unless otherwise directed in the applicable specification, the placement of geotextile shall be in accordance with the following:

- The surface to receive the geotextile shall be prepared to a relatively smooth condition free of obstructions, depressions, debris, and soft or low density pockets of material. The geotextile fabric shall be installed free from tensile stresses, folds, wrinkles, or creases.

- If more than one width of geotextile fabric is used, the Contractor shall either overlap the joints by a minimum of 400mm with no stitching, or overlap the joint by 200mm and provide two rows of stitching at each joint.

- The geotextile fabric shall be protected all times during construction. Wheeled or tracked vehicles shall not be allowed to travel directly on the geotextile fabric. Any geotextile fabric damaged during installation or during placement of granular material shall be replaced by the Contractor.

400.2.46.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.46.7 Measurement

Geotextile will be measured in square metres of ground covered, excluding the area associated with laps or stitching.

400.2.46.8 Payment Adjustment

Intentionally Deleted

400.2.47 PERMANENT ENVIRONMENTAL PROTECTION DEVICES

400.2.47.1 General

This specification covers the installation of permanent environmental protection devices including silt fences, synthetic permeable barriers, erosion control soil covering, rock check dams and straw bale barriers.

The work shall be in accordance with the Best Management Practices for the various structures as shown in the Design Guidelines for Erosion and Sediment Control for Highways, and as specified herein.

The location, spacing, and the estimated quantities of permanent environmental protection devices will be provided in the Technical Requirements.

400.2.47.1.1 Abbreviations and Definitions

BMP .... Best Management Practice
ECB .... Erosion Control Barrier (Silt Fence)
RECP .... Rolled Erosion Control Products
RCD .... Rock Check Dam
SBB .... Straw Bale Barrier
SBCD .... Straw Bale Check Dam
SPB .... Synthetic Permeable (Ditch) Barrier

400.2.47.2 Materials And Procedures

400.2.47.2.1 Commercially Available Products

Silt fences, synthetic permeable barriers and rolled erosion control products supplied by the Contractor shall be one of the Proven Products from the Alberta Transportation Products List. Alternative products that meet or exceed the material and performance properties shown on the Products List will be accepted subject to the Design Engineer's and the Department's review.

400.2.47.2.2 Pins

Pins shall be made, in either a T or U shape, from 4 mm diameter (minimum) ungalvanized wire. T-shaped pins shall be made from a single length of wire to a height of 200mm after bending. The bar of the T shall be 100mm wide and the free end of the wire shall be bent downward approximately 20mm. U-shaped pins shall have 200mm long parallel legs spaced 25mm apart at the crown.

The Contractor shall have the option of supplying biodegradable plastic or wooden pins, compatible with the proven product, as an alternative to ungalvanized wire pins. For synthetic permeable barriers, the pins shall be in accordance with manufacturer's recommendations.

400.2.47.2.3 Rock

Rock shall meet the requirements of Class 1M Riprap in accordance with Section 400.2.4 (RIPRAP).

400.2.47.2.4 Stakes

Stakes used for silt fence and straw bale check dams and barriers shall be new, construction grade or better spruce wood cut from sound timber, and shall be free from any form of decay. The stake dimensions shall be in accordance with best management practice. Broken or split ended stakes will not be acceptable. Stakes cut from other types of wood may be used subject to the prior acceptance by the Design Engineer and the Department.

400.2.47.2.5 Straw Bales

Straw bales shall be less than 1-year old and shall show no signs of weathering. Bales shall be comprised of weed-free cereal crop straw such as wheat, oats, rye, or barley. Straw bales shall be machine-made, tightly compacted and bound with two rows of wire or synthetic string, and shall be rectangular in plan and cross-section.

400.2.47.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.47.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.47.5 Construction

400.2.47.5.1 Erosion Control Barrier (Silt Fence)

Silt fence barriers shall be constructed as early as practicable to maximize the entrapment of silt, and shall be placed along the contour of the fill slopes at the elevation specified or as directed by the Design Engineer or the Department. The terminal ends of the barrier shall be at a marginally higher elevation to prevent water from bypassing them.

The geotextile used in the fence construction shall be self-edged at the top and shall be buried at the lower end in a shallow trench on the upstream side of the fence line as shown in the BMP

400.2.47.5.2 Rolled Erosion Control Products

Soil covering shall be placed immediately following seeding and fertilizing operations. The Contractor shall ensure that the ground surface is free from stones, or other debris, which would interfere with the uniform contact of the covering within the soil.

Soil coverings shall be unrolled in the direction of expected water flow and shall be applied without stretching so that they loosely, but smoothly, contact the soil surface. The top end of any ditch or slope installation shall be stapled and buried in a narrow trench that is at least 150mm deep. The soil backfill in the trench shall be firmly tamped in place.

Longitudinal laps in covering installation shall be achieved by excavating a check slot of 150mm minimum depth, at the location of the lap, and burying the upper end of the downslope blanket in the slot. The upslope covering shall then overlap the downslope one by a minimum of 150mm. Coverings lying side by side shall be lapped a minimum of 100mm.

Additional check slots shall be provided at a spacing of 15m along slopes and 10m along ditches measured parallel to the ground slope. The covering shall be folded to contact the cross-section of the slot and stapled in place. The trench shall then be firmly tamped. Pinning of RECP shall be as shown in the BMP A common row of pins shall be used for all laps.

400.2.47.5.3 Rock Check Dams

The rock check dam shall be constructed in a 0.15m deep key trench as shown in the BMP. Typically, the weir crest shall be 0.5 metre above the ditch bed elevation unless otherwise directed by the Design Engineer and as accepted by the Department.

400.2.47.5.4 Straw Bale Check Dams and Barriers

Straw Bale Check Dams and Straw Bale Barriers shall be constructed in accordance with BMP No. 11 and No. 12.

Bales shall be placed in an open trench excavated in the ditch to accommodate the dimensions of the barrier as shown on the BMP drawing. The bales shall butt tightly against each other and shall be pinned to the ground with wooden stakes as shown in the BMP The joint between bales shall be caulked using loosing straw.

At the junctions where the sideslopes and backslope meet the ditch bottom, one end face of the bales meeting at these junctions shall be distorted, or otherwise modified, so as to permit a snug fit with the adjacent bale. The joint at these junctions shall also be caulked with loose straw.

400.2.47.5.5 Synthetic Permeable (Ditch) Barrier

The Contractor shall integrate barrier installation with the installation of erosion control soil covering within ditch areas.

Synthetic permeable barriers shall be shall be installed in accordance with manufacturer's recommendations unless otherwise specified in the BMP No. 10.

400.2.47.6 Product Acceptance

All permanent environmental protection devices shall be maintained by the Contractor until the issuance of the Construction Completion Certificate. At no time shall silt or debris build-up be allowed to exceed more than one-half of the above ground vertical height of the structure. Damage to the permanent environmental protection devices, for whatever reason, shall be immediately repaired by the Contractor to the satisfaction of the Design Engineer and the Department.

The Contractor shall assume ownership of all silt and debris trapped by the permanent environmental protection devices and shall dispose of this material to the satisfaction of the Design Engineer and the Department.

400.2.47.7 Measurement

400.2.47.7.1 Erosion Control Barrier (Silt Fence)

Erosion control barrier will be measured in metres based on the length of the structure in-place.

400.2.47.7.2 Rolled Erosion Control Products

Erosion control soil covering will be measured in square metres, based on the surface area of the ground covered by the installation. No allowances will be made for the burying or lapping of material.

400.2.47.7.3 Rock Check Dams

Rock Check Dams will be measured by the volume of rocks present in each structure calculated to the nearest 0.1 cubic metre in-place.

400.2.47.7.4 Straw Bale Check Dams and Barriers

Each row of bales in the structure will be measured in lineal metres.

400.2.47.7.5 Synthetic Permeable (Ditch) Barrier

Each of the single rows of permeable ditch barriers will be measured to the nearest metre.

400.2.47.8 Payment Adjustment

Intentionally Deleted

400.2.48 GABIONS AND GABION MATTRESSES

400.2.48.1 General

This specification covers the preparation of the ground surface to receive gabions, the placement of geotextile and the construction of the gabion structures in place, complete with rock filling in accordance with these specifications at locations specified on the Detailed Designs or described in the Technical Requirements and in accordance with BMP No. 2a-c of the Design Guidelines for Erosion and Sediment Control for Highways.

400.2.48.2 Materials And Procedures

All materials shall be supplied by the Contractor.

400.2.48.2.1 Geotextile

When specified, geotextile fabric shall be Type 'B' non-woven, in accordance with Section 400.2.46 (Geotextile).

400.2.48.2.2 Rock

Rock used for gabion structures shall consist of clean, sound durable stones that are resistant to weathering and water action. Shale or other soft rock may not be used.

The stones shall be angular in shape with a height and width dimension of at least one third the length. The gradation of the mixture shall be such that at least 80 percent (by weight) of the stones, have a minimum dimension of at least 100mm. The maximum dimension of a stone shall be the lesser of 300mm or the gabion structure thickness.

400.2.48.2.3 Gabions and Gabion Mattress

The gabion materials supplied shall be of the Proven Products on the Alberta Transportation Products list. Alternative products meeting the properties listed below may be accepted pending review and acceptance by the Design Engineer and the Department.

Gabion units shall be manufactured from wire in accordance with Federal Specification QQ-W-461G, "Wire Steel, Carbon (Round, Bare and Coated)" and shall be soft tempered. Additional requirements of the wire for gabion units are given in Table 400.2.48.2.3.1.

TABLE 400.2.48.2.3.1
WIRE REQUIREMENTS FOR GABION UNITS

Property [1]	Type		
	Galvanized Basket	Galvanized and PVC Coated Basket	Galvanized and PVC Coated Mattress
Netting Wire dia. (mm)	2.90	2.65	2.20
Self-edge Wire dia. (mm)	3.85	3.40	2.65
Binding Wire dia. (mm) [2]	2.20	2.20	2.20
Zinc coating (gm/m2)	245	245	245
PVC coating (mm	--	0.42	0.42

Note (1): The allowable tolerance on all properties is ± 3 percent
Note (2): Galvanized clips with a wire diameter of 2.90mm may be used with galvanized baskets.

Mattresses and baskets shall be cubical in shape and shall be assembled from independent rectangular faces laced or clipped together. Each face shall be a non-ravelling wire mesh woven with a double twist into regular hexagonal openings measuring approximately 75mm x 100mm. The edges of each face shall be self-edged by weaving the mesh around a reinforcing wire in a manner designed to prevent slippage. The self-edging shall be secure at all points so that joints formed by tying adjacent faces along the self-edges shall be at least as strong as the internal mesh.

Gabion basket and mattress shall be supplied, complete with diaphragms and dividers from among the various sizes listed in Tables 400.2.48.2.3.2 and 400.2.48.2.3.3.

TABLE 400.2.48.2.3.2
GABION BASKET SIZES AND DIMENSIONS

Dimensions and Volumes					
Size No.	Number of Diaphragms	Length (m)	Width (m)	Depth (m)	Capacity (m3)
1	1	2	1	0.3	0.6
2	1	2	1	0.5	1
3	1	2	1	1	2
4	2	3	1	0.3	0.9
5	2	3	1	0.5	1.5
6	2	3	1	1	3

Dimensions and Volumes					
Size No.	**Number of Diaphragms**	**Length (m)**	**Width (m)**	**Depth (m)**	**Capacity (m3)**
7	3	4	1	0.3	1.2
8	3	4	1	0.5	2
9	3	4	1	1	4

TABLE 400.2.48.2.3.3
GABION MATTRESS SIZES AND DIMENSIONS

Dimensions and Volumes						
Size No.	**Number of Dividers**	**No. of Diaphragm**	**Length (m)**	**Width (m)**	**Depth (mm)**	**Plan Area (m2)**
10	1	18	30	2	230	60
11	2	27	30	3	230	90

400.2.48.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.48.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.48.5 Construction

All stumps, roots, debris and rocks shall be removed and disposed of as directed by the Design Engineer and as accepted by the Department, prior to placing gabions. Excavation to accommodate gabion installation shall be carried out to the lines and levels as specified on the Detailed Designs or as directed by the Design Engineer and as accepted by the Department. Geotextile shall be laid free from wrinkles onto the prepared ground surface. Laps in geotextile shall be a minimum of 500mm with the upslope portion on top. The edges of the geotextile shall be neatly trimmed or buried in the ground whichever is specified.

Individual gabion units shall form the component parts of a gabion structure.

Gabion cages shall be assembled by tying the appropriate faces together along the self-edges with binding wire. The binding wire shall be tightly looped around every other mesh opening to form a spiral with single and double loops alternating. Diaphragms and dividers shall be affixed in position by similarly binding them to the mesh of the assembled cage. Free ends of binding wire shall not be made to project from exposed faces of gabion structures.

When assembled, gabion baskets shall be divided by the diaphragms into compartments having a plan dimension of one metre square. Gabion mattress shall be separated lengthwise by the dividers into 1m wide strips. The diaphragms shall further subdivide the mattress into compartments that have a plan dimension of 1m x 3m.

Gabion units, grouped together to form a gabion structure, shall be securely bound to each other along all contacting self-edges in the same manner as the faces are bound in the assembly of the cages.

Irregular shapes in any structure shall be achieved by overlapping and bending the rectangular components. Cutting of the mesh shall be minimized to avoid damage to the galvanized wire. Rocks shall be infilled in the assembled cage units either by machine or by hand. When machine is used, minor rock repositioning shall be done by hand to fill the voids between larger rocks and thereby achieve a dense structure. Rocks along visible faces shall be selected and placed by hand from among the larger sizes with a flat face toward the exterior to produce a semblance of a masonry structure and a neat and workmanlike appearance.

Undue distortion in gabion units shall be avoided. Rock filing shall be carried out in stages with the difference in rock level between any two adjacent compartments limited to 250mm. Further, distortion of gabion baskets shall also be prevented by tying with binding wire, the opposite faces of a compartment at the surface level of the rocks when the depth of fill has reached designated levels. These levels shall be 300mm and 600mm for 1.0m deep baskets and 250mm for 0.5m deep baskets. Cross ties are not required for 0.3m deep baskets.

The exposed faces of a gabion structure shall be maintained true to vertical and horizontal alignment by stretching taut with a standard fence stretcher, or other acceptable method, before placing rocks within the baskets. No such stretching is required for gabion mattress installation. Following the filling of each gabion unit, the lid shall be affixed in position so that the self-edges coincide with the perimeter of the filled gabion unit. The self-edges shall then be laced together in the same manner as described above.

400.2.48.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.48.7 Measurement

400.2.48.7.1 Geotextile

Geotextile will be measured by the square metre, based on the surface area covered by the material, with no allowance made for laps.

400.2.48.7.2 Gabion

Gabion baskets will be measured in cubic metres based on the nominal dimensions of the baskets installed.

400.2.48.7.3 Gabion Mattress

Gabion mattress will be measured in square metres based on surface area of the mattress in place.

400.2.48.8 Payment Adjustment

Intentionally Deleted

400.2.49 TRAFFIC ACCOMMODATION AND TEMPORARY SIGNING

400.2.49.1 General

This specification covers all aspects of traffic accommodation including the preparation of the traffic accommodation strategy and the supply, installation, maintenance and removal of temporary construction signing and traffic control devices which are specifically related to construction, repair or emergency situations and which are generally removed when the work is completed or the situation returns to normal.

Permanent signing for normal use of the roadway is covered in Section 400.2.52 (Permanent Highway Signing).

400.2.49.2 Materials And Procedures

400.2.49.2.1 Traffic Accommodation Strategy

The Contractor shall prepare a traffic accommodation strategy detailing the measures he proposes for accommodating traffic throughout the Project Limits. The minimum requirements are specified in the Department manuals "Traffic Accommodation in Work Zones, Edition 2, 2001" and "Traffic Accommodation in Urban Work Zones, Edition 1, 2003". Any project specific requirements, in excess of the minimum requirements, will be identified in the Technical Requirements.

The traffic accommodation strategy shall consist of drawings detailing the configuration of temporary construction signs and other traffic control devices in the Project Limits and, written confirmation of the methods or procedures being used by the Contractor to address specific traffic safety related issues or situations at the Project Limits.

When localized detours are required, the Contractor's traffic accommodation strategy shall include detailed drawings of proposed traffic accommodation measures, signed and stamped by a

Professional Engineer. The detour plans shall be drawn to scale and shall include the proposed vertical and horizontal alignments. Detours shall meet or exceed the requirements of the following Department manuals:

- Traffic Accommodation in Work Zones, Edition 2, 2001;
- Traffic Accommodation in Urban Work Zones, Edition 1, 2003; and,
- Section B7 of the Highway Geometric Design Guide, 1999.

The Contractor shall submit the traffic accommodation strategy to the Department 14 days prior to the pre-construction meeting for the project or to a schedule as agreed upon by the Design Engineer and the Department. The Design Engineer and the Department will review the traffic accommodation strategy and communicate any concerns to the Contractor within 7 days of the pre-construction meeting. Any issues or concerns regarding the Contractor's proposed traffic accommodation strategy shall be addressed to the mutual satisfaction of the Contractor, Design Engineer and the Department prior to the commencement of the work.

The Contractor shall have no claim against the Department resulting from the Department’s failure to accept the Contractor’s traffic accommodation strategy submission, nor to address concerns raised by the Department during the review of the Contractor’s traffic accommodation strategy submission.

Requirements for Traffic Accommodation and Temporary Signing

Unless otherwise specified in the Technical Requirements, the Contractor shall accommodate public traffic through the Project Limits on a 24-hour per day basis using any means at the Contractor’s discretion, subject to the minimum requirements of the “Traffic Accommodation in Work Zones” and the “Traffic Accommodation in Urban Work Zones” manuals, and subject to the following:

The Contractor shall:

- make suitable provisions, including the use of detours, to accommodate all vehicular and pedestrian traffic safely and with a minimum of inconvenience through or around the work;
- provide, install, maintain and protect traffic control devices such as signs, barriers, fences and lights in accordance with Section 400.2.49 (Traffic Accommodation and Temporary Signing);
- install, maintain and protect any additional traffic control devices that the Department chooses to provide;
- provide the required number of flagpersons, during all periods of active equipment operations which may affect normal traffic operations;
- control his operations to ensure normal school bus operations are not interfered with;
- ensure uninterrupted access to developments along the Project;

- obtain prior acceptance from the Design Engineer and the Department before changing or disrupting existing accesses and road crossings;
- carry out construction operations in one continuous operation at road crossings, intersections and entrances for each phase of the work;
- when working in large cut or fill areas, stage construction as shown on Standard Drawing CB6-2.3M30, and as accepted by the Design Engineer and the Department;
- provide and use such other methods or equipment necessary to accommodate traffic safely through the work site; and

include provision in the traffic accommodation strategy for the new Standard Drawing "TCS-B-8.1 for Double Fines when Passing Workers in the active work area". The Contractor is advised that the signing sequence shown on this drawing is provided as general guidance only. The Contractor shall adjust the traffic accommodation strategy and construction zone signing as required based on the applicable conditions. If the Contractor's operations are such that the active work area exceeds 5 km in length, the Contractor shall install interim "speed limit" and "ID-503" signs at the approximate mid-point of the active work area. If the Contractor maintains separate active work areas where the cumulative length of the active work area plus any gaps exceeds 5 km, the Contractor shall sign each active work area separately in general accordance with Standard Drawing "TCS-B-8.1".

The Contractor shall promptly make any modifications to the traffic accommodation operations deemed necessary by the Design Engineer or the Department. The Department may suspend work in cases where in its opinion, the Contractor fails to adequately provide for the safety of the public, for recurring safety issues or when the Contractor fails to comply with orders issued by the Department regarding traffic accommodation operations.

The Contractor shall remove or cover all traffic control devices when not essential for the safe accommodation of traffic, in order to eliminate unnecessary inconvenience to the traffic.

The Contractor shall coordinate its traffic accommodation measures with those of other forces at or adjacent to the work, as required, to accommodate traffic safely and conveniently. This shall not relieve the Contractor of its responsibility for the safe accommodation of traffic over the whole of the work.

400.2.49.2.2 Typical Drawings

Drawings detailing minimum requirements for temporary signing and other traffic control devices for typical rural highway situations are contained in Section II of the Department manual entitled Traffic Accommodation in Work Zones, Second Edition, 2001.

Drawings detailing minimum requirements for temporary signing and other traffic control devices for typical urban highway situations are contained in Section II of the Department manual entitled Traffic Accommodation in Urban Work Zones, First Edition, 2003.

Any drawings necessary to address non-typical rural or urban highway situations shall be developed by the Contractor and included in the traffic accommodation strategy.

400.2.49.2.3 Temporary Construction Signing

Materials

The Contractor shall supply all signing materials including sign posts, weighted stands, brackets and any required mounting hardware and miscellaneous materials required for the erection of temporary construction signs.

All signs, barricades and other traffic control devices shall conform to the requirements for shape, colour and size specified in Section IV of the Department manual entitled "Traffic Accommodation in Work Zones". The orange portion of all signs, barricades and other traffic control devices shall be fully reflectorized using High Brightness, Retroreflective, Non-Metallized, Prismatic Sheeting Material which incorporates durable, transparent, fluorescent pigment and meets the brightness requirements as specified in ASTM D4956 Type VIII sheeting. Unless otherwise accepted by the Department, the orange coloured reflective sheeting supplied by the Contractor shall be one of the Proven Products for “Temporary Orange Work Zone/Construction Signs” listed on the Alberta Transportation Products List on the Department’s web site.

All other colours of sheeting material shall be Type III or Type IV high intensity retroreflective sheeting meeting or exceeding the minimum requirements as specified in ASTM-D4956.

Larger construction signs or oversized signs may be used where conditions require greater visibility in order to be effective. They shall be used in special circumstances where more than average attention value is required from the sign.

Equipment

The Contractor shall supply all equipment required to complete the work.

Erection of Signs

Work on the project shall not commence until all necessary temporary construction signs and all other traffic control devices as proposed in the traffic accommodation strategy are in place.

When signs require frequent moves, portable type signs, mounted on weighted stands, may be used. Portable signs shall be placed on the shoulder of the road such that the face of the sign is fully visible to oncoming traffic and the bottom of the sign is not less than 0.3m above the road surface. The stands shall be securely weighted and erected to ensure against being blown over by prevailing winds or gusts from passing vehicles.

Non-portable signs shall be conspicuously posted, and erected at right angles to the roadway, with the bottom of the sign at a height of 1.5m above the roadway surface, and not less than 2 metres nor more than 6.0m from the nearest traffic lane.

Traffic signs and devices shall be moved and kept as close to the work area as practical, as construction proceeds.

Objects within or immediately adjacent to the roadway which constitute a hazard to traffic shall be marked with alternating black and orange stripes attached directly to the object or erected immediately in front of it.

The use of signs shall be held to a minimum to prevent confusion.

"STOP" signs shall be installed on all subsidiary roads (local, district, municipal, service or approach) intersecting a primary highway detour route.

Speed zones, where required, shall be posted as indicated on the applicable drawing contained in the Traffic Accommodation in Work Zones manual.

<u>Maintenance and Removal of Signs</u>

Poorly maintained, defaced, damaged or dirty construction signs shall be replaced, repaired or cleaned without delay. Special care must be taken to ensure that construction materials and dust are not allowed to obscure the face of a sign.

Signs not in effect shall be covered or removed and all construction signs shall be removed after the project is completed.

<u>Modifications to Temporary Construction Signing</u>

The Contractor shall be totally responsible for the supply and proper placement of temporary construction signs. However, in the case of potential danger to the traveling public or other circumstances where the Department determines that signing is inadequate, the Department will require changes to the Contractor's operations to remedy the situation. These changes may involve the use of different types and/or sizes of signs, modifying the number or locations of signs, and any other modifications or additions required to protect the safety of the travelling public.

<u>Daily Recording of Temporary Construction Signing</u>

Each day and as the work area changes, the Contractor shall record the location of all temporary construction signs and any other traffic control devices used at the work areas. The Contractor shall record this information on a form suitable to the Department and shall submit it to the Department on a weekly basis or when requested.

400.2.49.2.4 Removal and Salvage of Existing Signs and Guideposts

All existing signs and guideposts which must be removed in the prosecution of the work shall be carefully salvaged by the Contractor. Critical signs necessary for the protection of traffic such as railroad crossing signs or stop signs shall be maintained. Maintenance, removal and salvage of signs and guideposts will be considered incidental to the work.

400.2.49.2.5 Sequential Arrowboards and Variable Message Boards

General

When specified in the Technical Requirements, the specifications, or as directed by the Department, the Contractor shall use sequential arrowboards for the accommodation of traffic. The Contractor shall have the option of supplying either stationary arrowboards or truck-mounted mobile arrowboards.

When specified in the Technical Requirements, the specifications, or as directed by the Department, the Contractor shall supply and operate an electronic variable message board in advance of the sequential arrowboard.

Stationary Arrowboards

Stationary arrowboards shall meet the following requirements:

- (i) Minimum size of 1.22 metres x 2.44 metres (4 ft x 8 ft),
- (ii) Minimum of 25 lamps that are legible at a minimum distance of 1,200 metres,
- (iii) Fully adjustable light intensity on all arrowboard lights,
- (iv) Operating modes which include:
  - (a) sequential left arrow or chevron
  - (b) sequential right arrow or chevron
  - (c) sequential double arrow or chevron
  - (d) horizontal bar
  - (e) all four lamps in the extreme corners of the panel shall be flashing

Truck-Mounted Mobile Arrowboards

Truck-mounted mobile arrowboards shall meet the following requirements:

- (i) Minimum size of 0.75 metres x 1.52 metres (2.5 ft x 5 ft),
- (ii) Minimum of 25 lamps are legible at a minimum distance of 1,200 metres,
- (iii) Fully adjustable light intensity on all arrowboard lights,
- (iv) Operating modes which include:
  - (a) sequential left arrow or chevron

(b) sequential right arrow or chevron
(c) sequential double arrow or chevron
(d) horizontal bar
(e) all four lamps in the extreme corners of the panel shall be flashing

400.2.49.2.6 Flagpersons

General

When construction operations or Project Limits conditions cause interruption, delay or hazard to the traveling public or anyone on the worksite, and necessitates the use of flagpersons; the Contractor shall provide and equip responsible flagpersons for the direction and control of traffic. The Contractor shall ensure that flagpersons are instructed in and use proper traffic control procedures appropriate for the prevailing conditions.

Flagpersons shall have proof of certification from a recognized training program on traffic control procedures through construction zones. The Department will recognize traffic control programs administered by the Alberta Construction Safety Association, however the Department reserves the right to accept or reject certification from any other institute.

Safety Apparel

Coveralls

Flagpersons shall be dressed in coveralls which meet the Class 3 Level 2 requirements of CSA Z96-02, High Visibility Safety Apparel. Each pair of coveralls shall have a permanent label affixed certifying compliance with Class 3 Level 2 of CSA Z96-02.

The colour of the coveralls shall be fluorescent yellow-green with silver retroreflective striping. The retroreflective striping shall be a minimum of 50mm wide, and shall be sewn onto a 100mm wide fluorescent red-orange background material. Flagperson safety apparel shall be kept clean and in good condition at all times. Faded, torn and/or dirty coveralls, or coveralls without CSA certification labels, will not be acceptable, and shall be replaced by the Contractor at the Department's discretion.

Headgear

Prior to commencement of the work, the Contractor shall identify and assess existing and potential hazards at the project site. Where there is a foreseeable risk of injury to a worker's head, flagperson's shall wear fluorescent orange protective hardhats meeting the requirements of CSA Standard Z94.1-92.

Where no foreseeable risk of head injury exists, flagpersons will be permitted to wear any type of fluorescent orange headgear.

Night Time Operations

During hours of darkness, flagpersons shall be equipped with hand held red traffic signal wands of sufficient brightness to be clearly visible to approaching traffic. In addition, flagging stations shall be illuminated by overhead lighting; and signs indicating hazardous conditions and signs requiring increased attention shall be marked with flashers.

400.2.49.2.7 Detours

Unless otherwise indicated in the Technical Requirements, the Contractor shall have the option of constructing temporary localized detours, or utilizing local roads for the accommodation of Public traffic around major phases of the work.

Localized Detour within or adjacent to the Right-of-Way

Subject to review by the Department, localized detours within or adjacent to the right-of-way may be utilized by the Contractor to carry traffic around the work.

If the Contractor elects to accommodate traffic using localized detours, the Contractor shall be responsible for the design, construction and removal of the localized detour. In addition, the Contractor shall be responsible for any environmental authorizations, right-of-way easements, the temporary relocation of any utilities, and including the reclamation of the disturbed areas to a similar condition as existed prior to the disturbance. Prior to the commencement of any construction, the Contractor shall provide a copy of the authorizations and easement agreements to the Department for its review.

Local Road Detour

When traffic is diverted entirely off the right-of-way via local roads, the Contractor shall establish and maintain local road detour signing, complete with signs at every intersection in accordance with the Technical Requirements.

The Contractor shall initially condition, maintain and restore roads used as local road detours to the satisfaction of the agency having jurisdiction, and in the case of provincially owned or controlled roads, to the satisfaction of the Department. The Contractor shall maintain the local roads, apply dust abatement, and following completion of the work, restore the road to a condition as good as existed prior to the start of work.

If the Contractor elects to use local roads to accommodate public traffic, the Contractor shall be solely responsible for obtaining authority to utilize the local road detour from the Local Authority.

400.2.49.2.8 Roadway Maintenance and Graveling

When the work requires disturbance of the surface of an existing roadway that is carrying public traffic, the Contractor shall keep the disturbed areas of the traveled lanes well graded, free of potholes and of sufficient width for the required number of travel lanes.

When in the opinion of the Department surfacing gravel is required for traffic accommodation on areas disturbed by the Contractor prior to the completion of the work on these areas, the Contractor shall promptly provide and place crushed surfacing gravel to the satisfaction of the Department.

For roads other than detours and haul roads from gravel pits, the provision and placing of crushed surfacing gravel shall be by the Contractor. If the Project has a Department option source of gravel, the Department will provide, at its source, the pit-run gravel to be crushed.

The Contractor will not be responsible for maintenance of those areas of an existing roadway which are to be constructed or reconstructed, but which have not yet been disturbed by the Contractor's construction or hauling activities.

400.2.49.2.9 Prolonged Shut-down

Prior to any prolonged shut-down of construction, the Contractor shall ensure that any disturbed roadway surface is restored to a condition suitable for traffic operations and acceptable to the Department. The Contractor will be responsible for normal winter snow and ice control for traffic accommodation during the prolonged shut-down.

Prior to commencing any prolonged shut-down of the work, the Contractor shall host a meeting between the Contractor, the Department, and the Maintenance Contractor. The purpose of the meeting shall be to develop a “Shutdown Plan” based on the specific needs and requirements of the project. The “Shutdown Plan” shall outline the Contractor’s methods and procedures for monitoring and maintaining the project during the winter shutdown period, and will outline any responsibilities of the other parties.

Notwithstanding the above, no component of the shut-down plan will negate the Contractor’s responsibilities for the project, except for snow and ice control.

400.2.49.2.10 Dust Abatement

The Contractor shall maintain detours and disturbed roadways that carry traffic within the Project limits free of excessive dust. In this case, "disturbed roadways" shall mean sections of roadway under construction and/or sections of roadway being used by the contractor for hauling of equipment or materials. The Contractor shall supply and apply all dust abatement materials.

Dust abatement requirements for haul roads are detailed in Section 400.2.30 (Hauling).

400.2.49.2.11 Traffic Accommodation for Bridge Construction

In addition to the requirements stated herein, the following requirements are required for work involving bridges and bridge culverts.

Detailed traffic control plans, taking into account site specific conditions that may impact the work shall be provided for each bridge site.

Traffic control shall be in place only during the time it is applicable to the work on the bridge site.

Traffic control signals, if required, shall be adjusted to the traffic demands encountered.

The Contractor shall minimize inconvenience to traffic as much as possible, and shall provide the widest traffic roadway width practicable. The minimum traffic roadway width, as shown or specified, shall be maintained and be available to public traffic at all times.

The Contractor shall anticipate and as practical accommodate wide load vehicles that may enter the Project Limits.

400.2.49.3 Quality Management Sampling And Testing

To ensure the traffic accommodation strategy is performing as intended, the Contractor shall monitor and maintain traffic accommodation at the Project Limits on a regular basis. The Contractor shall designate a specific individual to perform this function to ensure any issues arising are addressed in a consistent and timely manner.

These worker(s) shall be qualified, trained and experienced in traffic control and must be knowledgeable in the operation of the traffic control devices and other related equipment. These workers shall be provided vehicles equipped with revolving warning lights and suitable communication devices to contact others for assistance if and when required. The Contractor shall identify those workers who will be responsible for monitoring and maintaining the traffic control devices at the preconstruction meeting.

The Contractor shall monitor all traffic control devices, temporary signing and roadway conditions during periods of inactivity. The frequency of inspection shall be commensurate with the traffic volumes on the highway. For all localized detours on roadway and bridge projects, and for staged construction on bridge projects, under no circumstances shall consecutive inspections be more than six hours apart, unless otherwise agreed by the Department. All site inspections shall be documented by the Contractor and available for the Department's review upon request.

400.2.49.4 Acceptance Sampling And Testing

The traffic accommodation measures will be monitored by the Department. If, in the opinion of the Department, traffic is being unduly hindered, the Contractor may be required to modify his traffic accommodation measures.

400.2.49.5 Construction

Intentionally Deleted

400.2.49.6 Product Acceptance

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400.2.49.7 Measurement

Intentionally Deleted

400.2.49.8 Payment Adjustment

400.2.49.8.1 Bonus and Penalty Assessment

The Contractor will be assessed a $250.00 penalty for each issued Notice of Default (as defined in section 16.7 of the DB Agreement).

The Contractor will be assessed a $1,000.00 penalty for each Remedial Action (as defined in section 16.6 of the DB Agreement) taken by the Province.

400.2.50 PAINTED ROADWAY LINES

400.2.50.1 General

400.2.50.1.1 Description

This specification covers the painting and removal of roadway lines including edge lines, lane lines, continuity lines and directional dividing lines as shown on the Detailed Designs or indicated in the Technical Requirements.

400.2.50.1.2 Contractor Quality Management Inspection Plan

The Contractor shall be totally responsible for quality management inspection throughout every stage of the work to ensure that materials and workmanship comply with the Technical Requirements.

The Contractor shall develop and submit in writing to the Department a Quality Management Inspection Program (QMIP) that addresses all the elements that affect the quality of the line painting including but not limited to:

- Paint Application Rates,
- Glass Bead Application Rates,
- Pavement Surface and Atmospheric Conditions,
- Line Widths, Line Lengths and Space Lengths.

The Contractor shall maintain records of QMIP data, complaints from the public, and other details relevant to the work and shall provide these records to the Department daily.

400.2.50.2 Materials And Procedures

The Contractor shall supply all paint and glass beads in accordance with Section 400.2.39 (Supply of Line Painting Materials).

400.2.50.2.1 Equipment

General

The Contractor shall provide all equipment necessary for completion of the work including but not limited to the painting truck, a pilot truck, a crash attenuator vehicle and all ancillary equipment such as fork lifts, hoists, pumps and transport vehicles required to load, unload and transport the paint and glass beads.

Painting Truck

The painting truck shall be self-propelled and equipped to meet or exceed the following requirements:

(a) Two paint tanks each having a minimum capacity of 270 litres feeding three lines for a simultaneous two-colour application (two yellow directional dividing lines and one white edgeline).

(b) Painting controls capable of adjusting the paint application for the length of dashed line required. Each spray gun shall have independent controls and adjustment mechanisms, and shall be operated from the operator's compartment.

(c) The compressor shall have a minimum rated capacity of 4.25 cubic metres per minute.

(d) Bead dispensers shall be electrically controlled, air operated, gravity fed with controls to adjust the bead flow. The bead dispensers shall be fed from tanks capable of holding a minimum of 45 kilograms of beads.

(e) A television vehicle guidance, or a vehicle guidance system mounted on a retractable A-frame with a guide wheel and pointer system, to assist the truck driver in maintaining alignment on the existing lines.

(f) A minimum of five spray guns and five bead dispensers mounted in the following configuration:

   (i) Three spray guns and three bead dispensers mounted on an independently-controlled boom located on the left side of the truck to paint the directional dividing lines. The outer two spray guns and bead dispensers shall be in a configuration that will produce two lines of equal width with the distance between the two lines equal to the width of one line (100mm). The inner spray gun and bead dispenser shall operate independently and shall be used to apply the directional dividing line where only a single directional dividing line is required. When a 200mm wide line is required, 2 guns shall be used simultaneously.

(ii) Two spray guns and two bead dispensers mounted on an independently controlled boom on the right side of the truck to apply the right edge line. When a 200mm wide line is required, 2 guns shall be used simultaneously.

(g) Equipped to apply white or yellow paint from the three spray guns mounted on the left hand side of the paint truck and to switch from one colour to the other during operation.

(h) Control of both independent booms, all spray guns, bead dispensers and painting controls from the operator's compartment(s).

Companion Vehicles

The painting vehicle shall be immediately followed by a vehicle equipped with a crash attenuator which meets National Cooperative Highway Research Program, Report 350 Test Criteria, Test Level 3 for 100 km/hour work zones. The weight of the crash attenuator vehicle including ballast, flashing arrow board and truck mounted crash attenuator shall be 6,300 to 12,000 kg.

The crash attenuator vehicle shall be followed by a ½ ton or larger truck acting as a pilot vehicle.

Safety Equipment

The painting truck and both companion vehicles shall be equipped with the following:

(a) A two-way radio for voice communication.

(b) An overhead revolving beacon with an amber lens a minimum of 180mm high and 180mm wide. The beacon shall be mounted on the top of the vehicle fully visible to traffic approaching from both front and rear.

(c) A sequential arrowboard meeting the requirements as shown in Section 400.2.49 (Traffic Accommodation and Temporary Signing).

(i) The arrowboard shall be controlled from a console located in the vehicle cab.

(ii) The arrowboard display shall be visible to traffic approaching the rear of the trucks.

(d) A "slow moving vehicle" sign. The sign shall be mounted at the rear of the vehicle and be visible to the public only when the painting truck is applying paint.

(e) A warning sign, mounted at the rear of the truck, stating "wet paint keep off". The sign shall have standard warning colours with letters having a minimum height of 150mm and shall be visible to the public only when the truck is applying paint.

400.2.50.2.2 Highway Operations

General

All painting shall be carried out during hours of daylight between ½ hour after sunrise and ½ hour before sunset. Generally, the Contractor may paint lines during any day of the week but is cautioned that traffic volumes are usually higher on all highways on Friday, Saturday and Sunday. Line painting on highways with relatively high traffic volumes shall be performed between Monday and Thursday inclusive if so directed by the Department.

Operation of the painting truck against the flow of traffic will not be permitted.

Loading glass beads or paint onto the painting truck is not permitted on a roadway surface.

Operation of Companion Vehicles

The Contractor shall operate both companion vehicles in conjunction with the painting truck during the painting of all longitudinal lines. Companion vehicle operators shall not attempt to control traffic from inside the vehicle.

The actual operating parameters of the companion vehicles will be determined by the Contractor to safely accommodate traffic and will be based on site specific conditions such as sight distances, highway geometrics and traffic patterns and volumes. Typical operating parameters are as follows:

Crash Attenuator Vehicle

The crash attenuator vehicle shall follow behind the painting truck at a distance of 50 to 400 metres. Typically, on 4 Lane highways the crash attenuator vehicle should closely follow the paint truck to encourage traffic to maintain the passing lane and not pull in behind the paint vehicle. On 2 Lane roadways, traffic should still be encouraged to pass both vehicles in one pass, however actual conditions may dictate that the crash attenuator vehicle give way to allow safe passing.

On Single Lane Roads (for example on interchange ramps) the crash attenuator vehicle shall be driven in the travel lane to keep traffic from passing the painting truck.

Pilot Vehicle

On 2 lane and 4 Lane Highways the pilot vehicle shall be operated as follows:

(i) On a 4 Lane Highway, the pilot truck shall be driven in the same travel lane as the paint machine, following it at a constant distance of approximately two kilometres.

(ii) On a 2 Lane Highway with a minimum 3 metre shoulder, the pilot truck shall be driven along the right shoulder, not straddling the right edge line and following the painting truck at a constant distance of approximately two kilometres.

(iii) On a 2 Lane Highway with less than a 3 metre shoulder, the pilot truck shall travel from approach road to approach road and stop until the paint machine has cleared the next approach road. Approach road in this context includes local roads, farm entrances, field entrances, etc. The pilot truck, when stopped in an approach road, shall sit parallel to the highway in order that the signs and arrowboard are fully visible to traffic approaching from the rear.

400.2.50.2.3 Arrowboard Message

The crash attenuator vehicle, pilot truck and the painting truck are to display the same message at all times. The message shall be one of the following:

(a) On 2 Lane Highway - a bar (6 horizontal lights flashing) is preferred but if a bar cannot be shown on the type of arrowboard used, the 4 corner lights flashing is an acceptable alternative.

(b) On a 4 Lane Highway - a right arrow when operating in the left lane and a left arrow when operating in the right lane.

(c) On a Single Lane Road (for example the exit leg of an interchange) - four flashing corner lights or a bar.

400.2.50.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.50.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.50.5 Construction

400.2.50.5.1 Areas to be Painted

The Contractor shall paint lane lines, continuity lines, edge lines and directional dividing lines on the highway sections, interchanges or intersections specified in the Detailed Designs. At intersections, edge lines shall be painted to the right-of-way limit or the point where the pavement ends whichever occurs first.

On pavement overlay projects, the Contractor shall ensure that the start and finish of "No-Passing Zones" are consistent with those on the underlying pavement, unless otherwise directed by the Department.

On new construction, the start and finish of "No-Passing Zones" will be determined and laid out by the Design Engineer and accepted by the Department.

400.2.50.5.2 Pavement Surface and Atmospheric Conditions

Painting shall not be performed during the following conditions:

(i) When the temperature is below 0ºC for alkyd paints and 10ºC for waterborne paints.
(ii) When wind conditions cause overspray.
(iii) When the visibility is less than 700 metres.
(iv) During periods of rainfall.

Areas to be painted shall be clean and dry during the application of paint.

Areas to be painted shall be inspected by the Contractor to ensure they are clean, free of sand and debris, and suitable for painting. Sweeping, when required, shall be completed by the Contractor.

400.2.50.5.3 Paint and Bead Application

All painted lines shall be uniformly applied at a minimum rate of not less than 38 l/km of solid 100mm wide line. Glass beads shall be applied immediately following the paint application at a uniform minimum application rate of not less than 600 g/l of paint.

The Contractor may heat alkyd paint to a maximum temperature of 65ºC prior to application to the roadway surface to reduce drying time. The Contractor shall use due care in heating the paint because of its volatile nature. Waterborne paints shall not be heated.

400.2.50.6 Product Acceptance

All painted lines shall not exceed a dimensional width of 110mm for specified 100mm wide line. No tolerance below 100mm is allowed for the specified 100mm wide line.

All painted lines shall not exceed a dimensional width of 210mm for specified 200mm wide line. No tolerance below 200mm is allowed for the specified 200mm wide line.

All painted direction dividing, lane dividing or continuity lines shall not exceed a maximum dimensional length deviation of +/- 100mm for specified 3.0m length of line.

All spaces between painted direction dividing, lane dividing or continuity lines shall not exceed a maximum dimensional length deviation of +/- 100mm for specified 6.0m or 3.0m length of space.

All paint shall be applied at the proper locations in accordance with the Detailed Designs, Technical Requirements or as directed by the Department.

All paint and glass beads shall be uniformly applied.

All painted lines shall be uniform in thickness and free of tire tracking, with no splatter, excessive overspray or other defects.

400.2.50.6.1 Removal, Repair or Replacement of Unacceptable Painted Lines

All painted lines that do not meet the requirements of the Technical Requirements shall be removed and correctly applied or repaired by the Contractor.

In cases where the paint is "tracked" by vehicles tires, the lines may be repaired by reapplying paint and glass beads to the damaged areas.

In cases where incorrectly painted lines need to be removed, the Contractor shall use methods and equipment that will totally eliminate the pattern of the lines without damaging the integrity of the pavement surface. The methods and equipment used for such work shall be reviewed and accepted by the Design Engineer and the Department prior to their use. Obliterating incorrectly painted lines through the sole use of paint, liquid asphalt, slurry seal or other similar materials will not be permitted.

400.2.50.6.2 Painting of Temporary Roadway Lines for Seasonal Shutdown

When the Contract is carried over from one season to the next, all newly constructed asphalt pavement or asphalt stabilized surfaces shall be provided with temporary roadway lines as directed by the Design Engineer and the Department. All temporary roadway lines shall be painted in conformance with the Technical Requirements.

400.2.50.6.3 Removal of Existing Painted Lines

Removal of existing painted lines shall be done as described in Section 400.2.50.6.1 (Removeal, Repair or Replacement of Unacceptable Painted Lines) for incorrectly painted lines.

400.2.50.7 Measurement

400.2.50.7.1 Painting Roadway Lines

Measurement of painted roadway lines will be made in kilometres along the centreline of the roadway for the length of road painted including the length of road through intersections.

400.2.50.8 Payment Adjustment

Intentionally Deleted

400.2.51 PAINTED PAVEMENT MESSAGES

400.2.51.1 General

The work shall consist of painting pavement messages such as crosswalk, stop ahead, turning arrows and stop bar lines, at the locations shown in the Technical Requirements and the Detailed Designs.

400.2.51.2 Materials And Procedures

400.2.51.2.1 Templates

The Contractor shall supply templates to the dimensions as shown on the applicable figures and drawings. The dimensions shown on the figures are in millimetres unless otherwise indicated.

400.2.51.2.2 Paint and Glass Beads

The Contractor shall supply the paint and glass bead materials in accordance with Section 400.2.39 (Supply of Line Painting Materials).

400.2.51.2.3 Scheduling of the Work

All painting shall be carried out during hours of daylight between ½ hour after sunrise and ½ hour before sunset. Generally the Contractor may paint messages during any day of the week but is cautioned that traffic volumes are usually higher on all highways on Friday, Saturday and Sunday. Message painting on highways with relatively high traffic volumes shall be performed between Monday and Thursday inclusive if so directed by the Department.

Scheduling of the work shall be subject to the approval of the Department. Prior to commencement of the work, the Contractor shall submit his schedule to the Department for consideration.

400.2.51.2.4 Painting Pavement Messages

Pavement Surface and Atmospheric Conditions

Painting shall not be performed during the following conditions:

- When the temperature is below 0ºC.
- When wind conditions cause overspray.

- When the visibility is less than 700 metres.
- During periods of rainfall.

Areas to be painted shall be clean and dry during the application of paint.

Areas to be painted shall be inspected by the Contractor to ensure they are clean, free of sand and debris, and suitable for painting and any required sweeping or otherwise cleaning shall be undertaken by the Contractor.

Paint and Bead Application

Messages shall be painted using the templates. Each message shall be painted once unless otherwise specified in the Technical Requirements or directed by the Design Engineer or the Department.

All painted messages shall be applied at the rate of 0.4 l/m2 of actual painted area. Glass beads shall be applied immediately following the paint application at a uniform application rate of 600 g/l of paint. Aircraft Patrol Zone markings do not require glass bead application. Messages initially applied at less than the specified rate, as determined by the Department, shall be repainted by the Contractor.

All painted messages shall be uniform in thickness with no splatter, excessive overspray or other defects.

Traffic shall be kept off painted messages until the paint has dried to traffic and will not track.

Durable Painted Messages

All work shall be performed in accordance with Section 400.2.51 (Painted Pavement Messages), and the manufacturer's recommended procedures. In cases of conflict the more stringent requirements shall apply.

Removal, Repair or Replacement of Unacceptable Painted Messages

All painted messages that do not meet the requirements of this specification shall be removed and correctly applied or repaired by the Contractor.

In cases where the paint is "tracked" by vehicles tires, the messages may be repaired by reapplying paint and glass beads to the damaged areas.

In cases where incorrectly painted messages need to be removed, the Contractor shall use methods and equipment that will totally eliminate the pattern of the messages without damaging the integrity of the pavement surface. The methods and equipment used for such work shall be reviewed and accepted by the Department prior to use. Obliterating incorrectly painted messages through the sole use of paint, liquid asphalt, slurry seal or other similar materials will not be permitted.

400.2.51.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.51.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.51.5 Construction

Intentionally Deleted

400.2.51.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.51.7 Measurement

Painted Messages and Durable Pavement Messages will be measured on a per message basis for each time the message is applied to the road.

400.2.51.8 Payment Adjustment

Intentionally Deleted

400.2.52 PERMANENT HIGHWAY SIGNING

400.2.52.1 General

The work consists of the removal and reinstallation or disposal of existing signs and the installation of new signs, and includes traffic control signing, guide signing and facility signing for the normal use of the roadway. Signing for construction, repair or emergency situations is specified in Section 400.2.49 (Traffic Accommodation and Temporary Signing).

The Contractor shall supply and install tubular steel sign posts for select sign installations as indicated in the Detailed Designs or as directed by the Department. Sign posts shall be installed either with an anchored post base or be embedded in a concrete foundation, as directed by the Design Engineer and as accepted by the Department.

400.2.52.2 Materials And Procedures

The Contractor shall supply all materials required for the installation of permanent signs including frames for cluster signs, concrete bases, steel breakaway posts, wooden posts and all bolts and required mounting hardware, in accordance with Section 400.2.38 (Supply of Permanent Highway Signs, Posts and Bases).

When the work necessitates the removal, salvage and reinstallation of signs, only materials from the existing installations shall be used. Contractor stockpiles of used material from other sources will not be considered acceptable.

400.2.52.2.1 Tubular Steel Sign Posts

The Contractor shall supply 60 or 90mm diameter (outside diameter) tubular steel posts for the installation of signs in accordance with the Technical Requirements and Detailed Designs. The steel posts shall be manufactured using 12 gauge aluminum steel sections. The tubular steel posts shall have a top cap that prevents any material entering the post from the top.

All fasteners and sign support brackets, shall include: frangible couplers, caps, bolts, nuts, washers and other hardware shall be cast aluminum alloy.

All tubular steel sign posts installed on concrete surfaces shall be supplied with frangible post support couplers. The Contractor shall provide a "Quickfix ™" frangible post support coupler or approved equivalent which has passed the required tests for a Test Level 3 (TL-3) for structural supports for highway signs, luminaires and traffic signals of the National Cooperative Highway Research Program (NCHRP) Report 350.

The concrete to be used for the concrete signs foundations shall be Class B - with Type HS Portland cement.

400.2.52.3 Quality Management Sampling And Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management System.

400.2.52.4 Acceptance Sampling And Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.52.5 Construction

400.2.52.5.1 Removal of Existing Signs

Existing signs which must be removed in the prosecution of the work shall be carefully salvaged and reinstalled. New wooden posts shall be used if the existing posts cannot be salvaged. Critical signs necessary for the protection of traffic such as railroad crossing signs or stop signs shall be maintained.

Existing signs designated for removal and disposal shall become the property of the Contractor.

400.2.52.5.2 Removal of Concrete Bases and Breakaway Posts

The Contractor shall remove the sign and breakaway posts from the existing concrete base and salvage for reinstallation or dispose of as directed by the Design Engineer or the Department.

When required, the existing base shall be removed, salvaged, and moved to the new installation site.

Where a base cannot be totally removed, the tops of the base shall be removed to below ground level and the excavation backfilled to the adjacent ground level.

400.2.52.5.3 General Installation and Layout

The Design Engineer will provide plan layout information in the form of a base line for the installation of the permanent signs. The Contractor shall establish the height and elevation of the sign and install it in accordance with the Detailed Designs or as directed by the Department.

It is the Contractor's responsibility to have all sign locations checked for utilities prior to digging holes for posts. Any adjustments to the locations of signs will be subject to the approval of the Design Engineer and acceptance by the Department.

The soil at the bottom of holes shall be thoroughly compacted to provide a firm bearing. Posts shall be set vertically and backfilled with material free of organics. All backfill shall be placed in thin layers and thoroughly compacted for the full depth. Cementitious materials shall not be used as backfill.

The disturbed area around installations shall be restored to the original contours.

The signs shall be fixed securely to the post(s) in accordance with the Technical Requirements.

400.2.52.5.4 Installation of Concrete Bases

Concrete bases shall be installed as shown on drawings TEB 1.82 and TEB 1.83. The Contractor shall excavate holes to a minimum of 300mm larger than the base and the base shall be installed in the centre of the excavation. The backfill around the base shall be placed in thin layers and shall be thoroughly compacted for the full depth.

400.2.52.5.5 Installation of Breakaway Steel Posts

All installations shall conform to drawing TEB 1.82. The installed post shall be within 1.5

degrees of vertical.

When salvaged materials are used, the sign and breakaway steel posts shall be reassembled and installed on the base at the new site. When new posts are required, the size of steel I-Beam post will be as shown on the Detailed Designs or specified by the Department or in the case of a replacement, it will be the same size as the post being replaced.

The Contractor shall saw cut the flange and web; and cut, drill, weld and shim the flanges for the base joint as required to ensure an unstressed installation.

Damage to galvanized surfaces shall be repaired by treating the damaged areas with zinc rich paint.

400.2.52.5.6 Installation of Wooden Posts

Posts shall be installed in accordance with drawing TEB 1.70 and shall be within 1.5 degree of vertical.

When a post is removed and replacement is not requested, the Contractor shall backfill the hole in thin compacted lifts.

Posts with rectangular cross-sections shall be installed such that the longer dimension is oriented parallel to the direction of the highway.

Unless otherwise directed by the Design Engineer or the Department, posts with a nominal cross-section larger than 100mm x 100mm shall be weakened as shown on Drawing TEB 1.81.

400.2.52.5.7 Installation of Cluster Frames

The new frames shall be installed perpendicular to and facing the approaching traffic lane and shall be securely fastened to the post in accordance with drawing TEB 1.69.

400.2.52.5.8 Installation of Signs

Signs shall be mounted in accordance with drawings TEB 1.69, TEB 1.71, TEB 1.72, TEB 1.75, TEB 1.82 and TEB 1.95.

The installed sign shall be clean and not bent or twisted. The reflectorized surface shall be free of scratches and marks and must be securely fastened to the post or frame.

Signs on utility posts shall be mounted by a procedure approved by the utility owner.

400.2.52.5.9 Tubular Steel Sign Posts

Stand alone signs shall be installed in concrete foundations with 90mm diameter posts.

Signs installed on medians or concrete structures shall be installed with 60mm diameter posts on detachable flush mounted post bases anchored to the surface by a minimum of four (4) approved anchors. The posts shall be attached in a manner which allows for easy removal and replacement of the post as required or as accepted by the Design Engineer and the Department

Concrete sign foundations shall be cast-in-place, and shall have minimum dimensions of 300mm dia. x 1,200mm deep. The concrete shall be poured so that the top of the foundation is 50mm below the surrounding ground. The remaining depth above the foundation shall be backfilled with topsoil as required.

Sign frames and support brackets will be required to stiffen signs mounted on tubular steel sign posts.

The tubular steel posts and bases shall be erected with a maximum tolerance of 25mm from vertical over the height of the pole.

400.2.52.6 Product Acceptance

Prior to the final acceptance of the work, all damage or deficiencies from any cause in signs and posts installed for the Project shall be rectified by the Contractor.

The Contractor shall, during the two year warranty period, straighten and recompact or reinstall as required, all posts which are more than 50mm from vertical in a 2m length of post.

400.2.52.7 Measurement

400.2.52.7.1 Removal of Existing Signs

Measurement will be made of the number of sign installations removed.

400.2.52.7.2 Breakaway Steel Posts

Measurement will be made of the number of steel posts removed and disposed of, and the number of steel posts removed, salvaged and reinstalled.

Measurement of the supply and installation of new Breakaway Steel Posts will be measured on a per post basis.

400.2.52.7.3 Concrete Bases

Measurement will be made separately of the number of bases supplied and installed; bases removed, salvaged and reinstalled; and bases removed and disposed of.

400.2.52.7.4 Wooden Posts

Measurement will be made of the number of posts of a particular cross-section supplied and installed.

400.2.52.7.5 Tubular Steel Sign Posts

Measurement will be made of the number of posts of a particular cross-section supplied and installed.

400.2.52.7.6 Cluster Frames

Measurement will be made of the number of cluster frames supplied and installed.

400.2.52.7.7 Signs

Measurement will be made of the number of signs within a particular size range, based on surface area.

400.2.52.8 Payment Adjustment

Intentionally Deleted

400.2.53 EXTRUDED POLYSTYRENE PAVEMENT INSULATION

400.2.53.1 General

400.2.53.1.1 Description

Where specified in the Technical Requirements and the Detailed Designs, Extruded Polystyrene Pavement Insulation shall be used for frost heave mitigation treatment of paved roadways. Extruded Polystyrene Pavement Insulation shall consist of extruded/expanded polystyrene boards place on a prepared subgrade or where required on a "granular working platform" and covered with a minimum thickness of Granular Base Course (GBC) placed by end dumping on existing GBC and spread onto the extruded polystyrene insulation boards by a small crawler tractor. The minimum thickness of GBC shall be compacted in one lift before placement of any additional GBC.

400.2.53.1.2 Definitions

"Extruded polystyrene insulation" means rigid, closed-cell extruded/expanded boards made by the continuous extrusion of polystyrene resin crystal.

"Production Lot" means the quantity of extruded polystyrene insulation boards produced in a continuous period of manufacturing, of the same grade and thickness, within the same production day.

"Granular working platform" means a layer of granular material, contained within a woven geotextile, in which the granular material is placed in one lift by means of end dumping, spreading and then compacted, in order to provide a stable platform, with minimal visual deflection, on which the extruded polystyrene insulation boards are placed.

400.2.53.2 Materials And Procedures

400.2.53.2.1 Extruded Polystyrene Insulation

The extruded polystyrene insulation shall meet the requirements of the Underwriters' Laboratory of Canada specification CAN/ULC S701, Thermal Insulation, Polystyrene Boards and Pipe Covering, for Type 4, with the exception of the minimum compressive strength. The minimum compressive strength for each grade of extruded polystyrene insulation shall be in accordance with Table No. 400.2.53.2.1.1.

TABLE 400.2.53.2.1.1
Minimum Compressive Strength

Grade	Minimum Compressive Strength, kPa at 5 percent Deflection or Yield [1]
1	690
2	400
3	275

Note:(1) One board from each Production Lot shall be selected at random, in the presence of the Department, as the material arrives at the Project, to ensure compliance with the Technical Requirements and the Detailed Designs. The randomly selected sample board is to be tested in accordance with CAN/ULC S701. The compressive strength shall be the average of 5 specimens taken at different locations across the width of the board and determined on the face perpendicular to the extrusion plane.

Each board of the same Production Lot shall be stamped with the same production code showing plant identification, type, grade, and date of production.

The Contractor shall submit test certificates to the Department for each Production Lot incorporated into the work showing compliance with all the requirements of the Technical Requirements and the Detailed Designs before installation of the extruded polystyrene insulation. The extruded polystyrene insulation must be accepted by the Design Engineer and the Department before placement.

The individual boards of extruded polystyrene insulation shall be 600mm x 2,400mm in size and either 25mm or 50mm in thickness.

The grade of extruded polystyrene insulation shall be as indicated in the Technical Requirements and the Detailed Designs.

400.2.53.2.2 Aggregate

The Contractor shall supply GBC in accordance with Section 400.2.21 (Granular Base Course) the Technical Requirements, and the Detailed Designs.

The Contractor shall supply granular fill in accordance with Section 400.2.22 (Granular Fill) the Technical Requirements, and the Detailed Designs. The granular fill must be accepted by the Design Engineer and the Department before placement.

400.2.53.2.3 Geotextile

The Contractor shall supply a Class 1 woven geotextile in accordance with Section 400.2.46 (Geotextile) the Technical Requirements, and the Detailed Designs. The geotextile must be accepted for use by the Department before placement.

400.2.53.3 Quality Management Sampling And Testing

Quality management testing is the responsibility of the Contractor. Tests performed by the Department will not be considered quality management tests.

The Contractor shall use Professional Engineering services and a qualified testing laboratory, licensed to practice in the Province of Alberta to assess and where necessary, modify the materials to ensure their end use meets all the Technical Requirements and the Detailed Designs.

The Contractor shall provide and maintain equipment and qualified personnel to perform all field-testing necessary to determine and monitor the characteristics of the materials being incorporated into the work.

The Contractor shall be responsible for the cost of quality management and shall be responsible for the cost of all consulting services retained by it.

All quality management sampling and testing will be carried out in accordance with the Contractor's "Quality Management System (QMS)", Table 400.2.53.2.1.1, and the Technical Requirements.

Copies of all quality management tests shall be submitted to the Department within 24 hours of the completion of each test.

400.2.53.3.1 Test Methods

Sampling and testing to follow requirements of Table 400.2.53.2.1.1. Alternative or supplemental test methods may be used but shall be outlined in the QMS.

400.2.53.4 Acceptance Sampling And Testing

The Department will from time to time take samples and carry out testing and inspection of the materials incorporated or being incorporated into the work. The Contractor shall cooperate with the Department for such sampling, testing, and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the work strictly in accordance with the requirements of the Technical Requirements.

Various alternative test methods may be used by the Department to confirm that the Technical Requirements are being met.

In cases of dispute regarding the acceptability of the extruded polystyrene insulation being supplied, all testing to confirm compliance with the Technical Requirements will be carried out by the Department, using the most recent edition of the test methods indicated in Section 400.2.53.2.1 (Extruded Polystryene Insulation).

400.2.53.4.1 Test Methods

Unless otherwise specified, methods shown in Table 400.2.53.2.1.1 will be used for sampling and testing of the extruded polystyrene insulation.

Other materials, such as but not limited to GBC, granular fill, and geotextiles will be sampled and tested in accordance with the applicable section of the Technical Requirements.

400.2.53.5 Construction

400.2.53.5.1 General

The treatment areas shall be prepared, the extruded polystyrene insulation placed, and covered with compacted GBC, as indicated in the Technical Requirements and the Detailed Designs.

400.2.53.5.2 Site Preparation

The dimensions of the area(s) to be treated by the extruded polystyrene insulation are to be in accordance with the Technical Requirements and the Detailed Designs.

The subgrade is to be shaped and compacted in accordance with Section 400.2.19 (Subgrade Preparation) and accepted by the Department before placement of the extruded polystyrene insulation.

400.2.53.5.3 Granular Working Platform

General

If the underlying soil conditions do not lend themselves to conventional site preparation, as indicated in Section 400.2.19 (Subgrade Preparation) or if indicated in the Technical

Requirements and the Detailed Designs, a granular working platform is to be constructed.

Excavation

If an excavation is required, in order to prepare a granular working platform, the excavation must be undertaken such that no equipment is permitted to operate on the exposed materials at the bottom of the excavation.

The excavation is to be of sufficient depth such that when backfilled with granular material and compacted there shall be no visible deflection of the surface of the granular working platform.

The dimensions of the excavation are to be in accordance with the Technical Requirements and the Detailed Designs but in any event are to be of sufficient size to permit the placement of the extruded polystyrene insulation.

The base of the excavation shall be smooth, have no protruding materials exceeding 10mm, free of obstructions, depressions, debris, and soft or disturbed pockets of material, to the required grade, and be accepted by the Department before placement of the geotextile.

Geotextile

A Class 1 woven geotextile, supplied and placed in accordance with Section 400.2.46 (Geotextile) the Technical Requirements, and the Detailed Designs must enclose the base and sides of the granular working platform. The geotextile must be accepted by the Department before placement of the granular fill.

Granular Fill

Granular fill is to be placed by end dumping and spreading onto the geotextile in one or more lifts as indicated in the Technical Requirements and the Detailed Designs. The initial lift of granular fill must be of sufficient thickness so that overstressing of the geotextile or displacement of the underlying soils does not occur. The granular fill is to meet the requirements of Section 400.2.3.8 (Granular Fill) the Technical Requirements and the Detailed Designs.

The surface of granular fill must be smooth, free of projections or depressions in excess of 5 mm when measured in any direction with a 1.5mm straight edge.

The Department, using a Contractor supplied tandem axle gravel truck, loaded to the legal limit, will assess the visual deflection of any granular working platform. The Department must accept the condition of the granular working platform before placement of the extruded polystyrene insulation.

400.2.53.5.4 Board Placement and Securing

The extruded polystyrene insulation boards shall be placed lengthwise and parallel to the centerline of the roadway. The start of the first layer and any subsequent change in thickness of extruded polystyrene insulation boards must be staggered 1/2 a board length. The longitudinal and transverse joints, between layers of extruded polystyrene insulation boards, shall be tight and staggered.

A transition zone is required between sections with no extruded polystyrene insulation to sections with extruded polystyrene insulation and for sections with changes in extruded polystyrene insulation thickness. Transition zones consist of a stepped pattern of insulation extruded polystyrene insulation to allow for gradual change in embankment thermal properties. The transition zone-stepped pattern is 9.6m for each 25mm change in extruded polystyrene insulation thickness.

Each board of extruded polystyrene insulation shall be secured in-place by hand placing sufficient granular material to ensure no movement of the boards takes place during subsequent operations. Alternatively, hardwood skewers may be used to secure the boards in-place. Each day, all placed extruded polystyrene insulation must be covered with the minimum thickness of GBC before completion of operations.

No vehicular traffic, of any kind, shall be allowed to operate directly on the surface of the extruded polystyrene insulation.

The extruded polystyrene insulation board placement and securing must be accepted by the Department before placement of the first lift of GBC.

400.2.53.5.5 Granular Base Course

Placement of the first lift of GBC over the extruded polystyrene insulation must be undertaken by end dumping on existing GBC and spreading with a small crawler tractor so that the boards are not displaced or damaged. The minimum thickness of the first lift of GBC is indicated in Table 400.2.53.5.5.1. The minimum thickness of the initial lift of GBC is to protect the extruded polystyrene insulation from subsequent construction traffic.

TABLE 400.2.53.5.5.1
Minimum GBC Thickness

Grade	Minimum Thickness, first lift of GBC (mm)
1	225
2	225
3	300

The minimum thickness of initial GBC shall be compacted in one lift to the requirements of Section 400.2.21 (Granular Base Course) before subsequent lifts of GBC are placed and compacted.

Before placement of subsequent layers of GBC and/or asphalt concrete pavement, the first lift of GBC must be accepted by the Department.

400.2.53.6 Product Acceptance

The Contractor shall repair and/or restore to the specified condition, any displaced boards prior to covering with GBC or any areas of aggregate segregation or excessive visual deflection, as directed by the Department.

400.2.53.6.1 End Product Acceptance or Rejection

Failure of an the polystyrene insulation sample board to comply with the Technical Requirements and the Detailed Designs shall be cause for rejection of the Production Lot from which the sample board was taken.

Culling of the rejected Production Lot by the Contractor shall be permitted. A proposal for retesting of the remaining material, to demonstrate conformance with the Technical Requirements or the Detailed Designs, shall be submitted to the Design Engineer and the Department for review and acceptance.

Retesting of material remaining from culling rejected material from the Production Lot shall be the responsibility of the Contractor.

400.2.53.7 Measurement

Measurement of Extruded Polystyrene Pavement Insulation will be in square metres.

