

SPECIFICATIONS FOR BRIDGE CONSTRUCTION

SECTION 20

DECK OVERLAY AND CONCRETE REHABILITATION

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20.1 General

Deck Overlay Construction is bridge deck repair and resurfacing with Class HPC or Class HPC with Steel Fibres. This work involves traffic accommodation, bridge deck preparation, partial or full depth repair and deck overlay construction. Usually this work will be done on one half of the bridge deck at a time, while traffic is maintained on the other half. This section describes the requirements of quality control that constitute good and acceptable construction practice in the placement of these specialized types of overlay concrete.

20.2 Traffic Accommodation

Requirements for traffic accommodation shall conform to Appendix A – “Traffic Accommodation and Temporary Signing” of the Specifications for Bridge Construction.

20.3 Preparation Work

Bridge deck preparation includes but is not limited to all work necessary on the bridge deck prior to overlay concrete placement. This work includes the following:

- Removal and disposal of asphaltic concrete pavement and 5 mm depth of underlying concrete
- Removal and disposal of existing concrete paving lips
- Partial depth repair
- Full depth repair
- Sandblasting of the deck surface
- Removal and reinstallation of bridgerail, if required, to accommodate screedrail.

All unsound concrete will be located and marked out by the Consultant after the Contractor has completed Surface Removal, thoroughly cleaned the deck surface of debris and water, and removed all equipment.

“Jack Hammers” heavier than nominal 14 kg class and “Chipping Hammers” heavier than nominal 7 kg shall not be used.

20.3.1 Surface Removal

All ACP, tack coat and 5 mm of the underlying concrete shall be removed by cold milling or other acceptable methods. Curb and deck joint paving lips shall be removed, including the reinforcing steel projecting into these components. On bridges not having deck joints at the abutments, the Contractor shall saw cut through the full depth and width of the asphaltic concrete at both ends of the bridge prior to cold milling.

The Contractor is advised to exercise care during cold-milling to avoid damaging existing reinforcing steel or stressing strands.

Cold-milling shall be carried out as close as possible to all curbs, medians, parapets, drains, and deck joints without causing damage; chipping equipment will be required for use in these areas. Thickness of the ACP will vary, and the Contractor shall take care to remove not more than 5 mm in depth of the concrete surface. In the event he mills off more than 5 mm of concrete, without being so directed by the Consultant, the Contractor shall be responsible for the cost of the additional quantity of overlay concrete required to replace the overmilled concrete and repairing damaged reinforcing steel or strands.

For rehabilitation projects consisting of either concrete or ACP overlay, a minimum of one undisturbed travel lane shall be available for traffic at all times during construction, unless otherwise approved by the Consultant. Cold milling shall be carried out in stages and all costs associated with Mobilization/Remobilization shall be included in the unit price bid for "Surface Removal".

The Contractor shall dispose of all debris in an area and in a manner suitable to the Consultant. Written acceptance from the owner of the disposal site shall be submitted, and evidence of his acceptance of the disposal site cleanup will be required before holdback will be released.

Payment for **Surface Removal** will be made on the basis of the unit price per square metre bid for this work, which price shall include full compensation for the cost of furnishing all labour, materials, equipment, tools and incidentals necessary to complete the work, including disposal of the debris.

20.3.2 Partial Depth Repair

All unsound concrete on the deck, curbs, parapets and medians will be located and marked out by the Consultant, and removed by the Contractor by chipping, scabbling or other acceptable means to provide a sound surface on which to bond the new concrete. Partially exposed rebar shall be entirely exposed by removal of the concrete to a depth of 25 mm below the bars. Additional rebar will be required when the existing rebar has a sectional loss of 20% or greater. The additional rebar shall be of the same bar size as that of the original. Splicing requirements shall be in accordance with 5.6 of the specifications. The supply and installation of the rebar will be considered incidental and no separate or additional payment will be made. For repair areas other than the deck substrate, the limits of the concrete removal shall be outlined by 25 mm deep sawcuts. The Contractor shall bend exposed rebar back to provide minimum 25 mm cover when accepted by the Consultant. All exposed rebar surfaces shall be sandblasted to a white-metal finish immediately prior to casting of concrete. The repair areas shall be formed and recast with 45 MPa Class HPC, using the procedures detailed in section 20.3.3 "Full Depth Repair". For other deteriorated areas, the preparation work shall be the same as above except that appropriate Alberta Transportation approved patching material can be used in lieu of the silica fume concrete. Removed deck concrete shall be replaced monolithically with the Deck Overlay Concrete. All debris shall be disposed of in an area suitable to the Consultant.

