Appendix D – Standard Structural Specifications (Version 4.1)

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PART AD - SPECIFICATIONS

GENERAL

AD1. SHOP DRAWINGS

AD1.1 Description

AD1.1.1 This Specification provides instructions for the preparation and submission of shop drawings:

(a) The term 'shop drawings' means drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data, including Site erection drawings which are to be provided by the Contractor to illustrate details of a portion of the Work; and,

(b) Submit specified shop drawings to the Contract Administrator for review. All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be show on all submissions for Contract Administrator review.

AD1.2 Shop Drawings

AD1.2.1 Original drawings shall be prepared by Contractor, Subcontractor, supplier, distributor or manufacturer to illustrate appropriate portion of Work including fabrication, layout, setting or erection details as specified in appropriate sections.

AD1.2.2 Shop drawings for the following components shall bear the seal of a Professional Engineer registered in the province of Manitoba:

(a) Pile Dynamic Analyser (PDA) Testing;

(b) Steel Sheet Piles;

(c) Temporary Shoring;

(d) Pumping Station components;

(i) Metal Fabrications, Layout and Erection Details;

(ii) Shoring and Dewatering System Required for Excavations;

(iii) Form Details for Suspended Slabs;

(iv) Shoring for Suspended Support Walls and Grade Beams;

(v) Monorail and Hoist System; and,

(vi) Pumping Station Superstructure Components.

(e) Mechanically Stabilized Earth Walls;

(f) All Concrete Form Details;

(g) Bearing Layout and Details;

(h) Metal Fabrications, Layout, and Erection Details for Girders;

(i) Metal Fabrication, Layout and Erection Details for Expansion Joints;

(j) Miscellaneous Metal Fabrication, Layout and Erection Details; and,

(k) Approach Guardrail.

AD1.3 Contractor's Responsibilities

(a) Review shop drawings, product data and samples prior to submission and stamp and sign drawings indicating conformance to the Contract requirements;

(b) Verify:

(i) Field Measurements;

(ii) Field Construction Criteria; and,

(iii) Catalogue numbers and similar data.

(c) Coordinate each submission with requirements of Work and Contract Documents. Individual shop drawings will not be reviewed until all related drawings are available;

(d) Notify Contract Administrator, in writing at time of submission, of deviations from requirements of Contract Documents;

(e) Responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator's review of submission, unless Contract Administrator gives written acceptance of specified deviations;

(f) Responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals;

(g) Make any corrections required by the Contract Administrator and resubmit the required number of corrected copies of shop drawings. Direct specific attention in writing or on resubmitted shop drawings to revisions other than the corrections requested by the Contract Administrator on previous submission;

(h) After Contract Administrator's review and return of copies, distribute copies to Subcontractors and others as appropriate; and,

(i) Maintain one (1) complete set of reviewed shop drawings, filed by Specification Section Number, at the Site of the Work for use and reference of the Contract Administrator and Subcontractors.

AD1.4 Submission Requirements

(a) Schedule submissions at least fourteen (14) Calendar Days before dates reviewed submissions will be needed, and allow for a fourteen (14) Calendar Day period for review by the Contract Administrator of each individual submission and re-submission, unless noted otherwise in the Contract Documents;

(b) Submit two (2) paper prints of shop drawings. The Contract Administrator will retain one (1) copy of all submittals and return one (1) copy to the Contractor. The Contract Administrator may elect to return the submittal in electronic format at their discretion;

(c) If agreed to by the Contract Administrator in writing, shop drawings may be submitted in electronic format by the Contractor;

(d) Accompany submissions with transmittal letter containing:
  (i) Date;
  (ii) Project title and Bid Opportunity number;
  (iii) Contractor's name and address;
  (iv) Number of each shop drawing, product data and sample submitted;
  (v) Specification Section, Title, Number and Clause;
  (vi) Drawing Number and Detail / Section Number; and,
  (vii) Other pertinent data.

(e) Submissions shall include:
  (i) Date and revision dates;
  (ii) Project title and Bid Opportunity number;
  (iii) Name of:
    (i) Contractor;
    (ii) Subcontractor;
    (iii) Supplier;
    (iv) Manufacturer;
    (v) Detailer (if applicable);
  (iv) Identification of product or material;
  (v) Relation to adjacent structure or materials;
  (vi) Field dimensions, clearly identified as such;
  (vii) Specification section name, number and clause number or drawing number and detail / section number;

(viii) Applicable standards, such as CSA or CGSB numbers; and,

(ix) Contractor's stamp, initialled or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.

AD1.5 Other Considerations

(a) Fabrication, erection, installation or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent shop drawings and resubmit;

(b) Material and equipment delivered to the Site of the Works will not be paid for at least until pertinent shop drawings have been submitted and reviewed;

(c) Incomplete shop drawing information will be considered as stipulated deductions for the purposes of progress payment certificates; and,

(d) No delay or cost claims will be allowed that arise because of delays in submissions, re-submissions and review of shop drawings.

AD2. TREE PROTECTION DURING CONSTRUCTION

AD2.1 Construction activities near trees may result in injury to the trunk, limbs or roots of trees causing damage or death of the tree. In order to prevent such damage.

AD2.1.1 Trees within or adjacent to a construction area must be protected during construction by means of a barrier surrounding a "Tree Protection Zone" (TPZ) as outlined in Sub Sections AD2.2 and AD2.3.

AD2.1.2 Activities which are likely to injure or destroy the tree are not permitted within the TPZ.

AD2.1.3 Tree pruning or root pruning of City of Winnipeg owned trees may only be done by a Contractor approved by the project's Qualified Tree Consultant (refer to AD2.5) or Urban Forestry Branch.

AD2.1.4 No objects may be attached to trees protected by City of Winnipeg by-laws without written authorization by the City of Winnipeg.

AD2.1.5 No City of Winnipeg tree or tree protected by a City of Winnipeg by-law may be removed without the written permission of the City of Winnipeg.

AD2.1.6 Operation of equipment within the dripline of the trees shall be kept to the minimum required to perform the work required. Equipment shall not be parked, repaired, refuelled; construction materials shall not be stored, and earth materials shall not be stockpiled within the driplines of trees. The dripline of a tree shall be considered to be the ground surface directly beneath the tips of its outermost branches. The Contractor shall ensure that the operations do not cause flooding or sediment deposition on areas where trees are located.

AD2.1.7 All damage to existing trees caused by the Contractor's activities shall be repaired to the requirements and satisfaction of the Contract Administrator and the City Forester or his/her designate.

AD2.2 Tree Protection Zone

AD2.2.1 The following is a chart showing optimal distances for determining a tree protection zone (the roots of a tree can extend from the trunk to approximately 2-3 times the distance of the drip line). Some site conditions may dictate the need for a smaller TPZ. The City of Winnipeg Urban Forestry Branch must be notified in these instances. Forestry will determine if the smaller TPZ is acceptable in the specific circumstance and advise of any additional tree protection or removal requirements.

Table AD2.1 – Tree Protection Zones	
Trunk Diameter (DBH)	Minimum Protection Distances Required
<10 cm	2.0m
11-40cm	2.4m
41-50cm	3.0m
51-60cm	3.6m
61-70cm	4.2m
71-80cm	4.8m
81-90cm	5.4m
91-100cm+	6.0m

AD2.2.2 Diameter at breast height (DBH) measurement of tree trunk is taken at 1.4 metres above ground.

AD2.2.3 Tree Protection Zone distances are to be measured from the outside edge of the tree base towards the drip line and may be limited by an existing paved surface, provided the existing paved surface remains intact throughout the construction work.

AD2.3 Tree Protection Barriers

AD2.3.1 Trees within tree protection zones shall be protected by means of a "tree protection barrier" meeting the following Specifications:

(a) The required barrier is a 1.2 metre high orange plastic web snow fencing on 50mm x 100mm frame or as directed by the City of Winnipeg Urban Forestry Branch in accordance with City of Winnipeg Protection of Existing Tree Specifications. The barrier can be lowered around branches lower than 1.2 metres. The barrier location can be adjusted to align with curbs and edges at clear path of travel zones;

(b) Trees identified to be at risk of construction activities entering the TPZ by the Contract Administrator are to be strapped with 25 x 100 x 2400mm wood planks, or suitably protected as approved by the Contract Administrator;

(c) Tree protection barriers are to be erected prior to the commencement of any construction or grading activities on the site and are to remain in place throughout the entire duration of the project. The applicant shall notify the City of Winnipeg prior to commencing any construction activities to confirm that the tree protection barriers are in place;

(d) All supports and bracing used to safely secure the barrier should be located outside the TPZ. All supports and bracing should minimize damage to roots. No grade change, storage of materials or equipment is permitted within this area. The tree protection barrier must not be removed without the written authorization of the City of Winnipeg; and,

(e) The Contractor shall not stockpile materials and soil or park vehicles and equipment on boulevards within the TPZ.

AD2.4 Utility Construction, Engineering and Capital Construction Projects

AD2.4.1 It is recognized that there are cases where trees are growing overtop existing utilities or beside capital infrastructure. While the guidelines in this section still apply, in these cases some modification to Table 1 in addition to root pruning may be permitted provided non-open trench methods of construction are employed (as defined in CW2110 and CW2130).

AD2.4.2 Root Pruning will be required to be done under the direction of, and along with, written sign-off by the Project's Qualified Tree Consultant (Refer to AD2.5). The objective is to avoid severance of anchor roots, which provide upright support for trees and minimize damage to the tree.

AD2.4.3 Above ground clearance for overhanging branches in the work zone must be anticipated. The utility or its consultant is required to have a Forestry approved tree service raise the crown of all branches to provide adequate clearance for construction equipment.

AD2.5 Qualified Tree Consultants

AD2.5.1 An arborist certified by the International Society of Arboriculture (ISA) who has a diploma (minimum) in arboriculture or urban forestry.

AD2.5.2 A landscape architect who is a member in good standing of the Manitoba Association of Landscape Architects.

AD3. INSTALLATION OF STRAW WATTLES

DESCRIPTION

AD3.1 Straw wattles are required to be installed as erosion control measures to mitigate any deleterious materials from entering the existing Land Drainage System.

MATERIALS

AD3.2 The straw wattles shall be Stenlog or other biodegradable straw wattles as approved by the Contract Administrator.

CONSTRUCTION METHODS

AD3.3 Install 300mm Stenlog or other straw wattle sediment control material in accordance with the manufacturer's specifications around all riprap areas related to drainage inlets and outlets, and catch basins within seeded areas.

AD3.4 Install straw wattles so that no gaps exist between the soil and the bottom of the wattle, and the ends of adjacent wattles are overlapped 150mm minimum to prevent water and sediment passing. Achieve a tight seal between the wattle segments.

AD3.5 Dogleg terminal ends of straw wattle up the slope to prevent channelling of sedimentation.

AD3.6 Use 300mm wooden stakes to fasten straw wattle to the soil. Place stakes on each side of the straw wattle, lying across the natural fibre twine, spaced 1200mm on centre. Leave 30 to 50mm of wood stake exposed above the wattle.

AD3.7 Avoid damage to wattles. Damaged areas of wattles should be cut and tied off, then treated as terminal ends.

AD3.8 At the direction of the Contract Administrator, the straw wattles shall be removed after seeding has established and before the end of the warranty period.

AD4. DITCH INLET GRATE

DESCRIPTION

AD4.1 General

AD4.1.1 This specification covers the supply and installation of ditch inlet grates, typically used in open swales or ditches as an alternative to City of Winnipeg Approved Product grated manhole cover AP-006.

MATERIALS AND EQUIPMENT

AD4.2 As per Contract Drawings.

AD4.3 All steel shall be supplied in accordance with details on the Contract Drawings. All steel shall be hot dip galvanized after fabrication and all hardware shall be stainless steel.

AD4.4 Cover to be Shopost Iron Works MK-A1 or approved equal in accordance with the Specifications.

CONSTRUCTION METHODS

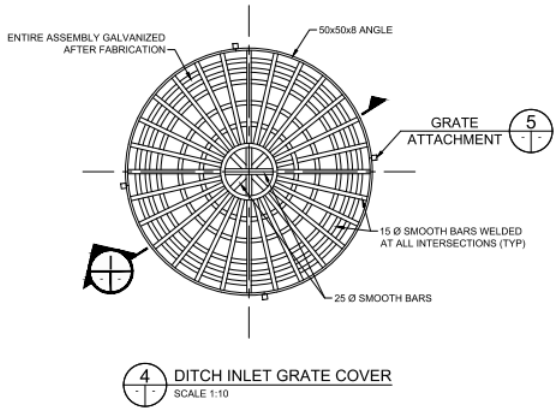
AD4.5 General

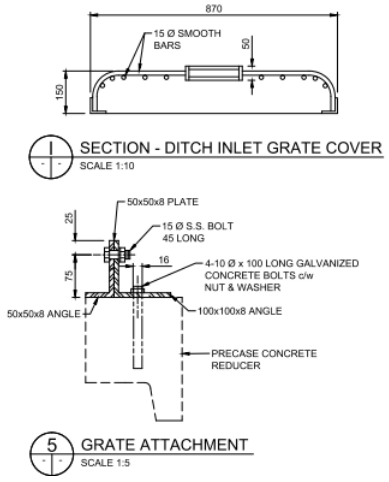
AD4.5.1 Contractor to securely affix ditch inlet grates to manhole reducer or riser utilizing stainless steel hardware.

AD4.5.2 Any galvanized surfaces that are damaged shall be coated with a galvanizing compound approved by the Contract Administrator.

MEASUREMENT AND PAYMENT

AD4.6 Ditch Inlet Grates will be measured on a unit basis and paid for at the Contract Unit Price per cover as “Ditch Inlet Grate”. The number to be paid for will be the total number of Ditch Inlet Grates installed in accordance with this specification and accepted by the Contract Administrator.





AD5. EROSION CONTROL BLANKET (ECB)

DESCRIPTION

AD5.1 This Specification covers the supply, installation, and maintenance of erosion control blanket to be installed around the perimeter of grouted stone rip rap.

MATERIALS AND EQUIPMENT

AD5.2 Erosion Control Blanket(ECB)

AD5.2.1 Erosion Control Blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut blanket with a functional longevity of up to 24 months. Suitable products include SC 150 Extended Term manufactured by North American Green, or approved equivalent.

AD5.2.2 The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the topside with heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and a maximum 159mm x 159mm mesh and on the bottom side with a lightweight photodegradable polypropylene netting with a maximum 127mm x 127mm mesh. The blanket shall be sewn together on 381mm centres (maximum) with degradable thread.

AD5.2.3 ECB shall have the following properties:

(a) Matrix 70% Straw Fibre (0.19kg/m2) and 30% Coconut Fibre (0.08kg/ m²);

(b) Netting top side heavyweight photodegradable with UV additives (1.47kg/100 m²);

(c) Bottom side lightweight photodegradable minimum netting weight (0.73 kg/100 m²); and,

(d) Degradable thread.

SUBMITTALS

AD5.3 The Contractor shall submit all manufacturers' product specifications and recommended installation methods for the proposed erosion control blankets and associated materials to the Contract Administrator a minimum of 14 days before construction.

CONSTRUCTION METHODS

AD5.4 The Contractor shall supply all ECB materials required and store them on-site. The installation and maintenance of all ECM will be as directed by the Contract Administrator.

AD5.5 Actual alignment and location of the ECB may be adjusted in the field by the Contract Administrator.

AD5.6 Erosion Control Blanket – Drainage Channel Installation

AD5.6.1 Excavation a trench 150 mm deep by 150 mm wide along outer perimeter of the ECB installation that is to be placed around the perimeter of grouted stone rip rap.

AD5.6.2 Place the ECB such that 300 mm of the blanket overlaps the grouted stone rip rap and the outer perimeter of the ECB is placed inside the trench. Anchor blanket with 200 mm long staples in the trench a maximum of 300 mm apart.

AD5.6.3 Backfill trench with topsoil, compact topsoil, and apply seed according to the Specifications.

AD5.6.4 Securely fasten blanket against soil surface with 200 mm long staples with a minimum of 4 staples per square metre.

AD5.6.5 Transverse joints and end seams in the ECB shall have a minimum overlap of 150 mm and secured with 200 mm staples a maximum of 300 mm apart.

MAINTENANCE

AD5.7 The areas covered with ECB shall be regularly inspected especially after severe rainfall or storm events, to check for blanket separation or breakage.

AD5.8 Any damaged or poorly performing areas as the result of storm events shall be replaced/repaired immediately. Re-grading of the slope by hand methods may be required in the event of rill or gully erosion.

AD5.9 Should the Contract Administrator determine that the Contractor has not maintained the erosion control blankets properly or has damaged the blankets from construction activities resulting in sediment releases beyond the Work area, the Contractor shall retrieve all sediment that has left the construction area, to the fullest extent possible, at his own cost. As a minimum, the Contractor shall remove all deltas and sediment deposited in drainage ways and re-grade and/or reseed the areas where sediment removal results in exposed soil. The removal and restoration shall take place within 5 working days of discovery unless precluded by legal, regulatory, or physical access restraints. If precluded, removal and restoration must take place within 5 working days of obtaining access. The Contractor is responsible for contacting all local, regional, provincial, and federal authorities before working in surface waters and for obtaining applicable permits. The Contractor's restoration Work to restore property outside of the designated Work area shall be at his own cost.