400.2.53.8 Payment Adjustment

Intentionally Deleted

400.2.54 BOTTOM ASH PAVEMENT INSULATION

400.2.54.1 General

400.2.54.1.1 Description

Where specified in the Technical Requirements and the Detailed Designs, Bottom Ash Pavement Insulation shall be used for frost heave mitigation treatment of paved roadways. Bottom Ash Pavement Insulation shall consist of Bottom Ash placed on an enclosing geotextile, in an excavation or subcut area, by end dumping. The Bottom Ash shall be compacted before the placement of the overlaying Granular Base Course (GBC).

400.2.54.2 Materials And Procedures

400.2.54.2.1 Bottom Ash

Ash is a by-product of coal fired electric generating stations. Flyash is the finer particular matter that rises out of the boiler with the combustion gases. Bottom Ash is a coarser grained ash product remaining in the boilers after the combustion of the coal.

The individual particles of Bottom Ash shall consist of the ash produced by the burning of coal and shall be angular and durable. Bottom Ash shall be free of large lumps that will not break down under ordinary compaction equipment.

The Bottom Ash shall be a uniformly graded material meeting the requirements of Table No. 400.2.54.2.1 when supplied to the Project.

TABLE 400.2.54.2.1
Bottom Ash Gradation [1]

Sieve Size (microns)	Maximum Percent Passing
12,500	90
80	15

Note (1): The Bottom Ash shall have no impurities such as clay particles and it shall have less than 5 percent by weight of unburned coal particles.

Bottom Ash shall be delivered to the Project with less than 35 percent natural moisture content and shall have a dry density of less than 1,100 kg/cu. m. at Standard Proctor compactive effort.

The Bottom Ash shall meet the requirements of Alberta Environment's "Alberta Tier 1 Criteria for Contaminated Soil Assessment Remediation" publication dated August, 2008 with the exception that "soluble boron" not "total boron" must be determined. Any test results that deviate from the Alberta Tier 1 Criteria must be clearly identified by the Contractor.

In addition, a standard bioassay test for toxicity shall be undertaken for the Bottom Ash.

The Contractor is responsible for obtaining all permits or approvals required to haul and place the Bottom Ash.

The Contractor shall submit test certificates to the Department showing compliance with all the requirements of the Technical Requirements or the Detailed Designs before installation of the Bottom Ash insulation. The Bottom Ash must be accepted by the Department before placement.

400.2.54.2.2 Aggregate

The Contractor shall supply GBC in accordance with Section 400.2.21 (Granular Base Course) the Technical Requirements, and the Detailed Designs.

400.2.54.2.3 Geotextile

The Contractor shall supply a Class 1 woven geotextile in accordance with Section 400.2.46 (Geotextile) the Technical Requirements, and the Detailed Designs. The geotextile must be accepted for use by the Department before placement.

400.2.54.3 Quality Management Sampling And Testing

Quality management testing is the responsibility of the Contractor. Tests performed by the Department will not be considered quality management tests.

The Contractor shall use Professional Engineering services and a qualified testing laboratory, licensed to practice in the Province of Alberta to assess and where necessary, modify the materials to ensure their end use meets all the Technical Requirements and the Detailed Designs.

The Contractor shall provide and maintain equipment and qualified personnel to perform all field-testing necessary to determine and monitor the characteristics of the materials being incorporated into the work.

The Contractor shall be responsible for the cost of quality management and shall be responsible for the cost of all consulting services retained by him.

All quality management sampling and testing will be carried out in accordance with the Contractor's "Quality Management System (QMS)", Table 400.2.54.3.1.1, and the Technical Requirements.

Copies of all quality management tests shall be submitted to the Department within 24 hours of the completion of each test.

400.2.54.3.1 Test Methods

Sampling and testing to follow requirements of Table 400.2.54.3.1.1. Alternative or supplemental test methods may be used but shall be outlined in the QMS.

TABLE 400.2.54.3.1.1
Sampling and Testing Methods

TEST	STANDARD	FREQUENCY (Minimum)
SAMPLING, Gravel and Sand	ATT- 38	As required
SIEVE ANALYSIS [(1)]	ATT-25 or 26	As required in ATT-38
MOISTURE-DENSITY RELATIONSHIP, Standard Compaction	ATT-58	As required & Test Sections [(2)]
RANDOM TEST SITE LOCATIONS	ATT-56	Each Test Sections
DENSITY, In-Place Nuclear Method	ATT-11	As required [(2)]
MOISTURE CONTENT, Oven Method, Soil and Gravel	ATT-15	As required [(2)]
Alberta Tier 1 Criteria	Alberta Environment [(3)]	Every 4,000 cu.m. for each source
Standard Bioassay Test for Toxicity	Environment Canada	Every 4,000 cu.m. for each source

Notes: (1) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Section 400.2.20 (Aggregate Production and Stockpiling).

(2) Control Strips are established as specified herein. Density Test Sections are randomly established every 1,000 square metres on all lifts of Bottom Ash.

(3) As per "Alberta Tier 1 Criteria for Contaminated Soil Assessment Remediation" dated August 2008.

400.2.54.4 Acceptance Sampling And Testing

The Department will from time to time take samples and carry out testing and inspection of the materials incorporated or being incorporated into the work. The Contractor shall cooperate with the Department for such sampling, testing, and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the work strictly in accordance with the requirements of the Technical Requirements.

Various alternative test methods may be used by the Department to confirm that the Technical Requirements are being met.

In cases of dispute regarding the acceptability of the Bottom Ash being supplied, all testing to confirm compliance with the Technical Requirements will be carried out by the Department, using the most recent edition of the test methods indicated in Section 400.2.54.4.1 (Test Methods).

400.2.54.4.1 Test Methods

Unless otherwise specified, methods shown in Table 400.2.54.4.1.1 will be used for sampling and testing of the Bottom Ash.

TABLE 400.2.54.4.1.1
Sampling and Testing Methods

TEST	STANDARD	FREQUENCY (Minimum)
SAMPLING, Gravel and Sand	ATT- 38	As required
SIEVE ANALYSIS (1)	ATT-25 or 26	As required in ATT-38
MOISTURE-DENSITY RELATIONSHIP, Standard Compaction	ATT-58	As required & Test Sections (2)
RANDOM TEST SITE LOCATIONS	ATT-56	Each Test Sections
DENSITY, In-Place Nuclear Method	ATT-11	As required (2)
MOISTURE CONTENT, Oven Method, Soil and Gravel	ATT-15	As required (2)
Alberta Tier 1 Criteria	Alberta Environment (3)	Every 4,000 cu.m. for each source
Standard Bioassay Test for Toxicity	Environment Canada	Every 4,000 cu.m. for each source

Notes: (1) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Section 400.2.20 (Aggregate Production and Stockpiling).

(2) Control Strips are established as specified herein. Density Test Sections are randomly established every 1,000 square metres on all lifts of Bottom Ash.

(3) As per "Alberta Tier 1 Criteria for Contaminated Soil Assessment Remediation" dated August 2008.

Other materials, such as but not limited to GBC, granular fill, and geotextile will be sampled and tested in accordance with the applicable section of the Technical Requirements.

400.2.54.5 Construction

400.2.54.5.1 General

The treatment areas shall be prepared, the Bottom Ash placed, compacted, and covered with GBC, as indicated in the Technical Requirements and the Detailed Designs.

400.2.54.5.2 Site Preparation

The dimensions of the area(s) to be treated by the Bottom Ash insulation are to be in accordance with the Technical Requirements and the Detailed Designs.

400.2.54.5.3 Excavation

The excavation must be undertaken such that no equipment is permitted to operate on the exposed materials at the bottom of the excavation.

The dimensions of the excavation are to be in accordance with the Technical Requirements and the Detailed Designs but in any event are to be of sufficient size to permit the placement of the Bottom Ash.

The excavation shall be shaped such that there is an 80m long transition from the base of the excavation to the top of the adjacent subgrade in the longitudinal direction. The side slopes of the excavation are to be cut back to 2:1 slope.

The base of the excavation shall be smooth, have no protruding materials exceeding 10mm, free of obstructions, depressions, debris, and soft or disturbed pockets of material, to the required grade, and be accepted by the Department before placement of the geotextile.

400.2.54.5.4 Geotextile

A Class 1 woven geotextile, supplied and placed in accordance with Section 400.2.46 (Geotextile) the Technical Requirements, and the Detailed Designs must enclose the base, sides, and surface of the Bottom Ash. The geotextile must be accepted by the Department before placement of the Bottom Ash.

400.2.54.5.5 Bottom Ash

Bottom Ash is to be placed by end dumping and spreading onto the geotextile in one or more lifts as indicated in the Technical Requirements and the Detailed Designs. The initial lift of granular fill must be of sufficient thickness so that overstressing of the geotextile or displacement of the underlying soils does not occur.

The final surface lift of the Bottom Ash, before covering with the geotextile, must meet the requirements of Section 400.2.23 (Tolerance for Surface Finish) for subgrade.

The Contractor shall avoid spilling the Bottom Ash during transportation and placement and shall be responsible for all costs associated with the clean up and reporting of such spills to the appropriate authorities.

The Bottom Ash placement and covering geotextile must be accepted by the Department before placement of the first lift of GBC.

400.2.54.5.6 Granular Base Course

Placement of the first lift of GBC over the Bottom Ash must be undertaken by end dumping on existing GBC and spreading with a small crawler tractor so that the Bottom Ash and the geotextile is not displaced or damaged. The minimum thickness of the first lift of GBC is to be 200mm.

The minimum thickness of initial GBC is to be compacted in one lift to the requirements of Section 400.2.21 (Granular Base Course) before subsequent lifts of GBC are placed and compacted. The Bottom Ash is to be compacted to a minimum of 95 percent of the corresponding maximum density established by ATT-19, Moisture-Density Relationship, Standard Compaction.

Before placement of subsequent layers of GBC and/or asphalt concrete pavement, the first lift of GBC must accepted by the Department.

400.2.54.6 Product Acceptance

The Contractor shall repair and/or restore to the specified condition, any areas of Bottom Ash segregation or excessive visual deflection before covering with GBC, as directed by the Department.

400.2.54.7 Measurement

Measurement of Bottom Ash Pavement Insulation will be in square metres.

400.2.54.8 Payment Adjustment

Intentionally Deleted

400.2.55 SUPPLY OF CABLE BARRIER AND METAL POSTS

400.2.55.1 General

The Contractor is required to supply and install cable barrier and metal posts for use as hazard avoidance barriers.

400.2.55.1.1 Standards of Reference

All material supplied shall refer to the following standards, specifications or publications:

Alberta Transportation, Traffic Control Standards Manual

TEB drawings referenced in this specification are found in the manual entitled "Typical Barrier Drawings" as published by Alberta Transportation.

Society of Automotive Engineers:

SAE J403 - Sept. 80 - Chemical Composition of SAE Carbon Steels

Canadian Standards Association:

CAN/CSA G40.20-M87 - General Requirements for Rolled or Welded Structural Quality Steel
CAN/CSA G40.21-M87 - Structural Quality Steel

CSA/CAN 3-G12-M78	- Zinc-Coated Steel Wire Strand
CSA W47.1-1983	- Certification of Companies for Fusion Welding of Steel Structures.
CSA W59-M1984	- Welded Steel Construction (Metal Arc Welding).
CSA G164-M1981	- Hot Dip Galvanizing of Irregularly Shaped Articles.

American National Standards Institute/American Society for Testing and Materials:

ASTM A307-86a	- Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A325M-86	- High-Strength Bolts for Structural Steel Joints (Metric).
ANSI/ASTM A536-84	- Ductile Iron Castings
ASTM A47-M84	- Ferritic Malleable Iron Castings (Metric)
ASTM B30-85a	- Copper-Base Alloys in Ingot Form

400.2.55.2 Materials and Procedures

The Contractor shall supply all materials necessary to complete the work on the project required in this Section 400.2.55 (Supply of Cable Barrier and Metal Posts). Previously installed material may not be used.

Prior to installing any cable barrier, the Contractor shall supply the Design Engineer and the Department with the material manufacturer's certification that the material conforms with the specifications.

The Contractor shall supply the following major components in accordance with the applicable drawings:

Posts c/w ground plates	TEB 3.42
Hook bolts c/w double hex nuts	TEB 3.43
Galvanized steel cables (305m rolls)	TEB 3.43
Tension bolts and ferrous castings	TEB 3.44
End fittings	TEB 3.44
Slicers and wedges	TEB 3.44
Pressed ferrules and cable fittings	TEB 3.44
Fabricated steel sections for anchor blocks	TEB 3.45

400.2.55.2.1 Cables

The barrier cable and the cable used for pressed ferrule and cable fittings shall conform to CSA/CAN 3-G12M for grade 110 steel wire strand, hot zinc coated (galvanized) or Class A electro-zinc-coated and shall be supplied in a continuous length of 305 metres on expendable reels.

The cable shall be a 13mm diameter, 7-wire strand weighing approximately 228 kg per 300 m with a minimum breaking strength of 70 kN.

400.2.55.2.2 Fittings

Ferrous castings for the end fitting and splicer shall conform to ASTM A47M for malleable iron, grade 32510 or ASTM Designation A536 for ductile iron, type 60-45-10.

The tension bolt for the end fitting shall be SAE 1035 hot rolled fine grained steel, and the ferrule shall be SAE 1020 rolled steel, conforming to SAE J403. As an option, the tension bolt may contain a square or hex nut welded as shown in drawing TEB 3.44, conforming to low hydrocarbon classification CSA W59M.

The ferrous castings, tension bolt and ferrule shall be hot dip galvanized conforming to CSA G164M. The ferrule shall be galvanized after it has been pressed onto the cable.

Wedges shall be bronze conforming to ASTM B30 for alloy suitable for sand casting.

All fittings shall be so designed and be of such section as to develop the full strength of a single cable or cable assemblies, as the case may be.

- Single cable assembly (minimum tensile strength of 100 kN)
- Three cable assembly (minimum tensile strength of 300 kN)

400.2.55.2.3 Posts and Fabricated Steel Sections for Anchor Blocks

Posts shall be American Standard Beam Section. Posts, ground plates, brackets, and splice plates shall conform to CSA/CAN G40.21M, grade 230G.

400.2.55.2.4 Hook Bolts and Nuts

Hook bolts and nuts shall conform to ASTM A307-86a.

Self-drilling, self-tapping fasteners shall be #12-24-1.50 indented hex washer head, cadmium plated.

400.2.55.2.5 Production

General Requirements

Welding shall conform to CSA W59M and W47.1.

All components and associated hardware except for self-drilling, self-tapping fasteners shall be hot dip galvanized after fabrication and shall conform to CSA G164M.

All dimensions are subject to manufacturing tolerances unless otherwise indicated. The individual components shall be capable of being assembled to conform to the finished structure as indicated in the Detailed Designs.

Pressed Ferrule and Cable Fitting

The ferrules supplied are for use at the end of the fitting cable and shall be pressed onto the end of the fitting cable.

The ferrule shall not slip from the cable when tested under a tensile static load to the limit of cable breakage.

Marking

Coils and reels of the guardrail cable shall be identified by an attached, durable tag on which the following information is indelibly recorded:

- Galvanized steel wire strand
- Manufacturer's name
- Nominal diameter of strand
- Grade
- Length of strand in metres
- Weight of strand in kilograms per coil.

400.2.55.2.6 Equipment

The Contractor shall supply all equipment necessary to complete the work on the Project required in this Section 400.2.55 (Supply of Cable Barrier and Metal Posts).

400.2.55.3 Quality Management Sampling and Testing

Sampling and testing for the purpose of quality management shall be performed in accordance with the Contractor's Quality Management Plan.

400.2.55.4 Acceptance Sampling and Testing

No formal testing or inspection activities are proposed; however, the Department may undertake any form of inspection, sampling or testing as necessary to determine specification compliance and acceptance.

400.2.55.5 Construction

Intentionally Deleted

400.2.55.6 Product Acceptance

In addition to compliance with the specifications for construction and material requirements, the completed product shall show careful finished workmanship in all particulars. Products not meeting these requirements shall be replaced, repaired or remedied to the satisfaction of the Department prior to accepting.

400.2.55.7 Measurement

Measurement for supply of cable barriers and metal posts, including any required end terminals and bridge connections, will be in metres of length of cable barrier.

400.2.55.8 Payment Adjustment

Intentionally Deleted

400.3 BRIDGES

400.3.1 <u>CONSTRUCTION REQUIREMENTS</u>

400.3.1.1 General

400.3.1.1.1 Materials

All materials incorporated into the bridge structures for the Project shall be new. Timber materials shall only be used for approach guardrail posts and blocking.

400.3.1.1.2 Site Office for Bridge Construction

The Contractor shall provide and maintain in a clean and safe condition an office trailer at the site for the sole use of the Department. The site office trailer shall be located within the Contractor's working area, separate from the Contractor's office or any other structure, and shall meet the following requirements:

- Minimum floor area $11m^2$, with minimum headroom of 2.4m
- Adequate lighting, heating and ventilation
- Windproof, weatherproof and insulated
- Lockable exterior door
- Adequate windows on all sides, with screens and shades
- Minimum two electrical receptacles
- Resilient flooring material
- One plan or drafting table with one stool
- One desk-minimum 1500 x 600, and two chairs
- One two-drawer filing cabinet.

Details of the site office trailer, its contents and its proposed location shall be submitted in advance to the Department for approval.

The Contractor shall provide the site office trailer prior to the commencement of any field work and ensure that it is continuously available until Traffic Availability has been achieved.

The location of the site office trailer will be determined by the Department based on the work sequence undertaken by the Contractor. The Contractor may be required to move the site office trailer occasionally, as may be reasonably requested by the Department from time to time, to locate it suitably with respect to the work.

If the site office trailer has not been provided to the Department prior to the commencement of any field work or becomes unavailable for the Department's use, Payment Adjustments of $2,000/week or portion thereof for the first four (4) weeks and $5,000/week or portion thereof thereafter shall apply.

400.3.2 EXCAVATION

400.3.2.1 General

Excavation is the removal of all material, of whatever nature, necessary for the construction of foundations, substructures or other works, in accordance with the Detailed Designs or as determined by the Design Engineer or the Department. Excavation shall include the construction of all cribs, cofferdams, dikes, berms or other devices necessary for the work, or necessary for maintaining the stability of adjacent headslopes, fills, or existing structures, the protection, dewatering and maintenance of the excavated region, and the disposal of excavated material not required or not suitable for backfill as determined by the Design Engineer and the Department. If any excavation or dredging is made at the site of the structure, the Contractor shall, after the foundation base is in place, backfill all such excavation to the original ground surface or river bed with material satisfactory to the Design Engineer and the Department. Material deposited within the stream area from foundation or other excavation, or from any other operations, shall be removed and the stream area freed from obstruction.

Where necessary the excavations shall be shored, braced or protected by cofferdams in accordance with approved methods. Whatever method is employed, the Contractor shall be responsible for maintaining the integrity and stability of existing adjacent headslopes and fills.

400.3.2.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work.

- drawings for cofferdams, shared excavations, etc.

400.3.2.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following to determine the acceptability of the work.

- Acceptance of submissions as outlined in this Section 400.3.2 (Excavation);
- Visual inspection of the work; and
- Audits of the Contractor's quality control/quality assurance inspection and testing records.

400.3.2.2 Depth of Footings

The elevations of the bottoms of the footings as shown on the Detailed Designs shall be considered as approximate only; the Design Engineer may order such changes in dimensions or elevations of footings as may be necessary to secure a satisfactory foundation.

400.3.2.3 Preparation of Foundations for Footings

All rock or other hard foundation material shall be free from all loose material, cleaned and cut to a firm surface either level, stepped, or roughened, as may be determined by the Design Engineer and/or the Department. All seams shall be cleaned out and filled with concrete, mortar or grout.

When concrete is to be cast on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation, and the final removal of the foundation material to grade shall not be made until just before the concrete is to be placed.

In the case of concrete culverts or certain spread footings, when a firm foundation is not attained at the grade established, the foundation shall be deepened to an elevation determined by the Design Engineer and accepted by the Department and backfilled with suitable clay or granular material as described under Section 400.3.3 (Backfill).

In the case of spread footings the lower part of the excavation, for a depth corresponding to the height of the footings, shall be made neat to the same plan dimensions and shape as the footing, and the concrete shall be poured therein without forms. Seepage water shall be collected and drained or pumped away before it can enter the neat portion of the excavation.

400.3.2.4 Cofferdams, Dikes and Berms

400.3.2.4.1 General

All cofferdams, dikes and berms constructed by the Contractor for foundation construction shall be carried to adequate depths and heights, be safely designed and constructed of good standard materials, and be made as watertight as is necessary for the proper performance of the work which must be done inside them. Their dimensions shall give sufficient clearance for the construction and inspection of forms, and to permit pumping of water outside of the forms.

400.3.2.4.2 Drawings Required

For substructure work, the Contractor shall submit to the Design Engineer for review and then to the Department for acceptance drawings or sketches showing the proposed method of cofferdam, shored excavation, dike or berm construction, and other details left open to his choice. Drawings for cofferdam or shored excavations shall bear the stamp of a Professional Engineer. Such drawings shall be accepted by the Department before construction is started on work governed by them. Acceptance of such drawings by the Department shall in no way relieve the Contractor of full responsibility for the success or failure of the work described by or related to those drawings.

400.3.2.4.3 Concrete Seal

When conditions are encountered which in the opinion of the Design Engineer and the Department make it impracticable to dewater the foundation before placing concrete, they may require or allow the construction of a concrete foundation seal below the elevation of the bottom of the footing, of such dimensions as may be necessary. The foundation shall then be pumped out and the balance of the concrete placed in the dry. During the placing of a foundation seal, the elevation of the water inside the cofferdam shall be controlled to prevent any flow through the seal and if the cofferdam is to remain in place, it shall be vented or ported at low water level.

400.3.2.4.4 Removal of Bracing

No timber or bracing shall be left in the cofferdams in such a way as to extend into the substructure concrete, without written permission of the Department.

400.3.2.4.5 Pumping of Water

Pumping from the interior of any cofferdam shall be done in such a way as to preclude the possibility of the flow of water through any fresh concrete. No pumping will be permitted during the placing of concrete or for a period of 24 hours after, unless the pumping is done from a suitable sump separated from the concrete by a watertight wall or other effective means. Pumping to dewater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure. In cases where turbid water is to be pumped from any excavation, a suitable settling basin shall be provided to ensure that only water free from suspended material finds its way into any stream.

400.3.2.4.6 Removal of Cofferdams, Dikes and Berms

Cofferdams, dikes and berms shall be removed after completion of the substructure for which they were placed, care being taken not to disturb or otherwise injure the finished works. Backfill required around the permanent work shall be placed prior to the removal of cofferdams, dikes or berms.

The Department reserves the right to require the Contractor to remove all materials from the streambed at any time to prevent stream pollution or adverse environmental effects, including bank erosion, or effects on adjacent structures or any other installations or property. If the Contractor fails to comply with this requirement, the Department further reserves the right to make immediate separate arrangements to remove such materials at the Contractor's expense. The Contractor shall be responsible for all costs incurred by the Department to remove such material and/or all damages incurred.

400.3.2.5 Inspection of Excavation

After the excavation is completed to the elevation shown on the Detailed Designs, the Contractor shall notify the Design Engineer and the Department. The depth of the excavation and the character of the foundation material shall be accepted by the Design Engineer before any further work can proceed.

The Design Engineer may then order test pits, test drilling, further excavation, or other work as necessary to obtain an acceptable excavation.

400.3.3 BACKFILL

400.3.3.1 General

Backfill shall include material required to fill excavations adjacent to various bridge components or culvert installations.

All materials shall be sourced and supplied by the Contractor. The Contractor shall be responsible for royalties, processing, loading, hauling, placing, compacting, quality management testing and any other incidentals required to supply these materials in place.

400.3.3.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work.

- backfill material tests (at least 14 days prior to placing)

400.3.3.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following to determine the acceptability of the work

- Acceptance of submissions as outlined in this Section 400.3.3 (Backfill);
- Visual inspection of the work; and
- Audits of the Contractor’s quality control/quality assurance inspection and testing records.

400.3.3.2 Materials

All material used for backfill including native material shall be of a quality acceptable to the Design Engineer and the Department and shall be in a thawed state when placing and compacting and be free from rocks, large or frozen lumps, wood, or other unsuitable material. No backfill material will be permitted to be placed on frozen substrate.

400.3.3.2.1 Compacted Non-granular Material

Compacted non-granular material shall be non-organic soil such as clay. When reviewed by the Design Engineer and accepted by the Department, non-granular material can be substituted with granular material.

Material used for the construction of the "clay seals" shall be highly plastic clay (exhibiting putty-like properties with considerable strength when dry). Material with very high swelling potential such as bentonite clays will not be permitted. When the proposed material characteristics for clay seals are in question, the Design Engineer and/or the Department may require the Contractor to classify the material using Test Method ASTM D2487 - Classification of Soils for Engineering Purposes. Material shall have a minimum Plasticity Index of 40.

400.3.3.2.2 Gravel Material and Crushed Aggregate Material

Where Gravel Material or Crushed Aggregate Material is specified, it shall consist of clean sand and gravel, complying with the following requirements:

Designation/Class			
Metric Sieve Size (CGSB 8-GP-2M)	***Gravel Material Des 6 Class 80**	**Crushed Aggregate Material Des 2 Class 40**	**Crushed Aggregate Material Des 2 Class 25**
Sieve Size µm	**Percent Passing**	**Percent Passing**	**Percent Passing**
125 000	--	--	
80 000	100	--	
50 000	55 - 100	--	
40 000	--	100	
25 000	38 - 100	0 - 94	100
20 000	--	--	82 - 97
16 000	32 - 85	55 - 85	70 - 94
10 000	--	44 - 74	52 - 79
5 000		32 - 62	35 - 64
1 250	--	17 - 43	18 - 43
630	--	12 - 34	12 - 34
315	6 - 30	8 - 26	8 - 26
160	--	5 - 18	5 -18
80	2 - 10	2 - 10	2 - 10
% fractures by weight (2 faces)	N/A	50+	60+
Plasticity Index	NP - 8	NP - 6	NP - 6

L.A. Abrasion Loss Percent Maximum	N/A	50	50

*Note: Native Gravel Material may require processing in order to meet the gradation requirements.

400.3.3.2.3 Inspection and Testing

Unless otherwise specified, the latest edition of the following standard Department Test methods (ATT) will be used to determine material characteristics.

Inspection and Testing by the Contractor

The Contractor shall be responsible for quality control and quality assurance testing required to ensure the work meets the Technical Requirements and the requirements of the Detailed Designs. Any quality control/quality assurance testing and inspection records made by the Contractor shall be open to the Department for auditing.

The Contractor shall submit to the Design Engineer for review and then to the Department for acceptance a sieve analysis representing the material to be used at site. The sampling and testing shall have been done no more than 90 days prior to usage, unless otherwise accepted by the Department. For non-granular material, the source and material shall be reviewed by the Design Engineer and accepted by the Department, two weeks prior to usage.

The Contractor shall be responsible for carrying out the appropriate testing procedures to confirm specification requirements. The Contractor shall use professional engineering services and a qualified testing firm licensed in the Province of Alberta for all quality control work associated with backfilling procedures.

The Contractor shall be totally responsible for production of aggregate that meets all the specified requirements. Des 2 Class 25 Crushed Aggregate material can be used where Des 2 Class 40 material has been specified.

Test methods and minimum frequencies for acceptance testing are shown in Table 400.3.3.2.3 Acceptance Testing Requirements.

TABLE 400.3.3.2.3
ACCEPTANCE TESTING REQUIREMENTS

Description	Standard	Minimum Frequency
Aggregates Tests		
Sieve Analysis		
1. Crushed Aggregate	ATT-25 or ATT-26	One per Source
2. Gravel Material	ATT-25	One per Source
Plasticity Index	AASHTO T90	When requested by the Department
Percent Fracture (crushed aggregate)	ATT-50	One per Source

Description		Standard	Minimum Frequency
L.A. Abrasion		AASHTO T96	When requested by the Department
Backfill Tests			
Moisture Density Tests (Proctor)			
1.	Crushed Aggregate (Des 2 Class 25)	ASTM D689	One test per source
2.	Non Granular Material (Soil)	ASTM D689	One test for each significant soil type
Density of Materials (In-place)			
1.	Crushed Aggregate (Des 2 Class 25)	ASTM D2922 ATT 8 or 9	Three tests on Culvert Bedding taken at invert level Three tests for every four lifts of backfill
2.	Crushed Aggregate (Des 2 Class 40) or Gravel Material	* ATT-58A (Control Strip Method)	For Culverts, control established on top lift of bedding material at invert level and the first lift of backfill material for each Bridge Component For Culverts, control re-established on each side of culvert at the 1/3 and mid-point of culvert backfill, and the mid-point of backfill for each Bridge Component Monitor for minimum number of passes on all other lifts
3.	Non Granular Material (Soil)	ASTM D2922 ATT 8 or 9	Embankment - Three tests per 2 m height of embankment, each side One test on clay seal at each end of Culvert

* At the Contractor's option, the Control Strip Method can be used for Des 2 Class 25 material.

400.3.3.3 Placing

All spaces excavated and not occupied by permanent work shall be backfilled with compacted material up to the elevation indicated on the Detailed Designs or determined by the Design Engineer and accepted by the Department. Compacted material may also be required in other locations as shown on the Detailed Designs or as required by the Design Engineer.

All backfill material, regardless of type shall be placed in layers not exceeding 150mm in thickness of loose material, and each layer shall be mechanically tamped with pneumatic tampers or the equivalent. The rate of placing the backfill material shall be such that the tamper can compact thoroughly and uniformly. Compaction of Crushed Aggregate (Des 2 Class 25) and Non Granular Material (Soil) shall be a minimum of 95% Proctor density with optimum moisture content. Compaction acceptance of Gravel Material and Crushed Aggregate (Des 2 Class 40) shall be done using the Control Strip Method with a Nuclear Gauge.

If Control Strips are being established, compaction equipment proposed by the Contractor must be reviewed by the Design Engineer and accepted by the Department.

Backfill material shall not be placed against any concrete abutment, wingwall or culvert until permission has been given by the Design Engineer and accepted by the Department, generally not until the concrete has been in place at least 7 days or the compressive strength of the concrete is 75% of the required 28 day strength.

Backfill material around culverts and concrete elements shall be placed simultaneously on both sides to the same elevation to avoid unbalanced loading. Special precautions shall be taken to prevent any wedging action against the concrete and the slope bounding the excavation for abutments and wingwalls. The slope shall be altered by stepping to prevent wedge action. Jetting of backfill material behind abutments and wingwalls will not be permitted.

400.3.4 BEARING PILES

400.3.4.1 General

This specification is for the supply and installation of steel H-piles, plain and galvanized steel pipe piles, precast concrete piles, and cast-in-place concrete piles. It includes driven bearing piles, drilled cast-in-place concrete bearing piles, and drilled cast-in-place concrete/steel pipe composite bearing piles.

400.3.4.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work.

- Mill certificate for piling;
- Pile driving equipment and procedures to be used for the installation of driven piles;
- Pile drilling equipment and procedures to be used for the installation of drilled piles; and
- Non-destructive testing results for steel pile splices.

400.3.4.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following to determine the acceptability of the work.

- Acceptance of submissions as outlined in this Section 400.3.4 (Bearing Piles);
- Visual inspection of the work including recording of blow counts for driven piles; and
- Audits of Contractor's quality control/quality assurance inspection and testing records.

400.3.4.2 Reference Drawings (attached after Section 400.3.4.6.8)

- Standard Pipe Pile Splice - S-1414-87
- Standard H-Pile Splice - S-1415-87
- Standard Closed Pipe Pile End Plate - S-1479

400.3.4.3 Materials

400.3.4.3.1 Steel "H" Piling

As a minimum, Steel "H" piling shall meet the requirements of Specification ASTM A36 or CSA G40.21M 300W. Where piling is designated in metric dimensions, imperial equivalent piling will be acceptable. Mill certificates shall be provided to the Design Engineer for review and then to the Department for acceptance prior to pile installation.

Splice plates shall be fabricated to the dimensions shown on Standard Drawing S-1415-87 "Standard H-Pile Splice".

400.3.4.3.2 Steel Pipe Piling

As a minimum, steel pipe piling shall meet the requirements of Specification ASTM 252 Grade 2 or better, except that hydrostatic testing is not required. Although piling is designated in metric dimensions, imperial equivalent piling will be acceptable. Mill certificates shall be provided to the Design Engineer for review and then to the Department for acceptance prior to pile installation. Some out-of-roundness of the pipe is acceptable provided an acceptable splice can be completed.

Galvanized piling shall be galvanized by the hot dip method, in accordance with CSA Standard G164.

Splice backup rings and closed pipe pile end plates shall be fabricated as shown on Standard Drawing S-1414-87 "Standard Pipe Pile Splice" and Standard Drawing 1479 "Standard Closed Pipe Pile End Plate".

400.3.4.3.3 Timber Piling

The use of timber piling will not be permitted.

400.3.4.3.4 Pile Concrete

Concrete shall meet the requirements of Pile Concrete as specified in Section 400.3.5 (Cast-In-Place Concrete).

400.3.4.3.5 Reinforcing Steel

Steel reinforcement incorporated in the pile concrete shall meet the requirements specified in Section 400.3.6 (Reinforcing Steel).

400.3.4.4 Handling

Piling shall be handled, hauled and stored in a manner that avoids damage to the piling materials. Loading and unloading shall be by crane, loader or other appropriate hoisting equipment.

Care shall be taken in order to prevent damaging the galvanized surface on galvanized piling. Fabric slings, wood blocking or other methods accepted by the Department shall be used to support and separate galvanized piling when handling, hauling or storing. Piling on which the galvanized coating has been damaged shall be replaced or repaired as determined by the Department. Where repair of damaged galvanizing is required, the repair shall be by metallizing in conformance with ASTM A780, Method A3, to a thickness of 180mm.

Temporary caps shall be supplied and secured on all open pipe piles or drilled holes.

400.3.4.5 Driven Bearing Piles

400.3.4.5.1 Equipment and Driving Methods

All pile driving equipment, driving methods and procedures shall be reviewed by the Design Engineer and then accepted by the Department before any driving is started. Acceptable driving equipment includes diesel hammers, vibratory hammers, driving frames or other equipment as may be required by the Department.

The driving of piles with driving extensions shall be avoided if practicable, and shall be done only under written permission of the Department. When driving extensions are used, one pile from each group of 10 shall be a long pile driven without extensions, and shall be used as a test pile to determine the average bearing power of the group. For the special types of piling, driving heads, mandrels, or other devices in accordance with the manufacturer's recommendations shall be provided so that the pile may be driven without damage and without unnecessary trimming.

The Contractor shall take adequate precautions to ensure that the piles are in proper alignment, including the use of installation frames, fixed leads or other means as are necessary. The method of alignment and maintaining alignment shall meet the acceptance of the Design Engineer and the Department.

For pile installation monitoring purposes, the Contractor shall paint markings on each pile at 0.25 m intervals, with a label at each 1.0 m interval, starting from the toe of the pile.

Piles shall be driven with a variation of not more than 20mm per metre from the vertical or from the batter shown on the Detailed Designs, except that piles in exposed bents shall not be out of position at the ground line by more than 50mm and shall not be out of position more than 25mm in the pile cap. Foundation piles shall not be out of the position shown on the Detailed Designs more than 150mm after driving.

400.3.4.5.2 Bearing Values

The piles shall all be driven to the tip elevations shown on the Detailed Designs, or lower, to achieve the required stability and specified minimum bearing capacity. The pile bearing capacities may be based on the criteria established by the Design Engineer but shall in no case be less than the bearing capacities estimated by the Bearing Formulas of this Section 400.3.4.5 (Driven Bearing Piles).

After the pile driving operations have been started, the Design Engineer with the Department's acceptance may revise the required pile tip elevations, if necessary, using the pile driving data as a guide.

In the case of friction piles, the piles shall be driven to the tip elevations shown on the Detailed Designs, or lower, in order to achieve the required stability and design load carrying capacity.

Bearing Formula

When not driven to practical refusal, the bearing values of piles may be required to be determined by load tests. In the absence of loading tests, the safe bearing values for piles shall be determined using the criteria established by the Design Engineer as well as by the following formula:

For Diesel Hammers

$$P = \frac{165xExF}{S+5}$$

Where
P - Pile reaction at Service Limit State (SLS) (kilonewtons)
E - Energy output of hammer (kilojoules)
F - Efficiency factor
S - The average penetration per blow for the last 10 to 20 blows (mm per blow)

The Design Engineer will determine and the Department accept the efficiency factor of the hammer at site by comparing the actual recorded blows per minute to data provided by the manufacturer of the hammer.

Loading Tests

When required by the Design Engineer and accepted by the Department, the size and number of piles shall be determined by actual loading tests. In general, these tests shall consist of the application of a test load placed upon a suitable platform supported by the pile, with suitable apparatus for accurately measuring the test load and the settlement of the pile under each increment of load.

In lieu of hydraulic jacks with suitable yokes, pressure gauges may be used.

The safe allowable load shall be considered as 50% of that load which, after a continuous application of 48 hours, produces a permanent settlement not greater than 3.6 mm measured at the top of the pile. This maximum settlement shall not increase by a continuing application of the test load for a further period of 60 hours or longer. At least one pile for each group of 100 piles shall be tested.

The above formula is applicable only when:

(1) The head of the pile is not broomed, crushed, or deformed.
(2) The penetration is reasonably quick and uniform.
(3) A driving extension is not used.

The Contractor shall provide performance specifications for the type of hammer to be used. He will be required to demonstrate that the hammer is performing within the specified limits.

400.3.4.5.3 Steel Piles

Steel piles shall consist of structural steel shapes or pipes of the section shown on the Detailed Designs or otherwise specified.

When pipe piles are to be driven closed-ended, one section of pipe for each proposed pile shall be supplied with the end-plate welded-on, in conformity with Standard Drawing S-1479 "Standard Closed Pipe Pile End Plate".

When pipe piles are to be driven open-ended and the interiors cleaned out, a power screw rotary auger, acceptable to the Department shall be used to remove the required material. All loose material and all material adhering to the walls of the piles shall be removed.

The total energy developed by the hammer shall be sufficient to achieve the required bearing value or tip elevation, but in no case shall the total energy developed be less than 35 kJ per blow.

The head shall be cut squarely and a driving cap or follower shall be provided to hold the axis of the pile in line with the axis of the hammer. The follower shall be of adequate dimensions to allow driving the pile without trimming or reducing the cross-section of the pile. When damage or buckling is evident at the driving end of the pile in order to obtain the desired bearing capacity or penetration of the pile, the Contractor shall reinforce the driving end of the piling, or provide other suitable equipment or procedures, to prevent such damage.

Piles shall be cut off level at the required elevation. If capping is required, the connection shall be made according to details shown on the Detailed Designs.

The Contractor shall supply and secure temporary caps on all open pipe piles or drilled holes.

400.3.4.5.4 Steel Pile Splices

When splicing, the Contractor shall employ whatever means necessary to match out-of-round piling. Exposed pile splices shall be avoided. Refer to Standard Drawing S-1415-87 "Standard H-Pile Splice" and Standard Drawing S-1414-87 "Standard Pipe Pile Splice".

Where the upper portions of piling are specified to be galvanized, excess piling shall be removed from the ungalvanized portion of the piling to ensure that the galvanized portion extends to the elevation shown on the Detailed Designs. Splicing within the galvanized portion of the piling shall be avoided; however if splicing becomes necessary due to unforeseen circumstances, the damage galvanized area shall be metallized by the Contractor.

The Contractor shall advise his staff and his welding personnel of the hazardous fumes which are generated during welding or cutting of the galvanized steel.

400.3.4.5.5 Testing by the Contractor

The Contractor shall be responsible for quality control and quality assurance testing required to ensure the work meets the Technical Requirements and the requirements of the Detailed Designs.

The Contractor shall test a minimum of 20% of all full penetration pile splice welds by ultrasonic testing or radiographic inspection methods.. The Department will randomly select the splices for inspection. In addition, the Contractor shall inspect 100% of the full penetration tension splice welds, as defined on the Detailed Designs. The NDT shall be done by a company certified to CAN/CSA W178.1. Ultrasonic and radiographic testing technicians will be certified to level II of CGSB. The Department may require additional inspection if deemed necessary.

400.3.4.5.6 Defective Piles

The procedure incident to the driving of piles shall not subject them to excessive and undue abuse producing deformation of the steel or crushing and spalling of the concrete. Manipulation of piles to force them into proper position, considered by the Design Engineer or the Department to be excessive, will not be permitted. Piles damaged by improper driving, or driven out of proper location, or driven below the cut-off elevation, shall be corrected by one of the following methods accepted by the Design Engineer and then the Department:

(a) The piles shall be withdrawn and replaced by new and, if necessary, longer piles, or

(b) Replacement piles shall be driven adjacent to defective or low piles, or

(c) The piles shall be spliced or built up, as otherwise provided herein, or a sufficient portion of the footing extended to properly embed the piles. All piles, pushed up by the driving of adjacent piles or by any other cause, shall be driven down again.

In case the required penetration and bearing capacity are not obtained, the Contractor shall provide a hammer of greater energy, as applicable, or when accepted by the Design Engineer and then the Department, resort to pre-drilling.

400.3.4.6 Drilled Cast-in-place Concrete Bearing Piles

400.3.4.6.1 General

In addition to drilled cast-in-place concrete bearing piles this Section 400.3.4.6 (Drilled Cast-in-place Concrete Bearing Piles) shall include drilled cast-in-place concrete/steel pipe composite bearing piles. The work shall include drilling and belling the holes, as required, supplying and placing the steel pipe and reinforcing steel, and supplying, placing, protecting and curing the concrete.

400.3.4.6.2 Equipment and Drilling Methods

Due to the nature of the work, the Department requires that the drilling subcontractor have adequate equipment and a proven record of competence in this work.

All pile drilling equipment, drilling methods and procedures shall be reviewed by the Design Engineer and then accepted by the Department before drilling is started. Unless otherwise specified only powered screw rotary type augers will be acceptable.

The Contractor shall not proceed with the installation of further piling, if for any reason the quality of the adjacent piling is compromised due to the effects of vibration or other reasons.

400.3.4.6.3 Drilling Pile Holes

The drilled pile holes shall be stabilized and sealed by means of temporary casings or other methods to prevent the possible collapse of the pile holes or ingress of water. The Contractor shall make every attempt necessary to obtain "dry" pile holes prior to placing the pile concrete.

Temporary casing, if used in drilling operations, shall be removed from the hole as pile concrete is being poured. The bottom of the casing shall be maintained below the top of the concrete during withdrawal and pouring operations unless otherwise permitted by the Design Engineer and the Department. Separation of the concrete during withdrawal operations shall be avoided by hammering or otherwise vibrating the casing.

The elevations shown on the Detailed Design of the bottoms of the pile holes shall be considered approximate only, and the Design Engineer may order further drilling as necessary to secure satisfactory bearing of the piles. The final elevations of the bottoms of the pile holes shall be acceptable to the Department.

Where belling of the piles is specified, belling shall proceed only after the pile hole has been drilled to an elevation acceptable to the Design Engineer and the Department.

The walls and bottoms of the pile holes shall be cleaned to remove all loose and extraneous material. The Contractor shall determine if any gas is present in the pile holes and shall provide whatever means and equipment necessary to ensure a safe work site. Pile reinforcement and pile concrete shall not be placed without the acceptance of the pile holes by the Design Engineer and the Department.

400.3.4.6.4 Open Drilled Holes

The Contractor shall be responsible for covering all open drilled holes on the site until the time they are filled with concrete or otherwise properly backfilled. The covers shall be of adequate strength and securely fitted so that machinery and workmen are protected against cave-in and surface water is prevented from running into the pile hole.

400.3.4.6.5 Reinforcement

Steel reinforcement shall be fabricated in the sizes and to the dimensions shown on the Detailed Designs and shall be placed, centered and braced in the pile hole to the acceptance of the Design Engineer and the Department.

Particular care shall be taken in locating projecting "column dowel bars", to a tolerance not exceeding 10mm in any direction, and pouring will not be permitted until the Design Engineer and the Department is satisfied that adequate provisions have been made.

Adequate "shoes" or spacers shall be firmly anchored to the reinforcement to ensure the reinforcement is kept centered in the concrete.

400.3.4.6.6 Concrete Placement

When the reinforcement has been acceptably placed, concrete shall be immediately deposited in the pile hole. The concrete shall be "Pile Concrete" and the provisions of Section 400.3.5 (Cast-In-Place Concrete) shall apply.

Suitable forms shall be used to maintain the specified dimensions of concrete piles above ground level.

400.3.4.6.7 Cold Weather Conditions

In cold weather, which shall be considered to exist if nighttime low temperatures are expected to be below 0°C, heated concrete shall be used. Such concrete shall have a temperature of between 15°C and 25°C when placed.

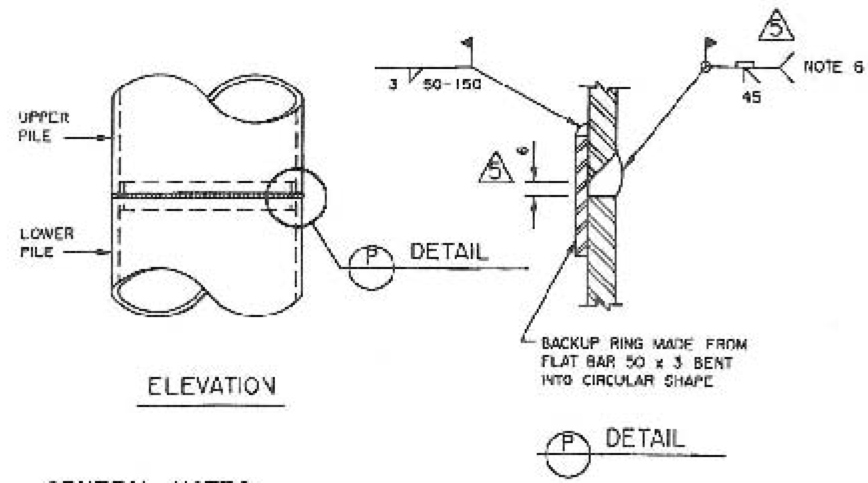
When the ground against which pile concrete is placed is below -5°C, the concrete shall be protected from heat loss. The pile boring shall be made oversize down to the depth of 2m, and the concrete shall be poured in an insulated form. Concrete at the top of the pile is to be insulated. After four days the form and insulation may be removed, and the space is to be backfilled immediately with compacted non-granular fill or lean concrete to the elevation of top of pile.

In a region where the ground temperature is above -10°C but below -5°C, the hole may be bored 100mm diameter oversize, and filled directly with pile concrete, as an alternative to the procedure described above. Concrete at the top of the pile is to be insulated.

If the top of the pile extends above the existing ground surface, in cold weather, it is to be adequately protected from the cold for a period long enough to ensure proper curing.

400.3.4.6.8 Pile Tolerance

Piles shall be accurately located, and shall be installed plumb or at the batter specified on the Detailed Designs. The maximum tolerance allowed shall be 50mm for variation off the centre of any pile at the cut-off elevation, and no pile shall be out of plumb or specified batter by more than 20mm per metre. Any pile out of centre or plumb beyond the tolerances specified shall be corrected.



GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE

2

REQUIREMENTS AND PROCEDURE FOR SPLICING PIPE PILES

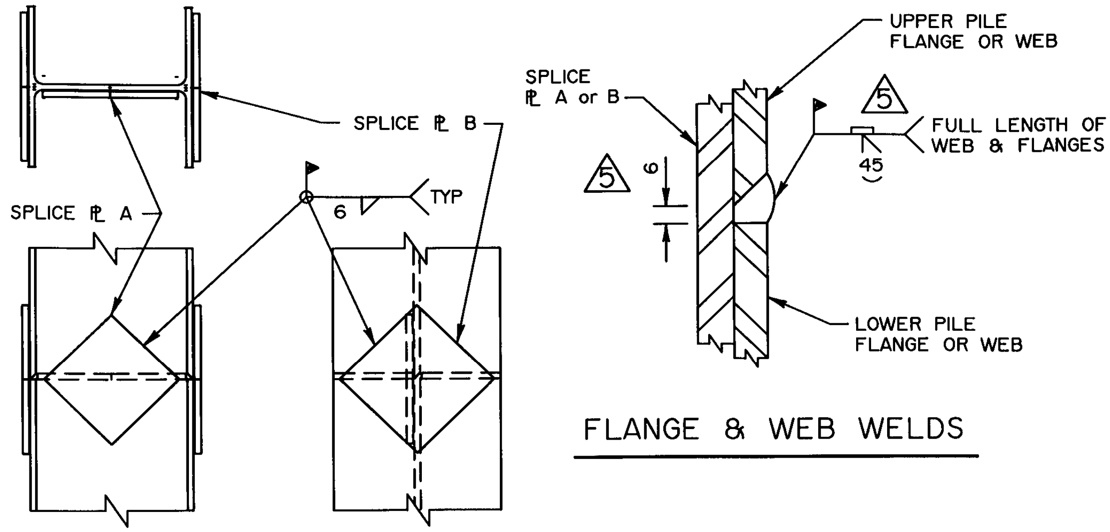
4 1. FIELD WELDING SHALL BE IN ACCORDANCE WITH SECTION 13.4
2. THE LOWER PILE SHALL BE TRIMMED TRUE AND SQUARE.
3. THE BEVEL ON THE UPPER PILE SHALL BE FLAME CUT USING A MECHANICAL PIPE BEVELLING MACHINE.
4. THE BACKUP PLATE SHALL BE WELDED TO THE UPPER PILE.
5. THE UPPER PILE SHALL BE POSITIONED WITH THE BACKUP RING FITTED INTO THE LOWER PILE.
6. SPLICE WELD SHALL PENETRATE BACKUP RING. TWO PASSES ARE REQUIRED IF THE PILE WALL IS GREATER THAN 8 mm. GRIND WELD SMOOTH IF THE SPLICE IS LOCATED ABOVE GROUND LEVEL.

NO	DATE	REVISIONS	BY
5	2005-05-19	DETAIL "P" REVISED	AW
4	2001-06-19	GENERAL NOTES	AW
3	99-03-29	BEB CHANGED TO TSB	FY
2	94-11-30	GENERAL NOTES	RJR
1	87-03-09	REDRAWN FROM S-1414	DHQ

Alberta TRANSPORTATION AND UTILITIES
TECHNICAL STANDARDS BRANCH

STANDARD
PIPE PILE SPLICE

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	PAGE	DRAWING
DHQ	MIK	87-03-09	EXECUTIVE DIRECTOR		May 8/87	3.15	S-1414-87



PILE DESIGNATION	SPLICE PLATE DIMENSIONS	
	PLATE A (WEB)	PLATE B (FLANGE)
HP 250 x 62	140 x 10 x 140	170 x 10 x 170
HP 310 x 94	175 x 12 x 175	200 x 12 x 200
HP 360 x 132	200 x 16 x 200	250 x 16 x 250

GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- 2 STEEL SHALL CONFORM TO ASTM A36 OR CSA G40.21M 300W.

REQUIREMENTS AND PROCEDURE FOR SPLICING H-PILES

4 1. FIELD WELDING SHALL BE IN ACCORDANCE WITH SECTION 13.4

2. PILE ENDS TO BE SPLICED SHALL BE FLAME CUT USING A STEEL GUIDE TO OBTAIN A SQUARE AND EVEN CUT. BEVEL CUTS SHALL BE MADE AT 45°.

3. SPLICE PLATES A & B SHALL BE WELDED TO THE UPPER PILE BEFORE POSITIONING IT.

4. THE UPPER PILE SHALL BE POSITIONED ON AND THE SPLICE PLATES WELDED TO THE LOWER PILE; BUTT WELDS SHALL THEN BE MADE.

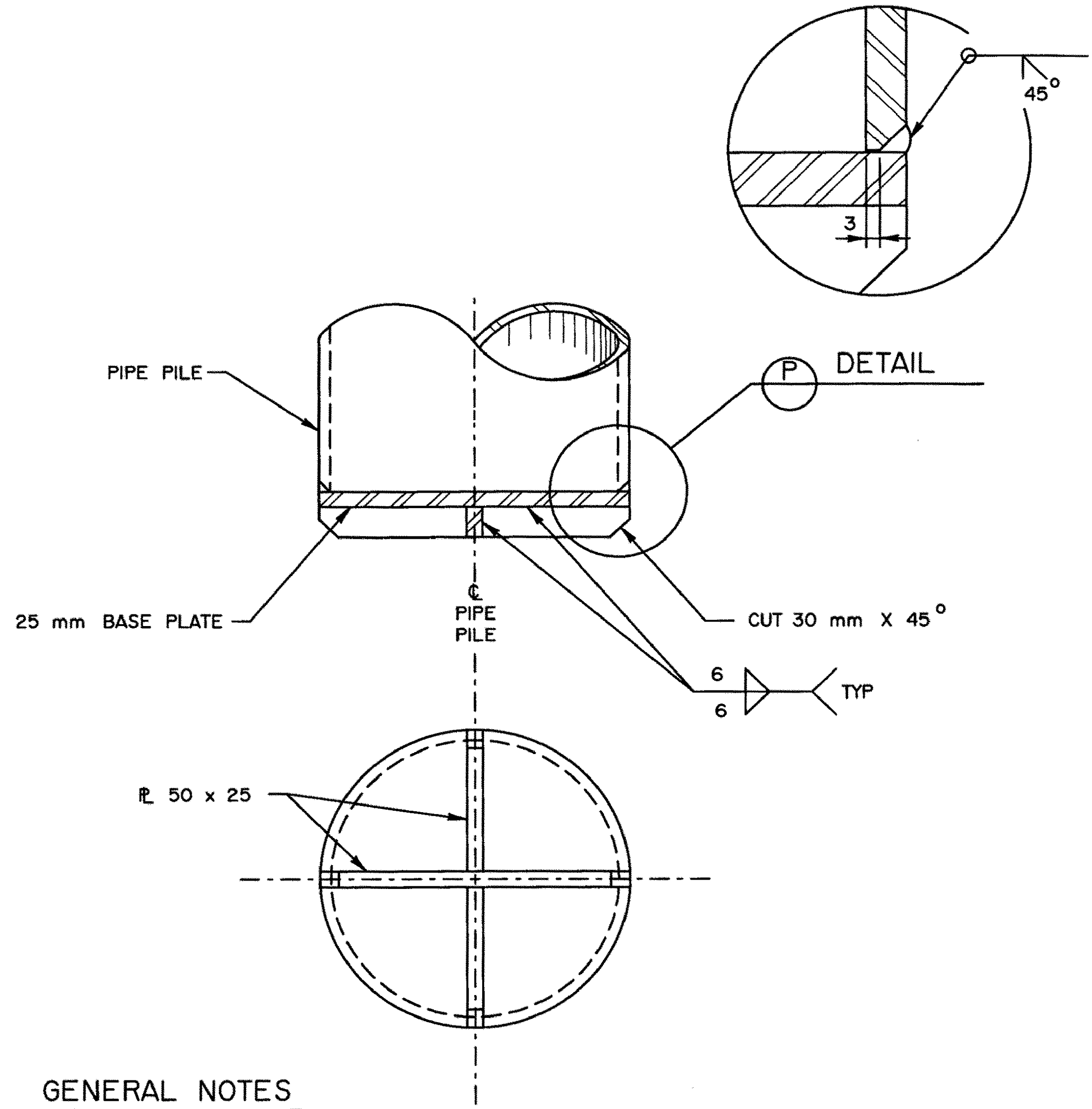
NO	DATE	REVISIONS	BY
5	2005-05-19	FLANGE & WEB WELDS REVISED	AW
4	2001-06-19	GENERAL NOTES	AW
3	99-03-29	BEB CHANGED TO TSB	RY
2	94-11-30	GENERAL NOTES	RJR
1	87-03-11	REDRAWN FROM S-1415	DHQ

Alberta TRANSPORTATION AND UTILITIES
TECHNICAL STANDARDS BRANCH

STANDARD
H-PILE SPLICE

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	PAGE	DRAWING
DHQ	MIK	87-03-11	EXECUTIVE DIRECTOR		May 8/87	3.13	S-1415-87

PLOTTED MAY 19, 2005 S1415X87 .RV4



GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- STEEL SHALL CONFORM TO ASTM A36 OR CSA G40.21M 300W.
- SHOP WELDING SHALL BE IN ACCORDANCE WITH SECTION 6

4

DRAFTING STANDARD PAGE: 3.9

NO	DATE	REVISIONS	BY
4			
3	2001-06-19	GENERAL NOTES	AW
2	99-03-29	BEB CHANGED TO TSB	RY
1	94-11-30	GENERAL NOTES AND PAGE NUMBER	RJR

Alberta TRANSPORTATION AND UTILITIES
TECHNICAL STANDARDS BRANCH

STANDARD
CLOSED PIPE PILE
END PLATE

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	PAGE	DRAWING
DHQ	MIK	87-03-30	EXECUTIVE DIRECTOR	[signature]	May 8/87	3.17	S-1479

PLOTTED JUNE 19, 2001 S1479X87 .RV3

400.3.5 CAST-IN-PLACE CONCRETE

400.3.5.1 General

This Section prescribes the quality requirements, the sampling and testing of the materials and concrete, the methods of producing and handling the constituent materials, and the batching, mixing, handling, transporting, placing and curing as outlined, and which constitute good and acceptable construction practice in structural and similar work. The Contractor shall supply all necessary materials.

Metric versions are inferred, when available and relevant.

400.3.5.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work:

- Test results of the aluminum content in the steel fibres for Class HPC Concrete with steel fibres (at least two weeks prior to placing).
- All Trial Batch Data.
- Concrete Mix Design for each proposed class of concrete to be used (at least two weeks prior to placement).
- False work and formwork drawings including girder profiles and deck thicknesses (at least three weeks prior to construction).
- Technical data on mixing, conveying, placing and compacting equipment shall be provided.
- Lighting to be used for deck pours;
- Systems for misting and wet cure (at least three weeks prior to pour date).
- Repair procedures for defects in deck surfaces.
- Systems for cold weather heating of concrete.
- Methods of depositing concrete underwater.
- Curing compounds for concrete slope protection;
- Curing concrete (provide daily temperatures) records;
- Repair procedures for concrete deck cracks;
- Concrete strength test results (within 2 days of testing); and
- Concrete core test results if required.

The Department shall be advised a minimum of two days prior to each concrete pour.

400.3.5.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following to determine the acceptability of the work:

- Acceptance of submissions as outlined in this Section 400.3.5 (Cast-in-Place Concrete);
- Visual inspections of the work;
- Audits of the Contractor's quality control/quality assurance inspection and testing records; and
- Testing to confirm the acceptability of materials and/or workmanship (See Sections 400.3.5.9 (Inspection and Testing Methods) and 400.3.5. 22.4 (Curing Requirements for Class HPC and Class HPC with Steel Fibres)).

400.3.5.1.3 Reference Drawings (as attached after Section 400.3.5.26.3)

- Standard Concrete Joints S-1411-87
- Standard Construction Joints S-1412-97

400.3.5.2 Materials for Concrete

Concrete shall consist of Portland cement, aggregates, water and admixtures or additives which shall conform to the requirements as specified.

Cement - Normal Portland cement, Type GU, or Sulphate Resistant, Type HS, shall be supplied unless otherwise specified on the Detailed Designs. Cement shall conform to the requirements of CSA Standard A 3001-03, Portland Cements.

Water - Water to be used for mixing concrete or mortar shall conform to the requirements of CSA Standard A23.1 and shall be free from injurious amounts of alkali, organic materials or deleterious substances. The Contractor shall not use water from shallow, stagnant or marshy sources.

Aggregates - Fine and coarse aggregates shall conform to the requirements of CSA Standard A23.1 and shall be stockpiled separately.

Admixtures - All admixtures accepted by the Design Engineer and then the Department, such as water reducing agents, air entraining agents and superplasticizers shall conform to ASTM C494 and be compatible with all other constituents. The addition of calcium chloride, accelerators, retarders or set controlling admixtures and air-reducing agents, will not be permitted.

Silica Fume - Condensed silica fume shall conform to CSA Standard A 3000-03 - Cementitious Material Compendium, Type SF, with a SiO_2 content of at least 85%, of a maximum of 10% ignition loss, and no more than 1% SO_3 content.

Air Entraining Agent - Air Entraining Agent shall be added to all concrete and shall conform to the requirements of ASTM C260.

Steel Fibres - When specified on the Detailed Designs steel fibres shall be Novocon XR, Wiremix or an acceptable equivalent. The fibres shall conform to ASTM A820/A820M-04 Type 1 or 5 and be 50 mm in length with the aluminum content no more than 0.020% by mass when tested in accordance with test method Environmental Protection Agency (EPA) 3050B.

Fly Ash - All fly ash shall conform to the requirements of CSA-A3000-03 Cementitious Material Compendium for Type “F” or “CI” fly ash. Only compatible superplasticizing admixtures and air entraining agents accepted by the Design Engineer and then by the Department shall be used with the fly ash. Characteristic data for fly ash is required to assure conformance to the standards.

400.3.5.3 Storage of Materials

Cement, silica fume, fly ash and steel fibres shall be stored in a suitable weather-tight building which shall protect these materials from dampness. Cement, silica fume and fly ash shall be free from lumps at all times during their use in the work. Cement, silica fume and fly ash which have been stored for a length of time resulting in the hardening or the formation of lumps shall not be used in the work. The steel fibres shall be free from balls and clumps at all times during their use in the work.

All aggregates shall be handled so as to prevent segregation and to obtain uniformity of materials. The separated aggregates, and aggregates secured from different sources, shall be piled in separate stockpiles. The site of the stockpiles shall be cleaned of all foreign materials and shall be reasonably level and firm. If the aggregates are placed directly on the ground, material shall not be removed from the stockpile within 150 mm of the ground level. This material shall remain undisturbed to avoid contaminating the aggregate being used with the ground material.

400.3.5.4 Class and Composition of Concrete

400.3.5.4.1 Class of Concrete

The class and composition of concrete used shall be in accordance with the following table unless otherwise accepted by the Department.

Class of Concrete	Minimum Specified Compressive Strength at 28 Days MPa	Size of Coarse Aggregate mm	Range of Slump mm	Total Air Content %	Max. Water/ Cementing Materials Ratio
B	25	28 to 5	50 to 70	4 - 7	0.45
C	35	20 to 5	60 to 80	5 - 8	0.42
HPC	45	20 to 5	90 to 150	5 - 8	0.38
D	30	14 to 5	50 to 70	5 - 8	0.42
S	20	28 to 5	50 to 70	4 - 7	0.50
Pile	25	28 to 5	100 to 140	4 - 7	0.45

Note

- The size of coarse aggregate shall be 28 to 5mm for Class C concrete when used in mass pours such as piers and abutments.
- The fly ash shall not exceed 30% by mass of cementing materials, however for High Performance Concrete (HPC) it shall be in accordance with Section 400.3.5.4.2 (Class HPC and Class HPC with Steel Fibres). Fly ash may be used in concrete mixes where the aggregate is assessed to be potentially alkali-silica reactive.

400.3.5.4.2 Class HPC and Class HPC with Steel Fibres

(a) Mix shall include silica fume and fly ash as supplementary cementing materials in combination with compatible air entraining, water reducing and/or superplasticizing admixtures, as required.

(b) The gradation limits for the fine aggregate shall conform to CSA A23.1, except that the amount of material finer than 160 μm shall not exceed 5%.

(c) Coarse aggregate shall conform to CSA A23.1 and the maximum combination of flat and elongated particles (4:1 ratio), as determined by CSA A23.2-13A, shall not exceed 10% of the mass of coarse aggregate.

(d) Minimum cement content (excluding supplementary cementing materials) shall be 335 kg/m^3

(e) Sum of silica fume and fly ash by mass of cementing materials shall be 17% to 20%.

(f) Silica fume by mass of cementing materials shall be 6% to 8%.

(g) Fly ash by mass of cementing materials shall be 11% to 15%.

(h) Slump retention of trial mix after 45 minutes of batching shall be at least 50% of initial slump. The initial slump of the trial mix shall be measured after an elapsed time from batching of not more than 15 minutes.

(i) Rapid chloride ion penetration shall be determined in accordance with ASTM C1202 on laboratory moist cured samples at 28 days. Rapid chloride ion penetration shall be less than 1000 coulombs for concrete.

(j) An air-void spacing factor shall be determined in accordance with ASTM C457, modified point-count method at 100 times magnification. The average of all tests shall not exceed 230 μm with no single test greater than 260 μm.

(k) When Class HPC with steel fibres is specified, it shall contain 60 kg of 50mm long Novocon XR, or an equivalent steel fibre accepted by the Design Engineer and the Department, per cubic metre. The Contractor shall provide test results of the aluminum content in the steel fibres, for review by the Design Engineer and then acceptance by the Department, a minimum of two weeks prior to placing concrete at site.

(l) The temperature of the centre of the in-situ concrete shall not fall below 10°C or exceed 60°C and the temperature difference between the centre and the surface shall not exceed 20°C. In addition, the requirements of Table 18 of CSA A23.1 shall apply.

(m) Trial batch(es) shall be performed at least 35 days prior to placement of concrete at site to verify that requirements pertaining to compressive strengths at 7 and 28 days, rapid chloride ion penetration and air void system parameters of hardened concrete have all been met. The shrinkage of the trial batch concrete shall be measured in accordance with ASTM C157 except that drying shall commence after 7 days of curing and shrinkage determined after 28 days of drying. The shrinkage data shall be submitted to the Department for information purposes.

400.3.5.4.3 Temperature

The temperature of all classes of concrete not containing silica fume shall be between 10°C and 25°C at discharge. Temperature requirements for Class HPC and Class HPC with steel fibres shall be between 10°C and 20°C at discharge.

400.3.5.4.4 Aggregate Tests and Concrete Mix Design

The Contractor shall submit the mix design he proposes for each proposed class of concrete to the Design Engineer for review and then to the Department for acceptance at least two weeks before scheduled placing of concrete.

For each mix design the following aggregate analysis shall be provided:

- "Fine and Coarse Aggregate Sieve" (CSA A23.2-2A)
- Amount of material finer than 80 µm in aggregate (CSA A23.2-5A)
- "Organic Impurities in Sands for Concrete"
- "Results of deleterious substances and physical properties of aggregates included in Table 12, CSA A23.1-04" (Test Methods A23.2-23A, A23.2-24A and A23.2-29A)
- "Assessment of Potential for Deleterious Alkali-Aggregate Reactivity (AAR)" (CSA A23.2-27A)
- "Petrographic Examination of Coarse Aggregate for Concrete" shall be required for Class HPC and Class HPC with steel fibres
- "Sources of proposed aggregate"

The analysis of the aggregates shall be current and fully represent the material to be used in production. All sampling and testing shall have been done no more than 90 days prior to concrete production, except for petrographic examination of coarse aggregate for concrete which shall be no more than 120 days. Additional analyses of more recent sampling shall be provided as required to confirm that the aggregates continue to meet requirements. A break in production of a particular class of concrete shall not constitute the need for additional testing when the Contractor provides conclusive evidence that the material initially tested, is still representative.

If the fine aggregate consists of a blend from more than one source, the "Fine Aggregate Sieve" analysis shall show the gradation of the blended fine aggregates. Similarly in the case of blended coarse aggregates, the "Coarse Aggregate Sieve" analysis shall indicate the gradation of the blended coarse aggregates.