Payment for **Partial Depth Repair** will be made on the basis of the unit price bid per square metre of concrete repaired. This will include the cost of removal of unsound concrete, sandblasting, disposal of debris, and the supply and placing of rebar (if required), replacement concrete and incidentals necessary to complete the work.

20.3.3 Full Depth Repair

Where concrete deterioration extends completely through the deck or at the curbs, as determined by the Consultant, all unsound concrete shall be removed and replaced with Class HPC. All exposed rebar and bond surfaces are to be sandblasted and blown clean prior to casting. Additional rebar will be required when the existing rebar has a sectional loss of 20% or greater. The additional rebar shall be of the same bar size as that of the original. Splicing requirements shall be in accordance with section 5.7 of the specifications. The supply and installation of the rebar will be considered incidental and no separate or additional payment will be made. The underside of the deck and curbs shall be formed so as to neatly restore the original lines of the concrete. Forms shall not be hung or suspended from existing deck reinforcing steel.

Before placing the concrete patch, the surfaces of adjoining concrete shall be saturated with water for a period not less than 30 minutes, and coated with an approved bonding agent immediately ahead of placing the fresh concrete. The concrete must be adequately vibrated and trowelled smooth and flush to the existing concrete. Concrete shall be cured in accordance with section 4.22 of the Specifications. When the conditions do not permit a monolithic pour, full depth repair concrete shall be cured at least 3 days and shall develop sufficient strength before placing the overlay so that it is not adversely affected by the overlay operation.

Payment for **Full Depth Repair** will be made on the basis of the unit price bid per square metre of concrete repaired. This will include the cost of removal of unsound concrete to full depth, sandblasting, provision and removal of all forming, scaffolding, falsework, disposal of debris, the supply and placing of rebar (if required), the replacement concrete and incidentals necessary to complete the work.

Fully acceptable Class HPC patching shall have a 28-day minimum compressive strength of 45 MPa based on the results of the strength tests as specified in section 4.9.1. The Department reserves the right to reject any concrete whatsoever which fails to meet these specifications.

In the event that the strength of any particular batch indicates concrete failing to meet fully the specifications above, the Department and Consultant may, at his sole discretion, accept that batch at reduced payment rates according to the following schedule:

28 Day Minimum Compressive Strength	Amount of Payment
45 MPa and over	Full bid price
42 - 45 MPa	Bid price less \$25.00 per square metre
40 - 42 MPa	Bid price less \$50.00 per square metre
37 - 40 MPa	Bid price less \$100.00 per square metre

All concrete below 37 MPa will be rejected.

20.3.4 Deck Surface Sandblasting

The entire deck surface, the vertical faces of the curb, median and parapet up to the height of the thickness of the overlay, and partial and full depth repair areas shall be sandblasted just prior to placing Deck Overlay Concrete to avoid rusting of the exposed sandblasted reinforcing steel. The Contractor shall provide adequate shielding to protect any exposed epoxy-coated reinforcing steel. Sandblasting should be sufficient to uniformly expose the fine aggregate, and clean the deck surface so that it is free of all sand, dust and other contaminants.

Sandblasting and all other surface preparation shall be done to the acceptance of the Consultant. If, in the opinion of the Consultant, rusting of the sandblasted reinforcing steel has occurred or the sandblasted deck has in any way become contaminated, the Contractor shall repeat the sandblasting at his expense.