AD6. SUPPLY AND INSTALL CULVERT END MARKERS

DESCRIPTION

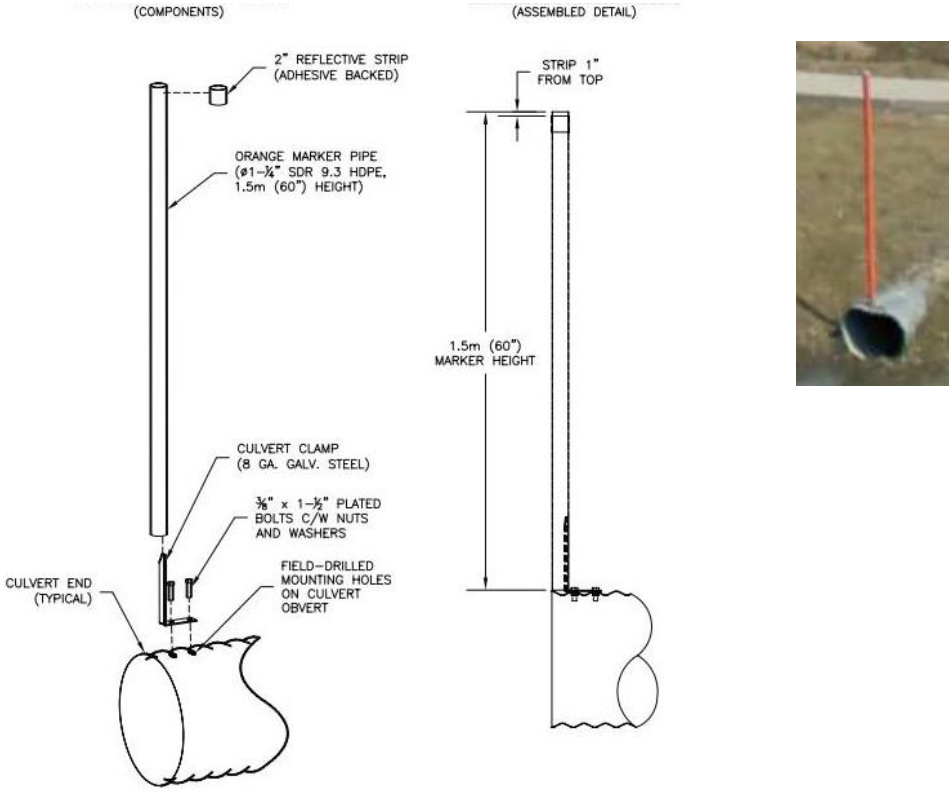
AD6.1 General

AD6.1.1 This specification covers the supply and installation of culvert end markers on each of the newly installed CSP culverts.

MATERIALS

AD6.2 Culvert End Markers

AD6.2.1 Supply and install units similar to that shown in the images below.



CONSTRUCTION METHODS

AD6.3 Culvert end markers are to be installed at each end of every new culvert within this project. Affix using industry standard hardware.

REMOVALS

AD7. BRIDGE DEMOLITION AND REMOVALS

AD7.1 Description

(a) This Specification shall cover all operations related to the demolition and removal of portions of existing bridge and underpass structures; and,

(b) The Work to be done by the Contractor under this Specification shall include the furnishings of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

AD7.2 Submittals

(a) The Contractor shall prepare a demolition and removals plan. The plan shall include the design and drawings, Sealed by an Engineer Registered in the Province of Manitoba, the sequence and methods to be used to demolish and remove the existing bridge. The demolition plan shall be in strict accordance with the Specifications and the Environmental Protection Plan;

(b) The demolition and removals plan shall indicate the sequence, machinery, methods and proposed access to accomplish the demolition of the existing bridges; and,

(c) The demolition plan shall be submitted a minimum of two (2) weeks days prior to the commencement of the demolition of any structure.

AD7.3 Construction Methods

(a) Debris screens or platforms, if required by the Contract Administrator, shall be provided for the protection of adjacent motorists and railway traffic. The Contractor shall submit detailed Working Drawings of the screens or platforms, for information purposes, to the Contract Administrator at least two (2) weeks prior to commencement of work;

(b) All material from the demolished bridge shall be removed from Site by the Contractor in accordance with the Contractor's Environmental Protection Plan;

(c) The Contractor shall remove the existing bridge and demolish the existing foundations to a point at least 1000 mm below the final proposed final ground elevations shown on the Drawings and shall backfill all area in accordance with the Drawings and Specifications. All demolished material including the existing bridge will remain the property of the Contractor and shall be disposed of in a manner consistent with all applicable laws and regulations; and,

(d) The Contractor shall provide flag persons, guards, barricades (if necessary), railings, necessary warning lights, warning signs and lights at excavations, temporary platforms, removals, and other construction, to ensure the safety of workers and public. Safety precautions shall comply with all applicable laws and regulations. The Contractor shall provide all other protective measures as may be required by any law in force in the Manitoba Workplace Safety and Health Act and the Canada Labour Code.

AD8. RESIDENTIAL HOUSE DEMOLITION AND REMOVALS

DESCRIPTION

AD8.1 General

AD8.1.1 This Specification covers all operations relating to "Demolition and Removals".

AD8.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

AD8.1.3 The Work shall include, but is not limited to the following:

(a) Demolition and removal of existing structures;

(b) Removal of existing concrete foundations;

(c) Protection of services to be maintained

(d) Disposal of demolition materials; and,

(e) Clean-up of Work Site in anticipation of new Work.

AD8.2 References

AD8.2.1 Removals are in accordance with Standard Construction Specifications:

(a) CW 1110 - General Instructions;

(b) CW 1120 – Existing Services, Utilities, and Structures;

(c) CW 3235 – Renewal of Existing Miscellaneous Concrete Slabs; and,

(d) CW 3240 – Renewal of Existing Curbs.

AD8.2.2 The National Building Code of Canada 2010 Volume 2, Part 8 – Safety Measures at Construction and Demolition Sites.

AD8.2.3 Manitoba Workplace Safety and Health Act, and all applicable National, Provincial, and Municipal regulations.

CONSTRUCTION METHODS

AD8.3 Protection

AD8.3.1 Prevent movement, settlement or damage of adjacent structures. Make good damage caused by demolition.

AD8.3.2 The Contractor shall provide and erect all protective barricades as required for demolition of houses in accordance with the requirements of the employment safety regulations under the Workplace Safety and Health Act, Employment Safety Act and Winnipeg By-Law No. 1481/77 pertaining to erection of barricades for protection. The Contractor shall provide the Contract Administrator with a Safe Work Plan at least five (5) Business Days prior to the commencement of any Work on the Site.

AD8.3.3 The Contractor shall also provide additional temporary barricades or rope off temporary demolition zones in the street right of way as may be necessary for any dangerous demolition operation in order to keep the public away from the Site. Such temporary barricades shall be removed as soon as possible in order to prevent unnecessary interruption of traffic.

AD8.3.4 The Contractor shall be responsible for maintaining all protective barricades, including gates, walks, lights, etc. in a good operating condition for the entire period of the demolition to the satisfaction of the Contract Administrator.

AD8.4 Execution

AD8.4.1 Inspection

(a) Inspect Site with Contract Administrator and verify extent and location of items designated for removal, disposal, salvage and items to remain;

(b) Locate and protect utilities;

(c) Notify and obtain approval of Contract Administrator before starting demolition; and,

(d) The Contractor shall arrange for and pay for all permits required for the demolition efforts.

AD8.4.2 Preparation

(a) Do not disrupt active or energized utilities;

(b) The Contractor shall arrange and pay for the appropriate utility to disconnect and seal off from the Site, all service lines, pipes or conduits that service the building(s) to be demolished;

(c) The Contractor shall disconnect and seal off all sewer and water service connections. If the Contractor is unable, or not licensed to complete this work, the Contractor shall subcontract the work to a subcontractor licensed by the City to do such work on behalf of the Contractor; and,

(d) The Contractor shall provide each utility and the City's Water and Waste Department with adequate prior notification as to when they will require these disconnection and sealing off services.

AD8.4.3 Safety Code and Requirements

(a) Unless otherwise specified, carry out demolition Work in accordance with the City of Winnipeg Safety Directives and Guidelines; and,

(b) Blasting operations shall not be permitted during demolition unless reviewed and approved by the Contract Administrator.

AD8.4.4 Demolition

(a) Demolish structures to permit construction of new Work as indicated;

(b) Upon being notified by the City, the Contractor shall promptly seal all potential entry points to the building. The Contractor shall maintain the building(s) in a boarded up state;

(c) The Contractor shall demolish the existing buildings, structures, fences, sidewalks, etc. on the Site as directed by the Contract Administrator. The Contractor shall completely demolish all buildings and structures/foundations that are above and below ground and remove all debris and rubbish from the Site. The Contractor shall not store or permit debris or rubbish to accumulate on the Site for more than one Working Day. The Contractor shall completely clear the Site except for any existing trees, which the Contractor shall protect from damage;

(d) At the end of each day's Work, leave Work in safe condition so that no part is in danger of toppling or failing;

(e) The Contractor shall keep the exposed basement areas of the Site free of water until it has been backfilled to the satisfaction of the Contract Administrator. All equipment, pumps and appurtenances as may be required to keep these areas free of water shall be provided and maintained by the Contractor;

(f) The Contractor shall not burn debris or other material on the Site;

(g) The Contractor shall fill the area below the existing ground exposed by the demolition with clean earth to a depth of 300 mm above the surface of the existing ground at the Site of the building;

(h) The clean earth fill shall be free of debris and rubbish of any kind and be approved by the Contract Administrator. The Contractor shall not place backfill material until the Contract Administrator has inspected the excavation. Should any backfill be placed before the permission of the Contract Administrator has been obtained, the excavation shall be re-opened by the Contractor, at his expense;

(i) The Contractor shall control dust from the demolition operations by suitable means to prevent harm to the work crews and the public to the satisfaction of the Contract Administrator. The Contractor shall utilize rubbish chutes to carry down all rubbish from the building under demolition;

(j) The Contractor shall ensure that the demolition operation be conducted with the minimum interference with streets, sidewalks, etc. No salvage material shall be placed or stored on streets, sidewalks, etc. within or surrounding the Site; and,

(k) The Contractor shall protect all existing trees located on the Site or within the street right-of-way from damage during the demolition operation. The Contractor shall not remove existing trees without the written consent of the Contract Administrator.

AD8.4.5 Disposal of Demolished Material

(a) The Contractor shall be responsible for removal of debris and waste from the Work area to the location to an appropriate solid waste disposal area approved by the Contract Administrator;

(b) Metal debris, which may include structural steel, miscellaneous inserts, and reinforcing steel, shall be removed from the Site and Disposed of by the Contractor;

(c) If asbestos or other hazardous materials are encountered during the Work of the Contract, the Contractor shall stop all work and notify the Contract Administrator immediately. Removal of hazardous materials shall be dealt with by the City and the Contractor shall await further instructions by the Contract Administrator; and,

(d) The Contractor will be responsible for the tipping fees for all demolition material.

AD8.4.6 Landscaping

(a) The lot shall be properly graded to drain away from adjacent properties;

(b) Landscaping shall be consistent with adjacent project landscaping works; and,

(c) Landscape maintenance shall be included for the duration of the maintenance period.

STRUCTURAL – GENERAL

AD9. STRUCTURAL CONCRETE

DESCRIPTION

AD9.1 This Specification shall cover all operations relating to the preparation of Portland Cement structural concrete for, and all concreting operations related to, the construction of structural concrete works as specified herein and as shown on the Drawings.

AD9.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

AD9.3 Scope of Work

AD9.3.1 The Work under this Specification shall include:

(a) Supplying and placing lean-mix concrete for structural working bases;

(b) Supplying and placing structural concrete for culverts;

(c) Supplying and placing structural concrete for tunnel foundations, walls, and roof;

(d) Supplying and placing structural concrete for retaining and MSE walls and coping;

(e) Supplying and placing structural concrete for pile caps, pier footings, and columns;

(f) Supplying and placing structural concrete for abutments;

(g) Supplying and placing structural concrete abutment diaphragms;

(h) Supplying and placing structural concrete for grade beams;

(i) Supplying and placing structural concrete for pier cap;

(j) Supplying and placing structural concrete for deck slab and bridge traffic barriers;

(k) Supplying and placing structural concrete for roof slab and approach slab; and,

(l) Supplying and placing structural concrete for the roadway traffic barriers and footings.

SUBMITTALS

AD9.4 General

AD9.4.1 The Contractor shall submit to the Contract Administrator for review and approval, at least fourteen (14) Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

AD9.4.2 The Contractor shall submit to the Contract Administrator for review and approval, at least fourteen (14) Days prior to the commencement of any Work on Site, the proposed materials to be used.

AD9.5 Concrete Mix Design Requirements

AD9.5.1 The Contractor shall submit a concrete mix design statement to the Contract Administrator for each of the concrete types specified herein that reflects the specified performance properties of the concrete. The mix design statement shall contain all the information as outlines on the concrete mix design statement as shown on the Manitoba Ready Mix Concrete Association website (www.mrmca.com). In addition, the mix design statement must indicate the expected method of placement (buggies, chute, or pump) methods are to be used, the method of placement must include a clear description of the pumping methods (line, vertical drop, length of hose, etc.).

AD9.5.2 The Supplier shall submit directly, in confidence, to the City of Winnipeg, the concrete mix designs for each of the concrete types specified herein. The purpose of this confidential submission will be for record keeping purposes and may be used as information related to supplementary testing and investigation of suspected defective concrete. The City of

Winnipeg will advise the Supplier if the in information needs to be released to third parties. The concrete mix design shall contain a description of the constituents and proportions, and at the minimum the following:

(a) Cementitious content in kilograms per cubic metre or equivalent units, and type of cementitious materials;

(b) Designated size, or sizes, of aggregates, and the gradation;

(c) Aggregate source location(s);

(d) Weights of aggregates in kilograms per cubic metre or equivalent units. Mass of aggregates is saturated surface dry basis;

(e) Maximum allowable water content in kilograms per cubic metre or equivalent units and the water/cementitious ratio;

(f) The limits for slump;

(g) The limits for air content; and,

(h) Quantity of other admixtures.

AD9.5.3 The concrete mix design statements must be received by the Contract Administrator a minimum of fourteen (14) days prior to the scheduled commencement of concrete placement for each of the concrete types. The concrete mix designs must be received by the City of Winnipeg a minimum of five (5) Business Days prior to the scheduled commencement of concrete placement for each the concrete types.

(a) The mix design statement shall also include the expected slump measurement for each concrete type. The tolerances for acceptance of slump measurements in the field, by the Contract Administrator, shall be in accordance to CSA A23.1-04 Clause 4.3.2.3.2; and,

(b) Any change in the constituent materials of any approved mix design shall require submission of a new concrete mix design statement, mix design, and mix design test data. If, during the progress of the Work, the concrete supplied is found to be unsatisfactory for any reason, including poor workability, the Contract Administrator may require the Contractor to make any necessary adjustments and associated resubmissions.

AD9.6 Concrete Mix Design Test Data

AD9.6.1 Concrete

(a) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, test data showing that the concrete to be supplied will meet the performance criteria stated in this Specification for each concrete type;

(b) The Contractor shall submit at a minimum, the test data to prove that the minimum compressive strength, flexural strength for Fibre Reinforced Concrete (FRC) only, air content, and slump of the concrete to be supplied meets or exceeds the performance criteria. In addition, test data shall be submitted to support requirements for post-cracking residual strength index (Ri) and fibre dispersion in accordance with the Canadian Highway Bridge Design Code (CHBDC) CAN/CSA-S6-06, Section 16, Fibre Reinforced Structures, Clause 16.6;

(c) Testing for post-cracking residual strength index (R_i) of FRC shall be tested as follows:

(i) One set of five concrete beam specimens, 100 mm by 100 mm by 350 mm long, shall be tested to failure in accordance to ASTM C1609-10. The average of the peak loads is the cracking load of the concrete (P_{cr});

(ii) A second set of five concrete beam specimens, 100 mm by 100 mm by 350 mm long, shall be tested to failure in accordance with ASTM C1399-04. The average of the peak loads during reloading is the post cracking load of the concrete (P_{pcr}); and,

(iii) The R_i is equal to the ratio of P_{pcr} over P_{cr}. The Contractor shall submit a summary of the results of all post-cracking residual strength index tests. Tests conducted in accordance to ASTM C1399-04 will be considered invalid by the Contract Administrator if the initial crack in the specimen has occurred after 0.5 mm deflection. Provide all load deflection curves with test submissions (initial and reloading curves).

(d) All tests shall be based on the concrete samples taken from the point of discharge into the formwork. For example, at the concrete chute from the delivery truck if being placed by buggies, or at the end of the pump line should the Contractor choose to pump the concrete into the form. At the discretion of the Contract Administrator, if the Contractor can demonstrate a relationship between the plastic concrete properties at the point of discharge into the formwork and the end of the chute of the delivery truck, the Contract Administrator may accept test results at the end of the chute with the appropriate adjustments to the wet concrete performance requirements as being representative of what is in the formwork.

AD9.6.2 Aggregates

(a) The Contractor shall furnish, in writing to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, the location of the sources where aggregate will be obtained in order that some may be inspected and tentatively accepted by the Contract Administrator. Changes in the source of aggregate supply during the course of the Contract shall not be permitted without notification in writing to and the expressed approval of the Contract Administrator;

(b) The Contractor shall submit to the Contract Administrator for review and approval recent test information on sieve analysis of fine and coarse aggregates in accordance with CSA Standard Test Method A23.2-2A;

(c) The Contractor shall submit to the Contract Administrator for review and approval recent test information on tests for organic impurities in fine aggregates for concrete, in accordance with CSA Standard Test Method A23.2-7A;

(d) The Contractor shall submit to the Contract Administrator for review and approval recent test information on relative density and absorption of coarse aggregate, in accordance with CSA Standard Test Methods A23.2-12A;

(e) The Contractor shall submit to the Contract Administrator for review and approval recent test information on petrographic examination of aggregates for concrete, in accordance with CSA Standard Test Methods A23.2-15A. The purpose of the petrographic analysis is to ensure the aggregates provided are of the highest quality for use in the production of concrete and will produce a durable overlay. An acceptable aggregate will have an excellent rating as judged by an experienced petrographer, with a (weighted) petrographic number typically in the range of 100 to 120;

(f) The Contractor shall submit to the Contract Administrator for review and approval recent test information on resistance to degradation of large-size coarse aggregate by abrasion and impact in the Los Angeles Machine, in accordance with CSA Standard Test Method A23.2-16A; and,

(g) The Contractor shall submit to the Contract Administrator for review and approval recent test information on potential alkali reactivity of cement aggregate combinations (mortar bar method), in accordance with CSA Standard Test Method A23.2-27A.

AD9.6.3 The Contractor shall submit to the Contract Administrator copies of all material quality control test results.

AD9.7 Notification of Ready Mix Supplier

AD9.7.1 The Contractor shall submit to the Contract Administrator the name and qualifications of the Ready Mix Concrete Supplier that he is proposing to use, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement. The Contract Administrator will verify the acceptability of the Supplier and the concrete mix design requirements. Acceptance of the Supplier and the concrete mix design(s) by the Contract Administrator does not relieve or reduce the responsibility of the Contractor or Supplier from the requirements of this Specification.

AD9.8 Temporary False Work, Formwork and Shoring Works

AD9.8.1 The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, detailed design calculations and shop drawings for any temporary Works, including falsework, formwork, and shoring, that are sealed, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba.

