Previous Version	New Version
Section 1 Excavation	**Section 1 Excavation**
1.1 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 drawings or as determined by the Department and Consultant. 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 Consultant. If any excavation or dredging is made at the site of the structure, the Contractor shall, without extra charge, after the foundation base is in place, backfill all such excavation to the original ground surface or river bed with material satisfactory to the Consultant. 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. For projects where the existing ACP approach road surface is to be retained as is, the Contractor shall provide suitable and adequate protection for the existing ACP during excavation/trimming procedures or other construction activities. This may consist of placement of filter fabric and sand or road crushed granular material or other means over the existing ACP. This protection work will be considered to be incidental, and no extra payment will be made. The Contractor shall be responsible to correct any damages, to the Consultant's acceptance which occurs to the existing ACP.	**1.1 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 drawings or as determined by the Consultant. 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 Consultant. If any excavation or dredging is made at the site of the structure, the Contractor shall, without extra charge, after the foundation base is in place, backfill all such excavation to the original ground surface or river bed with material satisfactory to the Consultant. 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, excavations shall be shored, braced or protected by cofferdams. The Contractor shall *maintain* the integrity and stability of existing headslopes and fills *at all times*. For projects *in which* the existing *asphalt concrete pavement (ACP) surfaces are* to be retained, the Contractor shall provide suitable and adequate protection *of* the ACP during *excavation, trimming,* or other construction activities. *Protection may include* placement of filter fabric and sand or crushed granular material over the ACP. *Protection of the existing ACP* will be considered to be incidental *to the work* and no *separate or additional* payment will be made. *Any damage to the ACP caused by the Contractor's operations shall be repaired at his expense to the satisfaction of the Consultant.*
1.2 Clearing Any clearing that may be required for the completion of the Bridge portion of the Work under this contract shall be considered incidental and shall be done by the Contractor.	**1.2 Clearing** Clearing required for the completion of the Bridge Work *will* be considered incidental *to the Work and no separate or additional payment will be made*.
1.3 Depth of Footings The elevations of the bottoms of the footings as shown on the drawings shall	**1.3 Depth of Footings** *The bottom of footing elevations* shown on the drawings shall be considered

be considered as approximate only; the Department and Consultant may order such changes in dimensions or elevations of footings as may be necessary to secure a satisfactory foundation.	as approximate only. *The* Department and Consultant may *require* changes in *final* dimensions or elevations of footings *to establish* a satisfactory foundation.
1.4 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 Consultant. 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 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.	**1.4 Preparation of Foundations for Footings** All rock or other hard foundation material shall be free *of* loose material, cleaned and cut to a firm surface *as shown on the drawings*. 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 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 *placed* without forms. Seepage water shall be collected and drained or pumped away before it can enter the neat portion of the excavation.
1.5.1 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. No separate payment will be made for the supply, construction or removal of cofferdams, dikes or berms. Full compensation for the cost of such material and labour shall be considered to be included in the price bid for the specified work to be carried out inside the cofferdam, dike or berm.	1.5.1 General All cofferdams, dikes and berms 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 construction and inspection of forms and permit pumping of water outside of the forms. No separate *or additional* payment will be made for the supply, construction or removal of cofferdams, dikes or berms. Full compensation for the cost of such material, *equipment, tools, labour and incidentals* shall be considered included in the price bid for the specified work to be carried out inside the cofferdam, dike or berm.
1.5.2 Drawings Required For substructure work, the Contractor shall submit drawings or sketches showing the proposed method of cofferdam, shored excavation, dike or berm	1.5.2 Drawings Required For substructure work, the Contractor shall submit drawings *of the proposed* cofferdam, shored excavation, dike or berm construction, and *associated*

construction, and other details left open to his choice. Drawings for cofferdam or shored excavations shall bear the stamp of a Professional Engineer, registered in Alberta. *Such* drawings shall be submitted to the Consultant before construction is started on work governed by them. The Consultant shall review the drawings as to intent only, and any acceptance of such drawings by the Consultant 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.	*work procedures. The drawings and work procedures shall be signed and sealed by* a Professional Engineer, registered in the Province of Alberta. *The* drawings shall be submitted to the Consultant *two weeks prior to the commencement of the work for review and acceptance*. The Consultant *will* review the drawings as to intent only, and any acceptance of such drawings by the Consultant shall in no way relieve the Contractor of *his* full responsibility for the work.
1.5.3 Concrete Seal When conditions are encountered which in the opinion of the Department and Consultant make it impracticable to dewater the foundation before placing concrete, he 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. All costs incurred in the construction of the seal shall be the responsibility of the Contractor, unless the seal is called for on the drawings, in which case the seal concrete will be paid for at the tendered price.	1.5.3 Concrete Seal When conditions are encountered which in the opinion of the Department and Consultant make it impracticable to dewater the foundation before placing concrete, he may require or allow the construction of a concrete foundation seal below the elevation of the bottom of the *foundation*, of such dimensions as may be necessary. The foundation shall then be pumped out and the *work completed* 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. *No separate or additional payment will be made for construction of the concrete seal unless it is specified on the drawings, in which case it will be paid for at the price bid*.
1.5.6 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 and Consultant 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 and Consultant 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 and Consultant to remove such material and/or all damages incurred.	1.5.6 Removal of Cofferdams, Dikes and Berms Cofferdams, dikes and berms shall be removed after completion of the *Work* for which they were *installed. The Contractor shall take* not to disturb or *damage* the finished works *in any way during removal operations*. Backfill required around the permanent work shall be placed prior to removal of cofferdams, dikes or berms. The Consultant 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 and Consultant 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 and Consultant to remove such

	material and/or all damages incurred.
1.6 Inspection of Excavation After the excavation is completed to the elevation shown on the drawings, the Contractor shall notify the Consultant. The Consultant shall review and accept the depth of the excavation and the character of the foundation material before any further work can proceed. The Department and Consultant may then order test pits, test drilling, further excavation, or other work as necessary to obtain an acceptable excavation.	**1.6 Inspection of Excavation** After the excavation is completed to the elevation shown on the drawings, the Contractor shall notify the Consultant. The Consultant shall review and accept the depth of the excavation and the character of the foundation material before any further work *proceeds*. The Consultant may *require* test pits, test drilling, further excavation, or other work as necessary to obtain an acceptable excavation.
Section 2 Backfill	**Section 2 Backfill**
2.2.1 Compacted Non 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 Consultant 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.	2.2.1 Compacted Non granular Material ... Material used for the construction of the "clay seals" shall be highly plastic clay. Material with high swelling potential such as bentonite clays will not be permitted. When the proposed material characteristics for clay seals are *questionable* the Consultant *will* 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.
2.2.3 Backfill Material Tests ... 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 with no cost to the Department. Results of all quality control tests shall be submitted to the Consultant as they become available.	2.2.3 Backfill Material Tests ... The Contractor shall be *fully* responsible for production of aggregate that meets all the specification requirements. Des 2 Class 25 Crushed Aggregate material can be used where Des 2 Class 40 material has been specified *at no separate or additional* cost to the Department. Results of all quality control tests shall be submitted to the Consultant *within 3 days of the test being completed*.
2.3 Placing ...	**2.3 Placing** ...

All backfill material, regardless of type shall be placed in layers not exceeding 150 mm 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. On projects where Control Strips are being established, compaction equipment proposed by the Contractor must be reviewed and accepted by the Consultant. Backfill material shall not be placed against any concrete abutment, wingwall or culvert until permission has been given by the Consultant, 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.	All backfill material, regardless of type shall be placed in lifts not exceeding 150 mm in thickness of loose material, and each *lift* shall be mechanically tamped with pneumatic tampers or and approved 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. On projects where Control Strips are being established, compaction equipment proposed by the Contractor must be reviewed and accepted by the Consultant. Backfill material shall not be placed against any concrete abutment, wingwall or culvert until permission has been given by the Consultant*. Generally, placement will not proceed* 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 *stepped* to prevent wedge action. Jetting of backfill material behind abutments and wingwalls will not be permitted.
2.4 Measurement and Payment Payment for Backfill of the type(s) specified will be either at the unit price bid per cubic metre or lump sum price basis. Such price shall include the cost for all labour, material, equipment, and other items of expense that may be necessary for the successful completion of the backfill. Payment will be determined as follows: 2.4.1 Unit Price per Cubic Metre When payment is to be on unit price basis, the quantity to be paid for shall be the volume, in cubic metres, of the compacted, in place backfill incorporated into the work, based on the dimensions/elevations, indicated on the drawings, or as determined by the Department and Consultant. The quantity will be	**2.4 Measurement and Payment** Payment for Backfill of the type(s) specified will be at the unit price bid per cubic metre or lump sum price bid. *The* price *bid* shall include the cost for all labour, material, equipment, *tools, and incidentals necessary to complete the Work*. 2.4.1 Unit Price per Cubic Metre *When the Unit Price Schedule contains unit price bid for this work, payment will be made for the quantity of compacted* Backfill incorporated in the work based on the *dimensions and elevations* indicated on the drawings or as determined by the Department and Consultant. The quantity will be determined by measuring the volume of the excavation.

determined by measuring the volume of the excavation. 2.4.2 Lump Sum Price When payment is to be on lump sum price basis, the lump sum price shall include full payment for the fill of all structural excavations and other areas specified in conformity with the drawings or specifications.	2.4.2 Lump Sum Price *When the Unit Price Schedule contains lump sum price bid for this work, payment will be made for the compacted Backfill of all structural excavations and other areas shown on the drawings.*
Section 3 Bearing Piles	**Section 3 *Foundation* Piles**
3.1 General This specification is for the supply and installation of steel H-piles, plain and galvanized steel pipe piles, timber 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.	**3.1 General** This specification is for the supply and installation of *plain and galvanized steel H-piles and pipe piles*, timber piles, precast concrete piles, and cast-in-place concrete piles. It includes driven piles, drilled cast-in-place concrete piles, and drilled cast-in-place concrete/steel pipe composite piles.
3.3 Handling ... Care shall be taken in order to prevent damaging the galvanized surface on galvanized piling. Fabric slings, wood blocking or other approved methods 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 Consultant, at the Contractor's cost. Where repair of damaged galvanizing is required, the repair shall be by metallizing in conformance with ASTM A780, Method A3, to a thickness of 180 µm. Special care shall be taken to avoid breaking through the surface treatment of treated piles, and cant-hooks, dogs, or pike poles shall not be used. Cuts or breaks in the surface of treated piles shall be given three brush coats of creosote oil of approved quality, and creosote oil shall be poured into all bolt holes.	**3.3 Handling** ... Care shall be taken in order to prevent damage of galvanized *pile surfaces*. Fabric slings, wood blocking or other approved methods 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 *by the Contractor at his expense as determined by the Consultant*. Where repair of damaged galvanizing is required, the repair shall be by metallizing in conformance with ASTM A780, Method A3, to a thickness of 180 µm. Special care shall be taken to avoid breaking through the surface treatment of treated timber piles, and cant-hooks, dogs, or pike poles shall not be used. Cuts or breaks in the surface of treated timber piles shall be given three brush coats of *preservative material* of approved quality, and *preservative material* shall be poured into all bolt holes.
3.4.1 Equipment and Driving Methods … 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	3.4.1 Equipment and Driving Methods … *For monitoring pile installation, 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*

means as are necessary. The method of alignment and maintaining alignment shall meet the acceptance of the Consultant. 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 20 mm per metre from the vertical or from the batter shown on the drawings, except that piles in exposed bents shall not be out of position at the ground line by more than 50 mm and shall not be out of position more than 25 mm in the pile cap. Foundation piles shall not be out of the position shown on the drawings more than 150 mm after driving.	*of the pile.* *The Contractor shall ensure that the piles are in proper position and alignment by using installation driving frames and fixed leads.* *Piles shall not be out of the horizontal position shown on the Drawings by more than 150 mm after driving, except for fully integral abutments the piles shall not be out of horizontal position by more than 50 mm. In addition, for fully integral abutments, the variation in position between the pile casing center and the pile centre shall not be more than 25 mm.* Piles shall be *not* driven with a variation of more than 20 mm per metre from the vertical or the batter as shown on the Drawings. Piles in exposed bents shall not be out of position *by more than 50 mm at the ground line or 25 mm in the pier cap*. *If tolerances are not met, the Contractor shall make immediate changes to his piling procedures. Any pile out of the specified tolerance shall be corrected at the Contractor's expense to the full satisfaction of the Consultant*.
3.4.2 Bearing Values The piles shall all be driven to the tip elevations shown on the drawings, or lower, to achieve the required stability and specified minimum bearing capacity. The pile bearing capacities shall be estimated by the Bearing Formulas of this Specification. After the pile driving operations have been started, the Department and Consultant may revise the required pile tip elevations, if necessary, using the pile driving data and the Bearing Formulas as a guide. In the event pile tip elevations are not given on the drawings, the pile bearing capacities shall be estimated by any or all of the methods outlined under Bearing Formulas Test Piles, or Pile Capacity Test Methods, as determined by the Consultant. In the case of friction piles, the piles shall be driven to the tip elevations shown on the Drawings, or lower, in order to achieve the required stability and design load carrying capacity. <u>Bearing Formulas</u> When not driven to practical refusal, the bearing values of piles may be required to be determined by test methods as specified above. In the	3.4.2 Pile Capacity *Piles* shall be driven to the tip elevations shown on the drawings, or lower *as determined by the Consultant*, to achieve the required stability and capacity. *Pile capacity* shall be *determined* by the Bearing Formulas of this Specification. After pile driving operations have *commenced*, the Consultant may revise the required pile tip elevations, if necessary, using the pile driving data and Bearing Formulas. In the event pile tip elevations are not *shown* on the Drawings, pile capacities shall be *determined in accordance with Section 3.6 "Pile Capacity Test Methods"*. <u>Bearing Formulas</u> When not driven to practical refusal, the *capacity* of piles may be required to be determined by test methods as specified *in Section 3.6 "Pile Capacity Test Methods"*. In the absence of capacity tests, the *pile capacity* shall be determined by the following formulas: Diesel and Hydraulic Hammers

absence of the above noted tests, the safe bearing values for piles shall be determined by the following formulas: For Diesel and Hydraulic Hammers …	…
3.4.3 Steel Piles Steel piles shall consist of structural steel shapes or pipes of the section shown on the drawings 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” included with these Specifications. … 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.	3.4.3 Steel Piles Steel piles shall consist of structural steel shapes or pipes of the section shown on the Drawings or otherwise specified. When pipe piles are to be driven closed ended, one section of pipe for each pile shall be supplied with *a welded pipe pile end plate in accordance* with Standard Drawing S 1479 “Standard Closed Pipe Pile End Plate”. … The total energy developed by the hammer shall be sufficient to achieve the required *capacity* or tip elevation, but in no case shall the total energy developed be less than 35 kJ per blow.
3.4.3.1 Steel Pile Splices ... 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 drawings. 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 at his cost. 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.	3.4.3.1 Steel Pile Splices ... 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 drawings. 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 *in accordance with ASTM A780, Method A3 to a thickness of 180 µm,* by the Contractor at his cost.
3.4.3.2 Testing by the Contractor The Contractor shall perform Ultrasonic testing for a minimum of 20% of all full penetration compression splice welds for all piles for each bridge component. Ultrasonic testing shall be done for welds for which visual inspection may indicate having some defect. Additional testing may be required for the full penetration compression splice welds to ensure the	3.4.3.2 Testing by the Contractor The Contractor shall perform ultrasonic testing for a minimum of 20% of all full penetration compression splice welds for all piles for each bridge component. Ultrasonic testing shall also be *completed* for welds *in* which visual inspection *indicates the presences of a potential* defect. Additional testing may be required for the full penetration compression splice welds to

integrity of the structure. 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 testing technicians shall be certified to Level II of Canadian General Standard Board (CGSB). A copy of test results shall be provided to the Consultant for his review within three days of the inspection. The Consultant may require additional inspection if deemed necessary. All costs associated with non-destructive inspection of welds shall be the responsibility of the Contractor.	ensure the integrity of the structure. *The* Contractor shall *test* 100% of full penetration tension splice welds as shown on the *Drawings*. *Ultrasonic testing* shall be done by a company certified to CAN/CSA W178.1. Ultrasonic testing technicians shall be certified to Level II of Canadian General Standard Board (CGSB). A copy of test results shall be provided to the Consultant for his review within three days of the *testing*. The Consultant may require additional *testing and* inspection if determined necessary. All costs associated with *weld testing* shall be *included in the price bid for the Work and no separate or additional payment will be made*.
3.4.5 Defective Piles The procedure incident to the driving of piles shall not subject them to excessive and undue abuse producing deformation of the steel, injurious splitting, splintering and brooming of the wood, or crushing and spalling of the concrete. Manipulation of piles to force them into proper position, considered by the Consultant 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, at the Contractor's expense, by one of the following methods accepted by the Consultant: (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. Timber piles shall not be spliced without specific permission of the Consultant. 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 Consultant/Department, resort to pre-drilling. This will be considered incidental to the work of achieving acceptable penetration and bearing capacity, and not claimable as extra work.	3.4.5 Defective Piles The *method used to drive* piles shall not *result in* deformation of the steel, splitting, splintering *or* brooming of the wood, or crushing and spalling of the concrete. Manipulation of piles to force them into proper position, considered by the Consultant to be *harmful*, will not be permitted. Piles damaged by driving, or driven out of proper location, or driven below the cut off elevation, shall be corrected by *the Contractor at his expense by using* one of the following methods *acceptable* to the Consultant: (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, *except timber piles,* shall be spliced or built up as *determined by the Consultant*, or *(d)* 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. *When* the required penetration and capacity are not *achieved*, the Contractor shall provide a hammer of greater energy or, when accepted by the Consultant, *pre-drill the piles. Providing a hammer with greater energy and/or pre-drilling the piles to achieve acceptable penetration and capacity* will be considered incidental to the Work *and no separate or additional payment will be made*.
3.4.6 Measurement and Payment … Pile Driving	3.4.6 Measurement and Payment … Pile Driving

Payment for Pile Driving will be made on the basis of the unit price per metre bid, which price shall include full compensation for the cost of furnishing all labour, tools, and equipment, and other necessary or incidental costs of handling, driving, splicing, cutting off of piles, reinforcement of pile heads and all other incidental work connected therewith. It shall also include full compensation for all drilling, blasting, splice plates, splice rings, or other work or materials necessary to obtain the required penetration or bearing values of piles. … Pile Splicing When the Contract contains a bid item for Pile Splicing, piles which penetrate in excess of 20% of the estimated length, splicing will be paid for at the assigned unit price for Pile Splicing and will include all labour, materials, equipment, tools and incidentals necessary to complete the work. Only one splice for each additional length of pile, up to twelve metres, will be paid for. … Test Piles Test piles retained in the structure will be paid for at the bid price of other piling used. If, however, piling is not used in the structure, the test piles will be paid for as Extra Work, due to consideration being given to the cost of bringing the pile driver to the site and removing it from the work.	Payment for Pile Driving will be made on the basis of the unit price per metre bid, which price shall include full compensation for the cost of furnishing all labour, tools, equipment and *incidentals associated with* handling, driving, splicing, cutting, and *tip reinforcing necessary to obtain the required penetration or capacity*. … Pile Splicing *Where* piles penetrate *further than* 20% of the estimated *tip elevation*, splicing will be paid for at the assigned unit price for pile splicing and will include all labour, materials, equipment, tools and incidentals necessary to complete the work. Only one splice for each additional length of pile, up to twelve metres, will be paid for. *The unit price for pile splicing shall be:* *H-Piles: $1000* *Pipe Piles: $1200* *…* Test Piles Test piles retained in the structure will be paid for at the bid price of other piling used. If *test piles are not incorporated into the final* structure, *they* will be paid for as Extra Work.
3.5.1 General In addition to drilled cast-in-place concrete bearing piles this section 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.	3.5.1 General In addition to drilled cast-in-place concrete piles this section shall include drilled cast-in-place concrete/steel pipe composite 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.
3.5.3 Cast-In-Place Pile Bearing Values Where cast-in-place piles are designed based on the use of semi-empirical methods, supported by a geotechnical investigation with soil strength parameters determined by laboratory, field testing and local experience, and with appropriate levels of construction monitoring and verification the ultimate bearing capacity may be adjusted for Limit State Design by a geotechnical	3.5.3 Cast-In-Place Pile *Capacity* Where cast-in-place piles are designed *using* semi-empirical methods *and* supported by a *comprehensive* geotechnical investigation with field testing and *construction monitoring*, the ultimate bearing capacity may be adjusted for Limit State Design by a geotechnical resistance factor of 0.4. If working state design methods are used the allowable loads shall be as determined by

resistance factor of 0.4. If working state design methods are used the allowable loads shall be as determined by the Consultant.	the Consultant.
3.5.4 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. … The elevations shown on the drawings of the bottoms of the pile holes shall be considered approximate only, and the Department and Consultant may order further drilling as necessary to secure satisfactory bearing of the piles.	3.5.4 Drilling Pile Holes *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 pile concrete. *To assist in the Contractor's attempts to achieve a dry hole he shall, at a minimum, have available for use casings of appropriate size and lengths, bailing buckets, final cleanout buckets and water pumps.* … *Pile hole* elevations shown on the Drawings shall be considered approximate only, and the Consultant may *determine* further drilling is necessary to *achieve* satisfactory *capacity* of the piles.
3.5.6 Reinforcement ... Particular care shall be taken in locating projecting "column dowel bars", to a tolerance not exceeding 10 mm in any direction, and pouring will not be permitted until the Consultant is satisfied that adequate provisions have been made.	3.5.6 Reinforcement ... Particular care shall be taken in locating projecting *reinforcing steel*, to a tolerance not exceeding 10 mm in any direction, and *casting* will not be permitted until the Consultant is satisfied that adequate provisions have been made.
3.5.7 Concrete Placement ... Pile concrete placed under water will require validation by Crosshole Sonic Logging (CSL) in accordance with section 4.15.3 "Concrete Placed under Water".	3.5.7 Concrete Placement ... Pile concrete placed under water *shall be completed in accordance with Section 4 and requires* validation by Crosshole Sonic Logging (CSL).
3.5.8 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	3.5.8 Cold Weather Conditions When the ground against which pile concrete is placed is below -5°C, *the pile hole shall be oversized by 100 mm. Immediately after placing and finishing the pile concrete, the top exposed surface shall be protected with insulated tarps or other means to adequately cure the concrete for a period of seven days. If the top of the pile extends above the ground surface it shall be protected in accordance with Section 4 "Concreting in Cold Weather".*

oversize down to the depth of 2 m, 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 100 mm 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.	
3.5.9 Pile Tolerance Piles shall be accurately located, and shall be installed plumb or at the batter specified on the drawings. The maximum tolerance allowed shall be 50 mm 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 20 mm per metre. Any pile out of centre or plumb beyond the tolerances specified shall be corrected at the Contractor's expense.	3.5.9 Pile Tolerance Piles shall *not be out of the horizontal position shown on the Drawings by more than 50 mm. Piles shall not be out of the vertical or batter position shown on the Drawings by more than 20 mm per metre.* *If tolerances are not met, the Contractor shall make immediate changes to his piling procedures. Any pile out of the specified* tolerance shall be corrected at the Contractor's expense *to the full satisfaction of the Consultant*.
Section 4 Cast-In-Place Concrete	**Section 4 Cast-In-Place Concrete**
4.2 Materials for Concrete Concrete shall consist of hydraulic cement, aggregates, water and admixtures or additives which shall conform to the requirements as specified below: Cement - Hydraulic cement shall conform to the requirements of CSA Standard A 3001. General Use (Normal) Type GU, or High Sulphate Resistant Type HS or HSb, shall be supplied unless otherwise specified. Silica Fume - Condensed silica fume shall conform…more than 1% SO_3 content. Fly Ash - All fly ash shall conform to the requirements of CSA Standard A 3001 for Type F or Type CI fly ash. Water - Water to be used for mixing concrete or mortar shall conform to the	**4.2 Materials** Concrete shall consist of hydraulic cement, aggregates, water and admixtures or additives which shall conform to the requirements as specified below: *Hydraulic* Cement - Hydraulic cement shall conform to the requirements of CSA Standard A 3001. General Use (Normal) Type GU, or High Sulphate Resistant Type HS, or HSb shall be supplied unless otherwise specified. *As an alternative to Type HSb cement, concrete intended for placement in sulphate environments may be produced with combinations of Type GU cement and supplementary cementing materials provided current CSA A3004-C8 test data demonstrating compliance with CSA A3001 requirements for high sulfate resistance.*

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 approved admixtures, such as water reducing agents, air entraining agents and superplasticizers shall conform to ASTM C494 and be compatible with all other constituents including cement, silica fume and fly ash. The addition of calcium chloride, air reducing agents or accelerators will not be permitted.

Hydration Stabilizing Admixtures (HSA's) shall meet ASTM C494 requirements for Type D water reducing and retarding admixtures. The maximum allowable time of set retarding shall be three hours, as measured from the time of mixing. The appropriate dosage rates are to be verified with trial batch tests. The use of HSA's requires the approval of the Department and Consultant and their usage is limited to those projects where haul times are expected to exceed the specified times and/or projects which require retardation due to structural considerations.

Air Entraining Agent Air Entraining Agent shall be added to all concrete and shall conform to the requirements of ASTM C260.

Silica Fume - Condensed silica fume shall conform…morethan 1% SO_3 content.

Fly Ash - All fly ash shall conform to the requirements of CSA Standard A 3001 for Type F fly ash *with a maximum calcium oxide (CaO) content of 12%.*

Water - Water to be used for mixing concrete, *approved patching products, or concrete finishing materials,* shall conform to the requirements of CSA Standard A23.1 and shall be free from *harmful* amounts of alkali, organic materials or deleterious substances. The Contractor shall not use *slurry water, treated wash water or* 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 - *Admixtures shall be compatible with all mix constituents. Water reducing agents and superplasticizers shall conform to ASTM C494. The addition of calcium chloride, air reducing agents or accelerators will not be permitted. Air entraining agents shall conform to ASTM C260.*

The use of hydration stabilizing admixtures requires prior written acceptance of the Department and Consultant and their usage is limited to those projects where haul times are expected to exceed the specified times and/or projects which require hydration stabilization due to structural considerations. Hydration stabilizing admixtures shall meet ASTM C494 requirements for Type D water reducing and retarding admixtures.

4.4.1 Class of Concrete

Class of Concrete[4]	Minimum Specified Compressive Strength at 28 Days (MPa)	Nominal Maximum Aggregate Size (mm)	Range of Slump (mm)	Total Air Content[5] (%)	Max. Water/ Cementing Materials Ratio
B	25	28 to 5	50 to 70	4 - 7	0.45
C	35	20 to 5[1]	60 to 80	5 - 8	0.40
HPC[3]	45	20 to 5[2]	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

4.4.1 Class of Concrete

Class of Concrete[4]	Minimum Specified Compressive Strength at 28 Days (MPa)	Nominal Maximum Aggregate Size (mm)	Range of Slump[6] (mm)	Total Air Content[5] (%)	Max. Water/ Cementing Materials Ratio
C	35	20 to 5[1]	*100 ± 30*	5 - 8	0.40
HPC[3]	45	20 to 5[2]	*120 ± 30*	5 - 8	0.38
D	30	14 to 5	*100 ± 30*	5 - 8	0.42
S	20	28 to 5	*100 ± 30*	4 - 7	0.50
Pile	*30*	28 to 5	*130 ± 30*	4 - 7	*0.42*

Notes ... 4. The fly ash shall not exceed 30% by mass of cementing materials, however for High Performance Concrete (HPC) it shall be in accordance with 4.4.2. Fly ash may be used in concrete mixes where the aggregate is assessed to be potentially alkali-silica reactive. 5. Range in air content to be in compliance with maximum aggregate size as per CSA A23.1 Table 4.	Notes ... 4. The fly ash shall not exceed 30% by mass of cementing materials. *For* High Performance Concrete (HPC) it shall be in accordance with 4.4.2. Fly ash may be used in concrete mixes where the aggregate is assessed to be potentially alkali-silica reactive. 5. Range in air content to be in compliance with actual maximum aggregate size as per CSA A23.1 Table 4. *6. Slump ranges proposed by the Contractor that are outside those specified require acceptance from the Department.* *7. For MSE Wall panels, smaller aggregate may be required to suit panel design.* *8. Additional requirements for Class HPC and Class HPC with Steel Fibres are listed in Section 4.4.2.*
4.4.2 Class HPC and Class HPC with Steel Fibres … (h) Slump retention of trial mix after 45 minutes 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 duplicate laboratory moist cured samples at 28 days. The average of all tests shall not exceed 1000 coulombs with no single test greater than 1250 coulombs. For HPC with steel fibres, testing shall be done without the presence of the steel fibres. (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 50 mm long steel fibres, per m^3. The Contractor shall provide test results of the aluminum content in the steel fibres, for the consultants review, 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 21 of CSA A23.1 shall apply. (m) Trial batch(es) shall be performed at least 35 days prior to placement of	4.4.2 Class HPC and Class HPC with Steel Fibres … (h) *Resistance to chloride ion penetration shall be determined in accordance with ASTM C1202 on duplicate laboratory moist cured samples at 28 days. The average of all tests shall not exceed 1000 coulombs with no single test greater than 1250 coulombs. When only two test values are used to calculate the average coulomb rating, no test shall exceed 1000 coulombs. For HPC with steel fibres, testing shall be done without the presence of steel fibres.* *(i)* 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. *When only two test values are used to calculate the average air-void spacing factor, no test shall exceed 230 µm.* *(j)* When Class HPC with steel fibres is specified, it shall contain 60 kg of 50 mm long steel fibres, per m^3. The Contractor shall provide test results of the aluminum content in the steel fibres, for the consultants review, a minimum of two weeks prior to placing concrete at site. *When alternative steel fibres are proposed their equivalency and dosage rate shall be determined in accordance with ASTM C1609. The toughness (TD600) shall be greater than or equal to that determined for the specified fibre type and dosage rate.*

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. Shrinkage test results shall be submitted to the Consultant within seven days of test completion.	
4.4.4 Aggregate Tests and Concrete Mix Design The Contractor shall submit the mix design he proposes for each proposed class of concrete including applicable material test reports for the Consultant's review two weeks before scheduled placing of concrete. Aggregate tests and concrete mix design shall not be required for concrete used for the construction of culvert collars or cut-off walls when culverts are 3 metre diameter or smaller. For each mix design the following aggregate analysis shall be provided: - Source(s) of proposed aggregate(s) - 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 (CSA A23.2-7A) - Results of deleterious substances and physical properties of aggregates included in Table 12, CSA A23.1-04 (Test Methods A23.2-3A, A23.2-4A, 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 (CSA A23.2-15A) 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 120 days prior to concrete production, except for sieve analysis, material finer than 80 µm and organic impurities in sand which shall be no more than 90 days and petrographic examination of coarse aggregate for concrete which shall be no more than 180 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	4.4.4 *Concrete Mix Design and Aggregate Testing* The Contractor shall submit a concrete mix design for each class of concrete including applicable material test reports for the Consultant's review *a minimum of* two weeks before *concrete placement*. *A concrete mix design and material test reports are* not required for concrete used *in* the construction of culvert collars or cut-off walls when culverts are *less than* 3 metres in diameter. The sampling and testing of aggregates shall be completed by *a concrete* testing laboratory *certified to CSA A283. Concrete mix designs, including the review of all material test reports, shall be signed and sealed* by a Professional Engineer registered in the Province of Alberta *employed by a concrete testing laboratory certified to CSA A283. The Engineer shall also provide a professional opinion indicating that the concrete mix is* suitable for the intended use and *can be* expected to *meet specification requirements.* *Alternatively, concrete mix designs, including the sampling and testing of aggregates and review of material test reports may be completed by a qualified professional employed by the concrete supplier. When the concrete mix design is completed by the concrete supplier it shall be reviewed for compliance with the respective specifications, signed and sealed by a Professional Engineer registered in the Province of Alberta employed by an independent concrete testing laboratory certified to CSA A283. The independent review Engineer shall also provide a professional* opinion *indicating that the concrete mix is* suitable for the intended use and *can be* expected to *meet specification requirements.* *Material test reports shall be current and fully represent materials to be used in production. For each mix design submission the source(s) of proposed aggregate(s) and following aggregate analysis shall be provided:*

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, including testing in accordance with CSA A23.2-28A. 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 A23.2-15A 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 the aggregates may

Aggregate Analysis	*Standard*	*Required Frequency of Analysis (maximum days prior to production)*
Fine and Coarse Aggregate Sieve	*(CSA A23.2-2A)*	*90*
Amount of material finer than 80 µm in aggregate	*(CSA A23.2-5A)*	*90*
Organic Impurities in Sands for Concrete	*(CSA A23.2-7A)*	*90*
Results of deleterious substances and physical properties of aggregates	*(Table 12, CSA A23.1; A23.2-3A, A23.2-4A, A23.2-23A, A23.2-24A A23.2-29A)*	*180*
Potential expansivity of aggregates	*(CSA A23.2-14A)*	*24 months*
Detection of alkali-silica reactive aggregate by accelerated expansion of mortar bars	*(CSA A23.2-25A)*	*12 months*
Petrographic Examination of Coarse Aggregate for Concrete	*(CSA A23.2-15A)*	*180*

Additional analyses shall be provided *by the Contractor when requested by the Consultant* to confirm that the mix constituents continue to meet specification 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

be completed by the concrete supplier, with the condition that documentation is stamped by a Professional Engineer registered in the Province of Alberta. For either situation, the mix design, including sampling and testing, shall be reviewed and stamped for compliance with respective 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 Consultant 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 3 m3 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 4.4.2(i). Concrete mixes that will be placed by concrete pump shall be designed for pumping.	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. *Iron stone content in fine aggregate (material retained on the 2.5 mm sieve) shall not exceed 1.5% by total dry mass of fine aggregate for all classes of concrete except pile concrete.*
	4.4.5 Trial Batches *The Contractor is required to complete trial batch(es) for Class HPC, Class HPC with Steel Fibres, and/or any class of concrete containing hydration stabilizing admixtures. The Contractor shall produce evidence satisfactory to the Consultant that the proportions selected will produce concrete of the quality specified. The trial batch(es) shall be performed a minimum of 35 days prior to placement of concrete at site. Each trial batch shall be a minimum of 3 m^3 or 50% of the rated mixer capacity (whichever is greater). For multi-year projects, all trial batch testing shall be repeated in conjunction with required aggregate testing.* *(a) Class HPC and Class HPC with Steel Fibres* *Slump retention shall be evaluated at 15, 30, 50, and 70 minutes after batching. At 70 minutes from the time of batching, samples shall be cast to determine compressive strength at 7 and 28 days, rapid chloride ion penetration, and hardened air void system in accordance with the*

	requirements of Section 4.4.2. Shrinkage of the trial batch concrete shall be measured in accordance with CSA A23.2-21C. Shrinkage test results shall be submitted to the Consultant within seven days of test completion. *(b) Hydration Stabilized Concrete Mixes* *The design length of hydration stabilization shall be the difference of the project haul time and the specified allowable haul time (not exceeding 90 minutes) or that required by structural considerations. The hydration stabilized mix design, including a detailed concrete batching procedure, shall be submitted and reviewed in accordance with Section 4.4.4. Hydration stabilized concrete mixes demonstrating significant inconsistencies, as determined by the Consultant, shall require additional trial batch testing to demonstrate compliance.* *The time of initial and final set, compressive strength at 3, 7, and 28 days and hardened air void system shall be determined. Hardened air void systems shall meet the requirements of Section 4.4.2 (i). Slump retention shall be assessed at 15 minutes after batching, quarter points of the design hydration stabilization period and 30 minutes prior to the anticipated initial set. Trial batch(es) of Class HPC and Class HPC with steel fibres shall also meet the requirements for rapid chloride permeability and submission of shrinkage test results to the Consultant within seven days of test completion.*
4.4.5 Mix Adjustments For all classes of concrete other than HPC and HPC with steel fibres, in case, 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, but only with the prior acceptance of the Consultant. Notwithstanding the Consultant's review of the mix design, it remains the Contractor's responsibility that the concrete meets all the requirements of this Specification.	*4.4.6* Mix Adjustments *If during the progress of the work the initial approved mix design is modified or* found to be unsatisfactory for any reason the Contractor shall *resubmit a revised mix design, in accordance with the requirements of Section 4.4.4, to the Consultant for review and acceptance prior to continuing concrete operations*.
4.6.1 General All concrete shall be mixed thoroughly with all ingredients uniformly distributed. The Consultant 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.	4.6.1 General All concrete shall be mixed thoroughly with all ingredients uniformly distributed. The Consultant 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 materials *enter the mixing* drum.