Fine aggregate, tested in accordance with CSA Test Method A23.2-7A, "Organic Impurities in Sands for Concrete", shall produce a colour not darker than the Standard colour (Organic Plate Number 3). Aggregate producing a colour darker than the Standard colour will be rejected in the absence of a satisfactory record of performance of a similar class of concrete (minimum 30 tests over the last 12 months); provisions 4.2.3.3.3.2 (a) & (b) of CSA Standard CAN3-A23.1-04 shall not apply.

The potential for deleterious alkali-aggregate reactivity shall be assessed in accordance with CSA A23.2-27A. This assessment shall include the risk level associated with structure size and environment, the level of prevention related to service life requirements and the determination of the appropriate preventative measures. For bridge structures, the service life is considered to be 75 years. Current (less than 18 months old) test data evaluating the potential alkali-silica reactivity of aggregates tested in accordance with CSA A23.2-14A or CSA A23.2-25A is required. In the absence of current test data and outside of areas of known highly reactive aggregate, the aggregate shall be presumed to be moderately reactive.

Petrographic analysis on the proposed coarse aggregates shall be performed in accordance with CSA A 23.2-15A by experienced personnel employed by CSA certified laboratory. The (weighted) petrographic number shall not exceed 130, and the ironstone content shall not exceed 0.8%. The Petrographic Analysis report shall be stamped by either, a Professional Engineer, Professional Geologist, or a Geological Engineer registered in the Province of Alberta.

The sampling and testing of aggregates, and the concrete mix design shall be completed by an independent CSA certified and qualified concrete testing laboratory which shall have a permit to practice in the Province of Alberta. Concrete mix designs including sampling and testing of aggregates may be completed by the concrete supplier, with the condition that documentation is stamped by a Professional Engineer. For either situation, the mix design including sampling and testing shall be reviewed and stamped for compliance with the applicable specifications, by an independent CSA certified and qualified concrete testing laboratory having a permit to practice in the Province of Alberta. For either case, the testing laboratory shall provide an engineering opinion that concrete aggregate and mix designs are suitable for the intended use and are expected to perform to specified standards.

For Class HPC and Class HPC with steel fibres, the Contractor shall produce evidence satisfactory to the Design Engineer and then to the Department that the proportions selected will produce concrete of the quality specified. This shall include the preparation of satisfactory trial mixes, before the concrete is used. The trial mix shall be a minimum of $3m^3$ or 50% of the rated mixer capacity (whichever is greater) and simulate the anticipated placing procedures at site. In preparing the trial mixes the workability and slump retention characteristics shall be assessed at 30, 45 and 60 minute intervals. In addition the concrete from the trial mixes shall also satisfy the rapid chloride ion penetration requirement in accordance with Section 400.3.5.4.2(i).

Concrete mixes that will be placed by concrete pump shall be designed for pumping.

400.3.5.4.5 Initial Mixes and Adjustments

For all classes of concrete other than HPC and HPC with steel fibres, in cases of initial mixing operations or changes in source of water or aggregates, the mix adopted shall be designed for an excess compressive strength of 10% above the specified 28 day nominal compressive strength. After the mix has been adequately proven as to strength and performance, adjustment may be undertaken, but only with the acceptance of the Design Engineer and then of the Department. If, during the progress of the work, the mix design is found to be unsatisfactory for any reason including poor workability, the Contractor shall make the necessary adjustments. Notwithstanding the Department's acceptance of the design mix, it remains the Contractor's responsibility that the concrete meets all the requirements of the Technical Requirements.

400.3.5.5 Measurement of Materials

Coarse and fine aggregate materials shall be separated and measured separately by weighing, except as otherwise specified or where other methods are specifically authorized by the Department. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Each size of aggregate, and the cement, shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities can be measured to within one percent of the desired amount. The mixing water shall be measured by volume or by weight. The water measuring device shall be capable of control accurate to plus or minus 1/2% of the design quantity. All measuring devices shall be subject to acceptance by the Department. Unless otherwise accepted by the Department, air entraining agent and other admixtures shall be added to the mix in a water-diluted solution; the dilution of the solution shall be accepted by the Design Engineer and then by the Department. For mix adjustments at the site, the Contractor shall maintain facilities to control the amount of superplasticizer and air entrainment so that the required tolerances can be met.

400.3.5.6 Mixing Concrete

Mobile continuous mixers or other such concrete supply equipment will not be accepted for use.

400.3.5.6.1 General

All concrete shall be mixed thoroughly until it is uniform in appearance, with all ingredients uniformly distributed. In no case shall the mixing time per batch be less than one minute for mixers of one cubic metre capacity or less. The Department may require that the uniformity of the mixed concrete be tested for conformance with CSA A23.1, Clause 5.2.3.5. The "Batch" is considered as the quantity of concrete inside the mixer regardless of size of the mixer. The mixing period shall be measured from the time all materials are in the mixer drum.

The Contractor shall in no case load the mixer above its rated capacity. The Contractor shall maintain the mixer in good condition. Inner surfaces of the mixer shall be kept free of hardened concrete and mortar. Mixer blades which are bent or worn down so as to affect the mixing efficiency shall be renewed. Any mixer leaking mortar or causing waste of materials through faulty charging shall be taken out of service until repaired. The Contractor shall, at all times, operate the mixer at the speed recommended by the manufacturer and shall, if requested, supply to the Department the manufacturer's certification of the mixing capacity of the machine in use.

The mixer shall be fitted with an accurate and dependable means for measuring the water added, which is not affected by variation in pressure in the water supply line. All joints, valves and other parts shall be maintained so that there is no leakage of water into the mixer drum. Failure of the Contractor to have an accurately working and dependable water gauge on a mixer shall be cause for the Department to prohibit the mixer to be used.

Water shall be released first and continue to flow while the solid materials are entering the mixer. The water discharge pipe shall be so arranged and be of such size that the flow into the mixer is completed within the first quarter of the mixing time, and the water is delivered well within the mixer where it will be quickly mixed with the entire batch.

Air entraining agents and admixtures shall be placed in the mixer after the initial water is in the mixer drum but before the remaining materials are added. Superplasticizer shall be added after initial mixing and as per the manufacturer’s recommendation.

400.3.5.6.2 Truck Mixing

Truck mixers, unless otherwise authorized by the Department, shall be of the revolving drum type, watertight, and so constructed that the concrete can be mixed to ensure uniform distribution of materials throughout the mass. All materials for the concrete shall be accurately measured in accordance with Section 400.3.5.5 (Measurement of Materials), and charged concurrently at the proportions which satisfy the accepted mix design into the drum at the production plant. Increases in water-cement ratio will not be permitted.

The maximum size of batch in truck mixers shall not exceed the maximum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing shall commence immediately upon introduction of ingredients into the drum and be continued for at least 50 revolutions with the mixing rate being in accordance with the manufacturer’s recommended rate, and shall be such as to thoroughly mix the concrete.

When adjustment to the mix by adding water, air entraining agent or superplasticizer at the site is authorized by the Design Engineer and accepted by the Department, the mixer shall be run for a minimum of 20 additional revolutions to ensure homogeneity of the concrete before discharge. Discharge chutes shall be kept clean and free from hardened concrete and shall be wetted down prior to use.

400.3.5.6.3 Time of Hauling

The maximum time allowed for all classes of concrete other than Class HPC and Class HPC with steel fibres including delivery to the site of the work and discharge shall not exceed 90 minutes after batching. Batching of all classes of concrete is considered to occur when any of the mix ingredients are introduced into the truck mixer drum, regardless of whether or not the drum is revolved. For Class HPC and Class HPC with steel fibres this requirement is reduced to 70 minutes.

400.3.5.7 Delivery

The Concrete supplier shall have sufficient plant capacity and satisfactory transporting equipment to ensure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such that the development of cold joints will not occur. The methods of delivering and handling the concrete shall facilitate placing with a minimum of rehandling, and without damage to the structure or the concrete.

400.3.5.8 Pour Schedules

The Contractor shall submit to the Design Engineer and then to the Department the proposed pour schedule for any particular pour. If in the opinion of the Design Engineer or the Department the amount of pour is deemed larger than can be poured with the facilities outlined the Contractor shall either:

(a) Limit the amount to be poured at any time (using adequate construction joints), or

(b) Augment his facilities in order to complete the proposed pour, or

(c) In the case of continuous pouring provide additional crews and have adequate lighting to provide for proper placing, finishing and inspecting.

400.3.5.9 Inspection and Testing Methods

400.3.5.9.1 Inspection and Testing by Contractor

The Contractor shall be responsible for all quality control and quality assurance testing required to ensure that the work meets the Technical Requirements and the requirements of the Detailed Designs.

Any quality control/quality assurance testing and inspection records made by the Contractor shall be open to the Department for auditing. The Contractor shall utilize ACI or CSA certified testers with extensive related experience to test at site, the air content, slump, unit weight, temperature, etc. of each batch; results of all tests shall be provided to the Department. Additional tests will be required if the results are borderline or widely variable. In case of any unacceptable result, one check test will be permitted. The certified testers shall also cast the test cylinders as specified in Section 400.3.5.9.5 (Test Cylinders).

The certification of the testers shall be current and available for examination by the Department.

400.3.5.9.2 Inspection and Testing by Department

The Department shall be afforded full facilities for the acceptance inspection and testing that may be carried out relative to the concrete itself and/or the constituent materials. This includes at the worksite and any plant used for the manufacture of concrete wherever this may be situated. The facilities shall be adequate in the opinion of the Department to permit proper sampling of concrete, making of test cylinders and testing slump and air content.

400.3.5.9.3 Strength Tests

"Strength Test's" will be carried out by the Contractor and shall consist of the compression tests of four standard test specimens, sampled, made, cured, and tested in accordance with CSA Standard Specifications as referenced with modifications as indicated. One cylinder shall be tested at seven days. The 28 day test result shall be the average of the strengths of the remaining three specimens, except that any specimens in a test showing distinct evidence of improper sampling, molding or testing, shall be discarded and the remaining strengths averaged. Additional cylinders may be cast, at the discretion of the Department or the Contractor.

For Class HPC and Class HPC with steel fibres, the Contractor shall take a strength test to represent each approximate $20m^3$ portion of the concrete pour to a minimum of one strength test for every two batches of concrete. For all other concrete, the Contractor shall take a strength test to represent each bridge element or portion of the element (i.e. abutment seat, abutment backwall, pier footing, and pier cap), except on larger pours where a strength test shall be taken to represent each approximately $30m^3$ portion of the concrete pour to a minimum of one strength test for every three batches of concrete. Such tests shall be taken from representative batches as determined by the Department.

400.3.5.9.4 Sampling

Sampling of concrete shall be carried out in accordance with CSA Standard A23.2-1C. When a concrete pump is used to place concrete, sampling shall be at the end of the discharge hose.

400.3.5.9.5 Test Cylinders

Making and curing concrete test cylinders shall be carried out in accordance with CSA Standard A23.2-3C, except that the time for cylinders to reach the testing laboratory shall be between 20 and 48 hours. The test cylinders shall be cast in standard CSA approved heavy duty steel or plastic moulds. Plastic moulds shall have a wall thickness of at least 6 mm. The Contractor shall provide properly designed temperature-controlled storage boxes for test cylinders, as specified in Section 5.3.2.1 of CSA Standard A23.2-3C, for a period of at least 24 hours, and further protection, as required, from adverse weather and mishandling until removed from the site. The Contractor shall provide a max-min thermometer for each storage box and record site curing temperatures for all test cylinders. Storage in a portable building which will be used by the Contractor's personnel or Department during the first 24 hour storage period will not be permitted. Storage facilities shall be provided, installed and accepted by the Department before any concrete is placed.

The Contractor shall be responsible to deliver the test cylinders to an independent CSA certified testing laboratory. Handling and transporting of the cylinders shall be in accordance with CSA Standard 23.2-3C. No extra laboratory curing time will be allowed for cylinders that are delivered late to the laboratory. For Class HPC and HPC with steel fibres, the ends of cylinders shall be ground flat prior to testing.

If the test cylinders exhibit frost etchings or were stored at temperatures below 10°C or above 25°C or are otherwise mishandled resulting in unreliable strength test results; the Department may reject these portions of the work, unless core-testing, at the Contractor's expense confirms the in-situ strength of the concrete.

Handling and transporting of the cylinders shall be in accordance with CSA Standard 23.2-3C. For Class HPC and HPC with steel fibres, the ends of cylinders shall be ground flat prior to testing.

400.3.5.9.6 Slump

Slump tests shall be made in accordance with CSA Standard A23.2-5C.

400.3.5.9.7 Air Content

Air content tests shall be made in accordance with CSA Standard A23.2- 4C.

400.3.5.9.8 Testing Cylinders

Test cylinders shall be tested in compression in accordance with CSA Standard A23.2-9C by a CSA certified engineering laboratory.

400.3.5.9.9 Failure to Meet Slump or Air Content Specifications

In the event that slump and/or air content are outside the specified tolerance range, as determined by the Contractor's or the Department's testing, the Design Engineer and then the Department may, accept adjustments of the deficient condition as an alternate to rejection provided adjustments are made within the maximum time allowed as specified in Section 400.3.5.6.3 (Time of Hauling). Concrete that does not meet the specifications will be rejected after the maximum time is exceeded.

For Class HPC and Class HPC with steel fibres the Contractor will be allowed to adjust only the quantities of superplasticizer and air entraining agent. Addition of water at site to the batch will only be permitted subject to an alternate batching procedure accepted by the Design Engineer and then by the Department. In no case shall accepted batch adjustment relieve the Contractor of his responsibility for the eventual durability, strength, and acceptability of the concrete concerned. The Department reserves the right to reject any batch in the event of confirmed unacceptability, and to require immediate removal of any concrete from this batch which may have already been placed in the structure.

400.3.5.10 Falsework and Formwork

400.3.5.10.1 General

Detailed falsework and formwork drawings shall be supplied to the Design Engineer for review and then to the Department for acceptance as to concept only. The drawings shall be submitted three weeks before construction of the work begins. The drawings shall bear the seal of a Professional Engineer, who shall assume full responsibility to ensure that his design is being followed in construction of the falsework and formwork. Safety and compliance with the

Occupational Health and Safety Act (Alberta) and regulations thereunder, shall be integral parts of its design. All falsework and formwork shall be fabricated in accordance with the drawings.

400.3.5.10.2 Design

For the design of falsework and formwork, the density of fresh concrete shall be assumed to be 2400 kg/m^3. All forms shall be of wood, metal or other acceptable materials, and shall be designed and built mortar-tight and of sufficient rigidity to prevent distortion due to the pressure of vibrated concrete and other loads incidental to the construction operation. The forms shall be substantial and unyielding, and shall be designed so that finished concrete will conform to the design dimensions and contours. The shape, strength, rigidity, water tightness and surface smoothness of re-used forms shall be maintained at all times. Any warped or bulged formwork must be repaired or replaced before being used. Forms which are unsatisfactory in any respect shall not be used.

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. Falsework which cannot be founded on a satisfactory footing shall be supported on piling which shall be spaced, driven and removed in a manner acceptable to the Design Engineer and the Department.

For timber formwork, drawings shall specify the type and grade of lumber and show the size and spacing of all members. The formwork drawings shall also show the type, size and spacing of all ties or other hardware, and the type, size and spacing of all bracing.

When forms appear to be unsatisfactory in the opinion of the Design Engineer or the Department, either before or during the placing of concrete, the Department will order the work stopped until the defects have been corrected.

For narrow walls and columns, where the bottom of the form is inaccessible, removable panels shall be provided in the bottom form panel to enable cleaning out of extraneous material immediately before placing the concrete.

400.3.5.10.3 Forms for Exposed Surfaces

Forms for exposed surfaces which require a Class 1 "Ordinary Surface Finish" shall be made of good quality plywood, or an acceptable equivalent, of uniform thickness, with or without a form liner. Forms for exposed surfaces requiring a Class 2 "Rubbed Finish" or Class 3 "Bonded Concrete Surface Finish" shall be all new material, made of "Coated Formply", consisting of Douglas Fir substrate with resin-impregnated paper overlay and factory treated chemically active release agent, "ULTRAFORM", or "POURFORM 107", are acceptable formwork panels, however other forming panels will be considered if approved equal. All form material for exposed surfaces shall be full-sized sheets, as practical. The re-use of any forms must have the acceptance of the Department.

All forms for exposed surfaces shall be mortar-tight, filleted at all sharp corners, and given a bevel or draft in the case of all projections. At the top edges of exposed surfaces, the chamfers are to be formed by chamfer strips.

The minimum acceptable forming for all exposed concrete where the pour height is 1.5m or less shall have 18mm approved plywood, supported at 300mm maximum on centres. Where the pour height is greater than 1.5m the minimum acceptable forming for all exposed concrete shall have 18mm approved plywood, "Coated Formply", supported at 200mm maximum on centres. The support spacing specified here assumed the use of new material. Closer spacing may be required in case of re-used material. Strong-backs or walers placed perpendicularly to the supports shall be employed to ensure straightness of the form.

Metal bolts or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 20mm from the concrete surface. Break-back type form ties shall have all spacing washers removed and the tie shall be broken back a distance of at least 20mm from the concrete surface. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest possible size. Torch cutting of steel hangers and ties will not be permitted. Formwork hangers or ties for exposed surfaces of decks, curbs and barriers shall be an acceptable break-back type with surface cone, or removable threaded type. As practical, internal ties for the construction of curb and barriers should not be used. Cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in color.

400.3.5.10.4 Forms for Unexposed Surfaces

The minimum acceptable forming for unexposed concrete shall have 15mm plywood supported at 400mm maximum on centres.

400.3.5.10.5 Standard Details

Refer to Standard Drawing S-1411-87 "Standard Concrete Joints" and Standard Drawing S-1412-99 "Standard Construction Joints," included with these Technical Requirements, for details of joints.

400.3.5.10.6 Deck Formwork

Unless otherwise noted, diaphragms and girders will be designed for construction loads during deck concrete pour in accordance with CSA-S6-00 Clause 3.16, and the loads assumed for such design shall be shown on the Detailed Designs. The Contractor shall be responsible for maintaining girder stability until the deck concrete has gained sufficient strength. Where required, deck formwork design shall include any additional bracing system to those shown on the contract drawings. Care shall be taken in the design and installation of support brackets to avoid damage to girder flanges and webs. Where such brackets bear against girder webs, the girder webs shall be protected by timber or neoprene softeners. Effects of concentrated loads on thin webs shall be checked by the Design Engineer, and where necessary, sufficient means shall be provided to distribute or carry such concentrated loads to the supporting flanges or stiffeners.

Formwork for decks, curbs, sidewalks, and parapets shall be fabricated so that the lines and grades shown on the drawings are achieved. Girders will be erected to normally accepted industry standards of tolerance; it shall be necessary to adjust the formwork to compensate for variances in girder dimensions, positioning, alignment, and sweep.

Prior to commencing deck formwork, the Contractor shall profile all the girders and determine the deck concrete thickness values required to achieve the specified gradeline. This information shall be provided to the Design Engineer for review and then to the Department for acceptance prior to commencing any deck formwork.

In the event that actual girder camber values vary significantly from the estimated values indicated on the Drawings, the Design Engineer may require the Contractor to raise or lower the gradeline accordingly. The final gradeline shall be acceptable to the Department.

400.3.5.11 Protection of "Weathering" Steel Girders

Where steel girders are fabricated of "weathering" steel, it is essential that the uniformity of rust formation is not adversely affected by the Contractor's operation.

The Contractor shall exercise utmost care and provide the necessary protection to prevent marking or staining of the girders. All joints between deck formwork and steel members (including interior girders, and diaphragms) shall be sealed to prevent leakage of cement paste or concrete. Caulking, duct tape, ethafoam, or any other suitable means or material, shall be used to achieve the seal.

Should foreign material spill onto the girders despite the protection provided, the Contractor shall clean off, wash, and sandblast the contaminated areas, to the satisfaction of the Department. Additionally, should the exterior face of an exterior girder become stained or marked, the entire exterior face of the girder line shall be lightly sandblasted and "weathered" so that uniformity of girder color, in the opinion of the Department, is achieved.

"Weathering" shall be achieved by repeatedly fogging the exterior girder faces with clean water and allowing them to dry. Fogging should leave the girders wet but not "running wet", and should be repeated when the girders are completely dry.

400.3.5.12 Protection of Substructure Units from Rust Staining

The substructure will be subject to staining, during the period from erection to casting of the concrete deck. The Contractor shall be responsible either to take suitable measures to coat or cover the piers and abutments before erection, or to adequately remove all staining so that the required concrete finishes may be applied with no trace of stain remaining. Final acceptance of pier finish will not be given by the Department until after all deck and curb concrete is in place.

400.3.5.13 Removal of Falsework, Forms and Housing

Forms and their supports shall not be removed without the acceptance of the Design Engineer and then the Department. In determining the time for the removal of falsework, forms and housing, and the discontinuance of heating, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the curing of the concrete, and the materials used in the mix.

The following guide for removal of forms and supports may be used if the temperature of the concrete is maintained at no less than 15°C:

Portion of Work		Age or Minimum Strength
Arches and girders	-	14 days (or 80% of 28-day strength)
Pier caps and beams	-	5 days (or 50% of 28-day strength)
Columns	-	1 to 3 days
Decks & Slabs	-	5 days (or 50% of 28-day strength)
Vertical faces of supported elements	-	12 to 24 hours
Walls over 3 m high	-	2 days

Supports and forms may be removed from arches, girders, deck, pier caps and beams earlier than the minimum curing periods specified above, with the Design Engineer's and then the Department's acceptance. In seeking acceptance the Contractor shall, at its own expense, furnish evidence satisfactory to the Design Engineer and the Department that the strength of the concrete in place has attained the above noted percentage of the specified 28-day strength before removal.

Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

All formwork must be removed from the completed structure. For certain special situations, formwork may remain in place, when the Contractor's formal request is approved by the Department.

400.3.5.14 Handling and Placing Concrete

400.3.5.14.1 General

The Contractor shall give the Department a minimum of two days advance notice of a concrete pour date or a change to a pour date.

The method of concrete placement shall have a consistent, minimal impact on the concrete properties. Prior to its use all equipment proposed for use in mixing, conveying, placing and compacting the concrete shall be submitted to the Design Engineer for review and then to the Department for acceptance. All the necessary equipment for any particular pour shall be on site and proven to be in working condition before the pour commences, with backup equipment on site as determined by the Department. The equipment shall be well maintained, suitable in kind and adequate in capacity for the work.

In preparation for the placing of concrete, all sawdust, chips and other construction debris and extraneous matter shall be removed from the interior of forms. Struts, stays, and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. When placing operations would involve free drop of concrete by more than 1 m, it shall be deposited through metal or other acceptable pipes.

Concrete for the structure shall be deposited in the forms in the order indicated on the Detailed Designs, and each portion placed between construction joints shall be placed in one continuous operation. No other order of pouring shall be done unless otherwise accepted by the Design Engineer and the Department.

Concrete placing operations shall not work off, or transport concrete directly over, concrete already placed, when this concrete is less than 48 hours old, no matter what system of runways, supports or protection is used on the surface of the concrete already placed, if it is subjected thereby to live or dead loads. Concrete more than 48 hours old but of less than the specified 28-day strength shall not be loaded without the acceptance of the Design Engineer and then of the Department.

400.3.5.14.2 Consolidation

Concrete, during and immediately after depositing, shall be thoroughly consolidated. The consolidation shall be done by mechanical vibration subject to the following provisions:

- The vibration shall be internal unless special authorization of other methods is given by the Department, or the Department requests the use of other methods.

- Vibrators shall be of a type and design acceptable to the Department. They shall be capable of transmitting vibrations to the concrete at frequencies of not less than 4500 impulses per minute

- The intensity of vibration shall be such as to visibly affect a mass of concrete of 25mm slump over a radius of at least 0.5m.

- The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms.

- Vibrator operators shall be suitably instructed in the use of vibrators, and the importance of adequate and thorough vibration of the concrete.

- Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and imbedded fixtures and into the corners and angles of the forms. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted vertically and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any point to the extent that localized areas of grout are formed. Application of vibrators shall be at points uniformly spaced and not farther apart than the radius over which the vibration is visibly effective.

- Vibration shall not be applied directly or through the reinforcement of sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.

- Vibration shall be supplemented by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

400.3.5.14.3 Additional Requirements

When concrete placing is discontinued, for whatever reason, all accumulations of mortar splashed on the reinforcing steel and the form surfaces shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete-steel bond at and near the surface of the concrete, while cleaning the reinforcing steel.

Concrete shall be placed while fresh and before it has taken its initial set. Retempering of partially hardened concrete with additional water will not be permitted. No concrete shall be used which does not reach its final position in the forms within the time stipulated under Section 400.3.5.6.3 (Time of Hauling) above.

After initial set of the concrete the forms shall not be jarred and no strain shall be placed on the ends of reinforcing bars which project.

Concrete which would be adversely affected by the presence of freestanding water shall be protected to prevent its occurrence, and the Contractor shall take whatever steps may be necessary to prevent free water build-up in the event of unexpected rainfall or similar occurrences for the first 24 hours.

Water used to keep equipment clean during the pour, or to clean equipment at the end of the pour, shall be discharged clear of the structure.

400.3.5.14.4 Pumping

The operation of the pump shall produce a continuous flow of concrete without air pockets. The equipment shall be so arranged that the impact on the plastic air content of the concrete shall not vary by $\pm$0.5% and that no vibrations result which might damage freshly placed concrete. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

400.3.5.15 Placing Pile Concrete

400.3.5.15.1 General

The Contractor shall make every attempt to obtain a “Dry” pile hole prior to placing pile concrete. In the event that all reasonable attempts at obtaining a dry hole fail, the Department may permit the placement of pile concrete under water.

400.3.5.15.2 Concrete Placed in the Dry

Pile concrete shall be placed by means of a hopper equipped with a centre pipe drop tube. The pipe drop tube shall be a minimum of 200mm in diameter and 2 m long. Concrete may be placed free fall, providing the fall is vertically down the centre of the casing or drilled hole and there are no transverse ties or spacers. Pile concrete shall have a slump range of 100 - 140mm at time of discharge. Concrete in the upper 3m of the piles shall be consolidated by the use of an acceptable concrete vibrator.

400.3.5.15.3 Concrete Placed under Water

Placement of pile concrete under water shall be in accordance with Section 400.3.5.21 (Depositing Concrete Under Water) of this Section 400.3.5 (Cast-in-Place Concrete).

400.3.5.16 Placing Deck, Curb, Barrier, Median and Deck Overlay Concrete

400.3.5.16.1 General

Concrete placing will not be permitted when the air temperature is below +5°C or above 22°C, nor in the event of rain or excessive wind or dust, nor when there are other conditions judged by the Department to be detrimental to the concrete. Deck concrete placing shall normally be between the hours of 6:00 pm and 10:00 am except with specific acceptance of the Department. Night pours shall require proper lighting as reviewed by the Design Engineer and then accepted by the Department. The temperature of the concrete during discharge shall be between 10°C and 20°C unless reviewed by the Design Engineer and accepted by the Department. The temperature of the mix shall be maintained below the 20°C maximum temperature by the inclusion of ice to the mix which shall not alter the design water-cement ratio. Immediately prior to placing concrete, the substrates shall be thoroughly wetted down with clean water.

All deck concrete and deck overlay concrete shall be consolidated in accordance with Section 400.3.5.14.2 (Consolidation) even when vibratory drum type finishing machines are used.

<u>Placing/Finishing Machines</u>
For all deck concrete and deck overlay concrete, screeding shall be by concrete placing/finishing machines as follows or acceptable equivalents:

- Bidwell Model RF200 or Model 364
- Gomaco Model C450

The Contractor shall provide two work bridges, separate from the placing/finishing machine, of adequate length to completely span the width of the pour. The work bridges will facilitate the operations of concrete finishing and placing of wet burlap, and shall also be made available to the Department for straight-edge checking. The work bridges shall be supported essentially parallel to the concrete surface, between 250mm and 600mm above the concrete surface, and shall be at least 800mm wide to permit diverse uses concurrently, and be rigid enough that dynamic deflections are insignificant.

400.3.5.16.2 Screed Guide Rails

Acceptable steel screed guide rails shall be installed to suit the profile of the required surface and to ensure a smooth and continuous surface from end to end of the bridge. Guide rails must be located outside of the finished surface of the pour for overlay concrete and also for deck concrete, unless specified otherwise in the Detailed Designs. All rails and supports shall be removed with minimum disturbance to the concrete.

400.3.5.16.3 Dry-Run

The finishing machine shall be set-up to match the skew angle of the bridge, when the skew angle exceeds 15°. For skewed bridge structures on vertical curves this requirement may be altered to suit actual site conditions.

The finishing machine and guide rails shall be adjusted so that the height of the screed will finish the concrete to the design gradeline and crown. To confirm the adjustment of the machine and guiderails, the screed shall be dry-run prior to the pour and clearance measurements taken at each of the girder tenth points, and submitted to the Design Engineer for review and then to the Department for acceptance. Re-setting of the machine and/or screed rails shall be done as necessary, to obtain an acceptable dry-run. Adjustments to the machine or screed rails will not be permitted after an acceptable dry-run has been completed.

Where screed rails are supported on cantilevered formwork that could deflect under the weight of the fresh concrete and the deck finishing machine, the Contractor shall pre-load a section of the cantilevered formwork on each side of the bridge to determine deflections that will occur during concrete placement. The formwork, machine and/or screed rails shall be adjusted to compensate for the expected formwork deflection.

400.3.5.16.4 Fog Misting and Wet Cure Systems

Details of the fog misting and wet cure systems shall be submitted for review to the Design Engineer and then to the Department for acceptance three weeks prior to the scheduled pour date. Details shall include information with regards to the type and description of equipment and materials being used and work method/techniques employed to satisfactorily carry out the work.

400.3.5.16.5 Screeding Concrete

The screed shall be moved slowly and at a uniform rate. In general, the direction of pouring should be from the low end of the bridge to the high end. A roll of concrete shall be maintained along the entire front of the screed at all times to ensure the filling and consolidation of the surface concrete. The contractor shall also ensure that the required concrete thickness is being placed by randomly probing the concrete behind the finishing machine.

Screeding shall be completed in no more than two passes. The screed shall not be allowed to run except when screeding is actually in progress. The screeded surface shall not be walked on or otherwise damaged.

400.3.5.16.6 Bull Floating/Surface Texturing

The concrete surface produced behind the finishing machine shall be magnesium floated the minimum amount necessary to ensure that the surface is free from open texturing, plucked aggregate and local projections or depressions. It is imperative that competent workers be employed to carryout bull floating and surface texturing.

400.3.5.16.7 Surface Defects and Tolerances

The finished surface of the concrete shall conform to the design gradeline profiles as indicated on the Detailed Designs and/or as determined on site.

The surface shall be free from open texturing, plucked aggregate and local projections.

Except across the crown, the surface shall be such that when tested with a 3 m long straight edge placed anywhere in any direction on the surface, there shall not be a gap greater than 3 mm between the bottom of the straight edge and the surface of the deck anywhere below the straight edge.

The surface shall be checked by the Contractor, as described above, immediately after final bull floating and before texturing.

The surface shall again be checked by the Contractor at the end of the curing period in the same manner and to the same tolerance.

Areas that do not meet the required surface accuracy shall be clearly marked out and the Contractor shall:

(a) Grind down any areas higher than 3mm but not higher than 10mm above the correct surface.

(b) Correct any areas lower than 3mm but not lower than 10mm below the correct surface, by grinding down the adjacent high areas.

(c) When the deviation exceeds 10mm from the correct surface, the deck slab shall be replaced for a length, width and depth which will allow the formation of a new slab of the required quality.

Grinding shall be carried out by an approved machine, of a type and capacity suitable for the total area of grinding involved, until the surface meets the specified requirements.

All corrective work will require the Contractor to submit a proposal to the Design Engineer for review and then to the Department for acceptance, prior to commencement of any work.

If the surface is damaged in any way by construction operations, or if the deck shows signs of distress or scaling prior to the final acceptance of the deck, it shall be repaired or replaced by the Contractor.

400.3.5.17 Placing Approach Slab and Roof Slab Concrete

After properly placing and consolidating the concrete, it shall be struck off and screeded to conform to the required cross-section and grade. Concrete placing shall be carried out in a manner such that the newly deposited concrete is continually placed against fresh concrete across the entire face of the pour and the formation of cold joints is avoided. A slight excess of concrete shall be kept in front of the screed at all times.

The surface shall then be floated longitudinally, transversely or in both directions as necessary to ensure that the surface is free from open texturing, plucked aggregates, and local projections or depressions. The surface shall be such that it does not vary more than 5mm from the required lines, under a 3m straightedge.

400.3.5.18 Concreting Shear Keys and Diaphragms

Precast concrete girders will be erected to normally accepted industry standards for tolerance. Forming of shear keys and diaphragms shall be designed to accommodate variations in girder dimensions, positioning, alignment, camber and sweep. Before concreting, the girder keyways must be saturated with water for a period not less than 30 minutes, and must be coated with an approved bonding agent immediately ahead of the concrete. Concrete placed in the keyways shall be adequately vibrated, and trowelled smooth and flush to the girders. Immediately after trowelling, wet burlap or white filter fabric shall be placed on the shear keys and kept continuously wet for the next 72 hours.

400.3.5.19 Construction Joints

400.3.5.19.1 General

Construction joints shall be made only where indicated on the Detailed Designs or shown in the pouring schedule unless otherwise reviewed by the Design Engineer and accepted by the Department.

If not detailed on the Detailed Designs, or in the case of emergency, construction joints shall be placed as determined by the Design Engineer and according to Standard Drawing S-1412-99. Shear keys or inclined reinforcement shall be used where necessary to transmit shear, or to bond the two sections together. Construction joints should be located to allow a minimum of 50 mm minimum concrete cover on reinforcing steel running parallel to the joint. Refer to Standard Drawing S-1412-99 "Standard Construction Joints" attached after Section 400.3.5.26.3 (Coring for Compressive Strength Testing).

400.3.5.19.2 Bonding

Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened and the surface of the hardened concrete shall be thoroughly cleaned and saturated with water, with all free standing water removed. The placing of concrete shall be carried out continuously from joint to joint. The face edges of all joints which are exposed to view shall be carefully finished true to line and elevation.

400.3.5.20 Concreting in Cold Weather

The Contractor shall accept full responsibility for the protection of concrete during adverse weather conditions.

When the ambient air temperature is, or is expected to be below 5°C, or when determined by the Design Engineer or the Department, the following provisions for cold weather concreting shall be put in place:

(1) All aggregate and mixing water shall be heated to a temperature of at least 20°C but not more than 65°C. The aggregates may be heated by either dry heat or steam; in the latter case the quantity of mixing water may need to be reduced. The temperature of the concrete shall be between 10°C and 25°C at the time of placing in the forms. In the case of mass pours, the Design Engineer with the Department's acceptance may alter the temperature requirements to suit.

(2) The Contractor shall enclose the structure in such a way that the concrete and air within the enclosure can be kept above 15°C for a period of 7 days after placing the concrete. The enclosure shall be constructed so that a minimum 300mm clearance exists between the enclosure and the concrete. To prevent overheating, the air temperature within the enclosure shall be monitored frequently, especially during the first 24 hours.

The relative humidity within the enclosure shall be maintained at not less than 65%. Heaters must be kept well clear of the formwork housing. Adequate ventilation is required to provide air for combustion, and to prevent the accumulation of carbon dioxide which can be harmful to the concrete. The use of salamanders, coke stoves, oil or gas burners and similar spot heaters which have an open flame and intense local heat is prohibited without the Department's specific acceptance.

The system of heating, and positioning of steam outlets, heaters, and fans, is to be designed to give the most uniform distribution of heat possible, and shall be submitted to the Design Engineer for review and then to the Department for acceptance.

(3) Before placing concrete, adequate pre-heat shall be provided to raise the temperature of formwork, reinforcing steel, previously-placed concrete, and/or soil to at least 10°C. The Contractor shall be responsible to make all arrangements for heating, and to ensure continuous protection from unsatisfactory temperature and moisture conditions during the curing period. The Design Engineer's review and the Department's acceptance of the Contractor's arrangements shall be obtained; it will be a requirement that pre-heat is adequate, in the Design Engineer's and Department's opinion, to ensure that no portion of the fresh concrete is damaged by freezing, or curing retarded by cold temperatures.

(4) Fully insulated formwork may be proposed as an alternative to provision of further heat during the curing period. Such formwork shall be designed and insulated with approved materials so that the initial heat of the mix, and the heat generated during the hydration of the cement, is retained to provide the specified curing conditions. The adequacy of the protection is the Contractor's responsibility.

(5) Protection and heating, where used, shall be withdrawn in such a manner so as not to induce thermal shock stresses in the concrete. The temperature of the concrete shall be gradually reduced at a rate not exceeding 10°C per day to that of the surrounding air. To achieve this, in a heated housing, the heat shall be slowly reduced and then shut off, and the whole housing allowed to cool to air temperature before the housing itself is removed. However, the protection shall not be removed until the temperature of the concrete has fallen to within 10°C of the temperature of the outside air.

400.3.5.21 Depositing Concrete Under Water

Concrete shall not be deposited in water except as specified and with the acceptance of the Department and under the immediate supervision of the Design Engineer and the Department. Anti-washout admixtures incorporating viscosity modifiers (whelan gum, etc.) may be used when specifically reviewed by the Design Engineer and accepted by the Department.

Concrete to be deposited in water shall be of the specified class, with mix design modified to yield 150mm to 175mm slump, and with an excess of 15% of the cement quantity added beyond this designed amount. The concrete temperature shall be between 10°C and 25°C.

To prevent segregation, concrete shall be carefully placed in a compact mass, in its final position, by means of a concrete pump. When specifically reviewed by the Design Engineer and accepted by the Department, a properly designed and operated tremie may be used. The concrete shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit and the forms underwater shall be watertight.

When placing concrete under water, the discharge end of the concrete pump line shall be lowered to the bottom of the form or hole. Pumping shall then proceed with the end of the discharge line being continually buried no less than 500mm below the surface of fresh concrete at all times, to maintain a seal until the form or hole is completely filled with fresh uncontaminated concrete.

A tremie, when reviewed by the Design Engineer and then accepted by the Department, shall consist of a rigid tube having a diameter between 200mm and 300mm, and if constructed in sections it shall have flanged couplings fitted with gaskets. The discharge end shall be closed at the start of the work to prevent water entering the tube. The tremie tube shall be kept full to the bottom of the hopper, and water shall be kept out at all times. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed. Sufficient tremies shall be used to place the concrete under water such that it is not necessary to move any of the tremies from one portion of the pour to another. The use of non-rigid tremie tubes will not be permitted.

Concrete shall not be placed in water which is below 4°C.

The surface of the concrete shall be kept as nearly horizontal as is practicable at all times. The discharge end of the tremie shall be kept buried at least 300mm in previously placed concrete.

Dewatering will not be permitted while concrete is being placed. Dewatering may proceed when the concrete seal is sufficiently hard and strong. All laitance or other unsatisfactory material shall be removed from the exposed surface by scraping, chipping or other means which will not injure the surface of the concrete.

400.3.5.22 Curing Concrete

400.3.5.22.1 General

Freshly deposited concrete shall be protected from freezing, abnormally high temperatures or temperature differentials, premature drying, excessive moisture, and moisture loss for the period of time necessary to develop the desired properties of the concrete.

All exposed concrete surfaces which are to receive a Class 2 or 3 finish shall be moist cured. The Contractor shall cover the concrete surface(s) with a single layer of clean, soaking wet burlap or light coloured filter fabric as soon as the surface will not be marred by so doing. The burlap or light coloured filter fabric shall be kept continuously wet for 72 hours.

All unexposed concrete surfaces not requiring the application of silane sealer shall receive two applications of an approved curing compound. The rate of each application shall not be less than the rate specified by the manufacturer of the compound. Curing compound shall not be used on any construction joints or when cold weather concreting is in effect.

400.3.5.22.2 Curing Requirements for Class B and Class C Concrete

Where the formwork is left in place for 72 hours or more, no additional curing will be required for either exposed or unexposed concrete surfaces.

400.3.5.22.3 Curing Requirements for Concrete Slope Protection

Concrete slope protection shall receive 2 coats of a curing compound acceptable to the Design Engineer and then the Department. The first coat is to be applied immediately after the concrete has been satisfactorily finished, and the second coat is to be applied within 3 hours after the application of the first coat. In cases where premature drying is severe or is anticipated to be severe, then moist curing, as specified in Section 400.3.5.22 (Curing Concrete), will also be required.

400.3.5.22.4 Curing Requirements for Class HPC and Class HPC with Steel Fibres

Two layers of light coloured filter fabric (Nilex C-14 or equivalent) or burlap shall be placed on the fresh concrete surface as soon as the surface will not be marred as a result of this placement. A fine spray of water shall be immediately applied to the filter fabric or burlap. Edges of the filter fabric or burlap shall overlap a minimum of 150mm and shall be held in place without marring the surface of the concrete.

The filter fabric or burlap shall be in a continuously wet condition throughout the curing period, by means of a soaker hose or other means as reviewed by the Design Engineer and accepted by the Department. Curing with filter fabric or burlap and water shall be maintained for a minimum period of 14 days for new bridge construction, with the exception of concrete for blockouts adjacent to deck joints, where the wet cure period is reduced to 3 days followed by the application of a chlorinated rubber curing compound.

For Class HPC and Class HPC with steel fibres, fog mist shall be applied continuously from the time of screeding until the concrete is covered with filter fabric or burlap, in such a way as to maintain high relative humidity above the concrete and prevent drying of the concrete surface. Water shall not be allowed to drip, flow or puddle on the concrete surface during fog misting, when placing the filter fabric or burlap or at any time before the concrete has achieved final set. Equipment and materials necessary for the fog mist system shall be demonstrated and approved prior to scheduling and placing of Class HPC concrete.

During the cure period for Class HPC and Class HPC with steel fibre concrete, the Contractor shall provide protection to ensure that the concrete temperature and the temperature differences remain within the limits specified in Section 400.3.5.4.2(l). The Contractor shall supply and install two thermocouplers, in the centre and at the surface of the concrete, for every $100m^2$ of deck, at locations determined by the Department. The Contractor shall monitor and record the temperatures every four hours for the first 3 days after concrete placement and every 12 hours thereafter during remaining curing period. Daily temperature records shall be forwarded to the Design Engineer and the Department.

400.3.5.22.5 Class HPC and Class HPC with Steel Fibres

Immediately after the curing period and before opening to public traffic, the Contractor and the Department shall jointly inspect the dry concrete surface(s) to identify all cracks. The Department will plot the width in millimetre and length in linear metres of cracks per square metre and report the findings to the Contractor. The Contractor shall repair the cracks if crack width is 0.2mm or more. The following procedure shall be used in the treatment of the same:

(a) Blow out cracks clean and dry with a jet of oil-free compressed air.

(b) Seal cracks with a gravity feed epoxy in accordance with the manufacturer's instructions. The gravity feed epoxy shall maximize the penetration by taking into consideration the ambient temperature, the substrate temperature, the viscosity and pot life of the material being used. Gravity feed epoxy material shall be reviewed by the Design Engineer and accepted by the Department prior to its usage.

(c) When cracks extend the full depth of the deck slab, barriers, or curbs or to the top layer of reinforcement of decks that are cast to grade, epoxy injection will be required. The epoxy material and injection procedure shall be submitted by the Contractor to the Design Engineer for review and then to the Department for acceptance.

400.3.5.23 Concrete Finishing Under Bearings

All concrete areas on which bearing plates or pads are to be placed are to be at the required elevation, and are to be finished or ground to a smooth and even surface in preparation for bearing plates or pads. The finished surface shall not vary more than 1mm over an area whose dimensions exceed the dimensions of the bearing plates by 60mm. Air voids created by forming grout-pad depressions shall be filled with an approved patching material, well in advance of girder erection. In cold weather conditions this work shall be completed while the concrete is still warm.

400.3.5.24 Concrete Surface Finish

400.3.5.24.1 General

Surfaces requiring concrete finishing shall conform to the requirements of Section 400.3.5.16.7 (Surface Defects and Tolerances). All mortar patches shall be cured as specified in Section 400.3.5.22 (Curing Concrete).

On unexposed concrete surfaces all cavities, honeycomb, and other deficiencies shall be thoroughly chipped out, cleaned, and after having been kept saturated with water for a period of not less than 30 minutes, shall be filled with cement mortar.

On exposed concrete surfaces to 600mm below grade or, in the case of river piers, 600mm below lowest water level, surface finishes shall be applied as follows:

Class 1 Ordinary Finish
- all exposed concrete surfaces unless other finishes are specified.

Class 2 Rubbed Finish
- solid shaft river piers;
- inside surfaces of curb, parapet and sidewalk; and
- median vertical faces.

Class 3 Bonded Concrete Finish
- abutment seats except top surface;
- pier caps except top surface;
- exterior faces of curtain walls/wingwalls;
- grade separation piers except top surfaces;
- exterior concrete girder faces;
- exposed end surfaces of cast-in-place concrete diaphragms;
- underside of the deck overhang to top flange of girder; and
- exterior surfaces of curb, parapet and sidewalk.

Class 4 Floated Finish
- top surfaces of concrete deck and roof slabs which are to receive waterproofing membranes and wearing surfaces.

Class 5 Floated Surface Finish, Broomed Texture

- top surfaces of curbs, sidewalks, and medians;
- approach slab concrete which will be covered by a wearing surface only (without waterproofing membrane); and
- concrete slope protection.

Class 6 Floated Finish, Surface Textured

- top surfaces of deck, roof and approach slabs which will not be covered with either waterproofing membrane or wearing surface.

Only approved wood or magnesium floats shall be used for finishing concrete.

400.3.5.24.2 Class 1. Ordinary Surface Finish

Unformed Surfaces - Immediately following placing and compacting, the concrete shall be screeded to conform to the required surface elevations, and then trowelled to ensure that the surface is free from open texturing, plucked aggregate, and local projections or depressions.

Formed Surfaces - Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces. On all surfaces the cavities produced by form ties, and all other holes, honeycomb areas, broken corners or edges and other defects, shall be thoroughly chipped out, cleaned, and after having been kept saturated with water for a period of not less than 30 minutes, shall be filled with cement mortar. Mortar shall be not more than one hour old. The mortar patches shall be cured as specified under Section 400.3.5.22 (Curing Concrete). All concrete joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

400.3.5.24.3 Class 2. Rubbed Finish

Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces. All lines that are not true must be corrected by chipping, grinding or patching as necessary. Parging to correct irregularities will not be permitted. On all surfaces, the cavities produced by form ties, air bubbles and all other holes, honeycomb areas, broken corners or edges and other defects, shall be thoroughly exposed by wire brushing with a stiff bristled, powered, wire brush. The cleaned surface, after having been kept saturated with water for a period of not less than 30 minutes, shall be filled with cement mortar. Mortar shall be not more than one hour old. The mortar patches shall be cured as specified under Section 400.3.5.22 (Curing Concrete). All concrete joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges. The small surface voids formed by air bubbles must be filled by rubbing a thin grout composed of bonding agent, water, clean fine sand and cement into the moistened surface. When the patching and filling have adequately hardened, a carborundum stone shall be used to finish the surface to a smooth, uniform and closed texture. Any voids opened during the stone rubbing process shall be re-filled.

It is essential that the prepared concrete surface, including all patching and filling be uniform in colour and texture. All portions of bridge elements, including those cast in more than one pour, shall be of the same colour and texture. Any staining caused by cement, water, weather, or other conditions shall be prevented, removed, or covered by methods and materials acceptable to the Department. After the surface preparation has been completed to the satisfaction of the Department, the Contractor shall apply sealer as specified in Section 400.3.5.25 (Sealer).

If uniformity of colour is not achieved to the satisfaction of the Department, the Contractor, rather than applying the sealer as specified in Section 400.3.5.25 (Sealer), shall supply and apply an approved pigmented concrete sealer as specified for Class "3" "Bonded Concrete Finish".

400.3.5.24.4 Class 3. Bonded Concrete Surface Finish

Surface preparation shall be done as is specified for Section 400.3.5.24.3 (Class 2 Rubbed Finish) except that uniformity in colour is not required.

After the surface preparation has been completed to the satisfaction of the Department, the Contractor shall then supply and apply an approved pigmented concrete sealer, which meets the requirements for a type 3 sealer of the "Alberta Transportation Concrete Sealer Test Procedure - B388".

The pigmented concrete sealer shall be applied in accordance with the manufacturer's specifications. The colour of the proposed coating, which shall be similar to the natural colour of cured concrete, must be acceptable to the Department before application of the coating. A minimum of two applications of the pigmented sealer are required. The Contractor shall ensure that no colour variation is visible, and shall match the colour of any previously painted adjoining surfaces. Acceptance of the pigmented sealer used will not be taken to relieve the Contractor of full responsibility for its acceptable performance and appearance.

400.3.5.24.5 Class 4. Floated Surface Finish

Unless otherwise noted on the Detailed Designs, concrete which is to receive a waterproofing membrane and a final wearing surface, shall be floated and trowelled as necessary to provide a smoothly textured surface.

400.3.5.24.6 Class 5. Floated Surface Finish, Broomed Texture

The concrete surface shall be floated and trowelled as necessary to produce a smooth surface. The surface shall not vary more than 3mm under a 3m long straightedge.

After the concrete has set sufficiently, the surface shall be given a transversely broomed finish using a coarse broom to produce regular corrugations to a maximum depth of 3mm. An edging tool shall be used at all edges and expansion joints. Where indicated on the Detailed Designs, sidewalk surfaces shall be laid out in blocks using an acceptable grooving tool.

400.3.5.24.7 Class 6. Floated Finish, Surface Textured

After the concrete has been bull floated, it shall be given a suitable texture with a “flat wire” texture broom having a single row of tines. The desired texture is transverse grooving which may vary from 1.5mm width at 10mm centres to 5mm width at 20mm centres, and the groove depth shall be 3mm to 5mm. This operation shall be done at such time and in such manner that the desired texture will be achieved while minimizing the displacement of the larger aggregate particles or steel fibres. The textured surface shall be uniform and consistent.

Following the surface texturing, a strip of the concrete along the inside curb line, shall be trowelled smooth and the surface left closed.

400.3.5.25 Sealer

An approved Type 1c sealer shall be applied to all concrete surfaces which are susceptible to deterioration by water and de-icing salts. This shall include all concrete surfaces to 600mm below grade, or in the case of river piers 600mm below lowest water level, or as specified and shall include all surfaces which are to receive a Class 2, Class 5 and Class 6 Finish. This does not apply to surfaces covered with waterproofing membrane and ACP wearing surface, drain troughs and concrete slope protection. Sealer will not be required on the underside of bridge decks and on concrete diaphragms in the interior bay areas, however the faces of the end diaphragms nearest the abutment backwalls, inside face of backwall and top surface of abutment seat, excluding bearing recess pockets, and the deck and curb overhangs shall be sealed.

Type 1c sealers shall meet the Department's current "Specifications for the Supply of Concrete Sealers, Evaluation Procedures for Sealers Used on Concrete Bridge Elements" (B388).

The sealer shall be applied in accordance with the manufacturer's recommendations however the application rate shall be increased by 30% from that indicated on the approval list. Before applying the sealer the concrete shall be cured for at least 14 days. Mortar patches shall be cured for at least two days. The concrete surface shall be dry, and air blasted to remove all dust and accepted by the Department prior to applying sealer. In order to ensure uniform and sufficient coverage rates the Contractor shall apply measured volumes of sealing compound to appropriately dimensioned areas of concrete surface, using a minimum of 2 coats.

400.3.5.26 Concrete Strength Requirements

The Department reserves the right to reject any concrete whatsoever which does not meet all the requirements for that class of concrete as stated in Section 400.3.5.4 (Class and Composition of Concrete). However, provided that the Design Engineer is of the opinion that the low strength concrete will meet all performance requirements throughout the service life of the structure, the Department may accept concrete the strength of which falls below the specified strength requirements.

In this case, Payment Adjustments (deduction from Payment) will be applied in accordance with the following:

400.3.5.26.1 Payment Reduction Scales

<u>Class B Concrete, Pile Concrete, 25 MPa</u>

Strength Test Results

24 MPa to 25 MPa $15 per cu. metre

23 MPa to 24 MPa	$30 per cu. metre
22 MPa to 23 MPa	$45 per cu. metre
21 MPa to 22 MPa	$60 per cu. metre
20 MPa to 21 MPa	$80 per cu. metre

Class C Concrete, 35 MPa
Strength Test Results

34 MPa to 35 MPa	$15 per cu. metre
33 MPa to 34 MPa	$30 per cu. metre
32 MPa to 33 MPa	$45 per cu. metre
31 MPa to 32 MPa	$60 per cu. metre
30 MPa to 31 MPa	$80 per cu. metre
29 MPa to 30 MPa	$110 per cu. metre
28 MPa to 29 MPa	$150 per cu. metre
27 MPa to 28 MPa	$200 per cu. metre

Class HPC and Class HPC with Steel Fibres Concrete, 45 MPa
Strength Test Results

44 MPa to 45 MPa	$20 per cu. metre
43 MPa to 44 MPa	$50 per cu. metre
42 MPa to 43 MPa	$90 per cu. metre
41 MPa to 42 MPa	$140 per cu. metre
40 MPa to 41 MPa	$200 per cu. metre

Class D Concrete, 30 MPa
Strength Test Results

29 MPa to 30 MPa	$15 per cu. metre
28 MPa to 29 MPa	$30 per cu. metre
27 MPa to 28 MPa	$45 per cu. metre
26 MPa to 27 MPa	$60 per cu. metre
25 MPa to 26 MPa	$80 per cu. metre
24 MPa to 25 MPa	$110 per cu. metre.

Class S Concrete, 20 MPa
Strength Test Results

18 MPa to 20 MPa	$15 per cu. metre
16 MPa to 18 MPa	$35 per cu. metre

The reduced payment shall apply to the volume of concrete represented by the strength test as defined in Section 400.3.5.9.3 (Strength Tests).

Concrete with strengths below the scales shown;
i.e. - Class B and Pile concrete below 20 MPa
- Class C concrete below 27 MPa
- Class HPC and Class HPC with steel fibres concrete below 40 MPa
- Class D concrete below 24 MPa
- Class S concrete below 16 MPa

will be rejected.

If the minimum specified compressive strength for a class of concrete as shown in Section 400.3.5.4.1 (Class of Concrete) is increased then the concrete strengths in the payment reduction scales shown in Section 400.3.5.26.1 (Payment Reduction Scales) shall be increased by the same amount.

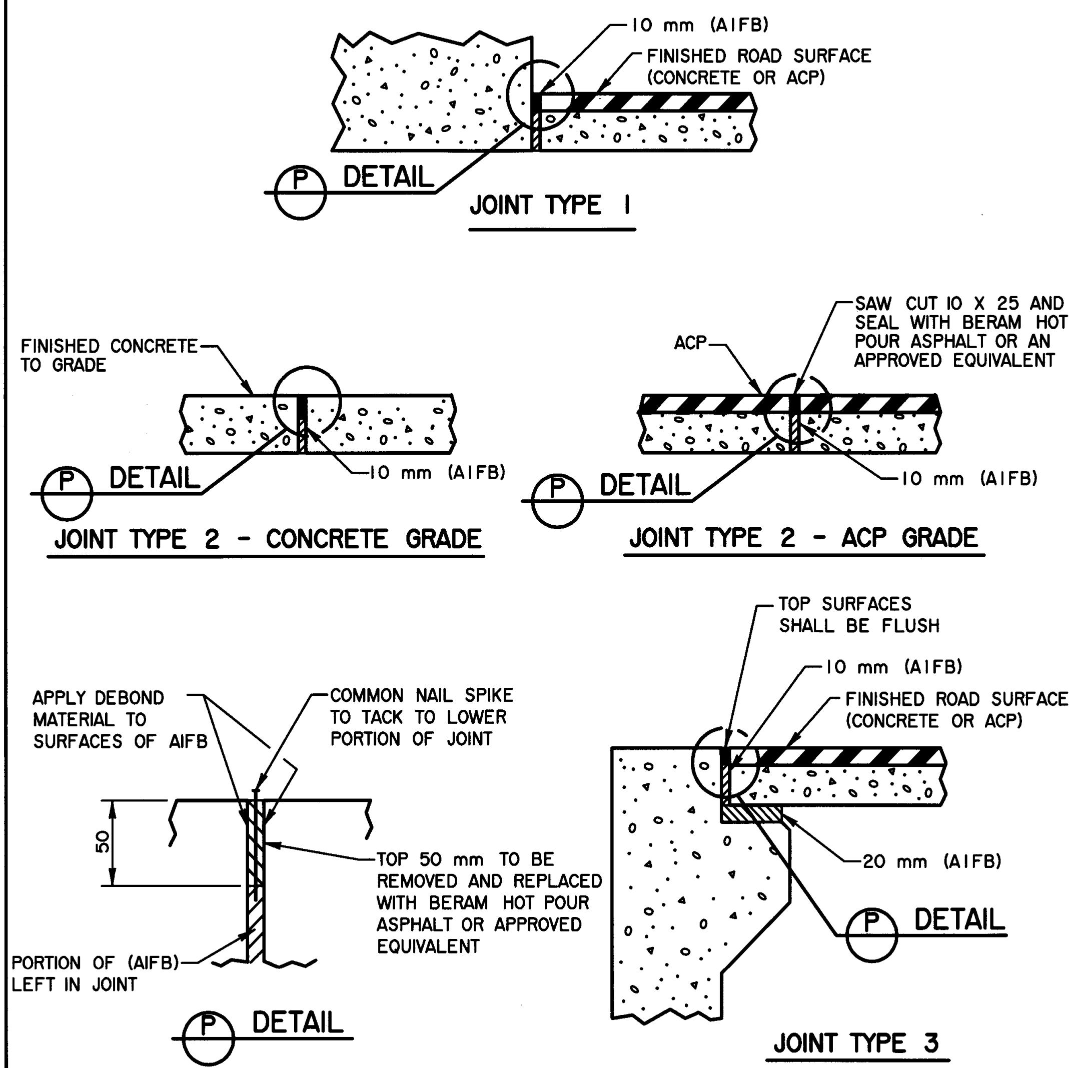
400.3.5.26.2 Open to Traffic

The bridge shall not be opened to traffic until the deck or overlay concrete has attained a minimum compression strength of 70% of the design strength. The concrete shall be cured in accordance with Section 400.3.5.22 (Curing Concrete). The Contractor shall be responsible for all costs associated with any additional testing that may be required to satisfy the strength requirement.

400.3.5.26.3 Coring for Compressive Strength Testing

Coring to confirm or contest low concrete strength test results shall be reviewed by the Design Engineer followed by submittal to the Department for acceptance. When coring is acceptable, arrangements shall be made by the Contractor, through the Department, to employ a CSA Category 1 or higher level certified testing laboratory, all at the expense of the Contractor. The cores shall be taken and tested within seven days of the testing of the twenty-eight day cylinders representing the concrete in question. Where practical, three 100mm diameter cores shall be taken for each non-compliant strength test previously taken, and there shall be no doubt that the cores taken, and the cylinders under consideration represent the same batch of concrete. Cores may not be taken unless the Design Engineer and the Department is present. Cores shall be tested by an independent CSA certified Category 1 or higher level testing laboratory and in accordance with the requirements of CSA Standard A23.2-14C. The average strength of the cores as reported by the testing service shall constitute a test.

The acceptability of the as-delivered concrete shall be determined using the concrete cylinders, with the modifications set out in the next two sentences. In cases where the concrete strength, as indicated by the cores, is higher than the strength based on the concrete cylinder results, the core results shall be used as the basis for acceptance of the concrete. If the core strengths are lower than the strength from the concrete cylinder tests, the cylinder tests shall govern.



GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- ASPHALT IMPREGNATED FIBREBOARD (AIFB) SHALL CONFORM TO THE CURRENT ASTM SPECIFICATION D1751 FOR PREFORMED EXPANSION JOINT FILLERS.

NO	DATE	REVISIONS	BY
5	2003-04-17	REVISED JOINTS TO INCLUDE ACP SURFACE	RY
4	99-04-14	REVISED JOINT 3	RY
3	99-03-29	BEB CHANGED TO TSB	RY
2	94-11-30	PAGE NUMBER	RJR
1	87-03-04	REDRAWN FROM S-1411	DHQ

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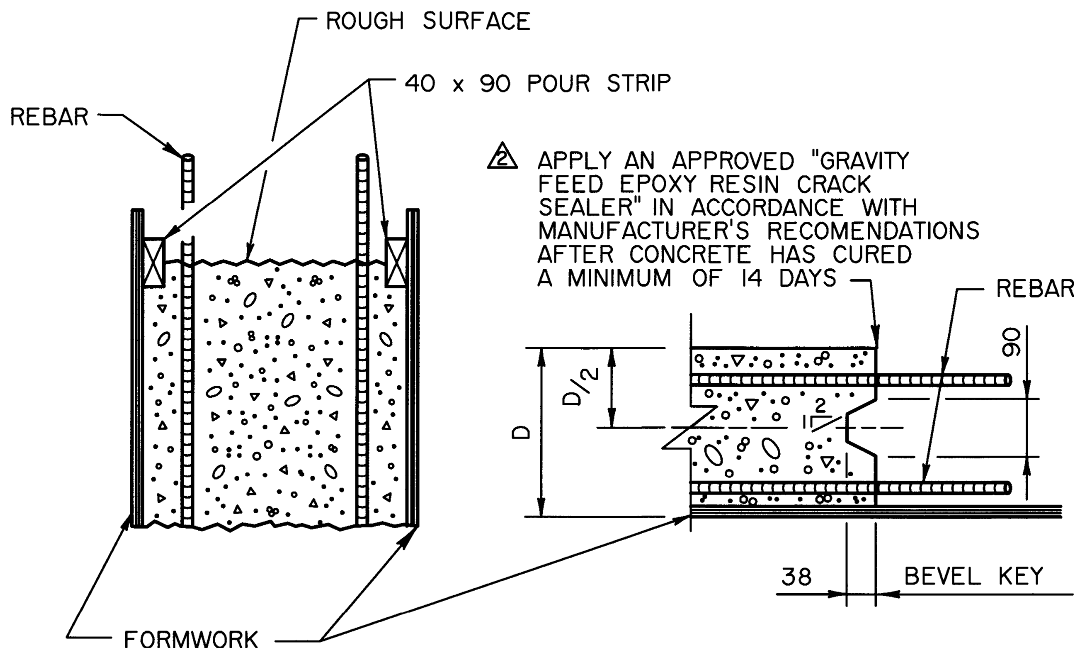
Alberta TRANSPORTATION AND UTILITIES
TECHNICAL STANDARDS BRANCH

STANDARD
CONCRETE JOINTS

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	PAGE 2	DRAWING
DHQ	MIK	87-03-04	EXECUTIVE DIRECTOR	[signature]	May 8/87	4.33	S-1411-87

PLOTTED APR 17, 2003 S1411X87 .RV5



SLAB DETAIL

WALL OR PIER SHAFT DETAIL

GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- SURFACES OF HORIZONTAL JOINTS SHALL BE THOROUGHLY CONSOLIDATED AND INTENTIONALLY LEFT IN A ROUGHENED CONDITION.
- JOINTS SHALL BE CLEANED OF SURFACE LAITANCE AND OTHER FOREIGN MATERIALS PRIOR TO PLACING NEW CONCRETE.

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DRAFTING STANDARDS PAGE: 6.3

NO	DATE	REVISIONS	BY
4			
3			
2	01-06-06	SLAB DETAIL JOINT REVISED	RY
1	99-04-12	REDRAWN FROM S-1412-98 REV 1	RY

Alberta TRANSPORTATION AND UTILITIES
TECHNICAL STANDARDS BRANCH

STANDARD CONSTRUCTION JOINTS

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	PAGE	DRAWING
RY	WS	99-04-12	EXECUTIVE DIRECTOR		May 8/87	4.35	S-1412-99

PLOTTED JUNE 06, 2001 S1412X99.RVI

400.3.6 REINFORCING STEEL

400.3.6.1 General

This specification is for the supply, fabrication, handling and placing of reinforcing steel. Reinforcement bars shall be supplied in the lengths and shapes, and installed as indicated on the Detailed Designs. No substitution of bars or changes to bar details will be allowed without the prior acceptance of the Design Engineer.

400.3.6.1.1 Submissions

Unless specified otherwise the following information shall be submitted to the Department at least seven days prior to commencement of work.

- proof of certification for CRSI Voluntary Certification Program
- reinforcing steel shop drawings

400.3.6.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department it is anticipated that the Department will undertake the following:

- Acceptance of submissions as outlined in this Section 400.3.6 (Reinforcing Steel);
- Visual inspection of the work; and
- Audits of the Contractor's quality control/quality assurance inspection and testing records.

400.3.6.2 Certification

Epoxy-coated reinforcing steel shall be coated by a manufacturer certified under the Concrete Reinforcing Steel Institute (CRSI) Voluntary Certification program for Fusion-Bonded Epoxy Coating Applicator plants. Proof of certification shall be submitted to the Department.

400.3.6.3 Fabrication

Reinforcing steel shall conform to the requirements of the CSA Standard G30.18M Grade 400. All hooks and bends shall be bent using the pin diameters and dimensions as recommended in The Reinforcing Steel Institute of Canada, (RSIC), Manual of Standard Practice, 1 Sparks Avenue, Willowdale, Ontario M2H 2W1, Phone: 416-499-4000, unless specified otherwise. Unless specified otherwise, all hooks and bends for epoxy coated reinforcing bars shall be bent using the pin diameters and dimensions as recommended in CAN/CSA-S6-06. Reinforcing bars shall conform accurately to the dimensions shown on the drawings and within the fabricating tolerance as shown in the RSIC, Manual of Standard Practice.

Epoxy-coated reinforcing steel shall be prepared and coated according to the requirements of ASTM A775 and the Ontario Provincial Standard Specification OPSS 1442, Material Specification for Epoxy-coated Steel Reinforcement for Concrete with additions and exceptions as described in this Section 400.3.6 (Reinforcing Steel). Film thickness of the coating, after curing, shall be 175 μm to 300 μm (7 to 12 mils). The epoxy coating material shall conform to the requirements of OPSS 1443, Material Specification for Organic Coatings for Steel Reinforcement.

Mesh reinforcement shall be supplied in flat sheets only.

400.3.6.4 Handling and Storage

The Contractor shall store steel reinforcement above the surface of the ground, upon platforms, skids, or other supports, and protect it from mechanical injury and surface deterioration caused by exposure to conditions producing rust. Steel reinforcement incorporated in the work shall be free from loose rust, scale, dirt, paint, oil, and other foreign material.

Special care shall be taken when handling epoxy-coated reinforcing steel to prevent damage to the epoxy coating. Epoxy-coated reinforcing bars shall not be dropped or dragged, and shall be lifted with non-metallic slings. Bar-to-bar abrasion and excessive sagging of bundles must be prevented, and bundles shall be handled with spreaders and non-metallic slings.

On site storage of the epoxy-coated reinforcing steel shall not exceed 120 days, and exposure to daylight shall not exceed 30 days. If the exposure time is expected to exceed 30 days, the reinforcing steel shall be protected by covering with opaque polyethylene sheeting or equivalent protective material.