AD9.8.2 Design Requirements

(a) All forms shall be of wood, metal or other materials as approved by the Contract Administrator;

(b) The falsework, formwork, and shoring for these Works shall be designed by a Professional Engineer registered in the Province of Manitoba. Falsework shall be designed according to the requirements of CSA S269.1, “False Work for Construction Purposes.” The shop drawings shall bear the Professional Engineer's seal. Shop drawings submitted without the seal of a Professional Engineer will be rejected. The submission of such shop drawings to the Contract Administrator shall in no way relieve the Contractor of full responsibility for the safety and structural integrity of the formwork and shoring;

(c) The falsework, formwork, and shoring for these Works shall be designed to safely support all vertical and lateral loads until such loads can be supported by the concrete all in accordance with CSA Standard CAN/CSA S269.3-M92. All proposed fastening methods to the existing deck superstructure must be submitted to the Contract Administrator for review and approval;

(d) The loads and lateral pressures outlined in Part 3, Section 102 of "Recommended Practice for Concrete Formwork", (ACI 347) and wind loads as specified by the National Building Code shall be used for design. Additional design considerations concerning factors of safety for formwork elements and allowable settlements outlined in Section 103 of the above reference shall apply;

(e) As a minimum, the following spacing’s shall apply for studding and walers:

(i) 20-mm plywood: studding 400 mm centre to centre (max.),
walers 760 mm centre to centre (max.).

(f) Forms shall be designed and constructed so that the completed Work will be within minus 3 mm or plus 6 mm of the dimensions shown on the Drawings;

(g) Formwork shall be designed to provide chamber, where applicable, to maintain the specified tolerance to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete, due to construction loads;

(h) Slots, recesses, chases, sleeves, inserts, bolts, hangers, and other items shall be accommodated in the design, in coordination and cooperation with the trade concerned. No openings in structural members are to be shown on the shop drawings without the prior written approval of the Contract Administrator;

(i) Shores shall be designed with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required;

(j) Mud sills of suitable size shall be designed beneath shores, to be bedded in sand or stone, where they would otherwise bear on soil. The soil below shores must be adequately prepared to avoid settlement during or after concreting. Shores must not be placed on frozen ground;

(k) Shores shall be braced horizontally in two directions and diagonally in the same two vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected;

(l) All exposed edges shall be chamfered 20 mm unless otherwise noted on the Drawings;

(m) Formwork shall be designed to have sufficient strength and rigidity so that the resultant finished concrete conforms to the shapes, lines, and dimensions of the members shown on the Drawings; and,

(n) Forms shall be designed to be sufficiently tight to prevent leakage of grout or cement paste.

AD9.8.3 Shop drawings shall show design loads, type, and number of equipment to be used for placing the concrete, method of construction, method of removal, type and grade of materials, and any further information that may be required by the Contract Administrator. The Contractor shall not proceed with any Work on site until the shop drawings have been reviewed and approved in writing by the Contract Administrator. Falsework must be designed to carry all loads associated with construction of overhangs including deflection due to dead loads, placement of concrete, hoarding, construction live loads, and any other loads that may occur.

AD9.8.4 For timber formwork and falsework, the shop drawings shall specify the type and grade of lumber and show the size and spacing of all members. The shop drawings shall also show the type, size and spacing of all ties or other hardware, and the type, size and spacing of all bracing.

AD9.9 Screed for Deck Slab Concrete

AD9.9.1 Plans for anchoring support rails shall be submitted to the Contract Administrator for review and acceptance at least fourteen (14) Days prior to the scheduled commencement of concrete placement. The Contract Administrator's written acceptance must be received by the Contractor prior to the installation of any anchorage devices.

AD9.10 Concrete Deck Slab Pour Sequence and Schedule

AD9.10.1 The Contractor shall pour the deck slab concrete in accordance with the pour sequence as outlined in the Drawings. Should the Contractor opt to submit an alternate construction pour sequence for the deck slab concrete, the Contractor shall submit the proposed alternate construction pour sequence to the Construction Administrator for review, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement.

AD9.10.2 The Contractor shall submit to the Contract Administrator for review, at least fourteen (14) Days prior to the placement of concrete, details of the construction joints.

AD9.10.3 The Contractor shall submit to the Contract Administrator for review and approval, at least fourteen (14) Days prior to scheduled commencement of concrete placement, the proposed concrete placement schedule for all other structural concrete placements of this Specification.

AD9.11 Temperature Management Plan

AD9.11.1 Provide the Contract Administrator with a Temperature Management Plan for all mass concrete at least five (5) Business Days prior to commencement of any Work on the Site but in no event later than the date specified in the General Conditions for the return of the executed Contract.

AD9.11.2 Mass concrete is defined as all structural concrete with a minimum thickness or dimension of 1.0 metres or more.

AD9.11.3 The Temperature Management Plan shall include methods to control peak temperature and excessive temperature differentials, equipment used to monitor temperatures, corrective actions if readings are in non-conformance with CAN/CSA A23.1-14, and reporting. At a minimum, the plan must include the following:

(a) A minimum of two groups of thermal monitors (thermocouples) shall be provided for each mass concrete component. More groups may be required based on shape of component, hoarding conditions, etc. With reference to the longest dimension of the component, one group shall be placed in the middle of the structure and the other near the edge. Generally each grouping will consist of a sensor in the core, edge of reinforcing, and exterior face of concrete (i.e. interior face of formwork). The core shall be defined as no less than 1.5 m into the component, or the middle if that dimension is less than 3.0 m;

(b) Unformed surfaces that will receive wet curing are typically covered with tarps or other insulating blankets. The surface temperature under the wet curing system shall also be taken;

(c) Ambient air temperatures shall be taken for each component. For components that are hoarded, the temperatures shall be taken inside the hoarding. External ambient air temperatures shall be taken for reference as well;

(d) Using the temperatures from the thermal monitors, surface temperatures, and ambient air temperatures, the temperature differentials of each grouping shall be provided for two directions of monitoring; core to formed concrete face (side), and core to unformed concrete face (top);

(e) The frequency of monitoring after final placement of concrete for each mass concrete component shall be as follows:

(i) 0-48 hours: once every hour;

(ii) 48 hours to end of wet curing period (7 days): once every four hours; and,

(iii) In winter conditions: once every 12 hours until core temperature reaches 0°C.

(f) It is recommended to use digital monitoring devices and standard spreadsheets for their ease of tracking. Upon completion of monitoring for each component, the information shall be saved and distributed to the Contract Administrator.

AD9.11.4 Peak concrete temperature and thermal differentials shall be maintained in accordance with CAN/CSA A23.1-14. The effect of mass concrete both in terms of cold weather and hot weather concreting should be addressed.

AD9.11.5 The Temperature Management Plan shall be prepared in accordance with the requirements of CSA A23.1 and shall include provisions for monitoring the temperature of the mass concrete pours and ambient temperature from time of placement until such time as management measures are no longer required.

MATERIALS

AD9.12 General

AD9.12.1 All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.

AD9.12.2 The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

AD9.13 Handling and Storage of Materials

AD9.13.1 All materials shall be handled and stored in a careful and workmanship like manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CSA Standard CAN/CSA-A23.1-04.

AD9.14 Concrete

AD9.14.1 Concrete materials susceptible to frost damage shall be protected from freezing.

AD9.14.2 Concrete shall have nominal compressive strengths (f'c) and meet the requirements for hardened concrete as specified in the following Table AD9.1.

TABLE AD9.1
REQUIREMENTS FOR HARDENED CONCRETE

Type of Concrete	Location	Nominal Compressive Strength [MPa]	Class of Exposure	Air Content Category	Max Agg. Size	Special Requirements	Post Residual Cracking Index
Type 1	Lean Mix Concrete	15 @ 28 Days	S-1	2	20 mm		
Type 2	Caissons, Piles, Footings	35 @ 56 Days	S-1	2	20 mm		
Type 3	Cast-in-Place Culverts, Retaining Walls, Abutment Backwalls, Approach Roadway Traffic Barrier Footings, MSE Wall Panels, Pile Caps, Grade Beams, Abutment Seats, Tunnel Raft Foundations, Walls and Roof	35 @ 28 Days	C-1	1	20 mm		
Type 4	Pier Columns/ Shafts, Pier Cap, Diaphragms, Deck Slab, Approach Slabs, Bridge Traffic Curbs and Barriers, Bridge Sidewalks, Retaining Wall and MSE Coping, and Approach Roadway Traffic Barriers	35 @ 28 Days	C-1	1	20 mm	Synthetic Fibres	0.15

AD9.14.3 Design Requirements

(a) The Contractor shall design falsework, formwork and shoring for the new Bridge deck slab overhangs to be released prior to the placement of the High Performance Concrete (HPC) deck overlay. The formwork shall not extend beneath the underside of the existing deck.

AD9.15 Working Base Concrete

AD9.15.1 Working base concrete shall be placed in the locations as shown on the Drawings.

AD9.15.2 Working base shall be concrete meeting the requirements of CAN/CSA A23.1 latest edition, for S-1 class of exposure, except as follows:

(a) 15 MPa at 28 days.

AD9.16 Aggregates

AD9.16.1 General

(a) All aggregates shall be handled to prevent segregation and inclusion of any foreign substances, and to obtain uniformity of materials. The two sizes of coarse and fine aggregates, and aggregates secured from different sources, shall be piled in separate stockpiles. The site of the stockpiles shall be cleaned of all foreign materials and shall be reasonably level and firm or on a built up platform. If the aggregates are placed directly on the ground, material shall not be removed from the stockpile within 150 mm of the ground level. This material shall remain undisturbed to avoid contaminating the aggregate being used with the ground material;

(b) The potential for deleterious alkali-aggregate reactivity shall be assessed in accordance with CSA A23.2-27A-04. Current (less than 18 months old) test data evaluating the potential alkali-silica reactivity of aggregates tested in accordance with CSA A23.2-14A-04 or CSA A23.2-25A-04 is required; and,

(c) Petrographic analysis when performed shall be in accordance with MTO (Ministry of Transportation Ontario) Lab Test Method LS 609. The (weighted) petrographic number shall not exceed 130.

AD9.16.2 Fine Aggregate

(a) Fine aggregate shall meet the grading requirements of CSA A23.1-04, Table 10, FA1, be graded uniformly and not more than 3% shall pass a 75 um sieve. Fine aggregate shall consist of sand, stone, screenings, other inert materials with similar characteristics or a combination thereof, having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances; and,

(b) Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1-04, Table 12.

AD9.16.3 Coarse Aggregate - Standard

(a) The maximum nominal size of coarse aggregate shall be 20 mm and meet the grading requirements of CSA A23.1-04, Table 11, Group I. Coarse aggregate shall be uniformly graded and not more than 2% shall pass a 75 um sieve. Coarse aggregate shall consist of crushed stone or gravel or a combination thereof, having hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter or other injurious substances. Coarse aggregate shall be clean and free from alkali, organic or other deleterious matter; shall have a minimum of two fractured faces; and shall have an absorption not exceeding 3%;

(b) The aggregate retained on the 5 mm sieve shall consist of clean, hard, tough, durable, angular particles with a rough surface texture, and shall be free from organic material, adherent coatings of clay, clay balls, an excess of thin particles or any other extraneous material;

(c) Course aggregate when tested for abrasion in accordance with ASTM C131 shall not have a loss greater than 30%; and,

(d) Tests of the coarse aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1-04, Table 12, for concrete exposed to freezing and thawing.

AD9.17 Admixtures

AD9.17.1 Air-entraining admixtures shall conform to the requirements of ASTM C260.

AD9.17.2 Chemical admixtures shall conform to the requirements of ASTM C494 or C1017 for flowing concrete.

AD9.17.3 All admixtures shall be compatible with all other constituents. The addition of calcium chloride, accelerators and air-reducing agents, will not be permitted, unless otherwise approved by the Contract Administrator.

AD9.18 Cementitious Materials

AD9.18.1 Cementitious materials shall conform to the requirements of CSA-A3001 and shall be free from lumps.

AD9.18.2 Should the Contractor choose to include a silica fume admixture in the concrete mix design, the substitution of silica fume shall not exceed 8% by mass of cement.

AD9.18.3 Should the Contractor choose to include fly ash in the concrete mix design, the fly ash shall be Class CI or F and the substitution shall not exceed 30% by mass of cement.

AD9.18.4 Cementitious materials shall be stored in a suitable weather-tight building that shall protect these materials from dampness and other destructive agents. Cementitious materials that have been stored for a length of time resulting in the hardening, or the formation of lumps, shall not be used in the Work.

AD9.19 Water

AD9.19.1 Water to be used for all operations in the Specification, including mixing and curing of concrete or grout, surface texturing operations, and saturating the substrate shall conform to the requirements of CSA A23.1-04 and shall be free of oil, alkali, acidic, organic materials or deleterious substances. The Contractor shall not use water from shallow, stagnant or marshy sources.

AD9.20 Synthetic Fibres

AD9.20.1 The synthetic fibres shall consist of 100% virgin polypropylene or 100% virgin polyolefin as accepted by the Contract Administrator. The dosage shall be designed by the Contractor to meet the requirements for post-cracking residual strength index (Ri) and fibre dispersion in accordance to the CHBDC CSA-S6-06, Fibre-Reinforced Structures, Clause 16.6 except the post-cracking residual strength index (Ri) shall be determined in accordance with ASTM C1609.

AD9.21 Formwork

AD9.21.1 Formwork materials shall conform to CSA Standard A23.1-04, and American Concrete Publication SP4, “Formwork for Concrete.”

AD9.21.2 Form sheeting plywood to be covered with form liner or to be directly in contact with soil shall be exterior Douglas Fir, concrete form grade, conforming to CSA Standard O121-M1978, a minimum of 20 mm thick.

AD9.21.3 Where form liner is not being used, form sheeting shall be Douglas Fir, overlay form liner type conforming to CSA Standard O121-M1978. Approved Manufacturers are “Evans” and “C-Z.”

AD9.21.4 Boards used for formwork shall be fully seasoned and free from defects such as knots, warps, cracks, etc., which may mark the concrete surface.

AD9.21.5 No formwork accessories will be allowed to be left in place within 50 mm of the surface following form removal. Items to be left in place must be made from a non-rusting material or stainless steel; and they shall not stain, blemish, or spall the concrete surface for the life of the concrete.

AD9.21.6 Forms for exposed surfaces that do not require a form liner may be either new plywood or steel as authorized by the Contract Administrator.

AD9.21.7 Studding shall be spruce or pine and shall have such dimensions and spacing that they shall withstand without distortion all the forces to which the forms shall be subjected.

AD9.21.8 Walers shall be spruce or pine, with minimum dimensions of 100 mm x 150 mm. Studding shall be spruce or pine, with minimum dimensions of 50 x 150.

AD9.21.9 Stay-in-place formwork or falsework is not acceptable and shall not be used by the Contractor unless specifically shown on the Drawings.

AD9.22 Form Coating

AD9.22.1 Form coating shall be "Sternson C.R.A." by Sternson, "SCP Strip Ease" by Specialty Construction Products, or approved equal as accepted by the Contract Administrator.

AD9.23 Permeable Formwork Liner

AD9.23.1 Formwork liner shall be Texel Drainaform, Hydroform, or approved equal as accepted by the Contract Administrator. This formwork liner shall be used on all exposed substructure and superstructure formed surfaces, except soffit surfaces, or where a normal form finish is specified.

AD9.23.2 Paper-lined forms shall be used on all soffit surfaces, such as deck slab overhangs. The Contractor shall provide conclusive evidence that the paper-lined form proposed for use will not stain or otherwise blemish the hardened concrete surface.

AD9.24 Curing Compound

AD9.24.1 Curing compounds shall be liquid membrane-forming and conform to the requirements of ASTM Standard C309-98a.

AD9.24.2 Curing compound for approach slabs and slope paving shall be resin-based and white-pigmented.

AD9.24.3 WR Meadows 1215 WHITE Pigmented Curing Compound is an approved product, or approved equal as accepted by the Contract Administrator.

AD9.25 Curing Blankets

AD9.25.1 Curing blankets for wet curing shall be 100 percent polyester, 3 mm thick, white in colour. An approved product is “Mirafi Geotextile P150”. Alternately, a 10 oz burlap, 5 mil polyethylene, curing blanket white in colour shall be used; “Curelap” manufactured by Midwest Canvas, together with a second layer of burlap, or approved equal as accepted by the Contract Administrator.

AD9.26 Bonding Agents

AD9.26.1 Latex Bonding Agent

(a) Latex bonding agent shall be Acryl-Stix, SikaCem 810, or approved equal as accepted by the Contract Administrator. Polyvinyl acetate-based latexes will not be permitted. Planicrete AC by MAPEI is approved for use as a latex bonding agent on concrete greater than 28 days in age.

AD9.26.2 Bonding Grout

(a) The grout for bonding the new deck slab concrete to the existing concrete deck slab concrete shall be mixed in an agitating hopper slurry pump and shall consist of the following constituents, by weight:

(i) 1 part water;

(ii) 1 part latex bonding agent; and,

(iii) 1½ parts Type GUSF Portland cement.

(b) The consistency of the bonding grout shall be such that it can be brushed on the existing concrete surface in a thin, even coating that will not run or puddle in low spots.

AD9.27 Epoxy Adhesive

AD9.27.1 Epoxy adhesive for bonding concrete to steel shall be one of the following approved products: Sternson ST432 or ST433, Dural Duralbond, Capper Capbond E, Sikadur 32 Hi-bond, Concressive 1001 LPL, Meadows Rezi-Weld 1000, or approved equal as accepted by the Contract Administrator.

AD9.28 Epoxy Grout

AD9.28.1 Epoxy grout shall be one of the following approved products: Sternson Talygrout 100, Sika Sikadur 42, CPD Epoxy Grout by Specialty Construction Products, Meadows Rezi-Weld EG-96, or approved equal as accepted by the Contract Administrator.

AD9.29 Cementitious Grout

AD9.29.1 Cementitous grout shall be nonshrink and nonmetalic. Approved products are Sternson M-bed Standard, Specialty Construction Products CPD Non-Shrink Grout, Sika 212 Non-Shrink Grout, or approved equal as accepted by the Contract Administrator. The minimum compressive strength of the grout at 28 days shall be 40 MPa.

AD9.30 Patching Mortar

AD9.30.1 Patching mortar shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2 parts sand by damp loose volume. White Portland Cement shall be substituted for a part of the grey Portland Cement on exposed concrete in order to produce a colour matching the colour of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling or placing.