4.6.2 Truck Mixing ... 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 Consultant, the mixer shall rotate 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.	4.6.2 Truck Mixing ... Maximum size of the batch in truck mixers shall not exceed the maximum rated capacity of the mixer as stated by the manufacturer and stamped on the mixer. Truck mixing shall commence immediately upon introduction of ingredients into the drum and be continued for at least *70* 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 air entraining agent or superplasticizer at the site is authorized by the Consultant, the mixer shall rotate for a minimum of *70* 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.
4.9.2 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.	4.9.2 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 *with the exception that when concrete is being placed underwater by tremie methods, sampling may occur at the pump's hopper*.
4.10.1 General Detailed falsework and formwork drawings shall be supplied to the Consultant for review and examination 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 registered in the Province of Alberta, who shall assume full responsibility to ensure that his design is being followed in construction of the falsework and formwork. Alberta Safety and compliance with the Occupational Health and Safety Act and Regulations thereunder, shall be integral parts of his design. All falsework and formwork shall be fabricated in accordance with the drawings.	4.10.1 General Detailed falsework and formwork drawings shall be supplied to the Consultant for review and examination as to concept only. The drawings shall be submitted three weeks before construction commences. The drawings shall bear the Seal of a Professional Engineer registered in the Province of Alberta, who shall assume full responsibility to ensure that his design is being followed in construction of the falsework and formwork. Compliance with the Occupational Health and Safety Act and Regulations therein, shall be integral parts of the design. All falsework and formwork shall be fabricated in accordance with the drawings. *The Contractor shall make every effort to accurately position formwork against hardened concrete so as to avoid form lines and discontinuities at the construction joint. Construction tolerances for formwork misalignments are outlined in Section 4.25.8.*

4.10.3 Forms for Exposed Surfaces … Metal bolts or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 20 mm 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 20 mm 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 practicality, internal ties for the construction of curb and barriers should not be used. All cavities created from ties or associated hardware removal shall be filled with an approved non-shrink grout and the surface left sound, smooth, even and uniform in color. The use of plastic sleeves and removable inner rods shall be discouraged and only when approved by the Department and the Consultant. If approved for certain applications, the plastic sleeve shall be removed for a distance of 100 mm from the face of the concrete. The inside of the resulting surfaces shall then be roughened by wire brushing or other acceptable means. The entire cavity shall be filled with an approved non-shrink grout.	4.10.3 Forms for Exposed Surfaces … Metal bolts or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 20 mm 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 20 mm 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 formwork hardware at concrete surfaces will not be permitted. *When plastic sleeves and removable inner rods are used, the plastic sleeve shall be removed for a distance of 100 mm from the face of the concrete except for curbs, barriers and medians where the entire plastic sleeve shall be removed. The cavity shall be filled with an approved non-shrink grout to 75 mm from the concrete surface and cured a minimum 24 hours. The remaining 75 mm of the cavity shall then be filled with an approved concrete patching material.*
4.10.5 Standard Details Refer to Standard Drawing S 1411 “Standard Concrete Joints” and Standard Drawing S 1412 “Standard Construction Joints”, included with these Specifications, for details of joints.	4.10.5 Standard Details *The Contractor shall use the standard details shown on* Standard Drawings S 1411 “Standard Concrete Joints”, S 1412 “Standard Construction Joints”, *and S-1443 “Deck Waterproofing”*.
4.10.6 Deck Formwork Unless otherwise noted, diaphragms and girders will be designed for construction loads during deck concrete pour in accordance with CSA-S6-06 Clause 3.16, and the loads assumed for such design shall be shown on contract drawings. Where construction loads or loading conditions proposed by the Contractor vary from those shown, the Contractor shall be responsible for maintaining girder stability and alignment 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	4.10.6 Deck Formwork Unless otherwise noted, diaphragms and girders will be designed in accordance with CSA-S6-06 Clause 3.16 *for construction loads during casting of deck concrete*. *The* loads assumed for such design will be shown on the Drawings. Where construction loads or loading conditions proposed by the Contractor vary from those shown, the Contractor shall be responsible for maintaining girder stability and alignment until the deck concrete has gained sufficient strength. Where required, deck formwork design shall include any additional bracing system to those shown on the Drawings. Care shall be taken in the design and installation of support brackets to avoid

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. No drilling of additional holes or any other modifications including field welding shall be made to the superstructure elements. Effects of concentrated loads on thin webs shall be checked, 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 at stationing corresponding to the camber diagram, as applicable and determine the girder haunch dimensions required to achieve the specified gradeline. This information shall be provided to the Consultant prior to commencing any deck formwork.	damage to girder flanges and webs. Where such brackets bear against girder webs, the girder webs shall be protected by timber or neoprene softeners. No drilling of additional holes or any other modifications including field welding shall be made to the superstructure elements. Effects of concentrated loads on thin webs shall be checked, and where necessary, sufficient means shall be provided to distribute or carry such concentrated loads to the supporting flanges or stiffeners. *Formwork hangers or ties for exposed surfaces of decks, including underside surfaces, shall be removable threaded type. No portion of the hardware associated with deck or deck overhang formwork shall be visible after all formwork has been removed. All cavities resulting from threaded rod removal along the underside of deck overhangs shall be adequately prepared and filled with an approved concrete patching material. Deck overhang patches shall be placed level with adjacent surfaces and be similar in color and texture. For interior bays, all cavities resulting from threaded rod removal shall be filled with Sikaflex 15LM or an approved equivalent. The caulked surface shall be placed level with adjacent surfaces and be similar in color.* 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; however, it may be necessary to adjust the formwork to compensate for variances in girder dimensions, positioning, alignment, and sweep. *After girder elevations at the abutments, piers and splice locations have been reviewed and accepted by the Consultant and prior* to commencing deck formwork, the Contractor shall profile all the girders at points corresponding to the camber diagram and determine the girder haunch dimensions required to achieve the specified gradeline. This information shall be provided to the Consultant for review and acceptance prior to commencing any deck formwork.
4.12 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	**4.12 Protection of *Concrete Work and Bridge Components from Staining*** *The Contractor shall take precautions to protect all concrete work and bridge components from staining. If staining occurs it shall be removed to the full satisfaction of the Consultant. Stained concrete surfaces that have received a Class 3 finish shall have the entire surface face of the component sandblasted and the Class 3 finish reapplied. Stained concrete surfaces that*

pier finish will not be given until after all deck and curb concrete is in place. This work will be considered incidental to the application of the specified concrete surface finish, and no separate payment will be made.	*have received a Class 2 finish shall have the entire surface face of the component refinished. There shall be no trace of staining after the specified concrete finishing is completed.*
4.14.1 General … 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 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 Consultant.	4.14.1 General … Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. When placing operations consist of free dropping concrete more than 1 m, it shall be deposited *by concrete pump, metal or plastic chutes or other means acceptable to the Consultant*. … Concrete placing operations shall not work off, or transport concrete directly over concrete *previously* placed without the acceptance of the Consultant.
4.14.3 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 puddle 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. Tempering 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 4.6.3 “Time of Hauling”. 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.	4.14.3 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. 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. *Re-tempering* of partially hardened concrete with additional water will not be permitted. *Concrete that does not reach its final position in the forms within the time limits specified shall not be used*. After initial set of the concrete, the forms shall not be jarred or *strain* placed on the ends of *projecting* reinforcing bars.
4.15.1 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	4.15.1 General The Contractor shall make all attempts *necessary* to obtain a dry pile hole prior to placing pile concrete. *If in the opinion of the Consultant and the*

dry hole fail, the Consultant may permit the placement of pile concrete under water.	*Department that all attempts to achieve a dry pile hole have been taken and proven unsuccessful, placement of pile concrete under water will be required.*
4.15.3 Concrete Placed under Water Placement of pile concrete under water shall be in accordance with Section 4.21 of this Specification and also with the following additional requirements: … The Consultant will determine the depth, location, diameter and number of core holes when concrete coring is required. If the Consultant is concerned about concrete strength or requires the use of a borehole camera for inspection, large diameter cores may be required. Minimum of two cores would be required to intercept the suspected defect zones. Correction of Unacceptable Drilled Pile When the Consultant determines a drilled pile is unacceptable, the Contractor shall submit a remedial action plan with supporting calculations for the Department and the Consultant's approval. The remedial action shall be designed by the Contractor and stamped by a Professional Engineer registered in the Province of Alberta. No compensation will be made for remedial work or losses or damages due to remedial work of drilled piles found defective or not in accordance with the Specifications.	4.15.3 Concrete Placed under Water Placement of pile concrete under water shall be in accordance with Section *4.22* of this Specification and also with the following additional requirements: … The Consultant *in consultation with the CSL engineer* will determine the depth, location, diameter and number of core holes when concrete coring is required. If the Consultant is concerned about concrete strength or requires the use of a borehole camera for inspection, large diameter cores may be required. Minimum of two cores would be required to intercept the suspected defect zones. *The pile will not be considered acceptable until the Consultant and the Department has reviewed and accepted the report and determined if further remedial action is required.* When the Consultant *and Department* determine a drilled pile is unacceptable, the Contractor shall submit a remedial action *proposal* with supporting calculations *to the Department and the Consultant for review and acceptance*. The remedial action shall be designed by the Contractor and *signed and sealed* by a Professional Engineer registered in the Province of Alberta. No compensation will be made for remedial work or losses or damages due to remedial work of drilled piles found defective or not in accordance with the Specifications
4.16.1 General Concrete placing will not be permitted when the air temperature is below +5°C or above 25°C, nor in the event of rain or excessive wind or dust, nor when there are other conditions judged by the Consultant to be detrimental to the concrete. Deck, roof slab, approach slab and deck overlay concrete placing shall 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 reviewed and accepted by the Consultant. The temperature of the concrete during discharge shall be between 10°C and 20°C unless reviewed and accepted otherwise by the Consultant. The temperature of the mix shall be maintained below the 20°C maximum temperatures by the inclusion of ice to the mix which shall not alter the design water cementing materials ratio. Immediately prior to placing concrete, the	4.16.1 General Concrete placing will not be permitted when the air temperature is below +5°C or above 25°C, in the event of rain or excessive wind or dust, *or* when there are other conditions judged by the Consultant to be *harmful* to the concrete. *HPC concrete and HPC concrete with steel fibres shall be placed between* the hours of 6:00 pm and 10:00 am *of the following day, unless reviewed and accepted by the* Department and Consultant. *HPC concrete and HPC concrete with steel fibres shall not be placed when the evaporation rate exceeds 0.5 kg/m2/hr. The evaporation rate shall be determined using Figure D.1, of CSA A23.1 – Annex D. The rate of evaporation shall be recorded as concrete placing operations progress and the Contractor shall make all necessary adjustments to ensure the evaporation rate does not exceed the specified limit. Lighting is required for night pours and shall be*

substrates shall be thoroughly wetted down with clean water. The Contractor's project manager and field superintendent may be required to attend a pre-construction meeting at a location determined by the Consultant, prior to commencement of any field work. … 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 filter fabric or wet burlap, and shall also be made available to the Consultant for straight edge checking. The work bridges shall be supported essentially parallel to the concrete surface, between 250 mm and 600 mm above the concrete surface, and shall be at least 800 mm wide to permit diverse uses concurrently, and be rigid enough that dynamic deflections are insignificant.	*reviewed and accepted by the Consultant.* The temperature of the concrete during discharge shall be between 10°C and 20°C unless reviewed and accepted by the Consultant. 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 cementing materials ratio. *Prior* to placing concrete, *substrate surfaces* shall be *brought to a saturated surface dry condition with clean water meeting the requirements of Section 4.2. Substrate surfaces shall be free of standing water*. The Contractor's project manager and field superintendent *shall* attend a pre-construction meeting at a location determined by the Consultant, prior to commencement of any *site* work. … 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 shall facilitate the operations of concrete finishing and placing of filter fabric and shall also be made available to the Consultant for straight edge checking. The work bridges shall be supported essentially parallel to the concrete surface, between 250 mm and 600 mm above the concrete surface, and shall be at least 800 mm wide to permit diverse uses concurrently, and be rigid enough that dynamic deflections are insignificant.
4.16.2 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 Special Provisions. All rails and supports shall be removed with minimum disturbance to the concrete.	4.16.2 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 and deck concrete, unless specified otherwise in the Special Provisions. *Rails shall extend beyond the end of the bridge to accommodate finishing of the entire concrete surface with the deck finishing machine.* All rails and supports shall be removed with minimal disturbance to the concrete.
4.16.4 Fog Misting and Wet Cure Systems The Contractor shall prepare details of the fog misting and wet cure systems. Details of the fog misting and wet cure systems shall be provided to the Consultant for review and 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. The fog misting and wet cure systems shall be demonstrated for adequacy and suitability, a minimum of 24 hours prior to placing HPC concrete.	
4.16.5 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.	*4.16.4* Screeding Concrete *Concrete shall be placed as close as practical ahead of the finishing machine, and at no time more than 6 m in front of the trailing end of the finishing machine's roller.* 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 concrete surface. The contractor shall also ensure that the required concrete thickness is being placed by *continually* probing the concrete behind the finishing machine. Screeding shall be completed in no more than two passes. *The screeded surface shall not be walked on or otherwise damaged and may require finishing machines or work bridges to be equipped or fitted with specialized work platforms to facilitate concrete finishing in front of curbs, barriers or medians*.
4.16.6 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.	*4.16.5* Bull Floating/Surface Texturing The concrete surface produced behind the finishing machine shall be *manually bull floated with a magnesium bull float* to ensure that the surface is free from open texturing, plucked aggregate and local projections or depressions. *Bull floating and surface texturing shall follow as close as practically possible behind the screed.* It is imperative that competent workers be employed to carryout bull floating and surface texturing. *Evaporation reducer or water shall not be finished into the concrete at any time during finishing operations*. *The Contractor shall check the concrete surface with a 3 m long expanded polystylene straight edge immediately after final bull floating and before texturing or application of evaporation reducer to ensure the required surface tolerances are met. Concrete surfaces that do not meet the surface tolerances described in 4.16.6 shall be corrected while the concrete is still plastic and before curing procedures are implemented.*

4.16.7 Surface Defects and Tolerances The finished surface of the concrete shall conform to the design gradeline profiles as indicated on the drawings 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, at his own expense: (a) Grind down any areas higher than 3 mm but not higher than 10 mm above the correct surface. (b) Correct any areas lower than 3 mm but not lower than 10 mm below the correct surface, by grinding down the adjacent high areas. (c) When the deviation exceeds 10 mm from the correct surface, the deck slab shall be removed and replaced in accordance with Section 20.3.2 "Partial Depth Repair", resulting in a product that is in no way inferior to the adjacent undisturbed slab. Replaced areas shall be at the Contractor's expense.	*4.16.6* Surface Defects and Tolerances The finished surface of the concrete shall conform to the design gradeline profiles as indicated on the drawings and/or as determined on site. *Any gradeline profile modifications shall be reviewed and accepted by the Consultant*. The surface shall be free from open texturing, plucked aggregate and local projections. Except across the crown, the surface shall be such that when checked with a 3 m long straight edge placed anywhere in any direction on the surface, there shall not be any gap greater than 3 mm between the bottom of the straight edge and the surface of the deck *concrete*. Areas that do not meet the required surface accuracy shall be clearly marked out and the Contractor shall, at his own expense: (a) Grind down any areas higher than 3 mm but not higher than 10 mm above the correct surface. (b) Correct any areas lower than 3 mm but not lower than 10 mm below the correct surface, by grinding down the adjacent high areas. (c) When the deviation exceeds 10 mm from the correct surface, the deck slab shall be removed and replaced in accordance with Section 20.3.2 "Partial Depth Repair", resulting in a product that is in no way inferior to the adjacent undisturbed slab. *The perimeter of the joint created by the repair area shall be waterproofed in accordance with the details on S-1443.* Replaced areas shall be at the Contractor's expense.
4.17 Placing Approach Slab and Roof Slab Concrete ... 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 5 mm from the required lines, under a 3 m straightedge.	**4.17 Placing Approach Slab and Roof Slab Concrete** ... The *concrete* surface shall then be *manually bull* 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 by more than *3* mm from the required lines, under a 3 m straightedge *placed anywhere, in any direction except across the crown*.
4.18 Concreting Shear Keys and Diaphragms	**4.18 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	*Form work for* shear keys and diaphragms shall be designed to accommodate variations in girder dimensions, positioning, alignment, camber and sweep. Girder keyways *and diaphragms shall be brought to a saturated surface dry condition prior to concrete placement. Saturation with water shall not be less than 30 minutes prior to blowing free of standing water.* Concrete placed in the keyways shall be adequately *consolidated* and trowelled smooth and *level with the top surfaces of* the girders. Immediately after trowelling, *two layers of clean Nilex 4504 white colored* filter fabric *or an approved equivalent* shall be placed on the shear keys and kept continuously wet for 72 hours.
	4.19 Concrete Slope Protection *A minimum of one week prior to commencing concrete slope protection work, the Contractor shall submit a detailed layout and forming plan to the Consultant for review and acceptance. The detailed layout and forming plan shall comply with Standard Drawing S-1409 and these specifications.* *All thickness measurements indicated herein are perpendicular to the slope surface.* *The slopes to be covered with concrete slope protection shall be trimmed and dressed by the Contractor to within 150 mm of the lines and grades shown on the Drawings. The Contractor shall supply and place Des 2 Class 25 crushed aggregate material to a minimum thickness of 100 mm over the trimmed slopes. Crushed aggregate material shall conform to the requirements of section 2.2.2 Gravel Material and Crushed Aggregate Material.* *Where slopes have been constructed by others, and excavation exceeding 250 mm or fill exceeding 150 mm is required due to discrepancies in position of the original surface, excavation beyond the 250 mm tolerance limit and/or fill beyond the 150 mm tolerance limit will be considered to be Extra Work. Depending upon the circumstances of the particular project the Department and Consultant may vary the specified concrete grades so as to minimize the amount of remedial trimming required. Excavation up to 250 mm and/or fill up to 150 mm will be considered as included in the bid price.* *Concrete for slope protection shall be Class C.* *Sheet reinforcing mesh shall be placed in accordance with Section 5 Reinforcing Steel. The method of securing and maintaining the wire mesh in*

	its proper location shall be reviewed and accepted by the Consultant. *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 proper cold joints between courses. Vertical or horizontal joints shall be formed or grooved 50 mm to the depth of the reinforcing mesh. All joints shall be finished with suitable edging and grooving tools and left unfilled. The concrete surfaces shall be given a Class 5 finish prior to edging and grooving. Finishing work shall be carried out by competent and experienced personnel only.* *Backfill at the toe, top or edges shall be non-granular, conforming to the requirements of section 2.2.1 Compacted Non-granular Material, and shall not be placed until the completed slope protection work has been reviewed and accepted by the Consultant.*
4.19.1 General ... If not detailed on the drawings, or in the case of emergency, construction joints shall be installed as determined by the Consultant and according to the standard drawing. Shear keys or inclined reinforcement shall be used where necessary to transmit shear, or to bond the two sections together. Construction joints shall 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 "Standard Construction Joints" included with these Specifications.	*4.20.1* General ... If not detailed on the drawings, or in the case of emergency, construction joints shall be installed *in accordance with Standard Drawings S1412 or* as determined by the Consultant. Shear keys or inclined reinforcement shall be used where necessary to transmit shear, or to bond the two sections together. Construction joints shall be located to allow a minimum of 50 mm concrete cover on reinforcing steel running parallel to the joint.
4.20 Concreting in Cold Weather The Contractor shall accept full responsibility for the protection of concrete during adverse weather conditions. In addition to the requirements stated below, all concrete shall be cured in accordance with Section 4.22. When the ambient air temperature is, or is expected to be below 5°C during the specified minimum curing period, or when determined by the Consultant, the following requirements for cold weather concreting shall be put in place: … (2) The Contractor shall enclose the structure in such a way that the concrete	***4.21*** **Concreting in Cold Weather** *When the ambient air temperature is, or is expected to be below 5°C during the placing and curing period, or when determined by the Consultant, a cold weather concreting plan shall be implemented. The Contractor shall submit a cold weather concreting plan to the Consultant for review and acceptance a minimum of two weeks prior to any concrete placement. In addition to the requirements stated below, all concrete shall be cured in accordance with Section 4.23.* *The following minimum requirements for cold weather concreting shall be*

and air within the enclosure can be kept above 15°C for a period of 7 days after placing the concrete. Where elements being cast consist of HPC concrete, the seven day period is increased to 14 days. Additionally, for deck construction, the Contractor shall submit to the Department and the Consultant, details of the enclosure structure, describing how the HPC concrete will be placed, finished and cured. For casting of HPC concrete, an enclosure structure is mandatory and no alternatives will be considered. The enclosure shall be constructed so that a minimum 300 mm 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.	*included in the Contractor's cold weather concreting plan:*
The relative humidity within the enclosure shall be maintained at not less than 85%. 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 Consultant'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 is subject to the review and acceptance of the Consultant.	(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. *Enclosures shall be constructed with a minimum 300 mm clearance between the enclosure and the concrete.*
	Where elements being cast consist of HPC concrete, the seven day period is increased to 14 days. For casting of HPC concrete an enclosure *shall be constructed large enough to comfortably accommodate the men and equipment necessary to place, finish and cure the concrete. In addition, the underside of the deck shall be suitably protected*.
	The relative humidity within the enclosure shall be maintained at not less than 85%. 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. 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 Consultant's specific acceptance.
	The system of heating, and positioning of steam outlets, heaters, and fans, *shall* be designed to give the most uniform distribution of heat possible.
(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 Consultant's acceptance of the Contractor's arrangements shall be obtained and it will be a requirement that pre heat is adequate, in the Consultant's opinion, to ensure that no portion of the fresh concrete is damaged by freezing, or curing retarded by cold temperatures.	(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 *between 10°C and 20°C*.
(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	(4) Fully insulated formwork may be proposed as an alternative to providing 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 conditions.
	(5) The adequacy of protection shall be monitored and recorded a minimum of every 4 hrs for the first 72 hrs and every 8 hrs for the remainder of the curing period, including measurement of internal and surface concrete temperatures. The protective measures shall be modified as necessary to maintain the specified conditions.

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. The temperature differential between the core of the element and the surface of the element shall not exceed 20°C. In addition the temperature differential between the surface of the element and the ambient air shall not exceed 15°C. Ambient air temperature is defined as the temperature at mid-height of the element and 300 mm from the surface of the element. The Contractor shall demonstrate to the satisfaction of the Consultant that the temperature and relative humidity requirements are met by continuously monitoring and recording air temperature and relative humidity within the curing enclosure.	*(6)* 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 an enclosure*, the heat shall be slowly reduced. The temperature differential between the core of the element and the surface of the element shall not exceed 20°C. In addition the temperature differential between the surface of the element and the ambient air shall not exceed 15°C. Ambient air temperature is defined as the temperature at mid-height and 300 mm from the surface of the element. *The Contractor shall measure the temperature of internal concrete, surface of the concrete and ambient air temperatures a minimum of every 4 hrs, and shall make adjustments as necessary to keep the rate of cooling within the specified parameters.* The Contractor shall demonstrate to the satisfaction of the Consultant that *the requirements of the cold weather concreting plan are met.*
4.21 Depositing Concrete under Water Concrete shall not be deposited in water except as specified and with the acceptance of the Consultant and under his immediate supervision. Anti-washout admixtures incorporating viscosity modifiers (whelan gum, etc.) may be used when specifically reviewed and accepted by the Consultant. Concrete to be deposited in water shall be of the specified class, with mix design modified to yield 170 mm ± 30 mm 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 and accepted by the Consultant, 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. 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 500 mm below the surface of fresh concrete at all times, to maintain a seal until the form or hole	***4.22*** **Depositing Concrete under Water** Concrete shall not be deposited *under water without* the acceptance of the Consultant and under his immediate supervision. *Concrete to be deposited in water shall be of the specified class, with the mix design modified to provide 170 mm ±30 mm slump without segregation and a 15% increase in cementing materials above the initial mix design quantity*. Anti-washout admixtures incorporating viscosity modifiers may be used *in the mix design*. *The modified concrete mix design for placement under water shall be submitted by the Contractor for review and acceptance by the Consultant in accordance with Section 4.4.4. The concrete temperature at discharge 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 and accepted by the Consultant, 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 *any formwork* underwater shall be watertight. 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 500 mm below the

is completely filled with fresh uncontaminated concrete. A tremie, when reviewed and accepted, shall consist of a rigid tube having a diameter between 200 mm and 300 mm, 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 300 mm 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.	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 and accepted *by the Consultant*, shall consist of a rigid tube having a diameter between 200 mm and 300 mm, 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 500 mm in previously placed concrete. Dewatering will not be permitted while concrete is being placed. Dewatering may proceed when the concrete seal *has gained sufficient strength such that dewatering is not harmful to the performance of the concrete*. *The Contractor shall remove* all laitance or other unsatisfactory material from the exposed *concrete* surface *as determined by the Consultant* by scraping, chipping or other *acceptable* means.
4.22.1 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 concrete surfaces consisting of Class B, C or D concrete shall be moist cured. The Contractor shall cover the concrete surface(s) with a single layer of clean, soaking wet burlap or light colored filter fabric as soon as the surface will not be marred by so doing. The burlap or light colored filter fabric shall be kept continuously wet for 72 hours. Where the formwork is left in	*4.23.1* General Freshly deposited concrete shall be protected from freezing, abnormally high temperatures or temperature differentials, premature drying, *water damage and moisture loss for the curing period*. All concrete surfaces consisting of Class C or D concrete shall be *wet* cured. The Contractor shall cover the concrete surface(s) with *two layers of clean Nilex 4504 white colored* filter fabric or an approved equivalent as soon as the surface will not be marred by so doing. The filter fabric shall be kept continuously wet for 72 hours. Where the formwork is left in place for 72 hours or more, no additional curing will be required. *Curing compounds shall*

place for 72 hours or more, no additional curing will be required. Curing requirements for Class HPC and Class HPC with steel fibres are stated in Section 4.22.3.	*not be used on any concrete surface other than concrete slope protection*.
4.22.2 Curing Requirements for Concrete Slope Protection Concrete slope protection shall receive 2 coats of a Type 2 curing compound meeting the requirements of ASTM C309 or ASTM C1315. 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. Each application shall be at a rate specified by the Manufacturer. In cases, where premature drying is severe or is anticipated to be severe, then moist curing, as specified in 4.22.1, will also be required.	*4.23.2* Curing Requirements for Concrete Slope Protection Concrete slope protection shall receive 2 coats of a Type 2 curing compound meeting the requirements of ASTM C309 or ASTM C1315. 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. Each application shall be at a rate specified by the Manufacturer.
4.22.3 Curing Requirements for Class HPC and Class HPC with Steel Fibres Curing methods and procedures shall be reviewed and accepted by the Consultant prior to scheduling placement of Class HPC or HPC with steel fibres concrete. Equipment and materials necessary for the fog mist and wet cure systems shall be demonstrated prior to scheduling placement of Class HPC or HPC with steel fibres concrete. During the cure period the Contractor shall provide protection to ensure that the difference between the concrete temperature and the ambient air temperature at the site remains within the limits specified in 4.4.2(l). The Contractor shall supply and install two thermocouples, one in the centre and one at the surface of the concrete, for every 100 m^2 of deck, at locations determined by the Consultant. The Contractor shall monitor and record the temperatures every four hours for the first 3 days after concrete placement and every 12 hours thereafter for the remainder of the specified cure period. Daily temperature records shall be forwarded to the Consultant and Department. 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. Fog misting will not be	*4.23.3* Curing Requirements for Class HPC and Class HPC with Steel Fibres *The Contractor shall prepare and submit details for his proposed curing procedures to the Consultant for review and acceptance a minimum of two weeks prior to the scheduled pour date. At a minimum, the details shall include a description of equipment, materials, and work methods/techniques employed to carry out the work.* During the cure period the Contractor shall provide protection to ensure that *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 21 of CSA A23.1 shall apply*. The Contractor shall supply and install two thermocouples, one in the centre and one at the surface of the concrete, for every 100 m^2 of deck, at locations determined by the Consultant. The Contractor shall monitor and record the temperatures every four hours for the first *72 hrs* after concrete placement and every *8* hours thereafter for the remainder of the specified cure period. Daily temperature records shall be forwarded to the Consultant. *Immediately after final bull floating and/or surface texturing an evaporation reducer, such as "Confilm" manufactured by BASF or an approved equivalent, having a monomolecular film forming compound intended for application to fresh concrete for temporary protection against moisture loss, shall be applied by a hand sprayer with a misting nozzle at the*

required for casting of curbs, barriers, medians and MSE wall coping. Two layers of light colored filter fabric or burlap shall be placed on the concrete surface as soon as the surface will not be marred as a result of this placement. A fine spray of clean water shall be immediately applied to the filter fabric or burlap. Edges of the filter fabric or burlap shall overlap a minimum of 150 mm 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 and accepted by the Consultant. Curing with filter fabric or burlap and water shall be maintained for a minimum period of 7 days for deck overlay Concrete and reconstruction projects where traffic is being impeded and 14 days for all new bridge construction. In the event that the wet curing is unacceptable, and any portion of the HPC or HPC with steel fibres becomes surface dry during the curing period, the Consultant will have cause to reject the concrete. When Class HPC is used for concrete paving lips and deck joint blockouts, the wet cure can be reduced to 3 days followed by the application of a Type 2 curing compound meeting the requirements of ASTM C309 or ASTM C1315. For those locations where formwork is removed prior to the completion of this specified curing period, the resulting exposed concrete surfaces shall be wet cured for the remaining days.	*manufacturer's recommended concentration and application rate*. Two layers of *Nilex 4504 white* filter fabric or an approved equivalent shall be placed on the concrete surface as soon as the surface will not be marred *by its installation*. *The fabric shall be pre-wet or a fine spray of clean water immediately applied once placed.* Edges of the filter fabric shall overlap a minimum of 150 mm and be held in place without marring the surface of the concrete. The filter fabric shall be in a continuously wet condition throughout the curing period by means of soaker hoses or other means reviewed and accepted by the Consultant. *The use of polyethylene sheeting above the filter fabric to reduce moisture loss will only be permitted if the sheeting is manufactured with regular perforations to permit the adequate application of curing water from above and reduce the heat generated by greenhouse effects.* Curing with filter fabric and water shall be maintained for a minimum period of 7 days for deck overlay concrete and *rehabilitation* projects where traffic is being impeded and 14 days for all new bridge construction. When Class HPC is used for concrete paving lips and deck joint blockouts *for rehabilitation projects*, the wet cure can be reduced to 3 days followed by the application of a Type 2 curing compound meeting the requirements of ASTM C309 or ASTM C1315. For those locations where formwork is removed prior to the completion of this specified curing period, the resulting exposed concrete surfaces shall be wet cured for the remaining days. In the event that curing is unacceptable, *or* any portion of the HPC or HPC with steel fibres becomes surface dry during the curing period, the Consultant will have cause to reject the concrete.
4.22.4 Class HPC and Class HPC with Steel Fibres – Crack Identification/Repair After the curing period and before opening to public traffic, the Contractor and the Consultant shall jointly inspect the dry concrete surface(s) to identify all cracks. The Consultant will plot the width in mm and length in linear m of cracks per m2 and report the findings to the Department. The Contractor shall repair the cracks at his own expense if crack width is 0.2 mm 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 flow epoxy in accordance with the	

Manufacturer's instructions. The gravity flow epoxy shall maximize the penetration by taking into consideration the ambient temperature, substrate temperature, viscosity and pot life of the material. The gravity flow epoxy material shall be chosen from the List posted at following Alberta Transportation website path: Alberta Transportation Product List/Crack Treatment/Concrete Crack filler/Proven or Potential. (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 for acceptance of the Consultant and Department.	
4.23 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 1 mm over an area whose dimensions exceed the dimensions of the bearing plates by 60 mm. 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.	***4.24*** **Concrete Finishing Under Bearings** *Concrete on which bearing plates, pads or shims are to be placed shall* be finished or ground to a smooth and even surface. *When checked with a straight edge placed anywhere in any direction on the concrete surface, there shall not be any gap greater than 1 mm between the bottom of the straight edge and the concrete surface*. Air voids created by forming grout pad *recesses* shall be filled with an approved patching material *a minimum of 7 days* in advance of girder erection. In cold weather conditions this work shall be completed while *the substrate concrete is warm from hydration processes. If the filling of air voids does not occur while the substrate concrete is still warm it shall be carried out in accordance with Section 4.21.*
4.24.1 General Surfaces requiring concrete finishing shall conform to the requirements of section 4.16.7, "Surface Defects and Tolerances". All mortar patches shall be cured as specified in section 4.22, "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 600 mm below grade or, in the case of river piers, 600 mm below lowest water level, surface finishes shall be applied as follows:	*4.25.1* General On exposed concrete surfaces to 600 mm below grade or, in the case of river piers, 600 mm below lowest water level, surface finishes shall be applied as follows: Class 1 Ordinary Surface Finish - All concrete surfaces unless other finishes are specified - Top surfaces of *pile caps*, abutment seats and pier caps Class 2 Rubbed Surface Finish - *Piers except grade separation piers* - *Traffic side* surfaces of curbs, barriers, medians and sidewalks - Cast-in-place concrete girders except exterior fascia.