Payment for **Sandblasting** will be made on the basis of the unit price bid per square metre of bridge deck surface for this work, which price shall include full compensation for the cost of furnishing all labour, materials, equipment, tools and incidentals necessary to complete the work.

Sandblasting at the vertical faces of the curb, median and parapet up to the height of the thickness of the overlay is considered to be incidental and no extra payment will be made.

20.4 Construction

20.4.1 General

The Deck Overlay Concrete shall consist of Class HPC or Class HPC with steel fibres as described in Section 4 "Cast-in-place Concrete", of which sections 4.2 to 4.9, 4.14, 4.16, 4.20 and 4.22 shall apply. Additional requirements are included in this section.

20.4.2 Gradeline Profiles/Dry Run

Design gradeline profiles for the finished overlay and transition ACP shall provide a smooth riding surface. Where no asphaltic concrete pavement exists on the bridge deck, the design gradeline profiles will be nominally 70 mm above the concrete surface. For projects with existing ACP, the Consultant, with the assistance of the Contractor, will profile the bridge deck and approaches prior to and after cold milling. When developing the gradeline profiles, the Consultant will consider such items as rideability, concrete thickness/quantity, dead load deflection and deck drainage. Emphasis should be on producing a high standard of overall rideability with a "reasonable" quantity of overlay concrete.

Typically the design gradeline will be determined on 3 m intervals on two to four profile lines for the entire length of each half of the bridge deck, to determine the overlay thickness and the height of the screed above the existing concrete, at each of these controlled points. The gradeline will be designed by the Consultant and be provided to the Contractor for his use in setting up his screed. The following are guidelines that shall be used to produce the gradeline profiles:

- provide two complete parallel profile lines for each construction stage
 - Line No. 1: 1.0 m from curb face.
 - Line No. 2: 0.3 m in from other edge of proposed pour.Stations of Line No. 1 and Line No. 2 shall be square to each other.
- establish station intervals at 3 m and at edges of existing joints that are to be retained or at new joint locations.
- profiles shall include 30 m (at 3 m intervals) of approaches at each end.
- fluorescent paint shall be used to mark profile points on the existing deck surface, curbs and approaches. The marks shall be approximately 40 mm in diameter. The Contractor shall be responsible for removing these profile points after the deck overlay is completed.
- provide profile plots on metric graph paper to a scale of:
 - Horizontal - 10 mm = 1000 mm
 - Vertical - 1 mm = 1 mm (normal) or 1 mm = 5 mm (minimum)
- proposed design gradeline shall be a smooth line achieving a nominal overlay thickness of 70 mm or as shown on the drawings.

The Consultant will provide the summary of proposed overlay thickness to the nearest mm at each controlled point prior to the Contractor setting screed guide rails.

The location of the longitudinal overlay construction joint will require the acceptance of the Consultant. Typically, the joint shall be located as close to the crown as possible; where the crown is located at or near a connection joint between two adjacent girders, the longitudinal overlay construction joint will be offset by a minimum 300 mm. A longitudinal bulkhead shall be provided at the location of the overlay construction joint.

The Contractor is responsible for properly setting the screed rails to match the gradeline provided by the Consultant with emphasis on providing positive longitudinal and transverse drainage from the bridge deck. Depressions in the concrete surface, resulting from deficient finishing procedures and creating ponded water, shall be repaired by the Contractor at his cost.

Sufficient screed guide rails for the entire contemplated pour shall be set out, adjusted for height, and accepted by the Consultant.

Screed guide rails upon which the finishing machine travels on shall be placed outside the area to be concreted. The guide rails shall be horizontally and vertically stable. Hold-down devices shot into the concrete will not be permitted.

The finishing machine and guide rails shall be adjusted so that the height of the screed above the existing concrete at each point conforms to the profile requirements. To confirm the adjustment of the machine and guide rails, the screed shall be "dry-run" prior to the pour and clearance measurements taken at each controlled point and provided to the Consultant for review and acceptance. Re-setting of the machine and/or guide rails shall be done as necessary, to obtain an acceptable dry-run. Adjustments to the machine or the rails will not be permitted after an acceptable dry-run has been made.