AD9.31 Flexible Joint Sealant

AD9.31.1 Flexible joint sealant for all horizontal, vertical, and sloping joints shall be guaranteed non-staining, grey polyurethane, accepted by the Contract Administrator and applied in strict accordance with the details shown on the Drawings and the Manufacturer's instructions including appropriate primers if recommended. Approved products are Vulkem 116 by Mameco, Sonolastic NP1 by Sonneborn, Sikaflex-1a by Sika, Bostik 915 by Bostik, or approved equal as accepted by the Contract Administrator.

AD9.32 Fibre Joint Filler

AD9.32.1 Fibre joint filler shall be rot-proof and of the preformed, nonextruding, resilient type made with a bituminous fibre such as Flexcell and shall conform to the requirements of ASTM Standard D1751-99 or approved equal as accepted by the Contract Administrator.

AD9.33 EMSEAL Precompressed Foam Joint Filler

AD9.33.1 Expansion joint seal shall be EMSEAL BEJS or equivalent as approved by the Contract Administrator to ASTM C711 and ASTM G155-00A:

(a) Sealant system shall be comprised of three components:

(i) Cellular polyurethane foam impregnated with hydrophobic 100% acrylic, water-based emulsion, factory coated with highway-grade, fuel resistant silicone;

(ii) Field-applied epoxy adhesive primer; and,

(iii) Field-injected silicone sealant bands.

(b) Impregnation agent to have proven non-migratory characteristics. Silicone coating to be highway-grade, low-modulus, fuel resistant silicone applied to the impregnated foam sealant at a width greater than maximum allowable joint extension and which when cured and compressed will form a bellows. Depth of seal as recommended by manufacturer. BEJS foam seal to be installed into manufacturer's standard field-applied epoxy adhesive. The BEJS SYSTEM is to be installed recessed from the surface such that when the field-applied injection band of silicone is installed between the substrates and the foam-and-silicone-bellows, the system will be ½" (12 mm) down from the substrate surface;

(c) Material shall be capable, as a dual seal, of movements of +50% to -50% (100% total) of nominal material size. Changes in plane and direction shall be executed using factory fabricated "Universal 90" transition assemblies. Transitions shall be warranted to be watertight at inside and outside corners through the full movement capabilities of the product;

(d) All substitute candidates to be certified in writing to be free in composition of any waxes or asphalts, wax compounds or asphalt compounds. All substitute candidates shall be certified in writing to be:

(i) Capable of withstanding 65°C for three (3) hours while compressed down to the minimum of movement capability dimension of the basis of design product (-50% of normal material size) without evidence of any bleeding of impregnation medium from the material; and,

(ii) That the same material after the heat stability test will self-expand to the maximum of movement capability dimension of the basis-of-design product (+50% of nominal material size) within twenty-four (24) hours at room temperature 20°C.

AD9.34 Ethafoam Joint Filler

AD9.34.1 Ethafoam joint filler shall be non-staining, polyethylene, closed-cell product for expansion and constraction and/or isolation joint application and the type shall be accepted by the Contract Administrator.

AD9.35 Low Density Styrofoam

AD9.35.1 Low density Styrofoam shall be the type accepted by the Contract Administrator.

AD9.36 Backup Rod

AD9.36.1 Backup rod shall be pre-formed compressible polyethylene, urethane, neoprene, or vinyl foam backer road, extruded into a closed cell form and oversized 30 to 50%.

AD9.37 Screed Bases and Chairs

AD9.37.1 Screed bases shall be Hilti HAS 304 stainless steel threaded rods, or approved equal as accepted by the Contract Administrator.

AD9.37.2 Screed chairs shall be Mega Screed as supplied by Brock White Canada Company, or approved equal as accepted by the Contract Administrator.

AD9.38 Dampproofing

AD9.38.1 Dampproofing materials shall be applied to all buried concrete surfaces in contact with the soil to within 300 mm of Finished Ground Elevation, with the exception of those surfaces cast directly against the soil or in contact with prefabricated drainage composite. Dampproofing materials shall be mineral colloid emulsified asphalt complying with Canadian General Standards Board Specification No. 37.16-M89. Acceptable product is Bakelite/Flintguard 710-11 Foundation Coating as manufactured by Bakor, Elsro Fibrated Foundation Coating, Insulmastic 7103 Fibered Waterproofing, or approved equal as accepted by the Contract Administrator.

AD9.38.2 All damaged concrete, including tie holes to be filled with non-shrink grout prior to application of dampproofing.

AD9.38.3 Primer for dampproofing shall be asphalt primer, penetrating type conforming to CGSB 37-GP-9Ma. Acceptable products are Bakor Penetrating 910-01 Asphalt Primer as manufactured by Bakor Inc., Elsro Asphalt Primer No. 510, Insulmastic 7501 C/B Roof & Foundation Primer, or approved equal as accepted by the Contract Administrator.

AD9.39 Miscellaneous Materials

AD9.39.1 Miscellaneous materials shall be of the type specified on the Drawings or as accepted by the Contract Administrator.

AD9.40 Benchmark Plugs

AD9.40.1 Benchmark plugs shall be supplied by the City of Winnipeg. Installation by the Contractor shall be considered incidental to these Works. Installation locations shall be determined by the Contract Administrator.

EQUIPMENT

AD9.41 General

AD9.41.1 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

AD9.42 Vibrators

AD9.42.1 The Contractor shall have sufficient numbers of internal concrete vibrators and experienced operators on site to properly consolidate all concrete in accordance with ACI 309. The type and size of vibrators shall be appropriate for the particular application, the size of the pour, and the amount of reinforcing and shall conform to standard construction procedures.

AD9.42.2 The Contractor shall have standby vibrators available at all times during the pour.

AD9.43 Placing and Finishing Equipment for Bridge Deck Concrete, Roof Slabs, and Approach Slabs

AD9.43.1 Placing Equipment

(a) Adjacent exposed reinforcing steel shall be adequately protected during concrete placement.

AD9.43.2 Screed

(a) The Contractor shall use a mechanical screed to strike the surface of the superstructure concrete;

(b) The screed shall be constructed to span the full out-to-out width of the bridge deck for concrete placement in one continuous operation;

(c) Screed rails are required and shall be sufficient in number and length to ensure that the concrete cover is maintained and the finished elevation of the deck slab concrete meets the design elevations;

(d) Screed guides shall be placed and fastened in position to ensure finishing of the concrete to the required profile. Supporting rails, upon which the finishing machine travels, shall be placed outside the area to be concreted. Provisions for anchorage of supporting rails shall provide for horizontal and vertical stability; positive anchorage may be required by the Contract Administrator. A hold-down device shot into concrete will not be permitted, unless the concrete is to be subsequently resurfaced;

(e) The mechanical screed on guides or rails shall be supported so that they are completely clear of the finished surface;

(f) Internal vibration of the concrete will be required with mechanical screeding. Care shall be taken not to overwork the concrete surface;

(g) Care shall be taken to ensure that the screed bars are seated uniformly on the screed chairs and that the ends of the screed bars do not overhang the screed chairs by more than 75 mm;

(h) Screed surface touching concrete shall not be made of aluminum (magnesium acceptable); and,

(i) The supply, setup, operation, and takedown of the screed for deck slab concrete shall be considered incidental to the placement of the deck slab concrete. No separate measurement or payment shall be made for this Work.

AD9.43.3 Moveable Work Bridges for Deck Slab Concrete

(a) At least two moveable Work Bridges will be required (one for finishing operations and one for curing operations), independent of the screeding and finishing machines for the deck slab concrete;

(b) These moveable Work Bridges shall travel guided on rails supported clear of the finished structural deck concrete;

(c) The Contractor shall install a sturdy walkway with safety railing on each side of the Work area for the purpose of providing access to the Work Bridge; and,

(d) The supply, set up, operation, and takedown of the moveable Work Bridges shall be considered incidental to the placement of the Bridge Deck concrete. No separate measurement or payment shall be made for this Work.

AD9.43.4 Moveable Deck Hoarding

(a) The moveable deck hoarding shall be constructed on wheels or rollers for ready mobility. Another acceptable method is to have stationary sides, with the roof on wheels or rollers;

(b) The rail system for the movable deck hoarding can be the same rail system used for the screed and the Work Bridges, subject to the approval of the Contract Administrator;

(c) The roof of the hoarding shall be checked for damage and water tested before each concrete pour, and all repairs shall be made, as required, before concrete placing will be allowed to begin; and,

(d) The hoarding shall not be removed from overtop of a newly completed structural deck without first obtaining permission from the Contract Administrator.

CONSTRUCTION METHODS

AD9.44 General

AD9.44.1 It is intended that this Section cover all construction Work associated with Structural Concreting operations.

AD9.44.2 Rate of application shall be the rate required to meet the requirements of ASTM C309-98a for the texture of concrete the curing compound is being applied to.

AD9.45 Temporary False Work, Formwork, and Shoring

AD9.45.1 Construction Requirements

(a) The Contractor shall construct falsework, formwork and shoring for the new deck slab concrete overhangs strictly in accordance with the accepted shop drawings;

(b) All forms shall be of wood, metal or other materials as approved by the Contract Administrator. No formwork shall extend beneath the underside of the superstructure;

(c) The falsework, formwork, and shoring for these Works shall be erected, and braced, as designed, and maintained to safely support all vertical and lateral loads until such loads can be supported by the concrete. All proposed fastening shall be as shown on the accepted shop drawings;

(d) Forms shall be constructed and maintained so that the completed Work is within minus 3 mm or plus 6 mm of the dimensions shown on the Drawings;

(e) Formwork shall be cambered, where necessary to maintain the specified tolerance to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete, due to construction loads;

(f) Slots, recesses, chases, sleeves, inserts, bolts, hangers, and other items shall be formed or set in coordination and cooperation with the trade concerned. No openings shall be made in structural members that are not shown on the shop drawings without the prior written approval of the Contract Administrator;

(g) Shores shall be provided with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required;

(h) Mud sills of suitable size shall be provided beneath shores, bedded in sand or stone, where they would otherwise bear on soil. The soil below shores must be adequately prepared to avoid settlement during or after concreting. Shores must not be placed on frozen ground;

(i) Shores shall be braced horizontally in two directions and diagonally in the same two vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected;

(j) All exposed edges shall be chamfered 20 mm unless otherwise noted on the Drawings;

(k) Formwork shall have sufficient strength and rigidity so that the resultant finished concrete conforms to the shapes, lines, and dimensions of the members shown on the Drawings; and,

(l) Forms shall be constructed so as to be sufficiently tight to prevent leakage of grout or cement paste.

AD9.45.2 Form panels shall be constructed so that the contact edges are kept flush and aligned.

AD9.45.3 Forms for the concrete barriers shall be accordingly aligned to each other and to the geometry shown on the Drawings so as to provide a smooth, continuous barrier. Any misalignments in the barrier shall be cause for rejection and removal of same. No snap ties within the barriers shall be placed below 250 mm above the top of the upper lift elevation.

AD9.45.4 Forms shall be clean before use. Plywood and other wood surfaces shall be sealed against absorption of moisture from the concrete by a field applied form coating or a factory applied liner as accepted by the Contract Administrator.

AD9.45.5 Where prefabricated panels are used, care shall be taken to ensure that adjacent panels remain flush. Where metal forms are used, all bolts and rivets shall be counter sunk and well ground to provide a smooth, plane surface.

AD9.45.6 Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be commercially manufactured types. The portion remaining within the concrete shall leave no metal within 50 mm of the surface when the concrete is exposed to view. Spreader cones on ties shall not exceed 30 mm in diameter. 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 for exterior surfaces of decks and curbs shall be an acceptable break-back type with surface cone, or removable threaded type. Cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in matching colour of surrounding concrete.

AD9.45.7 Formwork shall be constructed to permit easy dismantling and stripping and such that removal will not damage the concrete. Provision shall be made in the formwork for shores to remain undisturbed during stripping where required.

AD9.45.8 It shall be permissible to use the forms over again where possible to a maximum of three uses, provided they are thoroughly cleaned and in good condition after being removed from the former portions of the Work. The Contract Administrator shall be the sole judge of their condition and his decision shall be final regarding the use of them again.

AD9.45.9 Where required by the Contract Administrator, the Contractor shall cast test panels not using less than two panels of representative samples of the forms he proposes for reuse and shall strip them after forty-eight (48) hours for the Contract Administrator to judge the type of surface produced.

AD9.45.10 All form lumber, studding, etc., becomes the property of the Contractor when the Work is finished, and it shall be removed from the concrete and the Site by the Contractor after the concrete is set, incidental to the Work of this Specification, and the entire site shall be left in a neat and clean condition.

AD9.46 Concrete Construction Joints

AD9.46.1 Concrete construction joints shall be located only where shown on the Drawings or as otherwise directed in writing by the Contract Administrator. Concrete construction joints shall be formed at right angles to the direction of the main reinforcing steel. All reinforcing steel shall be continuous across the joints.

AD9.46.2 Forms shall be re-tightened and all reinforcing steel shall be thoroughly cleaned at the joint prior to concreting.

AD9.46.3 After the forms are stripped off the construction joint, the entire face of the joint, including the reinforcing steel, shall be thoroughly cleaned down to sound concrete and the surface roughened.

AD9.46.4 Refer to AD9.56 for the requirements to prepare the hardened concrete at a construction joint for receiving new concrete.

AD9.47 Bridge Deck Screeds

AD9.47.1 Setting Deck Screeds

(a) The Contractor shall adjust screeds to maintain uniform slab thickness. Adjust screed heights to plan elevations or to such other elevation as may be determined by the Contract Administrator in the field. Screed bases will be permitted to be drilled and grouted into existing concrete and shall be adjustable to achieve the required elevations; and,

(b) The screed chairs and screed rail supports shall be spaced to prevent deflections of the screed bars or screed rails during screeding operations.

AD9.47.2 Care should be exercised during screeding operations, especially at the extents of the rails, to ensure the paste that is being pushed forward by the rails or rollers is removed. Where there is paste pushed forward, it shall be removed from the rails and placed at the leading edge of concrete placement. It should be noted this is a critical operation for the mitigation of potential scaling at the edges of the bridge deck.

AD9.48 Concrete Bridge Traffic Barrier Joints

AD9.48.1 For the joint sealing at all locations, the contractor shall submit shop drawings and his proposed installation procedures to the Contract Administrator for approval fourteen (14) days prior to installation.

AD9.48.2 The installation of the fibre joint filler and the EMSEAL joint sealing shall be undertaken as shown on the drawings.

AD9.48.3 EMSEAL joint seals shall not be field spliced except when specifically permitted by the Contract Administrator in writing.

AD9.48.4 Furnish fibre joint filler for each joint in a single piece for the required depth and width for each joint, unless otherwise approved by the Contract Administrator. If permitted, multiple pieces shall be fastened together for a given joint by butting ends and securing in place by stapling or other positive fastening methods.

AD9.48.5 The EMSEAL joint sealing at the barrier joints shall be installed as per the Manufacturer's recommendations.

AD9.48.6 All joint sealing of Bridge traffic barriers shall take place prior to the installation of the Bituminous Paving.

AD9.48.7 The supply and installation of EMSEAL joint sealing and fibre joint fillers shall be considered incidental to the Work, and no additional measurement or payment shall be made for this Work.

AD9.49 Anchor Units for Bridge Traffic Barrier Posts and End Rail Units

AD9.49.1 All anchor units shall be as specified on the Drawings.

AD9.49.2 All anchor units shall be held securely in place so as not to become displaced during concrete placement operations.

AD9.50 Permeable Formwork Liner

AD9.50.1 Permeable formwork liner shall be used on all exposed surfaces, except on soffit surfaces, or surfaces where a normal an architectural form finish is specified.

AD9.50.2 The permeable formwork liner shall be used for only one (1) application.

AD9.50.3 The supply, setup, application, and removal of permeable formwork liner shall be considered incidental to the placement of structural concrete, and no separate measurement or payment shall be made for this Work.

AD9.51 Control Joint Seals

AD9.51.1 Formed control joints sealant for all horizontal, vertical and sloping joints shall be applied in strict accordance with the details shown on the Drawings and the Manufacturer's instructions including appropriate primers if recommended.

AD9.51.2 Form control joints shall be thoroughly cleaned before sealing.

AD9.52 Benchmarks

AD9.52.1 The Contractor shall install benchmark plugs supplied by the Contract Administrator at such locations on the structure as may be directed by the Contract Administrator.

AD9.53 Structure Identification Date

AD9.53.1 The Contractor shall indent into the exposed concrete a structure identification date as shown on the Drawings, in accordance with the detail shown on the Drawings, or as otherwise directed by the Contract Administrator.

AD9.54 Approach Slabs Works

AD9.54.1 The Contractor shall undertake the approach slab Works, as shown on the Drawings.

AD9.55 Supply of Structural Concrete

AD9.55.1 All structural concrete shall be supplied from a plant certified by the Manitoba Ready Mix Concrete Association. The Contractor, upon request from the Contract Administrator, shall furnish proof of this certification.

AD9.55.2 All mixing of concrete must meet the provisions of CSA A23.1-04, Clause 5.2, Production of Concrete.

AD9.55.3 Time of Hauling

(a) The maximum time allowed for all types of concrete to be delivered to the Site of the Work, including the time required to discharge, shall not exceed 120 minutes after batching. Batching of all types of concrete is considered to occur when any of the mix ingredients are introduced into the mixer, regardless of whether or not the mixer is revolving. For concrete that includes silica fume and fly ash, this requirement is reduced to 90 minutes;

(b) Each batch of concrete delivered to the Site shall be accompanied by a time slip issued at the batching plant, bearing the time of batching. In hot or cold weather, or under conditions contributing to quick stiffening of the concrete, a time less than 120 and/or 90 minutes may be specified by the Contract Administrator. The Contractor will be informed of this requirement twenty-four (24) hours prior to the scheduled placing of concrete;

(c) To avoid the reduction of delivery and discharge time in hot weather, the Contractor will be allowed to substitute crushed ice for a portion of the mixing water provided the specified water/cementitious ratio is maintained. All of the ice shall be melted completely before discharging any of the concrete at the delivery point;

(d) Unless otherwise noted in Table AD9.1 no retarders shall be used;

(e) The concrete, when discharged from truck mixers or truck agitators, shall be of the consistency and workability required for the job without the use of additional mixing water. If the slump of the concrete is less than that designated by the mix design statement, then water can be added on site provided the additional water meets the requirements of CSA A23.1-04 5.2.4.3.2. If additional water is to be added on site, it must be done under the guidance of the Suppliers' designated quality control person. The Supplier shall certify that the addition of water on site does not change the Mix Design for the concrete supplied. Any other water added to the concrete without such control will be grounds for rejection of the concrete by the Contract Administrator; and,

(f) A record of the actual proportions used for each concrete placement shall be kept by the Supplier and a copy of this record shall be submitted to the Owner upon request.