Class 1 Ordinary Surface Finish - all exposed concrete surfaces unless other finishes are specified - top surfaces of abutment seats and pier caps Class 2 Rubbed Surface Finish - solid shaft river piers - inside surfaces of curb, barrier, median and sidewalk Class 3 Bonded Concrete Surface Finish - abutment seats except top surface - pier caps except top surface - exterior faces of curtain walls/wingwalls, cast-in-place walls and MSE wall copings - grade separation piers except top surfaces - exterior concrete girder faces (when specified) - exposed end surfaces of cast in place concrete diaphragms (when specified) - underside of the deck overhang to top flange of girder - exterior surfaces of deck slab, curb, barrier and sidewalk Class 4 Floated Surface 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) - concrete slope protection Class 6 Floated Surface Finish, Surface Textured - top surfaces of deck, deck overlay, 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.	Class 3 Bonded Concrete Surface Finish * - Abutment seats except top surface - Pier caps except top surface - Exterior faces of curtain walls/wingwalls, - Cast-in-place walls, MSE wall panels, and wall copings - 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 - Exterior surfaces of deck slab, curb, barrier and sidewalk ** Class 3 bonded concrete surface finishes shall only be applied to the above listed components when specified in the Special Provisions of the Contract. When a Class 3 surface finish is not specified in the Special Provisions of the Contract, all above listed components shall receive a Class 2 finish.* Class 4 Floated Surface Finish - Top surfaces of concrete deck, roof slabs, and approach 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) - Concrete slope protection - Deck joint blockout concrete top surfaces Class 6 Floated Surface Finish, Surface Textured - Top surfaces of deck, deck overlay, roof and approach slabs which will not be covered with either waterproofing membrane or wearing surface *Wood* or magnesium tools shall be used for finishing concrete *and be of a type and quality acceptable to the Consultant*.
4.24.2 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	*4.25.2* Class 1 Ordinary Surface Finish Unformed Surfaces - Immediately following placing and *consolidation*, 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 - Immediate 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 in 4.22 "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.	then trowelled to ensure that the surface is free from open texturing, plucked aggregate, and local projections or depressions. *Concrete surfaces shall be such that when checked with a 1.2 m long straight edge placed anywhere in any direction on the surface, there shall not be any gap greater than 3 mm between the bottom of the straight edge and the concrete surface unless otherwise specified.* 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 *shall be filled with a Department approved patching product acceptable to the Consultant. The repair material shall be appropriate for the intended application and be placed in accordance with the manufacturer's recommendations. All repairs shall be wet cured for a minimum of 72 hrs. Curing compounds are not permitted.*
4.24.3 Class 2 Rubbed Surface 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 in section 4.22 "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	*4.25.3* Class 2 Rubbed Surface Finish Immediately following the removal of forms, all *concrete* fins and irregular projections shall be removed. *Prior to commencement of concrete finishing, surfaces that do not meet tolerance requirements shall be corrected by grinding or partial depth repair as outlined in Section 20*. Parging *or surface patching* 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 any other defects, shall be thoroughly exposed by *diamond grinding wheels or similar tools. Surface voids greater than 19 mm diameter but less than 0.05 m2 in area or 30 mm deep shall be filled with a Department approved patching material. Surface voids less than 19 mm in diameter and 30 mm deep may be filled with a pre-bagged sack rub material. Sack rub materials shall be placed over the entire prepared surface in accordance with the manufacturer's recommendations. Both sack rub and patching materials shall be wet cured for a minimum of 72 hrs.* When the patching and *sack rub materials* have adequately cured, a carborundum stone or approved equivalent methods shall be used to finish the surface to a smooth, uniform and closed texture. Any voids or cavities opened during the stone rubbing process shall be re filled. *Class 2 concrete surfaces shall be such that when checked with a 1.2 m long straight edge placed anywhere in any direction on the surface, there shall not*

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 Consultant. After the surface preparation has been completed to the satisfaction of the Consultant, the Contractor shall apply sealer as specified in section 4.25 "Type 1c Sealer". If uniformity of colour is not achieved to the satisfaction of the Consultant, the Contractor, rather than applying the sealer as specified in section 4.25 "Type 1c Sealer", shall supply and apply an approved pigmented concrete sealer as specified for Class 3 "Bonded Concrete Surface Finish".	*be any gap greater than 3 mm between the bottom of the straight edge and the concrete surface unless otherwise specified.* It is essential that *all of* the prepared concrete surfaces, including all patching and *sack rubbing* be uniform in colour and texture. After the surface preparation has been completed to the satisfaction of the Consultant, the Contractor shall apply sealer as specified in section *4.26* "Type 1c Sealer".
4.24.4 Class 3 Bonded Concrete Surface Finish ... The pigmented concrete sealer shall be applied in accordance with the manufacturer's specifications. The colour(s) of the proposed coating scheme, which typically shall be similar to the natural colour of cured concrete, must be acceptable to the Consultant before application of the coating. A minimum of two applications of the pigmented sealer are required. When spray application is used the surface shall be back rolled. 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 considered to relieve the Contractor of full responsibility for its acceptable performance and appearance.	4.25.4 Class 3 Bonded Concrete Surface Finish ... The pigmented concrete sealer shall be applied in accordance with the manufacturer's specifications *and as a minimum two applications totaling the approved application rate of the pigmented sealer are required*. The colour(s) of the proposed coating scheme, which typically shall be similar to the natural colour of cured concrete, must be acceptable to the *Department and* Consultant before application of the coating. *If a colour scheme has been designed for the site it will be specified in the Special Provisions.* When spray application is used the surface shall be back rolled. 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 considered to relieve the Contractor of full responsibility for its acceptable performance and appearance.
4.24.5 Class 4 Floated Surface Finish Unless otherwise noted on the drawings, concrete which is to receive a waterproofing membrane and a final wearing surface, shall be floated and trowelled as necessary to provide a smooth surface	*4.25.5* Class 4 Floated Surface Finish Unless otherwise noted on the Drawings, concrete *surfaces receiving* a waterproofing membrane and a final wearing surface, shall be *manually bull* floated and trowelled as necessary to provide a smooth surface.
4.24.7 Class 6 Floated Surface Finish, Surface Textured ... Following the surface texturing, a strip of the concrete along the inside curb line, shall be trowelled smooth and the surface left closed.	*4.25.7* Class 6 Floated Surface Finish, Surface Textured ... Following surface texturing, *a 300 mm width of concrete surface adjacent to the curb, barrier or median* shall be trowelled smooth and the surface left

	closed.
	4.25.8 Repairing Concrete Defects *Honeycomb, cavities, cracking and other casting defects shall be immediately reported to the Consultant. Repair procedures shall be developed by the Contractor and submitted for review and acceptance by the Department and Consultant prior to the commencement of the repair. Damaged concrete shall be repaired by the Contractor at his own expense to the satisfaction of the Consultant.* *(a) Honeycomb, Cavities, Casting Defects* *Honeycomb, cavities and other deficiencies are defined as those areas that are greater than 30 mm in depth or 0.05m² in area. Defects less than 30 mm in depth or 0.05m² in area shall be repaired in accordance with Section 4.25.3.* *As a minimum, the Contractor's repair procedure shall include removing and replacing the defective concrete with the originally specified class of concrete. Repair extents shall be saw cut 25 mm deep in neat perpendicular lines and concrete removed to a depth of 35 mm below reinforcing steel. Repair areas shall be roughened to remove all loose material and laitance. Exposed reinforcing steel shall be cleaned and repaired to its original condition. Repair areas shall be saturated with water for a period of 24 hrs prior to concrete placement. Repair areas shall be free of standing water immediately prior to concrete placement. Curing shall be in accordance with the requirements for the class of concrete.* *Formwork misalignment for highly visible components, including medians, curbs, barriers, exterior deck fascia, pier shafts, and exterior faces of wingwalls shall be such that when checked with a 1.2 m long straight edge placed anywhere in any direction on the surface, there shall not be any gap greater than 3 mm between the bottom of the straight edge and the concrete surface. The gap for formwork misalignment of all other components shall not be greater than 5 mm. Concrete elements with formwork misalignments exceeding the allowable tolerances shall be removed and recast.* *(b) Cracks* *For class HPC and HPC with steel fibres the Contractor and the*

	Consultant shall jointly inspect and identify all cracks after the curing period and before opening to traffic. The Consultant will plot the width in millimeters and length in linear meters of cracks and report the findings to the Department. The Contractor shall complete all required crack repairs prior to opening to traffic. *The Contractor shall repair cracks with widths greater than or equal to 0.2 mm using the following procedure:* *(i) Clean and dry cracks with oil-free compressed air.* *(ii) Seal cracks with a gravity flow concrete crack filler in accordance with the Manufacturer's recommendations. The crack filler shall maximize the penetration by taking into consideration the ambient temperature, substrate temperature, viscosity and pot life of the material. The crack filler shall be chosen from the Alberta Transportation Product List/Crack Treatment/Concrete Crack filler/Proven Products and have a viscosity less than 105 centipoises (cP).* *(iii) When cracks extend the full depth of the deck slab, barriers or curbs or extend partial depth of decks that are cast to grade, epoxy injection will be required. The epoxy resin shall meet the requirements of ASTM C881 Type IV, Grade 1, Class B or C and have a viscosity less than 500 cP. An injection procedure shall be submitted by the Contractor to the Consultant for review and acceptance.* *For all other classes of concrete, cracks 0.2 mm or greater in width identified prior to issuance of the construction completion certificate, shall be repaired by epoxy injection in accordance with the manufacturer's recommendations. The epoxy for crack injection shall meet the requirements of ASTM C881 Type IV, Grade 1, Class B or C. The viscosity shall not exceed 500 CPS.* *All costs associated with crack repairs will be considered incidental to the Work and no separate or additional payment will be made.*
4.25 Type 1c 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 600 mm below grade, or in the case of river piers 600 mm below lowest water level, or as specified and shall include all surfaces which are to receive a Class 2, Class 5 and Class 6 Surface Finish. This does not apply to surfaces covered with waterproofing membrane and ACP wearing surface, drain troughs and concrete slope protection. Sealer will not	*4.26* Type 1c Sealer An approved Type 1c sealer shall be applied to all concrete surfaces which are *to receive a Class 2, Class 5 and Class 6 surface finish*. This shall include all concrete surfaces to 600 mm below grade or in the case of river piers 600 mm below lowest water level. *Surfaces that are to receive a waterproofing membrane shall not have sealer applied*. Sealer will not be required on the underside of bridge decks *or* on concrete diaphragms in the interior bay areas, however, the faces of the end diaphragms nearest the abutment

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, shall be sealed. Type 1c sealers shall meet the current Material Testing Specifications for Concrete Sealers - 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 28 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 Consultant 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.	backwalls, inside face of backwall and top surface of abutment seat, excluding bearing recess pockets, shall be sealed. Type 1c sealers shall meet the current Material Testing Specifications for Concrete Sealers - 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 *approved Product List*. Before applying the sealer, the concrete shall be cured for at least 28 days. The concrete surface shall be dry, and air blasted to remove all dust and accepted by the Consultant 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. *Asphalt concrete pavement surfaces shall be adequately protected from overspray and runoff during sealer application.*
4.26.1 Payment Scales Class B Concrete, Class Pile Concrete, 25 MPa Strength Test Results 25 MPa and over Full bid price 24 MPa to 25 MPa Bid price less $30 per cubic metre 23 MPa to 24 MPa Bid price less $60 per cubic metre 22 MPa to 23 MPa Bid price less $90 per cubic metre 21 MPa to 22 MPa Bid price less $120 per cubic metre 20 MPa to 21 MPa Bid price less $160 per cubic metre Class C Concrete, 35 MPa Strength Test Results 35 MPa and over Full bid price … Concrete will be rejected 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	*4.27.1* Payment Scales Class C Concrete, 35 MPa Strength Test Results 35 MPa and over Full bid price … Concrete will be rejected with *representative strengths less than the following*: - Class C concrete - 27 MPa - Class HPC and Class HPC with steel fibres concrete - 40 MPa - Class D and Pile concrete - 24 MPa - Class S concrete - 16 MPa

	4.28.2 Concrete Slope Protection *Payment for Concrete Slope Protection will be made at the unit price bid per square metre, and shall include full compensation for the cost of furnishing all tools, labour, equipment, materials, and incidentals necessary for the completed work, including the preparation of the slopes, supply and placing of reinforcing steel, steel mesh, concrete, and backfilling. The quantity to be paid for will be the number of square metres satisfactorily placed, and shall include trough drains adjoining the slope protection and the vertical surfaces of toe cut off walls. No payment will be made for top cut off walls or edge walls.*
Section 5 Reinforcing Steel	**Section 5 Reinforcing Steel**
5.1 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 drawings. All reinforcing steel shall meet the requirements of the current edition of Reinforcing Steel Institute of Canada Manual of Standard Practise. The Bar Lists in the drawings are provided for estimating purposes only. No substitution of bars or changes to bar details will be allowed without the prior acceptance of the Consultant.	**5.1 General** This Specification is for the supply, fabrication, handling and placing of plain reinforcing steel, epoxy coated reinforcing steel, corrosion resistant reinforcing steel (CRR), and stainless reinforcing steel. *All reinforcing steel* shall be supplied and installed *in the lengths and shapes shown* on the Drawings. No substitution of bars or changes to bar details will be *permitted* without prior approval of the Consultant.
	5.2 Material Types *5.2.1 Plain Reinforcing Steel* *Plain reinforcing steel shall be Grade 400, meeting the requirements of CSA Standard G30.18M.* *5.2.2 Epoxy Coated Reinforcing Steel* *Plain reinforcing steel meeting the requirements of Subsection 5.2.1 shall be used in the production of epoxy coated reinforcing steel.* *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 Consultant prior to delivery of the material.* *Epoxy coated reinforcing steel shall be prepared and coated in accordance*

	with the requirements of Ontario Provincial Standard Specification OPSS 1442, Material Specification for Epoxy Coated Steel Reinforcement for Concrete, and the requirements contained herein. *The film thickness of the epoxy 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.* *5.2.3 Corrosion Resistant Reinforcing Steel* *Corrosion resistant reinforcing steel (CRR) shall consist of either low carbon/chromium reinforcing steel or stainless reinforcing steel.* *Low carbon/chromium reinforcing steel shall meet the requirements of ASTM A1035. The minimum yield strength based on the 0.2% offset method shall be equal to 690 MPa.* *Stainless reinforcing steel, if used, shall meet the requirements of Subsection 5.2.4, Stainless Reinforcing Steel.* *Unless otherwise specified, only one type of CRR shall be supplied for use throughout the project.* *5.2.4 Stainless Reinforcing Steel* *Stainless reinforcing steel shall be of the following designations as defined by the Unified Numbering System (UNS):* *- S31653* *- S31603* *- S31803* *- S30400* *- S32304* *Stainless reinforcing steel shall meet the requirements of ASTM A276 and ASTM A955/A955M (including Annex 1.2 or 1.3). The minimum yield strength shall be 420 MPa.* *Unless otherwise specified, only one type of stainless reinforcing steel shall be supplied for use throughout the project.*
	5.3 Material Production and Testing *Reinforcing steel shall be produced and tested in accordance with the applicable standard(s). Material manufacturer mill test certificates showing*

	proof of compliance shall be submitted to the Consultant for review and acceptance prior to the placement of any reinforcing steel. *Mill test certificates shall be provided for each lot delivered to the site. The following additional information, as applicable, shall be supplied for each lot of stainless reinforcing steel delivered to the site:* - *Austenitic grades: Test results verifying compliance with ASTM A262, Practice E.* - *Duplex grades: Test results verifying compliance with ASTM A923, Method A, by demonstrating an unaffected etched structure.* *Stainless reinforcing steel shall be pickled to remove all mill scale and surface oxidation. Details of the Manufacturer's pickling process shall be included with the mill test certificate submissions.*
5.3 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. 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 specifications. 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.	***5.4*** **Fabrication** *All bars requiring bends shall be cold bent at the fabrication facility. Heating of bars to facilitate bending will not be permitted.* *Bars shall be cut by shearing or with fluid cooled saws. Torch cutting will not be permitted. Bars showing evidence of torch cutting will be rejected.* *Unless otherwise specified, all hooks and bends shall be fabricated using the pin diameters and dimensions recommended in The Reinforcing Steel Institute of Canada (RSIC) Manual of Standard Practice. Bars shall conform accurately to the dimensions shown on the Drawings, and be within the fabricating tolerances detailed in the RSIC Manual of Standard Practice.* *Fabrication of epoxy coated reinforcing steel after application of the coating shall be in accordance with the requirements of Ontario Provincial Standard Specification OPSS 1442.* *Fabrication of stainless reinforcing steel shall be carried such that bar surfaces are not contaminated with deposits of iron or other non stainless steels; or suffer damage due to straightening or bending.* *Reinforcing steel shall be fabricated without laminations or burrs.*
5.4 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	***5.5 Shipping,*** **Handling and Storage** *Reinforcing steel shall be covered and protected at all times during transportation.*

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.	*Reinforcing steel of differing material types shall be stored separately. Bar tags identifying the material type shall be clearly visible and shall be maintained in-place until installation of the material.* *The Contractor shall store all reinforcing steel on platforms, skids, or other suitable means of support able to keep the material above the ground surface while protecting it from mechanical damage or deterioration.* *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. Protective measure shall be implemented to prevent bar to bar abrasion and excessive sagging of bundles.* On-site storage of epoxy coated reinforcing steel shall not exceed 120 days, and exposure to daylight shall not exceed 30 days. If the daylight exposure time is expected to exceed 30 days, *the Contractor shall protect* the reinforcing steel by covering with opaque polyethylene sheeting or equivalent protective material *acceptable to the Consultant*. *On-site storage of all other types of reinforcing steel shall not exceed 120 days unless protected with polyethylene sheeting or equivalent protective material acceptable to the Consultant.* *The Contractor shall take all precautions necessary to prevent damage to the material during handling operations. Bundles shall be handled with spreaders and non metallic slings, or by other methods acceptable to the Consultant. Damaged materials shall be replaced by the Contractor at his expense.*
5.6 Placing and Fastening All steel reinforcement shall be accurately placed in the positions shown on the plans, 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 250 mm 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	**5.6 Placing and Fastening** *Reinforcing steel incorporated into the work shall be free from loose rust, scale, dirt, paint, oil or other foreign materials*. *Reinforcing steel* shall be accurately placed in the positions shown on the *Drawings*, and *shall be securely* tied and chaired before placing the concrete. Bars shall be tied at all intersections except *when the bar* spacing is less than 250 mm in each direction; alternate intersections *may* be tied *at these locations*. *Specified distances from forms shall be maintained by supports, spacers, or other means approved by the Consultant.* *Reinforcing cover shall not be less than that specified on the Drawings.*

minimum specified on the drawings. 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 4.24.2, unless otherwise reviewed and accepted by the Consultant. 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.	*Supports used to prevent bars from contact with forms or for separation between layers of bars shall be of adequate strength, shape and dimension, and approved for use by the Consultant. Supports shall be either plastic or precast concrete. Where additional reinforcing support bars are proposed by the Contractor they shall be of the same material type and grade used in the work. Supports and spacers fabricated from alternate material types may be used upon approval by the Consultant.* *Plastic bolster slab supports shall be Aztec Strong Back Slab/Beam Bolster - PSBB manufactured by Dayton Superior or an approved equivalent. Bolster slab supports shall be staggered and configured to facilitate full concrete consolidation.* *Precast concrete supports shall be used for all exposed faces of curbs, medians and barriers. Precast concrete supports shall be Total Bond Concrete Supports manufactured by Con Sys Inc or an approved equivalent. Precast concrete supports shall have the compressive strength, rapid chloride permeability, and air content meeting the specification requirements for the class of concrete being placed.* *Except as noted herein, tie wire shall be manufactured from the same material type as the reinforcing steel being tied. Plastic coated tie wire may be used where low carbon/chromium reinforcing steel is being placed. Where stainless reinforcing steel is being placed, tie-wire shall be stainless steel of any grade listed in Subsection 5.2.4.* *Welding of reinforcing steel will not be permitted.* *Field bending of reinforcing steel, regardless of circumstance, will not be permitted unless specified on the Drawings.* *Field cutting of epoxy coated reinforcing steel shall be carried out only where necessary and approved by the Consultant. Cuts shall be made by shearing or saw cutting only. The epoxy coating on sheared or saw cut ends shall be patched in accordance with the specifications contained herein.*
5.7 Splicing Splicing of bars, unless shown on the plans, is prohibited except with the written acceptance of the Consultant. Splices, where possible, shall be staggered. For lapped splices, the bars shall be placed in contact and wired together in	**5.7 Splicing** Splicing of bars, unless shown on the *Drawings or approved in writing by the Consultant, is prohibited*. Splices, where *permitted*, shall be staggered. For lapped splices, bars shall be placed in contact and wired together *while maintaining the minimum*

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.	*required* clear distance to other bars and the required minimum distance to the surface of the concrete.
	5.8 Repair of Epoxy Coated Reinforcing Steel *The Contractor shall be responsible for the repair of all damage to epoxy coating up to the time the reinforcing steel is acceptably incorporated into the concrete. Where field cutting of the epoxy coated reinforcing steel is necessary and accepted by the Consultant, cutting shall be either shearing or saw cutting.* *Repair of damaged coating and sheared or sawed ends shall be carried out using a two component epoxy coating patching material approved for use by the reinforcing steel Manufacturer.* *Surface preparation and material application shall be completed in accordance with the patching material Manufacturer's written recommendations; the following requirements; and to the satisfaction of the Consultant. The areas to be repaired shall be cleaned by removing all surface contaminants and damaged coating before applying the patching material. Where rust is present, it shall be completely removed immediately prior to application of the patching material. The patching material shall be overlapped onto the original coating for a minimum distance of 25 mm or as recommended by the patching material Manufacturer. The dry film thickness of the patched areas shall be between 175 µm and 300 µm.* *All costs associated with the repair of damaged epoxy coating will be considered incidental to the Work, and no separate or additional payment will be made.*
	5.9 Repair of Stainless Reinforcing Steel *Individual stainless steel reinforcing bars exhibiting any of the following defects shall be repaired or replaced at the Contractor's expense:* *- Any single area of iron contamination greater than 100 mm in length.* *- Two or more areas of iron contamination greater than 50 mm in length.* *- Frequent small occurrences of iron contamination along the full length of the bar.*

	Bars exhibiting excessive staining, as determined by the Consultant, shall have the contaminants identified by energy dispersive x-ray analysis (EDXA). Contaminant identification shall be carried out by the Contractor at his expense. *Methods proposed for the repair of stainless reinforcing steel bars shall be approved by the Department and Consultant prior to implementation.* *Stainless reinforcing steel bars exhibiting signs of mechanical damage shall be replaced.*
5.8 Measurement and Payment Steel reinforcement incorporated in the concrete will be measured in kilograms, based on the total computed mass for the size and length of bars as shown on the drawings or authorized by the Consultant. The mass of bars will be calculated as follows: Bar Designation 10M 15M 20M 25M 30M 35M 45M 55M Mass (kg/m) 0.785 1.570 2.355 3.925 5.495 7.850 11.775 19.625 No allowance will be made for tie wire, chairs, and other material used in fastening the reinforcing steel in place. If bars are substituted upon the Contractor's request, and as a result more steel is used than specified, only the amount specified shall be included. Payment for the supply of plain reinforcing steel and the supply of epoxy-coated reinforcing steel will be made on the basis of the unit price bid per kilogram acceptably supplied and delivered to the site. When the materials are delivered to the site, payments for the supply of plain reinforcing steel or epoxy-coated reinforcing steel will be made to a maximum of 90% of the cost of the materials based upon the unit price bid. Payment for the remainder of the price bid for supply will be made as the materials are acceptably installed. Payment for the placing of reinforcing steel will be made on the basis of the unit price bid per kilogram acceptably placed and remaining in the work, which price shall include full compensation for the cost of furnishing all labour, equipment, tools and incidentals necessary to complete the work. Mesh reinforcement shall be supplied and placed by the Contractor, and its cost included with the tendered unit price for the relevant portion of the Contract.	*5.10.1 Measurement* Steel *reinforcing* incorporated in the concrete will be measured in kilograms, based on the total computed mass for the size and length of bars as shown on the Drawings or *accepted* by the Consultant. *Any proposed substitution of imperial reinforcing steel for metric reinforcing steel must be reviewed and approved by the Consultant prior to the substitution taking place. The nominal cross sectional area of metric and imperial bar sizes used for evaluating substitutions will be in accordance with ASTM A1035, ASTM A955/A955M and CAN/CSA G30.18, respectively.* The mass for all reinforcing steel will be calculated as follows: Metric Bar Designation 10M 15M 20M 25M 30M 35M 45M 55M *Imperial Bar Designation 4 5 6 8 9 11 14 18* Mass (kg/m) 0.785 1.570 2.355 3.925 5.495 7.850 11.77 19.625 *5.10.2 Payment* *5.10.2.1 Supply* *Payment for the supply of reinforcing steel will be made at the unit prices bid per kilogram for "Plain Reinforcing Steel - Supply", "Epoxy Coated Reinforcing Steel - Supply", "Corrosion Resistant Reinforcing Steel - Supply" or "Stainless Reinforcing Steel - Supply", as applicable, and will be full compensation for the supply and fabrication of reinforcing steel; delivery to the project site; and all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.* *When stainless steel is supplied for use where CRR is specified, payment will be made at the unit price bid for "Corrosion Resistant Reinforcing Steel -*

	Supply". No separate or additional payment will be made. *Payment will be made for 90% of the unit price bid for material acceptably supplied and delivered to the site. Payment for the remainder of the unit price bid will be made as the materials are acceptably installed.* *All costs associated with the handling and storage of reinforcing steel will be considered incidental to the Work, and no separate or additional payment will be made.* *5.10.2.2 Placement* *Payment for the installation of reinforcing steel will be made at the unit price bid per kilogram for "Reinforcing Steel - Place" for steel acceptably placed and remaining in the work, regardless of type; and will be full compensation for all labour, equipment, tools and incidental necessary to complete the work. No allowance will be made for tie wire, chairs or other materials used for fastening the reinforcing steel in place.*
Section 6 Structural Steel	**Section 6 Structural Steel**
6.2.1 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.	6.2.1 Standards Fabrication of structural steel shall conform to *"AASHTO LRFD Bridge Construction Specifications"* 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. *The fabrication of steel structures composed of structural tubing shall be in accordance with the American Welding Society (AWS) – Structural Welding Code D1.1.*
6.2.2 Qualification The Contractor shall notify the Department and Consultant of any subcontractors in his employ. The Contractor shall remain responsible for the work of the subcontractors. All terms of the contract, such as Canadian Welding Bureau (CWB) approval and right of access shall apply to the subcontractor. The Fabricator shall operate a recognized steel fabricating shop accepted by	6.2.2 Qualification The Contractor shall notify the Department and Consultant *two weeks prior to fabrication* of any subcontractors in his employ. The Contractor shall remain responsible for the work of the subcontractors. All terms of the contract, such as Canadian Welding Bureau (CWB) approval *and Canadian Institute of Steel Construction (CISC) certification* and right of access shall apply to the subcontractor.

the Consultant. The Fabricator 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 tackers 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 Consultant.	The fabricator shall operate a recognized steel fabricating shop accepted by the Consultant. The fabricator 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 1 or Division 2 *Field welding/repairs……Division 1 or Division 2* *In addition fabricators of steel girders, girder components and welded steel trusses shall be certified by the Canadian Institute of Steel Construction (CISC) as meeting the quality compliance requirements in the category of steel bridges.* Only welders, welding operators and tackers 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 Consultant.
6.2.3.1 Review of Plate Arrangement for Welded Plate Girders Prior to the placing of material orders, the Contractor shall submit to the Department and Consultant for review and 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, the location of all shop and field splices and such other information as may be requested by the Department and Consultant to permit an assessment of the acceptability of the proposal.	6.2.3.1 Review of Plate Arrangement for Welded Plate Girders Prior to the placing of material orders, the Contractor shall submit to the Department and Consultant for review, three copies of sketch drawings showing the general description of the proposed fabrication scheme. This shall include the general arrangement of plates or shapes, the location of all shop and field splices and such other information as may be requested by the Department and Consultant to permit an assessment of the acceptability of the proposal.
6.2.3.2 Welding Procedures Welding procedures shall be submitted for each type of weld used in the structure. The procedures shall bear the approval of the CWB and shall also be reviewed by the Department prior to use on the structure.	6.2.3.2 Welding Procedures Welding procedures, *including Welding Procedure Datasheets* shall be submitted for each type of weld used in the structure. The procedures shall bear the approval of the CWB and shall also be reviewed by the Department *and Consultant* prior to use on the structure.
6.2.4.1 Structural Steel Structural Steel shall conform to the standard noted on the drawings. 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 provided to the Consultant for review and acceptance prior to shipment of material from the mill to provide sufficient time for replacement or	6.2.4.1 Structural Steel Structural Steel shall conform to the standard noted on the drawings. 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 provided to the Consultant for review and 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 specification.	for heat treating of material that does not meet the specification. *Repair of steel plates or rolled shapes by welding at the producing mill is not permitted.* *Where mill test certificates originate from a mill outside Canada or the United States of America, the Contractor shall have the material tested and the mill test certificate verified by a Canadian laboratory. This laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and the signature of an authorized officer. It shall state that the material is in conformance with the specified Contract requirements.*
6.2.4.2 Bolts All bolts, nuts and washers shall conform to American Society for Testing and Materials (ASTM) Standard A325 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 A325M and those of a "weathering" steel shall have the A325M 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 provided.	6.2.4.2 Bolts All bolts shall conform to American Society for Testing and Materials (ASTM) Standard A325 or shall meet property class 8.8 of the Industrial Fasteners Institute for metric high strength structural bolts. *The nuts shall be conform to ASTM A563 and harden washers shall conform to ASTM F436*. Metric bolts shall be marked with the symbol A325M and those of "weathering" steel shall have the A325M symbol underlined. *Weathering steel* nuts shall be marked with three circumferential lines or shall be marked with a symbol "3". *Weathering steel* washers shall be identified by a symbol "3". Certified mill test reports for the fastener material shall be provided. *For bolts supplied from a manufacturer outside Canada or the United States of America, the above information shall be verified by a Canadian testing laboratory as outlined in clause 6.2.4.1.*
6.2.4.4 Bearings Certified mill test reports for all bearing material shall be provided 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 shall conform to Section 18 "Bearings" Division II of the AASHTO Standard Specifications for Highway Bridges 2002 edition.	6.2.4.4 Bearings *Bearings shall be in accordance with Section 8, of the Specifications for Bridge Construction.*

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 Bearing base plate corrosion protection shall be as per section 12.2.6.8.	
6.2.5.3 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. Tack Welds shall be sufficiently ground-out prior to final weld in order to obtain a uniform weld bead. Cracked tack welds shall be completely removed prior to welding over.	6.2.5.3 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. Tack welds shall be sufficiently ground-out prior to final weld in order to obtain a uniform weld bead. Cracked tack welds shall be completely removed prior to *re-welding*.
6.2.5.7 Methods of Weldment Repair Repair procedures for unsatisfactory weldments shall be submitted for review and acceptance by the Department and Consultant prior to repair work commencing.	6.2.5.7 *Submission for Repair Procedures* *The Contractor shall submit repair procedures for damaged base metal and unsatisfactory weldments, prepared by a Professional Engineer registered in the Province of Alberta* for review by the Department and Consultant prior to repair work commencing.
6.2.5.9 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 as determined by the Consultant 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 Consultant.	6.2.5.9 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 as determined by the Consultant will not require grinding. Fillet welds *shall be continuous with uniform size and profile. At locations which are* 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 Consultant.
6.2.6.5 Flame Cut Edges The flame cut edges of girder flanges shall have a maximum Brinell hardness as stated by section 6.2.8.10. The surface roughness of the flame cut edge	6.2.6.5 Flame Cut Edges The flame cut edges of girder flanges shall have a maximum Brinell hardness as stated by section 6.2.8.10. The surface roughness of the flame cut edge

shall not be greater than ANSI B46.1 500 µin. (12.5 µm) 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 Consultant will perform Brinell hardness tests at random on the as is flame cut edge. If the hardness exceeds the requirements, the Contractor shall submit for review and acceptance, his procedures for repairing the edges to meet the requirements. The surface of flame cut apertures shall be finished by grinding and shall be free of nicks and gouges	shall not be greater than ANSI B46.1 500 µin. (12.5 µm) and be such that as to allow Brinell hardness testing without spot grinding. *The Consultant will perform Brinell hardness tests at random on the as is flame cut edge. If the hardness exceeds the requirements, the Contractor shall submit for review, his procedures for repairing the edges to meet the requirements. The surface of flame cut apertures shall be finished by grinding and shall be free of nicks and gouges.* The Contractor shall report all blow backs or signs of lamination observed during the cutting of the material. *In case of plate lamination, the Contractor at his expense shall arrange for a CAN/CSA 178.1 certified NDT company to determine the extent. The ultrasonic testing technician shall be certified to Level II of CGSB. The report shall be prepared by a Professional Engineer registered in the Province of Alberta indicating the material is suitable for the girder fabrication and shall be forwarded to the Consultant for review and acceptance of the material*.
6.2.6.16 Flame Straightening Flame straightening shall not be performed on any material or member without a written request to the Department and the Consultant. The Contractor shall submit a procedure stating location, temperatures and cooling rates, to the Department and the Consultant for review and acceptance.	6.2.6.16 Flame Straightening Flame straightening shall not be performed on any material or member without a written request to the Department and the Consultant. The Contractor shall submit a procedure stating location, temperatures and cooling rates, to the Department and the Consultant for review. *Straightening shall only be performed in the presence of the Consultant.*
6.2.7.2 Galvanizing Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware with additions and exceptions as described in this specification. The Fabricator 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 submitted 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	6.2.7.2 *Prime Coating* *At all bearing locations, girder bottom flanges shall be prime coated all around (bottom, top and edges) 100 mm beyond the bearing dimension. In addition, at locations where the abutments are incorporating deck joints, the prime coat shall be extended up the web, including bearing/jacking stiffeners and underside of top flange. The prime coat shall be an approved organic zinc epoxy primer that has been qualified by test as a Class B coating, in accordance with the "Testing Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints" as described in Appendix A of the Research Council on Structural Connections "Specification for Structural Joints Using High-Strength Bolts". The coating supplier shall provide a certificate stating compliance with this specification for the coating proposed to the Consultant for review and acceptance.* *6.2.7.3* Galvanizing

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 Consultant will determine the acceptability of repaired areas	Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and ASTM F2329 Standard Specification for Zinc Coating *Hot-Dip Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners* with additions and exceptions as described in this specification. The fabricator 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 submitted for review prior to its use. It should be noted that repairs may require complete removal of the galvanized coating and re-galvanizing. Repair shall be in compliance with ASTM A780, Method A3 "Metallizing". *However repair for areas not exceeding 100 mm^2 may be done in accordance with ASTM Method A1 "Repair Using Zinc-Based Alloy".* The thickness of the *coating for both methods* shall be 180 µm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing. The Consultant will determine the acceptability of repaired areas.
	6.2.8.2 Responsibility *It is the Contractor's responsibility to ensure that the supply of material and the fabrication are in accordance with the contract requirements. The inspection and testing by the Consultant shall not be deemed to relieve the Contractor of any of his/her obligations.*
6.2.8.3 Testing by the Contractor The exception to section 6.2.8.2 is that inspection made necessary for any repair work during the course of fabrication or handling, and additional unspecified material splices shall be paid for by the Contractor. Any test records made by the fabricating shop in the course of normal quality control shall be open to the Consultant for inspection.	*6.2.8.4* Testing by the Contractor The exception to section *6.2.8.3* is that *additional* inspection *required by the Consultant shall be paid by the Contractor for the following conditions:* • *Any repair work during the course of cutting, welding, fabrication or handling,* • *Evaluation of any defective material by the Consultant.* • *Additional unspecified material splices.* Any test records made by the fabricating shop in the course of normal quality control shall be open to the Consultant for inspection.