20.4.3 Cement/Silica Fume Slurry Grout

After all deck preparation is complete, the wet cure water supply system specified in section 4.22 shall be used to continuously soak the entire deck for a minimum of 3 hours with clean water conforming to concrete mixing water. Just before concrete placing commences the deck shall be blown free of all excess water. A thin coating of cement slurry grout shall be scrubbed onto the prepared surface.

The grout for bonding the new concrete overlay to the existing concrete shall be mixed in a mechanical mixer, and shall consist of equivalent parts by weight of 4% silica fume, 46% Type GU hydraulic cement and 50% sand of maximum 2.5 mm aggregate size, mixed with sufficient water to form a slurry. The consistency of the slurry shall be such that it can be applied with a stiff brush or broom to the existing concrete surface in a thin, even coating that will not run or puddle in low spots.

Care shall be exercised to ensure that the surface receives a thorough, even coating, and that no grout is permitted to pond. The rate of progress in applying grout shall be limited so that the grout is placed immediately prior to placing the new concrete, and in no case shall the grout be permitted to dry before placing of the concrete.

Mixed grout, not yet deposited, shall be re-agitated at frequent intervals to prevent segregation. Any grout that has not been placed within 45 minutes will be rejected. The Contractor shall have at least two grout mixers on site during placing of the overlay.

20.4.4 Conveyance of Concrete on Deck

Vehicles and equipment shall not be permitted directly on the prepared surface. The Contractor may, however back his truck mixers onto the deck, and discharge concrete directly ahead of the finishing machine provided the deck is continuously protected. The sandblasted surface shall not become contaminated with water, oil, spilled concrete, or other substances. The protection shall remain in place until it has to be removed to allow air blasting and grouting.

20.4.5 Mixing Overlay Concrete

The Deck Overlay Concrete shall be mixed at a qualified concrete batch plant or at the bridge site in truck mixers. Concrete produced at a qualified batch plant will only be acceptable when the anticipated delivery and discharge time is in conformance with section 4.6 "Mixing Concrete" of the Specifications. In the event of site batching, additional requirements are included in this section.

Pre-bagging for Site Batching

The fine and coarse aggregates, cement, fibres if applicable and silica fume shall be measured and pre-mixed together in the approved proportions before being packaged in suitable bags. Each bag shall be in good condition, free of holes or tears, with all seams fully sealed. The bags must be constructed of moisture proof material and securely closed after filling. The bags shall have adequate lifting hooks or straps attached to the top and shall be designed to suitably discharge the material from the bottom of the bag through a discharge opening of at least 460 mm diameter. Each bag shall have at least a nominal 1100 kg capacity. Partially filled bags will not be permitted for use on the site.

Materials shall be proportioned by weight. The accuracy of all weighing devices shall be such that successive quantities can be measured to within one percent of the desired amount. As a minimum quantity, 1100 kg of dry materials in the correct proportions shall be mixed together until the materials are fully dispersed, before being placed in a bag.

The Department and Consultant shall be given full access to inspect all aspects of the mixing operation, including supply of materials, drying of aggregates, proportioning the constituents, mixing, bagging, and storage. The Contractor shall take particular care to protect the bagged pre-mix from the elements during hauling and storage at the site.

Truck Mixers and Water Supply for Site Batching

The Deck Overlay Concrete shall be mixed at the bridge site in truck mixers. The Contractor shall provide all labour, materials, and equipment necessary to do the work.

The Contractor shall employ adequate equipment in order to mix concrete at a rate sufficient to ensure continuous concrete placement. A minimum of three truck mixers shall be brought to the site prior to each overlay pour and utilized in the mixing operation. Truck mixers 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 charged into the drum at the bridge site.