AD9.55.4 Delivery of Concrete

(a) The Contractor shall satisfy himself that the Concrete Supplier has sufficient plant capacity and satisfactory transporting equipment to ensure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such that the development of cold joints will not occur. The methods of delivering and handling the concrete shall facilitate placing with a minimum of rehandling, and without damage to the structure or the concrete.

AD9.55.5 Concrete Placement Schedule

(a) The Contractor shall submit to the Contract Administrator the proposed concrete placement schedule for all concrete placements for review and approval. If, in the opinion of the Contract Administrator, the volume of the placement is deemed larger than can be placed with the facilities provided, the Contractor shall either:

(i) Limit the amount to be placed at any time (using adequate construction joints);

(ii) Augment his facilities and Plant in order to complete the proposed placement; and,

(iii) In the case of continuous placing, provide additional crews and have adequate lighting to provide for proper placing, finishing, curing and inspecting.

(b) The Contractor shall adhere strictly to the concrete placement schedule, as approved by the Contract Administrator.

AD9.56 Preparation for Concreting Against Hardened Concrete

AD9.56.1 All hardened concrete against which new concrete is to be placed shall be prepared in the following manner:

(a) Concrete shall be removed to sound concrete or to the limits as shown on the Drawings, whichever is greater. The resulting surface shall be roughened to remove latent cement and miscellaneous debris;

(b) All existing surfaces and exposed reinforcing steel are to be sandblasted to reveal a clean substrate and kept clean until concrete placement. Sandblasting shall be followed by cleaning operations to remove all residues;

(c) Mechanical methods such as bush hammering may be permitted if approved in writing by the Contract Administrator. Care should be exercised to assess potential for cracking in smaller components. Mechanical methods will not be permitted for deck slabs, deck barriers, or abutment levelling slab (for expansion joints); and,

(d) Immediately prior to placing new concrete for deck slabs, bonding grout shall be thoroughly brushed onto the entire surface of the existing hardened concrete in a thin and even coating that will not run or puddle.

AD9.57 Placing Structural Concrete

AD9.57.1 General

(a) The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to concrete placement so that an adequate inspection may be made of formwork, shoring, reinforcement, deck joints, mechanical screed setup, movable hoarding, and related Works. No concrete pour shall be scheduled without the prior written approval of the Contract Administrator.

AD9.57.2 Dry Run for Deck Slab Screed Machine

(a) The Contractor shall conduct a dry run of the screed machine in the presence of the Contract Administrator to verify that the screed supporting rails are properly set to ensure compliance with the specified longitudinal and transverse deck grades. Sufficient screed supporting guide rails to provide the required coverage for the entire pour, as approved by the Contract Administrator, shall be set out and adjusted for height at least one (1) Working Day prior to the proposed pour. The Contract Administrator will verify that the screed machine and screed rails have been adjusted so that the height of the screed above the existing concrete at each point meets the requirements. To confirm the Contractor's adjustments of the machine and screed

rails, the screed machine shall be “dry run”, and screed clearance measurements taken at each support point by the Contractor. Resetting of the machine and/or screed rails shall be done by the Contractor as required by the Contract Administrator.

AD9.57.3 Placing Structural Concrete

(a) Placement of deck concrete shall not be permitted when the surface moisture evaporation exceeds 0.75 kg/m2/h. Fog misting is mandatory regardless of drying conditions. The Contractor shall use fog misting operations as accepted by the Contract Administrator;

(b) The nomograph, Figure D1, Appendix D of CSA Standard A23.1-04 shall be used to estimate surface moisture evaporation rates;

(c) All deck concrete shall be placed at night. Concrete pours shall not commence prior to 8:00 pm or extend past 7:00 am;

(d) Equipment for mixing or conveying concrete shall be thoroughly flushed with clean water before and after each pour. Water used for this purpose shall be discharged outside the forms. All equipment and processes are subject to acceptance by the Contract Administrator;

(e) Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent segregation and a marked change in consistency;

(f) Runways for concrete buggies and all pumping equipment shall be supported directly by the formwork and not on reinforcement;

(g) Before depositing any concrete, all debris shall be removed from the space to be occupied by the concrete, and any mortar splashed upon the reinforcement or forms shall be removed;

(h) Formwork liners shall be cooled immediately prior to placing concrete by spraying with cold water;

(i) Placing of concrete, once started, shall be continuous. No concrete shall be placed on concrete which has sufficiently hardened to cause the formation of seams or “cold joints” within the section. If placing must be interrupted, construction joints shall be located where shown on the Drawings or as accepted by the Contract Administrator;

(j) Concrete shall be placed as nearly as possible in its final position. Rakes or mechanical vibrators shall not be used to transport concrete;

(k) The maximum free drop of concrete into the forms shall not be greater than 1.5 m, otherwise rubber tubes or pouring ports spaced not more than 1.5 m vertically and 2.5 m horizontally shall be used. The Contractor shall obtain the Contract Administrator's acceptance, prior to pouring concrete, of all placing operations;

(l) All concrete, during and immediately after depositing, shall be consolidated by mechanical vibrators so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into the corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Mechanical vibrators shall have a minimum frequency of 7000 revolutions per minute immersed;

(m) Vibrators shall be inserted systematically into the concrete at intervals such that the zones of influence of the vibrator overlap (generally 300 to 900 mm). Apply the vibrator at any point until the concrete is sufficiently compacted (5 to 15 seconds), but not long enough for segregation to occur. The vibrators shall be inserted vertically and withdrawn out of the concrete slowly. Spare vibrators in good working condition shall be kept on the job site during all placing operations;

(n) Concrete shall not be placed during rain or snow unless adequate protection is provided for formwork and concrete surfaces, to the satisfaction of the Contract Administrator; and,

(o) Before any concrete is placed for the approach slabs, or Bridge deck slab, the Contractor shall demonstrate to the satisfaction of the Contract Administrator before each pour that all necessary adjustments have been made to provide the required camber, crown, slab thickness, and concrete cover. This demonstration may be carried out by means of an attachment securely fastened to the finisher's strike-off machine and moving the machine and the strike-off across the deck over the reinforcing steel with a minimum 3 mm clearance between the steel and attachment.

AD9.58 Finishing of Concrete Surfaces

AD9.58.1 Finishing Operations for Unformed Surfaces

(a) The Contractor shall ensure that sufficient personnel are provided for the finishing of the slab surfaces. In the event that the depositing, vibrating, and screeding operations progress faster than the concrete finishing, the Contractor shall reduce the rate of concrete placement or cease the depositing of concrete until the exposed area of unfinished concrete has been satisfactorily minimized. The Contract Administrator's judgement in this matter shall be final and binding on the Contractor. All loads of concrete that exceed the 120 minute discharge time limit during the delay, while the finishing operations catch up, shall be rejected.

AD9.58.2 Type 1 Finish – Exposed Formed Surfaces

(a) A permeable formwork liner finish shall be applied to all exposed formed surfaces including all exposed concrete surfaces not included in Type 2 and Type 3 finishes;

(b) Exposed surfaces imply all surfaces exposed to view including surfaces to 300 mm below finish grade elevations;

(c) All surfaces to receive a formwork liner finish shall be formed using an approved permeable formwork liner; and,

(d) The surfaces shall be patched as specified in this Specification.

AD9.58.3 Type 2 Finish – Unformed Surfaces

(a) All unformed concrete surfaces shall be finished as outlined hereinafter;

(b) Screeding of all unformed concrete surfaces shall be performed by the sawing movement of a straightedge along wood or metal strips or form edges that have been accurately set at required elevations;

(c) Screeding shall be done on all concrete surfaces as a first step in other finishing operations. Screeding shall be done immediately after the concrete has been vibrated; and,

(d) After screeding, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared. Concrete surfaces after floating shall have a uniform, smooth, granular texture.

AD9.58.4 Type 3 Finish - Surfaces Below Finished Grade

(a) All surfaces below 300 mm below finished grade except underside of footings shall be patched in accordance with the requirements of Sections AD9.26, AD9.27, and AD9.61 of this Specification; and,

(b) All surfaces below 300 mm below finish grade shall receive dampproofing in accordance with AD9.38 of this Specification.

AD9.58.5 Working Base Concrete Finish

(a) During placing, concrete working base shall be vibrated, screeded and floated; and,

(b) The supply, set up, operation, and finishing of working base concrete shall be considered incidental to the works of this specification, and no separate measurement or payment shall be made for this Work.

AD9.59 General Curing Requirements

AD9.59.1 Refer to AD9.62 for cold weather curing requirements and AD9.63 of this Specification for hot weather curing requirements.

AD9.59.2 Proper curing of cast-in-place structural concrete is of critical importance to the long-term durability and performance of the structures. Special attention should be paid to moisture loss and shrinkage, thermal differentials, and rate of temperature change. In general, curing shall be in accordance with CAN/CSA A23.1-14.

AD9.59.3 Curing of mass concrete shall be in accordance with CAN/CSA A23.1-14 with monitoring and preventative actions in accordance with the Temperature Management Plan.

AD9.59.4 The use of curing compound shall not be allowed on concrete areas that are to receive additional concrete, dampproofing, a waterproofing membrane, or a high performance concrete or asphalt overlay.

AD9.59.5 All structural concrete shall be wet cured for seven days.

AD9.59.6 Freshly finished concrete shall be wet cured for seven days by immediately applying wet curing blankets to the exposed concrete surface immediately following finishing operations and continuously wetted for at least seven (7) consecutive days thereafter.

AD9.59.7 If approved in writing by the City, areas to receive wet curing may substitute wet curing for application of curing compound. Curing compound shall be applied at the rate required by ASTM P198 for the accepted product. The compound must be applied uniformly and by roller. Spraying of the compound will not be permitted.

AD9.59.8 Concrete shall be protected from the harmful effects of sunshine, drying winds, surface dripping, running water, vibration, and mechanical shock. No machinery shall travel in the vicinity of freshly placed concrete for a period of twenty-four (24) hours. Concrete shall be protected from freezing until at least twenty-four (24) hours after the end of the curing period.

AD9.59.9 Changes in temperature of the concrete shall be uniform and gradual and shall not exceed 3ºC in one hour or 20ºC in twenty-four (24) hours.

AD9.59.10 Care shall be exercised to ensure that the polyester curing blanket is well drained and that it is placed as soon as the surface will support it without deformation. The Contractor shall ensure that water from the polyester curing blankets does not run into areas where concrete placement and finishing operations are underway. If this occurs, concrete placement shall stop until the problem is corrected satisfactory to the Contract Administrator.

AD9.59.11 For curing of barriers, formwork shall remain in place for six (6) consecutive days following concreting. The barrier forms shall not be loosened, regardless of the impact on the formliner or forms, for the full curing period. The top surface of the concrete surface shall be moist cured during this timeframe.

AD9.60 Form Removal

AD9.60.1 The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to form removal. The Contractor shall not commence any form removal operations without the prior written acceptance of the Contract Administrator.

AD9.60.2 All forms shall remain in place and the concrete shall not be loaded for a minimum of seven (7) days after initial concrete placement, unless otherwise authorized by the Contract Administrator in writing.

AD9.60.3 Notwithstanding the above, the minimum strength of in-place concrete prior to removal of vertical forms for deck extensions shall be 25 MPa, with the added provision that the member shall be of sufficient strength to safely carry its own weight, together with super-imposed construction loads. Bridge deck overhang forms shall be loosened before forms are constructed and concrete is placed for bridge traffic barriers. Stripping of these forms shall not be permitted until a concrete strength of 28 MPa has been achieved by the deck slab concrete and the concrete bridge traffic barriers.

AD9.60.4 Field-cured test specimens representative of the cast-in-place concrete being stripped shall be tested as specified in this Specification to verify the concrete strength.

AD9.61 Patching of Formed Surfaces

AD9.61.1 The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to removal of forms. Immediately after forms have been removed and before the Contractor commences any surface finishing or concrete patching operations, all newly exposed concrete surfaces shall be inspected by the Contract Administrator.

AD9.61.2 Any repair or surface finishing started before this inspection may be rejected and required to be removed.

AD9.61.3 Patching of formed surfaces shall take place within twenty-four (24) hours of formwork removal.

AD9.61.4 All formed concrete surfaces shall have bolts, ties, struts, and all other timber or metal parts not specifically required for construction purposes cut back 75 mm from the surface before patching.

AD9.61.5 Minor surface defects caused by honeycomb, air pockets greater than 5 mm in diameter, voids left by strutting, and tie holes shall be repaired by removing the defective concrete to sound concrete, dampening the area to be patched, then applying bonding grout followed by patching mortar. Bonding grout shall be well brushed onto the area immediately prior to patching. When the bonding grout begins to lose the water sheen, the patching mortar shall be thoroughly trowelled into the repair area to fill all voids. It shall be struck off slightly higher than the adjacent concrete surface and left for one (1) hour before final finishing to facilitate initial shrinkage of the patching mortar. It shall be touched up until it is satisfactory to the Contract Administrator. The patch shall be cured as specified in this Specification. The final colour shall match the surrounding concrete.

AD9.61.6 Concrete shall be cast against forms which will produce plane surfaces with no bulges, indentations, or protuberances other than those shown on the Drawings. All objectionable fins, projections, offsets, streaks, or other surface imperfections on the concrete surface shall be removed by means acceptable to the Contract Administrator. Cement washes of any kind shall not be used.

AD9.61.7 The arrangement of panel joints shall be kept to a minimum. Panels containing worn edges, patches, or other defects which will impair the texture of concrete surfaces shall not be used.

AD9.62 Cold Weather Concreting

AD9.62.1 The requirements of CSA Standard A23.1-04 shall be applied to all concreting operations during cold weather, i.e., if the mean daily temperature falls below 5°C during placing or curing.

AD9.63 Hot Weather Concreting

AD9.63.1 General

(a) The requirements of this section shall be applied during hot weather, i.e., air temperatures forecast to go higher than 27°C during placing;

(b) Concrete at discharge shall be at as low a temperature as possible, preferably as low as 15°C, but not above 25°C. Concrete containing silica fume shall be between 10°C minimum and 18°C maximum at discharge. Aggregate stockpiles should be cooled by water sprays and sun shades;

(c) The Contractor shall use cold water and/or ice in the mix to keep the temperature of the fresh concrete down, if required. Ice may be substituted for a portion of the mixing water; provided it has melted by the time mixing is completed;

(d) Form and conveying equipment shall be kept as cool as possible before concreting by shading them from the sun, painting their surfaces white and/or the use of water sprays;

(e) Sun shades and wind breaks shall be used as required during placing and finishing;

(f) Work shall be planned so that concrete can be placed as quickly as possible to avoid "cold joints";

(g) The Contract Administrator's acceptance is necessary before the Contractor may use admixtures such as retardants to delay setting, or water reducing agents to maintain Workability and strength, and these must appear in the Mix Design Statement submitted to the Contract Administrator; and,

(h) Hot weather curing shall follow immediately after the finishing operation.

AD9.63.2 Hot-Weather Curing

(a) When the air temperature is at or above 25°C, curing shall be accomplished by fog misting and by using saturated absorptive fabric, in order to achieve cooling by evaporation. Note that fog misting is mandatory for all deck slab pours at all temperatures;

(b) Mass concrete shall be water cured for the basic curing period when the air temperature is at or above 20°C, in order to minimize the temperature rise of the concrete; and,

(c) At no point during the curing period shall the concrete, mass or normal, to exceed 70°C.

AD9.63.3 Job Preparation

(a) When the air temperature is forecast to rise to 25°C or higher during the placing period, provisions shall be made by the Contractor for protection of the concrete in place from the effects of hot and/or drying weather conditions. Under severe drying conditions, the formwork, reinforcement, and concreting equipment shall be protected from the direct rays of the sun or cooled by mist fogging and evaporation, to the satisfaction of the Contract Administrator.

AD9.63.4 Concrete Temperature at Placement

(a) The temperature of the concrete as placed shall be as low as practicable and in no case greater than the following temperatures, as shown in Table AD9.2, “Acceptable Concrete Temperature”, for the indicated size of the concrete section.

TABLE AD9.2: ACCEPTABLE CONCRETE TEMPERATURES

THICKNESS OF SECTION	TEMPERATURE °C	
	MINIMUM	MAXIMUM
Less than:		
1.0 m	10	27
1.2 m	5	25

AD9.63.5 Cleanup

(a) The Contractor shall cleanup equipment and construction debris on at least a daily basis to the satisfaction of the Contract Administrator.

CONCRETE QUALITY

AD9.64 Inspection

AD9.64.1 All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.

AD9.64.2 The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

AD9.64.3 Quality Assurance testing shall be undertaken by the Contract Administrator. Quality Control testing shall be undertaken by the Contractor.

AD9.65 Access

AD9.65.1 The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

AD9.66 Materials

AD9.66.1 All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Quality Assurance Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City of Winnipeg for any materials taken by the Contract Administrator for testing purposes.

AD9.66.2 All materials shall conform to CSA Standard A23.1-04.

AD9.66.3 All testing of materials shall conform to CSA Standard A23.2-04.

AD9.66.4 All materials shall be submitted to the Contract Administrator for acceptance at least twenty (20) Business Days prior to its scheduled incorporation into any construction. If, in the opinion of the Contract Administrator, such materials, in whole or in part, do not conform to the Specifications detailed herein or are found to be defective in manufacture or have become damaged in transit, storage, or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

AD9.67 Quality Assurance and Quality Control

AD9.67.1 The Contract Administrator shall be afforded full access for the inspection and control and assurance testing of concrete and constituent materials, both at the Site of Work and at any plant used for the production of concrete, to determine whether the concrete is being supplied in accordance with this Specification.

AD9.67.2 The Contract Administrator reserves the right to reject concrete in the field that does not meet the Specifications.

AD9.67.3 The Contractor shall provide, without charge, the samples of concrete and the constituent materials required for Quality Assurance tests and provide such assistance and use of tools and construction equipment as is required.

AD9.67.4 Quality Assurance and control tests will be used to determine the acceptability of the concrete supplied by the Contractor.

AD9.67.5 The Contractor will be required to undertake Quality Control tests, of all concrete supplied. All test results are to be copied to the Contract Administrator immediately after the tests have been performed.

AD9.67.6 The frequency and number of concrete Quality Control tests shall be in accordance with the requirements of CSA Standard A23.1-04. An outline of the quality tests is indicated below.