400.3.6.5 Field Repair of Epoxy Coating

The Contractor shall be responsible for the field repair of all damage to epoxy coating up to the time the reinforcing steel is acceptably incorporated into the concrete structure, whether the damage is due to field cutting or handling damage. Where field cutting of the epoxy-coated reinforcing steel is necessary and accepted by the Department, it shall be either sheared or saw cut.

Repair of damaged coating, sheared or sawed ends shall be done to the Department's acceptance using the epoxy coating supplier's approved patching material and in accordance with the patching material manufacturer's written recommendations regarding surface preparation and patching material application. At a minimum the areas to be repaired shall be cleaned by removing all surface contaminants and damaged coating before applying patching material. Where rust is present, it shall be entirely removed immediately before applying the patching material. The patching material shall be overlapped onto the original coating for 25mm or as recommended by the manufacturer. The dry film thickness of the patched areas shall be between 175mm to 300mm. When the field repairs result in a total bar surface area covered by patching material that exceeds 5% of the bar surface area, the bar shall be replaced.

400.3.6.6 Placing and Fastening

All steel reinforcement shall be accurately placed in the positions shown on the Detailed Designs, and firmly tied and chaired before placing the concrete. When placed in the work it shall be free from dirt, detrimental rust, loose scale, paint, oil or other foreign material. Bars shall be tied at all intersections, except where spacing is less than 250mm in each direction, when alternate intersections shall be tied. Tack welding of reinforcing steel shall not be allowed.

Distances from the forms shall be maintained by means of stays, spacers, or other approved supports. Reinforcing cover shall not be less than the minimum specified on the Detailed Designs. Spacers for securing reinforcement from contact with the forms or for separation between layers of bars shall be plastic chairs, precast concrete supports, galvanized metal or epoxy-coated metal; of acceptable shape and dimensions. Precast concrete supports shall be used for all exposed faces of curbs, medians and barriers. Precast concrete supports shall have compressive strengths equal to or exceeding the placed concrete. Tie-wire for epoxy coated reinforcing shall be plastic coated. Any metal chairs protruding through the surface of the hardened concrete shall be cut back at least 25 mm, and the holes filled in accordance with Section 400.3.5.24.2 (Class 1 Ordinary Surface Finish), unless otherwise reviewed and accepted by the Department. Metal chairs shall not be used to support reinforcement on surfaces which are to be exposed or are to be finished; where possible, this reinforcement is to be supported entirely from above.

400.3.6.7 Splicing

Splicing of bars, unless shown on the Detailed Designs, is prohibited except with the written acceptance of the Design Engineer and the Department. Splices, where possible, shall be staggered.

For lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the required minimum clear distance to other bars, and the required minimum distance to the surface of the concrete.

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width.

400.3.7 STRUCTURAL STEEL

400.3.7.1 General

This specification is for the supply, fabrication, delivery and erection of structural steel. Structural steel shall include steel girders, trusses, diaphragms, bracing, splice plates, deck drains, structural bearings, anchor bolts, dowels, deck joint assemblies, buffer angles, connector angles, anchor bolt sleeves, curb and median cover and trough plates, pier nose plates, pier bracing, and miscellaneous components.

400.3.7.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work:

- Identification of subcontractors;

- Proposed fabrication sequences (at least 14 days prior to fabrication);
- Web and flange plate arrangements for welded plate girders (at least 14 days prior to fabrication);
- Welding procedures for all welds;
- Shop drawings (five copies);
- Mill certificates and mill test reports for all material;
- Results of impact tests for structural steel;
- Repair procedures for unsatisfactory weldments and accidental arc strikes, if required;
- Repair procedures for flame cut edges, if required;
- Details of additional splices, if required;
- Repair procedures for excessive girder camber, if required;
- Repair procedures for flame straightening of members, if required;
- Repair procedures for galvanizing, if required;
- Erection procedures, including drawings for falsework, berms and traffic accommodation (five copies) (at least 28 days prior to erection);
- Methods and materials for setting anchor bolts and constructing bearing pads;
- Procedures for straightening bent material during erection, if required;
- Girder elevations and alignments prior to bolt tightening;
- Methods for correction of misfits during erection, if required; and
- Methods of forming and pouring grout (at least 14 days prior to placing grout).

The Department shall be advised a minimum of two days prior to a component being ready for inspection at an inspection station.

400.3.7.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Design.

- Unless determined otherwise by the Department, it is anticipated that the Department will determine the undertake the following testing to determine the acceptability of the work.

- Acceptance of submissions as outlined in this Section 400.3.7 (Structural Steel);

- Visual inspection of the work;

- Audits of the Contractor's quality control/quality assurance inspection testing records; and

- Radiographic, ultrasonic, magnetic particle and other testing to confirm the acceptability of materials and/or workmanship. (See Section 400.3.7.2.8 (Testing and Inspection) for details).

400.3.7.2 Supply and Fabrication

400.3.7.2.1 Standards

Fabrication of structural steel shall conform to "The American Association of State Highway and Transport Officials (AASHTO), Standard Specifications for Highway Bridges" and the

American Welding Society (AWS) - Bridge Welding Code, D1.5.

Where imperial/metric conversions are necessary, The National Standard of Canada, CAN3-Z234.1-79 shall be used as the basis of conversion.

All welding, cutting and preparation shall be in accordance with the AWS - Bridge Welding Code, D1.5.

400.3.7.2.2 Qualification

The Contractor shall notify the Department of any subcontractors with which it has contracted in respect of this Section 400.3.7(Structural Steel). The Contractor shall remain responsible for the work of such subcontractors. All requirements of this Section 400.3.7(Structural Steel), such as Canadian Welding Bureau (CWB) approval and right of access, shall apply to such subcontractor.

The Contractor or subcontractor fabricating the structural steel shall operate a recognized steel fabricating shop accepted by the Department.

The Contractor or subcontractor fabricating the structural steel shall be fully approved by the CWB as per Canadian Standards Association (CSA) Standard W47.1 in the following Divisions:

Fabrication of steel girders, girder components and welded steel trusses	Division 1
All other bridge components	Division 2

Only welders, welding operators and tack welders approved by the CWB in the particular category shall be permitted to perform weldments. Their qualifications shall be current and available for examination by the Department.

400.3.7.2.3 Engineering Data

Approval of Plate Arrangement for Welded Plate Girders

Prior to the placing of material orders, the Contractor shall submit to the Design Engineer for review and then to the Department, for acceptance three copies of sketch drawings showing the general description of the proposed fabrication scheme. This shall include the general arrangement of plates or shapes, including the location of all shop and field splices and such other information as may be requested by the Department to permit an assessment of the acceptability of the proposal.

Welding Procedures

Welding procedures shall be prepared for each type of weld used in the structure. The procedures shall bear the approval of the CWB and shall be submitted to the Design Engineer for review and then to the Department for acceptance prior to use on the structure.

Shop Drawings

Five copies of the shop drawings showing all details shall be prepared by the Contractor and submitted to the Design Engineer for review and then to the Department for acceptance prior to fabrication. The shop drawings shall be legible and of adequate quality to be reproduced and microfilmed. Each drawing shall have a sufficient blank space for the Design Engineer's reviewing stamp. The Department's acceptance of the shop drawings shall not be construed as relieving the Contractor from its responsibility for errors or omissions. All shop drawings will be stamped as follows:

"This acceptance applies to general arrangements and details of design but not to dimensions or details of fabrication and is subject to the requirements of specifications and to such corrections as may be marked here on."

Fabrication shall not commence prior to the review and acceptance of the shop drawings.

In addition to specific details, the shop drawings shall include the following:

(a) Drawings showing details of connections not shown on the Detailed Designs shall bear the signature and stamp of a Professional Engineer;

(b) All dimensions shall be correct at 20°C unless otherwise noted;

(c) Weld procedure identification shall be shown on the shop drawings in the tail of the weld symbols;

(d) All material splice locations shall be shown on the drawings;

(e) Bearings shall be centered at -5°C;

(f) Shop assembly drawings shall indicate camber and splice joint offsets measured to the top of top flange at a maximum spacing of 4m; and

(g) The Department's bridge file number and project name shall be shown on all the shop drawings.

<u>Proposed Fabrication Sequence</u>

Prior to commencement of fabrication, the Contractor shall present an outline of the fabrication sequence that clearly describes the order of make-up and assembly of all the component parts, as well as shop assembly, inspection stations, and surface preparation to the Design Engineer for review and then to the Department for acceptance.

<u>Mill Certificates</u>

Mill certificates shall be provided to the Design Engineer for review and then to the Department for acceptance of all material before fabrication commences.

<u>Schedules</u>

The Contractor shall provide and keep current a complete fabrication schedule in a form satisfactory to the Department.

400.3.7.2.4 Materials

Structural Steel

Structural Steel shall conform to the standard noted on the Detailed Designs. Interpretation of equivalent steels will be as per Appendix "A" of the CSA Standard G40.21 (1976 only). Mill certificate data and results of impact tests shall be submitted to the Design Engineer, for review and then to the Department for acceptance prior to shipment of material from the mill to provide sufficient time for replacement or for heat treating of material that does not meet the requirements.

Bolts

All bolts, nuts and washers shall conform to American Society for Testing and Materials (ASTM) Standard A 325 or shall meet property class 8.8 of the Industrial Fasteners Institute for metric high strength structural bolts, nuts and washers. Metric bolts shall be marked with the symbol A 325M and those of a "weathering" steel shall have the A 325M symbol underlined. Metric nuts shall be marked with three circumferential lines with an "M" between two of them or shall be marked with a "3" if made of a weathering grade. Washers shall be identified as metric preferably by having an "M" indented in the surface or a "3" for weathering grades. Certified mill test reports for the fastener material shall be submitted to the Design Engineer for review and then to the Department for acceptance.

Stud Shear Connectors

All stud shear connectors shall conform to the chemical requirements of ASTM Standard A 108, Grades 1015, 1018 or 1020. In addition they shall meet the mechanical properties specified in AWS D1.5, Table 7.1 for Type B studs. Certified mill test reports for the stud material shall be submitted to the Design Engineer for review and then to the Department for acceptance.

Bearings

Certified mill test reports for all bearing material shall be submitted to the Design Engineer for review and then to the Department for acceptance.

(a) Stainless Steel
Stainless Steel shall conform to the requirements of American Iron and Steel Institute (AISI) Standard Type 304, No. 8 Mirror Finish.

(b) Elastomer Compound
Elastomer shall conform to Section 18 "Bearings" Division II of AASHTO Standard Specifications for Highway Bridges. Elastomer compound shall conform to low temperature AASHTO grade 5 material testing requirements in Table 18.4.5.1-1A and -1B at the specified hardness.

(c) Teflon
Teflon shall be unfilled, 100% virgin polymer.

(d) Base Plate Corrosion Protection

The bearing base plate corrosion protection of the bottom face of each base plate shall be in accordance with Section 400.3.13.2.6 (Base Plate Corrosion Protection).

400.3.7.2.5 Welding

Filler Metals & Welding Processes

Low hydrogen filler, fluxes and low hydrogen welding practices shall be used throughout. The deposited weld metal shall provide strength, durability, impact toughness and corrosion resistance equivalent to base metal. The low hydrogen covering and flux shall be protected and stored as specified by AWS Standard D1.5. Flux cored welding or use of cored filler wires in the submerged arc process or shielding gas processes are not considered as conforming to low hydrogen practice, and will not be permitted.

(a) Submerged Arc Welding (SAW)

Submerged arc welding process is allowed for all flat and horizontal position welds. All flange and web butt joints shall be made by an approved semi or fully automatic submerged arc process. All web to flange fillet welds and all longitudinal stiffener to web fillet welds shall be made by an approved fully automatic submerged arc process.

(b) Shielded Metal Arc Welding (SMAW)

Shielded metal arc welding is allowed for girder vertical stiffener to flange fillet welds and for miscellaneous components such as deck drains, bridge bearings, deck joint assemblies, pier nose plates and buffer angles.

(c) Metal Core Arc Welding (MCAW)

Metal core welding process utilizing low hydrogen consumables with AWS designation of H4 is allowed for vertical stiffeners and horizontal gussets of the girders, and miscellaneous components such as deck drains, bridge bearings, deck joint assemblies, pier nose plates and buffer angles.

Field application of metal core arc welding is not allowed.

Cleaning Prior to Welding

Weld areas must be clean, free of mill scale, dirt, grease, and other contaminants prior to welding.

Tack and Temporary Welds

Tack and temporary welds shall not be allowed unless they are to be incorporated in the final weld. Tack welds, where allowed, shall be of a minimum length of four times the nominal size of the weld and length shall not exceed 15 times the weld size, and shall be subject to the same quality requirements as the final welds. Cracked tack welds shall be completely removed prior to welding over.

Run-off Tabs

Run-off tabs shall be used at the ends of all welds that terminate at the edge of a member. They shall be tack welded only to that portion of the material that will not remain a part of the structure, or where the tack will be welded over and fused into the final joint. After welding, the tabs are to be removed by flame cutting, not by breaking off.

Preheat

Preheat requirements shall be performed and maintained as per AWS D1.5, except that all welds on girder flanges shall be preheated to a minimum temperature of 100ºC unless a higher temperature is required by AWS D1.5 for the flange thickness. The preheat temperature of the web to flange joint shall be measured 75mm from the point of welding on the side of the flange opposite to the side where the weld is being applied.

Welding at Stiffener Ends

To prevent notching effects, stiffeners and attachments fillet welded to structural members shall have the fillet welds terminate 10 mm short of edges.

Methods of Weldment Repair

Repair procedures for unsatisfactory weldments shall be prepared by an experienced welding engineer registered as a Professional Engineer and submitted to the Design Engineer for review and then to the Department for acceptance

Arc Strikes

Arc strikes will not be permitted. In the event of accidental arc strikes, a repair procedure shall be prepared by an experienced welding engineer registered as a Professional Engineer and submitted to the Design Engineer for review, and to the Department for acceptance. The repair procedure shall include the complete grinding out of the crater produced by the arc strike. These areas will be examined by non-destructive testing to ensure complete removal to the base metal in the affected area. The non-destructive test report shall be reviewed by the experienced welding engineer and submitted to the Department for acceptance.

Grinding of Welds

Flange butt welds shall be ground flush or to a specified slope on both sides. Web butt welds which are sufficiently smooth with a neat appearance and uniform profile will not require grinding. Fillet welds not conforming to acceptable profile shall be ground to the proper profile without substantial removal of the base metal. Grinding shall be smooth and parallel to the line of stress. Caution shall be exercised to prevent over grinding. Acceptability of the welds without grinding will be determined by the Department.

Plug and Slot Welds

Plug welds or slot welds shall not be permitted.

Welding to Girder Flanges and Webs

With the exception of longitudinal web to flange welds and longitudinal stiffener to web welds, all stiffener, gusset plate, or any other detail material welds to girder webs shall be a minimum of 300 mm from the web butt welds.

400.3.7.2.6 Fabrication

Fabrication shall be performed in an enclosed area which is adequately heated.

Heat Number Transfer

As the plate is subdivided for webs and flanges, all heat numbers shall be transferred to each individual section. The numbers shall remain legible until such time as the material location in the final assembly has been recorded. Mill identification numbers stamped into the material shall be removed by grinding at an appropriate time.

Marking Systems

Methods and medium of marking and the location of marks shall be accepted by the Department. Steel stamps shall not be used. The only exception is the match marking of splice plates which may be steel stamped using low stress stamps. The stamps and specific locations of such stamps must be shown on the shop drawings and accepted by the Department.

Cutting of Plate

All plate material for main members, splice plates and any plate material welded to the main member shall be flame cut using an automatic cutting machine. Shearing is not allowed.

Flange Stripping

All flange material shall be cut so that the direction of the applied stress will be parallel to the direction of the plate rolling.

Flame Cut Edges

The flame cut edges of girder flanges shall have a maximum Brinell hardness as stated by Section 400.3.7.2.8 (Hardness Tests). The surface roughness of the flame cut edge shall not be greater than ANS I B46.1 500 min. (12.5mm) and be such that as to allow Brinell hardness testing without spot grinding. The Contractor shall report all blow backs or signs of lamination observed during the cutting of the material. The Department will perform Brinell hardness tests at random on the as is flame cut edge. If the hardness exceeds the requirements, the procedure for repairing the edges to meet the requirements shall be submitted to the Design Engineer for review and then to the Department for acceptance.

The surface of flame cut apertures shall be finished by grinding and shall be free of nicks and gouges.

Additional Material Splices

Additional splices, other than those shown on the shop drawings, will require review by the Design Engineer and then acceptance by the Department.

Vertical Alignment

The structure shall be fabricated to conform to the requirements of the deflection and vertical curve, as noted on the Detailed Designs. For rolled shapes, advantage shall be taken of mill camber that may be inherent in the material.

Shop Assembly

(a) Plate Girders
Shop assembly of girders shall be by the progressive assembly method according to AASHTO, except that only two, instead of three, sections need to be assembled. The detailed method of assembly, including points of support, dimensional checks, method of trimming to length, drilling and marking of splices, shall be to the procedure submitted and accepted by the Department as per Section 400.3.7.2.3 (Proposed Fabrication Sequence). Each individual girder section shall meet the camber requirements for that particular length, with the splices between these sections falling on the theoretical camber line for the entire span. Correction for variation in flange thickness must be considered. When the camber of the girder fails to meet the required tolerance, the Contractor shall submit a proposed method of repair for review by the Design Engineer and then acceptance by the Department. No flame cambering will be allowed without prior acceptance and witnessing of the Department. The camber of each individual girder section must be known for the next two girder sections in the girder line prior to shop assembly of any particular girder section. This is to allow the Department to call for the best fit line to reduce the effect of any camber differences should it be deemed necessary. Camber for plate girders will be measured on the top of the top flange. The camber of plate girders shall be measured in the "no load" condition.

(b) Box Girders
The progressive shop assembly for box girders shall be as per Section 400.3.7.2.6 (Fabrication- Shop Assembly, (a) Plate Girders), items described in this section are specific to box girders.

The camber of box girders shall be measured on the top of the top flange, and each top flange of a box shall individually meet the required camber. Girder sections assembled for splicing shall be supported within 2 m of the end of each section. Girder sections shall be supported in such a manner as to provide the correct angular relationship at the splice between girder sections while the splices are being reamed or drilled. Shop drawings shall clearly indicate the expected dead load deflection of each section and the elevations of the sections while supported for the drilling or reaming of each splice.

(c) Drilling
All splices shall be drilled from solid material while assembled or shall be subpunched or sub-drilled and then reamed to full size while in the shop assembly position. No reaming shall take place until acceptance of the assembly has been obtained from the Department.

Splice Plates

After shop assembly, splice plates and girders shall be clearly match marked to assure proper orientation and location of splice material for erection. All holes shall align with holes in the attached member. Splice plates shall then be removed, de-burred, solvent cleaned to remove all oil and sandblasted to remove all mill scale, in order to provide a suitable faying surface. These plates shall then be securely ship-bolted to the girders. The match marking system shall be shown on the shop drawings.

Bolt Holes

Clause 11.4.8 in Division II of AASHTO shall apply except that all bolt holes in load carrying segments of main members and any material welded to main members shall be drilled full size or subpunched and reamed to full size. All holes in girder splices shall be circular and perpendicular to the member and shall be deburred to ensure a proper faying surface.

Dimensional Tolerances

Normal tolerance for structural steel fabrication and fitting between hole groups will be + 3mm unless specified otherwise. The dimensional tolerances for structural members shall be within the AWS Standard D1.5, Section 3.5, except as otherwise noted below:

(a) Combined Warpage & Tilt
Combined warpage and tilt of flange at any cross section of welded I-shape beams or girders shall be determined by measuring the offset at the toe of the flange from a line normal to the plane of the web through the intersection of the centerline of the web with the outside surface of the flange plate. This offset shall not exceed 1/200 of the total width of the flange or 3 mm whichever is greater at bolted splice location. Bolted splices of main stress carrying members shall have parallel planes and the surfaces shall be in full contact without any gap.

(b) Girder Camber
Camber of beams and girders shall be uniform, true and accurate to the centreline of the top flange. Permissible variation in camber shall be within + (0.2Lt + 3) mm; where Lt is the test length in metres. This applies to fabricated pieces only, prior to shop assembly. During shop assembly, splice points shall be located on the theoretical camber line or at a specified amount from the line should the Department choose to correct for shop camber deviations.

Where field splices are eliminated by combining girder segments into longer girder lengths, the cambers of the girders at the eliminated splice points shall be within + 3mm.

(c) Box Girders
Tolerances for box girder camber, sweep and depth shall be measured relative to two imaginary surfaces: a vertical plane passing through the centre line of the girder, and a surface located at the theoretical underside of the top flanges following the theoretical camber of the girder.

(d) Splices
Fill plates shall not be permitted at main girder field splices unless specified in the Detailed Designs. The tolerance for girder depth or box girder geometry shall be as specified by

AWS D1.5, except that the difference between similar dimensions of the adjoining sections being spliced shall not exceed + 3mm.

(e) Fitted Stiffeners
The Bearing ends of bearing stiffeners shall be flush and square with the web and shall have at least 75% of this area in contact with the flanges whereas fitted stiffeners may have a gap of up to 1 mm between stiffener and flange.

(f) Bearing to Bearing Dimension
Bearing to bearing distance is a set dimension and therefore has no tolerance.

(g) Deck Joint Assemblies
Deck joint assemblies shall be assembled for inspection in a relaxed condition with erection angles removed. Acceptance of the assembly by the Department is required prior to application of the erection angles. Tolerances for straightness shall be considered over the length of the assembly between the crown and gutter line both before and after galvanizing. Deviation from straightness in a vertical plane shall not exceed + 6mm. Horizontal sweep or variations in gap setting shall not be greater than 3mm.

Flange Corner Chamfer

Corners of all flanges shall be ground to a 2mm chamfer.

Milling Tolerances

Tolerance for milled to bear stiffeners shall be 0.05mm with at least 75 percent of the area in bearing.

Web Panning

The maximum variation from flatness for webs shall be 0.01d where d is the least dimension of the panel formed by the girder flanges and/or stiffeners. Should the panning in one panel be convex and the panning in the adjacent panel concave then the sum of the panning in the two adjacent sections shall not exceed that allowed for one panel.

Field Weld Preparation

All material to be field welded shall be prepared in the shop.

Flame Straightening

Flame straightening shall not be performed on any material or member without a written request to the Department. The procedure for flame straightening shall be prepared by an experienced welding engineer and submitted to the Design Engineer for review and then to the Department for acceptance. The procedure shall address location, temperatures and cooling rates.

Stress Relieving

When stress relieving is specified, it shall be performed in accordance with AWS D1.5. Copies of the furnace charts shall be supplied to the Department.

Handling and Storage

All lifting and handling shall be done using devices that do not mark, damage, or distort the assemblies or members in any way. Girders shall be stored and transported in the upright position, supported on sufficient skids and safely shored to maintain the proper section without buckling, twisting or in any way damaging or misaligning the material.

400.3.7.2.7 Surface Preparation

Blast Cleaning

Unless otherwise noted, all steel components shall be blast cleaned after fabrication in accordance with the Society for Protective Coating Standard (SSPC) No. SP6. Essentially this is a surface from which all oil, grease, dirt, rust, scale and foreign matter have been completely removed, and all rust, mill scale and old paint have been removed except for slight shadows, streaks or discolorations caused by rust stain or mill scale oxide binder.

Galvanizing

Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of CSA Standard G164 with additions and exceptions as described in this specification. The Contractor shall provide a smooth finish on all edges and surfaces, and remove all weld spatter and all welding flux residue from the steel components prior to galvanizing.

Repair of galvanizing shall only be done if bare areas are infrequent, small, and suitable for repair. A detailed repair procedure shall be prepared by a Professional Engineer prior to its use and submitted to the Department for acceptance. It should be noted that repairs may require complete removal of the galvanized coating and regalvanizing. Repair shall be in compliance with ASTM A 780, Method A3 Metallizing. The thickness of the metallizing shall be 180mm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing. The Department will determine the acceptability of repaired areas.

400.3.7.2.8 Testing and Inspection

Access

The Contractor shall provide full facilities for the inspection of material and workmanship by the Department. Free access shall be allowed to the Department to all parts of the works. When required by the Department, the Contractor shall provide needed manpower for assistance in checking layout and performing inspection duties.

Testing and Inspection by the Contractor

The Contractor shall be responsible for all quality control and quality assurance testing and inspection required to ensure that the work meets the Technical Requirements and the requirements of the Detailed Designs.

Any quality control/quality assurance testing and inspection records made by the Contractor shall be open to the Department for auditing.

Testing and Inspection by the Department

To confirm acceptability of materials and/or workmanship, the Department will perform visual, radiographic, ultrasonic, magnetic particle and any other inspection that may be specified or required. The testing by the Department or by its testing agencies will be at the Department's expense, except that testing made necessary by the repair of faulty work shall be paid for by the Contractor.

The Contractor shall be responsible for all travel, boarding and lodging costs incurred by the Department to inspect bridge girders and finger plate deck joints being fabricated outside the Province of Alberta. The cost shall also include for a Department's representative to attend the pre-job meeting for each fabrication shop and three additional trips per bridge to oversee the inspection of girders during the course of fabrication. This requirement for attending the pre-job meeting for each fabrication shop will also apply for the finger plate deck joints. However, the additional trip requirement will be reduced to one per bridge for the Department's representative.

Inspection Stations

To ensure that each stage of inspection is performed in an orderly manner, during the fabrication of major structures, Inspection Stations will be set up at specific points. Sub-assemblies of the work will then be checked and tested by the Design Engineer, prior to being confirmed and tested by the Department, and all deficiencies shall be corrected, prior to the work being sent to the next stage of fabrication.

Typical check points for a plate girder are:

- Flange plates prepared.
- Web plates prepared.
- Web to flange welds completed prior to fitting any stiffeners.
- Completion of all welding prior to splicing.
- Splice set-up prior to drilling.
- Surface preparation and coating.
- Clearance to ship.

Non-destructive Methods of Examination

The methods of non-destructive examination shall be in accordance with the following standards:

- Radiography - AWS Standard D1.5
- Ultrasonic - AWS Standard D1.5
- Magnetic Particle - ASTM Standard E-709
- Dye-Penetrant - ASTM Standard E-165
- Hardness tests - ASTM Standard E-103

Radiographic Inspection Schedule

Unless determined otherwise, radiographic inspection of welded plate girders will be performed by the Department in accordance with the following schedule:

(a) 100 percent of all tension flange butt welds, all stiffener butt welds and all diaphragm butt welds, and any groove welded attachments to flange plates.

(b) 25 percent of all other flange butt welds.

(c) All web butt welds in tension zone plus additional 300mm of web butt weld in compression zone at the end of the web.

Radiographic Inspection of Miscellaneous Material

Unless determined otherwise, radiographic inspection of miscellaneous material shall be performed by the Department in accordance with the following schedule:

(a) 100% of all tension members.

(b) 50% of all other members.

Magnetic Particle Inspection Schedule

Unless determined otherwise, magnetic particle inspection of welded plate girders shall be performed by the Department in accordance with the following schedule:

(a) 50 percent of the web to flange welds or any fillet welds placed on flange plates

(b) 10 percent of the web to stiffener welds

(c) 100 percent of the stiffeners to flange welds

(d) 100 percent of the bearing sole plate to flange welds

(e) 20 percent of the diaphragm connector plate welds

Dye Penetrant Inspection

Dye penetrant inspection will be performed by the Department in areas of the structure deemed necessary by the Department. In particular, the ends of the weld metal of all flange butt welds after the removal of run-off tabs will be inspected using this method. Defects discovered by this inspection shall be repaired by the Contractor, and the suspect area reinspected.

Hardness Tests

Hardness tests shall be performed by the Department on the flame cut edges of the girder flange prior to assembly. Unless otherwise noted, the hardness of the flame cut edges shall not exceed a maximum Brinell as noted below:

(a) For carbon steels with a yield strength less than and including 300 MPa, the maximum Brinell shall be 200 BHN.

(b) For carbon steels with a yield strength greater than 300 MPa, the maximum Brinell shall be 220 BHN.

Remedial work to the edges which exceed the specified hardness shall be performed and re-inspected prior to assembly.

Testing Stud Shear Connectors

Stud shear connectors shall meet all requirements as outlined by AWS D1.5. The Contractor shall perform bend testing in accordance with AWS D1.5. When bend testing, the studs shall be bent towards the centre of the girder.

Inspection Schedules

The Contractor shall ensure that adequate notice of scheduled inspection requirements be given to the Department and inspection agencies, and that access to the work is provided at all times. The Contractor shall provide the Department with his sequence of fabrication in order that the inspection program can be properly integrated and agreed to, prior to commencement of fabrication.

Testing of Deck Joint Strip Seal

The installation of strip seals in deck joints shall be tested by the Contractor in the presence of the Department for leakage. The failed areas shall be corrected and retested. The defective or torn seal shall be replaced at the Contractor's expense.

Notification

The Contractor shall notify the Department 48 hours prior to contemplating shipment to facilitate final inspection of the materials. Material that has not been inspected in the fabrication plant will not be paid for until such material has been inspected and accepted. The Contractor may be charged with all expenses incurred for inspection of the material at the site.

400.3.7.3 Structural Steel Erection

The Contractor shall erect the structural steel, remove any temporary construction and do all work required to complete the erection in accordance with the Detailed Designs and the Technical Requirements. No drilling of additional holes or any other modifications including field welding, shall be made to steel elements other than deck joints. Lifting devices shall not be welded to the girders. The Contractor shall not erect the structural steel until the substructure concrete has been cured a minimum of three days and achieved 80% of the 28 day specified concrete strength requirement. Without restricting generality, erection includes:

- placing of anchor bolts and bearings
- erecting of temporary supporting structures
- erecting of structural steel
- placing of expansion assemblies
- grouting of anchor bolts
- placing and sealing of grout pads
- touching up painting as required

400.3.7.3.1 Handling and Storing Materials

Material to be stored shall be placed on timber blocking. It shall be kept clean, and stored in a properly drained area. Girders and beams shall be placed upright and shored. Long members, such as deck joint assemblies, buffer angles, columns and chords, shall be supported on timber blocking to prevent damage from deflection. Galvanized material shall be handled and stored as per Section 400.3.13.2.8 (Material Handling and Storage).

400.3.7.3.2 Bridge Girders

Temporary Supporting Structures and Berms

The temporary supporting structures and berms shall be designed, constructed and maintained to safely support all loads. Berms shall be constructed in a manner and of such materials that they will not be eroded by stream flow nor introduce silt into the water. The Contractor shall prepare and submit drawings to the Design Engineer for review and then to the Department for acceptance for temporary supporting structures, and berms, and for traffic control and accommodation where applicable. Acceptance of the Contractor's drawings shall not be considered as relieving the Contractor of any responsibility. All drawings submitted shall bear the seal of a Professional Engineer.

Temporary supporting structures and/or berms will not be permitted to remain in any stream channel during spring break-up or run-off periods, unless all necessary approvals have been obtained from pertinent agencies and prior written acceptance obtained from the Department.

Incidental damage to other property, such as earth fills and stream banks, resulting from the existence of berms, shall be the responsibility of the Contractor.

Review of Erection Procedure

The Contractor shall submit to the Design Engineer for review and to the Department, for acceptance, four copies of the detailed erection procedure four weeks in advance of the scheduled start of erection. The erection procedure shall include all drawings and documents necessary to describe the following:

(a) traffic accommodation strategy (TAS), as applicable.

(b) Access to work, earth berms and work bridges.

(c) Type and capacity of equipment.

(d) Sequence of operation including position of cranes, trucks with members.

(e) Position of cranes relative to substructure elements such as abutment backwalls, with details of load distribution of wheels and outriggers.

(f) Lifting devices and lifting points. No drilling of additional holes or any other modifications, including field welding, shall be made to steel elements other than deck joints. Lifting devices shall not be welded to the girders.

(g) Details of temporary works, supporting structures drawings including proposed methods to be used to ensure the required splice elevations and structure shape prior to bolt torquing, method of providing temporary supports for stability, top of girder elevations at each bearing and each splice location where appropriate.

(h) Bolt tightening sequence.

(i) Grout Pad Construction. Refer to Section 400.3.7.3.2 (Grout Pockets and Grout Pads).

(j) Details of release of temporary supporting structures.

(k) Provide an "As-Constructed" detailed survey of the substructure showing the following:
- location and elevation of all bearing grout pad recesses including anchor bolt voids,
- shim height at each bearing location,
- top of girder elevations at each bearing and each splice location where appropriate.
- longitudinal measurements between centreline of bearings of all substructure elements.

The erection procedure shall bear the stamp of a Professional Engineer registered in Alberta, who shall assume full responsibility to ensure that his erection procedure is being followed. Safety and compliance with the *Occupational Health and Safety Act* (Alberta) and regulations thereunder, shall be an integral part of the design.

The Contractor shall continue to be fully responsible for the results obtained by the use of these sealed drawings, with the Professional Engineer also assuming responsibility, as the Contractor's agent, for the results obtained.

Site work shall not commence until acceptance of the proposal by the Department has been obtained. The Contractor's project manager, Design Engineer and field superintendent may be required to attend a pre-job meeting at a location determined by the Department prior to commencement of any field work.

The Department’s acceptance shall not be considered as relieving the Contractor of the responsibility for the safety of its methods or equipment, nor from carrying out the work in full accordance with the drawings and specifications.

Before erection begins the Contractor shall do a complete superstructure layout by means of chalk lines and markings applied to all substructure units, showing bearing and girder positions in accordance with the contractor's accepted layout plan.

Fall Protection for Girder Erection and Deck Forming

In order to provide a safe working area for girder erection and deck formwork, the Contractor shall provide 100% fall protection and a safe work procedure.

Bearings and Anchorage

Masonry bearing plates shall not be placed upon bridge seat bearing areas which are improperly finished, deformed or irregular. Bearing plates shall be set level in their exact position.

The Contractor shall remove anchor bolt void forming materials, and accurately set the anchor bolts, except where the bolts were cast into the concrete. Any residues on the concrete surfaces, such as oils, grease or other contaminants, shall be removed by sandblasting. All methods and materials for setting anchor bolts and constructing bearing pads shall be submitted to the Design Engineer for review and then to the Department for acceptance. The location of the anchor bolts, in relation to the slotted holes in the expansion shoes, shall correspond with the temperature at the time of erection. The nuts on the anchor bolts, at the expansion ends of spans, shall be adjusted to permit free movement of the spans.

When steel bearings are employed in conjunction with grout pockets in the substructure, the bearings shall be set accurately on galvanized steel shims, and grouted as detailed on the Detailed Designs, after the girder erection has been completed. The shims must be located so that a minimum 75mm grout coverage is provided. When grout pockets are not detailed, the bearing plates shall be set on the properly finished bearing areas in exact position and shall have a full and even bearing on the concrete.

Straightening Bent Material

Straightening of plates, angles or other shapes will not be permitted without submission to the Design Engineer for review and then to the Department for acceptance. In all cases a detailed procedure in writing must be submitted by the Contractor, and accepted prior to any straightening being undertaken.

Following the accepted straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fractures, which may include non-destructive testing.

Assembly

The parts shall be accurately assembled as shown on the shop drawings and all match-marks shall be followed. The material shall be carefully handled to avoid damage. Hammering, which will injure or distort the members, shall not be permitted. Bearing surfaces and surfaces to be in permanent contact shall be clean before the members are assembled.

Splices and field connections shall have one half of the holes filled with bolts and cylindrical erection pins (half bolts and half pins evenly distributed throughout the splice or connection) before bolting. Splices and connections carrying traffic during erection shall have three-fourths of the holes filled.

Fitting-up bolts shall be of the same nominal diameter as the bolts, and cylindrical erection pins shall be sized to accurately fit the holes.

Should adjustments in elevation of the girder splices become necessary only enough pins or bolts shall be removed to allow free rotation of the joints.

High-Tensile-Strength Bolted Connections

(a) General
Bolted parts shall fit solidly together when assembled. Contact surfaces, including those adjacent to the washers, shall be descaled or carry the normal tight mill scale. Contact surfaces shall be free of dirt, paint, oil, loose scale, burrs, pits and other defects that would prevent solid seating of the parts. Unless otherwise noted, bolts in exterior girders shall be installed with the heads on the outside face of the girder web and bolts in all girders shall be installed with the heads on the bottom faces of lower flanges unless otherwise noted. Nuts for bolts that will be partially embedded in concrete shall be located on the side of the member that will be encased in concrete.

Connections shall be assembled with a hardened washer under the bolt head or nut, whichever is the element turned in tightening. Surfaces of bolted parts in contact with the bolt head and nut shall be parallel.

For sloped surfaces, bevelled washers shall be used. The bevelled washers shall be designed to produce a bearing surface normal to the bolt axis.

Bolts shall be of new quality and stored in weatherproof containers to prevent loss of lubrication or accumulation of dirt.

All girders shall be erected with elevations and alignments checked by the Design Engineer and then accepted by the Department, prior to any bolt tightening.

(b) Bolt Tension
Each bolt shall be tightened so as to provide, when all bolts in the joint are tight, at least the minimum bolt tension shown in the following table for the size of bolt used:

Table 1 BOLT TENSION

Specified Bolt Size (A325M Bolts)	Minimum Bolt Tension		Commonly Supplied Equivalent Imperial Size (A325 Bolts)	Minimum Bolt Tension	
	Kilonewtons	pounds-force		Kilonewtons	pounds-force
M16X2	94	21,180	5/8	85	19,200
M20X2.5	147	33,050	3/4	126	28,400

Specified Bolt Size (A325M Bolts)	Minimum Bolt Tension		Commonly Supplied Equivalent Imperial Size (A325 Bolts)	Minimum Bolt Tension	
	Kilonewtons	pounds-force		Kilonewtons	pounds-force
M22X2.5	181	40,700	7/8	175	39,250
M24X3	212	47,660	1	227	51,500
--	--	--	1 1/8	251	56,450
M30X3.5	337	75,760	1 1/4	319	71,700
--	--	--	1 3/8	380	85,450
M36X4	490	110,160	1 1/2	463	104,000

(c) Turn-of-nut tightening

Tightening of all high strength bolts shall be by the turn-of-nut method. Before final tightening there shall be a sufficient number of bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into full contact with each other. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. After all bolts have been taken to the snug tight condition, the Contractor shall match mark the outer face of each nut and protruding end of bolt to have a common reference line to determine the relative rotation. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified below, with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

Amount of rotation of nut relative to bolt, regardless of which is turned:
- 1/3 turn where bolt length is 4 bolt diameters or less
- 1/2 turn where bolt length is over 4 bolt diameters and not exceeding 8 bolt diameters
- 2/3 turn where bolt length exceeds 8 bolt diameters

Notes
- tolerance 1/6 turn (60º) over, nothing under
- length of bolt measured from underside of head

(d) Reuse of Fasteners

High strength bolts shall be tensioned only once and shall not be reused. Retightening previously tightened bolts, which may have been loosened by tightening of adjacent bolts shall not be considered as reuse.

(e) Department Inspection

The Contractor shall provide safe and adequate access meeting *Occupational Health and*

Safety Act (Alberta) requirements to all working areas, including all necessary scaffolding to enable the Department to carry out its inspection. The Contractor shall provide a competent workman to assist the Department in the inspection of bolt tightening work.

Misfits

The correction of minor misfits involving reasonable amounts of reaming, cold cutting and chipping will be considered incidental to the work of erection. However, any deformation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins, or by a moderate amount or reaming and slight chipping or cutting, shall be reported immediately to the Design Engineer and the Department , and their acceptance of the method of correction obtained. The correction shall be made in Department's presence.

Girder Adjustment

It is essential that the girders are erected with utmost attention being given to girder positioning, alignment, and elevation. Adjustment to girder position, bearing location and bearing elevation shall be done in order to achieve as closely as possible the lines and grades shown on the Detailed Designs.

The Contractor shall ensure that the structural steel is maintained in correct alignment until the adjoining or encasing concrete components have been completed.

Grout Pockets and Grout Pads

The Contractor shall fill the grout pockets and construct the grout pads using Sika 212 flowable grout or equivalent accepted by the Design Engineer and the Department. Filling of grout pockets and construction of grout pads shall be done by workers competent in this work.

Grout shall be packaged in waterproof containers with the production date and shelf life of the material shown. It shall be mixed, placed, and cured in strict accordance with the manufacturer's recommendations.

The method of forming and pouring the grout shall be submitted to the Design Engineer for review and then to the Department for acceptance. Dry-pack methods of constructing grout pads will not be accepted.

Sealer shall be supplied and applied to the exposed grout pad surfaces in accordance with Section 400.3.5.25 (Sealer).

Grouting in Cold Weather

When the daily minimum air temperature or the temperature of the girders, bearings or substructure concrete in the immediate area of the grouting falls below 5°C, the following provisions for cold weather grouting shall be affected:

(a) Before grouting, adequate preheat shall be provided to raise the temperature of the adjacent areas of the girders, bearings and substructure concrete to at least 10°C.

(b) Temperature of the grout during placing shall be between 10°C and 25°C.

(c) The grout pads (or girders where appropriate) shall be enclosed and kept at 10°C to 25°C for at least five days. The system of heating shall be designed to prevent excessive drying-out of the grout.

Removal of Temporary Supporting Structures, Berms, and Clean-Up

Upon completion of the erection and before final acceptance, the Contractor shall remove all earth material or temporary falsework supporting structures placed in the stream channel or elsewhere during construction. The Contractor shall remove all piling, excavated or surplus materials, rubbish and temporary buildings, replace or renew any damaged fences, and restore in an acceptable manner all property damaged during the execution of the work. Disposal of surplus materials shall be in a manner and location satisfactory to the Department.

The Contractor shall leave the bridge site, roadway and adjacent property in a neatly restored and presentable condition, satisfactory to the Department. When required, the Contractor shall provide written evidence that affected property owners or regulatory agencies have been satisfied.

All steel shall be left clean and free of oil, grease, mud, dust, road spray or other foreign matter.

400.3.8 PRECAST CONCRETE

400.3.8.1 General

This specification is for the supply, manufacture, delivery and erection of prestressed and precast concrete bridge units and miscellaneous precast components.

400.3.8.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work.

- Identification of subconsultants;
- Shop drawings (five copies);
- Stressing calculations including jack calibration data (four copies);
- Load/elongation curve for prestressing strand;
- Concrete and grout mix designs, including test data showing conformance of cement, silica fume, aggregate and admixtures to required standards;
- Construction Data Sheets including stressing data sheets (within 7 days of completion of girders for each bridge);
- Mill certificates for miscellaneous steel;
- Mill test report for all bearing material;
- Repair procedures for galvanizing, if required;
- Details of concrete curing systems (at least 14 days prior to fabrication);

- Time-temperature graphs showing concrete curing rates (within 7 days of completion of girders for each bridge);
- Methods, procedures and devices to accurately position the stressing strand;
- Repair procedures, if required, for repair of casting defects or other damage to precast concrete units;
- Concrete cylinder strength results (within 2 days of testing);
- Concrete core strength results, if required (within 2 days of testing);
- Erection procedures, including drawings for falsework, berms and traffic accommodation (two copies) (at least 28 days prior to erection and grading); and
- Methods of forming and pouring grout (at least 14 days prior to placing grout).

400.3.8.1.2 Testing and Acceptance

The acceptance of the work will be based on meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following to determine the acceptability of the work.

- Acceptance of submissions as outlined in this Section 400.3.8;
- Visual inspection of the work;
- Audits of the Contractor's quality control/quality assurance inspection and testing records; and
- Concrete cylinder strength tests to confirm the acceptability of materials and/or workmanship (See Section 400.3.8.2.6 (Testing and Inspection)).

400.3.8.1.3 Reference Drawings (as attached after Section 400.3.8.3.13)

- Type 1c Sealer for Precast Girders S-1637-97

400.3.8.1.4 Reference Tables (as attached after Section 400.3.8.3.13)

- Construction Data Sheet A

400.3.8.2 Supply and Manufacture

400.3.8.2.1 Standards

The manufacture of prestressed and precast concrete bridge units shall be in accordance with the Canadian Standards Association (CSA) Standard A23.4.

Where imperial/metric conversions are necessary, The National Standard of Canada, CAN3-Z234.1-79 shall be used as the basis of conversion.

400.3.8.2.2 Qualification

The Contractor shall notify the Department of any subcontractors with which it has contracted in respect of this Section 400.3.8(Precast Concrete). The Contractor shall remain responsible for the work of such subcontractors. All requirements of this Section 400.3.8(Precast Concrete), such as right of access, shall apply to such subcontractor.

The Fabricator shall operate a recognized precast concrete fabricating plant and be fully certified by the Canadian Precast/Prestressed Concrete Institute (CPCI) Certification Program.

400.3.8.2.3 Engineering Data

Shop Drawings

Five copies of the shop drawings showing all necessary fabrication details of the precast units, such as reinforcing steel, blockouts, stressing system, anchorage devices, void support system and screed rail shall be submitted to the Design Engineer for review, and then to the Department for acceptance prior to manufacturing. The shop drawings shall be legible and of adequate quality to be reproduced and microfilmed. Each drawing shall have a sufficient blank space for the Design Engineer's reviewing stamp. The Department's acceptance of the shop drawings shall not be construed as relieving the Contractor from its responsibility for errors or omissions. All shop drawings will be stamped as follows:

"This acceptance applies to general arrangements and details of design but not to dimensions or details of fabrication and is subject to the requirements of specifications and to such corrections as may be marked here on."

Fabrication shall not commence prior to the acceptance of the shop drawings.

The Department's bridge file number and project name shall be shown on shop drawings.

Stressing Calculations

Four copies of the stressing calculations showing elongations and gauge pressures as well as the strand release sequence data shall be submitted to the Design Engineer for review and then to the Department for acceptance prior to manufacturing. Jack calibrations, performed within the previous six months, shall be included.

Stressing Steel Certificate

A copy of the load/elongation curve for each lot of stressing steel shall be submitted to the Design Engineer for review and then to the Department for acceptance prior to manufacturing.

Concrete and Grout Mix Design

A copy of the concrete mix design and the grouting mortar mix design shall be submitted to the Design Engineer for review and then to the Department for acceptance prior to manufacturing. The mix design shall indicate the design strength, proportions of the constituent materials, type and brand of cement, type and brand of silica fume, origin of aggregates and brand names of all admixtures.

The sampling and testing of aggregates, including the concrete mix design shall be completed by an independent CSA certified and qualified concrete testing laboratory which shall have the appropriate permit to practice in the Province of Alberta. Concrete mix designs including sampling and testing of aggregates may be completed by the concrete supplier, with the condition that documentation is stamped by a Professional Engineer. For either situation, the mix design, including sampling and testing, shall be reviewed and stamped for compliance with the respective specifications, by an independent CSA certified and qualified concrete testing laboratory which has the appropriate permit to practice in the Province of Alberta. For either case, the testing laboratory shall provide an engineering opinion that the concrete aggregate and mix designs are suitable for the intended use and are expected to perform to specified standards.

The mix design shall include one microscopic air-void analysis performed by an independent testing laboratory in order to determine the spacing factor of the hardened concrete. The test sample shall be made from a trial concrete batch, vibrated into a cylinder mould so as to represent the level of vibration of the production concrete in the forms. If adjustments to the mix design are necessary, the air-void analysis shall be repeated.

Only the accepted mix design shall be used to cast units. Changes in cement type, and/or decreasing cement content shall be construed as a change in mix design and will not be allowed.

Other Data

The Department may request test data to prove conformance to the standards for other materials including cement, silica fume, aggregate and admixtures.

Construction Data Sheets

During manufacture, the Construction Data Sheets shall be kept up to date by the Contractor and available for the Design Engineer's and Department's review. Copies of the data sheets shall be provided to the Department upon completion of the contract. One copy of the stressing data sheets for each bridge unit shall also be submitted with the Construction Data Sheets.

400.3.8.2.4 Materials

Cement

Portland Cement conforming to the requirements of CSA Standard A5 shall be used.

Water

Water to be used for mixing concrete or mortar shall conform to the requirements of CSA Standard A23.1 and shall be free from injurious amount of alkali, organic materials or deleterious substances. The Contractor shall not use water from shallow, stagnant or marshy sources.

Silica Fume

Ten percent condensed silica fume by weight of cement (plus or minus 0.5 percent) shall be used in all precast concrete. Condensed silica fume shall conform to Table 5 & 6 of CSA Standard A 3000-03 - Cementitious Material Compendium, Type SF, with a SiO_2 content of at least 85%, of a maximum of 10% ignition loss, and no more than 1% SO_3 content. A compatible, superplasticizing admixture accepted by the Design Engineer and then by the Department shall be used together with the silica fume.

Aggregates

Aggregate tests shall be performed and submitted with the concrete mix design as per Section 400.3.5.4.4 (Aggregate Tests and Concrete Mix Design).

(a) Standard Weight Aggregates

Fine and coarse standard weight aggregates shall conform to the requirements of CSA Standard A23.1, with maximum aggregate size of 14mm.

(b) Lightweight Aggregates

Fine and coarse lightweight aggregates shall conform to the requirements of the ASTM Standard C330, with maximum aggregate size of 14 mm.

Air Entraining Agent

Air entraining agent shall conform to the requirements of the ASTM Standard C260.

Chemical Admixtures

Chemical admixtures shall conform to the requirements of ASTM Standard C494 and shall be accepted by the Design Engineer and the Department. All chemical admixtures must be suitable for use in precast concrete, be supplied by the same manufacturer as the air entrainment agent, and be compatible with each other.

Acceptable admixtures are air-entraining agents, superplasticizers and water-reducing agents. The addition of calcium chloride, accelerators, retarders or set controlling admixtures and air-reducing agents will not be permitted.

Concrete

Concrete shall consist of Portland Cement, condensed silica fume, aggregates, water and acceptable admixtures. The type of concrete to be used will be specified on the Detailed Designs.

The unit weight, entrained air and air void spacing requirements for the various types of concrete are specified in Table 400.3.8.1 below.

Table 400.3.8.1

Type of Concrete	Aggregates	Concrete Unit Weight (in plastic state) kg/m^3	Minimum Entrained Air %	Maximum Air Void Spacing (hardened concrete) mm
Standard Weight	Fine and Coarse Standard Weight	--	5	0.23
Lightweight	Fine and Coarse Lightweight	1680 + 5%	6	0.23
Semi-Lightweight	Fine Standard Weight & Coarse Lightweight	1920 + 5%	6	0.23

Reinforcing Steel

Plain and epoxy coated reinforcing steel shall conform to Section 400.3.6 (Reinforcing Steel).

Stressing Strand

Stressing strand shall be uncoated Grade 1860, low relaxation 7-wire strand conforming to the requirements of the ASTM Standard A-416. Shop drawings and stressing calculations shall clearly show the type of strand to be used, and changes will not be allowed during production.

Lifting Hooks

Lifting hooks made of stressing strand shall conform to the requirements of the ASTM Standard A416, and shall be fabricated in a manner that distributes the load evenly to all strands.

Miscellaneous Steel

Miscellaneous steel shall conform to the requirements of the CSA Standard CAN/CSA G40.21M-300W or ASTM Standard A36 or as specified on the Detailed Designs. The Contractor shall submit mill certificates to the Design Engineer for review and then to the Department for acceptance to prove conformance to the standard. Fabrication shall conform to Section 400.3.7 (Structural Steel).

Bridgerail and Anchor Bolts

Bolts for bridgerail anchor assemblies shall be as per Section 400.3.13.2.4 (Materials). The assemblies shall be hot dip galvanized after fabrication. All nuts and washers shall be shop assembled on the anchor bolts.

Voids and Ducts

All void and duct material must be accepted by the Design Engineer and then by the Department and remain dimensionally stable during the casting and steaming of the units. Voids shorter than 400 mm should be eliminated except when noted otherwise on the Detailed Designs.

Bearings

Certified mill test reports for all bearing material shall be submitted to the Design Engineer for review and then to the Department for acceptance prior to installation.

(a) Stainless Steel
Stainless Steel shall conform to the requirements of American Iron and Steel Institute (AISI) Standard Type 304, No. 8 Mirror Finish.

(b) Elastomer
Elastomer compound shall conform to Section 18 "Bearings" Division II of AASHTO Standard Specifications for Highway Bridges. Elastomer compound shall conform to low temperature AASHTO grade 5 material testing requirements in Table 18.4.5.1-1A and -1B at the specified hardness. Field welding adjacent to elastomeric pads shall be performed with care to avoid damage to the elastomer and shall be carried out in accordance with the field welding of structural member's requirements of Section 400.3.14.4.1 (Field Welding of Structural Members) of the Technical Requirements. The temperature of the steel adjacent to the elastomer should be kept below 120°C. The distance between the weld and elastomer should be at least 40mm.

(c) Teflon
Teflon shall be unfilled, 100% virgin polymer.

(d) Base Plate Corrosion Protection
Bearing base plate corrosion protection shall be as per Section 400.3.13.2.6 (Fabrication).

Galvanizing

Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of CSA Standard G164 with additions and exceptions as described in this specification. The Contractor shall provide a smooth finish on all edges and surfaces, and remove all weld spatter and all welding flux residue from the steel components prior to galvanizing.

Repair of galvanizing shall only be done if bare areas are infrequent, small and suitable for repair. A detailed repair procedure shall be prepared by a Professional Engineer prior to its use and submitted to the Department for acceptance. It should be noted that repairs may require complete removal of the galvanized coating and regalvanizing. Repair shall be in compliance with ASTM A780, Method A3 Metallizing. The thickness of the metallizing shall be 180 mm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing. The Department will determine the acceptability of repaired areas.

400.3.8.2.5 Manufacture

Forms

Precast concrete units are to be manufactured in steel forms accepted by the Design Engineer and then by the Department. For all beam members the forms shall be designed so that they can be removed without damaging the beam. For all "I" or "T" beam members the side forms shall be removed horizontally away from the beam by a method that prevents any contact of the form with the top flange after release of the form. The top flange shall not be subjected to a vertical force at any time.

Formed holes in the units to accommodate formwork shall not be permitted.

Reinforcing Steel

Fabrication, handling, storage, placement and fastening of all steel reinforcement shall conform to Section 400.3.6 (Reinforcing Steel).

Reinforcement shall be placed, secured and inspected for acceptance by the Design Engineer and then the Department prior to placement of concrete.

Stressing Strand

Stressing strand shall be free of corrosion, dirt, grease, rust, oil or other foreign material that may impede bond between the steel and the concrete. Stressing strand shall be protected at all times from manufacture to encasing in concrete or grouting. Stressing strand that has sustained physical damage at any time shall be rejected. Stressing strand splices shall not be placed within a precast concrete unit.

The Contractor shall submit to the Design Engineer for review and then to the Department for acceptance the methods, procedures and devices to accurately position the stressing strand. The submission shall include strand anchorage, draping, hold downs, guides or any other required devices.

Stressing strands shall not be stressed more than 36 hours prior to being encased in concrete. The stress in the stressing strands shall be measured both by jacking gauges and by elongation of the strands. The maximum allowable discrepancy between jack pressure and elongation shall be within 5% or the factors contributing to the difference must be identified and corrected before proceeding. Changes in strand temperature and slippage at strand anchorages shall be monitored between stressing and concrete encasement and any changes in strand stress due to these effects shall be accounted for in the design.

Seven wire stressing strand with any broken wire shall be removed and replaced. All stressing strands shall be checked for wire breaks before placement of concrete.

The precast unit ends shall have 15mm deep strand termination recesses formed around the strands. All strands shall be cut flush with the bottom of the recesses, and the recesses shall then be cement mortar grouted flush with the ends of the precast units. An approved Type 1c sealer shall be applied over the patched recessed areas as per Section 400.3.8.2.5 (Manufacture). Sealer shall not be applied to the patched recessed areas when precast unit ends are designed to be encased in field cast concrete.

The Contractor shall be responsible for recording and reporting the elongation and tension of each strand during the stressing operation.

Void and Duct Placement

Voids and ducts shall be placed as shown on the Detailed Designs and must be tied and securely held in the required positions to prevent movement. Continuous ducts shall align precisely. The ends of the voids shall be sealed by methods accepted by the Department. Voids found to be distorted, damaged or of insufficient strength will be rejected. Blow holes caused by air expanding within the voids and rising to the surface, shall be repaired when the concrete is in the plastic state.

Identification of Units

Fabricator's name, year of manufacture, unit serial number and design loading shall be cast into the bottom of the units in 50mm letters about 1.0m from the unit end.

Concrete Measuring, Mixing and Placing

The procedures outlined in the ACI Standard 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete" shall be followed. The time from initial mixing of the concrete until placing the concrete in the forms shall not exceed one hour. The elapsed time between placement of the concrete onto previously placed concrete shall not exceed 30 minutes.

Concrete Temperature

The concrete temperature shall not be less than 10°C nor greater than 30°C at the time of placing in the forms.

Finished Riding Surface

Where the top surface of the girder is designed to be the riding surface, the use of a continuous screed rail, independent of the top of the grout keys, shall be employed. The top surface shall follow a smooth profile, which incorporates the required camber adjustments.

Camber Hubs

Three camber hubs shall be placed in each girder, located along the centerline of the girder at the midpoint and 150mm from each end. The camber hubs shall consist of 10mm galvanized bars, of sufficient length to project vertically 10mm above the riding surface.

The Contractor shall store the members in such a manner as to provide access for measuring camber as determined by the Department. The Contractor shall record the girder camber at the midpoint of each girder within 24 hours of girder destressing.

Concrete Finish

The concrete surfaces of units shall be finished as specified, and completed to the acceptance of the Department.

(a) Class 1 Form Surface Finish
This finish is essentially that obtained when concrete has been cast and adequately compacted in a properly oiled steel form. All fins, honeycomb, irregularities, cavities over 10 mm diameter or other similar defects shall be thoroughly chipped out. These areas shall be saturated with water for a period of not less than thirty minutes, carefully pointed and trued with mortar of a colour which will match the existing concrete. Mortar used for pointing shall be less than one hour old. The patches shall be properly cured by placing the repaired unit in the steam cure for a period of four days immediately after patching.

The finished surfaces shall be true and uniform. All surfaces which cannot be repaired to the satisfaction of the Department shall be finished as specified for Class 2 at no expense to the Department.

(b) Class 2 Rubbed Finish
Class 2 finish shall be essentially the same as Class 1 except that all holes, cavities and defects shall be repaired so that the finished surface presents a smooth, true, dense, uniformly coloured, and non-stained appearance. The concrete surfaces shall be thoroughly wire brushed to expose any hole or cavity prior to repairs. All residue of form oil shall be removed from the surface.

(c) Class 3 Bonded Concrete Surface Finish
The surface shall be prepared in accordance with the requirements of Class 2 Rubbed Finish except that it need not be of uniform colour. When surface preparation has been completed to the satisfaction of the Department, the Contractor shall then apply a pigmented concrete sealer such as Capseal A50 or equivalent, which meets the requirements for a type 3 sealer of the "Alberta Infrastructure and Transportation Concrete Test Procedure - B388", latest version.

The pigmented sealer shall be applied at site and in accordance with the manufacturer's specifications. The colour of the pigmented sealer must be accepted by the Department before application. At least two applications of the coating are required, and the Contractor shall ensure that no colour variation will be visible. Approval of the pigmented sealer will not relieve the Contractor of full responsibility for its acceptable performance and appearance.

(d) Class 4 Floated Surface Finish
After the concrete has been consolidated and the surface carefully screeded to the cross section and profile shown on the drawings, it shall be floated and trowelled as necessary to provide a closed, uniformly textured surface without brooming.

(e) Class 5 Floated Surface Finish, Broomed Texture
After the concrete has been consolidated, the surface shall be carefully screeded to the cross

section and profile shown on the Detailed Designs. When the concrete has hardened sufficiently, the surface shall be finished with a broom of an accepted type. The broom strokes shall be perpendicular to the edge of the unit, and extended from edge to edge, with adjacent strokes slightly overlapped producing corrugations of 2 to 3mm in depth. Brooming shall be done when the concrete has set sufficiently to produce clear, crisp brooming marks which do not sag or slump, without tearing the surface or disturbing coarse aggregate particles. After final brooming the surface finish shall be free of porous spots, irregularities, depressions, pockets and rough spots and must not vary more than 5mm when measured using a 3m straight edge.

Accepted finishing and edging tools shall be used on all edges and expansion joints after brooming.

Curing

All prestressed concrete units shall be cured at an elevated temperature. The curing of prestressed concrete units shall essentially be in accordance with CSA A23.4 unless otherwise specified by the Department. The ambient curing temperature shall be increased at a rate not exceeding 20°C per hour until a maximum temperature of not more than 60°C is attained. After curing, the temperature of the units shall not be reduced at a rate exceeding 10°C per hour until the temperature of the concrete has fallen to within 10°C of the temperature of the outside air.

(a) Prestressed Concrete

(i) Curing in the Form

The initial application of heat shall commence only after the last of the freshly placed concrete has attained its initial set, normally two to four hours after casting. Heat shall not be applied directly to the concrete, but by a method that will produce a consistent ambient temperature throughout the entire form and enclosure. The increase in temperature and the holding temperature shall be monitored and permanently recorded on a chart at a minimum of 3 quarter points along the form.

(ii) Curing after Removal from the Form

Upon removal from the forms the units shall be cleaned, patched and finished within a period not exceeding 12 hours. The units shall be placed in a manner that will facilitate any clean up or repair work, and that will allow full inspection of all surfaces by the Department. Within 24 hours of removal from the form, the units shall be placed within a suitable enclosure, for curing. The curing enclosure shall provide a minimum of 150mm of free air space between the concrete surfaces and the coverings. Flexible coverings shall be secured to prevent any moisture loss.

The difference in ambient air temperature adjacent to the concrete at different locations within the enclosure shall not exceed 10°C at any time.

The curing process shall be continued for a period of four days with one of the following methods:

1) Steam Curing

Steam jets shall not directly impinge on the concrete surfaces. The steam must be in a saturated condition maintaining an atmosphere of 100% relative humidity and a uniform ambient temperature of 50°C to 60°C.

2) Curing with Continuous Misting and Heat

A sufficient number of atomizing misting nozzles shall be strategically located to produce a fine mist with 100% relative humidity in the enclosure. The water shall be preheated to a temperature which will produce a misting temperature compatible with the ambient temperature. The enclosure shall be heated with radiant heaters to a temperature of 50°C to 60°C. Dry heat shall not touch the concrete surface at any time. A control system shall be installed to shut off the heat when the humidity level drops below 90% in the enclosure. Should the temperature in the concrete rise above 40°C without the misting, the unit will be rejected.

Two continuously recording thermometers and two continuously recording hygrometers shall be provided for each curing enclosure to monitor the concrete and curing rates. All time-temperature and time-humidity recordings shall be clearly shown on the graph.

(b) Non-Prestressed Concrete

Curing of all non-prestressed concrete shall be in accordance with one of the following methods:

(i) Elevated Temperature Curing
Upon removal from the forms the units shall be cleaned, patched, finished and elevated temperature cured for four days in accordance with Section 400.3.8.2.5 (Curing) (a) Prestressed Concrete.

(ii) Moist Curing

The units may be moist cured in lieu of elevated temperature curing in accordance with the following:

Upon removal from the forms the units shall be cleaned, patched, finished, and ready for inspection within a period not exceeding 12 hours. Patching shall be performed with an approved product and at an ambient temperature of 15ºC to 30ºC. After completion of patching and finishing and within 24 hours of removal from the form, the units shall be placed under two layers of light coloured filter fabric (Nilex C-14 or equivalent accepted by the Department) or burlap at an ambient temperature of not less than 15ºC. The filter fabric or burlap shall be kept in a continuously wet condition throughout the curing period by means of a soaker hose or other means acceptable to the Department. Curing with filter fabric or burlap and water shall be maintained for a minimum period of seven days.

Release of Stressing Strand

The stressing strand shall not be released until the specified concrete release strength is attained, and the release shall be in accordance with the accepted sequence.

Evidence of casting defects shall be reported to the Design Engineer, and the Department prior to release of the strands.

Repairing Damaged Concrete

Serious damage, honeycomb and other casting defects shall be immediately reported to the Design Engineer and the Department. Repair procedures shall be submitted for review by the Design Engineer and then acceptance by the Department prior to the commencement of the repair. All repairs shall be completed prior to curing of the unit.

Repairs to defects including cracks, honeycombs or spalls shall be carried out in accordance with the following requirements. Any unacceptable cracks, honeycombs or spalls will result in rejection of the affected unit.

All repair procedures shall be developed by a Professional Engineer, reviewed by the Design Engineer and accepted by the Department prior to the commencement of the repair. All repairs shall be completed prior to curing of the unit at an ambient temperature of 15°C to 30°C.

The "bearing area" of a girder is defined as the portion of the girder bottom flange extending from the end of the girder to the inside edge of the girder bearing. It does not include the transition between the bottom flange and the web. The "anchorage area" is defined as the full height portion of the girder that is less than two times the girder depth from the end of the girder but is not in the bearing area.

(a) Cracks

Cracks in the bearing area of a girder are unacceptable unless they are less than 0.1mm in width and are initiated by a stress raiser, e.g. a formed hole in the girder. Unacceptable cracks in the bearing area will result in rejection of the unit.

Cracks in the anchorage area of a girder exceeding 1.5mm in width are unacceptable and will result in rejection of the unit. All cracks in the anchorage area 0.2mm to 1.5mm in width shall be repaired by epoxy injection in accordance with the manufacturer's instructions. Coring shall be carried out to confirm the penetration of the epoxy into the cracks if so requested by the Department.

Cracks outside of the girder bearing and anchorage areas that are wider than 0.1mm or longer than 300mm are unacceptable and will result in rejection of the unit.

(b) Honeycombs and Spalls

Honeycombs or spalls in the bearing areas of a girder are unacceptable and will result in rejection of the unit.

Major honeycombs and spalls in the anchorage areas of a girder are unacceptable and will result in rejection of the unit. Major honeycombs and spalls are described as honeycombs and spalls that are more than 30mm deep or more than 0.1m2 in area. Repairs of minor honeycombs and spalls in the anchorage areas of a girder may be made after destressing of the girder.

Repairs of honeycombs and spalls outside of the bearing or anchorage areas of a girder may be made using cementitious material prior to destressing of the girder.

Sealer

The Contractor shall supply and apply approved Type 1c sealer to the girder surfaces as shown on Standard Drawing S-1637 "Type 1c Sealer for Precast Girders" included with these specifications.

Type 1c sealers shall be in accordance with Section 400.3.5.25 (Sealer) and meet the current "Specifications for the Supply of Concrete Sealers, Evaluation Procedures for Sealers Used on Concrete Bridge Elements" (B388).

The sealer shall be applied on clean dry surfaces free of form oil, and in accordance with the manufacturer's recommendations however the application rate shall be increased by 30% from that indicated on the approved list. Before applying the sealer the concrete shall be cured for at least 14 days. Mortar patches shall be cured for at least two days. The concrete surface shall be dry, and air blasted to remove all dust and accepted by the Department prior to applying sealer. In order to ensure uniform and sufficient coverage rates the Contractor shall apply measured volumes of sealing compound to appropriately dimensioned areas of concrete surface, using a minimum of 2 coats.

The Contractor shall ensure that the sealer is not applied in the grout pockets, lifting hook pockets or areas of the girders that will have field concrete cast against them.