6.2.8.6 Radiographic Inspection Schedule Unless otherwise noted, radiographic inspection of welded plate girders will be performed in accordance with the following schedule: (a) 100% of all tension flange and stress reversal butt welds, all stiffener butt welds and all diaphragm butt welds, and any groove welded attachments to flange plates. (b) A minimum of 25% of all other flange butt welds randomly selected by the Consultant for each structure. Additional testing may be required to ensure the quality of welds. (c) All web butt welds in tension and stress reversal zones plus additional 300 mm of web butt weld in compression zone at the end of the web.	*6.2.8.7* Radiographic Inspection Schedule Unless otherwise noted, radiographic inspection of welded plate girders will be performed in accordance with the following schedule: (a) 100% of all tension flange and stress reversal butt welds, all stiffener butt welds and all diaphragm butt welds, and any groove welded attachments to flange plates. (b) A minimum of 25% of all other flange butt welds randomly selected by the Consultant for each structure. (c) All web butt welds in tension and stress reversal zones plus additional 300 mm of web butt weld in compression zone at the end of the web. *(d) If defects are found during testing, additional areas will be tested to ensure the quality of welds.*
6.2.8.8 Magnetic Particle Inspection Schedule Unless otherwise noted, magnetic particle inspection of welded plate girders will be performed in accordance with the following schedule: (a) 50% of the web to flange welds or any fillet welds placed on flange plates (b) 10% of the web to stiffener welds (c) 100% of the stiffener to flange welds (d) 100% of the bearing sole plate to flange welds (e) 20% of the diaphragm connector plate welds	*6.2.8.9* Magnetic Particle Inspection Schedule Unless otherwise noted, magnetic particle inspection of welded plate girders will be performed in accordance with the following schedule: (a) 50% of the web to flange welds or any fillet welds placed on flange plates (b) 10% of the web to stiffener welds (c) 100% of the stiffener to flange welds (d) 100% of the bearing sole plate to flange welds (e) 20% of the diaphragm connector plate welds *(f) 100% of all manual (SMAW) welds*
6.2.8.11 Testing Stud Shear Connectors Stud shear connectors shall meet all requirements as outlined by AWS D1.5. When bend testing, the studs shall be bent towards the centre of the girder.	*6.2.8.12* Testing Stud Shear Connectors Stud shear connectors shall meet all requirements as outlined by AWS D1.5. When bend testing, the studs shall be bent towards the centre of the girder. *All the remaining studs shall be tested by striking with a hammer. A dull sound indicates incomplete fusion and a bend test will then be required for a potentially defective stud to ensure the integrity*.
6.2.8.13 Testing of Deck Joint Strip Seal The installation of strip seal shall be tested by the Contractor in the presence of the Consultant for leakage. The failed areas shall be corrected and retested. The defective or torn seal shall be replaced at the Contractor's expense.	*6.2.8.14* Strip Seal Deck Joint The installation of strip seal shall be tested by the Contractor in the presence of the Consultant for leakage. The failed areas shall be corrected and retested. The defective or torn seal shall be replaced at the Contractor's expense.

	The Contractor and the Strip Seal Deck Joint Supplier shall jointly provide warranty for the satisfactory performance of the deck joint assemblies for a period of five years. The joint warranty shall be provided to the Consultant prior to the issuance of the Construction Completion Certificate. *The deck joint warranty shall provide for the replacement and/or repair of the deck joint assemblies, including all necessary traffic control at no cost to the Department, should unsatisfactory performance occur during the five year period.*
6.3 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 drawings and these specifications. 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	6.3 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 drawings and these specifications. 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: - erecting of temporary supporting structures - *removing anchor bolt grout can lid* - erecting of structural steel - placing of expansion assemblies - touching up painting as required
6.3.1 Transportation, Handling and Storing Materials Girders and beams shall be transported in the vertical position. However these elements may be transported in other positions provided: • A Professional Engineer registered in the Province of Alberta performs the analysis and provides a written statement that the proposed method will not damage the elements. • Upon arrival at the site and prior to erection, the elements shall be checked by the Contractor in the presence of the Consultant to ensure all tolerances are met. The Contractor shall provide an adequate flat storage area for the inspection.	6.3.1 Transportation, Handling and Storing Materials Girders and beams shall be transported in the vertical position. However these elements may be transported in other positions provided: • A Professional Engineer registered in the Province of Alberta *shall determine static and dynamic forces during handling, transportation, and storage using a dynamic load allowance of 100%. Computed stresses shall be according to CAN/CSA-S6, Clause 10.10 and the maximum cyclic stress range shall not exceed the constant amplitude fatigue threshold for the appropriate fatigue categories specified in CAN/CSA-S6, Table 10.4. All the calculations and associated sketches, including*

	reasons why the girders cannot be shipped with the webs in the vertical plane, shall be submitted by the Contractor to the Consultant for review two weeks prior to shipping. The calculations and sketches shall be signed and sealed by the Engineer who performed the analysis and includes a written statement that the proposed method will not damage the elements. Upon arrival at the site and prior to erection, the elements shall be checked by the Contractor in the presence of the Consultant to ensure all tolerances are met. The Contractor shall provide an adequate flat storage area for the inspection.
6.3.2.4 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 subject to the Consultant's review and 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 drawings, after the girder erection has been completed. The shims must be located so that a minimum of 75 mm 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. When required, field welding adjacent to elastomeric pads shall be performed with care to avoid damage to the Elastomer. The temperature of the steel adjacent to the Elastomer should be kept below 120°C. The distance between the weld and the Elastomer should be at least 40 mm.	*Move to Section 8 Bridge Bearings*

6.3.2.9 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 drawings. The Contractor shall ensure that the structural steel is maintained in correct alignment until the adjoining or encasing concrete components have been completed.	*6.3.2.8* 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 drawings. The Contractor shall ensure that the structural steel is maintained in correct alignment *at all times during construction*.
6.3.2.10 Grout Pockets and Grout Pads The Contractor shall fill the grout pockets and construct the grout pads using Sika 212 flowable grout or approved equivalent. 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 Consultant for review and 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 4.25 “Type 1c Sealer”.	*Move to Section 8 Bridge Bearings*
6.3.2.11 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 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.	*Move to Section 8 Bridge Bearings*

6.4 Payment Supply of Structural Steel Girders and Associated Material will be paid for on the basis of the lump sum price bid. Items to be included in Supply of Structural Steel shall be as listed in the Special Provisions. Supply and Delivery of Bearings will be paid for on the basis of the lump sum price bid. Items to be included in Supply of Bearings shall be as listed in the Special Provisions. Installation of Bearings including grouting will be paid for on the basis of the lump sum price bid. Items to be included in Installation of Bearings shall be as listed in the Special Provisions. Supply and Delivery of Deck Joint Assemblies will be paid for on the basis of the lump sum price bid. Items to be included in Supply of Deck Joint Assemblies shall be as listed in the Special Provisions. Installation of Deck Joint Assemblies will be paid for on the basis of the lump sum price bid. Items to be included in Installation of Deck Joint Assemblies shall be as listed in the Special Provisions. Payment for Delivery of Girders will be made on the basis of the lump sum price bid. It shall include full compensation for the costs to deliver all structural steel and associated materials to the bridge site, and shall include the costs to obtain the necessary approvals and permits from the Motor Transport Board and/or the appropriate local road authorities to transport these materials. Payment for Delivery of Girders shall also include the costs to remove all road dirt and spray. Payment for Erection of Girders will be made on the basis of the lump sum price bid which price shall include full compensation for the cost of furnishing all labour, tools, equipment, and incidentals necessary to acceptably erect the structural steel and complete site clean-up. When materials are delivered to the work site, payments for: Supply of Structural Steel girders and Associated Materials, Supply and Delivery of Bearings, Supply and Delivery of Deck Joint Assemblies, and Delivery of Girders will be made to a maximum of 90% of the bid price of the materials and delivery. Payment for the remainder of the prices bid for supply and delivery	6.4 Payment *Payment for the* Supply of Structural Steel Girders and Associated Material will be made on the basis of the lump sum price bid. Items to be included in Supply of Structural Steel and Associated Material shall be as *indicated on the Drawings.* Payment for the Delivery of Girders will be made on the basis of the lump sum price bid and shall include full compensation for the costs to deliver all structural steel and associated materials to the bridge site *including necessary* approvals and permits from the Motor Transport Board and/or the appropriate local road authorities*. Cleaning of girders to remove any foreign material will be considered incidental to the work and no separate payment will be made*. Payment for the Erection of Girders will be made on the basis of the lump sum price bid and shall include full compensation for the cost of furnishing all *materials,* labour, tools, equipment, and incidentals necessary to acceptably erect the structural steel *girders and associated material* and complete site clean-up. *Payment for the* Supply and Delivery of Deck Joint Assemblies will be *made* on the basis of the lump sum price bid. Items to be included in Supply of Deck Joint Assemblies shall be as *indicated on the Drawings.* *Payment for the* Installation of Deck Joint Assemblies will be *made* on the basis of the lump sum price bid. Items to be included in Installation of Deck Joint Assemblies shall be as *indicated on the Drawings.* When materials are delivered to the work site, payments for Supply of Structural Steel Girders and Associated Materials, Delivery of Girders, and Supply and Delivery of Deck Joint Assemblies*,* will be made to a maximum of 90% of the bid price of the materials and delivery. Payment for the remainder of the prices bid for supply and delivery will be made as the materials are acceptably installed.

will be made as the materials are acceptably installed.	
Section 7 Precast Concrete Units	**Section 7 Precast Concrete Units**
7.2 Supply and Manufacture A pre-fabrication meeting is required prior to commencement of fabrication of precast concrete elements. The meeting will be held at fabricator's plant and the Contractor shall ensure the plant superintendent and plant manager responsible for the work and any manufacturer's representatives directly involved in the specialized work are in attendance. The Department/Consultant will conduct this meeting after the shop drawings have been approved. The Contractor shall provide two weeks notice to the Department/Consultant prior to the meeting.	7.2 Supply and Manufacture A pre-fabrication meeting is required prior to commencement of fabrication of precast concrete elements. The meeting will be held at fabricator's plant and the Contractor shall ensure the plant superintendent and plant manager responsible for the work and any manufacturer's representatives directly involved in the specialized work are in attendance. The Department/Consultant will conduct this meeting after the shop drawings have been *reviewed*. The Contractor shall provide two weeks notice to the Department/Consultant prior to the meeting.
7.2.3.1 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 Consultant for review and 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 Consultant's acceptance stamp. The Consultant's acceptance of the shop drawings shall not be construed as relieving the Contractor from his 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."	7.2.3.1 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 Consultant for review 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 Consultant's *review* stamp. The Consultant's *review* of the shop drawings shall not be construed as relieving the Contractor from his responsibility for errors or omissions. All shop drawings will be stamped as follows: "This *review* 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."
7.2.3.4 Concrete and Grout Mix Design A copy of the concrete mix design and the grouting mortar mix design shall be submitted to the Consultant 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, and the concrete mix design shall be completed by an independent CSA certified and qualified concrete testing	7.2.3.4 Concrete and Grout Mix Design A copy of the concrete mix design and the grouting mortar mix design *including applicable material test reports* shall be submitted to the Consultant for *review a minimum of two weeks* prior to manufacturing. *Material test reports shall be current and fully represent materials to be used in production.* 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.

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 registered in the Province of Alberta. 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 having a 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.	The sampling and testing of aggregates shall be completed by a concrete testing laboratory *certified to CSA A283*. Concrete mix designs, including *the review of all material test reports*, *shall be signed and sealed* by a Professional Engineer registered in the Province of Alberta *employed by a concrete testing laboratory certified to CSA A283. The Engineer shall also provide a professional opinion indicating that the concrete mix is suitable for the intended use and can be expected to meet specification requirements.* *Alternatively, concrete mix designs, including the sampling and testing of aggregates and review of material test reports may be completed by a qualified professional employed by the concrete supplier. When the concrete mix design is completed by the concrete supplier it shall be reviewed for compliance with the respective specifications, signed and sealed by a Professional Engineer registered in the Province of Alberta employed by an independent concrete testing laboratory certified to CSA A283. The independent review Engineer shall also provide a professional opinion indicating that the concrete mix is suitable for the intended use and can be expected to meet specification requirements.* 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 *reviewed* 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.
7.2.3.5 Other Data The Consultant may request test data to prove conformance to the standards for other materials including cement, silica fume, aggregate and admixtures.	
7.2.4.1 Cement	7.2.4.1 *Hydraulic* Cement
7.2.4.4 Aggregates Aggregate tests shall be performed and submitted to the Consultant for review with the concrete mix design as per section 4.4.4. (a) Standard Weight Aggregates	7.2.4.4 Aggregate *Testing* Aggregate tests *and analysis* shall be performed and submitted to the Consultant for review with the concrete mix design as *follows*: (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 14 mm.	Fine and coarse standard weight aggregates shall *be as per section 4.4.4 of Specifications for Bridge Construction* with maximum aggregate size of 14 mm.
7.2.4.8 Reinforcing Steel Plain and epoxy coated reinforcing steel shall conform to the Bridge Construction Specifications – Section 5 - Reinforcing Steel.	7.2.4.8 Reinforcing Steel *Reinforcing* steel shall conform to the Bridge Construction Specifications – Section 5 - Reinforcing Steel.
7.2.4.12 Bridgerail and Anchor Bolts Bolts for bridgerail anchor assemblies shall be as per section 12.2.4.2. The assemblies shall be hot dip galvanized after fabrication. All nuts and washers shall be shop assembled on the anchor bolts.	7.2.4.12 Bridgerail and Anchor Bolts Bolts for bridgerail anchor assemblies shall be as per section 12.2.4.2 *of The Specifications for Bridge Construction*. The assemblies shall be hot dip galvanized after fabrication. All nuts and washers shall be shop assembled on the anchor bolts.
7.2.4.14 Bearings Certified mill test reports for all bearing material shall be provided 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 shall conform to Section 18 “Bearings” Division II of the AASHTO Standard Specifications for Highway Bridges 2002 edition. 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 Bearing base plate corrosion protection shall be as per section 12.2.6.8.	7.2.4.14 Bearings *Bearings shall be in accordance with Section 8, of the Specifications for Bridge Construction.*
7.2.4.15 Galvanizing Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and	7.2.4.15 Galvanizing Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and ASTM F2329 Standard Specification for Zinc Coating *Hot-Dip Requirements for Application*

Steel Hardware with additions and exceptions as described in this specification. The Fabricator 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. 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 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 Consultant will determine the acceptability of repaired areas.	*to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners* with additions and exceptions as described in this specification. The fabricator 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. Repair of galvanizing shall only be done if bare areas are infrequent, small and suitable for repair. A detailed repair procedure shall be submitted *for review* prior to its use. It should be noted that repairs may require complete removal of the galvanized coating and re-galvanizing. Repair shall be in compliance with ASTM A780, Method A3 "Metallizing". *However repair for areas not exceeding 100 mm^2 may be done in accordance with ASTM Method A1 "Repair Using Zinc-Based Alloy".* The thickness of the *coating for both methods* shall be 180 µm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing. The Consultant will determine the acceptability of repaired areas.
7.2.5.1 Forms Precast concrete units are to be manufactured in steel forms accepted by the Consultant.	7.2.5.1 Forms Precast concrete units are to be manufactured in steel forms *which are acceptable* to the Consultant.
7.2.5.3 Stressing Strand ... 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 measured 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 15 mm deep strand termination recesses formed around the strands. All strands shall be cut flush with the bottom of	7.2.5.3 Stressing Strand ... Stressing strands shall not be stressed more than 36 hours prior to being encased in concrete. The *force in each strand* shall be measured *by both elongation and pressure gauge*. *Each strand shall be stressed to a calculated elongation, and a gauge pressure reading shall be taken as a check against the calculated force. During stressing, each strand shall be first pulled to a predetermined pre-pull gauge pressure to eliminate any slack and a reference mark be placed at the front of the stressing jack. A second mark shall be placed away from the first with a distance corresponding to the calculated elongation on the stressing sheet. Each strand shall then be pulled to the second reference mark and the gauge pressure reading taken.* *This process may be reversed, i.e. each strand shall be stressed to a calculated force (Determined by a gauge pressure calibration chart) and the elongation shall be measured as a check against the calculated force. During*

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 7.2.5.14. 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.	*stressing, each strand shall be first pulled to a predetermined pre-pull gauge pressure to eliminate any slack and a reference mark be placed at the front of the stressing jack. Each strand shall then be stressed to the gauge pressure corresponding to the stressing sheet and a second reference mark be placed at this gauge pressure. The elongation shall be the distance measured between the two reference marks.* 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 measured between stressing and concrete encasement and any changes in strand stress due to these effects shall be accounted for in the design. *The stressing procedure and stressing calculations shall be submitted for review by the Consultant*. 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 15 mm 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 *filled flush with the ends of the girders with a moisture insensitive epoxy paste adhesive meeting the requirements of ASTM C881, Type IV, Grade 3, Class B or C. The paste shall be grey in colour*. An approved Type 1c sealer shall be applied over the patched recessed areas as per section 7.2.5.14 *of the Specifications for Bridge Construction*. Sealer shall not be applied to the patched recessed areas when precast unit ends are designed to be encased in field cast concrete.
7.2.5.15 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 Consultant. The blasting shall be sufficient to remove all laitance and uniformly expose the aggregate particles.	7.2.5.15 Sandblasting The *roughening of* concrete surfaces in shear key, block out, diaphragm and girder end void locations shall be *achieved by sandblasting or other acceptable methods* by the Contractor to the acceptance of the Consultant. The *roughening* shall be sufficient to remove all laitance and uniformly expose the aggregate particles.
7.2.7.3 Coring ...	7.2.7.3 Coring ...

The Consultant 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 Consultant 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. *CSA Standard A23.1-09, Clause 4.4.6.6.2 "Cores drilled from a structure" shall not apply. The average strength of each set of three cores shall be equal to or greater than the 28-day specified strength.* 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.
7.3.1 General ... Without restricting generality, erection includes: - removing anchor bolt grout can lid - 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 - cutting-off lifting hooks, and grouting lifting holes on exterior girders and all lifting hook pockets	7.3.1 General ... - Without restricting generality, erection includes: - removing anchor bolt grout can lid - erecting the girders - placing and grouting of connector bolts and diaphragms - post-tensioning - cutting-off lifting hooks, and grouting lifting holes on exterior girders and all lifting hook pockets
7.3.4 Review of Erection Procedure … (k) Grout pad construction. Refer to section 7.3.6 of these Specifications. (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).	7.3.4 Review of Erection Procedure … (k) Details of release of temporary supporting structures. (l) 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).
7.3.6 Grout Pockets and Grout Pads 7.3.7 Grouting in Cold Weather	

7.3.8 Bearings and Anchorage 7.3.9 Assembly	
7.3.10 Lifting Hooks and Lifting Holes After the Consultant has approved the erected positions of the girders, all lifting holes on exterior girders shall be filled with an accepted grout. All lifting hooks shall be cut off 50 mm below surface, and all lifting hook pockets shall be filled with an accepted grout.	*7.3.6* Lifting Hooks and Lifting Holes After the Consultant has approved the erected positions of the girders, all lifting holes on exterior girders shall be filled with an *appropriate Alberta Transportation's approved patching material*. All lifting hooks shall be cut off 50 mm below surface, and all lifting hook pockets shall be filled with an accepted grout.
7.3.11 Painting of Metal Parts All non-galvanized metal parts, including bearing surfaces not in contact, shall be painted two field coats of paint. Any such painting will be considered as incidental to the work.	
7.3.12 Post-Tensioning System 7.3.12.1 General 7.3.12.2 Standards 7.3.12.3 Qualification 7.3.12.4 Submittals 7.3.12.5 Materials 7.3.12.6 Equipment	*7.3.7* Post-Tensioning System *7.3.7.1* General *7.3.7.2* Standards *7.3.7.3* Qualification *7.3.7.4* Submittals *7.3.7.5* Materials *7.3.7.6* Equipment
7.3.12.7 Construction ... Check grouted tendons in accordance with AASHTO LRFD Bridge Construction Specifications to ensure no leakage exist. If leaks are present, the Contractor shall submit a proposed method of repair for review and acceptance by the Consultant and the Department. The Contractor shall provide 50 mm 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.	*7.3.7.7* Construction ... The Contractor shall provide 50 mm 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.
7.3.13 Removal of Temporary supporting structures and Site Clean-up	*7.3.8* Removal of Temporary supporting structures and Site Clean-up

7.4 Payment Payment for the Supply of Girders and associated material will be made on the basis of the unit prices bid per girder, and in accordance with section 7.2.7, "Failure to Meet Strength Requirements". The unit prices bid shall include full compensation for the cost of furnishing all materials, labour, tools, equipment and incidentals necessary for fabrication. Supply and Delivery of Bearings will be paid for on the basis of a lump sum price bid. Items to be included in Supply of Bearings shall be as listed in the Special Provisions. Payment for Delivery of Girders will be made on the basis of the lump sum price bid. It shall include full compensation for the costs to deliver all girders and associated materials, and shall include the costs to obtain the necessary approvals and permits from the Motor Transport Board and/or the appropriate local road authorities to transport the girders. Also included shall be the costs to remove all road dirt and spray. Payment for Erection of Girders will be made on the basis of the lump sum price bid which price shall include full compensation for the cost of furnishing all materials, labour, tools, equipment, transportation and incidentals necessary to acceptably complete the erection and site clean-up. For the purposes of payment, installation of such items as bearing plates, anchor bolts, connector bolts, and other accessories and specified items, will be considered incidental and no separate payment will be made therefore. When materials are delivered to the worksite, payments for: Supply of Girders, Supply of Bearings, and Delivery of Girders will be made to a maximum of 90% of the price bid of the materials and delivery. Payment for the remainder of the prices bid for supply and delivery will be made as the materials are acceptably installed.	**7.4 Payment** Payment for the Supply of *Precast Concrete* Girders and Associated Material will be made on the unit price bid per girder. The unit prices bid shall include full compensation for the cost of furnishing all materials, labour, tools, equipment and incidentals necessary for fabrication. Payment for the Delivery of Girders will be made on the basis of the lump sum price bid *and* shall include full compensation for the costs to deliver all *precast concrete* girders and associated materials *to the bridge site including* necessary approvals and permits from the Motor Transport Board and/or the appropriate local road authorities. *Cleaning of girders to remove any foreign material will be considered incidental to the work and no separate payment will be made.* Payment for the Erection of Girders will be made on the basis of the lump sum price bid *and* shall include full compensation for the cost of furnishing all materials, labour, tools, equipment, and incidentals necessary to acceptably *erect the precast concrete girders and associated material and complete* site clean-up. *Payment for Post-Tensioning and Grouting will be made on the basis of the lump sum price bid which price shall include full compensation for the cost of furnishing all materials, labour, tools, equipment and incidentals necessary to acceptably complete the post-tensioning and grouting process and clean-up.* When materials are delivered to the work site, payments for Supply of *Precast Concrete Girders and Associated Material*, and Delivery of Girders will be made to a maximum of 90% of the bid price of the materials and delivery. Payment for the remainder of the prices bid for supply and delivery will be made as the materials are acceptably installed.
Section 8 Concrete Slope Protection	**Section 8 Bridge Bearings**
Concrete Slope Protection is moved to Section 4 Cast-In-Place Concrete.	*New section for bridge bearings. Bearing related information removed from Section 6 and Section 7 are referred to this section.*
Section 12 Bridgerail	**Section 12 Bridgerail**

12.2.1 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.	12.2.1 Standards The fabrication of bridgerail components shall conform to *AASHTO LRFD Bridge Construction Specifications* 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. *The fabrication of bridgerail components composed of structural tubing shall be in accordance with the American Welding Society (AWS) – Structural Welding Code D1.1.*
12.2.2 Qualification The Contractor shall notify the Department and Consultant 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.	12.2.2 Qualification The Contractor shall notify the Department and Consultant *two weeks prior to fabrication* 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.
12.2.3.1 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 Department before welding proceeds.	12.2.3.1 Welding Procedures Welding procedures *including Welding Procedure Datasheets* 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 Department *and Consultant* before welding proceeds.
12.2.3.2 Shop Drawings Shop drawing requirements shall be as per section 6.2.3.3.	12.2.3.2 Shop Drawings Shop drawing requirements shall be as per section 6.2.3.3 *of the Specifications for Bridge Construction*.
12.2.3.3 Mill Certificates Mill certificates shall be provided for all material before fabrication commences.	12.2.3.3 Mill Certificates Mill certificates shall be provided for all material before fabrication commences. *Where mill test certificates originate from a mill outside Canada or the United States of America, the Contractor shall have the material tested and the mill test certificate verified by a Canadian laboratory. This laboratory shall be certified by an organization accredited by the Standards Council of Canada to*

	comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and the signature of an authorized officer. It shall state that the material is in conformance with the specified Contract requirements.
12.2.6.3 Post Fabrication (a) W Posts ... (b) HSS Posts ... • Acceptability of the post to base plate weld shall be confirmed by sectioning one fabricated post, chosen at random by the Department and Consultant, 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.	12.2.6.3 Post Fabrication (a) W Posts ... (b) HSS Posts ... • *The Contractor shall arrange to have all post to base plate full penetration welds inspected either by ultrasonic testing or radiographic inspection methods. 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 Consultant*. 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.
12.2.6.4 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 ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware. 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.	12.2.6.4 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 ASTM *F2329 Standard Specification for Zinc Coating Hot-Dip Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners*. 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.
12.2.6.7 Galvanizing ... 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	12.2.6.7 Galvanizing ... Repair shall be in compliance with ASTM A780, Method A3 “Metallizing”. *However repair for areas not exceeding 100 mm^2 may be done in accordance with ASTM Method A1 ”Repair Using Zinc-Based Alloy”.* The thickness of the

galvanizing. The Consultant will determine the acceptability of lapped or repaired areas.	*coating for both methods* shall be 180 µm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing. The Consultant will determine the acceptability of lapped or repaired areas.
12.2.7.3 Testing by the Contractor The Contractor shall be responsible for sectioning and macro-etching the post to base plate weld as specified in "HSS Posts".	12.2.7.3 Testing by the Contractor The Contractor shall be responsible *for the cost of testing* post to base plate weld as specified in *clause 12.2.6.3 (b)*.
Section 14 Guardrail	**Section 14 Guardrail**
14.4 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 drawings or as directed by the Consultant. Permissible tolerance for plumb and grade of posts shall be 6 mm maximum. ... Any guardrail material requiring field modification to fit shall be reported to the Department and Consultant for their acceptance of the modification method use before work to be carried out. Modification by flame cutting method is prohibited. Modification by cold cutting method with a suitable drill press is allowed. Field guardrail modification is considered incidental to the work. Adequate edge distances of guardrail material shall be maintained during the modification process. All exposed steel areas shall be patched with two coats of zinc rich paint. Guardrail laps shall be in the direction of traffic flow. Bolts shall be tightened to a torque of 100 Nm. Metal reflectors (Scotchlite or equivalent) shall be supplied and attached to the top of every third guardrail post with two 30 mm 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 accepted by the Consultant before such work is commenced. The Contractor shall repair or replace components to the satisfaction of the Consultant.	**14.4 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 drawings or as directed by the Consultant. Permissible tolerance for plumb and grade of posts shall be *20* mm maximum. ... Any guardrail material requiring field modification to fit shall be reported to the Department and Consultant for their acceptance of the modification method use before work to be carried out. Modification by flame cutting method is prohibited. Modification by cold cutting method is allowed. Field guardrail modification is considered incidental to the work. Adequate edge distances of guardrail material shall be maintained during the modification process. Guardrail laps shall be in the direction of traffic flow. Bolts shall be tightened to a torque of 100 Nm. Metal reflectors (Scotchlite or equivalent) shall be supplied and attached to the top of every third guardrail post with two *50* mm ring nails. The Contractor shall take all necessary precautions to eliminate damage to galvanizing. Minor abrasions *and exposed steel areas resulting from cold cutting* shall be repaired *in accordance with ASTM A780 Method A2 "Repair Using Paints Containing Zinc Dust"*. Major abrasions shall be repaired by regalvanizing. The method to be used for repair of any damage shall be accepted by the Consultant before such work is commenced. The Contractor shall repair or replace components to the satisfaction of the Consultant.
Section 16 Bridge Deck Waterproofing	**Section 16 Bridge Deck Waterproofing**

16.1 General This specification shall include the supply and installation of an approved waterproof asphaltic membrane. The area to be covered by the waterproofing shall be as shown on the site specific construction drawings. The work shall be completed in accordance with standard drawing S-1443 Deck Waterproofing System with 80 mm Two-Course Hot-Mix Asphalt Concrete Pavement.	**16.1 General** This specification *is for* the supply and installation of bridge deck waterproofing. *Bridge deck waterproofing* shall be *carried out* in accordance with *the following specifications; as shown on the drawings and* standard drawing S 1443.
	16.2.1 General *The materials supplied shall be able to withstand the heat generated during the waterproofing processes without affecting the performance of the material.* *16.2.2 Submittals* *The Contractor shall submit documentation indicating specification compliance of his proposed materials to the Consultant for review and acceptance a minimum of two weeks prior to the commencement of waterproofing installation operations.* *16.2.3 Sampling and Testing* *The Contractor is advised that the Consultant may carry out additional material testing to confirm compliance.* *If requested by the Consultant or the Department, the Contractor shall provide sufficient additional quantities of the asphalt membrane, rubber membrane, membrane reinforcing fabric and/or protection board from the materials being used on the project.*
16.2 Materials All materials for this application shall be reviewed and accepted by the Consultant. 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 meet all	*16.2.4* Materials Tack Coat The tack coat *shall be a primer type meeting the requirements of CAN/CGSB 37 GP 9MA.* Asphalt Membrane Asphalt membrane *materials* shall be supplied in cakes *that are sealed and labeled by the manufacturer*. *Material for the* asphalt membrane shall be hot applied rubberized asphalt meeting the requirements of the Ontario Ministry of Transportation's OPSS

requirements of the Ontario Ministry of Transportation's OPSS 1213 Specification. The asphalt membrane shall be supplied in cakes ready for melting and application. Rubber Membrane The rubber membrane shall be 1.2 mm thick butyl rubber. <u>Membrane Reinforcing Fabric</u> Membrane reinforcing fabric shall be spun bonded sheet structure composed of 100% continuous filament polyester fibres bonded together at their crossover points. The membrane shall be supplied in minimum widths of 300 mm. The performance of the material shall be unaffected by the heat generated by the waterproofing processes. <u>Wick Drain</u> Wick drain shall be composite polypropylene with a total thickness of 3.6 mm and supplied in 100 mm widths. The puncture strength shall be a minimum of 45 N measured in accordance with ASTM D4833. The performance of the material shall be unaffected by the heat generated by the waterproofing processes. <u>Waterproofing Protection Board</u> The protection board shall be a durable panel of 3 mm 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 Specification OPSS 1215 for Protection Board.	1213 Specification. <u>Rubber Membrane</u> Rubber membrane shall consist of 1.2 mm thick butyl *and ethylene propylene diene monomer (EPDM)* rubber. *The membrane shall meet the requirements of CAN/CGSB 37.52M.* <u>Membrane Reinforcing Fabric</u> Membrane reinforcing fabric shall *consist of* spun bonded sheet structure composed of 100% continuous filament polyester fibres bonded together at their crossover points. The membrane shall be supplied in minimum widths of 300 mm. <u>Wick Drain</u> Wick drain shall consist of composite polypropylene with a total thickness of 3.6 mm, supplied in 100 mm widths. The puncture strength shall be a minimum of 45 N measured in accordance with ASTM D4833. <u>Waterproofing Protection Board</u> *Waterproofing* protection board shall *consist of* durable panels designed to provide a protective cushion between the hot mix asphaltic concrete pavement and the asphalt membrane. *The waterproofing protection board* shall meet *the requirements of* the Ontario Ministry of Transportation's OPSS 1215 Specification for Protection Board.
16.3 Equipment An approved heating and mixing kettle 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.	**16.3 Equipment** An approved heating and mixing kettle shall be used to heat the hot applied rubberized asphalt membrane. The kettle shall be *a* double boiler oil transfer type with a built in agitator, and *shall be* equipped with permanently installed dial type thermometers *with an accuracy of ± 2 °C* to measure the temperature of the melted compound and oil. *A separate calibrated thermometer with an accuracy of ± 2 °C shall be available on site to verify material temperatures.* *The unit shall be capable of keeping the contents continuously agitated, free flowing and lump free until the material is drawn for application.*
	16.4.1 General