AD9.67.7 Contract Administrator shall undertake cove meter survey of top of bridge deck and inside face of barriers. Concrete areas with cover not within specified tolerances will be rejected.

AD9.68 Concrete Testing

AD9.68.1 Slump tests shall be made in accordance with CSA Standard Test Method A23.2-5C-04, "Slump of Concrete". If the measured slump falls outside the limits in AD9.5 of this Specification, a second test shall be made. In the event of a second failure, the Contract Administrator reserves the right to refuse the use of the batch of concrete represented.

AD9.68.2 Air content determinations shall be made in accordance with CSA Standard Test Method A23.2-4C-04, "Air Content of Plastic Concrete by the Pressure Method". If the measured air content falls outside the limits in AD9.5 of this Specification, a second test shall be made at any time within the specified discharge time limit for the mix. In the event of a second failure, the Contract Administrator reserves the right to reject the batch of concrete represented.

AD9.68.3 The air-void system shall be proven satisfactory by data from tests performed in accordance with the test method of ASTM C457. The spacing factor, as determined on concrete cylinders moulded in accordance with CSA Standard Test Method A23.2-3C-04, shall be determined prior to the start of construction on cylinders of concrete made with the same materials, mix proportions, and mixing procedures as intended for the project. If deemed necessary by the Contract Administrator to further check the air-void system during construction, testing of cylinders may be from concrete as delivered to the job Site and will be carried out by the Contract Administrator. The concrete will be considered to have a satisfactory air-void system when the average of all tests shows a spacing factor not exceeding 230 microns with no single test greater than 260 microns.

AD9.68.4 Rapid chloride permeability testing shall be performed in accordance with ASTM C 1202 and shall meet the requirements of each class of concrete.

AD9.68.5 Testing for post-cracking residual strength index of FRC shall be conducted at the Contractor's expense as follows: one set of five concrete beam specimens, 100 mm by 100 mm b 350 mm long, shall be tested to failure using the same test set up in ASTM C 1399-04 without the steel plate. The average of the peak loads is the cracking load of the concrete (Pcr), and shall be provided to the Contract Administrator. A second set of five concrete beam specimens shall be tested to failure in accordance with ASTM C 1399-04. The average of the peak loads is the post cracking load of the concrete (Ppcr). Testing shall include the specified number of specimens from sub-structure concrete, traffic barrier concrete and deck slab concrete for a total of four (4) complete tests. The Contractor shall promptly submit a summary of the test results to the Contract Administrator upon the conclusion of each test.

AD9.68.6 Samples of concrete for test specimens shall be taken in accordance with CSA Standard Test Method CSA-A23.2-1C-04, "Sampling Plastic Concrete".

AD9.68.7 Test specimens shall be made and cured in accordance with CSA Standard Test Method A23.2-3C-04, "Making and Curing Concrete Compression and Flexure Test Specimens".

AD9.68.8 Compressive strength tests at twenty-eight (28) days shall be the basis for acceptance of all concrete supplied by the Contractor. For each twenty-eight (28) day strength test, the strength of two companion standard-cured test specimens shall be determined in accordance with CSA Standard Test Method A23.2-9C-04, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the average of the strengths of the two specimens. A compressive strength test at seven (7) days shall be taken, the strength of which will be used only as a preliminary indication of the concrete strength, a strength test being the strength of a single standard cured specimen.

AD9.68.9 Compressive strength tests on specimens cured under the same conditions as the concrete Works shall be made to check the strength of the in-place concrete so as to determine if the concrete has reached the minimum allowable working compressive strength as specified in Table AD9.1 of this Specification and also to check the adequacy of curing and/or cold weather protection. At least two (2) field-cured test specimens shall be taken to verify strength of the in-place concrete. For each field-cured strength test, the strength of field-cured test specimens shall be determined in accordance with CSA Standard Test Method A23.2-9C-04, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the strength of the specimen.

AD9.69 Corrective Action

AD9.69.1 If the results of the tests indicate that the concrete is not of the specified quality, the Contract Administrator shall have the right to implement additional testing, as required, to further evaluate the concrete, at the Contractor's expense. The Contractor shall, at his own expense, correct such Work or replace such materials found to be defective under this Specification in an acceptable manner to the satisfaction of the Contract Administrator.

AD10. SUBDRAIN SYSTEMS

AD10.1 Description

AD10.1.1 This Specification shall cover the supply and installation of the subdrain pipe and wall drain systems located along the tunnel substructure and behind retaining walls and each abutment.

AD10.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of the superintendence, overhead, labour materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

AD10.2 Material

AD10.2.1 General

(a) The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in the Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.

AD10.2.2 Drain Pipes, Fittings, and Accessories

(a) Drain pipes, fittings, and other accessories and appurtenances for the tunnel substructure drain pipe system, shall conform to the requirements of the City of Winnipeg Standard Construction Specification CW 3610 and requirements of the latest revision of CSA G401.93, for Corrugated Steel Pipe (CSP). Corrugated steel pipe shall be perforated aluminized Type 2, 1.6 mm gauge, diameter as shown on the Contract drawings; and,

(b) All other drain pipes, fittings, and other accessories and appurtenances shall conform to the requirement of Standard Construction Specification CW 2310 and CW 2131.

AD10.2.3 Filter Fabric

(a) Filter fabric shall either Mirafi P600X Woven by Dominion Textile Inc. or Typar Style 3607 by Dupont Company or approved equal as accepted by the Contract Administrator, and shall conform to the requirements of Standard Construction Specification CW 3616.

AD10.2.4 Tunnel Wall Drain

(a) Wall Drain shall be Miradrain 6000 by Mirafi, Nilex DN50, Aquadrain 15X, Bakor DB 6000 Drain Board, Soprema sopradrain eco-vent, Grace Hydroduct 220 drainage composite, BASF DBS 6000 or approved equal as accepted by the Contract Administrator. Mastic adhesive shall be as recommended by the wall drain manufacturer.

AD10.3 Equipment

AD10.3.1 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

AD10.4 Construction Methods

AD10.4.1 Subdrain Piping System

(a) Install a perforated drain pipe system along both tunnel walls and behind retaining walls and each abutment. The supply and installation of this drain pipe system shall include the drain pipe, all required fittings, drain pipe backfill materials, and the filter fabric; and,

(b) The drain pipe shall be laid to the line and grade shown on the Contract drawings or as directed by the Contract Administrator with the separate sections securely jointed together by means of tightly drawn coupling bands. Drain pipe of the round or elongated type shall have the outside laps of circumferential joints in each pipe section of the upstream end and longitudinal lap seams at the sides of the pipe.

AD10.4.2 Tunnel Wall Drain System

(a) Install a wall drain system to the vertical surface of the tunnel side walls and retaining walls. This involves the installation of the prefabricated drainage composite to the vertical surfaces.

AD11. SUPPLYING AND PLACING REINFORCING STEEL

DESCRIPTION

AD11.1 This Specification shall cover all operations relating to the supply, fabrication, delivery, and placement of black steel reinforcing, hot-dipped galvanized steel reinforcing and stainless steel reinforcing, and associated bar accessories, as specified herein and as shown on the Drawings.

AD11.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

AD11.3 Scope of Work

AD11.3.1 The Work under this Specification shall involve supplying and placing all steel reinforcing, as shown on the Drawings for the following Works:

SCOPE OF WORK	
Component	**Type of Steel Reinforcing**
Bridge Decks, Barriers, Curbs, Sidewalks, Medians, and Approach Slabs.	Stainless Steel Reinforcing
Bridge Substructure, Piers, and Abutments.	Hot-dipped Galvanized Steel Reinforcement or MMFX2 Reinforcement
Caissons, Piles, and Footings.	Uncoated Black Steel Reinforcement
Between Caissons, Piles and Footings, and Bearing Seats and Pier Shafts/Columns.	Epoxy Coated Steel Reinforcement or Approved Equal
Culverts and Tunnel Foundation, Walls, and Roof.	Hot-dipped Galvanized Steel Reinforcement or MMFX2 Reinforcement
Retaining Walls (including piles, MSE walls, and concrete facings)	Hot-dipped Galvanized Steel Reinforcement or MMFX2 Reinforcement

REFERENCES

AD11.4 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) ASTM A955M – Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcing;

(b) ASTM A615M – Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement;

(c) ASTM A143 – Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedures for Detecting Embrittlement;

(d) ASTM A780/A780M – Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings;

(e) ASTM A767/A767M – Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement;

(f) CAN/CSA A23.1/A23.2 – Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete;

(g) CAN/CSA G30.18-M92 – Billet Steel Bars for Concrete Reinforcement;

(h) ACI 315R – Manual of Engineering and Placing Drawings for Reinforced Concrete Structures; and,

(i) Reinforcing Steel Institute of Canada (RSIC), Manual of Standard Practice.

SUBMITTALS

AD11.5 General

(a) At least twenty-one (21) Days prior to the scheduled commencement of any fabrication, the qualifications of the Contractor and its Operators shall be submitted to the Contract Administrator for review and approval;

(b) The Contractor shall submit to the Contract Administrator for review and approval, at least fourteen (14) Days prior to commencement of any schedule Work on the Site, a proposed schedule, including methods and sequence of operations;

(c) The Contractor shall submit to the Contract Administrator for review, at least fourteen (14) Days prior to the commencement of any Work on Site, a QC testing program **for galvanized reinforcing** including the following minimum requirements:

(i) A Certificate of Compliance from the Manufacturer stating that the galvanizing coatings meet or exceed the requirements of ASTM A767M;

(ii) Reinforcing bending practices, in accordance with ASTM 767M;

(iii) Galvanizing coating thickness measurements, in accordance with ASTM 767M;

(iv) Temperature requirements, in accordance with AD11.13.2(f);

(v) Visual inspection criteria for hot-dip galvanizing, including confirmation of limited to no bare spots, blisters, flux, inclusions, dross, or excess zinc material;

(vi) Repair works, in accordance with ASTM A780M;

(vii) Confirmation of embrittlement protection, including bend tests in accordance with ASTM A143M, complete with photo documentation; and

(viii) Summary reporting for each shipment of reinforcing.

(d) The Contractor shall submit to the Contract Administrator for review, at least fourteen (14) Days prior to the commencement of any Work on Site a Certificate of Compliance from the Manufacturer stating that the stainless steel materials supplied comply with the provisions of ASTM A955M and these Specifications, including corrosion resistance;

(e) Contractor shall submit all original mill certificates to the Contract Administrator prior to placement of reinforcing on-site; and,

(f) Contractor to submit Shop Drawings (including bar lists) in accordance with section AD1 and the latest edition of the Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada (RSIC).

MATERIALS

AD11.6 General

AD11.6.1 The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

AD11.6.2 Bundles of reinforcing steel shall be identified by tags containing bar marks.

AD11.6.3 The reinforcing steel shall not be placed directly on the ground. Sufficient timber pallets or blocking shall be placed under the reinforcing steel to keep them free from dirt and mud.

AD11.7 Handling and Storage of Stainless Steel Reinforcing

AD11.7.1 Stainless steel reinforcing shall be store separately from other reinforcing steel with the bar tags maintained and clearly visible until placing operations commence. Stacks of bundles of straight bars shall have adequate blocking to prevent contact between the layers of bundles.

AD11.7.2 Chains for steel bands used for shipping shall not be in direct contact with stainless steel reinforcing. Wood or approved alternate should be used to protect the bars

AD11.7.3 Nylon or polypropylene slings shall be used for moving stainless steel reinforcing.

AD11.7.4 Keep carbon steel tools, chains, slings, etc. off stainless steel reinforcing.

AD11.8 Reinforcing Steel

AD11.8.1 Reinforcing steel shall be deemed to include all reinforcing bars, tie-bars, and dowels.

AD11.8.2 All reinforcing steel shall conform to the requirements of CSA Standard CAN/CSA G30.18-M92, Grade 400W, Billet-Steel Bars for Concrete Reinforcement.

AD11.8.3 Stainless steel, as shown on the Drawings, shall be a high-manganese, low-nickel, nitrogen-strengthened austenitic stainless steel. Stainless steel reinforcing shall meet or exceed the minimum requirements of ASTM A955M, 300 Series, minimum Grade 420, of the Types listed below in Table AD30.2, “Type of Stainless Steel Reinforcing”. Reinforcing deformations shall conform to the requirements of ASTM A615M. All hooks and bends shall be bent using pin diameters and dimension recommended by Reinforcing Steel Institute of Canada (RSIC), Manual of Standard Practice.

AD11.8.4 Deformed, low carbon chromium steel bars would be considered as an alternate to galvanized steel reinforcing and shall conform to the requirements of ASTM A615, Grade 75 and ASTM A1035. MMFX2 (Microcomposite) is an approved product.

AD11.8.5 If, in the opinion of the Contract Administrator, any reinforcing steel provided for the concrete Works exhibit flaws in manufacture or fabrication, such material shall be immediately removed from the Site and replaced with acceptable reinforcing steel. No additional costs will be applied to this Contract for the replacement of deficient reinforcing steel.

AD11.8.6 All reinforcing steel shall be straight and free from paint, oil, millscale, and injurious defects. Rust, surface seams or surface irregularities will not be cause for rejection, provided that the minimum dimensions, cross-sectional area, and tensile properties of a hand wire-brushed specimen are not less than the requirements of CSA Standard CAN/CSA G30.18-M92 and ASTM A955M.

TABLE AD30.2
TYPE OF STAINLESS STEEL REINFORCING

Common or Trade Name	AISI Type	UNS Designation
Type 316 LN	316 LN	S31653
Type 2205	Duplex 2205	S31803
Type 2304	EnduraMet 2304	S32304

AD11.9 Galvanizing

AD11.9.1 Shop Applied

(a) The galvanizing shall be shop applied and strictly in accordance with CSA Standard G164 and ASTM A767M latest addition to a retention equal to a Class II level (610 g/m2), except as otherwise specified herein;

(b) Preclean reinforcing steel using acceptable methods to produce an acceptable surface for quality hot-dip galvanizing. If sulfuric acid or hydrochloric acid is used as a pickling bath for precleaning, care shall be exercised to minimize the immersion time. If signs of hydrogen embrittlement are present after pickling due to excessive immersion time, all reinforcing in that shipment will be rejected and shall be replaced at no additional cost to the Contract;

(c) Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion;

(d) The surface finish shall be continuous, adherent, as smooth and evenly distributed as possible, and free from any defect detrimental to the stated end use of the coated article;

(e) Coating adhesion shall withstand normal handling consistent with the nature and thickness of the coating and normal use of the article;

(f) Sheared ends of bars shall be coated with a zinc-rich formulation before rusting occurs and before shipment to the job site; and,

(g) Furthermore, all field welds, as well as cracking and other visible damage or deterioration of the hot-dip galvanizing as a result of handling or bending operations, or any other causes, shall be galvanize-coated with field applied galvanizing touch-up material as specified hereinafter.

AD11.9.2 Field Applied

(a) All field applied galvanized coatings shall be applied in accordance with ASTM A780M;

(b) Further to ASTM A780M, paints used for field applied galvanizing shall contain zinc dust above 92% in the dried film;

(c) At least seven (7) days prior to any field applied galvanizing, the Contract shall submit the galvanizing product and application details to the Contract Administrator for review;

(d) Spray applied field galvanizing will not be permitted. Where restrictions occur that brush applied field galvanizing is not possible, spray applied field galvanizing may be permitted if accepted in writing by the Contract Administrator prior to application;

(e) All field applied galvanized coatings shall be applied in accordance with the manufacturer's recommendations and as directed by the Contract Administrator; and,

(f) The maximum area to be repaired in the field shall be 2,000 mm2. Any damaged article with a damaged area greater shall be rejected, removed, and replaced at the Contractor's expense.

AD11.10 Bar Accessories

AD11.10.1 Bar accessories shall be of types suitable for each type of reinforcing and a type acceptable to the Contract Administrator. They shall be made from a non-rusting material, and they shall not stain, blemish, or spall the concrete surface for the life of the concrete.

AD11.10.2 Bar chairs, bolsters, and bar supports shall be cementitious material as acceptable to the Contract Administrator. Plastic, PVC or galvanized bar chairs may be permitted if accepted in writing by the Contract Administrator prior to installation. Plastic, PVC, or galvanized bar chairs will not be accepted in any locations where they are exposed.

AD11.10.3 The use of pebbles, pieces of broken stone or brick, plastic, metal pipe, and wooden blocks, will not be permitted.

AD11.10.4 Placing of bar supports shall be done to meet the required construction loads.

AD11.10.5 Tie wire shall be the following:

(a) Black, soft-annealed 1.6 mm diameter wire or Nylon coated wire for black steel reinforcing;

(b) Nylon coated wire or 1.6 mm galvanized coated wire for hot-dipped galvanized steel reinforcing; and,

(c) Stainless steel, fully annealed 1.6 mm diameter wire, Type 316 or 316L for stainless steel reinforcing.

AD11.10.6 Approved products are as supplied by Con Sys Inc., Box 341, Pinawa, Manitoba, Canada R0E 1L0 (204) 753-2404, or approved equal as accepted by the Contract Administrator.

AD11.10.7 Bar accessories are not included in the Drawings and shall include bar chairs, spacers, clips, wire ties, wire (18 gauge minimum), or other similar devices and are to be acceptable to the Contract Administrator. The supplying and installation of bar accessories shall be deemed to be incidental to the supplying and placing of reinforcing steel.

AD11.11 Mechanical Splices

AD11.11.1 Mechanical splices shall be stainless steel, meeting the requirements of ASTM A955M, Type 316L, Type 2005, or Type 2304.

CONSTRUCTION METHODS

AD11.12 Fabrication of Reinforcing Steel

AD11.12.1 General

(a) Reinforcing steel shall be fabricated in accordance with CSA Standard CAN/CSA G30.18-M92 to the lengths and shapes as shown on the Drawings.

AD11.13 Reinforcing Steel

AD11.13.1 Black Steel Reinforcing

(a) Heating shall not be used as an aid in bending black steel reinforcing;

(b) Hooks and bends should be smooth and not sharp; and,

(c) Fabrication of the black steel reinforcing shall be straight and free of paint, oil, mill scale, and injurious defects.