The Contractor shall supply a suitable water source or tank, solely for the purpose of batching concrete, and having sufficient mixing water for each pour. The water supply shall be equipped with an accurate water measuring device, having 0.1 l increments.

Mixing of Deck Overlay Concrete for Site Batching

Initially, approximately two-thirds of the required mixing water shall be released into the drum, after which the air entraining agent, superplasticizer and other admixtures shall be added. The remaining required water shall continue to flow into the drum as the solid materials are being charged into the mixer. Mixing shall continue until all concrete is uniform in appearance, with all ingredients uniformly distributed.

The water supply pipe shall be adequate to ensure 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 quickly mix with the entire batch.

The Contractor shall take whatever steps are necessary to ensure that the full content of each pre-mix bag enters the mixer in an even and uniformly proportioned stream. Segregation, spillage, and other loss of material will not be tolerated. Particular care shall be taken to avoid the loss of cement and silica fume. Batch constituent materials must be accurately proportioned; increases in water-cement ratio will not be permitted.

The Contractor shall in no case load the mixer with more than 3 cubic metres of concrete, or above 85% of its rated capacity. The Contractor shall maintain the mixer in good condition while it is being employed on Department work. Inner surfaces of the mixer shall be kept free of hardened concrete and mortar, and 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 fault charging shall be taken out of service until repaired or improved. The Contractor shall, at all times, operate the mixer at the speed recommended by the Manufacturer and shall, if requested, supply the Manufacturer's certification of the mixing capacity of the machine in use.

The concrete shall be discharged within 70 minutes after the introduction of the water to the pre-mixed material.

Discharge chutes shall be kept clean and free from hardened concrete and shall be wetted down prior to use. After each batch is discharged, the drum shall be thoroughly cleaned and any excess water removed, before additional batches are mixed.

The truck mixer shall be backed onto the bridge deck protected with plywood or heavy tarps, and the concrete discharged directly in front of the finishing machine.

The Contractor shall test and record, at the mixing site, the bag production dates/numbers, the air content, slump, and temperature of each batch; results of all such tests shall be provided to the Consultant. In case of an unacceptable result, the Contractor will be allowed to adjust only the quantities of superplasticizer and air entraining agent. Addition of water to the batch will not be permitted. All batch adjustments shall be completed at the batching site, and will not be permitted on the deck or discharge area. 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.

20.5 Concrete Placement

In addition to the requirements of section 4.16, "Placing Deck, Curb and Deck Overlay Concrete", the following shall apply.

The Contractor shall take every precaution necessary to secure a smooth-riding bridge deck, within the tolerances indicated in section 4.16.6.

Concrete placing shall normally be between the hours of 6:00 pm and 10:00 am except with specific acceptance of the Department and Consultant. Night pours shall require proper lighting as acceptable to the Consultant. Adequate lighting will be required both in front and behind the finishing machine. Additionally, four-bulb halogen tower lights will be required at each end of the bridge and at the sampling and testing site.

Discharge chutes shall be kept clean and free from hardened concrete and shall be wetted down prior to use. After each batch is discharged, the drum shall be thoroughly cleaned and any excess water removed, before additional batches are mixed.

Concrete shall be placed so as to avoid segregation of materials. The concrete finishing machine shall conform to section 4.16 of the specifications.

Placement of the concrete shall be a continuous operation for the duration of the pour. No more than 5 minutes shall elapse between truck mixer discharges. In the event that due to equipment breakdown, concrete placement is stopped or delayed for a period of 60 minutes or more, further placement shall be discontinued and may resume only after a period of not less than 12 hours. This restriction does not prohibit continuation of placement provided a gap is left in the lane or strip; the gap shall be sufficient in length for the finishing machine to clear the previously placed concrete. The fill-in section shall be placed after a period of not less than 12 hours. The edge of any discontinued overlay shall be saw-cut before placing further overlay material.

The width of the initial overlay section placed shall extend to the approved construction joint location. The subsequent overlay course shall match the adjacent previously placed course, and shall not be placed until the course initially placed is at least 72 hours old.