	The Contractor shall provide the Consultant with 48 hours advance notice prior to commencing any waterproofing operations. *Waterproofing operations shall only be carried out when the air and concrete surface temperatures are 5 °C or higher.* *The Contractor shall carry out the operations involved in waterproofing in sequential order, and in such a manner that there are no delays between individual operations except those necessary to meet the requirements of these specifications.* *Placement of the first asphalt concrete placement lift shall commence within 7 days of waterproofing installation or as determined by the Consultant based on anticipated exposure conditions.*
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.	*16.4.2* Traffic Restriction *Once surface preparation operations have commenced the Contractor shall restrict* all traffic other than the construction equipment directly associated with waterproofing and *bridge* paving operations *from traveling over the prepared areas.* *These restrictions shall remain in place until such time that the asphalt concrete* pavement has been placed and cooled to ambient temperature.
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 these specifications. 16.4.3 Notice of Commencement of Waterproofing Operations The Contractor shall give the Consultant 48 hours notice prior to commencing any waterproofing operations.	
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	*16.4.3* Surface Preparation *16.4.3.1 Grout Tubes* *Grout tubes shall be cut flush with the concrete deck surface prior to surface preparation. If grout tubes project above the concrete after surface preparation, they shall be re cut flush with the concrete deck surface. A 450 mm by 450 mm piece of membrane reinforcing fabric, centered on the tube, shall be installed as described in Section 16.4.5, Waterproofing of Joints and*

coating. Tack coating and waterproofing shall not commence until the Consultant has 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°C. Waterproofing equipment or material shall not be permitted on the tack coat until it has fully cured and is completely tack free.	*Cracks.* *16.4.3.2 New Bridge Construction* *Concrete surfaces to receive waterproofing shall be cured a minimum of 14 days and then allowed to dry a minimum of 3 days. Concrete surfaces shall be completely dry prior to commencing waterproofing operations. Drying of concrete surfaces by the use of torches or other means that, in the opinion of the Consultant, may be potentially harmful will not be permitted.* *Once the concrete surfaces are completely dry, they shall be prepared for waterproofing installation by sandblasting or shotblasting to expose sound, laitance free concrete for the entire installation area. All dirt and debris shall be removed and disposed of leaving a prepared surface satisfactory for tack coating.* *16.4.3.3 Bridge Rehabilitation* *Concrete surfaces to receive waterproofing shall be ground, scabbled, or bush hammered to achieve a surface texture of 3 mm or less prior to sandblasting or shotblasting. Concrete surfaces shall also meet the requirements of Section 16.4.3.2, New Bridge Construction, prior to waterproofing installation.* *New concrete overlays or concrete patches that are to receive waterproofing shall be cured for a minimum of 7 days unless otherwise specified and allowed to dry a minimum of 3 days.*
	16.4.4 Tack Coating *Tack coat shall be applied wherever waterproofing membrane is required. Tack coating and waterproofing installation shall not commence until the Consultant has inspected and accepted the surface preparation work.* *Immediately prior to the application of the tack coat, the concrete surface shall be blown clean with oil and water free compressed air to remove all dust and other foreign material. The tack coat shall be cut back with an equal volume of gasoline type solvent or an alternative cut back asphalt product compatible with the asphalt membrane.* *The tack coat application shall be such that the tack material will be absorbed into the concrete, resulting in a surface that is dull and black in appearance. Excess application of tack coat, indicated by a shiny black surface, shall be avoided. Tack coat material shall be applied at an approximate rate of 0.25*

	L/m2. *Waterproofing equipment or material shall not be permitted on the tack coat until it has fully cured and is completely tack free.*
16.4.5 Waterproofing of Joints and Cracks Special attention shall be paid to waterproofing over all construction joints, lift hook pockets, patches, and cracks. Prior to the application of the hot asphalt membrane to the deck, a coat of hot asphalt membrane at least 4 mm thick and wide enough to extend 200 mm on either side of the joint or crack shall be applied in accordance with section 16.4.6, to the tack coated concrete surface. A strip of membrane reinforcing fabric material wide enough to extend 150 mm on either side of the construction joint, lift hook pocket, patch or crack shall be applied while the asphalt membrane is still hot and tacky. Membrane reinforcing fabric shall be overlapped 100 mm when multiple strips are used. 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 ACP surface course, and 150 mm onto the deck. The butyl rubber membrane shall extend 50 mm up the vertical face, 100 mm onto the deck surface, and overlapped 100 mm when multiple strips are used. The rubber membrane shall be applied while the asphalt membrane is still hot and tacky.	16.4.5 Waterproofing of Joints and Cracks *The Contractor shall pay particular* attention to waterproofing *installation* over construction joints, lift hook pockets, *grout tubes*, patches and cracks. *After tack coat application and prior* to application of the *primary* hot asphalt membrane, a coat of hot asphalt membrane *3 mm to* 4 mm thick and wide enough to extend 200 mm on either side of *each* joint or crack shall be applied in accordance with Section 16.4.6, *Application of Asphalt Membrane*. A strip of membrane reinforcing fabric material wide enough to extend 150 mm on either side of the construction joint, lift hook pocket, *grout tubes*, patch or crack shall be applied while the asphalt membrane is still hot and tacky. *The membrane reinforcing fabric shall then be covered with an additional layer of water proofing 2 mm to 3 mm thick*. *Membrane* reinforcing fabric shall be overlapped *for a minimum of* 100 mm when multiple strips are used. *For areas along* curbs, barrier walls, and deck drains, the hot asphalt membrane shall be applied to the height of the top of the hot mix ACP surface course and 150 mm onto the deck. *Rubber membrane shall be applied into the first coat of asphalt membrane while it is still hot and tacky*. The rubber membrane shall extend 50 mm up the vertical face and 100 mm onto the deck surface. *Rubber membrane shall be overlapped for a minimum of 100 mm where multiple strips are used. A second coat of asphalt membrane shall then be applied to fully cover the rubber membrane*.
16.4.6 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 4 mm and a maximum	16.4.6 Application of Asphalt Membrane Cakes of asphalt membrane shall be melted in the heating and mixing *kettle to a* temperature not exceeding that recommended by the membrane Manufacturer. *The asphalt membrane* shall not be applied until the tack coat has cured completely. *The application temperature of asphalt membrane shall be within the* range recommended by the Manufacturer. *The membrane shall be applied in* a uniform film having a minimum thickness of 4 mm and a maximum thickness of 6 mm.

thickness of 6 mm. The laying operation shall be such that discontinuities in the membrane are avoided and any joints lapped 150 mm. The membrane shall be applied over all waterproofed joints and cracks, and shall extend up the face of curbs, 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.	*Application of the asphalt membrane shall be carried out in a continuous manner to the extent practicable. Where joints are unavoidable, they shall be overlapped by a minimum of* 150 mm. The membrane shall be applied over all waterproofed joints and cracks, and shall extend up the face of curbs, barrier walls, and deck drains, to the height of the top of the *design* hot mix *asphalt* surface course. *The Contractor shall conduct his operations in such a manner that plugging of deck drains and/or drainage tubes is avoided. Plugged deck drains or drainage tubes shall be cleaned out by the Contractor at his expense*.
16.4.7 Installation of Wick Drain Wick drains shall be placed along the full length of gutters and installed when the asphalt membrane is still hot and tacky. Special attention shall be given to waterproofing and wick drain modifications at deck drain pipe locations. Wick drain details shall be in conformance with standard drawing S-1443.	16.4.7 *Wick Drain Installation* Wick drains shall be installed along the full lengths of *the* gutters, and *shall be* installed when the asphalt membrane is still hot and tacky. Special attention shall be given to waterproofing and wick drain modifications at deck drain pipe locations. *Tack coat shall not be applied to wick drains.*
16.4.8 Application of Protection Board The Contractor shall check and ensure that the asphalt membrane thickness conforms to the specified requirement, prior to placing the protection board. Protection boards shall be laid on the asphalt membrane, 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 minimum 12 mm to maximum of 25 mm both longitudinally and transversely. The protection board edge shall be within 5 mm 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 150 mm. 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 Consultant. Protection boards that are warped, distorted or damaged in any way, by manufacture, storage, handling or exposure to weather, shall be rejected.	16.4.8 *Protection Board Installation* The Contractor shall ensure that the asphalt membrane thickness *meets* the specified requirements prior to placing the protection board. Protection boards shall be laid on the asphalt membrane 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 a minimum 12 mm *and a* maximum of 25 mm, both longitudinally and transversely. The protection board edge shall be within 5 mm of all *wick drains, vertical faces of drains, and vertical faces of expansion joints*. *Protection board shall be lapped to produce a shingling effect in both the longitudinal and transverse directions*. Protection boards shall be placed such that the longitudinal (direction of traffic flow) joints are staggered *a minimum of* 150 mm. *Boards* shall be rolled *using* a linoleum or lawn type roller while the membrane is still warm 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. *At locations* where the edges of the protection board *have curled-up,* the *curled-up* edges shall be cemented down using hot membrane material to the satisfaction of the Consultant. Protection boards that are warped, distorted or damaged in any way, *whether* by manufacture, storage, handling or exposure to *the elements* shall be

	replaced with new material.
16.7 Measurement and Payment Payment for Deck Waterproofing will be made at the unit price bid per square metre of deck waterproofed, which price shall be full compensation for the cost of all labour, equipment and materials required for the preparation of the concrete deck surface including sandblasting, supply and application of the tack coat, asphalt membrane, rubber membrane and protection board, handling and controlling of traffic, and for all other items of work necessary for the satisfactory completion of the work.	***16.5* Measurement and Payment** *Measurement for payment of deck waterproofing will be by the square metre of waterproofing acceptably installed.* *Payment will be made at the unit price bid for "Deck Waterproofing", and will be full compensation for traffic control; preparation of the concrete deck surface, including sandblasting and/or shotblasting; the supply and application of the tack coat; the supply and installation of asphalt membrane, membrane reinforcing fabric, rubber membrane, wick drain, protection board; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.*
Section 17 Asphalt Concrete Pavement	**Section 17 Asphalt Concrete Pavement**
17.4 Sampling and Testing Unless otherwise specified sampling and testing procedures used to determine material characteristics shall be as outlined in the Standard Specifications for Highway Construction section 3.50.4 Sampling and Testing. The Consultant 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 Consultant at the positions where samples have been taken. Compensation for providing assistance with sampling and for reinstatement where samples are taken shall be included in the unit price bid for the various items of Work tested and no separate payment will be made. Sampling of the asphalt mixture by the Consultant shall be done at a minimum frequency of two samples for each lift of placement. Sample size shall be 6 kg. Quality Assurance (QA) testing done by the Consultant on each sample shall consist of an uncorrected asphalt content determination and aggregate gradation. The Consultant shall use the Contractors correction factor determination as a guide to approximate the 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	**17.4 Sampling and Testing** *Sampling* and testing procedures used to determine material characteristics shall be as outlined in the Standard Specifications for Highway Construction section 3.50.4 Sampling and Testing *unless otherwise specified*. *In addition to quality control testing completed by the Contractor described in Section 17.5, quality assurance (QA) testing will be completed by the Consultant. QA testing will be completed on two 6 kg samples per lift to determine the uncorrected asphalt content and aggregate gradation. The Consultant will use the Contractor's measured correction factor to establish the actual asphalt content. The actual asphalt content will be determined by test method ATT-12 or ATT-74, and includes the correction factor for 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 determined by the Consultant.* *The Consultant 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 lifts or other structures to the satisfaction of the Consultant at the positions where samples have been taken. Compensation for providing assistance with sampling and for reinstatement where samples are taken shall be included in the unit price bid for the various items of Work tested and no separate payment will be made*.

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 Consultant. Inspections during construction for pavement segregation shall be as outlined in section 3.50.4.7 of the Standard Specifications. Contrary to section 3.50.4.7.4 "Repairing Pavement Segregation", 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 Consultant'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. Generally, sampling and testing will only be carried out on projects consisting of 50 tonnes or more of ACP.	The Consultant'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.
17.5 Quality Control Testing The Contractor shall produce crushed aggregates in accordance with Specification 3.2, Aggregate Production and Stockpiling for Designation 1 aggregate and requirements listed in section 3.50.3.2 Design Requirements. The Contractor shall be totally responsible for production of aggregate that meets all the specified requirements. The Contractor shall be responsible for all costs associated with quality control testing. Results of all quality control tests shall be submitted to the Consultant as they become available. Unless otherwise specified, the latest edition of the following standard Alberta Transportation test methods (ATT) will be used to determine material characteristics. Test methods and minimum frequencies of testing are shown in Table 17.5 Quality Control Testing Requirements.	**17.5 Quality Control Testing** *Quality control testing shall be completed on all projects with 50 tonnes of ACP or more.* The Contractor shall be responsible for all *quality control testing and associated costs*. Results of all quality control tests shall be submitted to the Consultant *within 7 days of the test being completed*. *The Contractor shall produce crushed aggregates in accordance with Specification 3.2, Aggregate Production and Stockpiling for Designation 1 aggregate and requirements listed in section 3.50.3.2 Design Requirements.* Unless otherwise specified, the latest edition of the following standard Alberta Transportation test methods (ATT) will be used to determine material characteristics. Test methods and minimum frequencies of testing are shown in Table 17.5 Quality Control Testing Requirements.
Table 17.5 Quality Control Testing Requirements TEST STANDARD MINIMUM FREQUENCY AGGREGATE PRODUCTION SIEVE ANALYSIS 1. Sieve Analysis Crushed Aggregate ATT- 26 Minimum of one test for	Table 17.5 Quality Control Testing Requirements TEST *TEST METHOD* MINIMUM FREQUENCY *AGGREGATE PRODUCTION* *See Specification 3.2* *ASPHALT MIX PLANT* *1. Calibration* *ATT-17* *Once per project or as requested by the*

		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	ATT-17	
2. Inspection	ATT-16	Once per project or as required Minimum of one per lift.
SAMPLES		
1. Asphalt Cement	ATT-42	If requested by the Consultant
2. Tack, Prime and Fog Materials	ATT-42	If requested by the Consultant
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 Consultant (Coring done by Contractor)	ATT-56 ATT-5	As requested by the Consultant
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.

		Consultant
2. Inspection	*ATT-16*	*Minimum of one per lift.*
SAMPLES		
1. Asphalt Cement	*ATT-42*	*As requested by the Consultant*
2. Tack, Prime and Fog Materials	*ATT-42*	*As requested by the Consultant*
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 Consultant (Coring done by Contractor)	*ATT-56*	*As requested by the Consultant*
i) QA Cores for Pavement Density	*ATT-5*	*As requested by the Consultant*
ii) QA Cores for Asphalt Content and Gradation	*ATT-5*	*As requested by the Consultant*
ADDITIONAL TESTING REQUIREMENTS		
1. Sieve Analysis Crushed Aggregate	*ATT- 26*	*Minimum of one test for each aggregate component.*
ADDITIONAL TESTING REQUIREMENTS		
2. Percent Fracture of Crushed Aggregate	*ATT-50*	*Minimum of one test for each aggregate component.*
3. Mix Asphalt Content	*AASHTO T-164, T287 or ATT-12 or ATT-74*	*Minimum of one per lift.*
4. Correction Factors	*ATT-12, Part III or ATT-74, Part II*	*Once for each mix design.*
5. Mix Moisture Content	*ATT-15*	*Minimum of one per lift.*
6. Aggregate Sieve Analysis	*ATT-26*	*(3)*
7. Pavement Segregation	*Paving Guidelines and Segregation Rating Manual*	*(4)*
8. Field Formed Marshall Briquettes	*ATT-13*	*(1)*
9. Density Immersion Method, Saturated Surface Dry	*ATT-7*	*(2)*
10. Void Calculations, Cores or Formed Specimens	*ATT-36*	*(1)*
11. Temperatures	*ATT-30*	*(1)*
12. Percent Compaction, Cores,		

(2) Nuclear Density Testing is required on all projects. The Consultant may require the Contractor to obtain pavement cores (top lift only) for QC testing. (3) One sieve analysis of the combined aggregate (any combination of cold feed, extraction or ignition) are required per lift.	*or Nuclear Density ATT-67, ATT-5 or ATT-11 (2)* *13. Correction Factors, Nuclear Moisture-Density Measurement ATT-48 (2)* *14. Pavement Smoothness ATT-59 As requested by the Consultant* Notes: (1) Minimum frequency not specified. (2) Nuclear Density Testing is required on all projects. The Consultant may require the Contractor to obtain pavement cores (top lift only) for QC testing. (3) One sieve analysis of the combined aggregate (any combination of cold feed, extraction or ignition) is required per lift. *(4) At the end of paving each day or completion of a paving lift, the Consultant will perform an inspection of the paving to identify any areas of pavement segregation.*
17.6.3 Equipment for Transportation of Mixture ... 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.	17.6.3 Equipment for Transportation of Mixture ... Excess truck box lubricants such as detergent or lime solutions shall not be allowed to contaminate the mix. Petroleum based truck box lubricants shall not be used.
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 Consultant, 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	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 Consultant, such that displacement of the mat and/or disruption of underlying materials does not occur. Compaction equipment shall be in proper mechanical condition and operated such that uniform and complete compaction is obtained throughout the entire width, depth and length of the pavement being constructed. *Rollers shall be configured to ensure uniform and complete compaction up to the face of barriers, curbs and medians.* 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

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.	wetting the tires or drums to prevent adhesion or pickup of the asphalt mixture. *The Contractor shall provide as a minimum of one rubber tired roller and one smooth steel drum type roller. The rollers shall have a minimum 10 tonnes mass. Vibrators on vibratory rollers shall not be activated. Specialized equipment may be required to achieve adequate compaction and smoothness in tight corners at expansion assemblies and deck joints*.
17.7.4 Tack Coat Asphalt tack coat shall be applied to the existing protection board, polymer membrane waterproofing, granular base course, or existing asphalt concrete substrate and between lifts of asphalt concrete pavement, at the locations and to the dimensions designated by the Consultant.	17.7.4 Tack Coat Asphalt tack coat shall be applied to the existing protection board, polymer membrane waterproofing, granular base course, or existing asphalt concrete substrate and between lifts of asphalt concrete pavement, at the locations and to the dimensions designated by the Consultant. *Tack coat shall not be applied to wick drains.*
17.7.5.1 General ... 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.	17.7.5.1 General ... 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, *barriers*, *concrete paving lips*, manholes, drains or medians. – Damage is not done to guide posts, guardrails, signs, power conduits or any other roadside installations.
17.7.5.4 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 40 mm layers.	17.7.5.4 Hot-Applied Rubberized Asphalt Waterproofing *Membrane System Paving* *The ACP wearing surface shall be placed and compacted in two nominal 40 mm lifts.* *The first lift of ACP shall be spread by the asphalt paver in the direction of the protection board laps (downhill). In the event that paving cannot be carried out in the direction of the protection board laps, the Contractor shall submit a procedure for review, identifying measures that will be taken to ensure that the protection board and waterproofing membrane will not be damaged during paving. To avoid damaging the waterproofing membrane the paver*

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% average density.	*shall not exceed the placing rate or push the delivery trucks, all equipment shall perform all turning movements off the bridge deck, and the asphalt mixture shall not be dumped onto the protection board ahead of the paver.* *The allowable temperature range for compaction of ACP lifts on the hot-rubberized asphalt waterproofing membrane system shall be as follows:* COMPACTION TEMPERATURE RANGE ASPHALT GRADE — FIRST LIFT — SECOND LIFT 150 - 200 (A) *or PG58-28* — MAX. 105°C — 128°C - 138°C 200 - 300 (A) *or PG52-34* — MAX. 105°C — 123°C - 133°C *The minimum average Marshall density of the first lift shall be 95% with no individual test less than 93%. The remainder of the first lift shall have a minimum Marshall density of the 95%. The minimum average Marshall density of the second lift shall be 97% with no individual density less than 95%.*
17.7.5.6 Transition and Approach Road Paving The asphalt concrete pavement shall be placed as shown on the drawings and determined by the Consultant. Lifts of ACP shall not exceed 70 mm. Coarse aggregates shall be raked out of "feathered" edges of the asphalt concrete mat, to provide a smooth transition to the existing pavement. The temperature of the asphalt mixture shall be between 123°C and 138°C at the start of compaction.	17.7.5.6 Transition and Approach Road Paving The *ACP* shall be placed as shown on the drawings and *as* determined by the Consultant. Lifts of ACP shall not exceed 70 mm. The temperature of the asphalt mixture shall be between 123°C and 138°C at the start of compaction.
17.7.6.2 Segregated Areas Segregated areas identified by the Consultant shall be repaired by the Contractor. Methods of repair for segregation shall be as reviewed and accepted by the Department and Consultant. All repairs carried out by the Contractor shall be at his own expense.	17.7.6.2 Segregation *Pavement segregation shall be classified in accordance with section 3.50.4.7.2 "Classifying Pavement Segregation" of the Alberta Transportation Standard Specifications for Highway Construction. The Departments manual for "Paving Guidelines and Segregation Rating Manual" shall be used as reference in classifying segregation severity.* *(http://www.transportation.alberta.ca/Content/docType233/Production/pavsegman.pdf)* *During paving operations, the Contractor shall make every effort to achieve a finished surface that has a uniform closed texture and is free of segregated areas. At the end of paving each day or completion of a paving lift, the Consultant will perform an inspection of the paving to identify areas of pavement segregation. If segregation is present, the Contractor shall take*

	immediate corrective action to the paving process to prevent any further occurrence of segregation. The Contractor shall repair segregated areas of all severities as follows: *(a) When slight segregation is identified in the bottom lift, the Contractor shall identify and correct the cause of the segregation to prevent segregation in the top lift.* *(b) When any moderate or severe segregation or centre of paver streak is identified in the bottom lift, the top 20 mm of the lift shall be removed and replaced. Subsequent lift(s) shall be modified to meet the specification requirements and approved by the Consultant.* *(c) When any moderate or severe segregation or centre of paver streak is identified in the top lift, the entire lift shall be removed and replaced.* *(d) When slight segregation is identified in the top lift and the total area of slight segregation does not exceed 0.5% of the total paved area, the areas identified shall be repaired with a slurry patch.* *(e) When slight segregation is identified in the top lift and the total area of slight segregation exceeds 0.5% of the total paved area, the entire lift shall be removed and replaced.* *Methods of repair, removal and replacement shall be reviewed and accepted by the Consultant.*
Section 20 Deck Overlay and Concrete Rehabilitation	**Section 20 Deck Overlay and Concrete Rehabilitation**
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.	**20.1 General** Deck overlay *and concrete rehabilitation work may consist of, but not be limited to, surface removal, concrete repair, surface preparation, and/or deck overlay*.
20.2 Traffic Accommodation Requirements for traffic accommodation shall conform to Appendix A – "Traffic Accommodation and Temporary Signing" of the Specifications for Bridge Construction.	**20.2 Traffic Accommodation** *Unless otherwise approved by the Consultant, all rehabilitation projects which include either a concrete or ACP overlay shall be carried out in stages and shall have a minimum of one undisturbed travel lane available for the*

	accommodation of public traffic at all times during construction. *Traffic accommodation shall be in accordance with the requirements of Specification 7.1, "Traffic Accommodation and Temporary Signing", of the Standard Specifications for Highway Construction and as described in the Special Provisions.*
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 *Surface Preparation for Concrete Overlay*** *20.3.1 General* *Surface* preparation includes but is not limited to all work necessary *to prepare* the bridge *for* deck overlay concrete placement. This work includes, *but is not limited to,* the following: - *Surface removal* - Removal and disposal of existing concrete paving lips - Partial depth repair - Full depth repair - Sandblasting of *concrete surfaces to be overlaid* - Removal and reinstallation of bridgerail, if required, to accommodate *screed rail*. *Jack hammers* heavier than nominal 14 kg class and *chipping hammers* heavier than nominal 7 kg class shall not be used *for concrete removal*.
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	*20.3.2* Surface Removal *Surface removal shall be carried out in stages. The Contractor shall complete surface removal operations to the depth(s) shown on the Drawings or as described in the Special Provisions. The Contractor shall submit details of his proposed surface removal methods to the Consultant for review and acceptance a minimum of 1 week prior to the scheduled commencement of this work.* *Surface removal shall be carried out as close as possible to all curbs, medians, barriers, drains, deck joints, and other bridge components without causing damage. Chipping equipment shall be used in these areas to complete removal operations. Concrete curb and deck joint paving lips within the limits of the surface removal area shall be removed, including the*

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.	*reinforcing steel projecting into these components. For bridges that do not have formal deck joints at the abutments, the Contractor shall saw cut through the full depth and width of the wearing surface at both ends of the bridge or at the transition paving limits prior to commencing removal operations.* *When the specified removal depth includes more than 5 mm of concrete removal and cold milling methods are proposed by the Contractor, small milling machines having a maximum removal width of 1.2 m shall be used. Adjustments to the removal depth shall be carried out on an ongoing, as required basis to ensure an accurate depth of material removal is maintained throughout milling operations. If the Contractor removes material in excess of 5 mm from that specified without prior approval from the Consultant, the costs associated with the additional material replacement quantities shall be at the Contractor's expense.* *The Contractor shall remove milling debris from behind the cold milling machine and clean the milled surface on a continuous basis, as close to the milling machine as is safely practicable. Debris removal and surface cleaning details shall be included in the Contractor's proposed surface removal method submission. The Contractor shall dispose of all debris resulting from surface removal operations at an approved location.* *Reinforcing steel or other bridge components damaged as a result of the Contractor's surface removal operations shall be repaired or replaced by the Contractor at his expense.* *Upon completion of surface removal operations, including thorough cleaning and drying of the deck surface and removal of all equipment, the Consultant will inspect the deck surface and identify areas of unsound concrete to be repaired. Repairs shall be carried out in accordance with Subsection 20.4, Concrete Repair.*
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	*20.3.3* Deck Surface Sandblasting *Prior to deck overlay concrete placement, the Contractor shall sandblast the* entire deck surface *and* the vertical faces of the curb, median and parapet up to a height *equal to the overlay thickness. Adequate shielding shall be provided* to protect any repaired epoxy coated reinforcing steel *or galvanic anodes.* Sandblasting *shall be carried out to the extent necessary* to uniformly expose fine aggregate.

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.	*Following sandblasting, the Contractor shall clean the deck surface so that it is free of all sand, dust and other contaminants to the satisfaction of the Consultant. Debris from the cleaning operations shall be disposed of at an approved location.* *Once accepted by the Consultant, the Contractor shall be responsible for maintaining the cleaned deck in satisfactory condition until placement of deck overlay concrete. Additional preparation or cleaning, including sandblasting, that may become necessary during this period shall be carried out by the Contractor at his expense.*
	20.4 Concrete Repair *20.4.1 General* *At repair areas other than the deck substrate, the limits of concrete removal will be determined by the Consultant. The perimeters of repair areas shall be sawcut with neat, perpendicular, 25 mm deep cuts.* *The Contractor shall remove the areas of unsound concrete by chipping, scabbling or other means approved by the Consultant. Removal operations at each location shall result in a sound surface suitable for bonding to the deck overlay concrete or repair material.* *The Contractor shall contain all debris resulting from concrete removal operations and dispose of the material at an approved location. Methods of containment shall not result in damage to the existing bridge or surrounding areas, and are subject to acceptance by the Consultant.*
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	*20.4.2* Partial Depth Repair Partially exposed *reinforcing steel* shall be entirely exposed by removal of the concrete to a depth of 25 mm below the bars. *Exposed reinforcing steel and bonding surfaces shall be sandblasted and the areas blown clean with oil-free compressed air. Reinforcing steel shall be sandblasted to a white metal finish.*

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.	For repair areas *where epoxy coated reinforcing steel is exposed, the epoxy coating shall be completely removed by sandblasting. The exposed reinforcing bar shall then be protected by the installation of discrete galvanic anodes installed at a minimum of 1 anode per 300 mm of perimeter of the patch area, or the epoxy coating repaired in accordance with the requirements of Section 5, Reinforcing Steel. Galvanic anodes shall be a product selected from those listed on the Alberta Transportation Product List for Galvanic Corrosion Protection. Anodes shall be embedded in a low resistivity mortar and shall have the concrete cover specified on the Drawings, or as determined by the Consultant.* *Additional reinforcing steel shall be installed at all locations where the existing reinforcing steel has suffered sectional loss greater than 20%, or as determined by the Consultant. Additional reinforcing steel shall be of the same type used in the original construction or a corrosion resistant reinforcing steel type acceptable to the Consultant. Splicing and/or development requirements will be determined by the Consultant.* *Once a prepared area has been accepted by the Consultant and prior to placement of repair material, bonding surfaces shall be saturated with clean water for a minimum of 30 minutes. The area shall be blown free of any surface water immediately prior to placement of the repair material. Repairs shall be trowelled smooth, leveled flush to adjacent surfaces, and given the appropriate concrete finish if applicable.* *Unless otherwise shown on the Drawings or directed by the Consultant, the Contractor shall re-establish the original design concrete cover at each repair location.* *All partial depth repair areas located on the deck surface shall be poured monolithically with placement of deck overlay concrete. Other partial depth repair areas shall be formed and recast with an appropriate Alberta Transportation approved concrete patching product, extended with aggregates that meet the requirements of CAN/CSA 23.1 or ASTM C33.* *Where the volume of approved concrete patching product required for an individual partial depth repair area exceeds the volume produced by three 25 kg bags, a rubber paddled mortar mixer of adequate size shall be used for mixing the product. The use of free fall mixers will not be permitted.* *Where the repair area is large enough such that placement of an approved*

	concrete patching product becomes impractical, concrete shall be used. Class C concrete shall be used for substructure elements and Class HPC for all other elements. Repair procedures shall be in accordance with Subsection 20.4.3, Full Depth Repair, and the product Manufacturer's recommendations. In the case of conflict, the more stringent requirements shall apply.
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	*20.4.3* Full Depth Repair Where concrete deterioration extends completely through the deck, *curbs, or other elements* as determined by the Consultant, all unsound concrete shall be removed and replaced with *new concrete*. *Exposed reinforcing steel* and *bonding* surfaces *shall* be sandblasted and *the areas* blown clean *with oil-free compressed air. Reinforcing steel shall be sandblasted to a white metal finish.* *For repair areas where epoxy coated reinforcing steel is exposed, the epoxy coating shall be completely removed by sandblasting. The exposed reinforcing bar shall then be protected by the installation of discrete galvanic anodes installed at a minimum of 1 anode per 300 mm of perimeter of the repair area, or the epoxy coating repaired in accordance with the requirements of Section 5, Reinforcing Steel. Galvanic anodes shall be a product selected from those listed on the Alberta Transportation Product List for Galvanic Corrosion Protection. Anodes shall be embedded in a low resistivity mortar and shall have the concrete cover specified on the Drawings, or as determined by the Consultant.* Additional *reinforcing steel shall* be *installed at all locations where the existing reinforcing steel has suffered* sectional loss *greater than 20%, or as determined by the Consultant*. *Additional reinforcing steel* shall be of the same *type used in the original construction or a corrosion resistant reinforcing steel type acceptable to the Consultant*. Splicing *and/or development requirements will be determined by the Consultant*. The underside of the deck, curbs, *and other areas requiring full depth repair* shall be formed to neatly restore the original lines of the concrete. Forms shall not be hung or suspended from existing deck reinforcing steel. *Once a prepared area has been accepted by the Consultant and prior to concrete placement, bonding surfaces* shall be saturated with *clean* water for a *minimum of* 30 minutes. *The area shall be blown free of any surface water*

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.

immediately prior to concrete placement. Repairs shall be adequately vibrated, trowelled smooth, leveled flush to adjacent surfaces, and given the applicable concrete finish. Concrete shall be cured in accordance with Subsection 4.23 of Section 4, Cast-In-Place Concrete.

Full depth repairs located on the deck surface shall be recast monolithically with placement of deck overlay concrete. When conditions do not permit a monolithic pour with the deck overlay concrete, full depth repair concrete shall be placed to a depth such that, once the subsequent overlay concrete has been placed, the specified design overlay thickness is achieved.

Full depth repair concrete not poured monolithically with the overlay concrete shall be wet cured for a minimum of 7 days or until it has attained sufficient strength so it is not adversely affected by subsequent placement of the deck overlay as determined by the Consultant.

Class C concrete shall be used to repair substructure elements and Class HPC for all other elements.

Compressive strength tests shall be completed on each batch of concrete placed in accordance with Subsection 4.9.1 of Section 4, Cast-In-Place Concrete. Concrete shall have 28 day minimum compressive strengths meeting the requirements of Subsection 4.27 of Section 4, Cast-In-Place Concrete, for the applicable Class. The Department reserves the right to reject any concrete that fails to meet the full strength requirements of the Specifications.

In the event that the strength of any *respective concrete batch fails* to meet *full strength requirements, the Consultant may, in consultation with the Department,* accept that batch at reduced payment rates according to the following schedule:

28 Day Minimum Compressive Strength	Amount of Payment
Specified strength and over	Full bid price
up to 2 MPa *less than the specified strength*	Bid price less $25.00 per square metre
between 2 MPa and 4 MPa *less than the specified strength*	Bid price less $50.00 per square metre
between 4 MPa and 5 MPa *less than the specified strength*	Bid price less $100.00 per square metre

All concrete *showing a 28 day minimum compressive strength 5 MPa or*

	greater below that specified will be rejected.
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.	***20.5 Deck Overlay*** *20.5.1* General *Deck overlay concrete shall be placed as shown on the Drawings; in accordance with the requirements of this specification and Section 4, Cast in place Concrete; and as directed by the Consultant.* *20.5.2 Concrete* Deck overlay concrete shall *be* Class HPC or Class HPC with steel fibres, as *specified*.
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.	*20.5.3* Gradeline Profiles/Dry Run *The* gradeline *will be designed by the Consultant to provide a smooth riding surface* for the finished overlay and transition ACP. *The Contractor shall assist the Consultant with profiling of* the bridge and approaches prior to and after *surface removal*. When developing the gradeline profiles, the Consultant will consider such items as rideability, concrete*/ACP* thickness/quantity, dead load deflection and deck drainage. *The design gradeline will be used to determine the overlay thickness and the height of the screed above the existing concrete at each control point.* *Gradeline profiles will be produced by the Consultant using the following guidelines*: - *Two parallel* profile lines *the entire length of the bridge* for each construction stage *will be provided as follows:* • Line No. 1 *will be located* 1.0 m from curb face. • Line No. 2 *will be located* 0.3 m in from *the opposite* edge of proposed pour. *The* Stations of Line No. 1 and Line No. 2 *will* be square to each other. *Additional profile lines will be produced when determined by the Consultant.* - *Stations will be established* at 3.0 m *intervals; and at the edges of existing deck joints to be retained and/or at new deck joint locations*. - Profiles *will* include 30 m of approach at each end *of the bridge at 3.0 m intervals*. - Profile plots *will be to the following scales*: Horizontal: 10 mm = 1 000 mm

- 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

Vertical: 1 mm (normal) or 1 mm = 5 mm (minimum)

- *The* proposed design gradeline will be a smooth line achieving a nominal overlay thickness as shown on the Drawings.