AD11.13.2 Galvanized Reinforcing Steel

(a) The reinforcing fabricator shall consult with the Contractor, Contract Administrator and hot-dip galvanizer regarding potential problems or potential handling problems prior or during the galvanizing process;

(b) Remove all welding slag, splatter, antisplatter compounds, and burrs prior to delivery for galvanizing;

(c) Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil, paint, and other deleterious material prior to fabrication;

(d) Remove by blast cleaning or other methods surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation;

(e) Hooks or bends should be smooth and not sharp. Bars are to be bent prior to galvanizing. Minimum bend diameters shall be provided in accordance with ASTM A767 latest edition and not less than the following:

Minimum Finished Bend Diameters	
Bar No.	**Bend Diameters (mm)**
10M	60
15M	90
20M	120
25M	200
30M	240
35M	280

(f) The reinforcing shall be a minimum of 10°C prior to bending and galvanizing operations, regardless of ambient temperatures in the plant. Where ambient temperatures fall below 10°C, bending and galvanizing in a facility that is not enclosed and temperature controlled will not be permitted;

(g) The Contractor is responsible to ensure that accelerated strain-age embrittlement does not occur during the manufacturing, bending and galvanizing of the reinforcing steel. At a minimum, the Contractor shall address the requirements of AD11.5(c)

AD11.14 Stainless Steel Reinforcing

(a) Heating shall not be used as an aid in bending stainless steel reinforcing;

(b) Hooks and bends should be smooth and not sharp;

(c) Fabrication of the solid stainless steel reinforcing shall be such that the bar surfaces are not contaminated with deposits of iron and/or non-stainless steel or damage to the surface of the bars;

(d) The stainless steel reinforcing shall be mechanically or chemically de-scaled prior to fabrication, leaving a totally passive stainless steel finish free of millscale, slag, or oxidation. Iron contamination shall be removed with picking paste or by wire brushing. Wire brush cleaning shall be done with stainless steel wire brushes only; and,

(e) All hand tools shall be stainless tools that have not been used on carbon steel.

AD11.15 Placing of Reinforcing Steel

AD11.15.1 Reinforcing steel shall be placed accurately in the positions shown on the Drawings and shall be retained in such positions by means of a sufficient number of bar accessories so that the bars shall not be moved out of alignment during or after the depositing of concrete. The Contract Administrator's decision in this matter shall be final.

AD11.15.2 Bars shall be tied at all intersections, except where spacing is less than 250 mm in each direction, when alternate intersections shall be tied. Welding or tack welding or reinforcing steel will not be allowed.

AD11.15.3 All reinforcing splices shall be staggered

AD11.15.4 Tie wire shall not compromise the clear cover after reinforcing placement is complete. Where tie wire extends more than 10mm from the face of the outer reinforcing layer, it shall be flattened or bent inwards.

AD11.15.5 Reinforcing steel shall be free of all foreign material in order to ensure a positive bond between the concrete and steel. The Contractor shall also remove any dry concrete which has been deposited on the steel from previous pouring operations before additional concrete may be placed. Intersecting bars shall be tied positively at each intersection.

AD11.15.6 Splices in reinforcing steel shall be made only where indicated on the Drawings. Prior acceptance by the Contract Administrator shall be obtained where other splices must be made. Welded splices will not be permitted.

AD11.15.7 Place reinforcing bars to provide a clear space between the reinforcing bars as shown on the Drawings to accurately place preformed holes where necessary.

AD11.15.8 Reinforcing steel shall not be straightened or rebent in a manner that will injure the metal or create excess damage to the galvanized coating. Bars with bends not shown on the Drawings shall not be used.

AD11.15.9 Heating of reinforcing steel will not be permitted

AD11.15.10 A minimum of twenty-four (24) hours advance notice shall be given to the Contract Administrator prior to the pouring of any concrete to allow for inspection of the reinforcement.

AD11.15.11 Following placement of galvanized bars, all areas of damaged galvanizing shall be repaired using approved touch-up coating material specified in Clause AD11.9.2.

QUALITY CONTROL

AD11.16 Inspection

AD11.16.1 All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works which are not in accordance with the requirements of this Specification, regardless of any previous inspection or approval.

AD11.17 Access

AD11.17.1 The Contract Administrator shall be afforded full access for the inspection and control testing of reinforcing steel, both at the Site of Work and at any plant used for the fabrication of the reinforcing steel, to determine whether the reinforcing steel is being supplied in accordance with this Specification.

AD11.18 Quality Testing

AD11.18.1 Quality control testing may be used to determine the acceptability of the reinforcing steel supplied by the Contractor.

AD11.18.2 The Contractor shall provide, without charge, the samples of reinforcing steel required for quality control tests and provide such assistance and use of tools and construction equipment as is required.

AD12. SILANE SEALER

AD12.1 General

AD12.1.1 The Work shall consist of:

(a) Surface preparation and application of a penetrating concrete sealer on structural concrete components at the site as described in this Specification and as shown on the Drawings.

AD12.1.2 The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, handling and storage, and all things necessary for and incidental to the satisfactory performance and completion of all Work as herein specified and as indicated on the Drawings.

AD12.2 Submittals

AD12.2.1 The Contractor shall submit the following to the Contract Administrator:

(a) Submit fourteen (14) days prior to surface preparation, a written certification from a certified laboratory indicating conformance of the product to the Specifications;

(b) Submit fourteen (14) days prior to application, copies of all manufacturers' specifications and installation guidelines; and,

(c) The Contractor shall provide the Contract Administrator with one (1) copy of Material Safety Data Sheets (MSDS's) for each product to be supplied at least two (2) weeks prior to the commencement of Work.

AD12.3 Material

AD12.3.1 Approved products are as follows:

Product Name	**Manufacturer**
Hydrozo 100	BASF
Sealmaster 100%	Technical Barrier Systems Inc
Dry-Trete 1000L	DRE Industries Inc
Protectosil 300	Evonik / Degussa
Sikaguard SN-100	Sika Canada Inc

AD12.3.2 The penetrating concrete sealer shall be a Type 1c sealer in conformance with the Alberta Transportation, Technical Standards Branch, Specification for Concrete Sealers B388-April, 2010 or latest version.

AD12.3.3 Accessories and Application Equipment: As per manufacturer's specifications.

AD12.4 Construction Methods

AD12.4.1 All exposed concrete surfaces on the following elements should be treated:

(a) All concrete exposed to salt spray;

(b) All exposed concrete surfaces of the bridge superstructure;

(c) Exposed concrete pier surfaces. Sealing for abutments is not required provided they are not susceptible to salt spray;

(d) Exposed concrete retaining walls and MSE wall panels; and,

(e) For tunnel structures, any exposed concrete not including the roof.

AD12.4.2 Surface Preparation and application of sealant to be executed as per manufacturers Specification and in accordance with Alberta Infrastructure, Specifications for Bridge Construction – 2013 or latest version (Section 4.26).

AD12.4.3 Maintain sealant on all concrete required surfaces for a period of four (4) years. Any defective sealant or areas showing signs of distress, cracking, or flaking shall be removed and replaced at no additional cost to the City of Winnipeg.

AD12.5 Quality Assurance

AD12.5.1 The Contract Administrator may have the sample of the product tested for conformance to the Specifications.

AD12.5.2 Goods that do not meet the requirements of the specifications shall be replaced at no additional cost to the City of Winnipeg.

STRUCTURAL – SUBSTRUCTURE AND RETAINING WALLS

AD13. STRUCTURAL SHORING

AD13.1 Description

AD13.1.1 The Work covered under this item shall include all operations relating to supply and installation, and removal of shoring systems as specified herein.

AD13.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, safe working plans, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of the Work as hereinafter specified.

AD13.2 References and Building Codes

AD13.2.1 All applicable sections of the National Building Code of Canada, the Manitoba Building Code and the American Railway Engineering and Maintenance-of-Way Association (AREMA) shall apply to the manufacture, installation, excavation and items and activities incidental to Work included in this Specification.

AD13.3 Materials

AD13.3.1 General

(a) The Contractor is responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

AD13.3.2 Concrete

(a) Concrete to be used in soldier pile caissons and working base shall be high early strength, with a minimum 28-day compressive strength of 30 MPa and nominal 20 mm coarse aggregate. Air entrainment is not required.

AD13.3.3 Structural Steel

(a) All structural steel shapes shall be minimum CSA G40.21 Grade 300W, HSS sections shall be minimum CSA G40.21 Grade 350W, and sheet piling shall be minimum Grade 45 ASTM A572 material.

AD13.3.4 Timber Lagging

(a) Timber lagging shall be species S-P-F, beams and stringers, Grade No. 1 or better with an allowable bending stress of 6.6 MPa including all modification factors. The lagging thickness (horizontal dimension) shall be 150 mm minimum for the upper 2000 mm and 200 mm minimum for below 2000 mm depth. The vertical dimension of lagging shall be not less than 50 mm greater than the horizontal dimension.

AD13.4 Construction Methods

AD13.4.1 General Staging and Construction Requirements

(a) Prepare and submit a Structural Excavation and Shoring Safe Working Plan to the Contract Administrator for review a minimum of two (2) weeks prior to the commencement of this work;

(b) Prior to commencing excavation operations, install sediment control fencing or other such erosion control structures to prevent sediment-laden runoff from leaving the job Site and entering the City land drainage system. The sediment control fencing shall remain in place until all construction activities are complete;

(c) Complete excavations in accordance with the specified procedures and to the elevations and dimensions shown on the drawings or to adjusted elevations as directed by the Contract Administrator in order to obtain a firm, stable foundation; and,

(d) Handle, store and dispose of excavated materials in accordance with the Environmental Protection Plan and accepted by the Contract Administrator.

AD13.4.2 Monitoring for Temporary Shoring

(a) The maximum lateral deflection allowance for temporary shoring shall be 75mm or less as required by the Contract Administrator; if the measured deflection exceeds this limit then the Contractor shall terminate the excavation work immediately around this area to allow for further inspection and analysis by the Contract Administrator;

(b) Monitoring shall occur with a frequency to adequately assess the movement of the shoring system, but not less than one time per week near for shoring adjacent to railway operations and not less than two weeks at all other locations. Detailed records shall be kept and made available to the Contract Administrator and the City at their request; and,

(c) The Contractor shall propose a method to mitigate the lateral deflection and submit to the Contract Administrator for approval.

AD14. STRUCTURAL EXCAVATION

DESCRIPTION

AD14.1 The Work under this Specification shall include the following:

(a) Excavation required to construct the grade separation structures, culverts and retaining walls including, but not limited to, retaining walls, MSE walls, abutments, pier, roof slabs, approach slabs, tunnels, and approach roadways as shown on the Drawings;

(b) The design, fabrication, erection, and removal of all temporary shoring, and such temporary protective measures as may be required to construct the Works;

(c) The Contractor shall include construction access for all excavation works to the construction limits shown on the Drawings;

(d) The off-site disposal of surplus and unsuitable material; and,

(e) Dewatering and/or precipitation removal at the excavations as may be required for construction of the structure in the dry.

AD14.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

REFERENCES

AD14.3 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) CW3010 – Clearing and Grubbing;

(b) CW 3110 – Subgrade, Sub-Base, and Base Course Construction; and,

(c) CW 3170 – Earthwork and Grading;

SUBMITTALS

AD14.4 The Contractor shall submit the following to the Contract Administrator fourteen (14) Days prior to mobilization on site:

(a) Plan(s) highlighting the Site Layout which includes; laydown area location(s), staging areas, office facility location, access road(s), temporary secure fencing limits, and gate locations for review and approval; and,

(b) Shop drawings for the temporary shoring in accordance with AD1.2 for information purposes, bearing the seal of a Professional Engineer registered in the province of Manitoba.

EQUIPMENT

AD14.5 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

MATERIALS

AD14.6 The Contractor shall be responsible for the supply, safe storage, and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanship like manner, to the satisfaction of the Contract Administrator.

AD14.7 All excavated materials shall be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the Owner for any materials taken by the Contract Administrator for testing purposes.

AD14.8 Excavated material shall be unclassified excavation and shall include the excavation and satisfactory disposal of all cleared and grubbed materials, earth, gravel, sandstone, loose detached rock, shale, rubbish, cemented gravel or hard pan, disintegrated stone, rock in ledge or mass formation wet or dry, trees, shrubs, or all other material of whatever character which may be encountered.

CONSTRUCTION METHODS

AD14.9 Excavations shall be completed to the elevations required to construct the Works or to such other elevations as may be directed by the Contract Administrator in the field. Excavation sequence shall be done in a “top down” direction, in order to maintain stability. The dimensions of the excavation shall be such as to give sufficient clearances for the construction of forms and their subsequent removal.

AD14.10 All material shall be brought to the surface by approved method, and shall be disposed of off-site.

AD14.11 Benching and its requirements shall be in accordance with CW3110. Refer to Drawings for locations.

AD14.12 After each excavation is completed, the Contractor shall notify the Contract Administrator.

AD14.13 The bridge substructure foundation shall be protected from rain, snow, freezing temperatures and standing water.

AD14.14 The Contractor shall excavate only material that is necessary for the expeditious construction of the structure or as set out by the Contract Administrator in the field. If the Contract Administrator permits the excavation of runways, existing stock piling, or trenches within the right-of-way, the Contractor shall, on completion of the Work, backfill the runways and trenches to the elevation of the original ground existing at the time of excavation and compact the backfill material, all at his own expense and as directed by the Contract Administrator.

AD14.15 All excess excavated material shall become the property of the Contractor and shall be removed from the Site.

AD15. TUNNEL AND UNDERPASS SHORING, EXCAVATION AND DEWATERING

AD15.1 Description

AD15.1.1 The Work covered under this item shall include all operations relating to structural excavation, installation, and removal of shoring systems required to construct the underpass retaining walls, tunnel, and the tunnel approach retaining walls including dewatering procedures for the duration of the construction period as specified herein.

AD15.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, safe working plans, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of the Work as hereinafter specified.

AD15.2 Materials

AD15.2.1 General

(a) The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

AD15.2.2 Concrete

(a) Concrete to be used in soldier pile caissons and working base shall be high early strength, with a minimum 28-day compressive strength of 30 MPa and nominal 20 mm coarse aggregate. Air entrainment is not required.

AD15.2.3 Structural Steel

(a) All structural steel shapes shall be minimum CSA G40.21 Grade 300W, HSS sections shall be minimum CSA G40.21 Grade 350W, and sheet piling shall be minimum Grade 45 ASTM A572 material.

AD15.2.4 Timber Lagging

(a) Timber lagging shall be species S-P-F, beams and stringers, grade no. 1 or better with an allowable bending stress of 6.6 MPa including all modification factors. The lagging thickness (horizontal dimension) shall be 150 mm minimum for the upper 2000 mm and 200 mm minimum for below 2000 mm depth. The vertical dimension of lagging shall be not less than 50 mm greater than the horizontal dimension.

AD15.2.5 Foundation Replacement

(a) Well graded crushed limestone, conforming to the following gradation:

CANADIAN METRIC SIEVE SIZE	PERCENT OF TOTAL DRY WEIGHT PASSING EACH SIEVE
50,000	100%
5,000	25% - 80%
80	5% - 18%

AD15.3 Construction Methods

AD15.3.1 General Staging and Construction Requirements

(a) Construct the tunnel and retaining walls generally in accordance with the staging requirements identified on the Drawings;

(b) Groundwater depressurization and construction dewatering systems shall be in place and complete with approved water disposal procedures prior to the commencement of any excavation or shoring operations;

(c) Prepare and submit a Structural Excavation and Shoring Safe Working Plan to the Contract Administrator for review a minimum of two (2) weeks prior to the commencement of this work;

(d) Prior to commencing excavation operations, install sediment control fencing or other such erosion control structures to prevent sediment-laden runoff from leaving the job Site and entering the City land drainage system. The sediment control fencing shall remain in place until all construction activities are complete;

(e) Complete excavations in accordance with the specified procedures and to the elevations and dimensions shown on the Drawings or to adjusted elevations as directed by the Contract Administrator in order to obtain a firm, stable foundation;

(f) Dewater excavations so that construction of the tunnel is completed in the dry. Keep the bottom of excavations free from excessive moisture or free-flowing water;

(g) Undertake dewatering in accordance with the Water Management Plan and accepted by the Contract Administrator; and,

(h) Handle, store and dispose of excavated materials in accordance with the Environmental Protection Plan and accepted by the Contract Administrator.

AD15.3.2 Excavation Shoring Requirements

(a) Excavation shoring requirements for sheet pile cofferdam, braced soldier pile and cantilever shoring are shown on the Drawings.

AD15.3.3 Foundation Replacement

(a) Notify the Contract Administrator immediately if it appears that unsuitable material is present at the final base of excavation. Unsuitable material include soft spot, wet areas, frozen soil, organic material, fill soil, silt pockets, debris, etc,. The Contract Administrator will review the suitability of the foundation material and may specify replacement of the material;

(b) If replacement is required, remove the specified depth of unsuitable material and replace with specified crushed granular material compacted to a minimum of ninety-five (95) percent standard Proctor Maximum Dry Density; and,

(c) If the foundation is made unsuitable due to improper construction activities, the Contractor shall replace the affected area to the satisfaction of the Contract Administrator at Contractor's own cost.

AD15.3.4 Protection of the Works

(a) The Contractor shall be responsible for protection of the works during the duration of the Contract. This shall include but may not be limited to maintaining dewatering systems on completed works, providing fencing and security.

AD15.3.5 Monitoring for Temporary Shoring

(a) The maximum lateral deflection allowance for temporary shoring shall be 75mm or less as required by the Contract Administrator; if the measured deflection exceeds this limit then the Contractor shall terminate the excavation work immediately around this area to allow for further inspection and analysis by the Contract Administrator;

(b) Monitoring shall occur with a frequency to adequately assess the movement of the shoring system, but not less than one time per week near for shoring adjacent to railway operations and not less than two weeks at all other locations. Detailed records shall be kept and made available to the Contract Administrator and the City at their request; and,

(c) The Contractor shall propose a method to mitigate the lateral deflection and submit to the Contract Administrator for approval.

AD16. STEEL SHEET PILE WALLS

DESCRIPTION

AD16.1 General

AD16.1.1 This Specification covers all operations related to the construction of steel sheet pile retaining walls.

AD16.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

AD16.2 Submittals

AD16.2.1 Certificates

(a) At least two (2) weeks prior to start of pile driving, submit to the Contract Administrator, two (2) copies of steel producer mill test data and certification that steel piling, delivered to job site, meets requirements of this Section and is in accordance with CAN/CSA-G40.20-13; and,

(b) Contractor to be certified for fusion welding in accordance with CSA W47.1-12.

MATERIALS

AD16.3 General

AD16.3.1 The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.