The Department reserves the right to sample and test the sealer supplied by the Contractor.

Sandblasting

The concrete surfaces in shear key, block out, diaphragm and girder end void locations shall be sandblast roughened by the Contractor to the acceptance of the Design Engineer and then the Department. The blasting shall be sufficient to remove all laitance and uniformly expose the aggregate particles.

Dimensional Tolerances of Cast Units

The maximum dimensional deviation in mm, of cast units from that as detailed on the Detailed Designs shall not exceed the following:

Length	-	+ 20mm x length (m) ÷ 50
Width	-	+ 3mm
Depth	-	+ 5mm
Camber	-	+ 20mm x length (m) ÷ 50
Sweep (NU Girders)	-	1mm/m
Sweep (Other Units)	-	deviation from true, 20mm x length (m) ÷ 50
Projection of Stirrups		
Top of Girder	-	+ 12mm
Bearing Areas	-	out of flatness of bearing areas, 3mm
Bulkheads	-	warpage or tilt of ends, 5mm
Rail Anchor Bolts	-	out of line, 5mm
	-	in spacing, 5mm
	-	in projection, 5mm
Dowel Holes	-	out of plumb, 5mm
Void Location	-	surface to void dimension, + 15mm after casting

Handling and Storage

Precast units shall be handled by means of accepted lifting devices at designated locations. Units shall be maintained in an upright position, supported near the ends and on stable foundations.

400.3.8.2.6 Testing and Inspection

Access

The Contractor shall provide the Department with suitable and safe access to the works for the purposes of testing and inspection. The Contractor shall provide the following:

(a) Heated laboratory space, minimum of 3m x 3m, capable of being locked, located in the proximity of the work

(b) A work bench 1m x 3m x 1m high

(c) Cylinder storage chest with temperature control and a max./min. thermometer, as per CSA Standard A23.2-3C

(d) A sump and a water supply suitable for cleaning all testing equipment

(e) A calibrated weigh scale.

Testing and Inspection by the Contractor

The Contractor shall be responsible for quality control and quality assurance testing required to ensure the work meets the Technical Requirements and the requirements of the Detailed Designs.

Any quality control/quality assurance testing and inspection records made by the Contractor shall be open to the Department for auditing.

Release Strength Test Cylinders

The Contractor shall make and test concrete cylinders to prove that the required release strength as stated on the Detailed Designs has been attained prior to release of the stressing strand. When one or more units are cast continuously, at least two cylinders shall be taken from the concrete of the last unit poured to represent the release strength for all units. These cylinders shall be cured with the bridge unit. Only testing of the first cylinder will be necessary if the required release strength is obtained. In the event all cylinders are tested without the required strength being obtained, the Design Engineer and the Department shall be contacted and their acceptance obtained for the release of the units.

Testing and Inspection by the Department

The following stages of manufacturing require the Department's acceptance:

(a) Form dimensions and set-up
(b) Placement of reinforcing steel
(c) Placement of voids and hardware
(d) Stressing
(e) Concrete mixture and placement
(f) Form stripping
(g) Clean-up and repair
(h) Finishing and application of sealer
(i) Curing
(j) Application of Class 3 finishes
(k) Storage of units

The Department will make and test concrete cylinders to determine the 28-day strength. Samples for testing will be taken from the fresh concrete being placed in the forms at the rate of one set of cylinders for every three bridge units cast continuously. Additional cylinders may be cast at the discretion of the Department. A set shall consist of three cylinders. A strength test will be the average of the 28-day strengths of the three cylinders (one set). Continuous casting shall mean no break in the casting longer than one hour.

The concrete test cylinders will be tested by an independent testing laboratory at the Department’s expense. These tests shall represent the strength of the cast concrete. Test results will be forwarded to the Contractor.

The Contractor shall be responsible for all travel, boarding and lodging costs incurred by the Department to inspect prestressed and precast concrete bridge units and miscellaneous precast components being fabricated outside the Province of Alberta. Also included shall be the costs for a Department representative to attend the prejob meeting for each fabrication shop and three additional site visits per bridge during the course of fabrication.

Transportation of Test Cylinders

The Contractor shall be responsible to transport the test cylinders made by the Department to the testing laboratory retained to do the testing.

Test Methods

Sampling, making, curing and testing concrete specimens shall be in accordance with the requirements of the following CSA standards:

- Sampling - A23.2 - 1C
- Concrete Test Cylinders - A23.2 - 3C
- Testing Concrete Cylinders - A23.2 - 9C
- Air Content - A23.2 - 4C
- Unit Weight of Concrete - A23.2 - 6C
- Air Void Determination - A23.2 - 17C

Fabrication of Prestressed/Precast Units in Cold Weather

The Contractor shall accept full responsibility for the protection of precast concrete units when fabricating in adverse weather conditions.

When the ambient temperature is, or is expected to be, below 5°C during fabrication the following provisions for cold weather casting shall be put in place:

(a) The Contractor shall construct an enclosure capable of maintaining an ambient temperature within the structure of between 15°C and 30°C. The enclosure shall be sufficiently sized to accommodate steel forms, workers and the casting equipment. The enclosure temperature shall be constantly monitored and shall be maintained within the specified range.

(b) The heating system shall be designed to provide uniform distribution of heat and the combustion by-products shall be kept out of the enclosure.

(c) Before casting concrete, adequate preheat shall be provided to raise the temperature of the formwork, reinforcing steel, stressing strand, miscellaneous iron, etc. to a minimum of 10°C.

(d) The fabricated units shall be kept in the enclosure until they are patched, repaired and transferred to the curing enclosure.

400.3.8.2.7 Failure to Meet Strength Requirements

Right of Rejection

The Department reserves the right to reject any concrete whatsoever which does not meet the specified strength determined in accordance with the Technical Requirements and the Detailed Designs. However, provided that the Design Engineer is of the opinion that the low strength concrete will meet all performance requirements throughout the service life of the structure the Department may, at its discretion, accept concrete which does not meet the specified strength requirements, and in such case payment will be made in accordance with Section 400.3.8.2.7 (Failure to Meet Strength Requirements, Percentage Payment Schedule).

Percentage Payment Schedule

When the specified 28-day concrete strength is not met, the precast bridge unit shall be paid as per the following percentage of the unit price:

Strength below the specified 28-day strength	Percentage of Unit Price to be paid
1 MPa or less	95%
1 MPa to 2 MPa	90%
2 MPa to 3 MPa	85%
3 MPa to 4 MPa	80%

In the event that the concrete tested is more than 4 MPa below the specified 28-day compressive strength, the bridge units fabricated from the concrete represented by the test specimens shall be rejected. In the event that the unit has been delivered and/or erected in the field, it shall be removed and returned to the Contractor's plant for replacement. The entire cost of replacement, including delivery and erection costs, shall be at the Contractor's expense.

Coring

If any concrete tested fails to meet the specified strength, the Contractor may request permission to core. If the coring is accepted by the Department, the Contractor shall make arrangements, through the Department, to employ a CSA certified, Category 1 or higher level qualified testing laboratory, at the Contractor's expense.

The Design Engineer with the Department's acceptance will specify the location of the coring to ensure that the cores represent the same concrete as the cylinders. The average of three adjacent cores taken from one bridge unit shall constitute a test. The cores shall be taken and tested in accordance with CSA Standard A23.2- 14C within seven days of the date of testing the 28-day cylinders. The core test will represent all bridge units represented by the strength test. Alternatively, the Contractor may choose to take a core test from each of the other units in question, in which case each of these core tests will then represent a bridge unit.

The acceptability of the concrete shall be determined using the concrete cylinders, with the modification set out in the next two sentences. In cases where the concrete strength as indicated by the cores is higher than the strength based on the 28-day concrete cylinder tests, the core results shall be used as the basis for acceptance and payment of the concrete. If the core strengths are lower than the strength from the concrete strength cylinder tests, the cylinder tests shall govern.

400.3.8.3 Erection of Precast Concrete Girders

400.3.8.3.1 General

The Contractor shall erect the girders, remove any temporary construction, and do all work required to complete the erection in accordance with the Detailed Designs and the Technical Requirements. The drilling or coring of any holes in the precast units other than to confirm compressive strengths is not permitted. The Contractor shall not erect the precast concrete girders until the substructure concrete has been cured a minimum of three days and achieved 80% of the 28 day specified concrete strength requirements.

Without restricting generality, erection includes:

- removing anchor bolt grout can lids;
- placing and grouting anchor bolts and bearings;
- erecting the girders;
- placing and grouting of connector bolts and diaphragms;
- post-tensioning;
- placing and sealing grout bearing pads; and
- cutting-off lifting hooks, and grouting lifting holes on exterior girders and all lifting hook pockets

400.3.8.3.2 Handling and Storing Materials

Precast concrete units to be stored shall be placed upright and shored on timber blocking and kept clean and properly drained.

400.3.8.3.3 Temporary Supporting Structures and Berms

The temporary supporting structures and berms shall be properly designed and substantially constructed and maintained for the forces which may come upon them. Berms shall be constructed in a manner and of such materials that they will not be eroded by stream flow nor introduce silt into the water. The Contractor shall prepare and submit to the Design Engineer for review and then to the Department, for acceptance, drawings for temporary supporting structures and berms, and for traffic control and accommodation where applicable. Acceptance of the Contractor's drawings shall not be considered as relieving the Contractor of any responsibility. All drawings submitted shall bear the seal of a Professional Engineer.

Temporary supporting structures and/or berms will not be permitted to remain in any stream channel during spring break-up or run-off periods, unless all necessary approvals have been obtained by the Contractor from pertinent agencies.

Incidental damage to other property, such as fills and stream banks, resulting from the existence of berms, shall be the responsibility of the Contractor.

400.3.8.3.4 Review of Erection Procedure

The Contractor shall submit to the Design Engineer for review and then to the Department for acceptance, four copies of a detailed erection procedure four weeks in advance of the scheduled start of erection. The erection procedure shall include all drawings and documents necessary to describe the following:

(a) Access to work, earth berms and work bridges.

(b) Type and capacity of equipment.

(c) Sequence of operation, including position of cranes, trucks with girders, and traffic accommodation.

(d) Detailed crane position on the ground, particularly adjacent to substructure elements, such as abutment backwalls, with details of load distribution on wheels and outriggers.

Details of crane position on the structure, showing wheel loads and axle spacing of equipment moving on structure.

(e) Loads and their position from crane wheels and outriggers during all positions of lifting when crane is on structure.

(f) Details of temporary works, supporting structures drawings, including proposed methods to be used to ensure the required splice elevations and structure shape prior to placing concrete, and/or post-tensioning and method of providing temporary supports for stability.

(g) Details of lifting of units, showing vertical forces at lifting hooks.

(h) Provisions for control and adjustment of errors for width and positioning of curbs or exterior units.

(i) Complete details of blocking for bearings where necessary to constrain movements due to horizontal forces and/or gravity effects.

(j) Details of post-tensioning procedures, including strand specifications, jack dimensions, pressures, forces and elongations, and grouting.

(k) Grout Pad Construction. Refer to Section 400.3.8.3.6 (Grout Pockets and Grout Pads).

(l) Details of release of temporary supporting structures.

(m) Provide an "As Constructed" detailed survey of the substructure showing the following:
- location and elevation of all bearing grout pad recesses,
- shim height at each bearing location,
- top of girder elevations at each bearing (and each splice location where appropriate).

The erection procedure shall bear the seal of a Professional Engineer, who shall assume full responsibility to ensure that his design is being followed. Safety and compliance with the *Occupational Health and Safety Act* (Alberta) and regulations thereunder, shall be integral parts of his design.

The Contractor shall continue to be fully responsible for the results obtained by the use of these sealed drawings, with the Professional Engineer also assuming responsibility, as the Contractor's Agent, for the results obtained.

Work shall not commence until the Department's acceptance of the proposal has been obtained. The Contractor's project manager, Design Engineer and field superintendent may be required to attend a prejob meeting at a location determined by the Department prior to commencement of any field work.

Before erection begins the Contractor shall do a complete superstructure layout by means of chalk lines and markings applied to all substructure units, showing bearing and girder positions in accordance with the layout plan.

The Department's acceptance shall not be considered as relieving the Contractor of the responsibility for the safety of its methods or equipment, nor from carrying out the work in full accordance with the drawings and specifications.

400.3.8.3.5 Girder Adjustments

It is essential that the girders be erected with utmost attention being given to girder positioning, alignment, and elevation. The Contractor shall adjust girder position, bearing location and bearing elevation in order to achieve as closely as possible the lines and grades shown on the Detailed Designs. The Contractor shall minimize any differential camber (girder to girder), and the sweep of the girders by jacking, loading of girders, winching, or whatever means are necessary, and shall provide the necessary temporary attachments to hold the girders in position.

The maximum dimensional deviation in mm, of erected precast concrete units from that as detailed on the Detailed Designs shall not exceed the following:

Sweep (NU Girders)	-	1mm/m
Sweep (Other Units)	-	deviation from true, 20mm x length (m) ÷ 50

400.3.8.3.6 Grout Pockets and Grout Pads

The Contractor shall construct grout pads using Sika 212 flowable grout or equivalent accepted by the Design Engineer and the Department. Filling of grout pockets and construction of grout pads shall be done by workers competent in this work.

Grout shall be packaged in waterproof containers with the production date and shelf life of the material shown. It shall be mixed, placed, and cured in strict accordance with the manufacturer's recommendations.

The method of forming and pouring the grout shall be submitted to the Design Engineer for review and then to the Department for acceptance. Dry-pack methods of constructing grout pads will not be accepted.

Sealer shall be applied to the exposed grout pad surfaces in accordance with Section 400.3.5.25 (Sealer) of the specifications for "Cast-In-Place Concrete".

400.3.8.3.7 Grouting in Cold Weather

When the daily minimum air temperature or the temperature of the girders, bearings or substructure concrete in the immediate area of the grouting falls below 5°C, the following provisions for cold weather grouting shall be affected:

(a) Before grouting, adequate preheat shall be provided to raise the temperature of the adjacent areas of the girders, bearings, and substructure concrete to at least 10°C.

(b) Temperature of the grout during placing shall be between 10°C and 25°C.

(c) The grout pads (or girders where appropriate) shall be enclosed and kept at 10°C to 25°C for at least five days. The system of heating shall be designed to prevent excessive drying-out of the grout.

400.3.8.3.8 Bearings and Anchorage

The Contractor shall remove all anchor bolt void forming materials prior to grouting. Any residues on the concrete surface, such as oils, grease or other contaminants that can reduce bonding characteristics, shall be removed by sandblasting.

Anchor bolts shall be set accurately and grouted with a non-shrink cement grout accepted by the Department. All methods and materials for setting anchor bolts and building bearing pads shall be submitted to the Design Engineer for review and then to the Department for acceptance. The location of the anchor bolts, in relation to the slotted holes in the expansion shoes, shall correspond with the temperature at the time of erection. The nuts on the anchor bolts, at the expansion ends of spans, shall be adjusted to permit free movement of the spans.

When steel bearings are employed in conjunction with grout pockets in the substructure, the bearings shall be set accurately on galvanized steel shims, and grouted as detailed on the Detailed Designs, after the girder erection has been completed. The shims must be located so that a minimum of 75mm grout coverage is provided. When grout pockets are not detailed, the bearing plates shall be set on the properly finished bearing areas in exact position and shall have a full and even bearing on the concrete.

Where the design requires that the girders bear on neoprene pads placed directly on pier or abutment seat concrete, the Contractor shall supply and install shims cut from lead sheeting as determined by the Design Engineer to ensure full and uniform bearing.

400.3.8.3.9 Assembly

The parts shall be accurately assembled as shown on the Detailed Designs. The material shall be carefully handled so that no parts will be distorted, broken or otherwise damaged. Bearing surfaces, and surfaces to be in permanent contact, shall be cleaned before the members are assembled. Diaphragms shall be erected as indicated on the Detailed Designs.

400.3.8.3.10 Lifting Hooks and Lifting Holes

After the Department has accepted the erected positions of the girders, all lifting holes on exterior girders shall be filled with a grout accepted by the Design Engineer and the Department; all lifting hooks shall be cut off 50mm below surface, and all lifting hook pockets shall be filled with a grout accepted by the Design Engineer and the Department.

400.3.8.3.11 Painting of Metal Parts

All non-galvanized metal parts, including bearing surfaces not in contact, shall be painted with two field coats of paint. Any such painting will be considered as "incidental work".

400.3.8.3.12 Post-Tensioning System

General

This work consists of post-tensioning and grouting of cable ducts for cast-in-place and precast concrete.

Submissions

Unless noted otherwise the following information shall be submitted to the Design Engineer for review and then to the Department for acceptance at least seven days prior to commencement of post-tensioning work:

- Five sets of post-tensioning drawings illustrating the stressing system and, where appropriate, design details and sequence of stressing (at least 28 days prior to post-tensioning);
- Five sets of stressing calculations taking into account all applicable losses (at least 28 days prior to post-tensioning);
- Load/elongation curves for the prestressing strand;
- Mill certificates for the prestressing strand; and
- Details of permanent anchoring devices.

Testing and Acceptance

The acceptance of the post-tensioning work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following to determine the acceptability of the work.

- Acceptance of submissions as outlined in Section 400.3.8.3.12 (Post-Tensioning System);
- Visual inspection of the work; and
- Audits of the Contractor's quality control/quality assurance inspection and testing records.

Standards

Applicable requirements of the current edition of the following standards shall be followed:

- CSA A23.1/23.2 - Concrete Materials and Method of Concrete Construction

- CSA A23.4 - Precast Concrete Materials and Construction
- Section 400.3.5 (Cast-In-Place Concrete)
- Guide Specification Acceptance Standards for Post Tensioning Systems - PTI
- Specifications for Grouting of Post Tensioned-Structures - PTI
- AASHTO LRFD Bridge Construction Specifications

Qualification

The Contractor or its Sub-contractor shall have extensive experience in this work and shall utilize only fully trained, competent and experienced operators. The Contractor shall ensure that the site supervisor responsible for the tensioning and grouting operations is at the site whenever these operations are being carried out.

Materials

(a) Stressing Strand
Stressing strand shall conform to the requirements of Sections 400.3.8.2.4 (Materials) and 400.3.8.2.5 (Manufacture).

Corrosion inhibitor is required when the stressing and grouting operations are not completed within 20 calendar days of the installation of the stressing steel. The corrosion inhibitor, when required, shall be water-soluble and shall have no deleterious effect on the steel, grout or concrete, or bond strength of the steel to concrete.

(b) Anchorages and Distribution
All stressing steel shall be secured at the ends by means of permanent anchoring devices accepted by the Design Engineer and then the Department. These devices shall comply with CAN/CSA-S6-06 Clause 8.4.4.1.

Steel distribution plates or assemblies may be omitted when the anchoring devices are sufficiently large and used in conjunction with an embedded steel grillage that effectively distributes the compressive stresses to the concrete.

(c) Ducts
Ducts shall be corrugated, semi-rigid galvanized metal tubes and be capable of withstanding concrete pressures without excessive deformation or permitting the entrance of cement paste during the placement of concrete. The ducts shall have sufficient rigidity to maintain the required profile between points of supports. The interval between supports shall not exceed 1.0m.

The Contractor shall provide mortar tight inlets and outlets in all ducts with a nominal diameter of 20mm in the following locations:

- The anchorage area
- All high points of the duct, when the vertical distance between the highest and lowest point is more than 0.5m.
- Place an inlet at or near the lowest point.
- Place free draining outlet at all low points of duct.

The Contractor shall provide inlets and outlets with valves, caps or other devices capable of withstanding the grouting pressure. The ducts and vents shall be securely fastened in place to prevent movement. The Contractor shall provide details of inlets and outlets on the shop drawings.

(d) Concrete
Concrete shall be supplied in accordance with Section 400.3.5 (Cast-in-Place Concrete), however the maximum size of coarse aggregate shall be 10 mm and 28 day minimum compressive strength shall be a minimum of 50 MPa unless otherwise specified on the Detailed Designs.

(e) Grout
Grout shall be Class B or Class C as described in Table 10.9.3-1 and the properties as described in Table 10.9.3-2 of the 2002 Interim AASHTO LRFD Bridge Construction Specification. The average minimum compressive strength of 3 cubes at 28 days shall be a minimum of 35 MPa as per CSA A23.2-1B.

The Contractor shall carry out grout testing at the following frequencies.

Precast Concrete Girders: One strength test per girder line
Cast-In-Place Girders: One strength test for every four longitudinal ducts

Equipment

(a) Stressing
- Hydraulic jacks and pumps of sufficient capacity shall be used for tensioning of strands.
- The force induced in the stressing strand shall be measured using calibrated jacking gauges, load cells or a calibrated dynamometer.
- The pressure gauge shall have an accurate reading dial at least 150mm in diameter.
- The forces to be measured shall be within 25 and 75 percent of the total graduated capacity of the gauge, unless calibration data clearly establishes consistent accuracy over a wider range.
- The measuring devices shall be calibrated at least once every six months. The jack and the gauge shall be calibrated as a unit. A certified calibration chart shall be kept with each gauge.

(b) Grouting
- A high speed shear mixer shall be used that is capable of continuous mechanical mixing and producing grout that is free of lumps and undispersed cement. The water supply to the mixer shall be measured by an accurate gauge.
- The holding tank shall be capable of keeping the mixed grout in continuous motion until it is used. The outlet to the pump shall have a screen with 3 mm maximum clear opening.
- A positive displacement type pump shall be used which is capable of producing an outlet pressure of at least 1.0 MPa. A pressure gauge having a full-scale reading of no greater than 2 MPa shall be placed at some point in the grout line between the pump outlet and the duct inlet. A spare fully functional pump shall also be on site.

- Standby flushing equipment with water supply shall be available at the site prior to commencing grouting.
- The grouting equipment shall be of sufficient capacity to ensure that grouting of the longest duct can be completed within 30 minutes after mixing.
- Grout hoses and their rated pressure capacity shall be compatible with the pump output and the maximum grout pressure. All connections from the grout pump to the duct shall be airtight so that air cannot draw into the duct.

Construction

(a) Checking Post Tensioning Ducts
Prior to placing post-tensioning steel, the Contractor shall demonstrate to the satisfaction of the Design Engineer and the Department that all ducts are unobstructed.

(b) Welding
Welding of stressing tendons shall not be permitted. Stressing tendons shall not be used as an electrical "ground". Where the ends of strands are welded together to form a tendon so that the tendon may be pulled through the ducts, the length of the strands used as an electrical "ground" or 1m, whichever is greater, shall be cut off from the welded end prior to stressing.

(c) Tensioning
Post-tensioning shall be carried out as per the Detailed Designs and the reviewed and accepted post-tensioning drawings and stressing calculations. The stressing and release of tendons shall be done in the sequence specified on the post-tensioning drawings. All strands in each tendon shall be stressed simultaneously with a multi-strand jack. The force in the tendons shall be measured by means of pressure gauge and shall be verified by means of tendon elongation. All tendons shall be tensioned to a preliminary force as necessary to eliminate any slack in the tensioning system before elongation readings are started. This preliminary force shall be between 15 and 25 percent of the final jacking force.

Stressing tails of post-tensioned tendons shall not be cut off until the record of gauge pressures and tendon elongations have been submitted to the Design Engineer for review, and then to the Department for acceptance. A record of the following post-tensioning operations shall be kept for each tendon installed:

- Project Name & File Number
- Contractor/Subcontractor
- Tendon location & size
- Date tendon installed
- Tendon pack/heat number
- Modulus of elasticity (E)
- Date stressed
- Jack and gauge identifier
- Required jacking force and gauge pressures
- Elongation (anticipated and actual)
- Anchor set (anticipated and actual)

- Stressing sequence
- Witnesses to stressing operation
- Grout information (Brand Name)
- Time for grouting each tendon
- Date grouted

(d) Concreting
The anchorage recesses shall be concreted after tensioning but before grouting the tendons.

The concrete surface of the anchorage recesses shall be abrasive blasted. The recesses shall be thoroughly wetted and covered with a thin cement paste coating immediately before placing fresh concrete.

(e) Grouting
All ducts or openings shall be clean and free of all deleterious matter that would impair bonding of the grout to the ducts and stressing steel. All ducts shall be thoroughly flushed out with water and blown out with compressed oil free air. All inlets and outlets shall be checked for their capacity to accept injection of grout by blowing compressed oil free air through the system.

A thoroughly mixed grout, meeting all the requirements described in Section 400.3.8.3.12 (Post-Tensioning System) Materials – (e) Grout, shall be passed through a screen with 3 mm maximum clear openings before entering the pump. All grout vents shall be opened prior to commencement of grouting. The duct shall be completely filled by injecting grout from the lowest end of the tendon in an uphill direction. Grout shall be pumped continuously through the duct until no visible signs of water or air are ejected at the outlet. A fully operational grout pump shall be on site for all pumping procedures. A continuous, one way flow of grout shall be maintained at a rate of 5 to 15 lineal metres of duct per minute. The grouting of a tendon shall be completed within 30 minutes of mixing unless otherwise accepted by the Design Engineer and the Department.

The pumping pressure at the injection vent shall not exceed 1 MPa. If the actual pressure exceeds the maximum allowed, the injection vent shall be closed and the grout shall be injected at the next vent that has been or is ready to be closed as long as one way flow is maintained. Grout shall not be injected into a succeeding vent from which grout has not yet flowed. A fluidity test shall be performed on each tendon from the discharge outlet. The measured grout efflux time shall not be faster than the efflux time measured at the inlet or the minimum efflux time established. If the grout efflux time is not acceptable, additional grout shall be discharged from the discharge outlet. Grout efflux time shall be tested. This cycle shall be continued until acceptable grout fluidity is achieved. To ensure the tendon remains filled with grout, the ejection and injection vents shall be closed in sequence, respectively under pressure when the tendon duct is completely filled with grout. Valves and caps are not to be removed until the grout has set.

Grouting will not be permitted when the air temperature is below 5ºC or above 25ºC, nor when there are other conditions judged by the Design Engineer or the Department to be detrimental to the grouting operations.

The Contractor shall provide 50mm deep grout tube termination recesses formed around the tubes projecting from top of the deck. After grouting, all tubes shall be cut flush with the bottom of the recesses, and the recesses shall then be grouted flush with the top of the deck.

Testing and Inspection

The Contractor shall be responsible for quality control/quality assurance testing required to ensure the work meets the Technical Requirements and the requirements of the Detailed Designs.

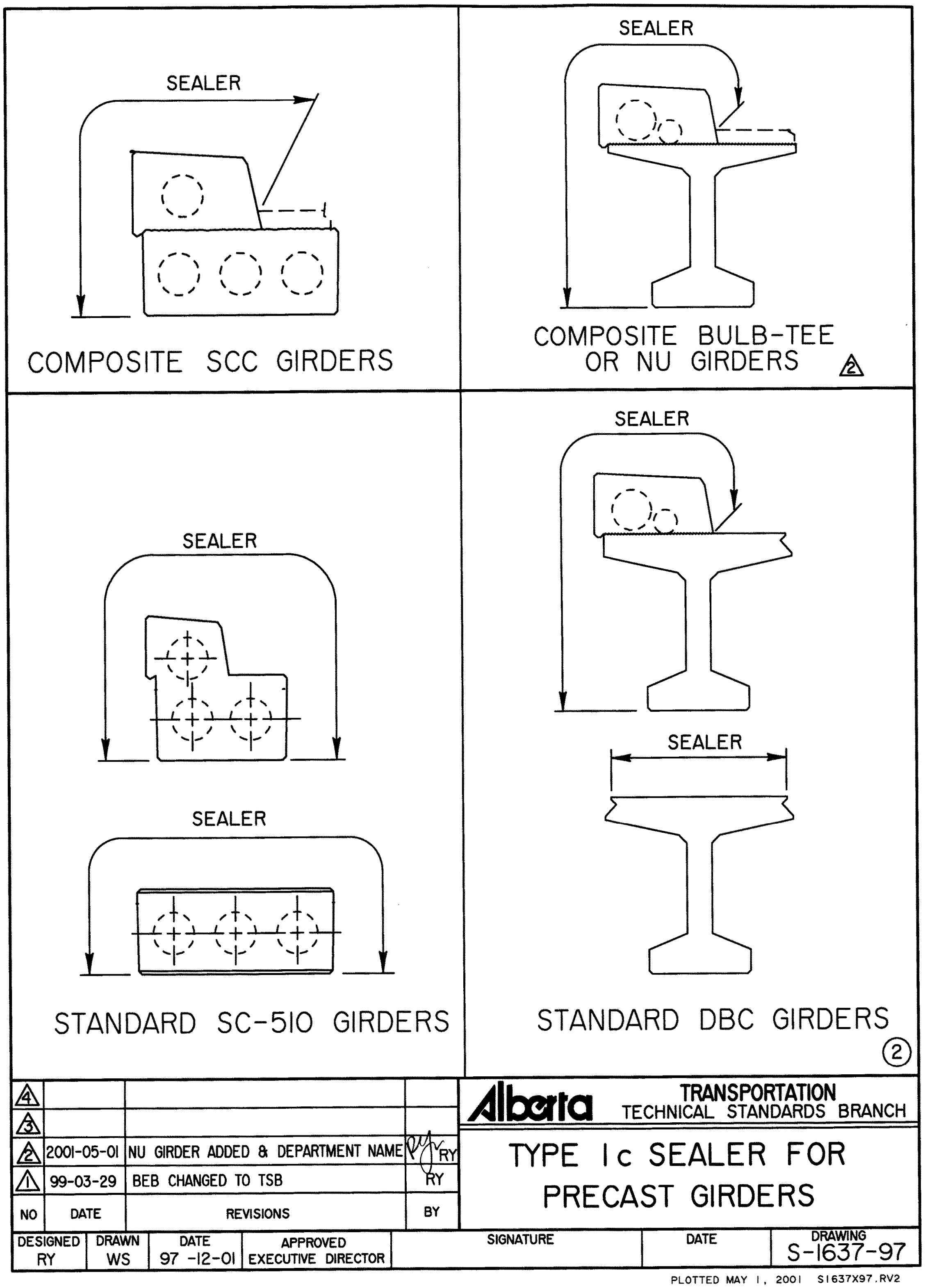
The stressing and grouting will require the presence of the Design Engineer and the Department. The Contractor shall ensure that adequate notice be given to the Department for these operations and access to the work is provided at all times.

Any quality control/quality assurance testing and inspection records made by the Contractor shall be open to the Department for auditing.

400.3.8.3.13 Removal of Temporary Supporting Structures and Site Clean-up

Upon completion of the erection and before final acceptance, the Contractor shall remove all earth material or temporary supporting structures placed in the stream channel or elsewhere during construction. The Contractor shall remove all piling, excavated or surplus materials, rubbish and temporary buildings, replace or renew any damaged fences, and restore in an acceptable manner all property damaged during the execution of the work. Disposal of surplus materials shall be in a manner and location satisfactory to the Department.

The Contractor shall leave the bridge site, roadway and adjacent property in a neatly restore, and presentable condition, satisfactory to the Department; when required, the Contractor shall provide written evidence that affected property owners or regulatory agencies have been satisfied.


SEALER
COMPOSITE SCC GIRDERS
SEALER
COMPOSITE BULB-TEE
OR NU GIRDERS
SEALER
SEALER
STANDARD SC-510 GIRDERS
SEALER
SEALER
STANDARD DBC GIRDERS
2
Alberta TRANSPORTATION
TECHNICAL STANDARDS BRANCH
TYPE Ic SEALER FOR
PRECAST GIRDERS
4
3
2 2001-05-01 NU GIRDER ADDED & DEPARTMENT NAME RY
1 99-03-29 BEB CHANGED TO TSB RY
NO DATE REVISIONS BY
DESIGNED RY
DRAWN WS
DATE 97-12-01
APPROVED EXECUTIVE DIRECTOR
SIGNATURE
DATE
DRAWING S-1637-97
PLOTTED MAY 1, 2001 S1637X97.RV2

Alberta TRANSPORTATION TECHNICAL STANDARDS BRANCH BRIDGE ENGINEERING SECTION	CONSTRUCTION DATA SHEET PROJECT: FABRICATOR:	File: Date: By: Page:

PRECAST UNIT							
TYPE							
DATE CAST							
SERIAL NO.							
CONCRETE							
UNIT WEIGHT (kg/m^3)							
SLUMP (mm)							
AIR (%age)							
STRENGTH	Release						
	28 days						
STRESSING							
ELONGATION	Required						
	Actual						
GAUGE PRESSURE	Required						
	Actual						
CAMBER							
PREDICTED (mm)							
1 DAY							
7 DAYS							
SHIPPING							

400.3.9 CONCRETE SLOPE PROTECTION

400.3.9.1 General

The slopes to be covered by slope protection, shall have been trimmed to the lines and grades specified on the Detailed Designs, with a tolerance of plus or minus 150mm. Concrete Slope Protection shall include fine-grading the slope surface to a plane 100mm below the specified grades, filling with 100mm of Crushed Aggregate Material Designation 2 Class 25, and placing 100mm of reinforced concrete as specified below.

All thickness measurements indicated herein will be made perpendicular to the slope surface.

Refer to Standard Drawing S-1409 "Standard Concrete Slope Protection" included with these specifications.

400.3.9.1.1 Submissions

Unless specified otherwise the following information shall be submitted to the Department at least seven days prior to commencement of work.

- Detailed layout and forming plan;
- Method of securing and maintaining wire mesh.

400.3.9.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following:

- Acceptance of submissions as outlined in this Section 400.3.9 (Concrete Slope Protection);
- Visual inspection of the work; and
- Auditing of the Contractor’s quality management inspection and testing records.

400.3.9.1.3 Reference Drawings (as attached after Section 400.3.9.4)

- Concrete Slope Protection S-1409-99.

400.3.9.2 Materials

The provisions of Section 400.3.5 (Cast-in-Place Concrete), shall apply.

Concrete for slope protection shall meet all the requirements of Class B concrete, as defined in Section 400.3.5.4.1 (Class of Concrete).

Wire mesh reinforcement shall be 152 x 152 MW 25.8 x 25.8, flat welded wire mesh sheets.

400.3.9.3 Placing

Before starting concrete slope protection work, the Contractor shall submit a detailed layout and forming plan to the Design Engineer for review, and then to the Department for acceptance.

The slopes to be covered by concrete slope protection shall be trimmed and dressed by the Contractor to lines and grades acceptable to the Department. The Contractor shall supply and place Crushed Aggregate Material Designation 2 Class 25 to a minimum thickness of 100 mm over the trimmed slopes. If top and/or toe cut-off walls are specified on the drawings, trenches shall be dug to suit. Granular fill shall conform to the requirements of the "Backfill" Specification, Section 400.3.3.2.2 (Gravel Material and Crushed Aggregate Material) for Designation 2, Class 25 material.

Sheet reinforcing mesh shall be placed in accordance with Section 400.3.6 (Reinforcing Steel). The method of securing and maintaining the wire mesh in its proper location shall be reviewed by the Design Engineer and then accepted by the Department.

The concrete shall be handled and placed in accordance with Section 400.3.5.14 (Handling and Placing Concrete).

The concrete shall be placed in either horizontal or vertical courses, with one course being allowed to cure for at least 12 hours before the adjoining course is placed. Formwork shall be provided below and above the wire mesh to ensure proper slab thickness, correct positioning of the mesh, and the formation of a proper cold joint between courses. Vertical or horizontal joints, as the case may be, shall be formed or grooved 50 mm to the depth of the reinforcing mesh. All joints shall be finished with a sidewalk type edging tool and left unfilled. The surfaces enclosed by joints shall be given a Class 5 finish as specified for curbs and sidewalks in Section 400.3.5.24.6 (Class 5. Floated Surface Finish, Broomed Texture). Finishing work shall be carried out by competent, fully experienced personnel only.

Curing shall be performed as specified in Section 400.3.5.22 (Curing Concrete).

Backfill at the toe, top or edges shall be non-granular, conforming to the requirements of "Backfill", Section 400.3.3.2.1 (Compacted Non-granular Material), and shall not be placed until the slope protection has been reviewed by the Design Engineer and then accepted by the Department.

400.3.9.4 Concrete Strength Requirements

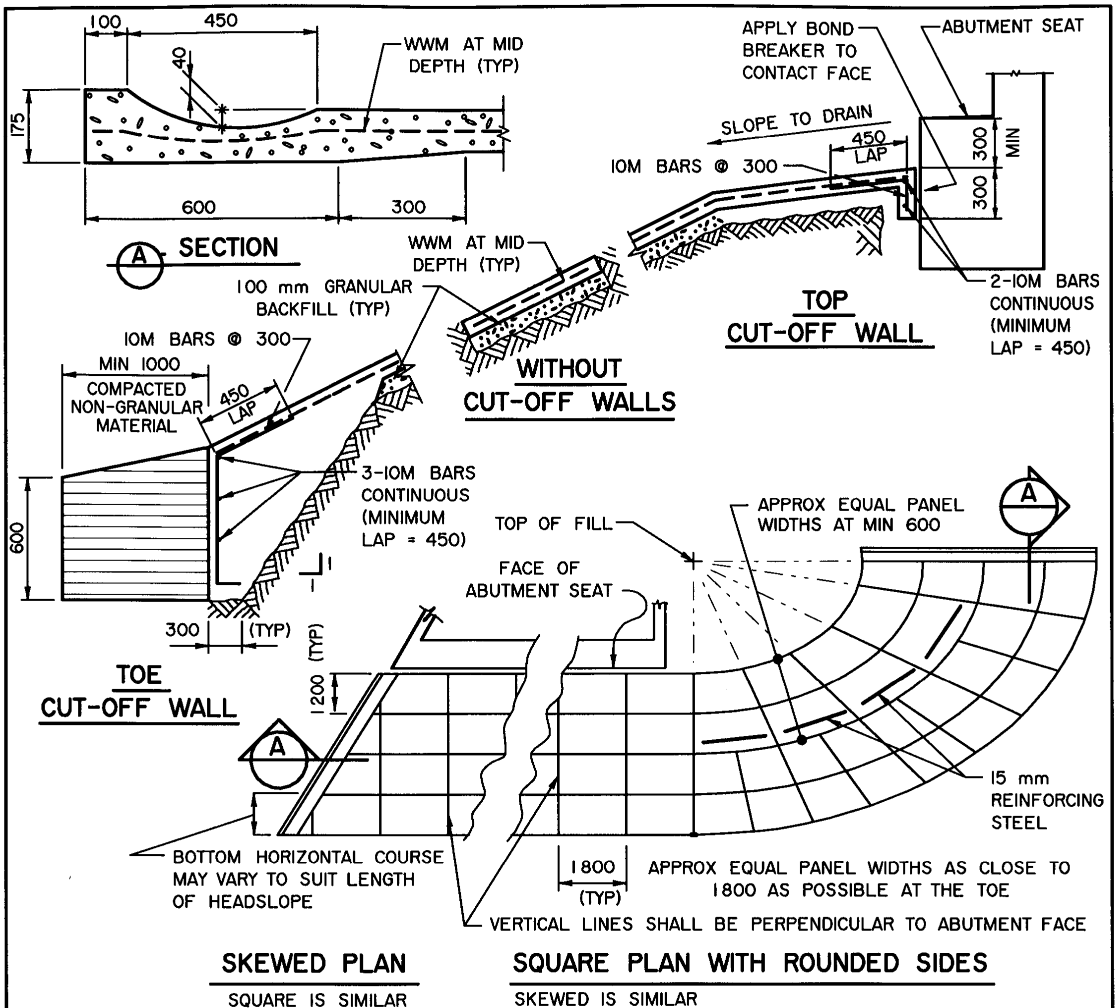
The Department reserves the right to reject any concrete whatsoever which does not meet the strength requirements for Class B concrete as tested in accordance with the requirements of Section 400.3.5 (Cast-In-Place Concrete).

The Department may accept concrete which does not meet the specified strength requirement and in such case payment for concrete slope protection shall be made in accordance with the following scale:

23 MPa to 25 MPa - less $ 5 per square metre

21 MPa to 23 MPa	-	less $10 per square metre
19 MPa to 21 MPa	-	less $15 per square metre

All concrete below 19 MPa in slope protection will be rejected.



GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- WELDED WIRE MESH (WWM) SHALL BE 152 x 152 MW25.8 x 25.8, SUPPLIED IN FLAT SHEETS, LAPPED A MINIMUM OF 152 mm AND SHALL BE SUPPLIED BY THE CONTRACTOR.
- ALL CONCRETE SHALL BE PLACED IN ALTERNATE HORIZONTAL (OR VERTICAL) COURSES. FIRST COURSES SHALL HAVE SET UP PRIOR TO PLACING ADJOINING COURSES.
- ALL JOINTS SHALL BE FORMED USING A SIDEWALK TYPE GROOVING TOOL.
- SLAB SHALL BE GIVEN A CLASS 6 SIDEWALK FINISH.

NO	DATE	REVISIONS	BY
4			
3			
2	2005-06-01	TOE CUT-OFF WALL DETAIL REVISED	RY
1	99-04-20	REDRAWN FROM S-1409-87	RY

Alberta TRANSPORTATION AND UTILITIES
TECHNICAL STANDARDS BRANCH

CONCRETE SLOPE PROTECTION

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	PAGE	DRAWING
DHQ	WS	99-04-20	EXECUTIVE DIRECTOR	[signature]	May 8/87	8.5	S-1409-99

PLOTTED JUNE 01, 2005 S1409X99 .RVI

400.3.10 DRAIN TROUGH TERMINAL PROTECTION

400.3.10.1 General

Drain trough terminal protection shall be constructed with burlap or reinforced polyethylene bags filled approximately two-thirds full of fresh Class B Concrete and placed on a shaped and prepared foundation.

Refer to Standard Drawing S-1410 "Standard Drain Trough Terminal Protection"(see Section 400.3.10.1.3 below).

400.3.10.1.1 Submissions

Unless specified otherwise the following information shall be submitted to the Department at least seven days prior to commencement of work.

- None identified.

400.3.10.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department it is anticipated that the Department will undertake the following:

- Visual inspection of the work; and
- Audits of the Contractor's quality control/quality assurance inspection and testing records.

400.3.10.1.3 Reference Drawings (as attached after Section 400.3.10.4)

- Standard Drain Trough Terminal Protection - S-1410-91

400.3.10.2 Materials

All materials shall be supplied by the Contractor. The bags shall be approximately 400mm x 700mm in size. The concrete shall be as specified under Section 400.3.5 (Cast-In-Place Concrete).

400.3.10.3 Preparation and Placing

A depression shall be formed at the toe of the drain trough as shown on Standard Drawing S-1410. The depression shall be compacted, and have the shape of a dish approximately 450mm deep and 3m in diameter.

The bags shall be two-thirds filled with fresh concrete. Bags shall be sewed, stapled or folded to form a straight-edge closure, and immediately placed in the work. The first bag shall be placed in the center (bottom) of the dish with subsequent bags placed in a circular direction around the first bag. Each bag shall overlap the closed end of the bag previously placed, and also the bag beside it, so that a shingled effect is produced.

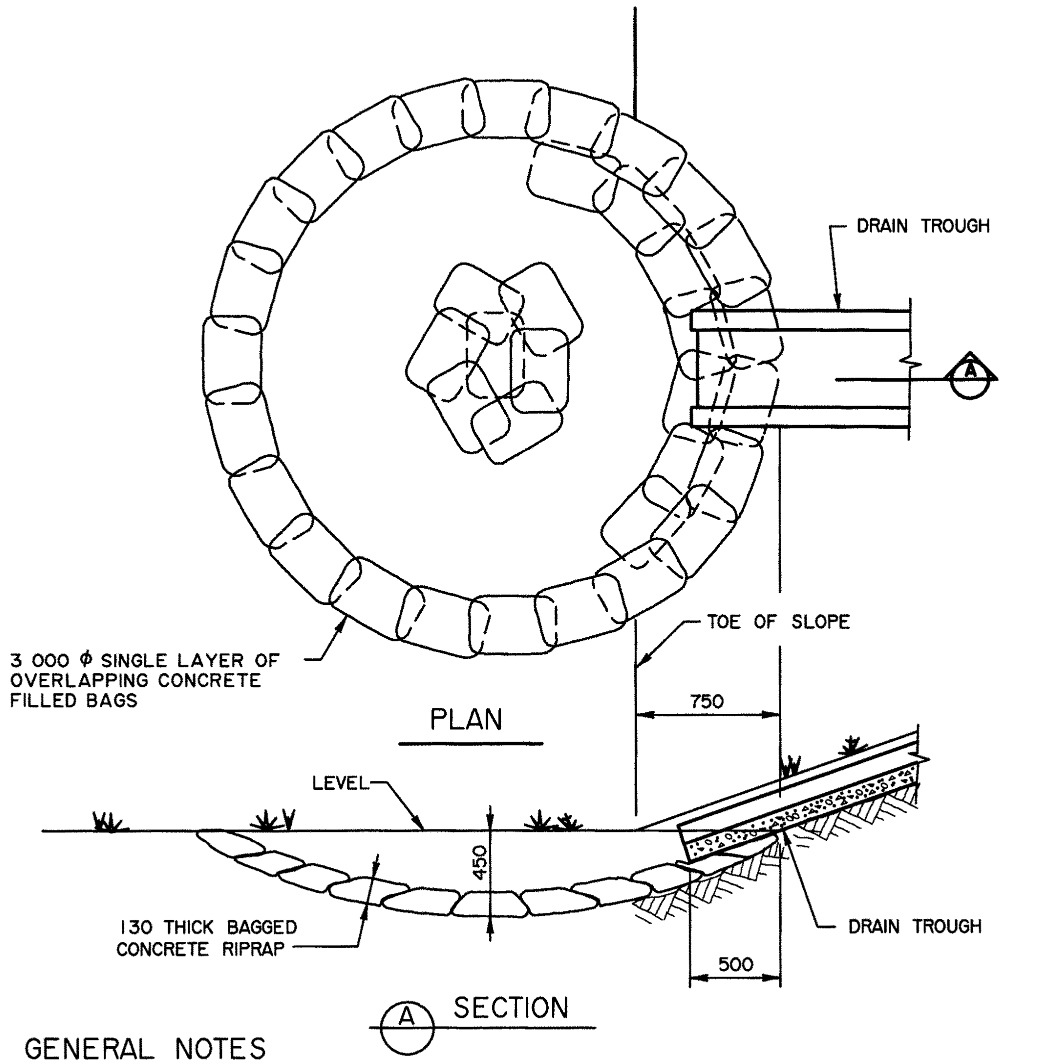
Folded bags must be handled so as to avoid spillage, and the folded part is to be on the underside when in place. The bags shall be rammed and packed against each other so as to obtain a closed and uniform surface. The placed drain trough terminal protection shall have an average thickness of 130mm.

The outer edge of the concrete-filled burlap bags of the completed drain trough terminal shall be level.

400.3.10.4 Rock Riprap Alternate

In lieu of bags filled with concrete, the Department may approve Class 1M rock riprap placed to a minimum depth of 350mm. The size of the terminal dish shall be the same as for bagged concrete terminal protection with the bed shaped to the extent that the dimension from the level surface to the top of rock rip rap is 320 ±100mm.

The dish formed in the subgrade shall be covered with Terrafix 270R or equivalent filter fabric accepted by the Department. The filter fabric shall be keyed 300mm into the subgrade at the perimeter of the dish in order to anchor the fabric. The rock riprap shall be placed so that the filter fabric is fully covered.



GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- 4 PLACING OF BAGGED CONCRETE RIPRAP SHALL START AT THE BOTTOM CENTRE OF THE DISHED AREA AND SHALL PROCEED IN A CIRCULAR LAYERED FASHION UPWARD UNTIL THE ENTIRE DISH IS COVERED. EACH CONCRETE FILLED BAG SHALL LAP OVER THE EDGES OF THE PREVIOUSLY PLACED BAGS.

2

7

NO	DATE	REVISIONS	BY
4	2003-03-21	GENERAL NOTES	JT
3	99-03-29	BEB CHANGED TO TSB	RY
2	94-11-30	GENERAL NOTES	RJR
1	91-01-29	REDRAWN FROM S-1410-87	DHQ

Alberta TRANSPORTATION AND UTILITIES
TECHNICAL STANDARDS BRANCH

STANDARD
DRAIN TROUGH
TERMINAL PROTECTION

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	PAGE	DRAWING
DHQ	MIK	91-01-29	EXECUTIVE DIRECTOR			9.3	S-1410-91

PLOTTED MAR 21, 2003 S1410X91.RV4

400.3.11 HEAVY ROCK RIPRAP

400.3.11.1 General

This specification is for the supply, delivery, and installation of heavy rock riprap. This work shall include all necessary trimming, excavation, and fill required to satisfactorily place the rock riprap, such as:

- excavation, trimming and shaping headslope
- excavation at headslope toe, and for rock apron
- excavation for rock in stream bank transition zone
- supply and placing of geotextile filter fabric
- supply and placing of gravel or granular bedding material
- backfill over rock in stream bank transition zone to restore lines of natural bank.

400.3.11.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work.

- evidence of the acceptability of riprap
- sampling and testing results for riprap, if required

400.3.11.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following.

- Acceptance of submissions as outlined in this Section 400.3.11 (Heavy Rock Riprap);
- Visual inspection of the work; and
- Audits of the Contractor's quality control/quality assurance inspection and testing records/

400.3.11.2 Permits

The Contractor shall obtain whatever permits, agreements, and authorizations are necessary, prior to loading the riprap. He shall advise the Department of any special provisions required under such permits, and must provide evidence satisfactory to the Department that the requirements of the permits have been fully complied with.

400.3.11.3 Rock Material

The rock supplied shall be hard, durable and angular in shape, resistant to weathering and water action, free from overburden, spoil, shale or shale seams and organic material, and shall meet the gradation requirements for the class specified. In general, no sandstone will be permitted for all classes, however if the proposed material meets or exceeds the minimum requirements, consideration may be given by the Department to accepting the material. For these occurrences, further testing shall be done to ensure acceptability. This would include testing of the material in accordance with CSA A23.2-15A “Petrographic Examination of Aggregates”. The minimum dimension of any single rock shall be not less than one third of its maximum dimension. The minimum acceptable unit weight of the rock is 2.5 t/m^3.

The Contractor shall provide the Design Engineer and the Department with evidence of the acceptability of the riprap material. Reliable performance records of proposed material, other than fieldstone, will be considered evidence of acceptability. Fieldstone shall be considered to have a reliable performance record, and will be accepted if it meets the gradation requirements.

Sampling and testing are required for Class 2 and Class 3 rock riprap for which no performance records are available. Sampling and testing are not required for Class 1 rock riprap and field stone. Tests are based on the Durability Index and Durability Absorption Ratio as developed by the State of California, Department of Transportation. The Contractor shall submit samples of the proposed material to an independent certified testing laboratory of his choice and provide written reports of the test results to the Design Engineer for review and then to the Department for acceptance. The reports shall be stamped by a Professional Engineer. The Contractor shall be responsible for all rock riprap sample testing including, but not limited to, transporting samples to an independent certified testing laboratory, testing, disposing of samples after testing, and providing written reports to the Design Engineer and the Department.

A representative sample of 70 kg minimum is required for each type and source of rock to be tested, and shall contain a number of pieces ranging up to 25 kg mass.

The acceptance of rock samples from a particular source or quarry site shall not necessarily be construed as constituting acceptance of all material from that location.

The material provided for each class specified shall have a gradation that conforms to the following:

		CLASS			
		1M	**1**	**2**	**3**
Nominal Mass (kg)		**7**	**40**	**200**	**700**
Nominal Diameter (mm)		**175**	**300**	**500**	**800**
None greater than:	kg or mm	40 300	130 450	700 800	1800 1100
20% to 50%	kg or mm	10 200	70 350	300 600	1100 900
50% to 80%	kg or mm	7 175	40 300	200 500	700 800
100% greater than:	kg or mm	3 125	10 200	40 300	200 500

Percentages quoted are by mass.
Sizes quoted are equivalent spherical diameters, and are for guidance only.

Rip Rap shall meet the following minimum requirements for specific gravity, absorption and durability:

Method of test	**Requirements**
California Department of Transportation Method of Test for Specific Gravity and Absorption of Coarse Aggregate (California Test 206)	Minimum Specific Gravity = 2.60 Maximum Absorption = 2.0 percent
California Department of Transportation	Minimum Durability Index = 52
Method of Test for Durability Index	Durability Index may be less than 52 if DAR* > 23
(California Test 229)	

* Durability Absorption Ratio (DAR) = Durability Index / (Absorption % + 1%)

400.3.11.4 Geotextile Filter Fabric

Where geotextile filter fabric is specified, the slope shall be graded to provide a smooth, uniform surface. All stumps, large rock, brush or other debris that could damage the fabric shall be removed. All holes and depressions shall be filled so that the fabric does not bridge them. Loose or unstable soils shall be replaced.

Non-woven geotextile filter fabric shall be used under all riprap in accordance with the following table of minimum average roll value properties (MARV's) for each specific Class of riprap:

Non-Woven Geotextile Filter Fabric		
Specifications and Physical Properties		
	Class 1M, 1 and 2	Class 3
Grab Strength	650 N	875 N
Elongation (Failure)	50%	50%
Puncture Strength	275N	550 N
Burst Strength	2.1 MPa	2.7 MPa
Trapezoidal Tear	250 N	350 N
Minimum Fabric Lap to be 300 mm		

The non-woven geotextile filter fabric shall meet the specifications and physical properties as listed above.

The fabric shall be laid parallel to the slope direction. It shall be placed in a loose fashion, however folds and wrinkles shall be avoided. Adjacent strips of fabric shall be overlapped a minimum of 300mm, except where placed underwater, the minimum lap width shall be 1 m. Overlaps shall be pinned using 6 mm diameter steel pins fitted with washers and spaced at 1 m intervals along the overlaps.

The top edge of the filter fabric shall be anchored by digging a 300mm deep trench, inserting the top edge of the fabric and backfilling with compacted soil.

Care shall be taken to prevent puncturing or tearing the geotextile. Any damage shall be repaired by use of patches that extend at least 1 m beyond the perimeter of the tear or puncture.

The fabric shall be covered by rock riprap within sufficient time so that ultraviolet damage does not occur; in no case shall this time exceed 7 days for ultraviolet material and 14 days for ultraviolet protected and low ultraviolet susceptible polymer geotextiles.

Riprap placement shall commence at the base of the blanket area and proceed up the slope. The height of drop of riprap shall be limited to 1.0m or less, and the riprap shall not be allowed to roll down the slope. Heavy equipment will not be permitted to operate directly on the geotextile.

400.3.11.5 Placing of Rock

The rock shall be handled, dumped or placed into position to conform to the specified gradation and to the cross section shown on the Detailed Designs. The finished surface shall be reasonably uniform, free from bumps or depressions, and with no excessively large cavities below or individual stones projecting above the general surface.

400.3.11.6 Inspection of Rock

Control of gradation will be by visual inspection. The Contractor shall provide a minimum of two samples of rock, of the minimum sample size specified below. These samples shall be proven to acceptably conform to the required gradation by direct weighing of all the individual pieces with suitable scales; the mass of each piece in the sample shall be painted on the piece. These samples, located as required by the Department at the construction site and at the source or quarry site, may be incorporated in the finished riprap when they are no longer required for reference purposes. The samples shall be used for frequent reference in judging the gradation of the riprap being loaded at the source and placed at the site. The minimum sample size in area shall be as follows:

Class	Minimum Sample Size
1M	1 m x 1 m
1	2 m x 2 m
2	3 m x 3 m

3	4 m x 4 m

The Contractor shall provide whatever facilities are required to assist the Department in checking gradation and measuring riprap in place.

If, during the delivery of the material to the site, a particular load is found to be made up of pieces predominantly one size, or to be lacking in pieces of one size, it shall be dumped in a suitable location outside the area to be protected. Additional material as required to make up the deficient sizes shall be added to this load such that the combination can then be placed to ensure uniformity.

400.3.12 DUCTS AND VOIDS

400.3.12.1 General

This specification is for the supply and installation of all ducts, conduits or voids as set out in the Detailed Designs and these specifications. Included are the following:

- utility ducts and voids
- rigid conduits, end caps, conduit expansion joints, junction boxes
- lamp standard anchorage assemblies.

400.3.12.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work.

- none identified

400.3.12.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following.

- Visual inspection of the work; and
- Audits of the Contractor's quality control/quality assurance inspection and testing records.

400.3.12.2 Material

All utility ducts and voids, and accompanying hardware, to be incorporated in or erected on the structure, shall be supplied by the Contractor and meet the acceptance of the appropriate electrical code and standard.

400.3.12.3 Installation

The various components shall be erected or placed in the locations shown on the Detailed Designs. Rigid conduit shall be bent only with a standard conduit bender.

Ducts, conduits and voids shall be firmly secured to prevent floating during casting.

Continuous pull wires shall be installed in all service ducts and conduits. The pull wires shall be 12 gauge galvanized steel, unspliced, extending with a tight fit through the duct end caps and terminating one metre beyond in 300mm loops.

In lieu of the galvanized pull wire, an 8mm monopoly rope or equivalent may be substituted in ducts over 75mm diameter. In this case, the rope shall be unspliced, with the extra length of 300mm each end coiled up inside the duct and the duct end caps secured in place.

When specified, lamp standards shall be properly bedded, securely bolted, and painted with two field coats.

The installation of any electrical equipment shall be carried out to completion by a fully qualified electrician, tested and left in good working order. All runs of conduit or duct shall be proven in the presence of the Design Engineer and the Department to be clear by passing through the entire length, a round object no less than 75% of the conduit area. Any required permits will be the responsibility of the Contractor.

400.3.13 BRIDGERAIL

400.3.13.1 General

This specification is for the supply, fabrication and installation of steel tube type bridgerail, thrie beam bridgerail, approach rail transition, and handrail. Bridgerail and handrail shall include all work constructed above the top of the bridge deck, curb, parapet, sidewalk, or culvert headwalls, and wing walls, and the supply and placing of anchor bolt assemblies, end connection plates and connection angles. Approach rail transition shall include thrie beam or W-beam guardrail sections, W-thrie beam transition section, terminal connectors, steel or timber guardrail posts, spacers, and guardrail connection and wing end sections where specified.

400.3.13.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work:

- Identification of subcontractors;
- Welding procedures for all welds;
- Shop drawings (five copies);
- Mill certificates, and mill reports for all material;

- Repair procedures for unsatisfactory weldments and accidental arc strikes, if required;
- Repair procedures for unsatisfactory galvanizing, if required;
- Repair procedures for short anchor bolts, if required; and
- Methods of forming and pouring grout (at least 14 days prior to placing grout).

400.3.13.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following to determine the acceptability of the work.

- Acceptance of submissions outlined in this Section 400.3.13 (Bridgerail);
- Visual inspections of the work;
- Audits of the Contractor's quality control/quality assurance inspection and testing records; and
- Testing to confirm the acceptability of materials and/or workmanship (see Sections 400.3.13.2.6 (Rail Fabrication), 400.3.13.2.6 (Base Plate Corrosion Protection), and 400.3.13.2.7 (Non-Destructive Testing).

400.3.13.2 Supply and Fabrication

400.3.13.2.1 Standards

The fabrication of bridgerail components shall conform to "The American Association of State Highway and Transport Officials (AASHTO), Standard Specifications for Highway Bridges" and the American Welding Society (AWS) - Bridge Welding Code, D1.5.

Where imperial/metric conversions are necessary, the National Standard of Canada, CAN3-Z234.1-79 shall be used as the basis of conversion.

All welding, cutting and preparation shall be in accordance with the American Welding Society (AWS) - Bridge Welding Code, D1.5.

400.3.13.2.2 Qualification

The Contractor shall notify the Department of any subcontractors in his employ. The Contractor shall remain responsible for the work of the subcontractors. All terms of the contract, such as CWB approval, right of access, etc., shall apply to the subcontractor.

The Fabricator shall be fully approved by the Canadian Welding Bureau (CWB) as per CSA Standard W47.1 in Divisions 1 or 2.

Only welders, welding operators and tackers approved by the Canadian Welding Bureau in the particular category shall be permitted to perform weldments. Their qualifications shall be current and available for examination by the Department.

400.3.13.2.3 Engineering Data

Welding Procedures

Welding procedures bearing the approval of the Canadian Welding Bureau shall be submitted for each type of weld to be used. The welding procedures shall be reviewed by the Design Engineer and then accepted by the Department before welding proceeds.

Shop Drawings

Shop drawing requirements shall be as per Section 400.3.7 (Structural Steel).

When railing for more than one bridge is included, individual shop and erection drawings shall be submitted for each bridge. Shop drawing mark numbers must be unique for each bridge.

Mill Certificates

Mill certificates shall be submitted to the Design Engineer for review and then to the Department for acceptance for all material before fabrication commences.

400.3.13.2.4 Materials

Steel

All steel shall conform to the standard noted on the Detailed Designs. The silicon content for various bridgerail and handrail components shall be as follows:

- Structural tubing less than 0.04%
- Structural sections, handrail bars, base plates less than 0.04% or between 0.15% to 0.25%

If substitutions are required they must be submitted to the Design Engineer for review and then to the Department for acceptance. In these cases interpretation of equivalent steel will be as per Appendix "A" of the CSA Standard G40.21 (1976 only).

Anchor Bolts

Anchor bolts shall conform to the standard noted on the Detailed Designs. The Contractor shall provide mill reports indicating the physical properties of the material to the Design Engineer for review and then to the Department for acceptance.

Connection Plate and Angle

Steel for connection plate and angle shall as a minimum conform to CSA Standard G40.21 Grade 300W or ASTM A36.

Grout

Grout for post bases shall be Sika 212 flowable grout or equivalent accepted by the Design

Engineer and the Department.

Approach Rail Transition

Thrie beam or W-beam guardrail sections, W-thrie beam transition section, terminal connectors, steel or timber guardrail posts, spacers, and guardrail connection and wing end sections shall be as specified in Section 400.3.15 (Guardrail).

400.3.13.2.5 Welding

Filler Metals

Low hydrogen fillers, fluxes and welding practices shall be used throughout. The low hydrogen covering and flux shall be protected and stored as specified by AWS Standard D1.5. Flux cored welding or use of cored filled wires in the submerged arc process or shielding gas processes will not be permitted.

Metal core welding process utilizing low hydrogen consumables with AWS designation of H4 is allowed. The deposited weld metal shall provide strength, durability, impact toughness and corrosion resistance equivalent to base metal.

Joint Preparation

Preparation of welded joints shall be as indicated on the Detailed Designs. Weld areas shall be clean, free of mill scale, dirt, grease, paint and other contaminants prior to welding.

Tack and Temporary Welds

Tack and temporary welds shall not be allowed unless they are to be incorporated into the final weld. Tack welds, where allowed, shall be of a minimum length of four times the nominal size of the weld, and shall be subject to the same quality requirements as the final welds. Cracked tack welds shall be completely removed prior to welding over.

Backing Bars

Backing bars shall be fitted all around the inside of the joint. The separation of faying surfaces between the backing bars and material to be welded shall not exceed 1mm, 100% fusion must be obtained into the backing bar including the corners of HSS members.

Run-off Tabs

Run-off tabs shall be used at the ends of all welds that terminate at the edge of a member. They shall be tack welded only to the portion of the material that will not remain a part of the structure, or where the tack will be welded over and fused into the final joint. After welding, the tabs shall be removed by flame cutting, not by breaking off.

Arc Strikes

Arc strikes are not permitted.

Methods of Weldment Repair

Repair procedures for unsatisfactory weldments shall be submitted to the Design Engineer for review, and then to the Department for acceptance prior to repair work commencing.

Grinding of Welds

Fillet welds not conforming to acceptable profile shall be ground to the proper profile without substantial removal of the base metal. Grinding shall be smooth and parallel to the line of stress. Caution shall be exercised to prevent over grinding. Acceptability of welds without grinding will be determined by the Department.

400.3.13.2.6 Fabrication

Fabrication shall be performed in an enclosed area which is adequately heated.

Rail Fabrication

All rail splices will be radiographed by the Department. Splices shall be completed using properly fitted backing bars. Only one splice per rail section will be permitted, and shall occur in an accepted location, clear of openings and connection holes. All splices shall be ground flush. Rail sections shall be orientated such that the tube seam is always located at the bottom, except for rectangular tube sections which shall have the tube seam oriented towards the bottom or the outside of the bridge. Edges of holes shall be smooth and free of notches or burrs.

Rail Sleeve Fabrication

Sleeves shall be square and be properly aligned in the rail end. Corners of the sleeves shall be rounded and smooth to ensure a good fit. Expansion joint sleeves shall be shop bolted to the appropriate rail section after galvanizing.

Post Fabrication

(a) W Posts
Posts shall be perpendicular to the base plates, unless otherwise noted on the Detailed Designs.

Base plates for the posts shall be flat, have square cut edges and corners with no lips or gouges. Anchor bolt holes shall be drilled accurately in size and location.

The rail post to base plate shall be welded by using 60°C preheat.

(b) HSS Posts
The following requirements shall apply to HSS posts, in addition to the requirements noted under W Posts:

- The tube weld seam shall be kept on the back side of the post.

- The rail post shall be butt welded to the base plate using a backing bar and a full penetration bevel groove weld. The backing bar shall be properly fitted and the post tube prepared to a sharp edged 45 degree chamfer. The groove weld shall be placed in a minimum of two passes by using 100°C of preheat and maintain a root opening of 5mm. A rod size no greater than 4.0mm shall be used for the first pass. A reinforcing fillet weld shall be placed all around the joint.
- Acceptability of the post to base plate weld shall be confirmed by sectioning one fabricated post, chosen at random by the Department, for every 50 posts fabricated. In each bridge structure at least one post shall be tested. The Contractor shall be responsible for sectioning and to provide the additional posts to replace those selected for destructive testing.
- Post caps shall be chamfered all around the top and match the contour of the post without burrs or overhang. The caps shall be attached to the posts in the shop after galvanizing. The caps shall fit tightly and include washers under the head of the cap attachment bolts.

Anchor Bolts

The threaded ends of all anchor bolts shall be chamfered. All anchor bolts, hardware and anchor bolt template shall be hot dip galvanized, after fabrication in accordance with CSA G164. Nuts shall freely spin on the bolt threads after galvanizing. The anchor bolts shall be shop assembled in cages after galvanizing with bolts aligned square and plumb. Alignment nuts shall not exceed 16 mm in thickness.

Tolerances

(a) Sleeve to Rail
Clearance between the rail sections and the sleeves shall be sufficient to ensure an easy fit after galvanizing. The maximum radial clearance allowed around the sleeve when fitted into the rail shall be 1mm (2mm total) after galvanizing with the tube seam removed.

Two sleeve test samples shall be made by the Contractor from the material to be used. Both test sleeves are to be galvanized, with one being retained by the galvanizing subcontractor and the other at the Fabricator's plant. The sleeves shall be used to check the sleeve to rail fit of all rails. In the case of handrail panels, the test samples shall consist of a welded unit with top and bottom tube, and sleeve sections spaced to match the handrail.

(b) Posts
Post assembly lengths shall be within 3mm of the specified length.

(c) Rails
Individual rail sections shall be straight and true with no evidence of kinks or dents and with a maximum variation from straightness not exceeding 3mm over a 3m length. Welded splices shall not be evident in the final product, and shall be straight, kink free and conform to the same section as the adjacent tubing. Bolted splices shall be straight with no offset due to loose fitting sleeves.