Fluorescent paint shall be used to mark profile *locations* on the existing deck surface, curbs and approaches. The *markings* shall be approximately 40 mm in diameter. The Contractor shall *remove all exposed markings remaining* after the deck overlay work is *complete*.

The Consultant will provide the summary of the proposed overlay thickness, to the nearest mm, at each control point prior to the Contractor setting *the* screed guide rails. *The Contractor is responsible for properly setting the screed rails to match the gradeline provided by the Consultant.*

Emphasis shall be placed on providing positive longitudinal and transverse drainage from the bridge deck. Depressions in the concrete surface resulting from deficient finishing procedures *which may result in ponding* water shall be repaired by the Contractor at his *expense.*

Screed guide rails shall be placed outside the area *of concrete placement*. 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. *Guide rails sufficient for the entire contemplated pour shall be set out, adjusted for height, and accepted by the Consultant prior to concrete placement.*

To confirm proper adjustment of the machine and guide rails, the screed shall be "dry run" prior to the pour; and clearance measurements taken at each control 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 *provide* an acceptable dry run. Adjustments to the machine or the rails will not be permitted after an acceptable dry run has been made.

Proposed longitudinal overlay construction joint locations shall be approved by the Consultant prior to commencement of overlay construction. Typically, *joints* 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 shall be offset by a minimum of 300 mm. *Longitudinal bulkheads* shall be provided at overlay construction joint *locations*.

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.	*20.5.4* Cement/Silica Fume Slurry Grout After all deck preparation *has been completed and accepted by the Consultant, surfaces to be overlaid* shall be continuously *saturated with clean water* for a minimum of 3 hours *prior to concrete placement*. *Immediately prior to the commencement of concrete placement operations, surfaces* shall be blown free of all excess water, *and a cement/silica fume slurry grout applied to enhance the bond between the prepared surfaces and the overlay concrete*. *Slurry* grout shall consist of 4% silica fume, 46% Type GU hydraulic cement and 50% sand *(*maximum 2.5 mm aggregate size*) by weight*, mixed with sufficient water to form a slurry. *Slurry grout shall be mixed in a rubber paddled mortar mixer.* The consistency of the *mixed* slurry *grout* shall be such that it can be applied with a stiff brush or broom to the existing concrete surface *without running, or puddling* in low spots. *The slurry grout shall be applied in a thin, even coat with no puddling. The rate of application shall be controlled to keep pace with the rate of concrete placement, and be limited such that slurry grout is applied immediately ahead of concrete placement. In no case shall the slurry grout be permitted to dry before concrete placement.* *Slurry grout shall be continuously mixed to prevent segregation, and applied within 45 minutes of initial mixing. Slurry grout in excess of 45 minutes old will be rejected. The Contractor shall have a minimum of two grout mixers on site during overlay placement.*
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.	*20.5.5* Conveyance of Concrete on Deck *Generally, vehicles* and equipment *will* not be permitted directly on the prepared *bridge deck* surface. *However, unless otherwise determined by the Consultant and provided the deck surface is continually protected, concrete mixer trucks will be permitted onto the deck to* discharge directly ahead of the finishing machine. *Deck protection shall consist of plywood, heavy tarps or other protective devices accepted for use by the Consultant.* *Deck protection shall be sufficient to protect the saturated surface from*

	becoming contaminated with water, oil, spilled concrete and/or other substances. The protection shall remain in place *for as long as practicable prior to* air blasting and slurry grouting. *All costs associated with the provision of deck protection necessary for mixer truck access will be considered incidental to the Work, and no separate or additional payment will be made.*
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. <u>Pre-bagging for Site Batching</u> 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.	*20.5.6* Mixing Overlay Concrete Deck overlay concrete shall be mixed at *an acceptable* concrete batch plant or at the bridge site in *mixer trucks*. *Site* batching *shall be in accordance with the following* requirements*:* <u>Pre bagging for Site Batching</u> *Fine* and coarse aggregates; cement; *steel* fibres, if applicable; and silica fume shall be measured and pre-mixed together in the approved proportions before being packaged into suitable bags. Each bag *delivered to the site* shall be in good condition, free of holes or tears, *and* with all seams fully sealed. The bags *shall* be constructed of moisture proof material, and *shall be* securely closed after filling. The bags shall have adequate lifting hooks or straps attached to the *tops,* and shall be designed to suitably discharge the material from the bottom of the bag through a discharge opening *with a minimum diameter of* 460 mm. Each bag shall have a *minimum* nominal 1100 kg capacity. Partially filled bags will not be *accepted* 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, 1 100 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 *all precautions necessary* to protect the bagged pre mix from *exposure to* the elements during hauling and storage at the site. Mixer Trucks and Water Supply for Site Batching. Deck overlay concrete shall be mixed at the bridge site in mixer trucks. The Contractor shall employ adequate equipment in order to mix concrete at

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

a rate sufficient to ensure continuous concrete placement. A minimum of three mixer trucks shall be brought to the site prior to each overlay pour, and utilized in mixing operations. *Mixer trucks* shall be revolving drum type, watertight, and constructed *so* that concrete can be mixed to ensure uniform distribution of materials. *Materials* for the concrete shall be *loaded* into the drum at the bridge site.

The Contractor shall provide a suitable water source or tank for the *dedicated* purpose of batching concrete. *The water supply shall have sufficient capacity* for each pour. The water supply shall be equipped with an accurate water measuring device *calibrated in* 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 *loaded* into the mixer. *The mixing time shall be as specified in the concrete mix design.*

The water supply pipe shall be adequate to ensure that *all remaining water addition* into the mixer is completed within the first quarter of the mixing time and the *outlet situated at a location* within the mixer where the water will quickly mix with the entire batch.

The Contractor shall take all steps necessary to ensure that the full content of each pre-mix bag enters the mixer in an even and uniformly proportioned *manner*. Segregation, spillage and/or 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 shall be accurately proportioned. Increases in water cement ratio will not be permitted.

The Contractor shall maintain the mixers in good condition *at all times while the work is being carried out.* Inner surfaces of the mixer shall be kept free of hardened concrete and mortar. *Mixer* blades which are bent or worn to *the point that mixing efficiency is affected shall be replaced or refurbished. Mixers* leaking mortar or causing waste of materials through faulty charging shall be *removed from* service until *the equipment has been* repaired *to the satisfaction of the Consultant.*

The Contractor shall *not* load mixers with more than 3 m^3 of concrete or *in excess of* 85% of its rated capacity, *whichever is less*. The Contractor shall

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.	*provide the Manufacturer's certification of the mixing capacity for each machine upon request. Mixers shall be only operated at the speeds recommended by the Manufacturer*. The Contractor shall record the bag production dates/numbers and *test* the air content, slump, and temperature of each batch *at the mixing site*. *Results* of all tests shall be provided to the Consultant. In the case of an unacceptable result, the Contractor will *only* be allowed to adjust the quantities of superplasticizer and air entraining agent. *Adding additional* 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 at the 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 *a rejected batch that* may have already been placed. Concrete shall be discharged within 70 minutes after *initial* introduction of water to the pre mixed material. Discharge chutes shall be kept clean, free from hardened concrete, and wetted down prior to use. After each batch is discharged, the drum shall be thoroughly cleaned and excess water removed before *a subsequent batch is* mixed.
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	*20.5.7* Concrete Placement *20.5.7.1 General* *Concrete placement shall be carried out in accordance with Section 4, Cast-In-Place Concrete, and the following requirements.* The Contractor shall *carry out his concrete placement operations in such a manner that* a smooth riding *surface* within the tolerances *specified in Section 4, Cast-In-Place Concrete, are achieved*. Adequate lighting *shall be provided* in front and behind the finishing machine.

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.	Additional tower lights *satisfactory to the Consultant shall be placed* at each end of the bridge and at the sampling and testing *area*. Concrete shall be placed *in such a manner that* segregation of materials *does not occur*. The concrete finishing machine shall *meet the requirements of Subsection 4.16.1 of Section 4, Cast-In-Place Concrete*. *Concrete placement* shall be *carried out in* a continuous operation for the duration of the pour. No more than 5 minutes shall *be allowed to* elapse between *individual* truck mixer discharges. The width of the initial overlay section placed shall extend to the approved construction joint location. *Subsequent* overlay *pours* shall not be placed until the *initial pour has cured a minimum of* 72 hours *or as determined by the Consultant*. In the event *of* equipment breakdown *and* concrete placement *for a respective section of bridge is suspended* for a period of 60 minutes or more, further *concrete* placement *for the affected section* shall be discontinued and *shall not* resume *for a minimum of* 12 hours. *Notwithstanding this* restriction, *concrete* placement *may continue on a subsequent section of the bridge* provided a gap sufficient in length for the finishing machine to clear the previously placed concrete *is left between the two sections*. *Prior to continuing concrete placement at a discontinued overlay section, the Contractor shall sawcut a clean, straight vertical edge satisfactory to the Consultant. Material beyond the saw cut shall be removed and disposed of at an approved location. Concrete* shall be placed *in a gap section between* 12 hour *and 36 hours after suspension of the pour at the affected section*.
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.	*20.5.7.2* Surface Texture *Deck overlay concrete shall receive a Class 6 finish when the overlay concrete is the final wearing surface or a Class 4 finish where a waterproofing membrane will be applied. Following surface texturing, a 400 mm wide strip of overlay adjacent to the curb shall be trowelled smooth and the surface left closed.* *At locations where,* in the opinion of the Consultant, *a satisfactory finish has not been achieved,* the Contractor *shall* saw cut transverse grooves *at his expense. Grooves shall be cut to* the dimensions described in the *Subsection 4.25.7 of Section 4, Cast-In-Place Concrete*.

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.	*20.5.7.3* End of Overlay *Generally, concrete overlays will terminate at a deck joint. At locations where an* overlay does not terminate at a deck joint, such as on roof slabs, the overlay shall be *extended for a distance of* 150 mm beyond the required end of the overlay *to a bulkhead*. After adequate curing *time,* the 150 mm over pour shall be saw cut, and *the material removed and* disposed *of at an approved location*. *All costs associated with installation of the bulkhead; saw cutting; and removal and disposal of over pour areas will be considered incidental to the Work, and no separate or additional payment will be made.*
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.	*20.5.7.4* Longitudinal and Transverse Overlay Construction Joints The Contractor shall construct an *acceptable* bulkhead at *each* construction joint location *to* maintain horizontal and vertical alignments during concrete placing and finishing. The resulting vertical *faces* of concrete shall be sandblasted *as described in Subsection 20.3.3*. For longitudinal and transverse construction joints, the top edge of the overlay concrete at the faces of curbs, barriers, medians, previously placed overlay concrete, *and/*or existing concrete shall be tooled to a depth of 12 mm and a width of 6 mm. *Tooled* grooves shall be filled with a *proven epoxy resin type* gravity flow *concrete crack filler* listed *on the* Alberta Transportation Product List. Prior to *epoxy application, the grooves* shall be blown clean to remove all deleterious materials and *the concrete contact surfaces* prepared in accordance with the *epoxy* Manufacturer's recommendations. *Tooled* grooves shall be *completely filled with* epoxy material *to a level equal to the adjacent concrete; multiple applications of epoxy may be required*. *All costs associated with constructing longitudinal and transverse overlay construction joints including sandblasting, groove tooling, and application of gravity flow epoxy crack filler will be* considered incidental to the Work, and no separate or additional payment will be made.
20.5.4 Curing Concrete Curing concrete shall be in accordance with section 4.22 "Curing Concrete" of the specifications.	*20.5.7.5* Curing Concrete Curing of overlay concrete shall be in accordance with *Subsection 4.23.3* of *Section 4, Cast-In-Place Concrete*. *If, in the opinion of the Consultant, the Contractor's wet curing procedures are*

	deemed deficient in any way and/or any portion of the overlay becomes surface dry during the curing period, the overlay may be rejected.
	20.5.7.6 Application of Sealer *The Contractor shall supply and apply a Type 1c sealer to all areas where a Class 6 surface finish has been applied and along trowelled gutter areas. Sealer shall be applied once the concrete has cured for a minimum of 14 days.* *Sealer shall be applied in accordance with Subsection 4.26 of Section 4, Cast-In-Place Concrete. In the event the deck overlay concrete surface becomes contaminated with dirt, debris or other deleterious material prior to sealer application, the Contractor shall clean the affected areas to the satisfaction of the Consultant.* *All costs associated with the supply and application of sealer to deck overlay areas, including cleaning as required, will be considered incidental to the Work, and no separate or additional payment will be made.*
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.	*20.5.7.7* Opening to Traffic *The* concrete overlay shall not be opened to traffic until the *concrete has been cured in accordance with Subsection 20.5.7.5 and has reached a minimum strength of 35 MPa.*
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 overlayed. 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 overlayed and remaining in the completed structure.	**20.6 Measurement and Payment** 20.6.1 *Surface Removal* *Measurement of surface removal will be by the square metre of surface acceptably removed, measured to the nearest 0.1 m^2.* *Payment will be made at the unit price bid for "Surface Removal", and will be full compensation for removal of the existing wearing surface and concrete to the depths specified; deck surface cleaning; disposal of debris; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.* *20.6.2 Partial and Full Depth Repairs* *Measurement of partial and full depth repair areas will be by the square metre of concrete acceptably repaired, regardless of depth, measured to the nearest 0.1 m^2.*

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 m^3 portion of the concrete pour indicates concrete failing to meet fully the specifications above, the Department may accept that 10 m^3 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.	*Payment will be made at the unit prices bid for “Partial Depth Repair” or “Full Depth Repair”, as applicable, for the locations identified. Payments will be full compensation for the containment and removal of unsound concrete; sandblasting; disposal of debris; the supply and installation of additional reinforcing steel where required; epoxy coated reinforcing steel coating repair and/or the supply and installation of galvanic anodes as required; provision and removal of all forming, scaffolding and falsework; repair material placement; and all labour, materials, equipment, tools and incidentals to complete the Work to the satisfaction of the Consultant.* *Where concrete is used for repairs, it will be subject to strength requirement testing and penalty assessment described in Subsection 20.4.3, Full Depth Repair.* *20.6.3 Deck Sandblasting* *Measurement of deck surface sandblasting will be by the square metre of horizontal bridge deck surface acceptably treated, measured to the nearest 0.1 m^2. No allowance will be made for required sandblasting of the vertical faces of curbs, medians and barriers.* *Payment will be made at the unit price bid for “Sandblasting - Bridge Deck", and will be full compensation for sandblasting; cleaning of the sandblasted area, including disposal of debris; and all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.* *20.6.4 Deck Overlay Concrete* *Measurement for the supply of deck overlay concrete will be by the cubic metre of acceptable overlay concrete remaining in the completed work, calculated to the nearest 0.1 m^3. The cubic metre quantity will be calculated by the Consultant from the final "dry run" values and the area overlaid. Concrete overpour will not be included in the quantity calculation.* *Payment will made at the unit price bid for "Deck Overlay Concrete - Supply", and will be full compensation for supplying the concrete to the bridge site from batch plants or by site batching; including all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.* *Measurement for placement of deck overlay concrete will be by the square metre of concrete acceptably placed and remaining in the structure,*

	measured to the nearest 0.1 m^2 *Payment will be made at the unit price bid for "Deck Overlay Concrete - Place", and will be full compensation for the supply and application of water for surface saturation; the supply and application of slurry grout; concrete placement, finishing and curing; and all labour, equipment, tools and incidentals to complete the Work to the satisfaction of the Consultant.* *Concrete overlay failing to meet the 28 day minimum compressive strength requirement of 45 MPa is subject to payment adjustment as described in Subsection 4.26 of Section 4, Cast-In-Place Concrete.*
Section 21 Removal and Salvage of Bridge Structures	**Section 21 Removal and Salvage of Bridge Structures**
21.1 General ... All materials in bridge structures are the property of the Department. Prior to removal of bridge structures the Contractor shall obtain, from the Consultant, a list of materials to be salvaged and permission to proceed. In general, treated timber, structural steel, corrugated steel pipes and precast concrete units will be listed for salvage.	**21.1 General** ... All materials in bridge structures are the property of the Department. Prior to removal of bridge structures the Contractor shall obtain, from the Consultant, a list of materials to be salvaged and permission to proceed. *Treated* timber, structural steel, corrugated steel pipes and precast concrete units *may be considered for salvage and when required will be specified in the Special Provision of the contract*.
21.4.3 Disposal ... In general, the portion of bridge abutments and piers located above natural ground level shall be completely removed, and the portion below the natural ground level may remain in place.	21.4.3 Disposal ... In general, the portion of bridge abutments and piers located above natural ground level shall be completely removed, and the portion *1 metre* below the natural ground level may remain in place.
Section 22 Painting	**Section 22 Painting**
22.2 Standards - Society for Protective Coatings (SSPC) "Standard Procedure for Evaluating the Qualifications of Painting Contractors" SSPC-QP1. - Society for Protective Coatings (SSPC) "Standard Procedure for Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint" SSPC-QP2 - Society for Protective Coatings (SSPC) Guide 6-Guide for Containing	**22.2 Standards** - Society for Protective Coatings (SSPC) "Standard Procedure for Evaluating the Qualifications of Painting Contractors" SSPC-QP1. - *SSPC* "Standard Procedure for Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint" SSPC-QP2 - *SSPC* Guide 6-Guide for Containing Debris Generated During Paint Removal Operations.

Debris Generated During Paint Removal Operations. - Society for Protective Coatings (SSPC) SP 1 Solvent Cleaning. - Society for Protective Coatings (SSPC) SP 6 Commercial Blast Cleaning. - Society for Protective Coatings (SSPC) SP 7 Brush-Off Blast Cleaning. - Society for Protective Coatings (SSPC) SP 10 Near-White Blast Cleaning. - Society for Protective Coatings (SSPC) SP 12 Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Re-coating. - Alberta Transportation "Fish Habitat Manual" - Alberta Transportation "Approved Paint Systems" SSPC specifications are available from: The Society of Protective Coatings Telephone: (412) 281-2331 40 - 24th Street, 6th Floor Website: http://www.sspc.org Pittsburgh, PA 15222-4656 USA Alberta Transportation APPROVED PRODUCTS – Bridge Coating Systems (Paint) are available on the internet at: http://www.transportation.alberta.ca/Content/docType253/Production/paintlist.pdf	- *SSPC* SP 1 Solvent Cleaning. - *SSPC* SP 2 Hand Tool Cleaning. - *SSPC* SP 3 Power Tool Cleaning. - *SSPC* SP 5 White Metal Blast Cleaning. - *SSPC* SP 6 Commercial Blast Cleaning. - *SSPC* SP 7 Brush-Off Blast Cleaning. - *SSPC* SP 10 Near-White Blast Cleaning. - *SSPC* SP 12 Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Re-coating. - *SSPC AB1 Mineral and Slag Abrasives.* - *SSPC AB2 Cleanliness of Recycled Ferrous Metallic Abrasives.* - *SSPC AB3 Newly Manufactured or Re-Manufactured Steel Abrasives.* - *SSPC PA Guide No.11 Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating* - *SSPC PA 2 Measurement of Dry Coating Thickness with Magnetic Gauges* - Alberta Transportation "Fish Habitat Manual" *SSPC specifications are available at http://www.sspc.org* Alberta Transportation *Product List – Approved Products "Bridge Coating Systems – Paint" available on the Department's website* at: http://www.transportation.alberta.ca/Content/docType253/Production/paintlist.pdf
22.3 Contractor Qualifications One of four levels of Contractor competency will be specified in the Special Provisions of the Contract. The levels of competency are as follows: CQ1 The Contractor and any subcontractors must have certification in good standing with the Society for Protective Coatings (SSPC) under SSPC-QP2. CQ2 The Contractor and any subcontractors must have certification in good standing with the Society for Protective Coatings (SSPC) under SSPC-QP1. CQ3 Contractor acceptance based on submission of documented experience which should include but not be limited to: The names of owners, projects and dates of previous bridge painting projects where containment and disposal of blasting spoil was practised, copies of any	**22.3 Contractor Qualifications** One of *the following four competency levels* will be specified in the Special Provisions of the Contract. CQ1 The Contractor *or painting* subcontractor must have certification in good standing with the Society for Protective Coatings (SSPC) under SSPC-QP2. CQ2 The Contractor *or painting* subcontractor must have certification in good standing with the Society for Protective Coatings (SSPC) under SSPC-QP1. CQ3 *The Contractor or painting subcontractor acceptance will be* based on submission of documented experience which should include but not be limited to: the names of owners, projects and dates of previous bridge painting projects where containment and disposal of blasting spoil was

relevant environmental permits and any citations for failure to comply. A list of qualified personnel will be responsible for the actual paint removal and application. Once accepted no personnel changes shall be made without the Consultant's acceptance. Permission for the Consultant to interview the owners, environmental departments and personnel listed above. Falsifying information in the submission will be grounds for disqualification of the bid. CQ4 No specific pre-qualification requirements.	practised, copies of any relevant environmental permits and any citations for failure to comply. A list of qualified personnel responsible for the actual paint removal and application will be required. Once accepted no personnel changes shall be made without the Consultant's written acceptance. Permission for the Consultant to interview the owners, environmental departments and personnel listed above. Falsifying information in the submission will be grounds for disqualification of the bid. CQ4 No specific pre-qualification requirements.
22.4.1 Supply The painting Contractor shall supply all materials to satisfactorily complete the work.	22.4.1 Supply The *Contractor or painting subcontractor* shall supply all materials to satisfactorily complete the work.
22.4.2 Blasting Media Contractors may choose the type of abrasive intended for use, taking into consideration the abrasive disposal and worker's health implications of each type.	22.4.2 Blasting Media Contractors may choose the type of abrasive intended for use, taking into consideration the abrasive disposal and worker's health implications of each type. *The abrasive selected shall comply with the applicable Society for Protective Coatings (SSPC) standard.*
22.4.3 Paint The contractor shall use only the paint systems listed in the Alberta Transportation "Approved Paint Systems" specified in the Special Provisions of the applicable painting contract. The material data sheets and material safety data sheets of the chosen paint system shall be submitted with the contractors work procedure. Only one paint system shall be used throughout the project unless specified otherwise. The contractor shall not change to another approved system once the initial paint system has been applied to any portion of the structure. For each batch, the Contractor shall carry out the necessary testing prior to usage, to ensure the paint being supplied meets Alberta Transportation requirements for: – colour – gloss – solids content – IR (Infra red analysis for comparison with the original approval testing) – EDXA (Energy dissipating x-ray analysis for comparison with the original	22.4.3 Paint The Contractor shall *select an approved product from the Alberta Transportation Product List – Approved Products "Bridge Coating Systems – Paint". The paint system shall be from the category specified in the Special Provisions*. The material data sheets and material safety data sheets of the chosen paint system shall be submitted with the *Contractor's work proposal*. *A single* paint system shall be used throughout the *entire* project unless specified otherwise. The Contractor shall not change to another *paint* system once the initial paint system has been applied to any portion of the structure. The paint shall be delivered in sealed, original, labelled containers bearing the Manufacturer's name, type of paint, brand name, colour designation, batch number and instructions for mixing and/or reducing. For each batch *of paint used on the project,* the Contractor shall *have an independent laboratory* carry out *quality control tests for colour, gloss and formulation. The results shall be submitted to the Consultant for review and acceptance a minimum two weeks prior to the anticipated commencement of painting operations. No paint shall be applied to the structure prior to*

approval testing) The paint shall be delivered in sealed, original, labelled containers, bearing the Manufacturer's name, type of paint, brand name, colour designation, batch number and instructions for mixing and/or reducing. Each batch of paint or coating will be sampled and tested by the Department and Consultant. Four (one litre) samples of paint will be removed and retained from a pail or barrel chosen at random by the Consultant. The samples will be tested to assure the paint complies with the original approval testing.	*acceptance of the test results by the Consultant and Department*. *Colour testing for the mixed top coat shall be carried out in accordance with ASTM D2244 with a CIE 1976 L*A*B, 2 degree observer, and a D65 illuminate.* *Gloss testing for the mixed top coat shall be carried out in accordance with ASTM D523 at 60 degrees.* *Infrared Spectroscopy (IR) shall be conducted on all individual components of the paint system prior to mixing, to confirm that the formulation conforms to that which was originally approved. A minimum 32 scans shall be taken with a Fourier transform infrared spectrometer between 4000 and 400 wave-numbers (CM-1) using the salt plate sandwich technique. The salt plate may be made from potassium bromide for non-aqueous paints. If the formulation contains water; appropriate, non-water soluble plates shall be used. Plate material shall be reported with each individual spectrum. The spectra shall be taken of vehicle portion of the coating without the pigment. For single component materials, a representative sample of the material shall be centrifuged to remove pigment and then analyzed. For plural component materials, each of the individual components shall be centrifuged to remove pigment and then analyzed separately. IR analysis of the mixed components is not required. The IR plots shall be completed with transmittance (0 – 100%) on the y-axis and Wave-numbers (4000 – 400; non-linear) on the x-axis. All peaks shall be labelled with the corresponding wave-number. The spectra shall be taken such that the largest peaks are at 50 – 0%T and the baseline is greater than 80%T. Materials with IR plots indicating a change in formulation from that which was originally approved will be rejected.* Each batch of paint *may be subjected to additional testing* by the Department or Consultant. *If requested, the Contractor shall provide* four *– 250 ml* samples of paint from a pail or barrel chosen by the *Department or* Consultant. *Samples shall be placed in suitable new, clean, metal containers; and sealed to avoid contamination of the paint.*
22.5 Examination of the Work Before submitting a bid the Contractor is required to thoroughly examine the bridge structure, to become aware of the existing condition of the surfaces to be painted. He is to be completely familiar with every detail and intent of both	

this specification and the scope of the work to be performed, as detailed in the contract Special Provisions. Each bidder is to examine the site and the surrounding area and become familiar with any restrictions or possible restrictions, public traffic, and the property of others. Bidders may conduct their own site testing to verify the blasting required and the lead content that may be expected in the blasting spoil. Any site testing must be pre-acceptable to Alberta Transportation/Consultant.	
22.6 Environmental Issues 22.6.1 Emission Levels 22.6.2 Environmental Regulations The Contractor shall ensure that existing paint being removed, and any abrasive material used to accomplish the removal, is contained and properly and safely disposed of in accordance with the applicable law. The Contractor shall comply with all Federal, Provincial, and Municipal, air, soil and water pollution control regulations, when cleaning and repainting the structural steel and when disposing of any waste generated. These specifications set forth minimum requirements necessary to protect the environment. The Contractor shall perform additional work or to otherwise modify containment or disposal procedures to ensure compliance with all applicable laws and regulations. 22.6.3 Fish Habitat 22.6.4 Blasting Spoil Recovery 22.6.5 Protection of Property 22.6.6 Compliance 22.6.7 Background Contamination Levels Pollution of the environment shall be minimized at all times during the cleaning and painting of the bridge. The Contractor's work may be monitored by other agencies. The Contractor is advised to consider collection of background levels of possible previous air, water and soil contamination prior to commencing work at the site.	***22.5 Environmental Considerations*** *22.5.1* Emission Levels *22.5.2* Environmental Regulations The Contractor shall ensure that existing paint being removed, and any abrasive material used to accomplish the removal, is contained and properly and safely disposed of in accordance with the applicable laws and regulations. The Contractor shall comply with all Federal, Provincial, and Municipal, air, soil and water pollution control regulations, when cleaning and repainting the structural steel and when disposing of any waste generated. These specifications set forth minimum requirements necessary to protect the environment. The Contractor shall perform additional work to modify containment or disposal procedures to ensure compliance with all applicable laws and regulations. *22.5.3* Fish Habitat *22.5.4* Blasting Spoil Recovery *22.5.5* Protection of Property *22.5.6* Quality Assurance *22.5.7* Background Contamination Levels Pollution of the environment shall be minimized at all times during the *Work.* The Contractor's *operations* may *also* be monitored by other agencies. *The Contractor shall identify locations in which to establish background soil, water/snow, and air contamination levels in his work proposal. After the Contractor's work proposal has been reviewed and accepted by the Consultant and prior to commencement of the work, the Contractor shall*

	collect soil, water/snow, and air samples from the project site for analysis. Samples shall be collected in the presence of the Consultant and at locations most likely affected by the work, such as at the dust collector, recycling unit, key points along the spoil material transfer lines, and spoil material storage areas. As a minimum, three samples shall be collected at each location and sent to an accredited laboratory approved by the Consultant for analysis. Analysis shall be consistent with regulatory reporting requirements and results submitted to the Consultant. *The Consultant may require the Contractor to collect additional soil, water/snow, and air samples at the site for analysis during the course of the work if contamination is suspected. If requested, the Contractor shall immediately collect samples and have them analyzed at the approved laboratory. Results shall be forwarded to the Consultant within one week of collecting the samples.* *The Contractor shall collect samples at all established background locations once painting operations are completed and equipment is removed from the site. As a minimum, two post construction composition tests shall be completed at each background location and results submitted to the Consultant for review and acceptance. Analysis shall be performed at the approved laboratory using the same test methods used for initial background analysis. If post construction analyses show that the Contractor's work has adversely affected the environment, site remediation will be required and shall be carried out to the full satisfaction of the Department and the Consultant.* *All cost associated with soil, water/snow, and air sampling including any subsequent site remediation requirements will be considered incidental to the Work and no separate or additional payment will be made*.
22.8 Work Proposal The contractor shall submit his proposed work methods to the Consultant, for review two weeks prior to commencement of work. These methods shall include but not be limited to: – Schedule – Sequence of operations – Traffic accommodation strategy – Placement of equipment	***22.7*** **Work Proposal** The Contractor shall submit his work proposal to the Consultant for review and acceptance a minimum of two weeks prior to the pre-construction meeting. The work proposal shall include, but not be limited to: – Schedule – Sequence of operations – Traffic accommodation strategy *– Site lay down plan including placement of equipment*

– Storage, handling and disposal of new and contaminated blasting material – Methods of weighing blasting material on and off the project – Method of separating hazardous and non hazardous blasting spoil – Sample documentation for tracking the disposal of hazardous waste – The final destination of hazardous waste Plans sealed by a Professional Engineer registered in Alberta, detailing the Contractor's containment structure, scaffolding, platforms, or swing stages to be employed, shall be submitted to the Consultant for review. These drawings shall clearly indicate where and how the spent blasting media is collected, recovered, weighed and removed from the project. All scaffolding, platforms, swing stages and material collection equipment shall be designed and operated in accordance with the authority having jurisdiction.	*– Proposed sampling locations for establishment of background contamination levels* *– Bridge washing strategy* – Storage, handling and disposal of new and contaminated blasting material – Methods of weighing blasting material on and off the project – Method of separating hazardous and non hazardous blasting spoil – Sample documentation for tracking the disposal of hazardous waste – The final destination of hazardous waste *– Chosen coating system from the Alberta Transportation Product List - Approved Products "Bridge Coating Systems (Paint)"* *– Bridge load evaluation report* *The Contractor shall submit drawings signed and* sealed by a Professional Engineer registered in the Province of Alberta detailing his containment structure, scaffolding, platforms, swing stages, *and attachments for the Consultant's review*. All scaffolding, platforms, swing stages and material collection equipment shall be designed and operated in accordance with the authority having jurisdiction.
	22.9 Bridge Load Evaluation Report *The Contractor shall engage a Professional Engineer registered in the Province of Alberta to prepare and submit a bridge load evaluation report. In the bridge evaluation report the Contractor's Engineer shall identify all loadings imposed on the bridge during the Work or staging of the Work, determine where to transfer the loads to the bridge, and evaluate the ability of the bridge to accommodate the loads in accordance with the Canadian Highway Bridge Design Code CAN/CSA-S6 and the following provisions:* • *Dead loads and dead load factors shall be in accordance with Section 14;* • *Vehicle live loads and vehicle live load factors shall be in accordance with Section 14. The load rating evaluation vehicles shall be the Alberta Transportation single unit vehicle (CS 28t), two-unit vehicle (CS2-49t) and vehicle train (CS3-63.5t).* • *Notwithstanding Clause 14.9.5.3, winds loads shall be considered when the Contractor's containment system results in an increased wind loading on the bridge. Wind loads shall be incorporated in the evaluation with load combinations ULS3 and ULS4 as per Section 3. Design wind loads may be adjusted if a written work procedure for removing the screens/containment system at projected wind speeds is developed by the Contractor's*

	Professional Engineer, adequately demonstrated, and reviewed and accepted by the Consultant and the Department. • *All other construction live loads and live load factors shall be in accordance with Section 3.* *Components of the bridge that shall be evaluated and rated include, but are not limited to, the bridge superstructure and bridge bearings. Bridge bearings shall be evaluated and rated in cases where the Contractor's containment system results in an increased wind loading on the bridge in any direction or alternate means of load transfer are imposed on the bridge. Bridge substructure components are typically not included in the evaluation and rating, but may be required at some bridge sites. When required, rating of the bridge substructure will be specified in the Special Provisions of the Contract.* *When containment systems include temporary structural elements to strengthen bridge components, details of the fabrication, installation and removal of the temporary structural elements shall be clearly detailed in the bridge load evaluation report.* *The bridge load evaluation report shall also provide Live Load Rating Factors, as described in Clause 14.15, for all three load evaluation vehicles under the ultimate limit state ULS1 and shall demonstrate that the bridge capacity is adequate under the ultimate limit states of ULS3 and ULS4. The capacity of the bridge will be considered acceptable if the Live Load Rating Factors are greater than 1.0 and if the factored resistances exceed the factored load effects.* *The bridge load evaluation report shall be stamped by the Contractor's Engineer, and shall clearly identify the magnitude and direction of the imposed loads, where the loads from the containment system will be transferred to the bridge, and the Engineer's assessment in the ability of the bridge to accommodate these loads. The report shall be submitted to the Consultant for review and acceptance as part of the Contractor's work proposal.* *All costs associated with the preparation of the load evaluation report will be considered incidental to the Work and no separate or additional payment will be made.*
22.12.2 Containment System	22.12.2 Containment System

... The containment system and its operation shall meet or exceed the class of containment specified in the Special Provisions. When abrasive blast cleaning is used to clean and prepare the steel surfaces, the Contractor shall contain the paint chips, abrasive particles, and debris resulting from the operation. The containment system includes but is not limited to, such articles as cover panels, screens, tarps, scaffolds, supports, shrouds and ground sheets used to enclose the entire work area or a paint removal tool. The materials used for screens shall be of a commercial brand designed specifically for the purpose of containing and facilitating collection of blasting and painting debris. If woven screens are used, the material shall contain not more than 15% voids with a mesh opening not exceeding 20 mils (500 microns). If monitoring detects leakage of dust through the woven screens, exceeding the allowable, then the screens shall be replaced with ones of a tighter weave which will meet the recovery requirements. All materials used for screens shall be adequately reinforced to prevent tearing or displacement when subjected to construction, wind or other environmental loads and their related conditions. The Contractor shall engage a Professional Engineer, licence to practice in Alberta, who shall identify any loadings imposed on the bridge during the Work including but not limited to any containment system, scaffolding, platforms or swing stages, personnel, equipment and wind loads. The Contractor's Engineer shall determine where to transfer the loads to the bridge, and shall evaluate the ability of the bridge to accommodate the loads. The Contractor shall submit a report, stamped by the Contractor's Engineer, which clearly identifies the loads, where the loads will be transferred to the bridge, and the Engineer's assessment of the ability of the bridge to accommodate these loads. The report shall be submitted to the Consultant as part of the Contractor's Work Proposal. All costs associated with the preparation of the report, including wind loading analysis, will be considered incidental to the Work and no separate or additional payment will be made. The Contractor shall supply auxiliary lighting to improve visibility where necessary within the enclosure.	... The containment system and its operation shall meet or exceed the class of containment specified in the Special Provisions. When abrasive blast cleaning is used to clean and prepare the steel surfaces, the Contractor shall contain the paint chips, abrasive particles, and debris resulting from the operation. The containment system includes but is not limited to, such articles as cover panels, screens, tarps, scaffolds, supports, shrouds and ground sheets used to enclose the entire work area, *and equipment to clean, transport, collect, and store blast media*. The materials used for screens shall be of a commercial brand designed specifically for the purpose of containing and facilitating collection of blasting and painting debris. If woven screens are used, the material shall contain not more than 15% voids with a mesh opening not exceeding 20 mils (500 microns). If monitoring detects leakage of dust through the woven screens, exceeding the allowable, then the screens shall be replaced with ones of a tighter weave which will meet the recovery requirements. All materials used for screens shall be adequately reinforced to prevent tearing or displacement when subjected to construction, wind or other environmental loads and their related conditions. The Contractor shall supply auxiliary lighting to improve visibility where necessary within enclosures.

