1.1 Excavation - General

Excavation is the removal of all material (including ice, water, etc.) required for the construction of foundations or substructures as indicated on the drawings or as determined by the Bridge Project Engineer. Structural excavation may be wet, as in excavations required within or adjacent to stream channels, or they may be dry as in excavation in dry land. Dry excavations may also become wet due to the presence of ground water and surface runoff. Channel excavation is excavation carried out to improve the alignment or carrying capacity of the stream channel and excavation as may be required to allow placing of riprap.

- Dry structural excavation is usually done with front-end loaders, bulldozers or backhoes.

- Wet structural excavation usually requires the equipment to be located above the excavation, involving draglines, backhoes, clamshells and airlift pumps.

- Channel excavation is usually done utilizing bulldozers, excavators and draglines.

1.2 Environmental Constraints

Alberta Environment's Code of Practice is to be followed for all projects involving a stream or river crossing. The Bridge Inspector be aware of the environmental constraints governing the site relating to excavation activities within or adjacent to the stream channel. The Contractor must be in conformance with the following:

- There are only certain time periods that construction activities are allowed within a channel under the Code of Practice.

- The Contractor is responsible to prepare an Environmental Construction Operation Plan (ECO Plan) prior to the commencement of constructions addressing:
  1. Spills adjacent to the stream channel.
  2. Ensuring equipment working within the stream channel to be well maintained and cleaned of oil, lubricants, dirt and other contaminants.
  3. Preventing turbidity or siltation downstream of excavation within or adjacent to the stream channel.

- The Contractor must accommodate natural drainage of surface water passing through the excavated site. Also, the Contractor shall obtain approval for his method and location of discharge of water pumped or drained from the excavations.

- Water pumped out of excavations may be detrimental to the environment, and may have to be pumped into a settling pond to remove the suspended materials.

- The Contractor's operations adjacent to the required excavations should not be allowed to affect in any way the existing stream channel or natural stream banks, unless permission has been received from the Bridge Project Engineer.

- Careful consideration should be given to the location of access roads down to the river.

- If the Contractor's activities contravene the environmental permit conditions, the Bridge Inspector shall require the Contractor to cease operations and he shall immediately contact the Bridge Project Engineer.

1.3 Safety

Excavations can be dangerous and have been the cause of many fatalities. The Occupational Health and Safety Act and Regulations of the Province of Alberta give safety guidelines and requirements relative to allowable vertical heights of excavated faces, back slopes and safety railings around tops of excavations.

Refer to the Alberta's Occupational Health and Safety Regulation, General Safety Requirements (to replace the existing General Safety Regulation) for specific approved safety requirements:

- Part 16 – Powered Mobile Equipment

- Part 27 - Excavation, Tunnelling and Trenching

- It is the responsibility of the Contractor to ensure that all safety requirements are met.

- The Bridge Inspector is responsible to point out any safety violations that he is aware of to the Contractor, and to take necessary action where there is non-compliance in accordance with the Department Policies contained in Section D of this manual.

1.4 Bridge Inspector's Record

Prior to the beginning of excavation, the Bridge Inspector must take a series of levels on the ground surface in the area around the excavation. These form the datum for calculations of excavated quantities and provide information for future reference, settlements of disputes, etc. Photographs of the original ground of the non-excavated site are required to record conditions prior to the beginning of excavation.

- It is the responsibility of the contractor to ensure that there are no utilities in the area to be excavated or, if there are utilities that they are accurately located, protected and/or relocated.

- The bore hole logs should be thoroughly reviewed so that the Bridge Inspector knows the type of material to be encountered when excavated, and a record kept of actual material type.

- The Bridge Project Engineer shall be notified if different materials are encountered to review the need for foundation modifications.

- All structures or improvements adjacent to the site of the excavation must be reviewed and photographed prior to the beginning of excavation so that any damages claimed later can be checked as to whether or not they occurred because of the excavation.

- The Bridge Inspector shall record the elevations of groundwater, stream water levels, and ice levels and the tops of berms and dikes.

- Photographs and records of equipment used for excavation are necessary for resolving disputes and claims.

1.5 Soil Materials and Ground Water

The Bridge Inspector should be aware of the effects of certain conditions and material types on the satisfactory performance of an excavation. High ground water levels make excavations difficult and free water lying at the bottom of an excavation can very rapidly disturb and soften otherwise suitable bearing materials. High ground water tables also provide a source of water in which can lead to frost heaving in cold weather conditions.

- Existing fill materials encountered in excavations are often incompetent and may have to be removed and the footing extended downward or the material replaced with a more competent bearing material compacted into place.