(d) Anchor Bolts
The bolts in an anchor bolt assembly shall fit in a template comprised of accurately located holes 2mm greater in diameter than the anchor bolts. The top of the bolts in the assembly shall be + 3mm from a level plane when the threaded portion is plumb. The threaded length shall not be less than specified, nor more than 15mm greater than that specified.

<u>Identification</u>

To assist field erection, shop drawing mark numbers shall be stamped on the rails and posts. Rail mark numbers shall be stamped on the underside of the rail near the ends. Post mark numbers shall be stamped on the underside of the base plates. The areas to be stamped shall be ground to remove mill scale. Stamps shall be a minimum of 12mm high, and the resulting marks shall be at least 1.0mm deep to be legible after galvanizing.

<u>Galvanizing</u>

Galvanizing shall be by the hot dip method after fabrication, in accordance with the latest edition of CSA Standard G164 with additions and exceptions as described in this specification.

The Contractor shall provide a smooth finish on all edges and surfaces and remove all weld spatters and all welding flux residue from the steel components prior to galvanizing. The galvanized finish shall meet the aesthetic requirements of the application and shall have a continuous outer free zinc layer without any significant zinc-iron alloy showing through the outside surface. Lumps, globules or heavy deposits of zinc will not be permitted. Handrails shall be free of any sharp protrusions or edges.

Double dip galvanizing is not advised but will be accepted by the Department if a surface finish similar in appearance, colour and quality to that of single dip galvanizing is produced. The lapped area of the double dip shall be straight, the coating smooth, adherent and free of uncoated areas, blisters, flux deposits, dross inclusions, acid and black spots.

Repair of galvanizing shall only be done if bare areas are infrequent, small, and suitable for repair. A detailed repair procedure shall be prepared by a Professional Engineer and then submitted to the Department for review and acceptance prior to its use. It should be noted that repairs may require complete removal of the galvanized coating and regalvanizing. Repair shall be in compliance with ASTM A780, Method A3 Metallizing. The thickness of the metallizing shall be 180 µm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing. The Department will determine the acceptability of lapped or repaired areas.

<u>Base Plate Corrosion Protection</u>

The bottom face of each base plate shall be protected by a medium grey colour barrier coating accepted by the Department, to prevent contact between the zinc and the concrete. The galvanized surface must be roughened prior to application of barrier coating. The surface preparation of the galvanized surface and the dry film thickness (DFT) of the coating shall be in accordance with the coating manufacturer's recommendations. The Department will test the adhesion of the fully cured coating as per ASTM D3359 "Standard Test Methods for Measuring Adhesion by Tape Test". The method selected for testing (Method A or B) shall depend on the dry film thickness of the coating. The coating manufacturer's product data sheets shall be provided to the Department prior to the application of the coating. The adhesion test result shall meet a minimum of "4B" classification i.e. a maximum allowable flaking of 5%.

Schedule

The Contractor shall provide and keep current a complete fabrication schedule in a form satisfactory to the Department.

400.3.13.2.7 Testing and Inspection

Testing and Inspection by the Contractor

The Contractor shall be responsible for quality control and quality assurance testing required to ensure the work meets the Technical Requirements and the requirements of the Detailed Designs. The Contractor shall be responsible for sectioning and macro-etching the post to base plate weld as specified in Section 400.3.13.2.6 (Fabrication).

Any quality control/quality assurance testing and inspection records made by the Contractor shall be open to the Department for auditing.

Testing and Inspection by the Department

To confirm acceptability of materials and/or workmanship, the Department will perform visual, radiographic, ultrasonic, magnetic particle and any other inspection that may be specified or required.

The Contractor shall ensure that adequate notice for inspection and testing be given to the Department and that access to the work is assured at all times. When required by the Department, the Contractor shall provide needed manpower for assistance in checking layout and performing inspection duties.

Testing and inspection made necessary by the repair of faulty work shall be paid for by the Contractor.

The Contractor shall be responsible for all travel, boarding and lodging costs incurred by the Department to inspect bridgerails being fabricated outside the Province of Alberta. The cost shall also include for a Department representative to attend the prejob meeting for each bridgerail fabricator and two additional trips for each shop during the course of fabrication.

Non-destructive Testing

The methods of non-destructive examination shall be in accordance with the following standards:

- Radiography - AWS Standard D1.5

- Ultrasonic - AWS Standard D1.5
- Magnetic Particle - ASTM Standard E-709
- Dye - Penetrant - ASTM Standard E-165

Notification

The Contractor shall notify the Department 48 hours prior to shipment to facilitate final inspection of the materials. The Contractor will be charged with all expenses incurred for inspection of the material at the site.

400.3.13.2.8 Material Handling and Storage

All lifting and handling shall be done using devices that do not mark, mar, damage or distort the galvanized members and assemblies in any way. Galvanized material shall be stacked or bundled and stored to prevent wet storage stain as per the American Hot Dip Galvanizers Association (AHDGA) publication "Wet Storage Stain". Delivery of a damaged product will be a cause for rejection.

400.3.13.3 Erection

Anchor bolt assemblies shall be accurately positioned with anchor bolt projections as shown and specified.

The line and grade of the railing shall be true to that shown on the Detailed Designs, and not follow any unevenness in the superstructure. It will be necessary to adjust the height and plumbness of each post, in order to compensate for normal superstructure variations, and achieve the desired line and grade on the bridgerail.

Anchor bolts that project less than the full thickness of the nuts, by more than 2 threads, shall be extended. The proposed repair will require the review of the Design Engineer and then the acceptance of the Department.

The method of forming and pouring the grout shall be submitted to the Design Engineer for review and then the Department for acceptance. Dry-pack methods of constructing grout pads will not be accepted.

Sealer shall be applied to the exposed grout pad surfaces in accordance with Section 400.3.5.25 (Sealer).

400.3.13.3.1 Grouting in Cold Weather

When the daily minimum air temperature, or the temperature of the bridgerail, the bridge substructure or superstructure in the immediate area of the grouting falls below 5°C, the following provisions for cold weather grouting shall be put into place:

(a) Before grouting, adequate preheat shall be provided to raise the temperature of the adjacent areas of the bridgerail, the bridge substructure and superstructure to at least 10°C.

(b) Temperature of the grout during placing shall be between 10°C and 25°C.

(c) The grout pad shall be enclosed and kept at 10°C to 25°C for at least 5 days. The system of heating shall be designed to prevent excessive drying-out of the grout.

400.3.13.3.2 Approach Rail Transition

The supply and installation of the approach rail transition including thrie beam or W-beam guardrail sections, W-thrie beam transition section, terminal connectors, steel or timber guardrail posts, spacers, and hardware as shown on the Detailed Designs shall be in accordance with Section 400.3.15 (Guardrail).

400.3.14 MISCELLANEOUS IRON

400.3.14.1 General

Items included as Miscellaneous Iron will typically include the following:

- steel drain troughs
- pier drip sheets
- deck buffer angles
- dowels
- connector angles
- anchor bolt sleeves
- bridge plaques
- bench mark tablets

400.3.14.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work.

- shop drawings
- welding procedures

400.3.14.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following.

- Acceptance of submissions as outlined in this Section 400.3.14 (Miscellaneous Iron);

- Visual inspections of the work; and
- Audits of the Contractor's quality control/quality assurance inspection and testing records. .

400.3.14.1.3 Reference Drawings (as attached after Section 400.3.14.4.2)

- Standard Irrigation Canal Bridge and Small Bridge Plaques S-1424-04
- Standard Large Bridge Plaque Installation Details S-1477-04
- Standard Bridge Bench Mark Tablet Installation S-1478
- Standard Large Bridge Plaque Castings Details S-1617-04

400.3.14.2 Fabrication and Installation

Miscellaneous Iron shall be supplied, fabricated, placed and erected by the Contractor as shown on the Detailed Designs and/or as specified in the applicable portions of Section 400.3.7 (Structural Steel).

Bridge plaques shall be fabricated and installed in accordance with the construction drawings and the following standard drawings:

- S-1424-04 "Standard Irrigation Canal Bridge and Small Bridge Plaques"
- S-1477-04 "Standard Large Bridge Plaque Installation Details"
- S-1617-04 "Standard Large Bridge Plaque Casting Details "

Bench mark tablets shall be supplied and installed by the Contractor in accordance with the construction drawings and the following standard drawing:

- S-1478 "Standard Bridge Bench Mark Tablet Installation"

See Section 400.3.14.1.3 (Reference Drawings) for this standard drawing.

400.3.14.3 Handling Galvanized Steel

All lifting and handling shall be done using devices that do not mark, mar, damage or distort the galvanized members and assemblies in any way. Galvanized material shall be stacked or bundled and stored to prevent wet storage stain as per American Hot Dip Galvanizers Association (AHDGA) publication "Wet Storage Stain". Delivery of a damaged product will be a cause for rejection.

400.3.14.4 Field Welding of Miscellaneous Iron

400.3.14.4.1 Field Welding Of Structural Members

Where the installation of Miscellaneous Iron includes field welding of structural members, the following requirements shall be met:

(a) All welding, cutting and preparation shall be in accordance with the American Welding Society (AWS) - Bridge Welding Code, D1.5.

(b) Only welders approved by the Canadian Welding Bureau in the particular category shall be permitted to perform weldments. Their qualification shall be current and available for examination by the Department.

(c) Welding procedures approved by the Canadian Welding Bureau shall be submitted to the Design Engineer for review and then the Department for acceptance prior to welding.

(d) Low hydrogen filler, fluxes and welding practices shall be used in accordance with Section 400.3.7.2.5 (Filler Metals and Welding Processes).

(e) When the air temperature is below 10°C, all material to be welded shall be preheated to 100°C for a distance of 80mm beyond the weld and shall be sheltered from the wind.

(f) When the air temperature is below 0°C, welding shall not be permitted unless suitable hoarding and heating, accepted by the Design Engineer and the Department, is provided.

400.3.14.4.2 Field Welding Of Non-Structural Members

Where the installation of Miscellaneous Iron includes field welding of non-structural members, the following requirements shall be met:

(a) Journeyman welders with Class B tickets shall be permitted to perform weldments. Their qualification shall be current and available for examination by the Department.

(b) Welding procedures prepared and stamped by a Professional Engineer shall be submitted to the Design Engineer for review and then acceptance by the Department prior to welding.

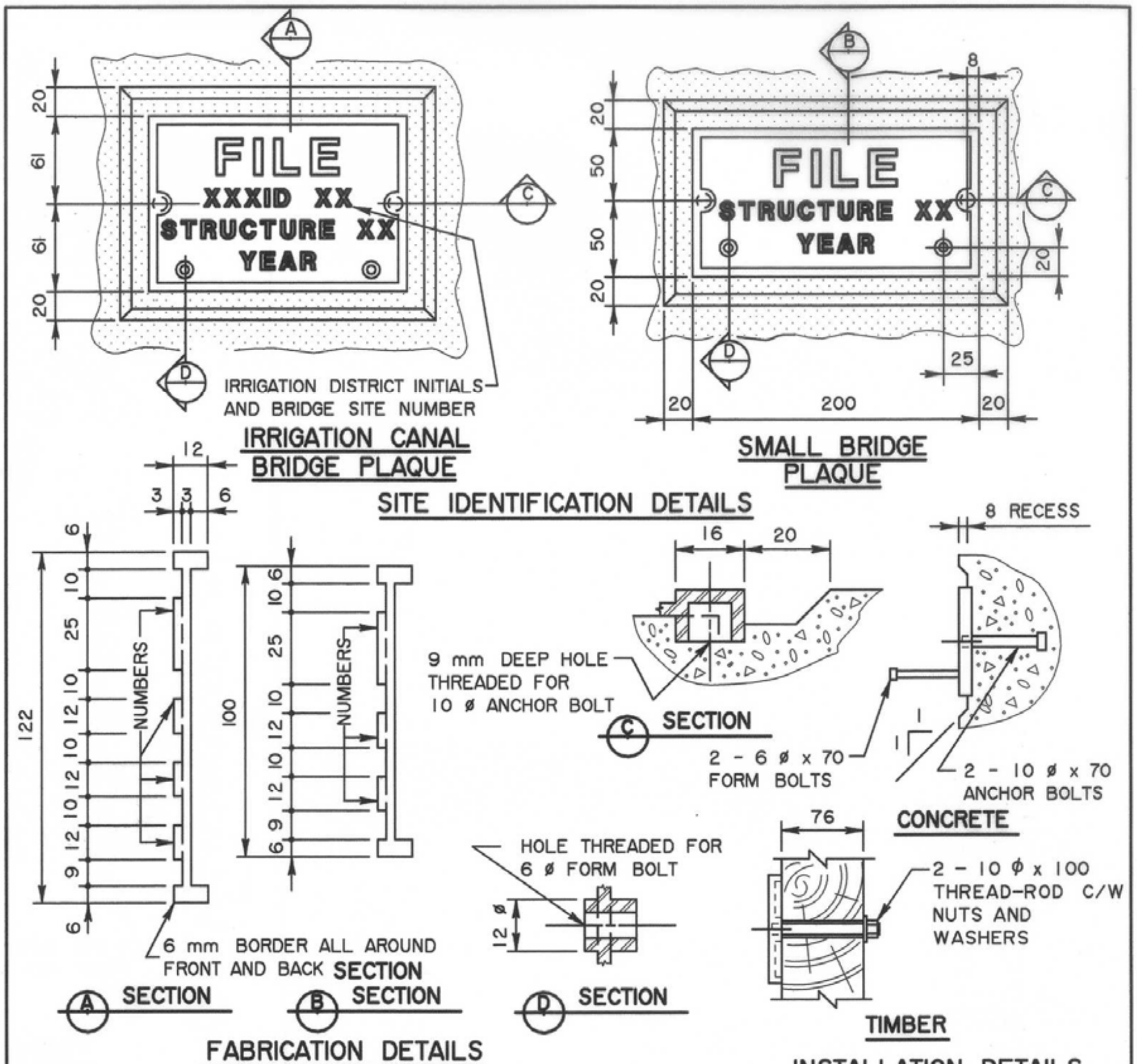
(c) Low hydrogen filler, fluxes and welding practice shall be used in accordance with Section 400.3.7.2.5 (Filler Metals and Welding Processes).

(d) When the air temperature is below 5°C, all material to be welded shall be preheated to 100°C for a distance of 80 mm beyond the weld and shall be sheltered from the wind.

(e) When the air temperature is below 0°C, welding shall not be permitted unless suitable hoarding and heating, is provided.

Unless otherwise determined by the Department, the following are examples of non-structural field welding.

- Type 1 deck joint splices



GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE. DIMENSIONS ARE TYPICAL UNLESS SHOWN OTHERWISE.
- THE "FILE NUMBER" AND "YEAR" OF CONSTRUCTION WILL BE SHOWN ON THE CONTRACT DRAWINGS. IRRIGATION "DISTRICT" INITIALS AND "SITE NUMBER" WILL BE INCLUDED WHERE APPLICABLE.
- THE "STRUCTURE NUMBER" IS TO BE OBTAINED FROM TECHNICAL STANDARDS BRANCH, BRIDGE ENGINEERING SECTION.
- PLAQUES SHALL BE CAST ALUMINUM. ALL SURFACES SHALL BE COVERED WITH BLACK BAKED ENAMEL
- LOCATION OF PLAQUES TO BE ON RIGHT HAND SIDE OF THE FIRST ABUTMENT ENCOUNTERED IN DIRECTION OF TRAVEL.

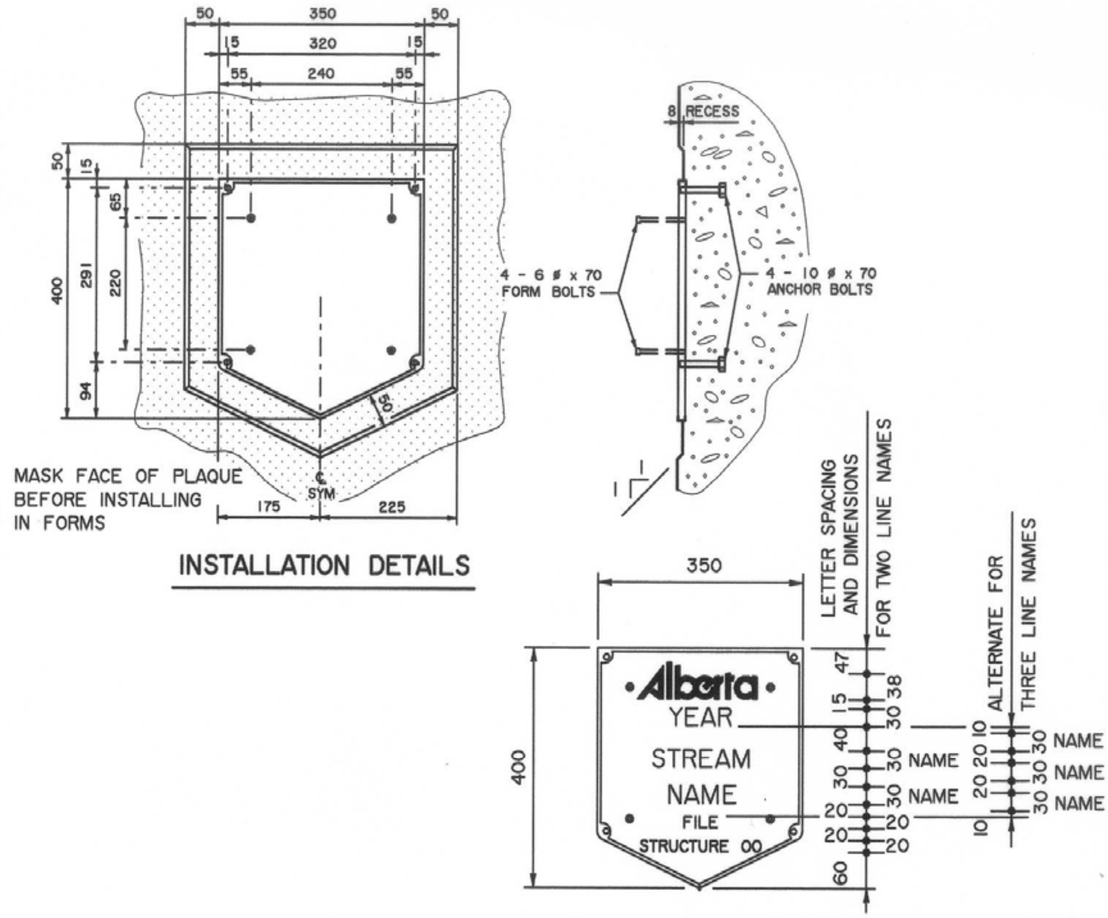
NO	DATE	REVISIONS	BY
4			
3			
2			
1	2004-05-21	REDRAWN FROM S-1424-87 REV 5	WS

Alberta TRANSPORTATION
TECHNICAL STANDARDS BRANCH

STANDARD
IRRIGATION CANAL BRIDGE AND SMALL BRIDGE PLAQUES

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	DRAWING
DHQ	WS	2004-05-21	EXECUTIVE DIRECTOR	Allan Kwan	May 26, 2004	S-1424-04

PLOTTED MAY 21, 2004 S1424x04.DGN



INSTALLATION DETAILS

SITE IDENTIFICATION DETAILS

GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- SEE DWG S-1617-04 FOR FOUNDRY CASTING DETAILS.
- THE "YEAR" OF COMPLETION, THE "STREAM OR STRUCTURE NAME", THE "FILE NUMBER" AND "STRUCTURE NUMBER" SPECIFIC TO THE BRIDGE SITE, AND THE LOCATION FOR INSTALLATION, WILL BE SHOWN ON THE CONTRACT DRAWINGS.
- LOCATION OF PLAQUES TO BE ON RIGHT HAND SIDE OF THE FIRST ABUTMENT ENCOUNTERED IN DIRECTION OF TRAVEL.

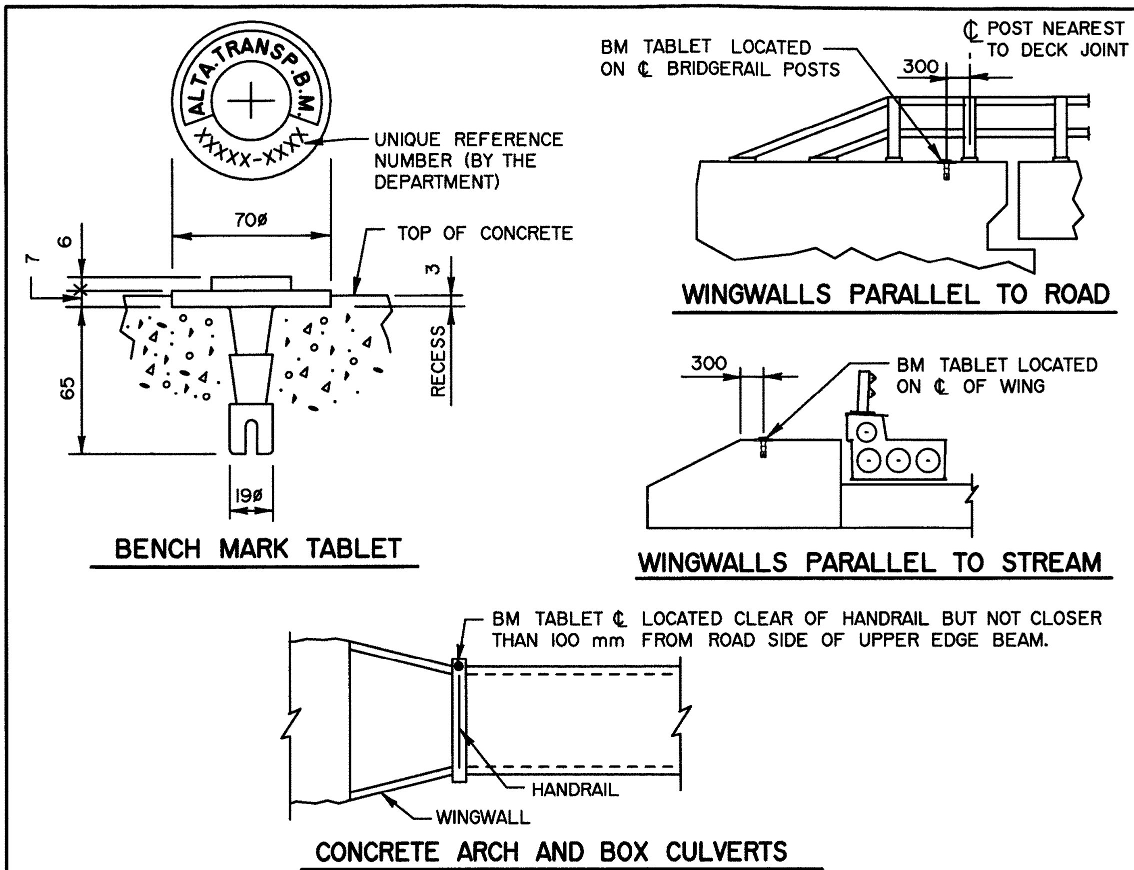
NO	DATE	REVISIONS	BY
4			
3			
2			
1	2004-05-21	REDRAWN FROM S-1477 REV 3	WS

Alberta TRANSPORTATION
TECHNICAL STANDARDS BRANCH

STANDARD
LARGE BRIDGE PLAQUE
INSTALLATION DETAILS

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	DRAWING
DHQ	WS	2004-05-21	EXECUTIVE DIRECTOR	Allan Kwan	May 26, 2004	S-1477-04

PLOTTED MAY 21, 2004 S1477-04.DGN



GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- 3 ONE BRONZE BM TABLET WILL BE SUPPLIED AND INSTALLED BY THE CONTRACTOR FOR EACH STRUCTURE AS PER SECTION 13 "MISCELLANEOUS IRON" OF THE BRIDGE CONSTRUCTION SPECIFICATIONS.
- BM TABLET SHALL GENERALLY BE PLACED ON THE NW CORNER OF THE BRIDGE AS PRESCRIBED ON THE BRIDGE DRAWINGS.
- BM TABLET SHALL BE PLACED ONLY IN SUBSTRUCTURE ELEMENTS NOT SUBJECT TO SETTLEMENT ie ABUTMENTS SUPPORTED ON PILES OR FIRM BEDROCK.
- 3 THE DEPARTMENT WILL ASSIGN A UNIQUE REFERENCE NUMBER FOR EACH BENCHMARK TABLET. THE NUMBER IS ISSUED BY THE SURVEY/IMAGERY COORDINATOR IN TECHNICAL STANDARDS BRANCH.
- 3 FINAL BM ELEVATION (TO NEAREST 0.001 m) SHALL BE DETERMINED BY THE CONSULTANT AFTER INSTALLATION AND SHALL BE SHOWN ON THE "AS CONSTRUCTED" GENERAL LAYOUT DRAWING. THE FINAL ELEVATION, AS WELL AS WHICH GEODETIC BASED BENCHMARK IT WAS TIED TO, SHALL BE REPORTED TO THE SURVEY/IMAGERY COORDINATOR IN TECHNICAL STANDARDS BRANCH.

5

1 DRAFTING STANDARDS PAGE: 3.5

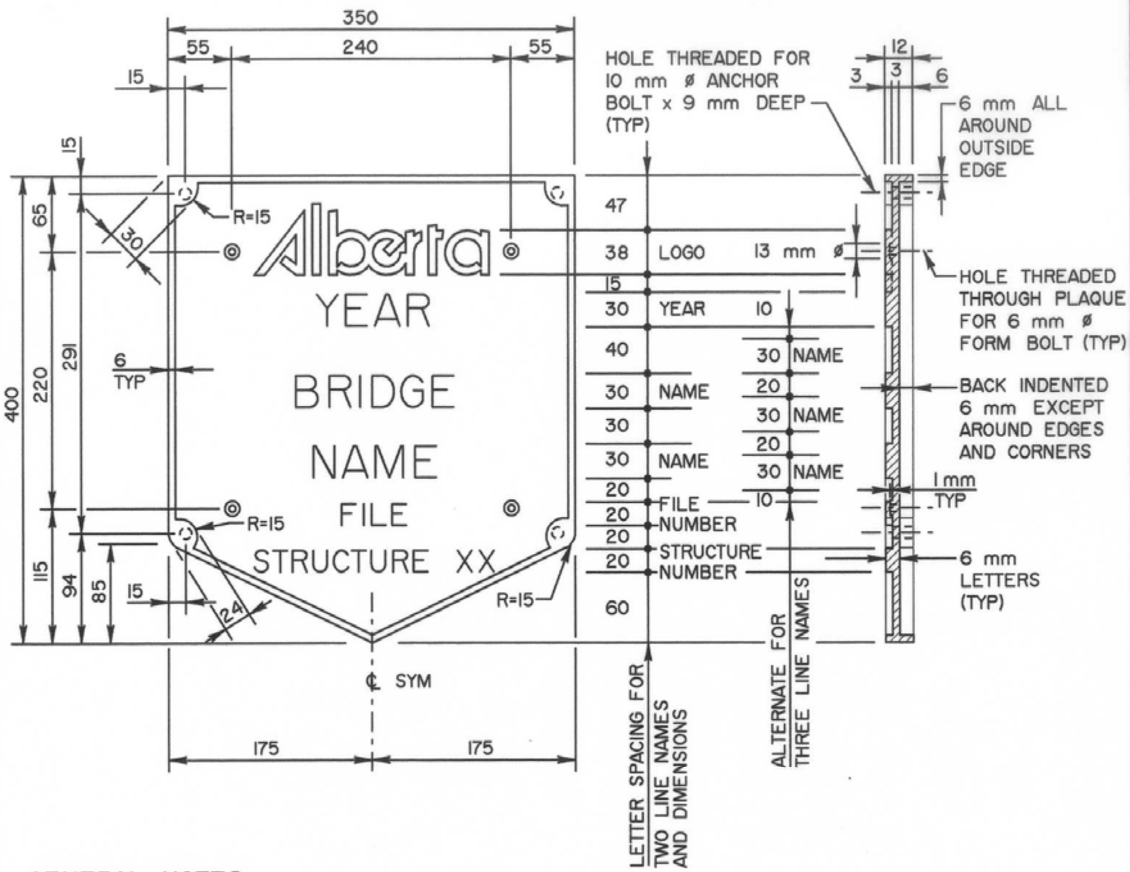
NO	DATE	REVISIONS	BY
4	99-03-29	BEB CHANGED TO TSB	RY
3	98-04-20	TABLET SUPPLIER AND REPORTING NOTES	CTC
2	94-11-30	SMALL CONTRACTS PAGE NO	RJR
1	90-03-01	DRAFTING STANDARDS PAGE NO	VGB

Alberta TRANSPORTATION AND UTILITIES
TECHNICAL STANDARDS BRANCH

STANDARD
BRIDGE BENCH MARK TABLET
INSTALLATION

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	PAGE 2	DRAWING
DHQ	WS	87-09-02	EXECUTIVE DIRECTOR	[signature]	May 8/87	13.9	S-1478

PLOTTED MARCH 29 1999 S1478X87 RV3



GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- PLAQUE TO BE FABRICATED TO DIMENSIONS SHOWN.
- THE ALBERTA LOGO IS TO FOLLOW IN ABSOLUTE DETAIL, DEVIATIONS REQUIRED FOR CASTING PURPOSES MUST BE APPROVED BY THE ENGINEER.
- ALL LETTERS AND NUMBERS CAST ON THE PLAQUE, EXCEPT FOR THE ALBERTA LOGO, SHALL BE UPPER CASE UNIVERS 65. DEVIATIONS MUST BE APPROVED BY THE ENGINEER.
- THE "YEAR" IS THAT OF THE PROJECT'S COMPLETION.
- THE "BRIDGE NAME" IS THE 'STREAM NAME' OR 'STRUCTURE NAME' AND IS PLACED ON 2 OR 3 LINES.
- THE "NAME", "FILE NUMBER" AND "STRUCTURE NUMBER" ARE SPECIFIC TO EVERY BRIDGE SITE AND ARE SHOWN ON THE CONTRACT DRAWINGS.
- THE "STRUCTURE NUMBER" IS TO BE OBTAINED FROM TECHNICAL STANDARDS BRANCH, BRIDGE ENGINEERING SECTION.
- PLAQUE SHALL BE SUPPLIED WITH BLACK BAKED ENAMEL EVERYWHERE, EXCEPT FOR FULL BORDERS AND ALL NUMERALS AND LETTERS, WHICH SHALL BE EXPOSED ALUMINUM.

NO	DATE	REVISIONS	BY
4			
3			
2			
1	2004-05-21	REDRAWN FROM S-1617 REV 2	WS

Alberta TRANSPORTATION
TECHNICAL STANDARDS BRANCH

STANDARD LARGE BRIDGE PLAQUE CASTINGS DETAILS

DESIGNED	DRAWN	DATE	APPROVED	SIGNATURE	DATE	DRAWING
LEA	WS	2004-05-21	EXECUTIVE DIRECTOR	Allan Kwan	May 26, 2004	S-1617-04

PLOTTED MAY 21, 2004 S1617X04.DGN

400.3.15 GUARDRAIL

400.3.15.1 General

This specification is for the supply and installation of approach rail transitions including thrie beam or W-beam guardrail sections, W-thrie beam transition sections, terminal connectors, steel or timber guardrail posts, spacers and hardware as shown on the Detailed Designs.

Drawings shall include Bridge Engineering Standard Drawings for approach rail transitions, and other drawings provided in the Detailed Designs.

400.3.15.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to the commencement of work.

- Mill certificates;
- Repair procedures for galvanizing if required.

400.3.15.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following.

- Acceptance of submissions as outlined in this Section 400.3.15 (Guardrail);
- Visual inspection of the work;
- Audits of the Contractor's quality control/quality assurance inspection and testing records; and
- testing to confirm the acceptability of materials and/or workmanship (see Section 400.3.15.3 (Inspection of Materials)).

400.3.15.2 Materials

400.3.15.2.1 Rails and Terminal Elements

Thrie beam/W-beam guardrail transitions shall consist of rail sections fabricated for installation to develop a continuous beam strength with the necessary safety and feature components.

All rail sections and other components shall match the design profiles and dimensions of the AASHTO/ARTBA hardware requirements for full interchangeability of similar components regardless of the source of manufacturer.

The rails and transition elements shall be manufactured from open hearth, electric furnace or basic oxygen semi-spring steel sheet and hot dip galvanized after fabrication, all in general accordance with the AASHTO Standard Designation M180 and shall conform to the Detailed Designs.

Rails and transitions shall be punched for splice and post bolts in conformity with the AASHTO Standard to the designated number of and centre to centre spacing of posts. If holes are punched after galvanizing the galvanizing around the hole shall be repaired in accordance with Section 400.3.13.2.6 (Galvanizing).

The rails and transition elements shall be manufactured according to the following standards:

Metal Properties

Properties of the base metal shall conform to the following requirements:

Minimum Yield Point:	345 MPa
Minimum Tensile Strength:	483 MPa
Minimum Elongation:	Minimum 12% in 50mm length

Sheet Thickness

The rails and transition elements thickness shall be manufactured according to Table 2 (Class A, Type 2) of AASHTO Standard M180 of the last edition with nominal base metal thickness of 2.8mm (2.57mm minimum) unless noted otherwise on the Detailed Designs.

Sheet width for the W-beam rail shall be 483mm with a permissible tolerance of minus 3mm.

Sheet width for the thrie beam rail shall be 750mm with a permissible tolerance of minus 3mm.

All welding required for the fabrication of terminal elements shall conform to the requirements of CSA W59M. Only welders, welding operators and tackers approved by the Canadian Welding Bureau in the particular category may be permitted to perform weldments.

All rails and transition elements shall be hot dip galvanized after fabrication conforming to CSA G164M.

A copy of the producer's certificate, conforming to Section 16 of CSA G40.20M, for each of the mechanical and chemical tests, including impact tests, shall be provided to the Department upon request.

400.3.15.2.2 Bolts, Nuts and Washers

All bolts, nuts and washers shall conform to ASTM A307, unless noted otherwise on the Detailed Designs, and shall be hot dip galvanized conforming to CSA G164M.

400.3.15.2.3 Wood Posts

Posts and offset blocks shall be Douglas Fir, Hemlock, Lodgepole Pine or better and shall meet the current edition of the National Lumber Grades Authority (NLGA) for No. 1 Structural Posts and Timbers graded conforming to the NLGA Standard Grading Rules for Canadian Lumber.

Posts shall be date stamped at the top of either side of the post not used for rail attachment with the last two digits of the year of installation. The stamp shall be 50mm x 50mm and have an indentation of 3mm.

Posts and blocks shall be rough sawn and holes drilled to the finished dimensions shown on the Detailed Designs. Surfacing shall be completed and incised prior to treatment with allowable tolerance of 1.5mm.

Wanes on any face shall not exceed the following width:

Above ground (including blocks):	25mm
Below ground:	60mm

Posts and blocks shall be pressure preservative treated in accordance with the current requirements of CSA Standard 080.

The retention of preservatives shall be as per assay and shall conform to the requirements of CSA Standard 080.14 Table 1, minimum retention of preservatives in pressure treated wood for highway construction, under the headings "Post-Guardrail, Guide, Sign and Sight" for posts and "Bridge Hand Rails, Guard Rails and Posts" for timbers not in contact with the ground or water.

400.3.15.2.4 Steel Posts

Steel for posts, spacers and hardware shall conform to CSA Standard G40.21 Grade 350W or ASTM Standard A36 and shall be hot dip galvanized after fabrication conforming to CSA G164M.

400.3.15.3 Inspection of Materials

All guardrail materials shall be inspected by the Department and materials which fail to meet these specifications will be rejected, and shall be replaced or repaired.

400.3.15.3.1 Guardrail Materials

The size and thickness of 2.67mm nominal base metal thickness rails and transition elements shall be within the tolerance specified below:

Base metal thickness		2.67mm
Galvanized finished thickness	-	2.82mm
Tolerance	-	0.23mm

The size and thickness of 3.5mm nominal base metal thickness rails and transition elements shall be within the tolerance specified below:

Base metal thickness		3.43mm
Galvanized finished thickness	-	3.58mm
Tolerance	-	0.25mm

400.3.15.3.2 Timber Material

Testing of the penetration of the preservative may be carried out by the Department. Warped wood posts will be rejected.

400.3.15.4 Installation

Guardrail shall be accurately set to the required depth and alignment, in a manner resulting in a smooth continuous installation, as shown on the Detailed Designs. Permissible tolerance for plumb and grade of posts shall be 6 mm maximum.

Holes for the guardrail posts shall be excavated by auger. The diameter of the holes augered shall be of sufficient size to allow for pneumatic tamping.

Unsuitable material at the bottom of the holes excavated shall be replaced with granular material as directed by the Design Engineer or the Department. The Contractor shall thoroughly compact the bottom of the hole. The guardrail posts shall rest directly and solidly on the bottom of the hole at the time of installation.

Excavated material which is unsuitable for use as backfill shall be replaced with granular material meeting the requirements of Section 400.3.3.2.2 (Gravel Material and Crushed Aggregate Material) for Designation 2, Class 25 material. Backfill shall be thoroughly compacted, using pneumatic tampers, in layers not exceeding 150 mm, for the full depth of the excavation. Where posts are installed on paved surfaces, the backfill for the top 150mm shall be completed using ACP in accordance with Section 400.3.17 (Asphalt Concrete Pavement).

Guardrail laps shall be in the direction of traffic flow. Bolts shall be tightened to a minimum torque of 100 Nm. Metal reflectors (Scotchlite or equivalent) shall be supplied and attached to the top of every third guardrail post with two 50mm ring nails.

The Contractor shall take all necessary precautions to eliminate damage to galvanizing. Minor abrasions shall be repaired by painting with two coats of zinc rich paint. Major abrasions shall be repaired by regalvanizing. The method to be used for repair of any damage shall be reviewed by the Design Engineer and then accepted by the Department before such work is commenced. The Contractor shall repair or replace components to the satisfaction of the Department.

The approach guardrail transition shall be connected to the bridgerail or parapets as shown on the Detailed Designs.

Surplus excavated material and debris shall be removed from the site.

400.3.16 BRIDGE DECK WATERPROOFING

400.3.16.1 General

This specification is for the supply and installation of the deck waterproofing system as shown on Standard Drawing S-1443-98 (see Section 300.4.2.7 (Durability)). The area to be covered by the waterproofing system shall be as shown on the Detailed Designs.

400.3.16.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work.

- samples of proposed protection board.

400.3.16.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following.

- Acceptance of submissions as outlined in this Section 400.3.16 (Bridge Deck Waterproofing);
- Visual inspection of the work;
- Audits of the Contractor's quality control/quality assurance inspection and testing records; and
- Testing to confirm the acceptability of materials and/or workmanship (see Section 400.3.16.5.2 (Inspection and Testing by the Department))

400.3.16.2 Materials

All materials for this application shall be accepted by the Design Engineer and the Department.

Tack Coat

The tack coat used in conjunction with the asphalt membrane shall be primer, cut back with an equal volume of gasoline type solvent, or an acceptable alternative cut-back asphalt product and be compatible with the asphalt membrane.

Asphalt Membrane

Asphalt membrane shall be hot applied rubberized asphalt and shall be supplied in cakes ready for melting and application.

Rubber Membrane

The rubber membrane shall be 1.2mm thick butyl rubber.

Waterproofing Protection Board

The protection board shall be a durable panel of 3mm thickness specifically designed to provide a protective cushion between the hot mix asphaltic concrete pavement and the asphalt waterproofing membrane. It shall have a water absorption property of 5% or less and shall meet the Ontario Ministry of Transportation and Communications Material Specification for Protection Board.

400.3.16.3 Equipment

A heating and mixing kettle accepted by the Department shall be used to heat the hot-applied rubberized asphalt membrane. The kettle shall be of the double boiler oil transfer type with a built-in agitator and equipped with permanently installed dial type thermometers to measure the temperature of the melted compound and the oil.

400.3.16.4 Installation

400.3.16.4.1 Traffic Restrictions

Traffic restrictions apply to all traffic other than the construction equipment directly associated with the waterproofing operations and the paving operations that follow.

After sandblasting operations have commenced, construction traffic will not be allowed on the sandblasted area until the ACP has been placed and cooled to ambient temperature.

400.3.16.4.2 Procedure

The Contractor shall perform all of the operations involved in waterproofing in sequential order, such that there are no delays between individual operations except those necessary to meet the requirements of this Section 400.3.16 (Bridge Deck Waterproofing).

400.3.16.4.3 Notice of Commencement of Waterproofing Operations

The Contractor shall give the Department 48 hours notice prior to commencing any waterproofing operations.

400.3.16.4.4 Surface Preparation

The deck concrete, including curbs, sidewalks and medians must be completely dry and cured at least 14 days before application of tack or membrane can proceed.

The existing surface of the concrete shall be completely sandblasted or shotblasted to expose sound, laitance-free concrete. All dirt and debris shall be removed and disposed of, leaving a prepared surface satisfactory for tack coating. Tack coating and waterproofing shall not commence until the Design Engineer and the Department have accepted all preparation work.

Immediately prior to the application of the tack coat, the concrete surface shall be air blasted to remove all dust and any other foreign material. The tack coat shall be cut back 50% with gasoline solvent. The application rate shall be such that the tack material will be absorbed into the concrete, resulting in a surface that is dull and black in appearance. The application of an excessive amount of tack as indicated by a shiny black surface shall be avoided. Tack coat material shall be applied with approved equipment which will provide uniform application at the required rate. The tack coat shall be applied only when the concrete is dry and clean, and when the air and concrete surface temperatures are above 5^0C. Waterproofing equipment or material shall not be permitted on the tack coat until it has fully cured and is completely tack-free.

400.3.16.4.5 Waterproofing of Joints and Cracks

Special attention shall be paid to waterproofing over all construction joints, and over any cracks designated by the Design Engineer or the Department that would not be bridged by the asphalt membrane.

Prior to the application of the asphalt membrane to the deck, a coat of hot asphalt membrane at least 4mm thick and wide enough to extend 200mm on either side of the joint or crack shall be applied in accordance with Section 400.3.16.4.8 (Application of Protection Board), to the tack-coated concrete surface. A strip of butyl rubber membrane material wide enough to extend 150mm on either side of the joint or crack shall be applied while the asphalt membrane is still hot. Along all curbs, barrier walls, and deck drains the hot asphalt membrane shall be applied to the height of the top of the hot mix surface course, and 150mm onto the deck. The rubber membrane shall extend 40mm up the vertical faces, and 110mm onto the deck surface.

400.3.16.4.6 Waterproofing Around Deck Drip Tubes

Special attention shall be paid to waterproofing around the deck drip tubes. The asphalt membrane shall be carefully applied around the drain tubes so that a positive seal is obtained. (It may be necessary to temporarily plug the tubes prior to waterproofing in order to prevent the entrance of hot membrane.) The tubes shall be trimmed flush with the top of the membrane to allow free drainage of water.

400.3.16.4.7 Application of Asphalt Membrane

Cakes of asphalt membrane shall be melted in the mechanically agitated heating and mixing unit specified. This unit shall keep the contents continuously agitated until the material can be drawn free flowing and lump-free from the mixing unit at a temperature not exceeding that recommended by the Manufacturer.

Membrane shall not be applied until the tack coat has cured completely. The asphalt membrane shall be applied within the temperature range recommended by the Manufacturer, to the clean, tack-coated concrete deck, to form a uniform film having a minimum thickness of 4mm and a maximum thickness of 6mm. The laying operation shall commence at the low end of the bridge and shall be such that discontinuities in the membrane are avoided and any joints lapped 150mm. The membrane shall be applied over all waterproofed joints and cracks, and shall extend up the face of curbs, medians, barrier walls, and deck drains, to the height of the top of the hot mix surface course. Deck drains and drainage tubes shall not be plugged.

400.3.16.4.8 Application of Protection Board

The Contractor shall check and ensure that the asphalt membrane thickness conforms to the Technical Requirements, prior to placing the protection board. Protection boards shall be laid on the asphalt membrane commencing at the low end of the bridge and overlapping to produce a shingling effect, while the membrane is still hot, with the length of the board running transversely, on the deck. The protection boards shall be placed with edges overlapping 25mm both longitudinally and transversely. The protection board edge shall be within 5mm of all curbs, drain verticals, and deck joint verticals.

Protection boards shall be placed such that the longitudinal (direction of traffic flow) joints are staggered at least 150mm. It shall be rolled by means of a linoleum or lawn type roller while the membrane is still warm, in order to ensure good contact with the membrane. Holes shall be cut through the protection board to allow water to drain freely through the drainage tubes. In instances where edges of the protection board curl up, the edges shall be cemented down using hot membrane material to the satisfaction of the Design Engineer and the Department. Protection boards that are warped, distorted or damaged in any way, by manufacture, storage, handling or exposure to weather, shall be rejected.

400.3.16.5 Inspection and Testing

400.3.16.5.1 Inspection and Testing by the Contractor

The Contractor shall be responsible for all quality control and quality assurance requirements to ensure the work meets the Technical Requirements and the requirements of the Detailed Designs.

Any quality control/quality assurance testing and inspection records made by the contractor shall be open to the Department for auditing.

400.3.16.5.2 Inspection and Testing by the Department

The Department may require that sufficient quantities of the asphalt membrane, rubber membrane, and protection board be supplied from the materials being used on the project for immediate analysis, flow tests, water absorption, or for other future testing purposes.

Test results and samples of proposed protection board shall be submitted to the Department for review. The Department may carry out additional testing to confirm test data provided.

400.3.16.6 List of Approved Materials

400.3.16.6.1 Hot Applied Rubberized Asphalt Membrane

- "Bakor" 790-11
- "Tremproof" 150
- "Permaquick 6100" W.I. 250
- "Hydrotech 6125"
- "Beamalastic 1213 BDM".

400.3.16.6.2 Rubber Membrane

- "Elastosheet 6147"
- “BP47 Elastometric Reinforcement”
- “Bakor 990-25"

400.3.16.6.3 Waterproofing Protection Board

Acceptable products of Protection Board shall consist of spun glass fibres and not cellulose reinforcing fibres. Products which currently meet the 5% or less water absorption requirement are:

- "Vibraflex MTO Protection Board"
- "Bakor Asphalt Protection Board"
- "IKO Protectboard".

400.3.17 ASPHALT CONCRETE PAVEMENT

400.3.17.1 General

Asphalt Concrete Pavement shall consist of crushed aggregates with reclaimed asphalt pavement (RAP), blend sand and filler material as required, and asphalt cement, combined in a hot mix plant as hereinafter specified, placed and compacted over hot applied rubberized asphalt membrane waterproofing complete with protection board on bridge decks in conformity with the lines, grades, dimensions and cross-section as provided and as shown on the Detailed Designs.

This specification shall be used in conjunction with Section 400.2.27 (Asphalt Concrete Pavement). In areas of conflict between this specification and Section 400.2.27 (Asphalt Concrete Pavement), this specification shall govern.

400.3.17.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work.

- asphalt mix design
- repairs of segregated ACP, if required

400.3.17.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following.

- Acceptance of submissions as outlined in this Section 400.3.17 (Asphalt Concrete Pavement);
- Visual inspections of the work;
- Audits of the Contractor's quality control/quality assurance inspection and testing records; and
- Testing to confirm the acceptability of materials and/or workmanship (See Sections 400.3.17.4.2 (Inspection and Testing by the Department) and 400.3.17.7.5).

400.3.17.2 Materials

The Contractor shall supply Aggregates and Asphalt Cement in accordance with Sections 400.2.20 (Aggregate Production and Stockpiling) and 400.2.33 (Supply of Asphalt).

A liquid asphalt shall be applied as a tack coat to ensure a bond between the surface being paved and the subsequent course, and shall consist of SS-1 or RC 30/70. When SS-1 is used it shall be diluted with an equal volume of water. In all cases where weather conditions permit, SS-1 shall be used in preference to RC 30/70. The tack coat materials shall conform to the specifications listed in Tables ASPH6 and ASPH7 of Section 400.2.33 (Supply of Asphalt).

The Contractor shall produce crushed aggregates in accordance with Section 400.2.20 (Aggregate Production and Stockpiling) for Designation 1 aggregate. The Contractor shall be totally responsible for production of aggregate that meets all the specified requirements.

400.3.17.3 Asphalt Mix Design

The Contractor shall prepare and submit asphalt mix designs in accordance with Section 400.2.27 that are representative of materials to be used. For asphalt mix designs which were completed in excess of six months prior to anticipated production, additional analysis of more recent sampling shall be provided, as required to confirm that the mix ingredients continue to meet requirements.

The asphalt mix type and grade of asphalt cement shall be as specified for the surface lift for the adjacent roadway.

400.3.17.4 Inspection and Testing

Unless otherwise specified sampling and testing procedures used to determine material characteristics shall be as outlined in Section 400.2.27 (Asphalt Concrete Pavement).

400.3.17.4.1 Inspection and Testing by the Contractor

The Contractor shall be responsible for all quality control and quality assurance testing required to ensure that the work meets the requirements of the Technical Requirements and the Detailed Designs. Quality control testing shall meet the requirements of Section 400.3.17.5 (Quality Control Testing).

Any quality control/quality assurance testing and inspection test records made by the Contractor shall be open to the Department for auditing.

400.3.17.4.2 Inspection and Testing by the Department

The Department shall have access to the work at all times for taking samples. The Contractor shall provide any assistance necessary for taking samples and shall reinstate pavement layers or other structures to the satisfaction of the Department at the positions where samples have been taken.

Sampling of the asphalt mixture by the Department will be done at a minimum frequency of two samples for each lift of placement. Sample size shall be 6 kg.

Acceptance testing done by the Department on each sample will consist of an uncorrected asphalt content determination and aggregate gradation.

The Department shall use the Contractors correction factor determination as a guide to approximate an actual asphalt content. The actual asphalt content is the amount of asphalt binder in the mix as determined by ATT-12 or ATT-74, and includes a correction factor for the asphalt binder lost due to absorption by the aggregate or aggregate loss.

In-place density testing may be carried out on an as required basis at locations as determined by the Department.

Inspections during construction for pavement segregation shall be as outlined in Section 400.2.27.6.8 (Pavement Segregation Requirements) of the Technical Requirements. Contrary to

Section 400.2.27.6.8 (Pavement Segregation Requirements) areas identified as either moderate or severe segregation, shall be removed and replaced. Areas identified as slight segregation shall be repaired using a slurry patch.

The Department's acceptance of any materials or mixtures shall in no way relieve the Contractor from his obligation to provide materials, mixtures and workmanship in accordance with the specifications.

400.3.17.5 Quality Control Testing

Unless otherwise specified, the latest edition of the following standard Department test methods (ATT) will be used to determine material characteristics.

Test methods and minimum frequencies of testing are shown in Table 17.5 Testing Requirements.

Table 17.5
Testing Requirements

Test	Standard	Minimum Frequency
AGGREGATE PRODUCTION		
SIEVE ANALYSIS 1. Sieve Analysis Crushed Aggregate	ATT- 26	Minimum of one test for each aggregate component.
PERCENT FRACTURE 1. Percent Fracture Crushed Aggregate	ATT- 50	Minimum of one test for each crushed aggregate component.
ASPHALT MIX PLANT 1. Calibration 2. Inspection	 ATT-17 ATT-16	 Once per project or as required Minimum of one per lift.
SAMPLES		
1. Asphalt Cement	ATT-42	If requested by the Department
2. Tack, Prime and Fog Materials	ATT-42	If requested by the Department
3. Cold Feed Aggregate	ATT-38	(3)
4. Mix	ATT-37	Minimum of one per lift
5. QA Cores - Stratified Random Test Sites Chosen By The Department (Coring done by Contractor)	ATT-56 ATT-5	As requested by the Department

Test	Standard	Minimum Frequency
OTHER SPECIFIED TESTS		
1. Mix Asphalt Content	AASHTO T-164, T287 or ATT-12 or ATT-74	Minimum of one per lift.
2. Correction Factors	ATT-12, Part III or ATT-74, Part II	Once for each mix design.
3. Mix Moisture Content	ATT-15	Minimum of one per lift.
4. Aggregate Sieve Analysis	ATT-26	(3)
5. Pavement Segregation	Paving Guidelines and Segregation Rating Manual	Daily Inspection
ADDITIONAL TESTING REQUIREMENTS		
1. Field Formed Marshall Briquettes	ATT-13	(1)
2. Density Immersion Method, Saturated Surface Dry	ATT-7	(2)
3. Void Calculations, Formed Specimens	ATT-36	(1)
4. Temperatures	ATT-30	(1)
5. Percent Compaction, Nuclear Density	ATT-67, ATT-5 or ATT-11	(2)

Notes: (1) Minimum frequency not specified.
(2) Nuclear Density Testing is required on all projects. The Department may require the Contractor to obtain pavement cores (top lift only) for quality management testing.
(3) One sieve analysis of the combined aggregate (any combination of cold feed, extraction or ignition) are required per lift.

400.3.17.6 Equipment and Methods

400.3.17.6.1 General

Equipment and methods used on this work shall be adequate to produce and place the material as specified herein, and shall be subject to the acceptance of the Design Engineer and the Department. The Department reserves the right to order changes or the discontinuance of use of any equipment or method which, in the opinion of the Department, fails to produce satisfactory results.

400.3.17.6.2 Asphalt Mixing Plant Requirements

All asphalt mixing plants used by the Contractor for the preparation of asphalt concrete material shall conform to the requirements of Section 400.2.27 (Asphalt Concrete Pavement). The Contractor shall provide the Department with a certificate of calibration which certifies that the plant has been calibrated to produce a uniform mixture in accordance with the Job Mix Formula.

400.3.17.6.3 Equipment for Transportation of Mixture

The mixture shall be transported from the asphalt plant to the worksite in trucks with smooth metal boxes in good and leakproof condition, previously cleaned of all foreign materials or hardened asphalt concrete mixture. Each vehicle shall be equipped with a tarpaulin of suitable material and of sufficient size to overhang the vehicle box when fully loaded. Tarpaulins shall be on the haul unit at all times and shall be used to cover the mixture completely unless otherwise determined by the Department. Tarpaulins shall be securely fastened on all sides of the box.

Truck boxes shall be clean, free from accumulations of asphalt mix and foreign material. Excess truck box lubricants such as detergent or lime solutions shall not be allowed to contaminate the mix, and shall be disposed of in an environmentally acceptable manner. Petroleum based truck box lubricants shall not be used

400.3.17.6.4 Paver

Pavers shall be acceptable to the Department and be self-propelled and operated to maintain required levels, cross-falls and joint matching.

400.3.17.6.5 Compaction Equipment

The Contractor shall provide sufficient self propelled equipment to obtain the required degree of compaction of the asphalt concrete mixture. The compaction capability of the equipment used shall equal or exceed the placing rate of the spreading operations and shall be capable of obtaining the required compaction before the temperature of the mat falls below specified levels. Compaction equipment shall be of a suitable size, weight and type as acceptable to the Department, such that displacement of the mat and/or disruption of underlying materials does not occur. Specialized equipment may be required to achieve adequate compaction and smoothness in tight corners, such as adjacent to expansion assemblies and deck joints.

The Contractor is advised that a minimum of two pieces of compaction equipment shall be provided. They shall be rollers of at least 10 tonnes mass, one rubber tired and one smooth steel drum type. Vibrators on vibratory rollers shall not be activated.

The compaction equipment shall be in proper mechanical condition and shall be operated such that uniform and complete compaction is obtained throughout the entire width, depth and length of the pavement being constructed. Rollers provided shall leave a smooth, properly finished surface, true to grade and cross-section without ruts or other irregularities. All compaction equipment shall be equipped with methods of wetting the tires or drums to prevent adhesion or pickup of the asphalt mixture.

400.3.17.7 Construction

400.3.17.7.1 Asphalt Temperatures

The asphalt tank supplying the plant mixer shall be equipped with heating apparatus capable of producing asphalt temperatures up to but not greater than 160°C uniformly throughout the entire contents of the tank. The Contractor shall maintain the asphalt temperature within plus or minus 10°C of the specified mixing temperature.

400.3.17.7.2 Mix Production

The Contractor shall produce an asphalt mixture in accordance with Section 400.2.27.5.1 (Equipment).

400.3.17.7.3 Protection of Adjacent Bridge Components

The Contractor must protect curbs, deck joints, and expansion assemblies to prevent splatter or spillage of asphaltic materials.

400.3.17.7.4 Tack Coat

Asphalt tack coat shall be applied to the existing protection board, waterproofing and between lifts of asphalt concrete pavement, at the locations and to the dimensions designated by the Design Engineer.

The surface to be tacked shall be dry and free of loose or deleterious material when the tack is applied.

The asphalt tack coat shall be applied in a uniform manner at an application rate of 0.5 ℓ/m2 and asphalt temperature designated by the Design Engineer and accepted by the Department. Air temperature in the shade at the time of application shall be 5°C or higher.

On areas where the Contractor is required to accommodate traffic, it shall tack the surface in two operations. In the first operation one half of the width shall be tacked with the remaining half being tacked after the first half has cured.

The tack coat shall be protected from traffic or other damage. Areas on which the tack has been damaged by traffic shall be retacked.

400.3.17.7.5 Spreading and Compaction

General

The mixture shall be placed only upon a dry, unfrozen substrate on which the tack coat has cured, and under weather and temperature conditions acceptable to the Design Engineer and the Department. Prior to the delivery of the mixture on the work, the base shall be cleaned of all loose or foreign material. The mixture shall be spread and compacted during daylight hours only, unless artificial light satisfactory to the Department is provided.

During spreading and compaction operations, care shall be taken at all times to ensure that:

- Asphalt mixture is not wasted over the side or onto the adjacent surface mat.
- Damage is not done to the waterproofing membrane, curbs, manholes, drains or medians.
- Damage is not done to guide posts, guardrails, signs, power conduits or any other roadside installations.

The Contractor shall make immediate and adequate repair of any damage resulting from his operations.

Spreading

The mix shall be spread at a temperature sufficient for specified compaction and finishing at the final placement area.

The manner of placing shall be as acceptable to the Department to ensure safe accommodation of traffic, quality control and drainage. The longitudinal and transverse edges of each lane shall be straight in alignment, uniform, and of the same thickness as the adjoining pavement layer. Adequate measures for the protection of the exposed edges shall be maintained throughout the work.

Each layer shall be placed, finished and compacted for the full width, and then allowed to cool down to 50°C or colder prior to commencing the subsequent layer.

In the placing of successive layers, the individual mixture spreads shall be aligned in a manner such that the longitudinal joints in successive layers do not coincide. Unless otherwise directed by the Department, the lateral distance between the longitudinal joints in the successive layers shall be not less than 0.30 m. The longitudinal joint of the final lift of asphalt concrete pavement shall not be located within the wheel path areas.

The surface of all lifts shall not exhibit evidence of segregation, such as pockets of fine and coarse material.

All longitudinal and transverse joints shall be of the vertical butt joint type, made in a careful manner, well bonded and sealed, and shall be finished to provide a continuous, smooth profile across the joints.

Compaction

The Contractor shall monitor the compaction process using a Control Strip Method. Control Strips are generally established on each mat placed.

The Control Strip lift shall be compacted using at least the following equipment:

(a) One steel roller weighing not less than 10 t; and

(b) One self-propelled pneumatic rollers, ballasted to its maximum capacity, weighing not less than 10 t.

Once the mix has been spread by the paver and the initial pass of the breakdown roller has been done, moisture and density measurements for determining the Control Density will commence at five locations within the Control Strip area, and will continue following repeated passes of the compaction equipment until the apparent maximum density is attained. These measurements will be taken by the Department using nuclear testing equipment.

The Contractor shall compact the pavement to a minimum average density of 97% of Marshall Density, with no individual density less than 95%.

When the compaction methods and procedures, in the opinion of the Department is not achieving the desired compaction specifications, the Department may require the Contractor, at any time to obtain cores of the top lift pavement. The number of cores will be determined by the Department. The cores will be tested by the Contractor and the results provided to the Department as they become available.

Percent compaction will be expressed in percent of Marshall Standard Density. The Marshall Standard Density used for determining pavement compaction shall be as follows:

(a) Marshall Densities determined on field sampled mix, or if not available then;
(b) Marshall Design Density as reported in the accepted mix design.

Coring shall be done using methods which will not damage the rubberized asphalt membrane or protection board. Core holes shall be completely de-watered and dried. A generous application of liquid asphalt shall be applied to the bottom and sides of the core hole and allowed to cure. Asphalt mix shall then be tamped in lifts into the core hole until flush with the surface of the surrounding pavement.

The Contractor shall not undertake any coring unless accepted by the Department.

In order to maintain the crown of the bridge deck and approaches, the contractor shall avoid operating the compaction equipment on or across the crown. Compaction procedures and equipment shall be such that displacement of the mixture does not occur. Roller wheels shall be kept slightly moistened by water or oil to prevent picking up the mixture, but an excess of either water or oil will not be permitted.

In cases where the asphaltic mixture is placed under weather and temperature conditions which may be considered less than ideal, the Contractor shall modify normal operations and provide special attention to these situations such that specified compaction results are achieved.

Hot-Applied Rubberized Membrane Waterproofing

The first layer of the ACP Wearing Surface shall be spread by the asphalt paver moving with the laps in the protection board.

With the possibility of damage to the waterproofing membrane, the paver must not push the delivery trucks and all equipment must perform all turning movements off the bridge deck. Dumping of the asphalt mixture onto the protection board ahead of the paver will not be permitted.

The prepared material shall be placed and compacted in two nominal 40mm layers.

To avoid displacement of the mixture the first lift shall be compacted only after the spread asphalt mixture has cooled to 105°C. The second lift shall be compacted when the spread asphalt mixture is within the following temperature ranges:

	COMPACTION TEMPERATURE RANGE	
ASPHALT GRADE	**FIRST LIFT**	**SECOND LIFT**
150 - 200 (A)	MAX. 105°C	128°C - 138°C
200 - 300 (A)	MAX. 105°C	123°C - 133°C

Due to the cooler compaction temperature (105°C) of the first lift, it may not be possible to achieve the 97 percent average density.

400.3.17.7.6 Surface Defects and Material Tolerances

The completed pavement and all intermediate lifts shall be smooth, true to established cross-section and grade, thoroughly compacted and free from ruts, humps, depressions, or other irregularities. Any ridges, indentations or other objectionable marks left in the surface of the asphalt concrete pavement shall be eliminated by rolling or by other means. The Contractor shall be responsible for all repairs of Surface Defects.

Smoothness

Except across the crown, the surface shall be such that when tested with a 3 m long straight edge placed anywhere in any direction on the surface, there shall not be a gap greater than 3 mm between the bottom of the straight edge and the surface of the deck anywhere below the straight edge. The surface shall be checked by the Department, as described above, immediately after the final rolling.

Any final lift pavement surface which does not meet the smoothness requirements given above shall be repaired by the Contractor to meet the requirements using methods acceptable to the Department.

Material removed by cold milling shall be hauled and disposed of by the Contractor.

Segregated Areas

Segregated areas identified by the Department shall be repaired by the Contractor. Methods of repair for segregation shall be as reviewed by the Design Engineer, and then accepted by the Department.

Obvious Defects

The finished surface of any lift shall have a uniform close texture and be free of visible signs of poor workmanship. Any obvious defects as determined by the Department such as, but not limited to the following, shall be promptly repaired in a manner acceptable to the Department.

(a) areas of excess or insufficient asphalt.

(b) improper matching of longitudinal and transverse joints.

(c) roller or tire marks.

(d) cracking or tearing.

(e) sampling locations not properly reinstated.

(f) improperly constructed patches.

Asphalt Content

For top lift material the average asphalt content shall not be greater than ±0.50% from the accepted mix design asphalt content.

For bottom lift material the average asphalt content shall not be greater than ±0.65% from the accepted mix design asphalt content.

Aggregate Gradation

For each lift of placement the difference between the average gradation and the Job Mix Formula gradation shall not exceed the amounts shown in the following table:

Aggregate Gradation Variation

Sieve Designation	**Maximum Permissible Variation* Percent by Weight Passing**
5000	±6
1250	±4

Sieve Designation	Maximum Permissible Variation* Percent by Weight Passing
630	±3
315	±3
160	±2.5
80	±2.0
*In any case the Average Gradation must meet the gradation requirements of Section 400.2.20 (Aggregate Production and Stockpiling)	

400.3.18 SUPPLY AND CONSTRUCTION OF CSP AND SPCSP STRUCTURES

400.3.18.1 General

This specification is for the supply, fabrication, delivery and installation of Corrugated Steel Pipe and Structural Plate Corrugated Steel Pipe with an equivalent diameter of 1500 mm or greater.

Abbreviations for the various types of metal pipe are as follows:

CSP	Corrugated Steel Pipe
CSP Arch	Corrugated Steel Pipe Arch
SPCSP	Structural plate Corrugated Steel Pipe
SPCSP Arch	Structural plate Corrugated Steel Pipe Arch

400.3.18.1.1 Submissions

Unless specified otherwise the following information shall be submitted to the Department at least seven days prior to commencement of work.

- Shop drawings (five copies); and
- Dates fabricated materials are to be shipped from the fabricating plant. This information shall be provided to the Department a minimum of two days prior to shipping.

400.3.18.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following:

- Acceptance of submissions as outlined in this Section 400.3.18 (Supply and Construction of CSP and SPCSP Structures);
- Visual inspection of the work;
- Audits of the Contractor's quality control/quality assurance inspection and testing records;

and
- Testing to confirm the acceptability of materials and/or workmanship (see Section 400.3.18.4.5 (Inspection and Testing)).

400.3.18.2 Reference Drawings

Installation of Large Steel Pipes, Standard Drawing S-1418-03 (see Sections 400.3.18.5.2 Bedding) and 400.3.18.5.4 (Backfilling)).

400.3.18.3 Reference Tables (attached after Section 400.3.18.8)

Details of Standard 2:1 Sloped End Sections for CSP Round Culverts	A
Details of Standard 2:1 Sloped End Sections for CSP Arch Culverts	B
Details of Standard 2:1 Sloped End Sections for SPCSP Round Culverts	C

400.3.18.4 Supply and Fabrication

400.3.18.4.1 Standards

The supply and fabrication of all galvanized, polymer coated and aluminium coated Corrugated Steel Pipe including couplers and appurtenances and Structural Plate Corrugated Steel Pipe shall be in accordance with the current edition of CSA Standard G401 with additions and exceptions as described in this specification.

400.3.18.4.2 Engineering Data

Shop Drawings

Five copies of the shop drawings for SPCSP structures and any non-standard materials (e.g. elbows, bottomless arch details, horizontal ellipses, etc.) as well as bevel end details shall be submitted to the Design Engineer for review and then to the Department for acceptance prior to fabrication.

Plate Arrangement

The arrangement of the plates for SPCSP structures shall be shown on the shop drawings. The drawings shall also indicate that the bolts in the valley of each longitudinal seam are nearer to the visible edge of the plate than the bolts in the crest. With the exception of "change of radii" locations, all longitudinal seams shall be staggered a minimum of 2N.

The Contractor shall use the shop drawings at the site to facilitate the assembly of the pipe.

400.3.18.4.3 Materials

Previously installed pipe shall not be used. All pipe supplied shall be clearly marked with the following information at intervals of not less than 3m.