22.12.3 Abrasive Blasting Spoil Recovery Monitoring (1) Conventional Abrasive Blasting Blasting debris containment must provide a minimum percentage of recovery and emission control effectiveness as specified in the Special Provisions. The Contractor shall monitor the blasting spoil recovery by weighing the blasting material delivered to the job and the blasting spoil removed from the job. An enclosure which does not meet the specified criteria must be modified at the contractor's expense. No blasting shall be performed using an unmodified containment that does not recover the required percentage of the blasting spoil. The Contractor shall maintain a documented reporting system to provide gross weights, tare of containers and the calculated weight of the material provided to and removed from the structure. The blasting spoil shall be protected from absorbing any moisture. Contaminated blasting spoil shall be in a dry condition prior to making the recovery calculation. The recovery efficiency is to be calculated as follows: (a) Determine the dry weight of abrasive (Wa) used to blast clean the entire structure or monitored portions thereof. (b) Determine the weight of paint debris (Wp) for the same area. (c) Determine the weight of abrasive and paint debris removed (Wd) after blast cleaning the designated area, or the whole structure. (d) Calculate the recovery efficiency (RE) as follows: (e) Recovery efficiency reports shall be submitted to the Consultant on a weekly basis and for the entire project at the end of the project. ... Where the bridge extends over the waterway, the Contractor shall contain all debris and waste materials as described herein and shall also provide a temporary platform located directly underneath the area enclosed for surface preparation cleaning, power tool cleaning, or blast cleaning and paint application. The platform shall be adequately sized to contain and/or filter debris, wash water and paint during the cleaning or application operation. The containment enclosure shall extend down to the level of the platform and shall be secured to prevent release of other than filtered material. The surface of the platform shall be constructed to ensure collection and filtration of spent waste materials or shall be designed to collect, funnel and discharge the spent waste materials into waste containers.	22.12.3 *Containment System Monitoring* (1) Abrasive Blasting *The containment system shall provide emission control effectiveness such that random escapes to the environment do not exceed 3% of the work day (e.g. 15 minutes over an 8 hour work shift). Operations shall cease immediately if the limits of emission control are exceeded. An enclosure which does not meet the specified criteria shall be modified at the Contractor's expense. Blasting shall not resume until the Contractor has modified his containment system and the modifications have been reviewed and accepted by the Consultant.* *The Contractor shall maintain a documented reporting system to provide gross weights, tare of containers and the calculated weight of the material provided to and removed from the structure. The blasting spoil shall be protected from absorbing any moisture. Contaminated blasting spoil shall be in a dry condition prior to making the recovery calculation.* ... *The* Contractor shall contain all debris and waste materials as described herein and shall also provide a temporary platform located directly underneath the area enclosed for surface preparation cleaning, power tool cleaning, or blast cleaning and paint application. The platform shall be adequately sized to contain and/or filter debris, wash water and paint during the cleaning or application operation. The containment enclosure shall extend down to the level of the platform and shall be secured to prevent release of other than filtered material. The surface of the platform shall be constructed to ensure collection and filtration of spent waste materials or shall be designed to collect, funnel and discharge the spent waste materials into waste containers.

22.13 Bridge Washing Before any blast cleaning operations commence, the Contractor shall carry out surface cleaning operations on all steel designated to receive a coating system. All organic materials such as bird droppings, nests and any other non-structural items or pollutants attached to the steel are to be removed by hand cleaning operations. All oil, grease and road tar shall be removed manually with solvent cleaning as per SSPC Specification SP1. Any area contaminated with oil or grease shall be cleaned with an approved biodegradable detergent. The detergent is to be environmentally friendly and non toxic to fish. The Contractor shall supply copies of the applicable MSDS sheets to the Consultant prior to using the material. The entire area to be coated shall be washed clean of road spatter, chlorides and other surface contaminates using water of sufficient pressure and volume to flush the chlorides free of the structure. Cleaning will be inspected by testing for the chloride levels on the cleaned steel and by testing the run off water at the lower extremities of the steel being cleaned. Chloride contamination of the cleaned surface shall be less than that specified in the Special Provision prior to blast cleaning. Wash water shall be filtered through a suitable fabric, to remove any coarse paint particles which may have been loosened and washed from the structure. Wash water may be filtered through a woven screen material containing not more than 15% voids with a mesh opening not exceeding 20 mils (500 microns). No restriction will be imposed on disposal of water passing through a woven screen meeting the above requirements.	**22.13 Surface Cleaning** *Prior to the commencement of any surface preparation operations,* the Contractor shall carry out surface cleaning on all steel designated to receive a coating system *and adjacent surfaces that could contaminate surfaces to be prepared*. *Surface cleaning shall consist of the hand removal of* organic materials such as bird droppings and nests and other non-structural items *adhered* to the steel, *and bridge washing*. *Oil*, grease and road tar shall be removed manually *by* solvent cleaning *in accordance with* SSPC Specification SP1. *Remaining* area contaminated with *residual* oil or grease shall be cleaned with an approved biodegradable detergent. The detergent *shall* be environmentally friendly and non-toxic. The Contractor shall supply copies of the MSDS sheets *for the proposed cleaning products* to the Consultant *for review and acceptance* prior to using *these materials*. *All areas* to be coated shall be washed clean of road spatter, chlorides and other contaminates using water of sufficient pressure and volume to flush the *contaminants from* the structure. *Areas of cleaned steel shall be tested* for chloride *contaminants, soluble ferrous ions and sulphate contaminants*. Chloride contamination shall be *tested using Quantab Method or by Kitagawa Tube. Soluble ferrous ion contaminants shall be tested using ferrous ion test strips. Sulphate contaminates shall be tested using a barium chloride optical comparator or an alternative method accepted by the Consultant*. *Cleaning shall result in surfaces with less than 7 µg/cm^2 of chloride ion contaminants; less than 10 µg/cm^2 of soluble ferrous ion contaminants; and less than 17 µg/cm^2 of sulphate contaminants. All testing shall be carried out by the Contractor and the results submitted to the Consultant for review and acceptance prior to commencing surface preparation operations.* *Wash water shall be captured, filtered and disposed of in compliance with all applicable laws and regulations*.
22.17.2 Paint Application ... (9) Finish coat paint shall not be applied over touched up primer which is not dry.	22.17.2 Paint Application ... (9) Finish coat paint shall not be applied over *wet* touched up primer. (10) *All portions of the paint system shall be within the range of film*

(10) No portion of the paint shall be less than the specified film thickness(es). The film thickness(es) shall not be so great that either the appearance or service life of the paint will be detrimentally affected. Bolts, rivets, edges of members and other changes in surface contour shall also receive the specified film thickness(es). (11) To ensure that the proper dry film thickness is obtained, the wet film thickness shall be checked at the time the paint is applied. The minimum wet film thickness shall be equal to the dry film thickness divided by the percentage (expressed as a decimal) of solids in the paint used, with the result rounded up to the next full mil. Each painter shall have his own wet film thickness gauge and do frequent checks of the paint film as it is applied.	*thickness(es) in which it was originally approved.* Bolts, rivets, edges of members and other changes in surface contour shall also receive the required film thickness(es). (11) To ensure that the proper dry film thickness is obtained, the wet film thickness shall be checked at the time the paint is applied. The minimum wet film thickness shall be equal to the dry film thickness divided by the percentage (expressed as a decimal) of solids in the paint used, with the result rounded up to the next full mil. Each painter shall have his own wet film thickness gauge and do frequent checks of the paint film as it is applied. *Dry film thickness shall be verified with a Type 2 constant pressure probe magnetic gauge a defined by SSPC-PA 2. The magnetic gauge shall be calibrated in accordance with SSPC-PA 2.*
22.21 Repair Repair areas, as determined by the Consultant, shall be cleaned of all damaged paint and the system re-applied using all coats typical to the original paint system. Each coat shall be thoroughly dry before applying subsequent coats. The Contractor shall carry out all repairs at no additional cost to the Department.	**22.21 Repair** *Areas requiring repair,* shall be cleaned of all damaged paint and the system re-applied using all coats typical to the original paint system. Each coat shall be thoroughly dry before applying subsequent coats. The Contractor shall carry out all repairs *to the satisfaction of the Consultant* at no additional cost to the Department. *Support points for work platforms or containment structures shall be painted with the accepted paint system. Work platform designs shall consider the potential to adjust touch points so coatings can be applied as work progresses. The Contractor may submit proposed alternate paint systems and application procedures for the painting of touch points, however, any proposed alternate paint systems shall be equivalent in the protection provided, expected durability and the manner in which the system ages so visual uniformity is preserved over the life of the coating. The use of alternate materials and methods will be at the sole discretion of the Department and Consultant.*
22.22 Site Clean-Up The Contractor shall leave the entire site in a neat and tidy condition with all paint cans, masking materials and other debris removed from the site and disposed of in an acceptable manner.	**22.22 Site Clean-Up** The Contractor shall leave the entire site in a neat and tidy condition with all paint cans, masking materials and other debris removed from the site and disposed of in manner *acceptable to the Consultant and the Department*.
22.25 Joint Warranty	***22.23 5 Year Bridge Painting Warranty***

(1)When required in the Special Provisions of the contract, the Coating Manufacturer, the General Contractor and the Painting Contractor shall jointly warrant the coating and its application against all defects in material and workmanship for a period of five years. The warranty period will commence on the date of the final acceptance of the completed painting contract. (2)The Contractor and the Manufacturer shall jointly execute the form entitled, "Agreement to Provide a 5 Year Bridge Painting Warranty". The completed form shall be provided, prior to award of contract. (3)During the warranty period the Consultant or Alberta Transportation will inspect the coating system, at least sixty days prior to warranty expiration, and will advise the Contractors, the Manufacturer, and the Surety in writing of any defects or repairs that are required. Intermediate inspections may be made and warranty repairs claimed and completed by the Contractor each year of the five year warranty period. (4)Failure of the coating system shall include but not be limited to: Any de-bonding or failure of adhesion of the coating either to the structural steel or lack of inter-coat adhesion; the appearance of any rust stains on the structure due to loss of paint or due to leaking from joints between structural members; any loss of normal gloss or rapid change of colour of the coating. Damage to the coating due to vehicle impact or snow removal equipment will not constitute failure of the system. (5)Repair under warranty includes the cost to supply material, labour, and equipment necessary to restore the coating to acceptable condition as judged by the Department. (6)Warranty repairs shall be completed within 45 days of notification, or if this would place the repair work in winter weather conditions, by May 30 of the following year.	*The Contractor shall warranty the Work against all defects in material and workmanship for a period of five years. The warranty period will commence on the date of the final acceptance of the Work.* *The Contractor shall execute the form entitled, "5 Year Bridge Painting Warranty", a sample copy of which is contained in this Specification.* *During the warranty period, the Consultant and/or the Department will conduct yearly inspections of the coating system. A final inspection of the coating system will be carried out a minimum of sixty days prior to the expiration of the warranty period.* *Failure of the coating system shall include, but not be limited to: Any de-bonding or failure of adhesion of the coating either to the structural steel or lack of inter-coat adhesion; the appearance of any rust stains on the structure due to loss of paint or due to leaking from joints between structural members; any loss of normal gloss or rapid change of colour of the coating. Damage to the coating due to vehicle impact or snow removal equipment will not constitute failure of the system.* *Repair under warranty shall include, but is not limited to, all permitting, approvals, traffic accommodation, containment systems, labour, materials, equipment, tools and incidentals necessary to restore the coating to a condition acceptable to the Department at no cost to the Department.* *Warranty repairs shall be completed within 60 days of notification or, in the event this would place the repair work period in winter weather conditions, by the following June 30.*
AGREEMENT TO PROVIDE 5 YEAR BRIDGE PAINTING WARRANTY _____ (Name of Paint Manufacturer) manufacturer of _____	**5 YEAR BRIDGE PAINTING WARRANTY** _____ (Name of Contractor)

___ (Paint System Name) and_____ _____ (Contractor/Applicator's Company Name) who is an approved paint Applicator of the paint system, hereby certify that in the event that the Contractor is awarded the painting contract for _____ (Contract Number) _____ (Bridge File Number and Name) the undersigned parties jointly agree to provide a 5 year warranty for the work. Warranty period will commence at the completion of the work. The Warranty shall include all repair costs needed within the 5 year period. MANUFACTURER: _____ _____ _____ (Name of Company Officer) (Corporate Position) (Signature of Company Officer) _____ _____ _____ (Name of Witness) (Signature of Witness) (Date) CONTRACTOR/APPLICATOR: _____ _____ _____ (Name of Company Officer) (Corporate Position) (Signature of Company Officer) _____ _____ _____ (Name of Witness) (Signature of Witness) (Date)	_____ (Contract Number) _____ _____ (Bridge File Number and Name) _____ _____ (Name of Paint Manufacturer) _____ _____ (Paint System Name) The undersigned party agrees to provide a 5 year warranty for the Work. The warranty period will commence upon final acceptance by the Department of the work; and shall include all labour, materials, equipment, tools and incidentals necessary to repair all defects and restore the coating to a condition acceptable to the Department, at no cost to the Department. CONTRACTOR: _____ _____ _____ (Name of Company Officer) (Corporate Position) (Signature of

	Company Officer) _____ _____ _____ (Name of Witness) (Signature of Witness) (Date)
22.26.6 Paint Unless otherwise noted on the drawings shop primer shall be Zinga, organic zinc rich primer.	*22.24.6* Paint Unless noted otherwise, shop primer shall be an *inorganic* zinc rich primer *from the Alberta Transportation Product List – Approved Products "Bridge Coating Systems – Paint"*.
22.26.9 Recoat Time The maximum and minimum recoat time for the coating system being applied shall be observed and required conditioning agents or surface roughing between coats shall be done. Zinga primer may be recoated with itself after 2 hours, with other top coats after 48 hours. If a Zinga primed surface is left for more than 14 days without top coating, it must be water washed to remove zinc salts which will have formed on the surface.	*22.24.9* Recoat Time The maximum and minimum recoat time for the coating system being applied shall be observed and required conditioning agents or surface roughing between coats shall be done.
22.24.1 Surface Preparation and Painting ... Progress payments will be made on a monthly basis and will be based on the percentage of the total estimated area satisfactorily cleaned and coated as determined by the Consultant. Payment will not be made for areas which do not have the specified number of coats for the paint system used nor for areas which are complete but have designated repairs outstanding.	*22.26.1* Surface Preparation and Painting … Progress payments will be made on a monthly basis and will be based on the percentage of the total estimated area satisfactorily cleaned, *prepared* and coated as determined by the Consultant. Payment will not be made for areas which do not have the specified number of coats for the paint system used nor for *surfaces that require repair as per Section 22.21*.
22.24.2 Protection of the Environment Payment for Protection of the Environment will be made on the basis of the lump sum price bid, which shall include full compensation for the cost of furnishing all labour, materials, equipment, tools and incidentals necessary to complete the work. The lump sum payment for protection of the environment will be made in stages. An initial payment of 25% of the lump sum price bid will be made at the time all containment structures and equipment are acceptably erected on	*22.26.2* Protection of the Environment *22.26.2.1 General* Payment for Protection of the Environment will be made *by either unit price per span or lump sum price bid as applicable. Payment will not be made for work related to shop coating projects. Payment will be full compensation for all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.*

the bridge and the Contractor is prepared to commence surface preparation and painting operations. An additional 50% of the lump sum price bid will be paid, on a pro-rated basis, as portions of the bridge are acceptably painted. The final 25% of the lump sum price bid will be paid when the work is acceptably completed; all blasting spoil material has been accounted for, removed from the bridge site and a disposal site owner's acceptance has been received by the Consultant.	*22.26.2.2 Unit Price per Span Price Bid* *When the Unit Price Schedule contains unit price bid for this work, each payment will be made in stages as follows:* *– An initial payment of 60% of the unit price bid will be made once the containment structure and equipment for a respective span have been acceptably installed; and the Contractor is prepared to commence surface preparation and painting operations.* *– The final 40% of the unit price bid will be paid when the work on the respective span has been acceptably completed; all blasting spoil has been accounted for; the blasting spoil has been removed from the bridge site and the Contractor has provided the Consultant with written acceptance of the materials from the owners of the disposal site(s); the containment structure and equipment has been removed; and the area is returned to a condition acceptable to the Consultant.* *22.26.2.3 Lump Sum Price Bid* *When the Unit Price Schedule contains lump sum price bid for this work, payment will be made in stages as follows:* *– An initial payment of 60% of the lump sum price bid will be made once the complete containment structure and equipment have been acceptably installed; and the Contractor is prepared to commence surface preparation and painting operations.* *- The final 40% of the lump sum price bid will be paid once the work has been acceptably completed; all blasting spoil has been accounted for; the blasting spoil has been removed from the bridge site and the Contractor has provided the Consultant with written acceptance of the materials from the owners of the disposal site(s); the containment structures and equipment has been removed; and the area is returned to a condition acceptable to the Consultant.*
Section 24 Sign Structures and Panels	**Section 24 Sign Structures and Panels**
24.2.1.1 Design Standards The design shall be carried out by the Contractor. The Contractor's design engineer shall be a Professional Engineer registered to practice in the Province of Alberta under the APEGGA Act.	24.2.1.1 Design Standards The design shall be carried out by the Contractor, *using the general layout information prepared by the Consultant*. The Contractor's design engineer shall be a Professional Engineer registered to practice in the Province of

The design shall be in accordance with the requirements of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", latest Edition and Interims, unless noted otherwise in these special provisions.	Alberta under the APEGGA Act.
AASHTO equation 3 1, Clause 3.8.1, shall be modified as follows:	The design shall be in accordance with the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, latest Edition and Interims, unless noted otherwise in these *specifications*.
Pz = 2.7 q Kz Cd	AASHTO equation 3 1, Clause 3.8.1, shall be modified as follows:
where q shall be taken from CAN/CSA S6 06, Table A3.1.7 for a return period of 50 years.	Pz = 2.5 q Kz Cd
The design ice thickness for ice accretion shall be the value given in CAN/CSA S6 06 Figure A3.1.4.	where q shall be taken from CAN/CSA S6 06, Table *A3.1.1* for a return period of 50 years.
For the design of all cantilevered sign structures, the Fatigue Importance Factors in Table 11 1 shall be based on Fatigue Category I. The deflection for cantilevered sign structures, as specified in Clause 11.8, shall not exceed 200 mm.	The design ice thickness for ice accretion shall be the value given in CAN/CSA S6 06 Figure A3.1.4.
Anchor bolts shall be post tensioned to 0.70 Fpu. Stresses for anchor bolts shall be limited to 0.50 Fpu applied to the root tensile stress area for Group Load Combination I, II & III. Stress range for Group IV shall be in accordance with Section 11. 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.	For the design of all cantilevered sign structures, the Fatigue Importance Factors in Table 11 1 shall be based on Fatigue Category I. *Further to AASHTO Standard Specifications section 11.7 "Fatigue Design Loads", a dynamic analysis of the structure will not be accepted in lieu of using the equivalent static pressures provided in the specifications;* *Further to AASHTO Standard Specifications section 11.7.1 "Galloping", the Department will not approve the use of vibration mitigation devices in lieu of designing to resist periodic galloping forces. Furthermore, the Department requires that the galloping loads be part of the fatigue design of all overhead cantilevered sign support structures regardless of their configuration;* *Further to AASHTO Standard Specifications section 11.8 "Deflection", the vertical deflection for sign structures shall not exceed 200 mm regardless of their configuration*.
Design sign panel area shall be taken as the largest of: (a) Actual sign panels shown on the drawings. (b) Future sign panels shown on the drawings. (c) Area of 3.5 m x 60% of horizontal span length, placed in any position along the span.	Design sign panel area shall be taken as the largest of: (a) Actual sign panels shown on the drawings. (b) Future sign panels shown on the drawings. (c) Area of 3.5 m x 60% of horizontal span length *(span length includes portion of arm over clear zone),* placed in any position along the span *that will produce the most critical loading conditions in the structure*.
The structures shall have a permanent vertical camber of at least L/200.	*Sign* structures shall have a *minimum* permanent vertical camber of L/200 *under a loaded condition, where L is the span of the horizontal arm of the*
The top of the concrete foundations shall project from 700 mm to 850 mm 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.	

	sign structure. Cantilever arm lengths shall not exceed 20m The top of the concrete foundations shall project from 700 mm to 850 mm 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 *measured to the bottom edge of sign panel of overhead sign structures* shall be 6.0 metres. *The bottom edge of the structural framing for the sign shall be at least 0.6 m higher than the bottom edge of the sign panels*.
24.2.1.2 Design Notes and Drawings ... (g) Erection procedure including tensioning procedure for anchor bolts.	24.2.1.2 Design Notes and Drawings ... (g) Erection procedure including *any temporary supports, grouting and tightening procedure for anchor rod nuts*.
24.2.2.1 Standards Fabrication of sign 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.	24.2.2.1 Standards Fabrication of sign structures shall conform to *AASHTO LRFD Bridge Construction Specifications* and the American Welding Society (AWS) Bridge Welding Code D1.5.
24.2.2.3 Engineering Data … (3) Mill Certificates Mill certificates shall be provided for all material before fabrication commences.	24.2.2.3 Engineering Data … (3) Mill Certificates Mill certificates shall be provided for all material before fabrication commences. *Where mill test certificates originate from a mill outside Canada or the United States of America, the Contractor shall have the material tested and the mill test certificate verified by a Canadian laboratory. This laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and the signature of an authorized officer. It shall state that the*

	material is in conformance with the specified Contract requirements.
24.2.2.4 Materials (a) All materials shall be new (b) The use of aluminum and aluminum alloy are not acceptable, unless specifically stated otherwise by the Consultant (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 provided (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	24.2.2.4 Materials (a) All materials shall be new. (b) The use of aluminum and aluminum alloy are not acceptable, unless specifically stated otherwise by the Consultant. (c) Structural steel plate material shall conform to either CSA G40.21M *grade* 300W* *or 350W* or ASTM A572 GR. 50*. However, the yield strength of the steel plate shall be limited to 300 MPa when designing for fatigue regardless of the material used*. *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 0.15 to 0.25% *inclusive*. *All other structural shapes except HSS incorporated in the design shall conform to CSA G40.20M grade 300W or 350W with silicon content less than 0.04% inclusive*. *(d) HSS members shall conform to CSA G40.20M 350W Class H with silicon content less than 0.04%.* *(e) All bolts shall conform to American Society for Testing and Materials (ASTM) Standard A325 or shall meet property class 8.8 of the Industrial Fasteners Institute for metric high strength structural bolts. The nuts shall be conform to ASTM A563 and harden washers shall conform to ASTM F436. Metric bolts shall be marked with the symbol A325M and those of "weathering" steel shall have the A325M symbol underlined. Weathering steel nuts shall be marked with three circumferential lines or shall be marked with a symbol "3". Weathering steel washers shall be identified by a symbol "3". Certified mill test reports for the fastener material shall be provided.* *(f) Anchor rods shall be manufactured from smooth rods conforming to the requirements of ASTM F1554 Grade 55 (Fy=380 MPa). The anchor rod assembly shall consist of, but not limited to: anchor rods complete with nuts and washers, top temporary templates c/w clamping nuts, bottom anchor plates c/w anchor nuts and clamping nuts.* *(g) All steel materials including all hardware and anchor rod assemblies shall be hot dip galvanized*
24.2.2.5 Welding (1) Filler Metals	24.2.2.5 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. Field application of metal core arc welding is not allowed.	Low hydrogen filler, fluxes and low hydrogen welding practices shall be used throughout. *Filler metal with AWS designation of hydrogen level of H4 will only be permitted.* 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 will be allowed. The deposited weld metal shall provide strength, durability, impact toughness and corrosion resistance equivalent to base metal. Field application of metal core arc welding is not allowed.
(2) Cleaning Prior to Welding Weld areas must be clean, free of mill scale, dirt, grease, and other contaminants prior to welding.	(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.	(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 backing bar is used for 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 150 mm of circumferential welds and 150 mm beyond hand holes (when provided) shall be full penetration groove welds. Transition 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° 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 5 mm. A rod size no greater than 4.0 mm shall be used for the first pass. A reinforcing fillet weld shall be placed all around the joint.	(4) Weld Penetration *The column to base plate and flange to horizontal arm full penetration welds shall be completed using backing bars. All other full penetration welds shall be made by using backing bars or backgouged to sound metal. The longitudinal seams shall have a minimum 60% penetration. Backing bars will not be allowed for longitudinal seam welds.* The following welds shall have 100% penetration: (a) Column to base plate (b) *Horizontal arm* to flange plate *(c)* Longitudinal seam welds within 150 mm of circumferential welds and 150 mm beyond hand holes (when provided) shall be full penetration groove welds. Transition between full and partial penetration welds shall be ground smooth. (d) Backing bar splices *Backing bars shall be minimum dimensions of 8 x 30 mm for full penetration welds. These shall be properly fitted and welded all around top and bottom of the member. The groove weld shall be placed in a minimum of two passes.* A reinforcing fillet weld shall be placed all around the joint.
(5) Tack and Temporary Welds	*(5) Preheat and Interpass Temperatures* *Preheat and interpass temperatures shall be as per AWS D1.5. All full*

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. The tabs shall be a minimum of 100 mm long unless greater length is required for satisfactory work. 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 for review and acceptance by the Department and Consultant 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 Department and Consultant for review and 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 the Consultant to ensure complete removal of the metal in the affected area. (9) Plug and Slot Welds Plug welds or slot welds shall not be permitted.	*penetration welds shall be preheated and interpass temperature maintained to a minimum of 100°C unless a higher temperature is required by AWS D1.5 Table 12.3 for the material thickness. The preheat temperature shall be measured 75 mm from the point of welding.* *(6)* 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 *re-welding*. *(7)* Run off Tabs Run off tabs shall be used at the ends of all welds that terminate at the edge of a member. The tabs shall be a minimum of 100 mm long unless greater length is required for satisfactory work. 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. *(8)* Methods of Weldment Repair Repair procedures for unsatisfactory weldments shall be submitted for review and acceptance by the Department and Consultant prior to repair work commencing. *(9)* Arc Strikes Arc strikes will not be permitted. In the event of accidental arc strikes, the Contractor shall submit to the Department and Consultant for review and 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 the Consultant to ensure complete removal of the metal in the affected area. *(10)* Plug and Slot Welds Plug welds or slot welds shall not be permitted.
24.2.2.6 Fabrication … (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 12 m span may have a bolted splice.	24.2.2.6 Fabrication … (4) Additional Requirements (a) Each column, arm, extension, clamp and bracket shall be fabricated from one piece of sheet steel *with a maximum of 2 longitudinal seam welds* unless accepted otherwise. *Laminating of plates shall not be allowed*

(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 10 mm larger than the bolt diameter. …	(b) Intermediate circumferential butt welds will not be allowed however horizontal members greater than 12 m 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. *The minimum bend radius for all cold formed sections shall be 100mm*. (d) All plates *and structural sections* 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 *sized in accordance with CAN/CSA S6-06 Clause 10.18.4.2(a). Further, the nominal diameter of all other bolt holes shall be 2mm greater than the nominal bolt size*. …
(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 60 mm or 0 to +5% (whichever is less) with the exception of sign bridge spans which shall be within 5 mm of the specified dimensions in unloaded condition. The tolerance for height shall be 0 to +60 mm. (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. …	(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 60 mm or 0 to +5% (whichever is less) with the exception of sign bridge spans which shall be within 5 mm of the specified dimensions in unloaded condition. The tolerance for height shall be *–0 to +60 mm*. (d) Across the Flat Dimensions *i. Regular Polygonal Cross-sections:* 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.
(7) Galvanizing Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and ASTM A153/A153M Standard Specification for Zinc Coating	

(Hot-Dip) on Iron and Steel Hardware with additions and exceptions as described in this specification. The Fabricator 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 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 Consultant will determine the acceptability of repaired areas.	*ii. Irregular Polygonal Cross-sections: The across the flats of the minor and major axis shall be within 2% of the specified dimensions and the sum of the minor and major axis across the flats must be within 1% of the specified dimensions.* … (7) Galvanizing *Factors contributing to galvanization-induced cracking shall be minimized.* Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and ASTM F2329 Standard Specification for *Zinc Coating Hot-Dip Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners* with additions and exceptions as described in this specification. The Fabricator 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 prior to its use. It should be noted that repairs may require complete removal of the galvanized coating and re-galvanizing. Repair shall be in compliance with ASTM A780, Method A3 "Metallizing". *However repair for areas not exceeding 100 mm2 may be done in accordance with ASTM Method A1 "Repair Using Zinc-Based Alloy"* The thickness of the *coating for both methods* shall be 180 µm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing. The Consultant will determine the acceptability of repaired areas.
24.2.3 Erection ... The structure shall be set accurately on galvanized shim plates. The shim plates must be located so that a minimum of 75 mm of distance is provided from shims to grout edge. The method of forming and pouring the grout shall be submitted to the Consultant for review and acceptance. Dry pack	24.2.3 Erection ... *The Contractor shall be responsible for any additional supports to maintain stability until the anchor rod nuts are fully tightened.* *After the top temporary template for the anchor rod assembly and clamping nuts are completely removed,* the structure shall be set accurately on

methods of constructing grout pads will not be accepted. Hand hole bolts shall be coated with anti seize lubricant. The Contractor shall erect the sign structure in a manner that addresses all safety issues including the interim period between erection, grouting and post-tensioning.	galvanized *shims on top of the concrete foundation*. The shim plates must be located so that a minimum of 75 mm of distance is provided from shims to grout edge. The method of forming and pouring the grout shall be submitted to the Consultant for review and acceptance. *Base plates shall be grouted with Sika 212 flowable grout or equivalent*. Dry pack methods of constructing grout pads will not be accepted. *The top of the finished grout elevation shall not be higher than the underside of the column base plate*. Hand hole bolts shall be coated with anti-seize lubricant.
24.2.4 Foundation ... (3)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. … (5) Protection of Sign Structures The Contractor shall erect the sign structure in a manner that addresses all safety issues including the interim period between erection, grouting and post-tensioning. After erection of sign structures, the Contractor shall place grout pockets and pads and post tension anchor bolts as soon as possible. However the Contractor shall provide adequate safe traffic accommodation until post tensioning and grouting is complete. (6) 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:	24.2.4 Foundation ... (3) Anchor *Rod* Installation Anchor *rods* shall be installed *true and plumb* in one complete assembly. *The assembly shall be accurately positioned and secured to prevent movement or displacement during concreting procedures.* No welding of any component is allowed. *The top anchor nuts shall have beveled washers if necessary to ensure full contact with the top of the column base plate. Anchor rod nuts shall be tightened an additional 1/3 turn of the nut past the snug-tight condition after the grout has attained sufficient strength. No nuts shall be allowed under the base plate. All voids including the slots and annular space around anchor rods in the base plate shall be filled with an approved corrosion inhibiting paste*. … (5) Protection of Sign Structures The Contractor shall erect the sign structure in a manner that addresses all safety issues including the interim period between erection grouting and *final tightening of anchor rod nuts*. After erection of the sign structures, the Contractor shall place grout pockets and pads and *tighten anchor rod nuts* as soon as possible *after grout has achieved sufficient strength*. However the Contractor shall provide adequate safe traffic accommodation until *tightening* and grouting is complete. (6) 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 *is, or is expected to be* below 5°C *during the placing and curing period*, the following provisions for cold weather grouting shall be applied:

(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.	(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 *15°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 *15°C* to 25°C for *a minimum of* five days. *The enclosure shall meet the requirements of Section 4 of the Specifications for Bridge Construction for concreting in cold weather*.
24.3.3 Construction ...	24.3.3 Construction … *19mm diameter x 38 mm long Stainless Steel slip arresting bolts shall be provided with each sign as follows:* *No. of Standard Height Sub Panels In Sign* / *Overall Maximum Sign Height (mm)* / *No. of Slip Arresting Bolts Per Each End of Each Sig* *< 9* / *2745* / *2* *10-13* / *3965* / *4* *14-17* / *5185* / *6* *Stainless steel slip arresting bolts and nuts shall meet the requirements of Type 316 ASTM F593H and Type 316 ASTM F594H respectively with a minimum yield strength of 310 MPa and a minimum tensile strength of 585 MPa. A stainless steel washer shall be provided under the nut side of the bolt. Slip arresting bolts shall have nuts tightened to a torque of 181 Nm.*
Section 25 Mechanically Stabilized Earth Walls	**Section 25 Mechanically Stabilized Earth Walls**
25.1 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 leveling pads, precast concrete panels, compacted granular backfill, soil reinforcement, perforated drain pipe complete with filter fabric sock, surface drains, cast-in-place concrete wall coping, traffic barrier, pedestrian railing, permanent safety railing or fence, hardware and all associated materials.	**25.1 General** This specification is for the design, supply, fabrication and construction of mechanically stabilized earth (MSE) retaining walls with precast concrete *fascia* panels. MSE retaining walls shall include, but not be limited to, excavation for the wall, concrete leveling pads, precast concrete *fascia* panels, compacted granular backfill, soil reinforcement, *inspection wires*, perforated drain pipe complete with filter fabric sock, *geotextiles, geomembranes*, surface drains, cast-in-place concrete wall coping, traffic barrier, pedestrian railing, permanent safety railing, hardware and all associated materials.