- Highly plastic clays are subject to swelling and shrinkage with changes in moisture content.

- Fine sand, silts and weak clays are easily disturbed during construction. They are sensitive to flows of ground water when excavations are carried below ground water table and are subject to erosion, frost heave and piping.

- Clay shale appears very competent at the time of excavation, but can be weaken rapidly with exposure to weather.

- Variability of soil types within the excavated area can cause problems for the Contractor and may require the over-excavation of softer portions. This should be reviewed with the Bridge Project Engineer.

1.5.1 Sulphates

The subsurface investigation may or may not indicate the presence of sulphates in the soil. During excavation the Bridge Inspector should examine the material being excavated. If a white powdery or feathery substance is noted, it is often an indication of relatively high sulphate content. It may be necessary to have a sample of the material delivered to a testing laboratory for analysis.

- The Bridge Project Engineer should be contacted for a decision as to whether tests for sulphates should be made, or if the cement type will have to be changed for concrete in contact with the soil.

- If the cement type is changed, the Contractor will be compensated for the increase cost of the cement, unless it is specified in the contract documents.

1.6 Foundation Requirements

The Specifications require that when concrete masonry is to be supported on an excavated surface other than rock, the foundation material must not be disturbed and final excavation to the required bottom grade must not be made until just before the concrete is to be placed.

- In preparation for casting of concrete footings, all loose material must be removed.

- With the approval of the Bridge Project Engineer, the Contractor may be allowed to dig slightly below the required elevation and then protect the excavated surface with a seal coat of lean concrete (a blinding course).

- Where excavations must be drained or de-watered, ensure that drainage trenches and sumps are located outside of the area in which the concrete is to be cast, so that the concrete is not placed with flowing water present.

1.7 Dry Structural Excavation

Dry structural excavations are usually quite straightforward. The Bridge Inspector must confirm that the bottom of the excavation is at the depth required by the drawings, and that the material encountered is the same as that anticipated from the test bore holes.

- Spread footings not supported on piling are to be cast “neat” into excavations, unless otherwise specified.

- Neat excavations are dug carefully to a size and shape conforming closely to or slightly larger than the required footing dimension shown on the drawings.

- Water trying to enter an excavation is to be controlled at a level above the newly poured concrete.

1.7.1 Shoring

Depending on the soil type and depth, excavations may require shoring. The Contractor is required to have all shoring designed by a Professional Engineer and it must meet the requirements of the Occupational Health and Safety Act.

- Shoring drawings shall be submitted to and reviewed by the Bridge Project Engineer, and the shoring will be inspected for conformance to the approved design. Deviations are to be discussed with the Contractor and the Bridge Project Engineer.

- During excavation, the Bridge Inspector shall monitor the performance of the shoring and report any inadequacies to the Bridge Project Engineer.

1.8 Wet Structural Excavation

Excavation within or adjacent to the streambed is usually classified as wet excavation. Such excavations are made by one of two methods. An open hole or 'glory hole' method by the use of dikes and berms or by constructing a cofferdam accessed by berms. The main purpose of either method is to eliminate/minimize water from the excavation.

- Details of cofferdams, dikes or berms must be submitted and approved by the Bridge Project Engineer and all work must meet environmental constraints.

- All cofferdams, dikes and berms must be removed as soon as that portion of the substructure is completed and in conformance with the applicable permits.

- After the removal of cofferdams, dikes, berms and work bridges, etc., it is essential that the Contractor restore the channel to its original condition or to such improved condition as is required by the plans and specifications and applicable environmental permit.

1.8.1 Open Hole or 'Glory Hole'

In this method of excavation, the area to be excavated is accessed and surrounded by berms or dikes. The hole is de-watered by various methods such as pumping or well points prior to excavation. A sloped, or terraced and sloped excavation is then made down to the footing level.

- Perimeter drainage must be maintained at the bottom of the sloped excavation, above the level of the neat excavation for the footing.

- It is essential that the neat excavation be carried out in the ‘dry’.

- When such excavations are carried out adjacent to the toe of a headslope fill, the Bridge Inspector should monitor the fill for possible signs of sliding or instability and immediately report any such occurrences to the Bridge Project Engineer.

1.8.2 Cofferdams

Cofferdams are usually constructed by driving interlocking sheet piling through the water bearing formations into the shale, sandstone or clay formation below to obtain a seal. The cofferdam is usually located about 2 m or more from the neat lines of the footing to be excavated. This is to allow for sufficient space to intercept perimeter drainage or water that will invariably leak into the cofferdam, and must be kept out of the neat excavation. Dependent upon the depth and head of water, cofferdams and shoring can be subjected to substantial lateral pressures.