- Manufacturer's Name or Trade Mark
- Nominal Thickness and Type of Metal
- Plate/Metal Coating (for non standard coating)
- Specification Designation
- Plant Designation Code
- Date of Manufacture

400.3.18.4.4 Fabrication

Fabrication of CSP

Sloped Ends
Sloped end sections are required for each culvert unless otherwise shown in the Detailed Designs. When 2:1 sloped end sections are specified the attached Tables A and B (attached after Section 400.3.18.8 (Rock Riprap)) will apply unless stated otherwise.

Termination of Lockseams

On pipes 1000mm diameter or larger all lockseams terminating at the cut edges of a sloped or square end section shall have a 75mm length of fillet weld run along both sides of the lockseam (staggered 300mm apart) at each cut edge. The weld and surrounding area shall be zinc coated in accordance with CSA G401.

Cut Ends

All cut edges of a sloped or square end section shall be made smooth by grinding so that all the burrs are removed. Any damaged protective coating shall be recoated with appropriate material in accordance with CSA G401.

Recorrugated Ends

All corrugated steel pipes shall have ends recorrugated to provide annular corrugations for couplers.

Couplers

Only annular corrugated couplers will be accepted by the Department. The couplers for pipes 1600mm and over in diameter shall be a minimum of 600mm width. There shall be a minimum of five bolts per coupler.

Fabrication of SPCSP

Sloped Ends
Sloped end sections are required for each culvert unless otherwise noted on the Detailed Designs. When 2:1 sloped end sections are specified the attached Table C (see Section 400.3.18.8 (Rock Riprap)) will apply unless stated otherwise.

400.3.18.4.5 Inspection and Testing

Inspection and Testing by the Contractor

The Contractor shall be responsible for all quality control and quality assurance testing required to ensure that the work meets the Technical Requirements and the requirements of the Detailed Designs. Any quality control/quality assurance testing and inspection records made by the Contractor shall be open to the Department for auditing.

Inspection and Testing by the Department

All materials shall be subject to inspection, sampling and acceptance testing by the Department. The Contractor shall provide safe, convenient access acceptable to the Department for inspection and sampling of the materials, and shall cooperate in the inspection and sampling process when requested to do so.

Any material found unacceptable by the Department shall be replaced with acceptable material by the Contractor.

Reinspection required due to faulty work shall be paid by the Contractor.

Notification

The Contractor shall contact the Department at least 72 hours prior to shipment. This is to facilitate inspection of the materials at the plant.

400.3.18.4.6 Storage of Material

Stockpiles

All material shall be unloaded and stockpiled in a neat and orderly manner, so as to facilitate inspection and inventory, and in such a manner as to ensure preservation of their quality and fitness for the work. Stockpiled materials, accepted on delivery as to quantity and observed condition, shall be subject to test, and shall meet requirements of the specifications at the time they are to be used in the work.

Storage Stains

In addition to CSA G401, when required by the Department, SPCSP material is to be stored concave down. This requirement is to reduce the occurrence of storage stain damage on plates that are not going to be assembled immediately.

400.3.18.4.7 Handling of Material

All culvert material shall be handled carefully and in such manner as to prevent bruising, scaling or breaking of the galvanized coating. Culvert material shall also be handled and unloaded without undue stress and in such a manner that the radii or dimensions of the pipes remain true. Coupling bands shall be shipped with all necessary hardware and fittings attached thereto, or in suitable shipping containers. All SPCSP bolts are to be shipped with plates. Where the material supplied is damaged, the Contractor shall immediately separate nested sections of plate or pipe to facilitate more detailed inspection. Culvert material designated by the Design Engineer or the Department as unacceptable, due to failure to meet specified requirements, shall be immediately repaired or replaced by the Contractor.

400.3.18.5 Installation

Metal pipes are flexible, and their resistance to deformation depends on careful bedding and backfilling. As they deflect under vertical load they must build up wide support and therefore, to obtain maximum load bearing capacity, it is essential that the material under and beside the pipe be of good quality, carefully placed and properly shaped and compacted as specified on the Detailed Designs. It is essential that the structure be kept dewatered to the bottom of the excavation until all backfilling is complete.

400.3.18.5.1 Excavation

Excavation shall be done to the lines and grades shown on the Detailed Designs, or as determined by the Design Engineer, and in accordance with the appropriate sections of Section 400.3.2 (Excavation), to permit placing of the bedding material.

400.3.18.5.2 Bedding

Where the bottom of the excavation lies at 600mm or less below the pipe invert the fill material shall be compacted by the Contractor to a minimum of 95% of Standard Proctor Density at optimum moisture content. Where the bottom of the excavation extends more than 600mm below the pipe invert, the fill material shall be compacted at the 600mm level to a minimum of 95% of Standard Proctor Density at optimum moisture content. The structural fill shall be placed in lifts not exceeding 150mm when compacted. The Contractor shall use whatever materials, labour, equipment and incidentals necessary to achieve a stable bed.

When in the opinion of the Design Engineer and/or the Department foundation conditions are considered soft and unstable, the Contractor shall supply and place woven geotextile filter fabric at the base of the excavation between the clay seals as shown on Standard Drawing S-1418-03. The woven geotextile filter fabric shall be in accordance with the following table:

Woven Geotextile Filter Fabric	
Specifications and Physical Properties	
Grab Strength	1275N
Elongation (Failure)	15%
Puncture Strength	275 N
Burst Strength	3.6 MPa
Trapezoidal Tear	475 N
Minimum Fabric Lap to be 1000 mm	

The granular material within 150mm of the bottom of the pipe shall be placed in a loose uncompacted state. All other structural fill, including the clay seepage cutoffs, shall be compacted to a minimum of 95% of Standard Proctor Density at optimum moisture content.

The top of the bedding is that portion of the structural fill in contact with the bottom of the pipe and shall be constructed to the exact grade established by the Design Engineer. Where camber is specified, the top of the bedding shall be constructed on a gradual crest curve with no sudden breaks in the grade. Where preshaping is specified, the top of the bedding shall be constructed to the exact curvature of the bottom plates. The top of the preshaping shall be 200mm to 300mm below the horizontal seam which joins the sidewall to the bottom plates, or as shown on the Detailed Design.

400.3.18.5.3 Assembly

Placing and assembly of the pipe may proceed only after the excavation, foundation and bottom bedding material and shape have been inspected by the Design Engineer, and the Department.

Assembly of CSP

CSP sections shall be laid so that the ends are in close contact. Couplers shall be well fitted and evenly tightened all around the pipe. Where required joints shall be sealed using materials supplied by the Contractor.

Assembly of SPCSP

SPCSP shall be assembled as shown on the Detailed Designs which will be provided by the pipe supplier and as outlined below:

(a) The pipe shall be assembled on the invert bed as detailed on the Detailed Designs and accepted by the Design Engineer and the Department.

(b) All bolted seams shall be properly lapped and plates shall be in contact for the full width and length of the lap. The bolts in the valley of each longitudinal seam shall be nearer to the visible edge of the plate than the bolts in the crest.

(c) Assembly and loose bolting of the side arc and top arc plates may then proceed starting from the upstream end of the structure and progressing towards the downstream end.

(d) After two complete rings have been loosely assembled, the vertical dimensions shall be checked and where necessary adjusted with horizontal cables and/or supports to obtain design rise dimensions.

(e) Each adjacent ring shall then be assembled and adjusted in a similar manner until the entire structure is loosely assembled and conforms to design geometry with nested plates.

(f) The vertical axis shall be upright and the longitudinal seams shall be straight. Rotation of the pipe and/or spiralling of the longitudinal seams shall not be permitted.

(g) Adjustments shall be made to produce design dimensions with fully nested laps. When horizontal tie cables are used for shape adjustment, adequate means shall be taken to ensure distribution of concentrated forces at the pipe walls. Distortion of the pipe side walls at the cable points will not be tolerated.

(h) Bolts shall be torqued to not less than 200 Nm and not more than 340 Nm. This includes bolts which connect special features to the pipe. Where the supplier’s specification for torque differs from this range the Contractor shall contact the Department for direction.

(i) Distortion of bolt holes caused by over-torquing, or poor assembly methods will not be permitted. Where additional holes are required they shall be drilled. Torch cutting of holes or welding on the pipe will not be permitted.

(j) The shape of the pipe shall be maintained within two percent of design dimensions. This includes the rise, the span, and any chords or chord offsets identified by the Design Engineer or the Department. Where required, the Contractor shall supply and install devices and/or use methods to maintain the shape of the structure. These devices shall not cause local distortions of the pipe or other signs of distress. Horizontal strutting shall not be used unless the Contractor obtains acceptance from the Design Engineer and the Department. Restraining devices shall be left in place until the structural fill reaches the top of the sidewall or as determined by the Department. When determined by the Department, the Contractor shall supply and install devices to monitor the shape of the pipe.

400.3.18.5.4 Backfilling

When the assembly of the structure has been accepted by the Design Engineer and the

Department, backfilling with Granular and or Non-Granular materials as specified on the Detailed Designs may proceed. Backfilling shall be in accordance with the current version of Standard Drawing S1418-03 and Section 400.3.3 (Backfill). In addition, the following requirements shall be met.

When the air temperature is below 0°C, no backfilling is allowed unless otherwise accepted by the Design Engineer and the Department. When acceptance is granted, all backfill materials shall be in a thawed state when placed and compacted. No backfill material will be permitted to be placed on frozen substrate.

The backfilling under the haunches shall be compacted in thin layers filling all corrugations and ensuring firm contact with the entire bottom surface of the pipe.

The backfilling shall fill each corrugation, be free of voids and provide uniform support to the pipe. The backfill shall be placed such that the level of fill on one side of the pipe does not exceed the level of fill on the other side of the pipe by more than 300mm.

The backfill shall be placed and compacted by equipment moving parallel to the pipe with simultaneous handwork along the pipe. Large earth moving equipment and large compaction equipment shall not be permitted within 1.0m of the pipe.

The first 300 mm of the backfill over the pipe shall be placed, levelled and compacted without vibration. Subsequent fill over the pipe shall be placed and compacted by equipment moving perpendicular to the longitudinal axis of the pipe. The Contractor shall obtain the Design Engineer's and the Department's acceptance before using any equipment above the pipe.

When water jetting methods are used, water jetting shall proceed on a 300mm pattern measured along the longitudinal axis of the structure for its entire length, and at a 300mm pattern perpendicular to the structure for a distance of 1000mm. The Design Engineer may recommend a more concentrated pattern if all voids adjacent to the structure are not filled. Equipment for water jetting shall provide a maximum nozzle pressure of 550 kPa. When the air temperature is below 0°C, water jetting will not be permitted, and backfilling may only proceed under the inspection of the Design Engineer and the Department, providing the backfill materials are in a thawed state when excavated, placed and compacted.

The Contractor shall supply suitable material for the Compacted Non-Granular Backfill. Generally the material shall consist of clay or till materials. Highly plastic clay material or material with high silt content will not be permitted. The quality of the material, and the methods of placing and compacting, shall be reviewed by the Design Engineer, and then accepted by the Department before commencement of this stage of construction.

400.3.18.5.5 Strutting for Composite Concrete/SPCSP Structure

For composite concrete/SPCSP structures strutting and scaffolding shall be supplied and installed as shown on the Detailed Designs.

400.3.18.6 Concrete Work

Where detailed and specified, the concrete work shall be constructed as shown on the Detailed Designs and in accordance with the Section 400.3 (Bridges):

Section 400.3.5 (Cast-In-Place Concrete)

Section 400.3.6 (Reinforcing Steel)

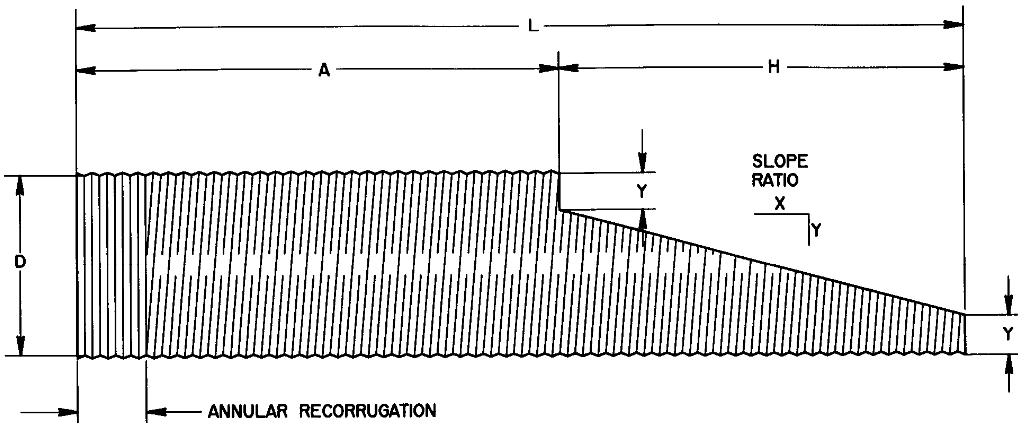
400.3.18.7 Fish Baffles

Fish baffles shall be constructed as shown in the Detailed Designs.

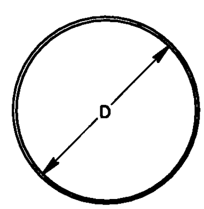
400.3.18.8 Rock Riprap

Rock riprap shall be placed as shown in the Detailed Designs and shall conform to Section 400.3.11 (Heavy Rock Riprap).

TABLE A
DETAILS OF STANDARD 2:1 SLOPED END SECTIONS FOR CSP ROUND CULVERTS



INSIDE DIAMETER "D" mm	SLOPE RATIO X:Y	"Y" mm	"A" m	"H" m	INVERT LENGTH OF SLOPED END SECTION "L" m
1200	2:1	150	4.2	1.800	6.0
1400	2:1	200	4.0	2.000	6.0
1600	2:1	200	3.6	2.400	6.0
1800	2:1	300	3.6	2.400	6.0
2000	2:1	300	5.2	2.800	8.0
2200	2:1	300	4.8	3.200	8.0
2400	2:1	400	4.8	3.200	8.0
2700	2:1	400	6.2	3.800	10.0
3000	2:1	500	6.0	4.000	10.0
3300	2:1	500	5.4	4.600	10.0
3600	2:1	600	5.2	4.800	10.0



SECTION

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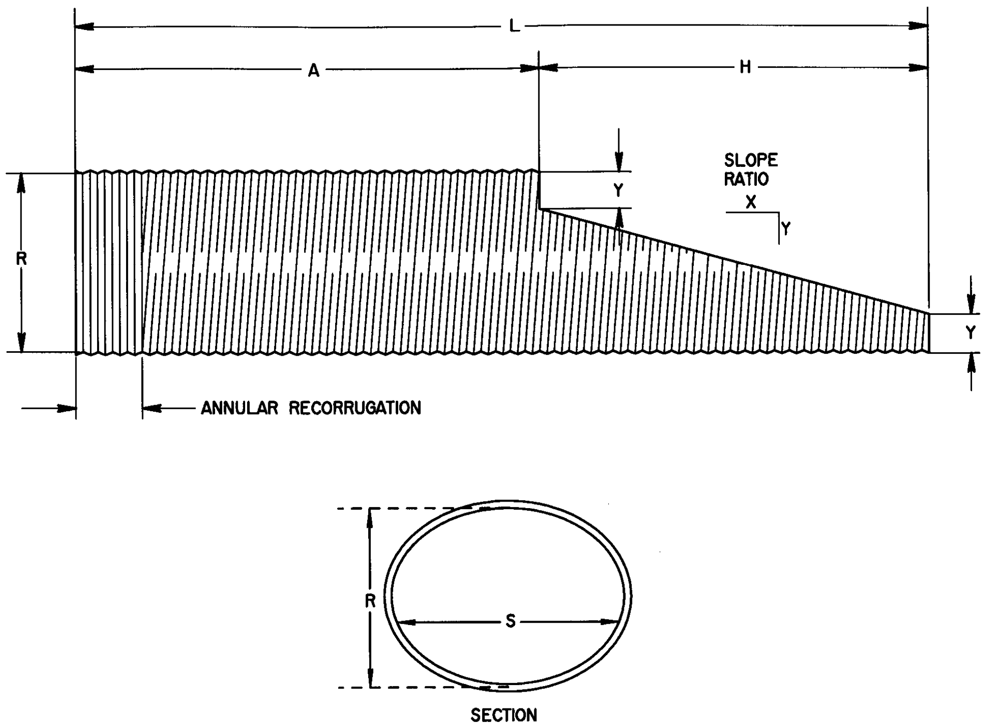
TABLE B
DETAILS OF STANDARD 2:1 SLOPED END SECTIONS FOR CSP ARCH CULVERTS



EQUIVALENT INSIDE DIAMETER "D" mm	SPAN "S" mm	RISE "R" mm	SLOPE RATIO X:Y	"Y" mm	"A" m	"H" m	INVERT LENGTH OF SLOPED END SECTION "L" m
1200	1390	970	2:1	150	4.660	1.340	6.0
1400	1630	1120	2:1	200	4.560	1.440	6.0
1600	1880	1260	2:1	250	4.480	1.520	6.0
1800	2130	1400	2:1	300	4.400	1.600	6.0

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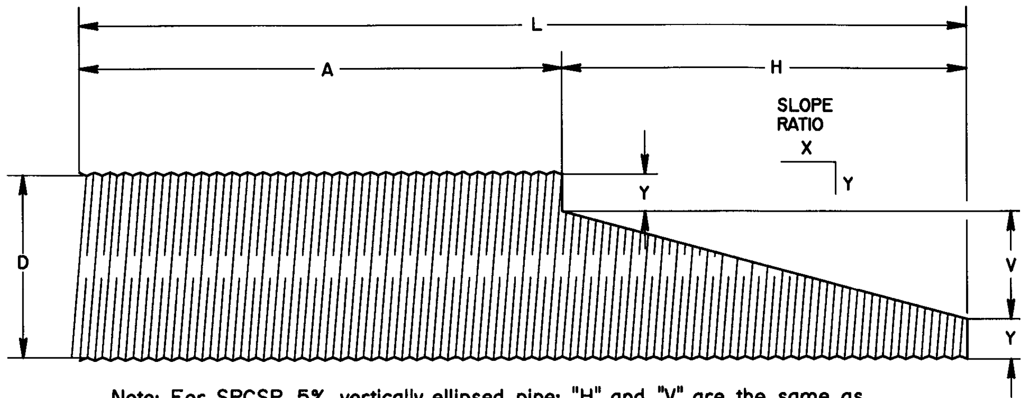
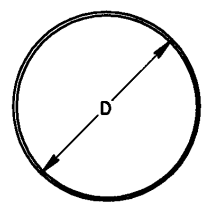
TABLE C
DETAILS OF STANDARD 2:1 SLOPED END SECTIONS FOR SPCSP ROUND CULVERTS



Note: For SPCSP 5% vertically ellipsed pipe: "H" and "V" are the same as for a round pipe of equivalent diameter; "Y" is variable with the increase in rise.

INSIDE DIAMETER "D" mm	SLOPE RATIO X:Y	"Y" mm	"H" m
1500	2:1	293	1.828
1660	2:1	373	1.828
1810	2:1	295	2.440
1970	2:1	375	2.440
2120	2:1	298	3.048
2280	2:1	378	3.048
2430	2:1	453	3.048
2590	2:1	533	3.048
2740	2:1	455	3.658
3050	2:1	610	3.658
3360	2:1	765	3.658
3670	2:1	920	3.658
3990	2:1	1080	3.658
4300	2:1	1235	3.658
4610	2:1	1390	3.658
4920	2:1	936	6.096
5230	2:1	1091	6.096
5540	2:1	1246	6.096
5850	2:1	1095	7.320
6160	2:1	1250	7.320
6470	2:1	1405	7.320
6780	2:1	1560	7.320
7090	2:1	1715	7.320
7400	2:1	1870	7.320
7710	2:1	2025	7.320
8020	2:1	2180	7.320



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400.3.19 SIGN AND LIGHTING STRUCTURES AND PANELS

400.3.19.1 General

This specification is for the supply, fabrication, erection and all associated work pertaining to overhead and cantilevered sign structures and panels, as well as to high mast lighting structures with a height less than 20m.

400.3.19.1.1 Submissions

Unless specified otherwise the following information shall be submitted to the Department at least seven days prior to commencement of work.

- Shop drawings (five copies);
- Identification of subcontractors;
- Welding procedures for all welds;
- Proposed fabrication sequence and schedules (at least fourteen days prior to fabrication); The Department shall be notified a minimum of two days prior to a component being ready for inspection at an inspection station;
- Mill certificates and mill test reports for all material;
- Repair procedures for unsatisfactory weldments and accidental arc strikes, if required;
- Product data sheets for coatings required between galvanized steel and concrete;
- Repair procedures for galvanizing, if required;
- The results of seam weld testing (within 2 days of testing); and
- Method for forming and placing of grout.

400.3.19.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following:

- Acceptance of submissions as outlined in this Section 400.3.19 (Sign and Lighting Structures and Panels);
- Visual inspection of the work;
- Audits of the Contractor's quality control/quality assurance inspection and testing records; and
- Testing to confirm the acceptability of materials and/or workmanship (see Section 400.3.19.2.2 (Supply and Fabrication)).

400.3.19.1.3 Reference Drawings (as attached after Section 400.3.19.3.3)

- Sign Structure Steel Identification Plaque S-1682-03

400.3.19.2 Sign and Lighting Structures

400.3.19.2.1 Shop Drawings

Five copies of the shop drawings showing all details shall be prepared by the Contractor and submitted to the Design Engineer for review and then to the Department for acceptance prior to fabrication.

The shop drawings shall be legible and of adequate quality to be reproduced and microfilmed. All drawings shall be done on standard 11 x 17 or 22 x 34 sheet sizes.

The shop drawings shall include the following:

(a) The Department's Bridge File numbers, A-Ident numbers and project title, as provided by the Department, shall be shown on all the shop drawings.

(b) Design criteria for each individual sign structure, including:

- Initial sign panel area and/or minimum design sign panel area
- Design wind pressure
- Fatigue category and fatigue loadings
- Design ice thickness
- Other dead loads
- Design temperature range
- Foundation soils parameters
- Critical anchor bolt forces

(c) Each individual shop fabricated section or assembly shall be shown separately with complete and clearly identified welded or bolted details.

(d) Weld procedure identification shall be shown on the shop drawings in the tail of the weld symbols.

(e) All material splice locations shall be shown on the drawings.

(f) Complete material list.

(g) Erection procedure including tensioning procedure for anchor bolts.

Fabrication shall not commence prior to the review and acceptance of the shop drawings.

400.3.19.2.2 Supply and Fabrication

<u>Standards</u>

Fabrication of sign and lighting structures shall conform to "The American Association of State Highway and Transport Officials (AASHTO), Standard Specifications for Highway Bridges" and the American Welding Society (AWS) - Bridge Welding Code, D1.5.

Where imperial/metric conversions are necessary, The National Standard of Canada, CAN 3-Z234.1-79 shall be used as the basis of conversion.

All welding, cutting and preparation shall be in accordance with the American Welding Society (AWS) - Bridge Welding Code, D1.5, and D1.1.

Qualification

(1) **Certification**

The Contractor or subcontractor fabricating the sign structures shall operate a recognized steel fabricating shop accepted by the Department.

The Contractor or subcontractor fabricating the sign structures shall be fully approved by the Canadian Welding Bureau (CWB) as per CSA Standard W47.1 in Divisions 1 or 2.

The Contractor shall notify the Department of any subcontractors with which it has contracted in respect of this Section 400.3.19(Sign and Lighting Structures and Panels). The Contractor shall remain responsible for the work of such subcontractors. All requirements of this Section 400.3.19(Sign and Lighting Structures and Panels), such as CWB approval and right of access, shall apply to such subcontractor.

Only welders, welding operators and tack welders approved by the Canadian Welding Bureau in the particular category shall be permitted to perform weldments. Their qualifications shall be current and available for examination by the Department.

Engineering Data

(1) **Welding Procedures**
Welding procedures shall be submitted for each type of weld used in the structure. The procedures shall bear the approval of the Canadian Welding Bureau and shall be submitted to the Design Engineer for review and then to the Department for acceptance prior to use on the structure.

(2) **Proposed Fabrication Sequence**
Prior to commencement of fabrication, the Contractor shall present for review and acceptance an outline of the fabrication sequence that clearly describes the order of make-up and assembly of all the component parts, as well as shop assembly inspection stations.

(3) **Mill Certificates**
Mill certificates shall be provided to the Design Engineer for review and then to the Department for acceptance for all material before fabrication commences.

(4) **Schedules**
The Contractor shall provide and keep current a complete fabrication schedule in a form satisfactory to the Department.

Materials

(a) All materials shall be new.

(b) The use of aluminum and aluminum alloy are not acceptable, unless specifically stated otherwise by the Department.

(c) Structural steel plate material shall conform to CSA G40.21M 300W*.

*Silicon content shall be less than 0.04% for the shafts, whereas for flanges and base plates the silicon content shall be either less than 0.04% or between 0.15 to 0.25%.

(d) All bolts, nuts and washers shall conform to ASTM standard A325 or shall meet property class 8.8 of the Industrial Fasteners Institute for metric high strength structural bolts, nuts and washers. Certified mill test reports for the fastener material shall be submitted to the Design Engineer for review and then to the Department for acceptance.

(e) Anchor bolts shall be fabricated from DYWIDAG thread bars conforming to the requirements of CSA Standard G279.

(f) All steel materials including all hardware and anchor bolts shall be hot-dip galvanized.

Welding

(1) **Filler Metals**
Low hydrogen filler, fluxes and low hydrogen welding practices shall be used throughout. The low hydrogen covering and flux shall be protected and stored as specified by AWS Standard D1.5. Flux cored welding or use of cored filler wires in the submerged arc process or shielding gas processes are not considered as conforming to low hydrogen practice. These methods will not be permitted. However metal core welding process utilizing low hydrogen electrodes with AWS designation of H4 will be allowed. The deposited weld metal shall provide strength, durability, impact toughness and corrosion resistance equivalent to base metal.

(2) **Cleaning Prior to Welding**
Weld areas must be clean, free of mill scale, dirt, grease, and other contaminants prior to welding.

(3) **Longitudinal Seams**
All longitudinal seams shall be made by an approved semi or fully automatic submerged arc or metal core welding processes.

(4) **Weld Penetration**
The full penetration welds shall be completed using properly fitted backing bars or backgouged to sound metal. The longitudinal seams shall have a minimum 60% penetration; however if a backing bar is used for a longitudinal seam, the weld penetration shall be 90%. The following welds shall have 100% penetration:

(a) Column to base plate.

(b) Member to flange plate.

(c) Flange plate to gusset plate.

(d) Longitudinal seam welds within 150mm of circumferential welds and 150mm beyond hand holes (when provided) shall be full penetration groove welds. The transitions between full and partial penetration welds shall be ground smooth.

(e) Backing bar splices

The backing bar for full penetration weld shall be properly fitted and the member prepared to a sharp edged 45 degree chamfer. The groove weld shall be placed in a minimum of two passes by using 100°C of preheat (unless higher preheat is required as per AWS) and maintain a root opening of 5mm. A rod size no greater than 4.0mm shall be used for the first pass. A reinforcing fillet weld shall be placed all around the joint.

(5) **Tack and Temporary Welds**
Tack and temporary welds shall not be allowed unless they are to be incorporated in the final weld. Tack welds, where allowed, shall be of a minimum length of four times the nominal size of the weld, and shall be subject to the same quality requirements as the final welds. Cracked tack welds shall be completely removed prior to welding over.

(6) **Run-off Tabs**
Run-off tabs shall be used at the ends of all welds that terminate at the edge of a member. They shall be tack welded only to that portion of the material that will not remain a part of the structure, or where the tack will be welded over and fused into the final joint. After welding, the tabs are to be removed by flame cutting, not by breaking off.

(7) **Methods of Weldment Repair**
Repair procedures for unsatisfactory weldments shall be submitted to the Design Engineer for review and then to the Department for acceptance prior to repair work commencing.

(8) **Arc Strikes**
Arc strikes will not be permitted. In the event of accidental arc strikes, the Contractor shall submit to the Design Engineer for review and then to the Department for acceptance a proposed repair procedure. The repair procedure shall include the complete grinding out of the crater produced by the arc strike. These areas will be examined by non-destructive testing to ensure complete removal to the base metal in the affected area. The non-destructive test report shall be reviewed by the experienced welding engineer and submitted to the Department for acceptance.

(9) **Plug and Slot Welds**
Plug welds or slot welds shall not be permitted.

<u>Fabrication</u>

Fabrication shall be performed in an enclosed area which is adequately heated. Field welding will not be allowed.

(1) **Pre-job Meeting**
Prior to commencement of fabrication, a pre-job meeting will be conducted by the Department. This meeting will be conducted after the shop drawings have been accepted. The Contractor shall ensure the plant superintendent, plant manager responsible for the work, the Design Engineer and any manufacturer's representatives directly involved in the specialized work are in attendance.

(2) **Cutting of Plate**
All plate material for main members and any plate material welded to the main member shall be flame cut using an automatic cutting machine. Shearing is not allowed.

(3) **Material Splices**
Additional splices, other than those shown on the shop drawings, will require acceptance of the Design Engineer and the Department.

(4) **Additional Requirements**

(a) Each column, arm, extension, clamp and bracket shall be fabricated from one piece of sheet steel unless accepted otherwise.

(b) Intermediate circumferential butt welds will not be allowed however horizontal members greater than 12m span may have a bolted splice.

(c) Columns, arms, extensions and clamps shall be brake press formed or roll formed. The brake press knife shall have a radius suitable for the thickness of the material and nature of the bend.

(d) All plate edges shall be free of notches and gouges.

(e) The depth or projection of any imperfections on the inner or outer surfaces shall not exceed 15% of wall thickness. Any depth or projection up to 33% of wall thickness may be repaired by welding. Any excessive projecting weld metal shall be removed.

(f) The diameter of bolt holes in base plates shall be 10mm larger than the bolt diameter.

(g) Punching of full size holes will not be permitted. The holes shall be circular and perpendicular to the member and shall be deburred to ensure a proper faying surface.

(h) Hand holes with cover plates on the top and bottom of columns are to be provided for illuminated sign structures or when required by the Detailed Designs.

(i) Hand holes (when required) shall be stiffened by providing a reinforcing rim with semi-circular ends. The rim shall be welded to the member with a full penetration groove weld supplemented with an all around fillet weld.

(j) Only low stress stamps shall be used for identification marks. The stamps and specific location shall be shown on the shop drawings and accepted by the Department.

(k) Stiffeners are not allowed on column to base plate and member to flange plate connections.

(5) **Dimensional Tolerances**
All fabrication shall meet the tolerances described below:

(a) Straightness
The straightness of any item shall not exceed the overall length divided by 300 from the surface at any point. This shall be measured with a straight line joining the surface at both ends. The difference between the straight line and the surface shall then be measured to determine the straightness.

(b) Twisting
The twist in the overall length of any column, arm, or extension shall not exceed 7°.

(c) Length
The specified length of any item shall be within 0 to 60mm or 0 to +5% (whichever is less) with the exception of sign bridge spans which shall be within 5mm of the specified dimensions in unloaded condition. The tolerance for height shall be - 0 to +60mm.

(d) Across the Flat Dimensions
The average of all across the flats dimensions from a given cross section shall be within 1% of the specified dimension. In addition, the ratio of the maximum to minimum across the flats dimensions shall be less than or equal to 1.05.

(e) Tolerance for Flatness of Base Plates and Flange Plates
Surfaces of column base plates shall be flat to within 3 mm tolerance in 305mm, and to within 5mm tolerance overall. Faying surfaces of flange plates shall be flat to within 2mm tolerance overall.

(f) Arm Rise
Arm rises apply to unloaded structure in the standing position.

(6) **Pre-Assembly**
After welding and fabrication, but prior to galvanizing, the Contractor shall pre assemble all structures complete with welded sign clamps to check the fit and geometry. Pre assembled structures shall be inspected by the Design Engineer and the Department.

Following inspection by the Department, the structures shall be disassembled for galvanizing.

(7) **Galvanizing**
Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of CSA Standard G164 with additions and exceptions as described in Section 400.3.19 (Sign and Lighting Structures and Panels). The Contractor shall provide a smooth finish on all edges and surfaces, and remove all weld spatter and all welding flux residue from the steel components prior to galvanizing. Lumps, globules or heavy deposits of zinc will not be permitted. All threaded holes or threaded couplings shall be retapped after galvanizing.

Repair of galvanizing shall only be done if bare areas are infrequent, small, and suitable for repair. A detailed repair procedure shall be submitted and accepted by the Department prior to its use. It should be noted that repairs may require complete removal of the galvanized coating and regalvanizing. Repair shall be in compliance with ASTM A 780, Method A3 Metallizing. The thickness of the metallizing shall be 180 μm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing. The Department will determine the acceptability of repaired areas.

(8) **Base Plate Corrosion Protection**
The bottom face of each base plate shall be protected by a medium grey colour barrier coating accepted by the Department, to prevent contact between the zinc and the grout. The galvanized surface must be roughened prior to application of barrier coating. The surface preparation of the galvanized surface and the dry film thickness (DFT) of the coating shall be in accordance with the coating manufacturer's recommendations. The Department will test the adhesion of fully cured coating as per ASTM D3359 "Standard Test Methods for Measuring Adhesion by Tape Test". The method selected for testing (Method A or B) shall depend on the dry film thickness of the coating. The coating manufacturer's product data sheets shall be provided to the Department prior to the application of the coating. The adhesion test result shall meet a minimum of "4B" classification (a maximum allowable flaking of 5%).

<u>Testing and Inspection</u>

(1) **Access**
The Contractor shall provide full facilities for the inspection of material and workmanship. Free access shall be allowed to the Department to all parts of the works. When required by the Department, the Contractor shall provide needed manpower for assistance in checking layout and performing inspection duties.

(2) **Testing and Inspection by the Contractor**
The Contractor shall be responsible for all quality control and quality assurance testing required to ensure that the work meets the Technical Requirements and the requirements of the Detailed Designs. Any quality control/quality assurance testing and inspection records made by the Contractor shall be open to the Department for auditing.

The Contractor shall arrange to have all full penetration welds inspected either by ultrasonic testing or radiographic inspection methods. Partial penetration seam welds shall be inspected by ultrasonic testing. The frequency of partial penetration weld inspections shall be three random locations per weld and the length of weld for ultrasonic inspection at each location shall be 200 mm. Calibration blocks for each thickness shall be prepared for ultrasonic testing to establish sensitivity levels and acceptance criteria. The NDT shall be done by a company certified to CAN/CSA W178.1. Ultrasonic and radiographic testing technicians shall be certified to Level II of CGSB. A copy of the test results shall be provided to the Design Engineer and the Department indicating the percentage of penetration. The Contractor shall not proceed to the next stage of fabrication until all the seam welds have passed the inspection and the results submitted to the Design Engineer for review and the Department for acceptance.

(3) **Testing and Inspection by the Department**
To confirm acceptability of materials and/or workmanship, the Department may perform visual, radiographic, ultrasonic, magnetic particle and any other inspection that may be specified or required. The testing will be performed by the Department or by it's testing agencies at the Department's expense.

Testing and inspection made necessary by the repair of faulty work shall be paid for by the Contractor.

The Contractor shall be responsible for all travel, boarding and lodging costs for a Department representative to attend the prejob meeting for each fabrication shop plus two additional trips for each fabrication shop during the course of fabrication when the sign structures are being fabricated outside the Province of Alberta.

(4) **Inspection Station**
To insure that each stage of inspection is performed in an orderly manner, during the fabrication, Inspection Stations will be set up at specific points. Certain items of the work will then be checked, and deficiencies shall be corrected, prior to the work being sent to the next stage of fabrication. These check points are to be agreed to by the Department and the Contractor prior to commencement of fabrication. The Department reserves the right to stop detrimental fabrication between check points if deemed necessary.

(5) **Non-destructive Methods of Examination**
The methods of non-destructive examination shall be in accordance with the following standards:
- Radiography - AWS Standard D1.5
- Ultrasonic - AWS Standard D1.5
- Magnetic Particle - ASTM Standard E-709

Identification Tag

The Contractor shall supply and install an identification tag on one column of each structure at 2.4m above base plate. The column shall be drilled and tapped for 2-10mm diameter attachment bolts. The Identification Tag shall be fabricated as per Standard Drawing S-1682-03.

400.3.19.2.3 Erection

Any product damaged in shipping shall be replaced at no extra cost to the Department.

The Contractor shall not erect the structural steel until the substructure concrete has been cured a minimum of three days and achieved 80% of the 28 day specified concrete strength requirement.

All components shall be handled with care to prevent stress to the components through bending or twisting. The use of steel chains as slings shall not be permitted. Any damage to the components through overstress, scratching or denting shall be repaired or replaced by the Contractor to the satisfaction of the Design Engineer and the Department.

The structure shall be set accurately on galvanized shim plates. The shim plates must be located so that a minimum of 75mm of distance is provided from shims to grout edge. The method of forming and pouring the grout shall be submitted to the Design Engineer for review and then to the Department for acceptance. Dry-pack methods of constructing grout pads will not be accepted.

Hand hole bolts shall be coated with anti seize lubricant.

(1) **High Tensile Strength Bolted Connections**
Bolted parts shall fit solidly together when assembled. Contact surfaces shall be free of dirt, grease, burrs, pits and other defects that would prevent solid seating of the parts. Connections shall be assembled with a hardened washer under the bolt head or nut, whichever is the element turned in tightening. Surfaces of bolted parts in contact with the bolt head and nut shall be parallel.

(2) **Bolt Tension**

Each bolt shall be tightened so as to provide, when all bolts in the joint are tight, at least the minimum bolt tension shown in the following table for the size of bolt used:

Table 1 Bolt Tension

Specified Bolt Size (A325M Bolts)	Minimum Bolt Tension		Commonly Supplied Equivalent Imperial Size (A325 Bolts)	Minimum Bolt Tension	
	Kilonewtons	pounds-force		Kilonewtons	pounds-force
M16X2	94	21,180	5/8	85	19,200
M20X2.5	147	33,050	3/4	126	28,400
M22X2.5	181	40,700	7/8	175	39,250
M24X3	212	47,660	1	227	51,500
- -	- -	- -	1 1/8	251	56,450
M30X3.5	337	75,760	1 1/4	319	71,700
- -	- -	- -	1 3/8	380	85,450
M36X4	490	110,160	1 1/2	463	104,000

All structural bolts shall be tightened by using turn of nut method to provide bolt tension specified in Table 1. There shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into full contact with each other. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified below, with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

Amount of rotation of nut relative to bolt, regardless of which is turned:
- 1/3 turn where bolt length is 4 bolt diameters or less
- 1/2 turn where bolt length is over 4 bolt diameters and not exceeding 8 bolt diameters
- 2/3 turn where bolt length exceeds 8 bolt diameters

Notes
- tolerance 1/6 turn (60º) over, nothing under
- length of bolt measured from underside of head

400.3.19.2.4 Foundation

Where detailed and specified, concrete work shall be constructed as shown on the Detailed Designs and in accordance with the following sections of the Technical Requirements:

Section 400.3.4 (Bearing Piles)
Section 400.3.5 (Cast-In-Place Concrete)
Section 400.3.6 (Reinforcing Steel)

(1) **Material**
- (a) All reinforcing steel shall conform to CSA G30.18-M92 Grade 400.
- (b) All concrete shall be Class C - 35 MPa, with Type HS sulphate resistance cement.

(2) **Anchor Bolt Installation**
Anchor bolts shall be supplied and installed in one complete assembly and consist of, but not limited to: anchor bolts complete with plate washers, full length sleeves filled with accepted corrosion inhibiting paste, top temporary templates, bottom anchor plates, bottom anchor nuts, thin clamping nuts and all necessary hardware for post-tensioning and future de-tensioning. No welding of any component is allowed. Anchor bolts shall be true and plumb. Anchor bolts shall be post-tensioned to 70% of the ultimate strength after the grout pads have attained design strength. The top anchor nuts shall have plastic caps, and all voids including annular space in the base plate shall be filled with corrosion inhibiting paste. Sufficient anchor bolt projection shall remain for future work. All Post-tensioning work and materials shall meet the requirements of Chapter 3 - Specifications of the PTI Post-tensioning Manual.

(3) **Grout Pockets and Grout Pads**
The Contractor shall fill the grout pockets and construct the grout pads using Sika 212 flowable grout or equivalent accepted by the Design Engineer and the Department. Filling of grout pockets and construction of grout pads shall be done by workers competent in this work. The grout pocket shall be 25mm deep and the total grout thickness shall not be less than 75mm.

Grout shall be packaged in waterproof containers with the production date and shelf life of the material shown. It shall be mixed, placed, and cured in strict accordance with the manufacturer's recommendations.

The method of forming and pouring the grout shall be submitted to the Design Engineer for review and then to the Department for acceptance. Dry pack methods of constructing grout pads will not be accepted.

(5) **Grouting in Cold Weather**
When the daily minimum air temperature, or the temperature of the girders, bearings or substructure concrete, in the immediate area of the grouting, falls below 5°C, the following provisions for cold weather grouting shall be effected:

(a) Before grouting, adequate preheat shall be provided to raise the temperature of the substructure concrete to at least 10°C.

(b) Temperature of the grout during placing shall be between 10°C and 25°C.

(c) The grout pads shall be enclosed and kept at 10°C to 25°C for at least five days. The system of heating shall be designed to prevent excessive drying out of the grout.

(6) **Clean-Up**
All steel shall be left clean and free of oil, grease, mud, dust, road spray or other foreign matter.

400.3.19.3 Sign Panels

The Contractor shall supply and install overhead sign panels as shown on the plans and in accordance with the requirements specified herein.

400.3.19.3.1 Shop Drawings

The Contractor shall provide to the Design Engineer for review and then to the Department for acceptance five copies of the shop drawings showing the number, spacing and locations of the aluminum T-section required for each sign panel(s), assembly and mounting details. These drawings shall also detail the required method of attaching the sign panels to the sign support arms.

The Department's review of the shop drawings shall not be construed as relieving the Contractor from its responsibility for errors or omissions in the drawings or for proper completion of the work in accordance with the DB Agreement.

Fabrication shall not commence prior to the review and acceptance of the shop drawings.

400.3.19.3.2 Materials

Extruded aluminum panels shall be manufactured in accordance with Section 400.2.38 (Supply of Permanent Highway Signs, Posts and Bases) of the Technical Requirements, except as noted herein.

Sheeting Materials

Reflective sheeting materials used on all overhead sign and cantilever sign structures shall be in accordance with Section 400.2.38.2.9 (Materials Specifications) of the Technical Requirements.

Backing

Each panel shall be fabricated from a number of rows of extruded aluminum sections bolted together. Each row of a panel shall be fabricated from a single piece of extruded aluminum up to a maximum length of 6 metres. Sign panels with a length in excess of 6 metres can be split into multiple sections with a vertical joint that runs the vertical distance of the panel. The location of the vertical joint shall be chosen to minimize the number of letters/symbols split between the two sections. The number of sections for a panel shall be minimized.

A 1.0cm wide x 2.5cm long slotting shall be located on both edges of the extruded aluminum panels. The slotting shall be centered on the identification groove running longitudinally with the first slot centered 76mm from the end of the section. The slotting shall be spaced on 152mm centres for the entire length of the section.

Extruded Aluminum Preparation

The extruded aluminum panels shall be clean of dust, dirt and/or grease. The method used for cleaning must not damage the anodized finish of the extruded aluminum panels or prevent the adhesion of the sheeting material to the extruded aluminum sections.

The ends of the extruded aluminum sections shall be checked to ensure that they are cut square to ensure flush joints between both panels and sections of a panel. The maximum allowable gap between two adjacent sections or panels shall be 5mm. All excess material found along the slots and edges of the panels shall be removed.

The joint between two sections of a single panel shall be connected together with a T-stiffener when installed on the sign support structure. Care should be taken in choosing the vertical joint location to avoid conflicts between the joint T-stiffeners and the T-stiffeners used to attach the sign panels to the sign support structure.

Adjacent sign panels shall not be connected together by a joint T-stiffener or the T-stiffener used to attach the sign panel to the sign support structure.

Application of Sheeting Materials

The sheeting material (lettering, symbols, borders, background, etc.) shall be applied to the extruded aluminum sections as required by the sheeting manufacturer and as shown on the Detailed Designs. The horizontal line of lettering/copy across a joint between panels, or sections of a sign panel, shall be less than 8mm.

Each panel, as shown on the Detailed Designs, shall be fabricated as an individual piece to facilitate future modifications. Large individual panels may be fabricated in multiple pieces as noted herein.

For sign panels where the background sheeting material is green and/ or yellow, the sheeting is to be wrapped around the edges of each extruded aluminum section except for the sections that are on the top and bottom edges of the sign panel. The outer edges of the sign panel are to be neatly trimmed flush with the edge of the aluminum panel.

400.3.19.3.3 Construction

Signs shall be shipped, stored and installed in a manner to prevent damage to the sign panels.

The Contractor shall erect the sign panels onto the sign structures as shown on the Detailed Designs to ensure that the signs are located correctly over the indicated lanes and that the correct vertical clearance is maintained.

The Contractor shall provide the T-Stiffeners, J-Clips, bolts, and all of the necessary hardware to securely assemble the sign and connect the sign panels to the sign structure as shown on the accepted shop drawings.

Individual extruded aluminum sign panels shall be fastened together using stainless steel 10mm diameter x 25mm long bolts, nuts, and with a single lock washer on the nut side of the bolt. The last slot of each joint between sections shall be bolted.

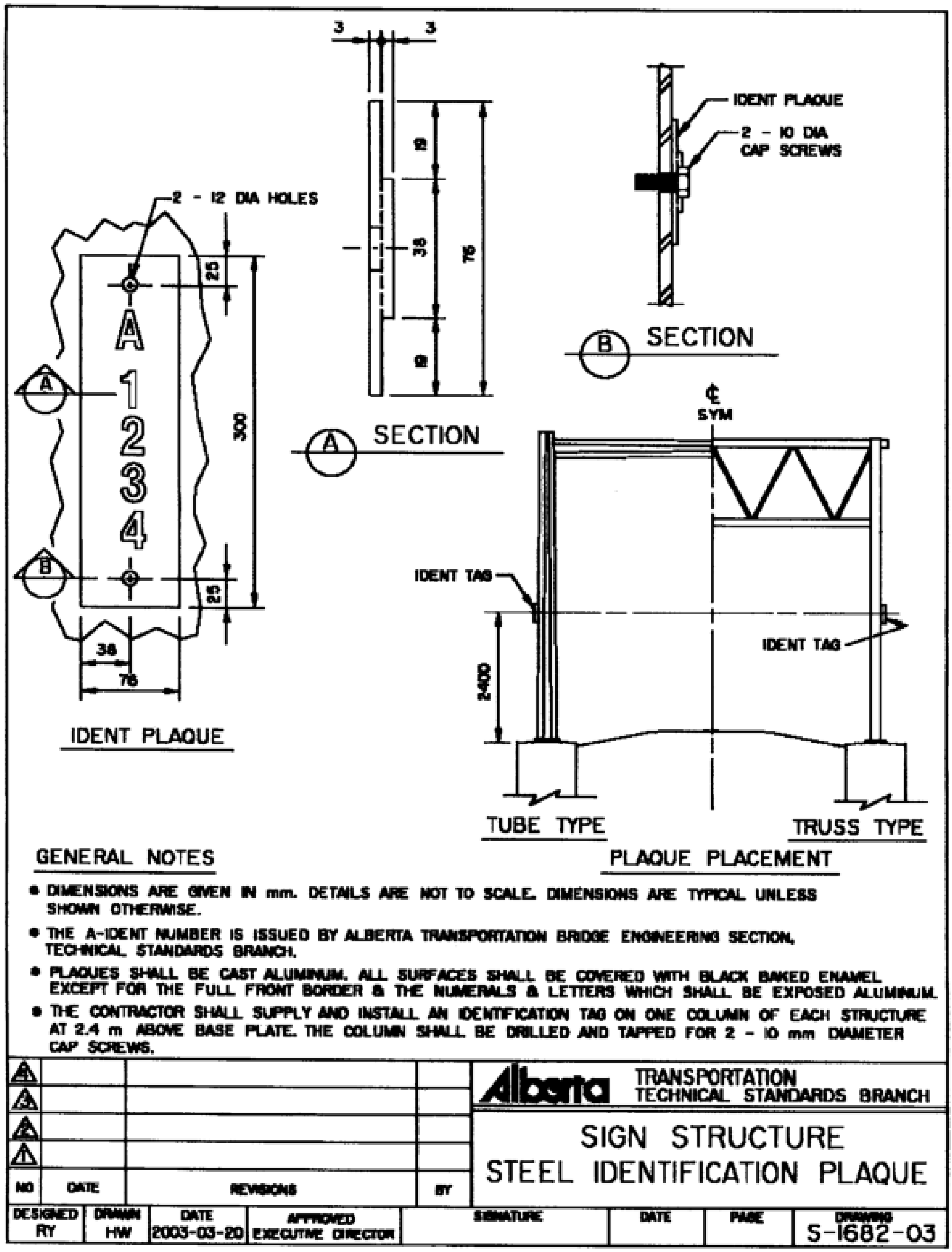
The bolting of the joint between the extruded aluminum sections shall be staggered between the rows of slots, except for the last slots at either end of the section or panel.

Sign panels shall be attached to the T-Stiffeners using J-Clip assemblies. The J-Clip assembly consists of a J-flip bolt whose square head fits into the channels that run along either edge of an extruded aluminum section, a J-Clip and a nut. J-Clip assemblies shall be placed where the edge/joint of the extruded aluminum sections meets a T-stiffener. The J-Clip assemblies shall alternate sides of the T-Stiffeners.

All joiner bolts and J-clip nuts must be tightened to a torque to 26.5 Nm within a tolerance of $\pm$ 0.5 Nm.

The face of the sign panels shall be cleaned prior to acceptance.

400.3.19.4 Drawing S-1682-03 - Identification Plaque



400.3.20 MECHANICALLY STABILIZED EARTH WALLS

400.3.20.1 General

This specification is for the design, supply, fabrication and construction of mechanically stabilized earth (MSE) retaining walls with precast concrete facing panels. MSE retaining walls shall include, but not be limited to, excavation for the wall, concrete levelling pads, precast concrete panels, compacted granular backfill, reinforcing strips, perforated drain pipe complete with filter fabric sock, surface drains, concrete wall coping, traffic barrier, safety handrail, hardware and all associated materials.

MSE retaining walls shall be designed and constructed in accordance with the Detailed Designs, the provisions contained herein and as determined by the Design Engineer and the Department.

The Contractor shall supply all necessary materials. All components of the MSE wall system shall be supplied from one MSE supplier.

400.3.20.2 Design

400.3.20.2.1 Design Requirements

Location, layout, geometry control, global stability and allowable bearing capacity requirements shall be as specified in the Technical Requirements and the Detailed Designs. The Contractor's design responsibility shall include internal stability and all elements for a complete MSE wall system.

The most stringent requirements of the most current version of the following standards shall be met:

- CAN/CSA S6 – Canadian Highway Bridge Design Code
- AASHTO LRFD Bridge Design Specifications
- Alberta Transportation Bridge Structures Design Criteria
- Alberta Transportation Roadside Design Guide Section H7.6

The design life for all MSE wall components shall be 100 years.

All MSE walls at bridge structures shall use steel reinforcements.

Highway and bridge surface drainage shall be included in the design and shall be controlled and channelled away from the back of the MSE walls and mechanically stabilized earth mass.

Weeping drains consisting of perforated 150mm diameter PVC complete with filter sock shall be provided near the front and the back bottom corner of the reinforced soil mass. The weeping drains shall be day lighted or connected for positive drainage. A water level within the mechanically stabilized earth mass shall be assumed to be at the invert level of the weeping drains.

Traffic barriers, safety handrails, sign structures, sound barriers and lighting posts may be mounted on top of and directly behind the MSE walls. The MSE wall design shall account for all load effects from such accessories, in accordance with the Technical Requirements and the Detailed Designs.

Obstructions such as foundation piles and associated casings, or casings for future pile installations in the soil reinforcement zone, shall be accommodated with appropriate arrangement of soil reinforcing around such obstructions. Splaying of soil reinforcement shall not exceed 20º from the perpendicular to the facing panel.

Minimum precast concrete panel thickness shall be 140mm, excluding any additional thickness required for aesthetic surface treatment. Minimum cover to reinforcing steel shall be 50mm on the front face and 40mm on the back face.

Precast concrete panels shall be designed to accommodate a differential settlement of 100mm in 10 metres of length along the wall. The spacing between adjacent panels shall be designed to be 20mm nominal.

Joints between panels shall have a lip and recess (ship lap) configuration so that joint material is protected and overall aesthetics is enhanced.

Acute corners less than 70º inside panels shall not be allowed.

Special corner units shall be used when interior angle between adjacent panels is 130º or less.

Top of the cast-in-place concrete wall coping shall be smooth and have no steps or abrupt change in height.

MSE wall panels shall be fully supported by compacted backfill without voids on the non-exposed side.

For stepped levelling pads, the maximum elevation difference between adjacent steps shall not exceed 750mm. The minimum length of each stepped section shall be 2250mm.

Where staged construction is required and large differential settlement is expected between stages, appropriately located full height vertical slip joints shall be provided.

400.3.20.2.2 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work:

- shop drawings (five copies at least three weeks prior to fabrication)
- results of product specific durability studies for geosynthetic reinforcement if required

400.3.20.2.3 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Designs. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following to determine the acceptability of the work:

- Acceptance of submissions as outlined in this Section 400.3.20 (Mechanically Stabilized Earth Walls);
- Visual inspection of the work; and
- Audits of the Contractor's quality control/quality assurance inspection and testing records.

The foundation subgrade shall be proof rolled to identify any soft spots. Soft material shall be removed and replaced with compacted granular material to the satisfaction of the geotechnical consultant.

400.3.20.2.4 Shop Drawings

Shop drawings shall be signed and sealed by a Professional Engineer,.

Shop drawings shall be legible and of adequate quality to be reproduced and microfilmed. Each drawing shall have sufficient blank space for the Design Engineer's review stamp.

As a minimum, shop drawings shall contain:

- Department bridge file number and project name on each drawing.
- Design criteria and materials lists.
- Wall layout plan and elevation complete with dimensions and elevations, and typical wall cross-sections.
- All component and connection details.
- Site drainage and drainage details.

The shop drawings shall be submitted to the Design Engineer for review and then to the Department for acceptance. The Department's acceptance of the shop drawings shall not be construed as relieving the Contractor from his responsibility for errors or omissions in the drawings or for the proper completion of the work in accordance with the DB Agreement.

Prior to commencing fabrication, all shop drawings shall be clearly signed by the Design Engineer as verification that the Design Engineer has completed his review and accepted the shop drawings.

400.3.20.3 Materials

400.3.20.3.1 Concrete Materials

The fabrication of precast concrete panels shall conform to the requirements of Section 400.3.8 (Precast Concrete) of the Technical Requirements. The concrete for the panels shall be Class HPC, conforming to the requirements of Section 400.3.5.4 (Class and Composition of Concrete) of the Technical Requirements, with the exception that maximum aggregate size shall be 14 mm. The concrete levelling pads and the MSE wall coping shall conform to the requirements of Section 400.3.5 (Cast-In-Place Concrete) of the Technical Requirements. The concrete for the levelling pads shall be Class B and the concrete for the wall coping shall be Class HPC. The exposed faces of the precast panels and the cast-in-place wall coping shall have a Class 2 finish. Chamfered edges shall be created around the periphery of all precast facing panels.

400.3.20.3.2 Concrete Reinforcing Materials

Reinforcing steel is to be in accordance with Section 400.3.6 (Reinforcing Steel) of the Technical Requirements.

Reinforcing steel shall conform to CAN/CSA G30.18, Grade 400 deformed billet steel bars and be epoxy coated.

400.3.20.3.3 Soil Reinforcing Materials

Steel reinforcing strips shall be galvanized in accordance with CAN/CSA G164 and have a minimum coating thickness of 87 microns (3.4 mils).

Geosynthetic reinforcements shall meet the requirement of AASHTO LRFD Bridge Design Code Clause 11.10.6.4.3b for applications for which the consequences of poor performance or failure would be severe. Results of product specific durability studies carried out to determine the product-specific long term for strength reduction factor (RF) shall be submitted to the Design Engineer for review and then to the Department for acceptance. These studies shall be used to estimate the short term and long term effects of the environment factors on the strength and deformational characteristics of the geosynthetic reinforcement throughout the specified design life.

Geosynthetic reinforcing materials shall satisfy the requirements of the following tests:

- GG 1-87 “Standard Test Method for Geogrid Rib Tensile Strength”
- GG 2-87 “Standard Test Method for Geogrid Rib Junction Strength”
- GG 3-90 “Standard Test Method for Tensile Creep Testing of Geogrids”
- GG4-05 “Standard Practice for Determination of the Long Term Creep Design Strengths of Geogrids”

Geosynthetic reinforcing materials shall contain stabilizers or inhibitors to prevent degradation of properties due to ultraviolet light exposure.

400.3.20.3.4 Safety Rail Materials

Safety rail shall be fabricated in accordance with Section 400.3.13 (Bridgerail) of the Technical Requirements.

400.3.20.3.5 Backfill Materials

The structural backfill shall be Des 2, Class 25 crushed aggregate material meeting the requirements of Section 400.3.3.2.2 (Gravel Material and Crushed Aggregate Material) of the Technical Requirements.

The physical properties of the structural granular backfill material selected by the Contractor shall be used by the MSE wall supplier in the design of the MSE walls. The selected structural granular backfill material shall also meet the following electrochemical parameters:

REQUIREMENTS FOR STEEL REINFORCING

Resistivity	≥ 3000 ohm-cm
pH	5 - 10
Chlorides	≤ 100 ppm
Sulphates	≤ 200 ppm
Organic Content	≤ 0.1%

REQUIREMENTS FOR GEOSYNTHETIC REINFORCING

pH	4.5 - 9
Maximum Soil Particle Size	≤ 19.0 mm*
Organic Content	≤ 0.1%
Design Temperature at the Wall Site	≤ 30oC

In no case shall any backfill material placed within 2.0m of the face panels have more than 5% passing the 0.75mm sieve size.

400.3.20.3.6 Sealer Materials

Sealer shall be applied to the exposed concrete surfaces of the precast concrete panels and the cast-in-place wall coping in accordance with Section 400.3.5.25 (Sealer) of the Technical Requirements.

400.3.20.3.7 Geotextile Filter Fabric

Woven geotextile filter fabric shall be in accordance with the following table of minimum average roll value properties:

Non-Woven Geotextile Filter Fabric	
Specifications and Physical Properties	
Grab Strength	650 N
Elongation (Failure)	50%
Puncture Strength	275 N
Burst Strength	2.1 MPa
Trapezoidal Tear	250 N
Minimum Fabric Lap to be 300mm	

400.3.20.4 Construction

The Contractor shall employ qualified personnel experienced in constructing MSE walls to complete this work. The MSE wall shall be installed in accordance with the supplier's recommendation. The supplier of the MSE wall system shall provide a qualified representative on site to advise the erection crew regarding construction procedures. The representative shall be present for a minimum of two days during the initial stages of construction and shall be available on an as required basis thereafter.

The construction of the MSE wall system shall conform to the details on the accepted shop drawings.

400.3.20.4.1 Excavation

Excavation for the wall shall be carried out in conformance with Section 400.3.2 (Excavation) of the Technical Requirements. Excavation shall be done to establish grades to within reasonably close conformity to the design grades and limits shown on the Detailed Designs and shop drawings. The foundation subgrade shall be proof rolled to identify any soft spots. Soft material shall be removed and replaced with compacted granular material to the satisfaction of the geotechnical consultant. Temporary excavation support as required shall be the responsibility of the Contractor. In addition, the Contractor shall establish the locations and extents of all underground services in the work area prior to commencement of work. All underground service locations shall be clearly marked and protected during the course of construction. All damages to existing services resulting from the Contractor's operations shall be repaired at the Contractor's expense.

400.3.20.4.2 Backfill

Backfill shall be in accordance with Section 400.3.3 (Backfill) of the Technical Requirements and shall include the supply, placing and compaction required for construction of the MSE walls. Backfill placement shall closely follow erection of each course of panels. Backfill shall be placed in such a manner as to avoid any damage or disturbances of the wall materials or misalignment of the face panels. All wall materials that are damaged during backfill placement shall be removed and replaced at the Contractor's expense. Any misalignment or distortion of the face panels due to placement of backfill shall be corrected by the Contractor at its expense.

A minimum 300mm wide strip of filter fabric shall be installed behind all face panel joints. An adhesive shall be used to hold the fabric securely against the panels.

No equipment shall be allowed to run directly on the soil reinforcement. Backfill compaction shall be performed in such a manner that the compactor shall move in a direction parallel to the wall panels and work toward the end of the soil reinforcement away from the wall facing. Only hand operated power tampers and vibrators shall be used for compaction within 750mm of the wall panels. The Contractor shall slope the last level of backfill material away from the wall panels, at the completion of each day's work to direct potential run-off away from the wall face. In addition, the Contractor shall not permit any surface runoff from adjacent areas to enter the wall construction site.

400.3.20.4.3 Precast Panel Tolerance

Precast concrete panel manufacturing tolerances shall be as described in CSA A23.4. Concrete panel vertical tolerances shall not exceed 20mm when measured with a 3m straight edge. The maximum allowable offset in any panel joint shall be 20mm. There shall be no joints or openings between adjacent wall panels larger than 40mm. The overall vertical tolerance of the completed wall (top to bottom) shall not exceed 13mm per 3m of wall height. Should any panels be out of tolerance, the backfill shall be removed and the panels reset to the proper tolerance.

Nominal-sized, pre-formed holes through the top row of the precast wall panels are permitted and encouraged to facilitate construction of the concrete coping.

400.3.20.4.4 Precast Panel Storage

Precast concrete panels shall be stacked on timber planks and separated by timber blocks. Soil reinforcing material and connectors shall be stored clear of the ground. All materials shall be covered and protected from rain, snow, dirt and ultraviolet light. The precast panels shall be stored such that the uniform color of the panels is maintained and protected from staining or discoloration.

400.3.21 POT BEARINGS

400.3.21.1 General

This specification is for the supply, fabrication and installation of pot bearings. The supply, fabrication and installation shall be in accordance with Section 400.3.7 (Structural Steel) and the

Ontario Provincial Standard Specification (OPSS) 1203, November 2003 with additions and exceptions as described in this Section 400.3.21 (Pot Bearings).

400.3.21.1.1 Submissions

Unless specified otherwise, the following information shall be submitted to the Department at least seven days prior to commencement of work:

- Identification of bearing supplier (at least 28 days prior to fabrication);
- Layout installation drawings (five copies) (at least 21 days prior to fabrication);
- Welding procedures for all welds;
- Shop drawings (five copies) (at least 21 days prior to fabrication);
- Mill certificates and mill test reports for all material;
- Repair procedures for unsatisfactory weldments and accidental arc strikes, if required;
- Repair procedures for galvanizing, if required;
- Methods and materials for setting anchor bolts and constructing bearing pads; and
- Methods of forming and pouring grout (at least 14 days prior to placing grout).

400.3.21.1.2 Testing and Acceptance

The acceptance of the work will be based on its meeting the Technical Requirements and the requirements of the Detailed Design. Unless determined otherwise by the Department, it is anticipated that the Department will undertake the following testing to determine the acceptability of the work.

- Acceptance of submissions as outlined in this Section 400.3.21 (Pot Bearings);
- Visual inspection of the work; and
- Audits of the Contractor's quality control/quality assurance inspection testing records.

400.3.21.2 Revisions to OPSS 1203

The following additions and exceptions shall apply to OPSS 1203, November 2003.

<u>Clause 1203.04.02.02 Design</u>

Delete the last paragraph and replace with the following:

The average stress in the elastomer at serviceability limit state loads shall not exceed the following values:

a) Pot Bearing 30 MPa

<u>Clause 1203.04.02.04.06 Contact Pressure</u>

Delete the first paragraph and replace with the following:

The average contact pressure for unfilled PTFE elements based on the recessed area of the PTFE shall not exceed the following:

Limit State	Dead Load (MPa)	Total Load (MPa)
Serviceability	25	35
Ultimate	40	55

Delete the last paragraph and replace with the following:

The average contact pressure at **ultimate** limit state loads for filled PTFE elements used to face mating surfaces of guides for lateral restraint shall not exceed the following:

a) PTFE filled with up to 15% by mass of glass fibres: 55 MPa

Clause 1203.04.02.09 Replaceability

Delete this clause and replace with the following:

The entire bearing assembly, except for the top plate used to attach it to the superstructure but including both contact surfaces of the sliding interface, shall be replaceable without damage to the structure and without removal of any concrete, welds or anchorages permanently attached to the structure and without lifting the superstructure more than 5 mm. Bearings shall not be recessed into plates that are permanently attached to the structure.

Clause 1203.05.01 Steel

Delete the first two paragraphs and replace with the following.

Bearing sole plate welded to steel superstructure shall be CSA G40.20/40.21 Grade 350 AT Cat. 3 whereas bolted sole plate shall be Grade 350 A.

Stainless steel for sliding surfaces shall have a minimum corrosion resistance according to ASTM Standard A 240/A 240M, Type 304, Number 8 mirror finish.

Clause 1203.05.04 Elastomers

Delete this clause and replace with the following.

The confined elastomer in the bearing shall be natural rubber with a hardness of 50 + 5 shore A. The elastomer shall conform to Section 18 “Bearings” Division II of AASHTO Standard Specifications for Highway Bridges and shall meet the requirements of AASHTO Grade 5 for cold temperature performance.

Clause 1203.07.01 Welding

Delete this clause.

Clause 1203.07.08 Corrosion Protection

Delete both paragraphs and insert the following:

Pot, piston and sliding plate shall be metallized as per CSA Standard G 189. The thickness of metallizing shall not be less than 180 microns. All remaining parts and hardware except stainless steel bolts and elastomer shall be galvanized as per CSA standard G164.

Top surface of slider plate when in contact with black steel (Grade 350 A or Grade 350 AT) shall be coated with two coats of epoxy paint after metallizing. The bottom face of the masonry plate shall be coated with a barrier coating after galvanizing in accordance with Section 400.3.13.2.6 (Fabrication) of the Technical Requirements.

Clause 1203.09 Owner Purchase of Material

Delete this clause.

400.3.21.3 Approved Pot Bearing Manufacturers

The following Pot Bearing Manufacturers have been approved for the use of their products, based on compliance with the design parameters in the Detailed Designs and the Technical Requirements.

- Glacier
- Goodco Ltd.
- Z-Tech Inc.
- LCL-Bridge

400.3.21.4 Testing and Inspection

400.3.21.4.1 Testing and Inspection by the Contractor

The Contractor shall be responsible for quality control and quality assurance testing required to ensure the work meets the Technical Requirements and the requirements of the Detailed Designs.

Any quality control/quality assurance testing and inspection records made by the Contractor shall be open to the Department for auditing.

400.3.21.4.2 Testing and Inspection by the Department

To confirm acceptability of materials and/or workmanship, the Department will perform visual and any other inspection that may be specified or required.

The Contractor shall ensure that adequate notice for inspection and testing be given to the Department and that access to the work is assured at all times.