25.2.1 Design Requirements Location, layout, geometry control, global stability and allowable bearing capacity requirements shall be as specified in the contract documents. The Contractor's design responsibility shall include internal stability and all elements for a complete MSE wall system. The most stringent requirements of the 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	25.2.1 *General* Location, layout, geometry control, *short and long term* global stability, *allowable rate of fill placement,* and allowable bearing capacity requirements shall be as specified in the contract documents. The Contractor's design responsibility shall include internal *and external* stability (*sliding and overturning), tensile resistance, pullout resistances, and all other* elements for a complete MSE wall system. *The Contractor shall check the global stability design using actual soil properties upon confirmation of the source of backfill.* *If the wall system selected by the Contractor requires modification to any component of the project, the Contractor will be solely responsible for all costs required to complete the change. Proposed changes to the project shall be submitted to the Consultant and the Department for review and acceptance 3 weeks prior to commencement of detailed design.* The most stringent requirements of the following standards shall be met: • *Alberta Transportation Bridge Structures Design Criteria* • *Alberta Transportation Roadside Design Guide* • *CAN/CSA S6 – Canadian Highway Bridge Design Code (CHBDC)* • *AASHTO LRFD Bridge Design Specifications*
The design life for all MSE wall components shall be 100 years. Highway and bridge surface drainage shall be controlled and channeled away from the back of the MSE walls and mechanically stabilized earth mass. Weeping drains consisting of perforated 150 mm diameter pipe complete with filter sock shall be provided near the front and the back bottom corner of the mechanically stabilized earth 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. MSE walls with traffic running parallel to the top of the wall shall have rigid bridge barriers meeting the requirements of CHBDC Section 12. Such bridge barriers shall be located on top of the MSE walls and supported on the moment slab to resist sliding and overturning. Flexible guardrail systems shall not be used. All obstacles, such as sign supports and lighting posts, mounted on top of the barriers shall meet set-back and clearance requirements specified in the Roadside Design Guide. The MSE wall design	*25.2.2 Drainage* Water carrying appurtenances, such as catch basins, drainage inlets/outlets, culverts etc., shall be placed away from, or beyond the ends of the soil reinforcement zone, and provisions shall be made to mitigate the detrimental effects of potential leakage. *All galvanized steel soil reinforcement shall be protected from exposure to roadway de-icing salt by an impermeable geomembrane placed above the top layer of soil reinforcement. The membrane shall be sealed to prevent leakage, sloped to drain away from the bridge or wall and be connected to an outlet beyond the MSE soil mass. A non-woven geotextile filter fabric layer shall be placed below and above the membrane to prevent puncture. Weep* drains consisting of flexible perforated 150 mm diameter pipe complete with filter sock shall be provided near the front and the back bottom corner of the *MSE soil* mass. *Weep* drains shall be day lighted or connected *to an outlet to establish* positive drainage. *Downspouts shall be provided for deck joint and deck wick drain drainage.*

shall account for all load effects from such accessories. Water carrying appurtenances, such as catch basins, drainage inlets/outlets, culverts etc., shall preferably be placed away from, or close to the end of the soil reinforcement zone, and provisions shall be made to mitigate the detrimental effects of potential leakage. 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. For those MSE wall systems that lend themselves to splaying of the soil reinforcement, the splay angle shall not exceed 20° from the perpendicular of the facing panel. For other MSE wall systems, coverage ratios of soil reinforcement shall be specifically developed for each project. Pedestrian railing and permanent safety railing or fence may be mounted on top of MSE wall coping. Minimum precast concrete panel thickness shall be 140 mm, excluding any additional thickness required for aesthetic surface treatment. Minimum cover to reinforcing steel shall be 50 mm on both the front and back faces. Precast concrete panels shall be designed to accommodate a differential settlement of 100 mm in 10 metres of length along the wall. The spacing between adjacent panels shall be designed to be 20 mm nominal. Joints between panels should have a lip and recess (ship lap) configuration so that joint material is protected and overall aesthetics is enhanced. Butt joints may also be used if the Contractor can provide a backing board with sufficient strength and durability to meet 100 years life expectancy requirement. Acute corners less than 70° inside panels shall not be allowed. Special corner units shall be used when interior angle between adjacent panels is 130° or less. The top of the cast-in-place concrete wall coping shall be smooth and have no steps or abrupt changes in height. MSE wall panels shall be fully supported by compacted backfill without voids on the non-exposed side. For stepped leveling pads, the maximum elevation difference between	*Downspouts shall be rigid PVC type DB2 conduit meeting the requirements of CSA C22.2 No. 211.1. Couplers shall be solvent bell ends (SBE). Downspouts shall have a vertical slip joint with a dished top drain inlet cast into the wall coping. Downspouts shall not be directed through the mechanically stabilized earth mass. Down spouts shall be recessed full height in a chase formed into the front of precast concrete fascia panels or by using special fascia panels and covered with a 10 gauge or 2.6 mm thick steel plate. The plate shall be shop painted with a system selected from the SS1 or SS2 category of the Department's list of approved coating systems. Surface preparation shall be in accordance with the selected coating systems published product data sheet.* *The run of MSE walls shall slope away from bridge abutments. Grassed swales with a non-degradable erosion control mat shall be provided behind the top of MSE cast-in-place concrete wall coping, beyond the footprint of the bridge deck, and shall have a minimum width of 600 mm and a minimum depth of 150 mm. Concrete swales of the same dimension shall be provided behind the top of MSE cast-in-place concrete wall coping within the footprint of the bridge deck. Closed cell foam of adequate thickness to accommodate thermal movements shall be provided between the concrete swale and integral concrete bridge abutments. A 10 mm thick asphalt impregnated fibre board shall be placed between the concrete swale and semi-integral or conventional concrete bridge abutments. Swales shall have a bottom liner of impervious geomembrane.* *When a headslope is provided between the bridge abutment and concrete swale it shall be protected with concrete slope protection. Isolation with closed cell foam or asphalt impregnated fibre board shall be provided between the top of the concrete slope protection and abutment concrete as described above.*

adjacent steps shall not exceed 1250 mm. The minimum length of each stepped section shall be 1500 mm. Where staged construction is required and large differential settlement is expected between stages, appropriately located full height vertical slip joints shall be provided.	
	25.2.3 Barriers/Railings *In locations where traffic runs adjacent to the top of, and nominally parallel to a MSE wall, a rigid bridge barrier shall be provided that meets the appropriate Performance Level requirements of the CAN/CSA-S6 CODE Section 12 – Barriers and Highway Accessory Supports. Flexible guardrail systems shall not be used. The MSE wall shall be designed to fully resist the collision loads applied to the barrier, and loads from any attachments such as sign supports and lamp posts. All obstacles, such as sign supports and lamp posts, shall meet set-back and clearance requirements specified in the Alberta Transportation Roadside Design Guide. The barriers shall be located on top of the MSE wall, and supported on a moment slab to resist sliding and overturning. Approach rail transitions shall be provided at either end of the rigid bridge barrier as outlined in the Alberta Transportation Roadside Design Guide. Details for the Department's standard PL-2 Barrier System on top of MSE walls can be found on standard drawing S-1798.* *In locations where a sidewalk or a combined pedestrian/cyclist use pathway runs adjacent to the top of, and nominally parallel to a MSE wall, a pedestrian/cyclist railing shall be provided that meets the requirements of the Alberta Transportation Bridge Structures Design Criteria Section 21.2 – Pedestrian/Cyclist Railing. The MSE wall shall be designed to fully resist the loads applied to the railing, and loads from any attachments such as sign supports and lamp posts. The railing shall be mounted on the top surface of the concrete coping of the MSE wall.* *Unless a traffic barrier or a pedestrian/cyclist railing is mounted directly on top of a MSE wall, a safety railing shall be mounted on the top surface of the concrete coping of the MSE wall and shall be designed as a "guard" in accordance with the Alberta Building Code, Part 9. Safety railings shall have a minimum height of 1070 mm and shall consist of vertical posts with not less than two horizontal rails. Chain link fence shall not be used. The MSE wall shall be designed to fully resist the loads applied to the railing.*

	In locations where traffic is running adjacent to the bottom of, and nominally parallel to a MSE Wall, and where thriebeam approach rail transitions are anchored to one or both ends of the MSE wall, anchor blocks with sufficient strength shall be provided for anchoring of the thriebeam transitions where they connect to the ends of the MSE wall.
	25.2.4 Miscellaneous Details *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 reinforcement around such obstructions. For those MSE wall systems that lend themselves to splaying of the soil reinforcement, the splay angle shall not exceed 20° from perpendicular to the facing panel. For other MSE wall systems, coverage ratios of soil reinforcement shall be specifically developed for each project.* *Concrete leveling pads shall be used and project a minimum of 75 mm either side of the precast concrete fascia panels. Precast concrete fascia panels shall be centered on the concrete leveling pad. For stepped leveling pads, the maximum elevation difference between adjacent steps shall not exceed 1250 mm. The minimum length of each stepped section shall be 1500 mm.* *All MSE walls shall be battered back 50 to 1. MSE wall panels shall be fully supported by compacted backfill without voids on the non-exposed side.* *All MSE walls shall have a cast-in-place concrete wall coping running the full length of the top of the wall. The top of the coping shall be smooth, have no steps or abrupt changes in height, and a 3% wash slope towards the back of the wall. Copings shall have a drip groove located in the soffit and control joints. Drip groove and control joints shall be detailed in accordance with Standard Drawing S-1680 "Standard Curb Details". Control joints shall be located at precast concrete fascia panel joints, perpendicular to the wall direction and in no case exceed 4 m spacing. At control joints, longitudinal reinforcing shall be discontinuous and have a 50 mm concrete cover measured from the center of the joint.* *Precast concrete fascia panels shall have a minimum thickness of 140 mm, excluding any additional thickness required for aesthetic surface treatments. The minimum cover to reinforcing steel shall be 50 mm from all faces. Joints between panels shall have a lip and recess (ship lap) configuration. Butt joints may be used if a precast HPC concrete backing block with filter fabric is*

	designed and installed along the joint to prevent soil infiltration. Backing blocks shall overlap adjacent panels a minimum of 200 mm and have a minimum thickness of 140 mm. *Precast concrete fascia panels shall be designed to accommodate a differential settlement of 100 mm in 10 metres of length along the wall. The spacing between adjacent panels shall be designed to be 20 mm nominal. Where staged construction is required, and large differential settlement is expected between stages, appropriately located full height vertical slip joints shall be provided.* *To facilitate construction of the cast-in-place concrete wall coping pre-formed holes in precast concrete fascia panels are permitted provided the holes are located a minimum of 100 mm above the wall coping soffit.* *Acute wall corners less than 70° (measured between backfill sides of panels) shall not be used. Special corner panels shall be used to maintain the 20 mm nominal design joint gap along the front face of panels on either side of the bend line.* *A minimum 300 mm wide strip of filter fabric shall be installed behind all precast concrete fascia panel joints. An adhesive shall be used to hold the fabric securely against the panels centered on the vertical and horizontal joints. At MSE wall corners, the fabric shall be installed in one piece.*
	25.2.5 Inspection Components *An inspection access walkway shall be provided full width of the bridge superstructure in front of the abutment seat and on top of MSE abutment walls. The inspection access walkway shall have a minimum vertical clearance of 1200 mm under the girders and a minimum clear width of 1000 mm.* *Galvanized steel inspection wires shall be provided in all MSE wall systems in addition to the soil reinforcement design requirements. One inspection wire shall be provided for each 25 m2 of wall area. Inspection wires shall be placed in vertically distributed sets of 2 or 3 depending on the wall height. Two locations shall be provided where the wall height is less than 6 m and 3 locations provided where the wall height is greater than 6 m. Vertical distribution shall be such that a single inspection wire is placed within the center of the bottom wall panel, center of the top wall panel, and in the center wall panel when 3 locations are required. Sets of inspection wires shall be*

	evenly distributed along the length of the wall. *Inspection access ports, wire removal and centering devices shall be detailed in accordance with the California Department of Transportation standard bridge detail sheet XS13-020-3. Inspection access ports shall be cast as voids in the panels at the panel manufacturing facility and the remaining cavity placed and filled with an approved type OH-V patching product in accordance with the manufacturer's recommendations. All inspection access ports shall be marked with a 25 mm diameter galvanized survey target anchored into the patching material and flush with the wall surface. Survey targets shall not receive pigmented sealer when specified.*
25.2.2 Submissions and Consultant Review ... As a minimum, shop drawings shall contain: • Alberta Transportation 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 Contractor shall incorporate as-built conditions and re-submit the revised design notes and shop drawings for records at the completion of construction.	*25.2.6* Submissions and Consultant Review ... As a minimum, shop drawings shall contain: • Alberta Transportation bridge file number and project name on each drawing. • Design criteria and material lists. • *Backfill properties*. • 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 Contractor shall incorporate as-built conditions and submit revised design notes and shop drawings for records at the completion of construction. *One paper copy and one electronic copy (PDF format) of as constructed shop drawings, design notes, and supplier inspection construction records shall be submitted to the Consultant within three weeks of wall completion.*
25.3.1 Concrete Materials The fabrication of precast concrete panels shall conform to the requirements of Section 7 "Precast Concrete Units" of the Specifications for Bridge Construction. Any panel with crack exceeding 0.15 mm in width or 0.1 mm/m2 (of panel area) in length shall be rejected. The concrete for the panels shall be Class HPC, conforming to the requirements of Section 4.4 "Class and Composition of Concrete" of the Specifications for Bridge	25.3.1 Concrete *Concrete for leveling pads shall be Class C. Concrete for precast concrete fascia panels, anchor blocks, backing blocks, cast-in-place concrete wall copings, and all other concrete components shall be Class HPC. Concrete shall conform to the requirements of Section 4 "Cast-In-Place Concrete" of the Specifications for Bridge Construction. The maximum aggregate size for HPC concrete used in panel production shall suit the panel design and the*

Construction, with the exception that maximum aggregate size shall be 14 mm. The concrete leveling pads and the MSE wall coping shall conform to the requirements of Section 4 “Cast-In-Place Concrete” of the Specifications for Bridge Construction. The concrete for the leveling pads shall be Class B and the concrete for the wall coping shall be Class HPC. Chamfered edges shall be created around the periphery of all precast facing panels. The exposed faces of the precast panels and the cast-in-place wall coping shall have a Class 2 finish.	*requirements of CAN/CSA S6 and CAN/CSA 23.1.*
25.3.2 Concrete Reinforcing Materials Reinforcing steel is to be in accordance with Section 5 “Reinforcing Steel” of the Specifications for Bridge Construction. Reinforcing steel shall conform to CAN/CSA G30.18 Grade 400 deformed billet steel bars and be epoxy coated.	25.3.2 Concrete Reinforcing Steel Reinforcing steel *shall* be in accordance with the requirements of Section 5 “Reinforcing Steel” of the Specifications for Bridge Construction.
25.3.3 Soil Reinforcing Materials Steel reinforcement shall be galvanized in accordance with the current edition of ASTM Standard A123/A123M. Geosynthetic reinforcing shall meet AASHTO LRFD Bridge Design Specifications Clause 11.10.6.4.3b. The requirements “for applications involving severe consequences of poor performance or failure” shall apply. Results of product specific durability studies carried out to determine the product-specific long term strength reduction factor (RF) shall be submitted for the Consultant’s review and approval. 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” • GG 4-05 “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.	25.3.3 Soil *Reinforcement* Steel reinforcement, *including inspection wires, shall meet the requirements of ASTM A1064 and* be galvanized in accordance ASTM Standard A123/A123M and ASTM A153/A153M. Geosynthetic reinforcing shall meet AASHTO LRFD Bridge Design Specifications Clause 11.10.6.4.3b. The requirements “for applications involving severe consequences of poor performance or failure” shall apply. Results of product specific durability studies carried out to determine the product-specific long term strength reduction factor (RF) shall be submitted for the Consultant’s review and approval. 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 *with the understanding that the test methods are current at the time of construction*: • GG 1 “Standard Test Method for Geogrid Rib Tensile Strength” • GG 2 “Standard Test Method for Geogrid Rib Junction Strength” • GG 3 “Standard Test Method for Tensile Creep Testing of Geogrids” • GG 4 “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. *The nominal long-term reinforcement material design strength (Tal) values for specific products shall be determined by third party agencies such that as the Highway Innovative Technology Evaluation Centre (HITEC) or AASHTO National transportation Product Evaluation Program (NTPEP), and product lines shall be re-tested every 3 years at a minimum.*
25.3.4 Safety Rail Materials Safety rail shall be fabricated in accordance with Section 12 “Bridgerail” of the Specifications for Bridge Construction.	25.3.4 *Barriers/Railings* *All steel components of traffic barriers, pedestrian/cyclist railings, and safety railings shall conform to CSA G40.21M-Grade 300W, and shall be galvanized in accordance ASTM Standard A123/A123M and ASTM A153/A153M. Steel components of traffic barriers, pedestrian/cyclist railings, and safety* railings shall be fabricated in accordance with Section 12 “Bridgerail” of the Specifications for Bridge Construction.
25.3.5 Backfill Materials The structural backfill shall be “Crushed Aggregate Material” meeting the requirements of the following table: … *Note: For MSE wall systems consisting of geosynthetic soil reinforcement, the backfill designation/class should be chosen by the designer based on expected performance of the geosynthetic reinforcement. 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: … In no case shall any backfill material placed within 2.0 m of the face panels have more than 5% passing the 0.75 mm sieve size.	25.3.5 Backfill *Backfill for construction of MSE walls* shall be *crushed aggregate material conforming to* the *gradation* requirements *listed in* the following table: … The *MSE wall supplier shall use* the physical properties of the backfill selected by the Contractor shall in his design. In no case shall any backfill placed within 2.0 m of the face panels have more than 5% passing the *80 µm* sieve size*. Soil filters between soil zones shall be designed based on the properties of the adjacent materials.* The selected backfill shall also meet the following parameters *based on soil reinforcement type used in the MSE wall system*: … *Collection of samples for testing shall be from proposed stockpiles at the top, middle and bottom portions, approximately 0.6 m in from the face of the stockpile. Resistivity testing shall be completed on 6 samples (2 top, 2 middle, 2 bottom). PH, chloride, sulphate, and organic content testing shall be completed on 9 samples (3 top, 3 middle, 3 bottom).*
25.3.7 Geotextile Filter Fabric Non-Woven geotextile filter fabric shall be in accordance with the following	*25.3.6* Geotextile Filter Fabric Non-woven geotextile filter fabric shall *comply* with the following minimum

<table>
<tr>
<td>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 300 mm</td>
<td>physical properties:

NON-WOVEN GEOTEXTILE FILTER FABRIC REQUIREMENTS
Fabric Requirements | Test Method (ASTM)
Grab Strength ≥ 650 N D4632
Elongation - Failure ≥ 50% D4632
CBR Puncture Strength ≥ 275 N D6241
Trapezoidal Tear ≥ 250 N D4533
The minimum fabric lap length shall be 300 mm.</td>
</tr>
<tr>
<td></td>
<td>25.3.7 Impermeable Geomembrane

Impermeable geomembrane shall be PVC, HDPE or LLDPE with a minimum thickness of 0.75 mm, and comply with the following minimum physical properties:

IMPERMEABLE GEOMEMBRANE REQUIREMENTS
Impermeable Geomembrane Requirements | Test Method (ASTM)
Tear Strength ≥ 45 N D1004
CBR Puncture Strength ≥ 140 N D6241

Specific designs may warrant the use of roughened surface geomembranes. The membrane shall be installed in accordance with the manufacturer's recommendations. All seams in the membrane shall be welded or bonded to prevent leakage.</td>
</tr>
<tr>
<td>25.3.6 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 4.25 "Type 1c Sealer" of the Specifications for Bridge Construction.</td>
<td>25.3.8 Concrete Sealer

Sealer shall be applied to exposed concrete surfaces in accordance with Section 4 of the Specifications for Bridge Construction.</td>
</tr>
<tr>
<td></td>
<td>25.4 Precast Concrete Fascia Panel Fabrication

The fabrication of precast concrete fascia panels shall be in accordance with Section 7 "Precast Concrete Units" of the Specifications for Bridge Construction, CAN/CSA A23.4, and as modified by this Section.

All edges of precast concrete fascia panels shall be chamfered.

Geosynthetic reinforcing embedded into precast concrete fascia panels shall exit perpendicular.

Concrete shall have a minimum strength of 18 MPa prior to formwork</td>
</tr>
</table>

	removal. *Exposed precast concrete fascia panels shall be finished in accordance with Section 4 of the Specifications for Bridge Construction with the exception that all required surface cavities shall be filled with a Department approved concrete patching material. The entire exposed panel fascia finish texture shall be a form finish and not a washed or rubbed finish.* *Panels with the following defects shall be rejected, and new panels provided:* *1. Units with variation in panel face trueness for any line across a panel face from a straight edge exceeding 2 mm over 1 m;* *2. Units with honeycombing, cracks, spalls or broken corners;* *3. Units with more than 10 surface cavities per square metre with cavity diameters from 2 mm up to 5 mm;* *4. Units with more than three surface cavity per square metre with cavity diameter from 5 mm up to 10 mm; and* *5. Units with any surface cavities greater than 10 mm in diameter.* *Inspection and assessment of surface cavities shall be carried out by the Contractor immediately after stripping of forms. Surface cavities of 5 mm or less on panels meeting the above acceptance criteria will not require further repair.* *Repair of surface cavities shall be completed in a sheltered environment and with a minimum ambient temperature of 10˚C. Saturation of the face of the panels in preparation for the repair of surface cavities shall begin immediately after stripping. During repair of surface cavities, and up to the start of elevated temperature curing or moist curing, panel faces shall be kept in a continuously wet condition. As an alternative to moist curing with filter fabric, panels may be moist cured in an enclosure with controlled temperature and humidity such that all exposed concrete surfaces remain saturated for the duration of the curing period. If stacked during curing, sufficient space shall be maintained between panels to permit airflow and inspection of surfaces.*
25.4 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	*25.5* Construction *25.5.1 General* The Contractor shall employ qualified personnel experienced in constructing MSE walls to *supervise and perform the* work. *Construction of the MSE wall system shall conform to the shop drawings, supplier's recommendations, and*

present for a minimum of 25% of the time throughout the construction of all phases of MSE wall as determined by the wall supplier. The construction of the MSE wall system shall conform to the details on the approved shop drawings.	*these specifications.* *The Contractor shall also require the* supplier of the MSE wall system provide a *full-*time qualified representative on site *during construction* to advise *the Contractor's personnel* regarding construction procedures *and to monitor that construction is being completed in accordance with the shop drawings and the supplier's recommendations. The suppliers on site representative shall provide the Consultant with a weekly summary report detailing daily construction activities and compliance. Work that is not in compliance with the shop drawings or supplier's recommendations shall be reported to the Consultant immediately.* *MSE wall components that are damaged during any construction operation shall be removed and replaced at the Contractor's expense.*
25.4.1 Conformance Criteria The Contractor shall provide formalized documentation, sealed and signed by the engineer, who is responsible for each of the following construction phases and prior to commencement of each subsequent construction activity: • Foundation base preparation • On-site delivery of all components • Alignment of precast wall panels as per contract requirements • Backfill material gradations and compaction requirements	*25.5.2* Conformance Criteria The Contractor shall provide formalized documentation, sealed and signed by the *Professional Engineer registered in the Province of Alberta,* for each of the following construction phases: • Foundation base preparation • On-site delivery of all components • Alignment of precast wall panels • Backfill requirements
25.4.2 Excavation Excavation for the wall shall be carried out in conformance with Section 1 "Excavation" of the Specifications for Bridge Construction. Excavation shall be done to establish grades to within reasonably close conformity to the design grades and limits shown on the drawings 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.	*25.5.3* Excavation *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. *Damages* to existing services resulting from the Contractor's operations shall be repaired at the Contractor's expense. Excavation for the *MSE* wall shall be carried out in conformance with Section 1 "Excavation" of the Specifications for Bridge Construction *and these specifications*. Excavation shall be *completed* to the design grades shown on the *design* drawings, shop drawings*, and as determined by the Consultant. The Contractor shall proof roll the foundation subgrade after excavation* to identify any soft spots. Soft material, *as determined by the Consultant,* shall be removed and replaced with compacted granular material to the satisfaction of the Consultant. *Any temporary* excavation support required

	shall be the *full* responsibility of the Contractor *and no separate or additional payment will be made*.
	25.5.4 Concrete Leveling Pads *Construction of concrete leveling pads shall conform to the requirements of Section 4 "Cast-In-Place Concrete" of the Specifications for Bridge Construction. Concrete leveling pad elevations shall be set by instrument. Tolerance from design profile shall be 3 mm over a 3 m length and panels shall be centered on the leveling pad.*
25.4.3 Backfill Backfill shall be in accordance with Section 2 "Backfill" of the Specifications for Bridge Construction 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 his expense. A minimum 300 mm 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 1000 mm 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.	*25.5.5 Backfill* Backfill shall include the supply, placing and compaction required for construction of the MSE wall *systems and be in accordance with Section 2 "Backfill" of the Specifications for Bridge Construction and these specifications*. 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 precast concrete *fascia panels. Any MSE wall components* that are damaged during backfill placement shall be removed and replaced at the Contractor's expense. Any misalignment or distortion of the *precast concrete fascia* panels due to placement of backfill shall be corrected by the Contractor at his expense. *Where geosynthetic reinforcement is used, overlap of geosynthetic reinforcement can occur in walls with curves or acute angle corners. For any wall layout where overlap of geosynthetic reinforcement occurs, a minimum 75 mm of compacted backfill shall be placed between geosynthetic reinforcement layers.* No equipment shall be allowed to run directly on soil reinforcement. Backfill compaction shall be performed such that equipment moves parallel to the wall panels and away from the precast concrete fascia panels toward the end of the soil reinforcement. Only hand operated power tampers and vibrators shall be used for compaction within 1000 mm of the wall panels. The Contractor shall slope the last level of backfill away from the wall panels, at the completion of each day's work to direct potential surface run-off away from the wall face. In addition, the Contractor shall not permit any surface run-off from adjacent areas to enter the wall construction site. *Backfill compaction testing of the reinforced backfill shall be done at a minimum frequency of one test per lift for every 45 m of wall or part thereof*

	with no less than one test per day. Backfill compaction shall be measured in accordance with Alberta Transportation Test Method ATT-58A, "DENSITY TEST, Control Strip Method". The density of compacted backfill shall be a minimum of 98% of the control strip density. *The Contractor shall also complete the following sampling and testing of the backfill during construction to demonstrate continued compliance:* *SAMPLING AND TESTING OF BACKFILL PROPERTIES DURING CONSTRUCTION* *Range of Resistivity (ohm-cm)* — *Sample Interval for Resistivity Testing (m^3)* — *Sample Interval for PH, Chlorides, Sulphates, Organic Testing (m^3)* *>5000* — *3000* — *1500* *<5000* — *1500* — *750* *Test results shall be submitted to the Consultant within 3 days of completion. If any test result does not meet specification requirements, the Contractor shall stop backfilling operations immediately and resample and test the backfill. Additional testing of material already placed may be required and will be determined by the Consultant. Backfilling operations shall not recommence until all additional sampling and testing is completed and any non-compliant backfill removed and replaced. All costs associated with sampling and testing, including removal and replacement of non-compliant backfill will be at the Contractor's expense.*
25.4.4 Precast Panel Tolerance Precast concrete panel manufacturing tolerances shall be as described in CSA A23.4. The tolerance after installation shall be: 1. The flatness tolerance of wall surfaces measured in any direction shall not exceed 10 mm/m 2. The offset of adjacent panel edges at joints shall not exceed 10 mm 3. The variation for minimal joint gap shall not exceed 1.5 mm/m 4. The overall vertical tolerance of the completed wall (top and bottom) shall not exceed 13 mm/3 m of wall height. Should any panels be out of tolerance, the backfill shall be removed and the panels reset to the proper tolerance. To facilitate construction of the cast-in-place concrete coping, nominal-sized,	*25.5.6 Precast Concrete Fascia Panel Installation Tolerances* *Installation tolerances of precast concrete fascia panels* shall be: 1. *Flatness* of wall surfaces measured in any direction shall not exceed *25 mm under a 3 m straight edge.* 2. *Offset* of adjacent panel edges at joints shall not exceed 10 mm. 3. *Overall vertical alignment* of the completed wall shall not exceed *4 mm/m of the total* wall height. 4. *Joint width shall be between 10 mm and 30 mm.* Should any panels be out of tolerance, the backfill shall be removed and the panels reset to the specified tolerance. *All precast concrete fascia panel lifting hook pockets shall be patched with an approved type NH or HEH concrete patching material.*

pre-formed holes in the precast panel are permitted providing the holes are located a minimum of 100 mm above the coping soffit.	
	25.5.7 Cast-in-Place Concrete Wall Copings *Construction of cast-in-place concrete wall copings and surface finishes shall conform to the requirements of Section 4 "Cast-In-Place Concrete" of the Specifications for Bridge Construction. Cast-in-place concrete wall coping elevations shall be set by instrument. Tolerance from design profile shall be 3 mm over a 3 m length.* *Galvanized anchor bolt assemblies for railings shall be cast into the concrete.* *Cast-in-place concrete wall coping sections at corners shall be isolated from contact with other concrete components with 12 mm thick closed cell foam.*
	25.5.8 Impermeable Geomembrane *Seams of impermeable geomembranes shall be placed parallel to the MSE wall and lapped in the direction of positive drainage to produce a shingling effect. Seams shall be welded in accordance with the manufacturer's recommendations and in weather conditions acceptable to the Consultant.*
	25.5.9 Barrier/Railings *All steel components of traffic barriers, pedestrian/cyclist railings, and safety railings shall be constructed in accordance with Section 12 "Bridgerail" of the Specifications for Bridge Construction.*
25.4.5 Material Storage The Contractor's lay-down area shall be level graded to ensure the panels are safely and uniformly supported on timber bearing blocks. Precast concrete panels shall be stacked on timber planks or pallets and separated by timber blocks as required by the precast design engineer. 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.	*25.5.10* Material Storage The Contractor's lay-down area shall be *graded level* to ensure panels are safely and uniformly supported on timber bearing blocks *with plastic separators*. Precast concrete *fascia* panels shall be stacked on timber planks or pallets and separated by timber blocks *with dimpled plastic separators designed by the precast supplier's* engineer. Soil reinforcement and connectors shall be stored above ground. All materials shall be covered and protected from rain, snow, dirt, ultraviolet light, and damage. Precast concrete fascia panels shall be stored such that the uniform color of the panels is maintained and protected from staining or discoloration. *Panels with stained, discoloured, or damaged front faces shall not be incorporated into the wall.*

25.5 Payment Measurement for payment for the design and construction of mechanically stabilized earth wall will be by square metre of installed precast panel wall face measured in place. Payment will be made at the unit price bid for "Mechanically Stabilized Earth Wall", and will be full compensation for design and construction including, but not limited to such items as all excavation, backfill and compaction below the MSE walls where required; all excavation, leveling pad construction, backfill and compaction within and beyond the MSE wall zone necessary for construction of the MSE wall; the supply and installation of precast concrete panels complete with epoxy coated reinforcing steel; cast-in-place concrete coping complete with epoxy coated reinforcing steel; soil reinforcement; sealer; drains; traffic barriers; the supply and installation of galvanized steel safety railing including anchor bolts and concrete swale at the top of the MSE wall; and all labour, material, equipment, tools and incidentals necessary to complete the Work. All costs associated with the design of the MSE wall will be considered incidental to the Work, and no separate or additional payment will be made.	***25.6*** **Payment** Measurement for payment of mechanically stabilized earth walls will be *based on the* square metre of installed precast *concrete fascia panels* in place. Payment will be made at the unit price bid for "Mechanically Stabilized Earth Wall", and will be full compensation for design, *construction, and submission of as-built shop drawings, design notes and construction records. Payment will also include*, but not be limited to, *excavation, backfill and compaction below the MSE walls where required*; all excavation, *concrete* leveling pad construction, backfill *material* and compaction within and beyond the MSE wall zone necessary for construction of the MSE wall; the supply and installation of precast concrete *fascia* panels complete with epoxy coated reinforcing steel; cast-in-place concrete *wall* coping complete with epoxy coated reinforcing steel*;* soil reinforcement *and inspection wires*; sealer; drains; traffic barriers *and anchor blocks*; the supply and installation of galvanized steel safety railing including anchor bolts and *swales* at the top of the MSE wall; and all labour, material, equipment, tools and incidentals necessary to complete the Work.
Section 26 RCP and PBC Structures	**Section 26 RCP and PBC Structures**
- None	- New