- Details for cofferdams and shoring must be stamped and sealed by a Professional Engineer.

- Care should be taken to ensure that the braces do not interfere with the pile locations where applicable.

- The Bridge Inspector should ensure that the Contractor monitors cofferdam or shoring walls daily for lateral movements and increased leakage through joints.

- Brace connections, wedges, etc. should also be checked regularly by the Contractor to ensure that they remain tight.

- The condition of the ground at foundation level should also be monitored. Any signs of increased water flows or softening of the material should be considered as danger signals and drawn to the Contractor’s attention.

- It is sometimes not possible to de-water a cofferdam. A concrete seal may have to be tremied into the bottom of the excavation. This is a critical operation and requires the approval of the Bridge Project Engineer.

1.9 Channel Excavation

Excavation carried out to improve the alignment or carrying capacity of a stream channel or required for placing riprap or concrete slope protection should suit the lines and elevations shown on the drawings.

- Any special environmental constraints will be noted on the drawings or in the Special Provisions.

- Note that as a result of excavation, special precaution may have to be taken to prevent fines in suspension from reaching the stream. This should be reviewed with the Bridge Project Engineer.

- If the Contractor activities contravene the requirements of the environmental permit, the Bridge Inspector shall require the Contractor to cease operations and the Bridge Inspector shall immediately contact the Bridge Project Engineer.

- In order to ensure that riprap aprons are installed at the correct elevation, it will be necessary to take levels as the excavation progresses.

1.10 Material Disposal

Excavated material suitable for re-use is usually stored at the some location on the site. The Contractor should ensure that this stockpiled material is not placed on private property, nor in a manner that will interrupt surface drainage, nor in a location that will interfere with subsequent construction operations. Unsuitable or surplus excavated materials are to be disposed of by the Contractor in a location and manner approved by the Bridge Project Engineer.

- When disposing of waste material, the Contractor shall provide the Bridge Project Engineer with a letter of permission from the land owner absolving the Department from all liability for damages prior to the Contractor receiving permission to dispose of his excavated material. If the material consist of wet excavation, the landowner should be advised that this material could take a long time to dry.

- Surplus excavated materials are to be disposed of in an area and manner approved by the Bridge Project Engineer.

- Material excavated from the riverbed shall not be disposed of close to river channel, as it will inevitably flow back into the river causing siltation.

1.10.1 Hauling of Waste Material

When hauling excavated material to a disposal area, often the wet material can leak out or be spilled onto the highway thus creating a slippery and hazardous condition for the travelling public, especially during the cold weather months.

- The Contractor shall have an approved traffic control plan in place for trucks entering and leaving the highway.

- The Contractor shall clean the roadway as required.

- The Contractor shall only be permitted to haul during certain hours of the day.

1.11 Checklist

1.11.1 Bridge Inspector's Responsibilities

- Read and study specifications, drawings and borehole logs.
- Review arrangements of access routes and disposal area.
- Ensure Contractor complies with Environmental Permit conditions.
- Observe how excavation and insitu material behaves on exposure to weather and water.
- Confirm the elevation and dimensions at the bottom of the excavation.
- Advise the Bridge Project Engineer of any water problems during excavation.
- Keep good records of any excavation extending beyond required depth.

1.11.2 Bridge Project Engineer's Responsibilities

- Review with the Contractor and the Bridge Inspector the terms and conditions of the Environmental Permit as it pertains to the Contractor's work procedures.
- Ensure that the Contractor's proposals for deep excavations, shoring and cofferdams are stamped and sealed by a Professional Engineer.
- Prior to any construction commencing on deep excavations, shoring or cofferdams, arrange for a job safety meeting with the Contractor identifying hazards and his safety procedures.
- Confirm and approve the neat excavation for a spread footing prior to the placement of concrete.
- If over excavation is assessed to be beneficial to the bridge project, the Bridge Project Engineer should ensure that Department Contract Administration Procedures are adhered to while processing the Extra Work Order.

SECTION 1

EXCAVATION

1-1 Abutment excavation near the top of headslope

1-2 Pier excavation near the toe of headslope

1-3 Pier excavation inside cofferdam in winter months

1-4 Pier excavation inside cofferdam - pumping water into cofferdam to equalize lateral pressure on walls

1-5 Silt retaining barrier/basin setup onsite to trap suspended material in water pumped out from pier excavation

1-6 Silt trap setup onsite for filtering suspended material in water pumped out from drilled pile