The Contractor shall be responsible for all travel, boarding and lodging costs incurred by the Department to inspect pot bearings being fabricated outside the Province of Alberta. The cost shall include for a Department's representative to attend the prejob meeting for each bearing fabricator and one additional trip for each shop during the course of fabrication.

APPENDIX A - DRAWINGS

14-A-01 - Cover Sheet
14-A-02 – Project Limits and To Be Acquired Lands – CNR Edson Subdivision to Stony Plain Road/100 Avenue
14-A-03 – Project Limits and To Be Acquired Lands – South of Stony Plain Road/100 Avenue to North of Whitemud Drive
14-A-04 – Project Scope – Stage 1 – 109/111 Avenue to Stony Plain Road/100 Avenue
14-A-05 – Project Scope – Stage 1 - South of Stony Plain Road/100 Avenue to North of Whitemud Drive
14-A-06 – Typical Sections and Details
14-A-07 – Typical Sections and Details
14-A-08 – Typical Sections and Details

APPENDIX B - REPORTING SUMMARY

1. GENERAL

1.1 Section References

References to section numbers in this Appendix B are to section numbers of the Technical Requirements.

1.2 Priority

In the event of any inconsistency between the listing of, criteria for and the descriptions of the reporting obligations set out in the body of Schedule 14 and the listing of such criteria included in this Appendix B, the more detailed provisions of the body of Schedule 14 shall govern.

2. REPORTING

The following is a summary, without limitation, of the reporting requirements set out in the Technical Requirement:

Guide Signing (Section 200.2.8)

General Design Documentation (Section 300.2.3)

Reclamation Certificates (Section 400.1.1)?

As-Built Construction Reports (Section 400.1.6)

Pavement Design Report (Section 300.3.1.8.1)

Bridge Structures Design Report Requirements (Section 300.4.3)

Excavation – Submissions (Section 400.3.2.1)

Backfill – Submissions (Section 400.3.3.1.1)

Bearing Piles – Submissions (Section 400.3.4.1.1)

Bridge Structures Final Design Report Requirements (Section 300.4.4)

Cast-In-Place Concrete – Submissions (Section 400.3.5.1.1)

Class HPC and Class HPC with Steel Fibres (Section 400.3.5.22.5)

Structural Steel – Submissions (Section 400.3.7.1.1)

Structural Steel - Engineering Data (Section 400.3.7.2.3)

Structural Steel - Fabrication (Section 400.3.7.2.6)

Structural Steel - Bridge Girders (Section 400.3.7.3.2)

Precast Concrete – Submissions (Section 400.3.8.1.1)

Precast Concrete – Engineering Data (Section 400.3.7.2.3)

Precast Concrete - Post-Tensioning – Submissions (Section 400.3.8.3.12)

Precast Concrete - Construction (Section 400.3.8.3.12)

Construction of CSP and SPCSP Structures – Submissions (Section 400.3.18.1.1)

Sign Structures – Submissions (Section 400.3.19.1.1)

MSE Walls – Submission (Section 400.3.20.2.2)

Pot Bearings – Submissions (Section 400.3.21.1.1)

APPENDIX C - *HISTORICAL RESOURCES ACT* (ALBERTA) CLEARANCE LETTER

Alberta Culture and Community Spirit
Historic Resources Management

Old St. Stephen's College
8820 – 112 Street
Edmonton, Alberta, Canada T6G 2P8
Telephone (780) 431-2300 Fax (780) 422-3106
www.culture.gov.ab.ca

RECEIVED
JUL 2? 2008

July 17, 2008

Project File: 4953-08-025

Ms. Bogusia Stapor
AL-TERRA Engineering Ltd.
4010 – 76 Avenue
Edmonton, Alberta
T6B 2P1

Dear Ms. Stapor:

SUBJECT: ALBERTA TRANSPORTATION
AGENT BEING AL-TERRA ENGINEERING LTD.
HIGHWAY 216 - HENDAY/STONY PLAIN RD & 100 AVENUE INTERCHANGE
WITHIN TOWNSHIPS 52 & 53, RANGE 25, W4M
***HISTORICAL RESOURCES ACT* CLEARANCE**

Alberta Culture and Community Spirit has received an Historic Resource Overview from the Archaeology Group regarding plans for the proposed Highway 216 - Anthony Henday Drive/Stony Plain Road (Highway 16A) and 100 Avenue Interchange. Ministry staff have reviewed the potential for historic resources to be impacted by this project and have concluded that **an Historic Resources Impact Assessment is not required.**

***HISTORICAL RESOURCES ACT* REQUIREMENTS**

Reporting the discovery of historic resources: Pursuant to Section 31 of the *Historical Resources Act*, should any archaeological resources, palaeontological resources and/or historic period sites be encountered during land disturbance activities, the Historic Resources Management Branch must be contacted immediately. It may then be necessary for further instructions regarding the documentation of these resources to be issued. Should you require additional information or have any questions concerning the above, please contact me at 780- 431-2374 or by e-mail at margret.ingibergsson@gov.ab.ca.

On behalf of Historic Resources Management Branch, I would like to thank you for your cooperation in our endeavour to conserve Alberta's past.

Sincerely,

M. Ingibergsson

Margret Ingibergsson
Land Use Planner

cc: Don Snider, Alberta Transportation
Walt Kowal, The Archaeology Group

APPENDIX D - GUIDE SIGNING FOR NEW INFRASTRUCTURE

Drawings:

14-D-01 – Guide Signing for New Infrastructure
14-D-02 – Guide Signing for New Infrastructure

APPENDIX E - LIST OF ACRONYMS

AAR:	Alkali-Aggregate Reactivity
AADT:	Average Annual Daily Traffic
AASHTO:	American Association of State Highway and Transportation Officials
ACI:	American Concrete Institute
ACP:	Asphalt Concrete Pavement
AGC:	Associated General Contractors
AHDGA:	American Hot Dip Galvanizers Association
AISI:	American Iron and Steel Institute
AMA:	Alberta Motor Association
ANSI:	American National Standards Institute
APEGGA:	Association of Professional Engineers, Geologists and Geophysicist of Alberta
ARTBA:	American Road and Transportation Builders Association
ASCII:	American Standard Code for Information Interchange
AWS:	American Welding Society
ASTM:	American Society for Testing and Materials
BIM:	Bridge Inspection and Maintenance
CAP:	Corrugated Aluminum Pipe
CEAA:	Canadian Environmental Assessment Act
CECAB:	Canadian Environmental Certification Appeals Board
CGSB:	Canadian General Standards Board
CN:	Canadian National Railway Company
CP:	Canadian Pacific Railway Limited
CSA:	Canadian Standards Association
CSE:	Copper Sulphate Electrode
CSP:	Corrugated Steel Pipe
CSV:	Comma Separated Value
CTA:	Canada Transportation Act
CWB:	Canadian Welding Bureau
DCMS:	Dynamic Changeable Message Signs
DD:	Design Data

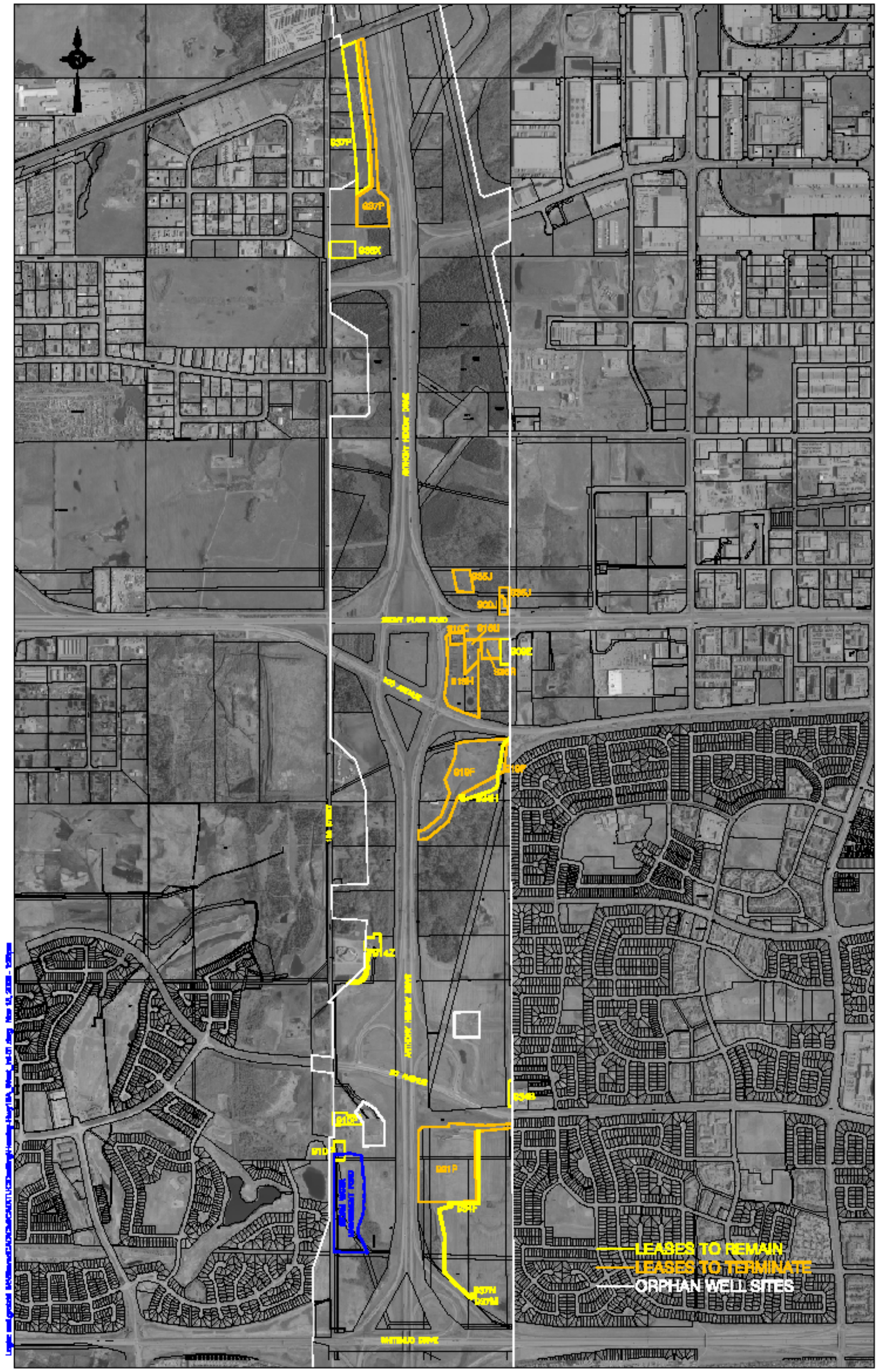
DFO:	Department of Fisheries and Oceans
DFT:	Dry Film Thickness
ESAL:	Equivalent Single Axle Load
EEMAC:	Electrical and Electronic Manufacturer's Association of Canada
EMS:	Environmental Management System
HERP:	Herbicide Exemption Request Program
ICP:	Inductively Coupled Plasma Spectrometry
IFI:	International Friction Index
IMU:	Inertial Measurement Unit
IRCA:	International Register for Certificated Auditors
IRI:	International Roughness Index
ISL:	Infrastructure Systems Limited
ISO:	International Standards Organization
Leq_{24}:	Weighted 24 hour equivalent sound level
LRFD:	Load and Resistance Factor Design
MAPP:	Medical Alert Pesticide Program
MSE:	Mechanically Stabilized Earth
MTO:	Ministry of Transportation Ontario
NCHRP:	National Cooperative Highway Research Program
NEMA:	National Electrical Manufactures Association
NQI:	National Quality Institute
NWPA:	Navigable Waters Protection Act
OSCAM:	On-Street Construction and Maintenance
PDF:	Portable Document Format
PG:	Performance Grade
PTFE:	Polytetrafluoroethylene
PTI:	Post Tensioning Institute
PVC:	Polyvinyl Chloride
QMS:	Quality Management System
RAP:	Reclaimed Asphalt Pavement
RAB:	Registrar Accreditation Board
RWIS:	Road Weather Information System
SHRP:	Strategic Highway Research Program
SPCSP:	Structural Plate Corrugated Steel Pipe
SSPC:	Society for Protective Coating Standards
TAC:	Transportation Association of Canada

APPENDIX F - ALBERTA INFRASTRUCTURE LAND LEASE SUMMARY AND DRAWINGS

- **Table**
- **Drawing**

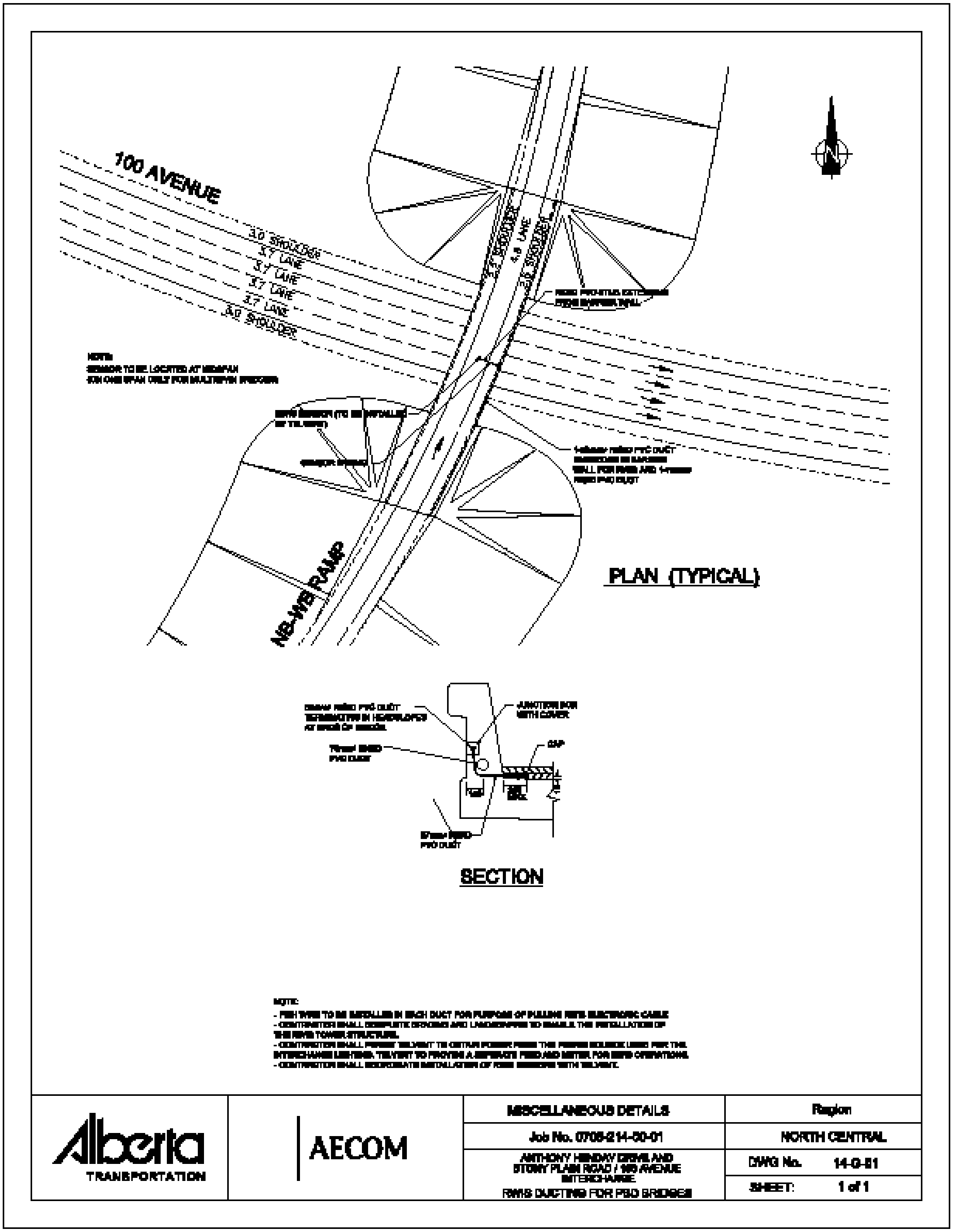
Appendix F - Alberta Infrastructure Land Lease Summary

Province File	Location	Status of Lease	Buildings/Structures to be Demolished
900J	SW-05-53-25-W4	Will be terminated	
935J	SW-05-53-25-W4	Will be terminated	
936R	NW-32-52-25-W4	Will be terminated	
921P	NW & SW-29-52-25-W4	Will be terminated	
916U	NW-32-52-25-W4	Will be terminated	~1400 sq ft house with full basement, attached garage with concrete pad, quonset with concrete pad, steel pole shed, small wood shed, two-car garage, and a well
910C	NW-32-52-25-W4	Will be terminated	~1000 sq ft house with full basement, two concrete pads, well, two small garden sheds
937P	W-08-53-25-W4	Partial termination (lease area within the Road Right of Way will be removed from the lease effective June 1, 2009)	
919H	NW-32-52-25-W4	Will be terminated	
919F	NW & SW-32-52-25-W4	Will be terminated	
909E	NW-32-52-25-W4	Not terminated	
934H	NW-32-52-25-W4	Not terminated	
914Z	SW-32-52-25-W4	Not terminated	
934B	NW-29-52-25-W4	Not terminated	
910P	W-29-52-25-W4	Not terminated	
934F	W-29-52-25-W4	Not terminated	
937M	SW 29-52-25-W4	Not terminated	
937N	SW 29-52-25-W4	Not terminated	
936X	SW-8-53-25-W4	Not Terminated	


LEASES TO REMAIN
LEASES TO TERMINATE
ORPHAN WELL SITES

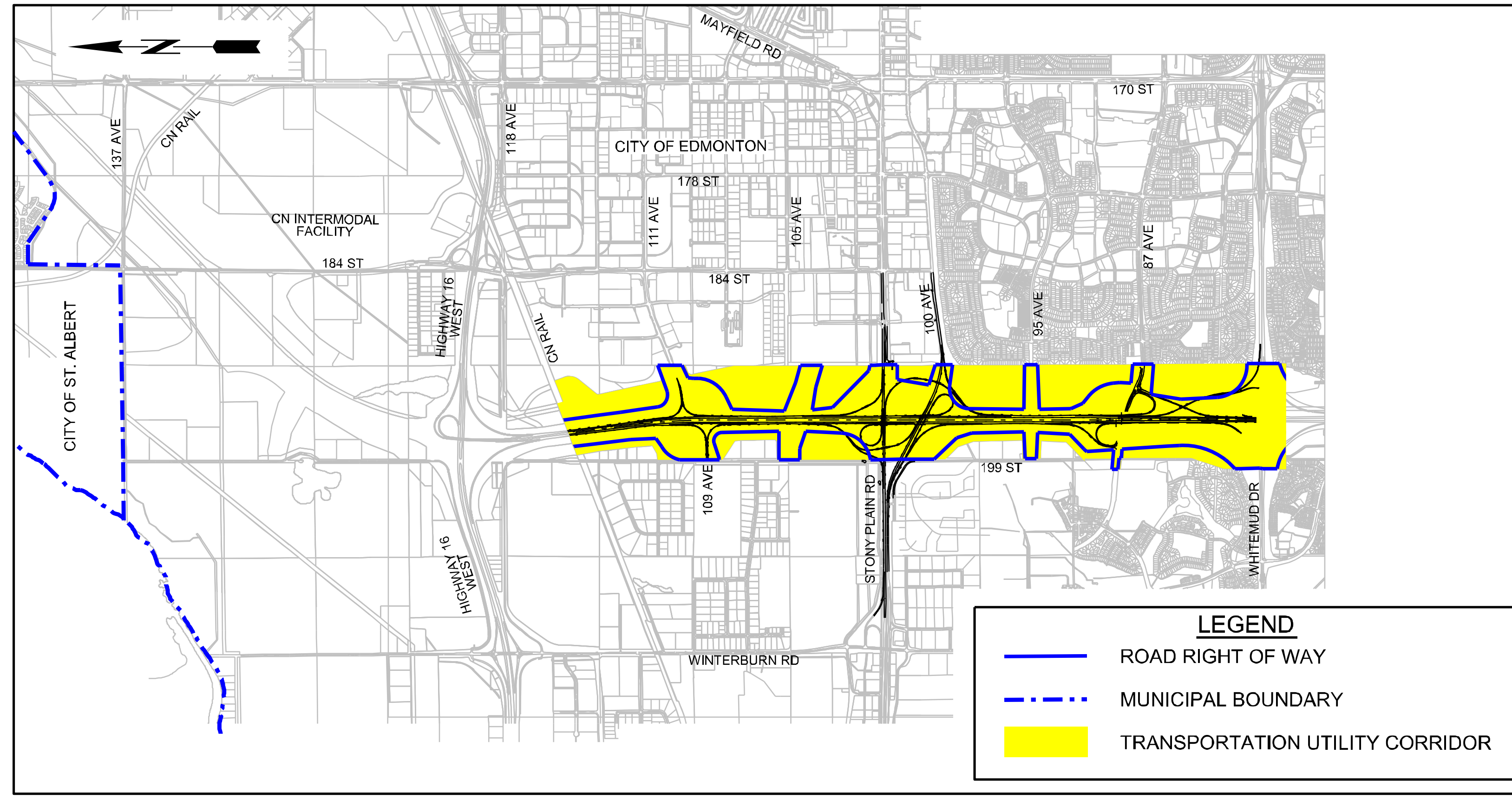
APPENDIX G - ROAD WEATHER INFORMATION SYSTEM DRAWING

- **Drawings 14-G-01**


100 AVENUE
3.0 SHOULDER
3.7 LANE
3.7 LANE
3.7 LANE
3.7 LANE
3.0 SHOULDER
NB-WB RAMP
PLAN (TYPICAL)
SECTION
Alberta
TRANSPORTATION
AECOM
MISCELLANEOUS DETAILS
ANTHONY HENDAY DRIVE AND
STONY PLAIN ROAD / 100 AVENUE
INTERCHANGE
RWIS DUCTING FOR PSD BRIDGES
Region
NORTH CENTRAL
DWG No.
SHEET:
1 of 1

DRAWING LIST

14-A-01	01 OF 08	COVER SHEET
PROJECT LIMITS AND TO BE ACQUIRED LANDS		
14-A-02	02 OF 08	ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD INTERCHANGE
14-A-03	03 OF 08	ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD INTERCHANGE
PROJECT SCOPE - STAGE 1		
14-A-04	04 OF 08	ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD INTERCHANGE
14-A-05	05 OF 08	ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD INTERCHANGE
TYPICAL SECTIONS AND DETAILS		
14-A-06	06 OF 08	TYPICAL SECTIONS AND DETAILS
14-A-07	07 OF 08	TYPICAL SECTIONS AND DETAILS
14-A-08	08 OF 08	TYPICAL SECTIONS AND DETAILS



DESIGN BUILD PROJECT

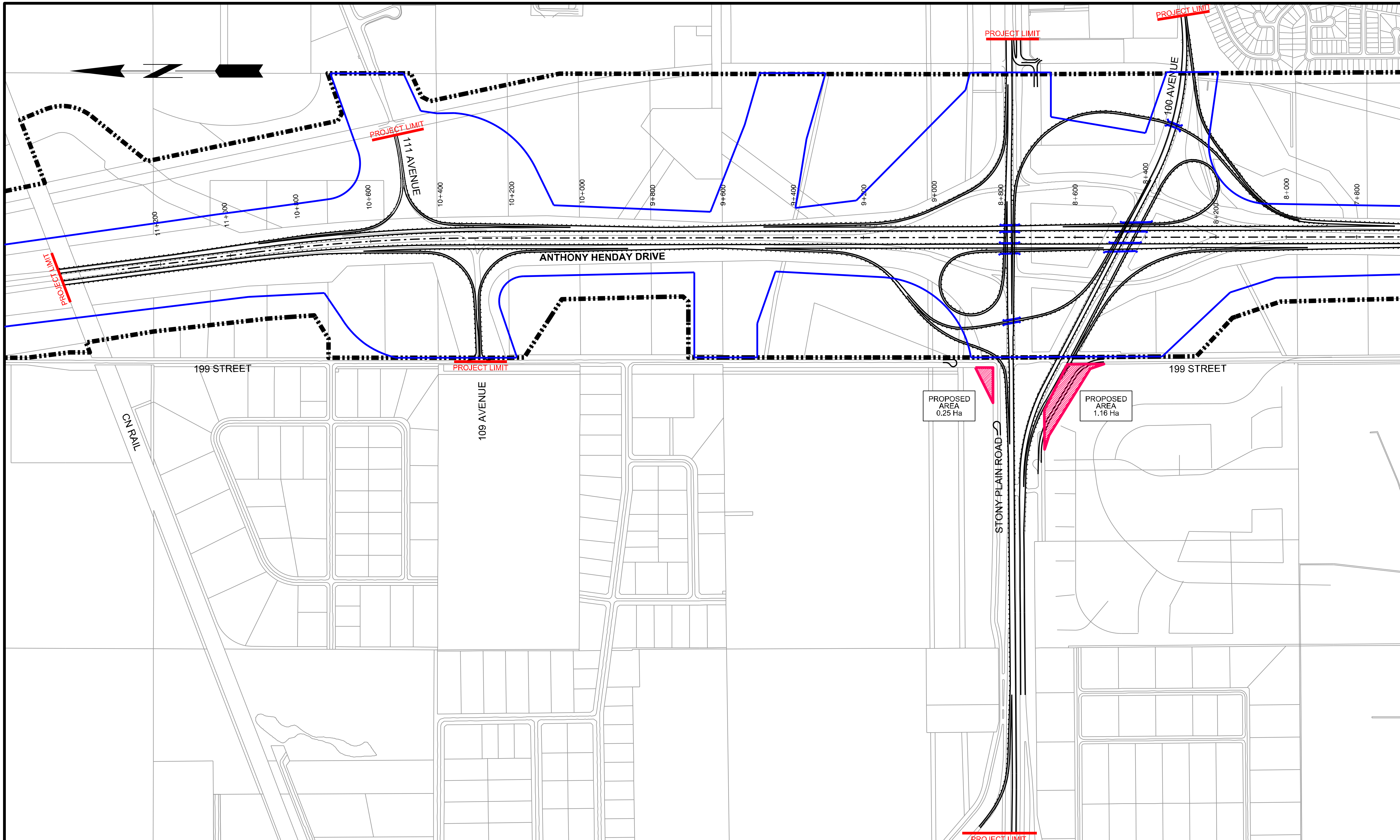
ANTHONY HENDAY DRIVE AND
STONY PLAIN ROAD/100 AVENUE INTERCHANGE
EDMONTON, ALBERTA, CANADA

SCHEDULE 14
APPENDIX A - DRAWINGS
ISSUED FOR DB AGREEMENT

UMA | AECOM
17007–107 Avenue
Edmonton, Alberta
Ph. 780–486–7000
www.uma.aecom.com

Alberta TRANSPORTATION

ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD / 100 AVENUE INTERCHANGE
COVER SHEET
14-A-01
1 ISSUED FOR DB AGREEMENT



LEGEND

- PROJECT LIMIT
- TUC BOUNDARY
- ROAD RIGHT OF WAY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS

CONSULTANT

JOB No. 0705–214–00–01 | PLAN No. 14–A–02

UMA | AECOM

17007–107 Avenue
Edmonton, Alberta
Ph. 780–486–7000
www.uma.aecom.com

ANTHONY HENDAY DRIVE
STONY PLAIN ROAD /100 AVENUE
INTERCHANGE

PROJECT LIMITS &
TO BE ACQUIRED LANDS

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	14–A–02	ANTHONY HENDAY DRIVE		02 of 08

Alberta TRANSPORTATION

50m 0 100m
SCALE 1:10000

No.	REVISION	BY	DATE
1	ISSUED FOR DB AGREEMENT	CMP	08/12/23

	BY	DATE
SURVEYED		
DESIGNED		
CHECKED		
DRAWN		

PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE

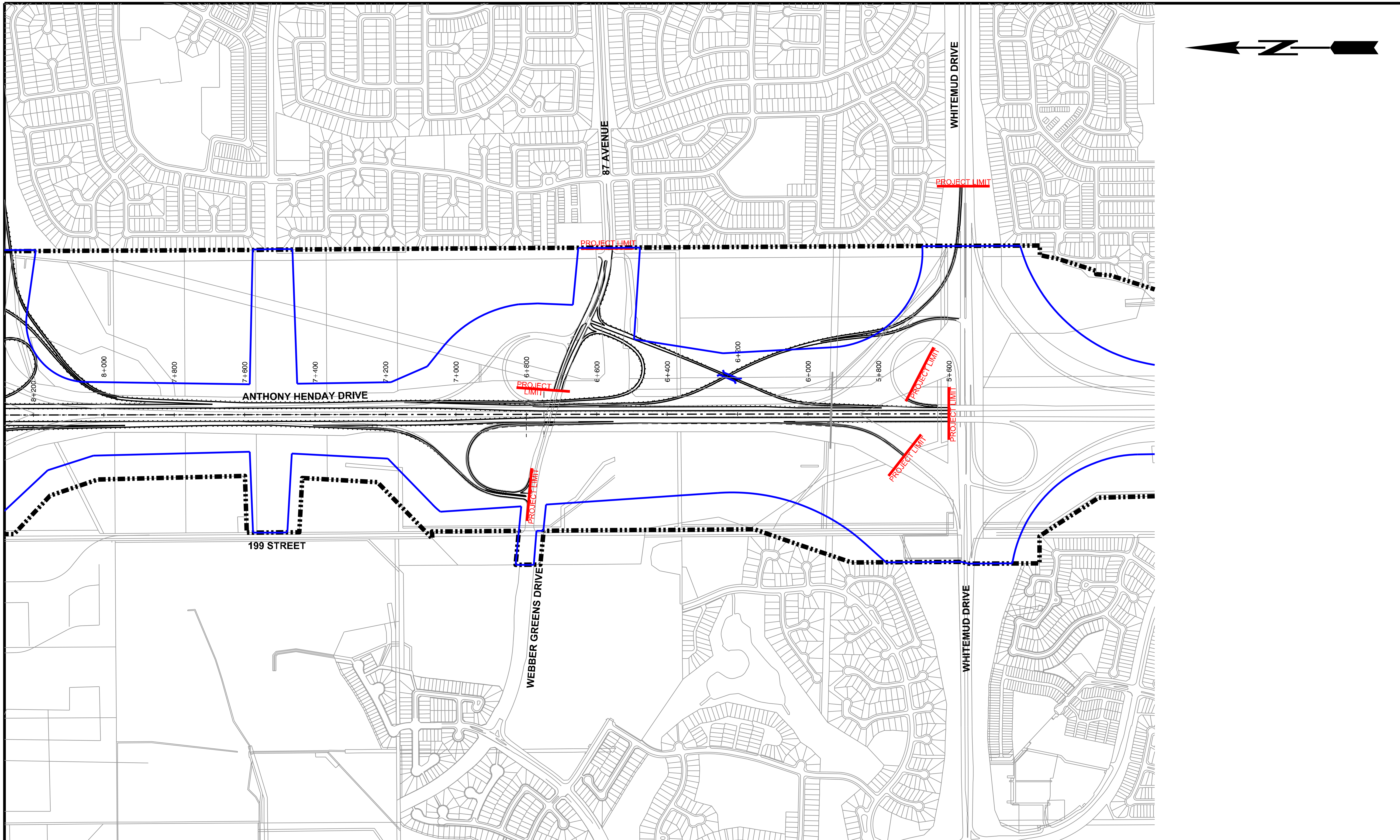
COORDINATE DATA: NAD 83
BASE LONGITUDE

PLAN No. 14–A–02
CONTRACT No.
PLAN LOCATION

BAR CODE

ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD /100 AVENUE INTERCHANGE
PROJECT LIMITS & TO BE ACQUIRED LANDS

	BY	DATE
TO IDMS		
TO GIS		
MICROFILMED		



No.	REVISION	BY	DATE
1	ISSUED FOR DB AGREEMENT	CMP	08/12/23

SURVEYED / DESIGNED / CHECKED / DRAWN — BY — DATE

PHOTO No. — TITLE SEARCH DATE — GRAPHICS FILE

COORDINATE DATA: NAD 83 — BASE LONGITUDE

PLAN No.: 14-A-03 — CONTRACT No. — PLAN LOCATION

BAR CODE

ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD /100 AVENUE INTERCHANGE

PROJECT LIMITS & TO BE ACQUIRED LANDS

TO IDMS / TO GIS / MICROFILMED — BY — DATE

LEGEND

- PROJECT LIMIT
- TUC BOUNDARY
- ROAD RIGHT OF WAY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS

CONSULTANT

JOB No. 0705-214-00-01 | PLAN No. 14-A-03

UMA | AECOM

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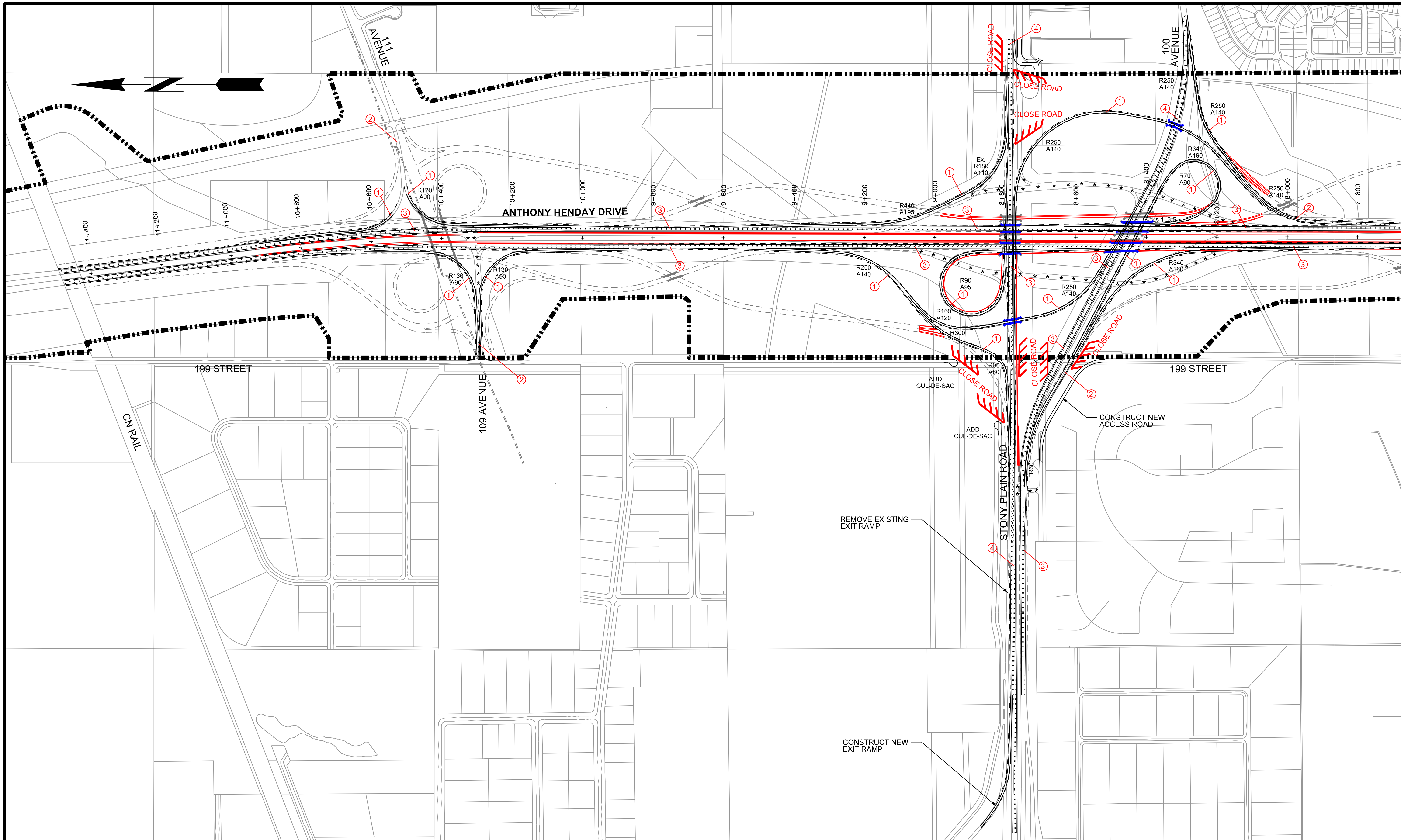
ANTHONY HENDAY DRIVE STONY PLAIN ROAD /100 AVENUE INTERCHANGE

PROJECT LIMITS & TO BE ACQUIRED LANDS

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	14-A-03	ANTHONY HENDAY DRIVE		03 of 08

Alberta TRANSPORTATION

50m 0 100m
SCALE 1:10000



NOTES

1. FUTURE MAINLINE GRADING REQUIRED AS SHOWN ON CROSS SECTIONS. REFER TO DRAWING 14-A-06.

LEGEND

- ROAD CLOSURE
- TUC BOUNDARY
- ② NUMBER OF PAVED LANES
- GRADING FOR ULTIMATE STAGE
- PAVING THIS STAGE
- ULTIMATE STAGE
- STAGE 1 BRIDGES
- ROADS TO REMOVE AND RESTORE

CONSULTANT

JOB No. 0705-214-00-01 PLAN No. 14-A-04

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ANTHONY HENDAY DRIVE STONY PLAIN ROAD /100 AVENUE INTERCHANGE

PROJECT SCOPE - STAGE 1

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	14-A-04	ANTHONY HENDAY DRIVE		04 of 08

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SCALE 1:10000

No.	REVISION	DATE	BY
1	ISSUED FOR DB AGREEMENT	08/12/23	CMP

SURVEYED / DESIGNED / CHECKED / DRAWN

PHOTO No. / TITLE SLAMCH DATE / GRAPHICS FILE

COORDINATE DATA NAD 83 BASE LONGITUDE

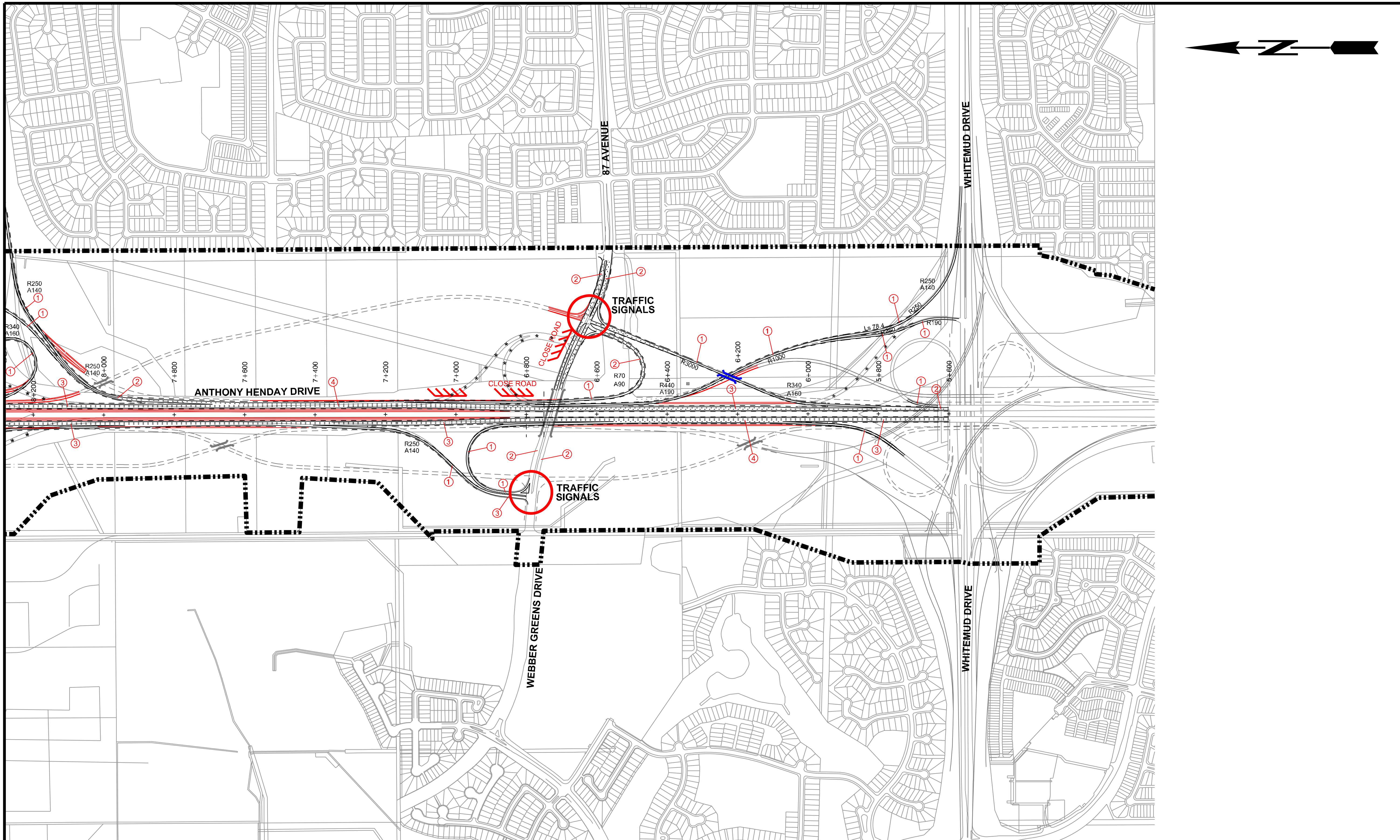
PLAN No. / CONTRACT No. 14-A-04 / PLAN LOCATION

BAR CODE

ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD /100 AVENUE INTERCHANGE

PROJECT SCOPE - STAGE 1

TO IDMS / TO GIS / MICROFILMED BY DATE



NOTES

1. FUTURE MAINLINE GRADING REQUIRED AS SHOWN ON CROSS SECTIONS. REFER TO DRAWING 14-A-06.

LEGEND

- ROAD CLOSURE
- TUC BOUNDARY
- ② NUMBER OF PAVED LANES
- GRADING FOR ULTIMATE STAGE
- PAVING THIS STAGE
- ULTIMATE STAGE
- STAGE 1 BRIDGES
- * * * * * * ROADS TO REMOVE AND RESTORE

CONSULTANT

JOB No. 0705-214-00-01 PLAN No. 14-A-05

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ANTHONY HENDAY DRIVE
STONY PLAIN ROAD /100 AVENUE
INTERCHANGE

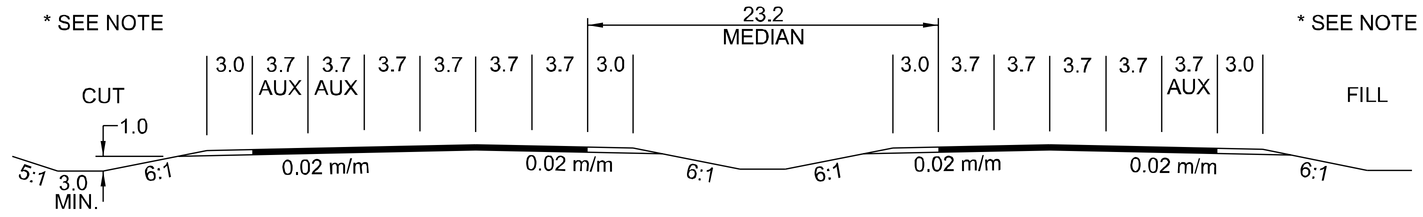
PROJECT SCOPE - STAGE 1

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	14-A-05	ANTHONY HENDAY DRIVE		05 of 08

Alberta TRANSPORTATION

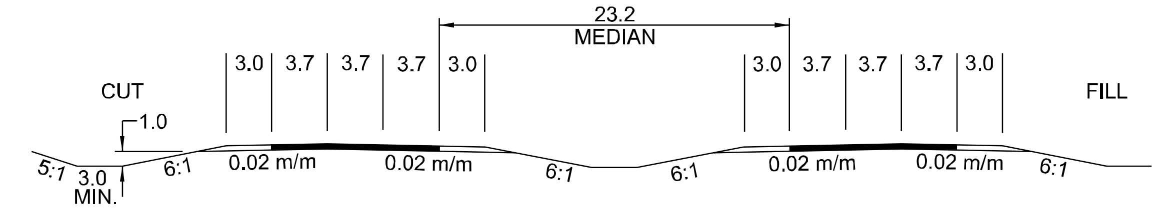
SCALE 1:10000

No.	REVISION	BY	DATE
1	ISSUED FOR DB AGREEMENT	CMP	09/12/23

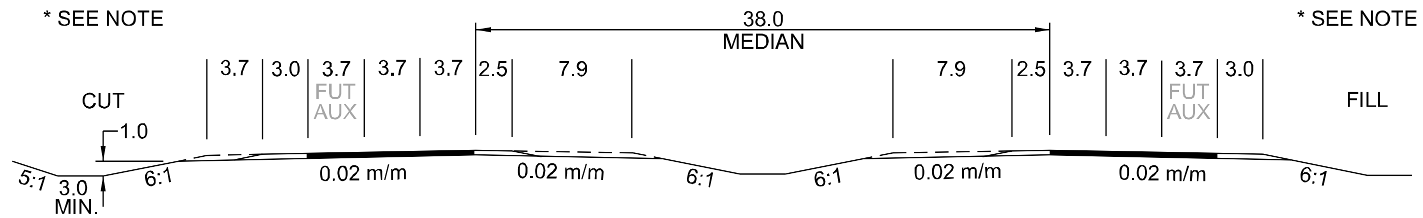


MAINLINE - ULTIMATE STAGE
8+200

* RAMPS NOT SHOWN FOR CLARITY

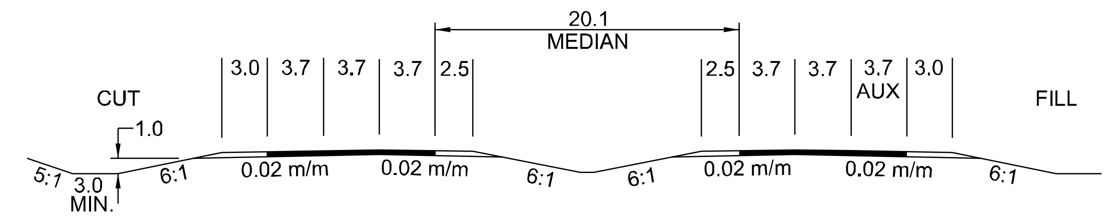


MAINLINE - STAGE 1 AT CN CROSSING

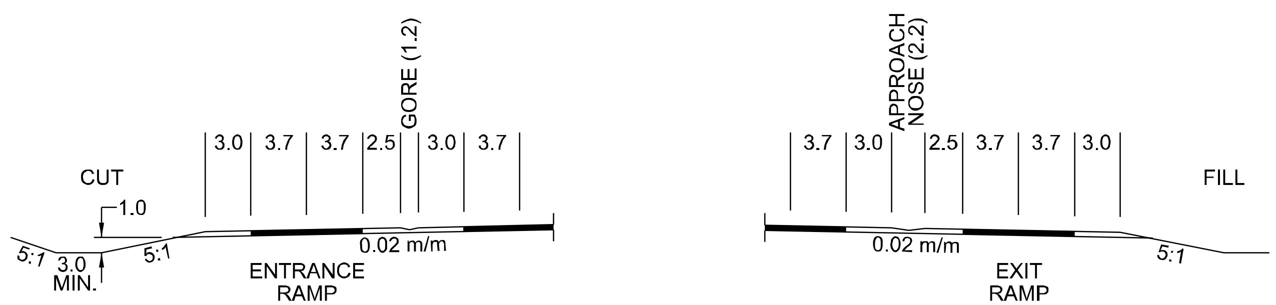


MAINLINE - STAGE 1
8+200

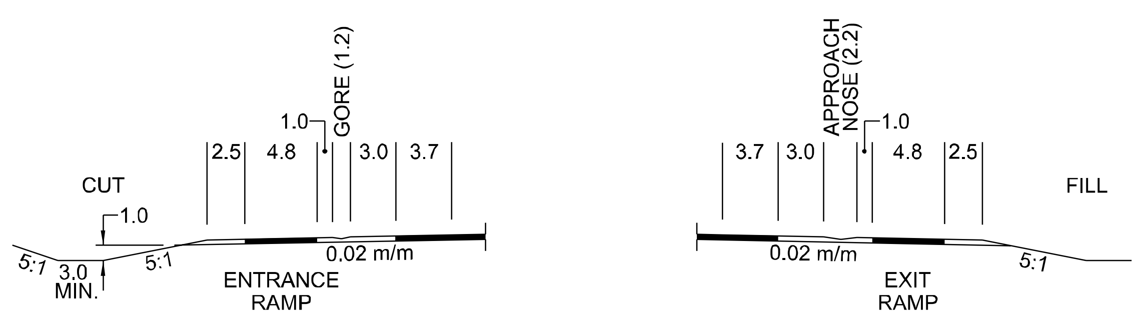
* RAMPS NOT SHOWN FOR CLARITY



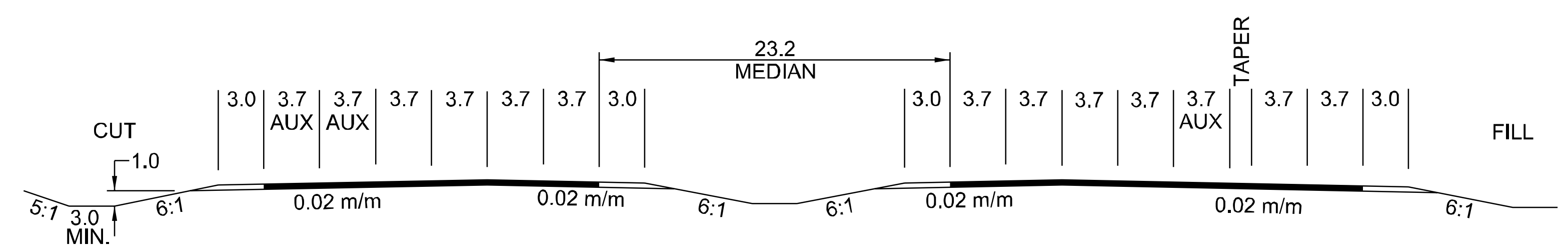
MAINLINE - STAGE 1 (AT WHITEMUD DRIVE STRUCTURES)
5+600



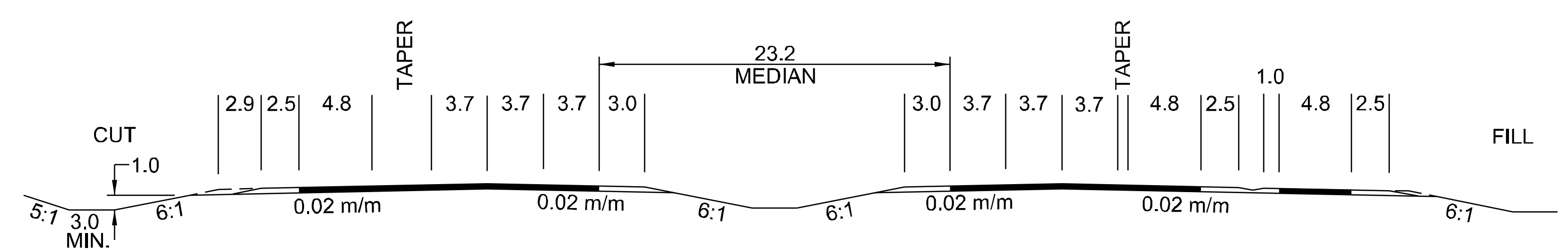
DOUBLE LANE RAMPS AT GORE/APPROACH NOSE



SINGLE LANE RAMPS AT GORE/APPROACH NOSE



MAINLINE - ULTIMATE STAGE (AT 87 AVENUE)
APPROX 6+750



MAINLINE - STAGE 1 (AT 87 AVENUE)
APPROX 6+750

NOTE:
REFER TO SECTION 200 OF SCHEDULE 14 FOR SIDESLOPE AND BACKSLOPE REQUIREMENTS

CONSULTANT				
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ANTHONY HENDAY DRIVE
STONY PLAIN ROAD /100 AVENUE
INTERCHANGE

TYPICAL SECTIONS AND DETAILS

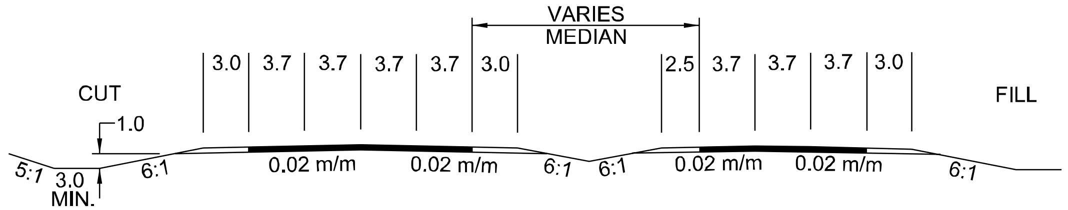
REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	14-A-06	ANTHONY HENDAY DRIVE		06 of 08

Alberta TRANSPORTATION

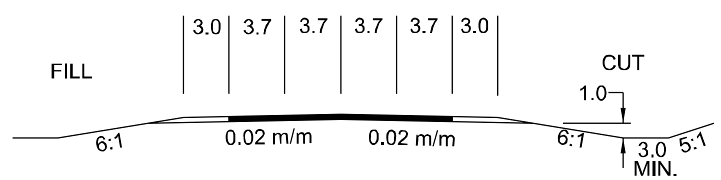
Scale N.T.S.

ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD /100 AVENUE INTERCHANGE
TYPICAL SECTIONS AND DETAILS

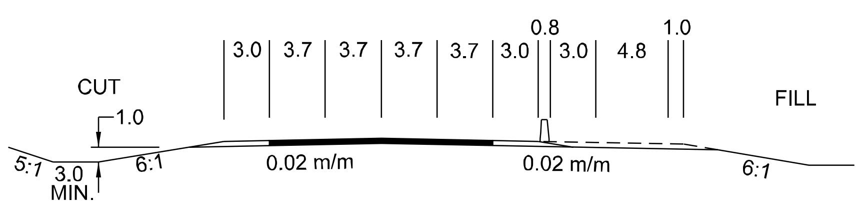
No.	REVISION	BY	DATE
1	ISSUED FOR DB AGREEMENT	CMP	08/12/23



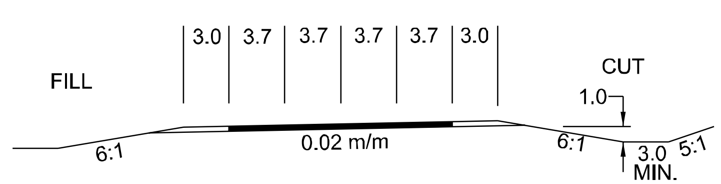
STONY PLAIN ROAD - STAGE 1
(WEST OF SPR EB-SB RAMP)



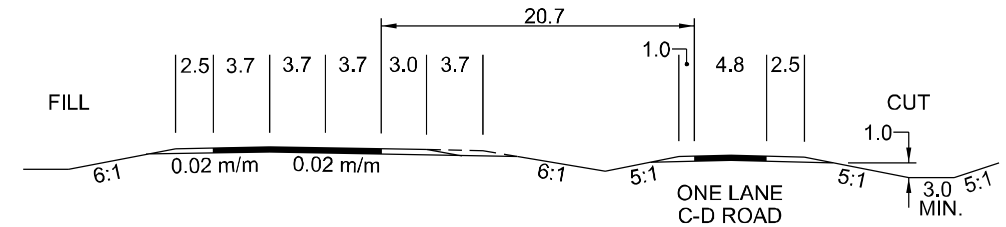
STONY PLAIN ROAD - STAGE 1
(EAST OF SPR WB-NB RAMP)



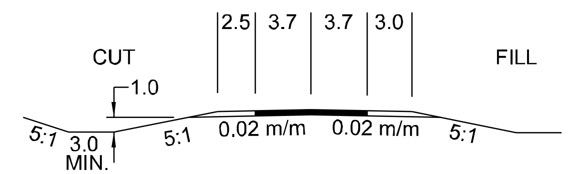
STONY PLAIN ROAD - STAGE 1
(WEST OF AHD SB-WB RAMP)



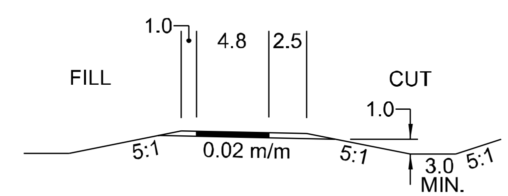
100 AVENUE - STAGE 1
(EAST OF AHD NB-EB RAMP)



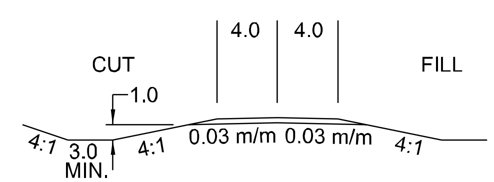
100 AVENUE WITH CD ROAD - STAGE 1
(WEST OF AHD SB TO 100 AVE EB RAMP)



TWO LANE
RAMP



ONE LANE
RAMP



ACCESS ROAD
(GRAVEL)

NOTE:
REFER TO SECTION 200 OF SCHEDULE 14 FOR
SIDESLOPE AND BACKSLOPE REQUIREMENTS

CONSULTANT		
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ANTHONY HENDAY DRIVE
STONY PLAIN ROAD /100 AVENUE
INTERCHANGE

TYPICAL SECTIONS AND DETAILS

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	14-A-07	ANTHONY HENDAY DRIVE		07 of 08

Alberta
TRANSPORTATION

Scale N.T.S.

ANTHONY HENDAY DRIVE AND
STONY PLAIN ROAD /100 AVENUE
INTERCHANGE
TYPICAL SECTIONS AND DETAILS

No.	REVISION	BY	DATE
1	ISSUED FOR DB AGREEMENT	CMP	08/12/23

SURVEYED / DESIGNED / CHECKED / DRAWN

PLAN No. 14-A-07

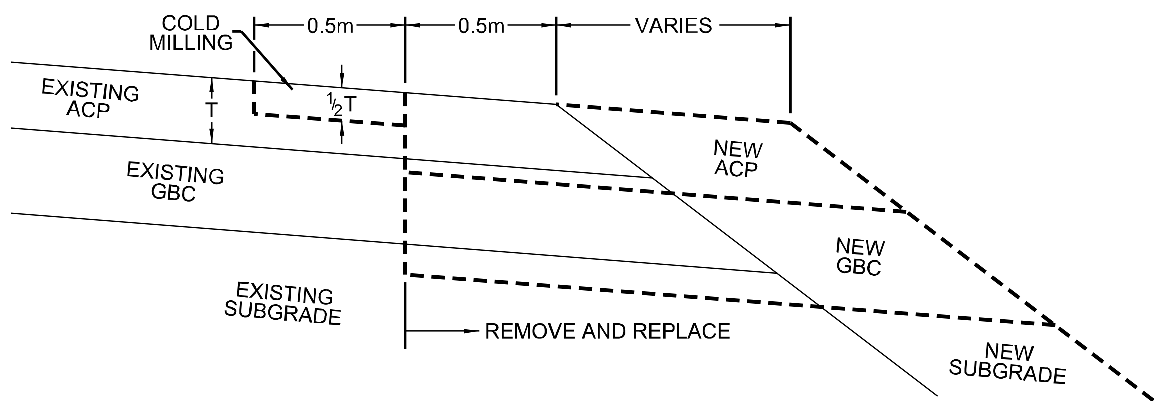
TO IDMS / TO GIS / MICROFILMED / BY / DATE

BAR CODE

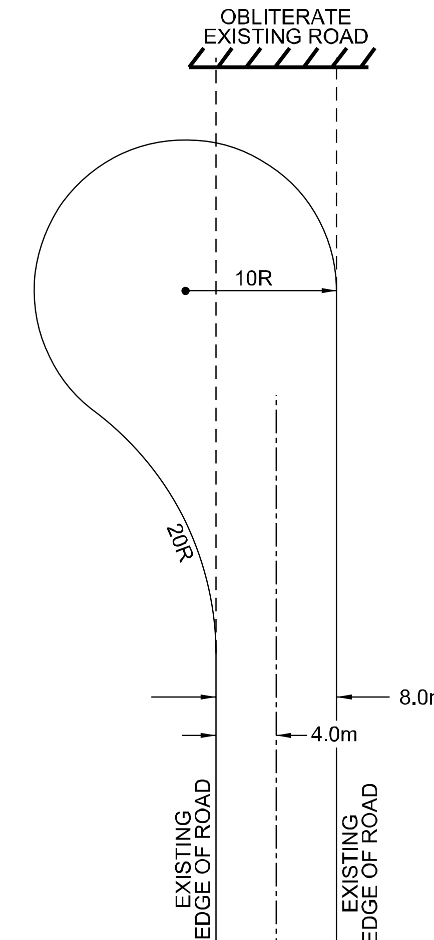
COORDINATE DATA NAD 83 BASE LONGITUDE

CONTRACT No. / PLAN LOCATION

PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE



PAVEMENT WIDENING TRANSITION DETAIL



ROAD CLOSURE CUL-DE-SAC DETAIL

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ANTHONY HENDAY DRIVE
STONY PLAIN ROAD /100 AVENUE
INTERCHANGE

TYPICAL SECTIONS AND DETAILS

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	14-A-08	ANTHONY HENDAY DRIVE		08 of 08

Alberta TRANSPORTATION

Scale N.T.S.

No.	REVISION	BY	DATE
1	ISSUED FOR DB AGREEMENT	CMP	08/12/23

NOTES

1. ROADWAY GEOMETRY SHOWN IS BASED ON A COMBINATION OF EXISTING CONDITIONS AND FUNCTIONAL/CONCEPTUAL DESIGN.
2. ALL DISTANCES INDICATED ON GUIDE SIGN PANELS MUST BE CONFIRMED PRIOR TO PANEL FABRICATION.
3. ROADWAY LANING TO BE CONFIRMED DURING DETAIL DESIGN. GUIDE SIGN PANEL MESSAGING AND LOCATION MUST BE CONFIRMED PRIOR TO PANEL FABRICATION.

LEGEND

- TUC BOUNDARY
- OVERHEAD BRIDGE
- CANTILEVER
- GROUND MOUNT
- STAGE 1 BRIDGES

CONSULTANT

JOB No. 0705-214-00-01 | PLAN No. 14-D-01

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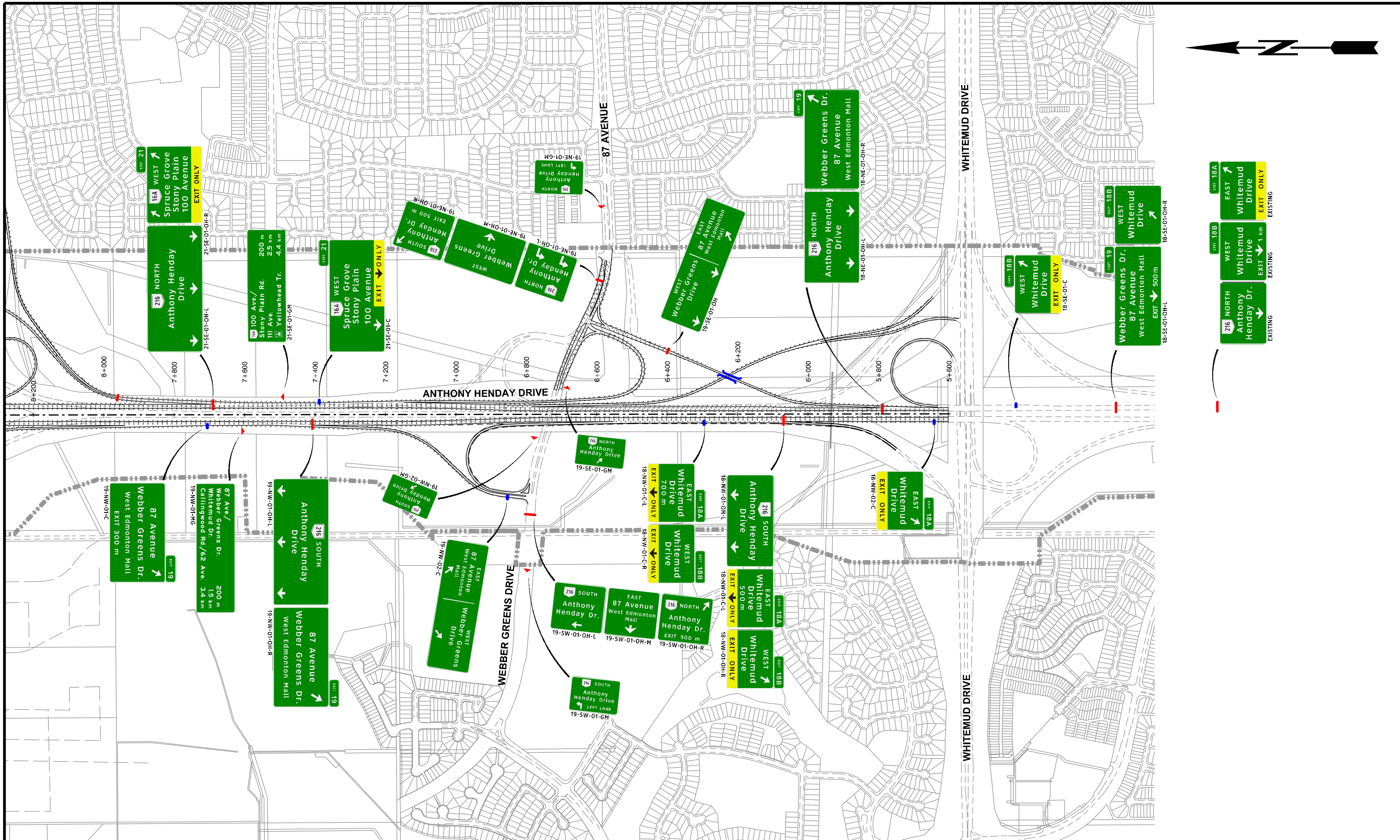
ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD /100 AVENUE INTERCHANGE

GUIDE SIGNING FOR NEW INFRASTRUCTURE

Alberta TRANSPORTATION

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	14 D 01	ANTHONY HENDAY DRIVE		1 of 2

No.	REVISION	BY	DATE
1	ISSUED FOR DB AGREEMENT	CMP	09/12/23



NOTES

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3. ROADWAY LANING TO BE CONFIRMED DURING DETAIL DESIGN. GUIDE SIGN PANEL MESSAGING AND LOCATION MUST BE CONFIRMED PRIOR TO PANEL FABRICATION.

LEGEND

- TUC BOUNDARY
- OVERHEAD BRIDGE
- CANTILEVER
- GROUND MOUNT
- STAGE 1 BRIDGES

CONSULTANT

JOB No. 0705-214-00-01 | PLAN No. 14-D-02

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ANTHONY HENDAY DRIVE AND
STONY PLAIN ROAD /100 AVENUE INTERCHANGE

GUIDE SIGNING FOR NEW INFRASTRUCTURE

REGION	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	14-D-02	ANTHONY HENDAY DRIVE		2 of 2

Alberta TRANSPORTATION

SCALE 1:10000

No.	REVISION	BY	DATE
1	ISSUED FOR DB AGREEMENT	CMP	09/12/23

ANTHONY HENDAY DRIVE AND STONY PLAIN ROAD /100 AVENUE INTERCHANGE
GUIDE SIGNING FOR NEW INFRASTRUCTURE

PLAN No. 14-D-02