20.5.1 Surface Texture

Surface texture shall be in accordance with section 4.24 of the specifications.

The Contractor is advised that achieving a satisfactory texture on concrete overlay is difficult. It is essential that a worker competent in this work be employed. Several types of wire brooms, rakes and combs should be available at site so that the one giving the best result can be selected. In the event that a satisfactory texture, in the opinion of the Consultant, is not achieved, the Contractor will be required to sawcut transverse grooves of the dimensions described in the specifications. This work shall be done at the Contractor's cost, and no additional payment for this work will be made.

Following the surface texturing, a strip of the overlay along the curb shall be trowelled smooth and the surface left closed so that a gutter is formed. The gutter shall have a width of 400 mm measured from the curb face.

20.5.2 End of Overlay

The overlay shall be placed to match the deck joints however where the overlay does not terminate at a deck joint, such as on roof slabs, the overlay shall be continued to and bulkheaded off 150 mm beyond the required end of the overlay. After adequate curing, the 150 mm over-pour shall be sawcut and disposed.

20.5.3 Longitudinal and Transverse Overlay Construction Joints

The Contractor shall construct an approved bulkhead at the construction joint location which will maintain horizontal and vertical alignments during concrete placing and finishing. The resulting vertical face of concrete shall be sandblasted in conformance to section 20.3.4 of the specifications. The sandblasting at the vertical face is considered to be incidental to the work and no extra payment will be made.

For longitudinal and transverse construction joints, the top edge of the overlay concrete at faces of curbs, barriers, medians, previously placed overlay concrete or existing concrete shall be tooled to a depth of 12 mm and a width of 6 mm. The tooled groove shall be filled with a gravity flow epoxy listed in the following Alberta Transportation website path: Alberta Transportation Product List/Crack Treatment/Concrete Crack Filler/Proven. Prior to installation, the contact concrete surfaces shall be blown clean to remove all deleterious materials and prepared in accordance with the manufacturer's recommendations. The tooled groove shall be full of epoxy material upon completion of the work and may require subsequent applications for maximum penetration. The creation of the tooled groove and the application of the gravity flow epoxy is considered incidental to the work and no extra payment will be made.

20.5.4 Curing Concrete

Curing concrete shall be in accordance with section 4.22 "Curing Concrete" of the specifications.

In the event that the wet curing is unacceptable, and any portion of the overlay becomes surface dry during the curing period, the Consultant will have cause to reject the overlay.

20.5.5 Opening to Traffic

In addition to the curing requirements, the concrete overlay shall not be opened to traffic until the requirements of section 4.26.2 of the specifications have been met.

20.6 Measurement and Payment

Payment for **Deck Overlay Concrete** will be made on the basis of the unit price bid per cubic metre for acceptable overlay concrete remaining in the completed work. The number of cubic metres to be paid for will be calculated by the Consultant from the final "dry-run" values, and the area overlaid. No separate or additional payment will be made for the supply of concrete overpour.

Payment for **Placement Deck Overlay Concrete** will be made on the basis of the unit price bid per square metre, which price shall include full compensation for the cost of all labour, tools, and equipment to satisfactorily place, finish, cure, and sawcut the overlay. It shall include all costs to remove and dispose concrete overpour and debris. The number of square metres to be paid for will be calculated by the Consultant from the actual area overlaid and remaining in the completed structure.

20.6.1 Failure to Meet Strength Requirements

Fully acceptable concrete shall have a 28 day minimum compressive strength of 45 MPa based on the results of the strength tests. The Department reserves the right to reject any concrete whatsoever which fails to meet these specifications, and to require its removal from the deck.

In the event that the strength test of any particular 10 m³ portion of the concrete pour indicates concrete failing to meet fully the specifications above, the Department may accept that 10 m³ portion at reduced payment rates according to Section 4 "Cast-in-place Concrete", of which section 4.26 shall apply only to the unit bid per cubic metre of overlay concrete. All concrete below 37.0 MPa will be rejected.