AD16.3.2 Steel Sheet Piles: To CAN/CSA-G40.21-13, (including chemical and mechanical requirements), Grade 350W, and following:

(a) Continuous interlocking, flat web with minimum web thickness 9.5 mm and minimum mass of 106.00 kg/m^2;

(b) Continuous interlocking (Z) section:

(i) Minimum effective section modulus of 1300 cm^{3}per metre of wall;

(ii) Minimum flange thickness of 9.5 mm; and,

(iii) Minimum web thickness of 9.5 mm.

(c) Sheet Piling: As manufactured by Piling Products, Inc., section designation PZC13 or as approved by the Contract Administrator;

(d) Special Corners: Shop fabricate by welding or provide standard fabricated special corners for type of steel piling supplied;

(e) Interlocks: Section of interlock bar of 1 m minimum length which will pass along full length of pile without binding;

(f) Mark each piece of sheet piling legibly by stencilling or die-and-stamping with following information:

(i) Heat Number;

(ii) Manufacturer's Name; and,

(iii) Length and Section Number.

(g) Do not precut lifting or slinging holes in sheet piles.

AD16.3.3 Structural Steel for Wales and Miscellaneous Steel: To CAN/CSA-G40.21-13, Grade 350W.

AD16.3.4 Shear Connectors

(a) Shear connectors shall be as specified and tested in accordance with AREMA Chapter 15, Clause 1.7.9.3;

(b) Diameter, length and spacing of the shear connectors shall be as indicated on the Drawings; and,

(c) Shear connectors shall be as manufactured by Continental Studwelding Ltd., or approved equal.

AD16.3.5 Nuts and Bolts: Hexagon nuts, bolts, and washers to ASTM A307-12.

AD16.3.6 Fill Material: Backfill in accordance with AD17.

CONSTRUCTION METHODS

AD16.4 General

AD16.4.1 Delivery, Handling and Storage

(a) Use slings for lifting piling so that mass is evenly distributed and piling is not subjected to excessive bending stresses;

(b) Store sheet piling on level ground or provide supports so that sheet piling is level when stored. Provide blocking at spacing not exceeding 5m so that there is no excessive sagging in piling. Overhang at ends not to exceed 0.5m. Block between lifts directly above blocking in lower lift; and,

(c) If material is stockpiled on structure, ensure that the structure is not overloaded.

AD16.4.2 Installation

(a) Welding to be in accordance with CSA W59-03 except where specified otherwise;

(b) Pile installation is not to commence until all required quality control tests have been completed and test results approved by Contract Administrator;

(c) For installation of sheet piles, provide installation equipment capable of installing sheet pile to elevations indicated;

(d) Submit full details of method and sequence of installation of piling to Contract Administrator for approval prior to start of pile installation work. Details must include guide frames and bracing if required, setting and driving sequence and number of piles in panels for driving. Contractor to verify elevation of 1050 mm LDS and maintain clearance as indicated on the Drawings;

(e) Do not drive sheet piles within a radius of 8 metres of concrete which has been in place for a time shorter than 3 days unless authorized by the Contract Administrator;

(f) Remove loose and displaced material from around sheet piles after completion of driving, and leave clean, solid surfaces to receive backfill;

(g) Provide sufficient length above cut-off elevation so that part damaged during driving is cut off. Cut off sheet piles neatly and squarely at elevations indicated;

(h) When installation is complete, face of wall at top of sheet piles to be within 25mm of location as indicated and deviation from batter not to exceed 1 in 100;

(i) If in the opinion of the Contract Administrator piles are placed beyond tolerances specified, the Contractor may be required to remove such piles and install new piles to the specified tolerances at his own expense;

(j) Cut weep holes as indicated. Provide filter material in area of weep holes as indicated;

(k) Remove cut-off lengths from site on completion of work; and,

(l) No excavation work around the sheet piles shall be allowed before obtaining an official approval from the Contract Administrator.

AD16.4.3 Monitoring for Temporary Shoring

(a) The maximum lateral deflection allowance for temporary shoring shall be 75mm or less as required by the Contract Administrator; if the measured deflection exceeds this limit then the Contractor shall terminate the excavation work immediately around this area to allow for further inspection and analysis by the Contract Administrator;

(b) Monitoring shall occur with a frequency to adequately assess the movement of the shoring system, but not less than one time per week near for shoring adjacent to railway operations and not less than two weeks at all other locations. Detailed records shall be kept and made available to the Contract Administrator and the City at their request; and,

(c) The Contractor shall propose a method to mitigate the lateral deflection and submit to the Contract Administrator for approval.

AD16.4.4 Obstructions

(a) If obstruction encountered during driving, leave obstructed pile and proceed to drive remaining piles. Return and attempt to complete driving of pile obstructed later; and,

(b) Advise Contract Administrator immediately if impossible to drive pile to full penetration, and obtain direction from Contract Administrator on further steps required to complete work.

AD16.4.5 Holes

(a) Patch holes in steel pile wall, except where permanent holes are indicated. Use 10mm thick plate of material equal to that of piling to patch holes and overlap not less than diameter of hole. Weld to develop full strength of plate; and,

(b) Make holes required in piling by drilling. Do not use flame cutting without permission of Contract Administrator.

AD16.4.6 Cutting

(a) When flame cutting tops of piles and flame cutting holes in piles, adopt following procedure;

(b) When air temperature is above 0˚C, no pre-heat is necessary;

(c) When air temperature is below 0˚C, pre-heat until steel 25mm on each side of line of cut has reached a temperature very warm to hand (approximately 35˚C). Tempil sticks or temperature indicating crayon marks may be used to measure temperature;

(d) Use torch guiding device to ensure smooth round holes or straight edges; and,

(e) Make cut smooth and free from notches throughout thickness. If grinding is employed to remove notch or crack, finished radius to be minimum 5mm.

AD16.4.7 Splicing

(a) Use full length piles unless splicing is indicated or unless approved by Contract Administrator.

AD16.4.8 Wales

(a) Install wales prior to excavation in front of the upper sheet pile walls. Shim as required.

AD16.4.9 Backfilling

(a) Backfill in accordance with AD17 and as indicated on the Drawings; and,

(b) Protect wales from damage or displacement during backfilling operations.

AD16.5 Quality Control

AD16.5.1 Source Quality Control: Hot Rolled Steel Sheet Piling

(a) Provide results of tests of sheet piling material to be used on project as follows:

(i) One tension test (and 1 bend test) from each heat for quantities of finished material less than (50) tonnes; and,

(ii) Two tension tests (and 2 bend tests) from each heat for quantities of finished material exceeding (50) tonnes.

(b) Tension tests in accordance with CAN/CSA-G40.20-13; (bend tests in accordance with ASTM-A6/A6M-13).

AD16.5.2 Quality Assurance

(a) Inspection and testing of steel sheet piling material to be carried out by testing laboratory designated by the Contract Administrator at any time during course of work;

(b) Materials inspected or tested by the Contract Administrator which fail to meet Contract requirements will be rejected at any time in course of work; and,

(c) Where tests or inspections by designated testing laboratory reveal work not in accordance with Contract requirements, Contractor to pay costs for additional tests or inspections as Contract Administrator may require to verify acceptability of corrected work.

AD17. STRUCTURAL BACKFILL

DESCRIPTION

AD17.1 The Works in this section include the following:

(a) Granular Backfill required at the outside face of the MSE walls, piers, abutments, retaining walls, and culverts as shown on the Drawings and to the requirements of this Specification; and,

(b) Suitable Site Backfill Material at locations shown on the Drawings and to the requirements of this Specification.

AD17.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

REFERENCES

AD17.3 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) CW 3110 – Subgrade, Sub-Base, and Base Course Construction; and,

(b) CW 3170 – Earthwork and Grading.

EQUIPMENT

AD17.4 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

MATERIALS

AD17.5 All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the Owner for any materials taken by the Contract Administrator for testing purposes.

AD17.6 All materials shall be accepted by the Contract Administrator at least fourteen (14) Days before any construction is undertaken. If, in the opinion of the Contract Administrator, such materials in whole or in part, do not conform to the Specification detailed herein, or are found to be defective in manufacture, or have become damaged in transit, storage, or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

AD17.7 Backfill materials shall be free of frozen lumps and shall be placed and compacted in an unfrozen state. Backfill shall not be placed on frozen subsoil.

AD17.8 All granular backfill, including levelling base fill, shall be clean and free from organic material, meeting the following gradation requirements:

CANADIAN METRIC SIEVE SIZE	PERCENT PASSING BY WEIGHT
50 000	100
20 000	75 - 100
5 000	45 - 85
2 500	35 - 55
315	15 - 35
160	5 - 20
80	0 - 7

AD17.9 Suitable site backfill material shall be in accordance with CW3110 and CW3170 and as accepted by the Contract Administrator, preferably native material if deemed suitable by the Contract Administrator.

AD17.10 Excavated material may be used for backfilling provided it meets the above requirements. Excavated granular material intended to be used for backfilling is not be contaminated by top soil or organic materials.

CONSTRUCTION METHODS

AD17.11 Granular Backfill Material

AD17.11.1 The Contract Administrator shall be notified at least one (1) working day in advance of any backfilling operations. No backfill shall be placed against any concrete until accepted by the Contract Administrator.

AD17.11.2 All granular backfill material shall be supplied, placed, and compacted in lifts of 150 mm (maximum) to a minimum of 98% of Standard Proctor Dry Density. Lifts shall be brought up on all sides at the same time.

AD17.11.3 The Contractor shall be required to provide necessary water or equipment during compaction of backfill material to achieve the required densities.

AD17.11.4 The Standard Proctor Density for granular shall be determined at the optimum moisture content in accordance with standard laboratory Proctor Compaction Test Procedure.

AD17.11.5 The field density of the compacted layers shall be verified by Field Density Tests in accordance with ASTM Standard, Test for Density of Soil in Place by the Sand-Cone Method, or equivalent as accepted by the Contract Administrator.

AD17.11.6 The frequency and number of tests to be made shall be as determined by the Contract Administrator.

AD17.12 Suitable Site Backfill Material

AD17.12.1 The installation of suitable site backfill material shall be in accordance with CW3170, Clauses 9.6 and 9.7.

QUALITY CONTROL

AD17.13 All workmanship and materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or acceptance that may have previously been given. The Contract Administrator reserves the right to reject any materials or Works which are not in accordance with the requirements of this Specification.

AD17.14 The Contract Administrator shall be afforded full access for the inspection and control testing of constituent materials both at the Site of the Work and at any plant used for production of the materials to determine whether the material is being supplied and placed in accordance with this Specification.

AD17.15 Any backfill material that does not meet the gradation and/or compaction requirements of this Specification shall be removed and replaced by the Contractor at his own expense, to the satisfaction of the Contract Administrator.

AD18. MECHANICALLY STABILIZED EARTH (MSE) WALLS

DESCRIPTION

AD18.1 The Works in this section include the design, supplying and installation of the mechanically stabilized earth (MSE) walls located at the grade separation structures and as shown on the Drawings.

AD18.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

MATERIALS

AD18.3 Precast Concrete Panels

AD18.3.1 Cast from 35 MPa (minimum) concrete that conforms to CAN/CSA A23.1 exposure Class C-1 and the requirements of AD9 Structural Concrete for Type 3 concrete except the maximum aggregate size may be 14 mm.

AD18.3.2 Panels shall be concrete grey with smooth finish.

AD18.3.3 Reinforcing steel shall be galvanized reinforcing steel that conforms to AD11.

AD18.4 Soil Reinforcement

AD18.4.1 Soil reinforcement shall be ASTM A572 Grade 65 steel strip, hot rolled to the required shape and dimensions.

AD18.4.2 Steel soil reinforcement and steel connection hardware shall be hot-dip galvanised in accordance with ASTM A123.

AD18.5 Selected Granular Backfill

AD18.5.1 Granular backfill material for MSE walls shall conform to the following requirements:

(a) Grading: 100% passing 100 mm Sieve, 60% passing 425 µm (No. 40) Sieve and 0-15% passing 75 µm (No. 200) Sieve;

(b) Plastic Index < 6, determined in accordance with AASHTO T90;

(c) Angle of internal friction of not less than 34 degrees, as determined by the Standard Direct Shear Test, AASHTO T 236, on the portion finer than the No. 10 sieve, utilizing a sample of the material compacted to 95% of AASHTO T 99, Methods C or D at optimum moisture content. No testing is required for backfill where 80 percent of sizes are greater than 20 mm;

(d) The materials shall be substantially free of shale or other soft, poor durability particles;

(e) Magnesium sulphate soundness loss of less than 30 percent after four cycles;

(f) pH of 5 to 10;

(g) Resistivity not less than 3,000 ohm-cm;

(h) Chlorides not greater than 100 ppm; and,

(i) Sulphates not greater than 200 ppm.

AD18.5.2 Cellular concrete backfill for MSE walls shall conform to the following requirements:

(a) Slurry shall be supplied by redi-mix supplier, shall consist of GU cement, fly ash, and water, and shall have a density of 16.8 kN/m^3;

(b) Synthetic foaming agent shall allow pours up to 2 metres deep;

(c) Wet-cast density shall be 4.66 $kN//m^3$ 3 $\pm$ 10% with an expected dry density rate of 3.9 – 4.4 kN/m^3;

(d) Minimum f'c at 28 days shall be 300 kPa; and,

(e) The Contractor shall be responsible in providing a Concrete Quality Control & Quality Assurance Plan to the Contract Administrator, in accordance with Specification AD1. Shop Drawings.

AD18.5.3 Impermeable Geomembrane

(a) 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

(b) 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.

AD18.5.4 Miscellaneous Components

(a) All formwork, including MSE panels, shall be lined with geo-fabric or poly sheeting so fresh cellular concrete does not leak out;

(b) Structural steel shall conform to AASHTO M 270 (ASTM A709) Grade 36 unless otherwise specified. All steel components shall be hot-dipped galvanized in accordance with ASTM A123;

(c) Pipe and perforated pipe shall conform to subsections 708 and 709 of AASHTO Guide Specifications for Highway Construction or as approved by the Contract Administrator;

(d) Filter fabric shall conform to subsection 620 of the AASHTO Guide Specification for Highway Construction or as approved by the Contract Administrator; and,

(e) Rock used for drainage material shall conform to Section 2.3 of CW 3120.

CONSTRUCTION METHOD

AD18.6 Preparations

AD18.6.1 The contractor shall submit shop drawings and design calculations to the Contract Administrator for review and approval as highlighted in AD1.2. Shop Drawings . The shop drawings and design calculations shall be sealed, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba. The submitted shop drawings and design calculations shall include the following:

(a) Complete design calculations substantiating that the proposed design satisfies the required design parameters stated on the Drawings;

(b) Complete details of all elements required for the proper construction of the MSE walls, including complete material specifications;

(c) Earthwork requirements including specifications for material and compaction of backfill;

(d) Details of revisions or additions to drainage systems or other required facilities; and,

(e) Other information required in the plans or requested by the Contract Administrator.

AD18.6.2 The Contractor shall not start the Work until the Contract Administrator has approved the shop drawings. Such approval shall not relieve the contractor of any of his responsibility under the contract for the successful completion of the Work.

CONSTRUCTION

AD18.7 Fabrication and preparation of galvanized reinforcing steel shall conform to AD11.

AD18.8 Precast concrete panel manufacturing tolerances shall be as described in CAN/CSA A23.4. The tolerance after installation shall be:

(a) The flatness tolerance of wall surfaces measured in any direction shall not exceed 10 mm/m;

(b) The offset of adjacent panel edges at joints shall not exceed 10 mm;

(c) The variation for minimal joint gap shall not exceed 1.5 mm/m; and,

(d) The overall vertical tolerance of the completed wall (top and bottom) shall not exceed 13 mm/3 m of wall height.

AD18.9 The lay-down area for the MSE wall materials 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 off the ground surface. All materials shall be covered and protected from rain, snow, dirt, and ultraviolet light. The precast panels shall be stored such that a uniform colour of the panels is maintained and protected from staining or discoloration.

AD18.10 Construct concrete levelling pads for the precast panel per the shop drawings from the MSE wall supplier.

AD18.11 Pre-install connecting points for soil reinforcing elements in accordance with the approved shop drawings.

AD18.12 Connect soil-reinforcing elements to the precast panels. Uniformly tension all soil reinforcement to remove any slack in the connection or material.

AD18.13 Selected backfill, either cellular concrete or granular material, shall be placed and compacted simultaneously with the placement of soil reinforcement. Placement and compaction shall be accomplished without distortion or displacement of the soil reinforcement.

AD18.14 Contractor shall not damage any existing structures or utilities. Any damage by the Contract must be repaired or replaced at the Contractors own cost to the satisfaction of the Contract Administrator.

AD18.15 Sheep foot or grid-type rollers shall not be used for compacting backfill within the limits of the soil reinforcement. At each level of soil reinforcement, the backfill material shall be roughly levelled to an elevation approximately 300 mm above the level of connection at the facing before placing the soil reinforcement.

AD19. ROCK-SOCKETED CAISSON

AD19.1 Description

AD19.1.1 This Specification shall cover all operations related to supply and installation of rock-socketed caissons, including but not limited to overburden drilling, rock coring, water control, supply and install of steel casings, supply and placement of concrete and reinforcing steel, removal of temporary steel casings and disposal of excavated material.

AD19.1.2 The Work to be done by the Contractor under this Section shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

AD19.2 Definitions

AD19.2.1 Overburden: All material encountered above the bedrock including imported fill and native soils.

AD19.2.2 Weathered Rock Zone: Weathered rock encountered above the sound bedrock including voids and soil filled cavities which would require temporary or permanent steel casing to support the caisson hole.

AD19.2.3 Sound Rock: Rock which may contain fractures but a casing is not required to support the caisson hole.

AD19.3 Elevations on Drawings

AD19.3.1 The caisson elevations shown on the drawings are approximate only. Refer to the test hole logs and all other available information to gain more knowledge about the surface and subsurface conditions.

AD19.4 Materials

AD19.4.1 General

(a) The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

AD19.4.2 Handling and Storage

(a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CSA Standard CAN/CSA A23.1-14. Materials damaged by careless or negligent handling or storage by the Contractor shall be replaced at the Contractor's expense.

AD19.4.3 Testing

(a) All materials supplied under this Specification shall be subject to inspection by the Contract Administrator and testing by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes; and,

(b) All materials shall be approved by the Contract Administrator at least twenty-one (21) days before any construction is undertaken. If, in the opinion of the Contract Administrator, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

AD19.4.4 Steel Casings

(a) Steel casings shall be a minimum of 20 mm thick and sized in accordance with the Drawings.

AD19.4.5 Concrete

(a) The concrete shall conform to AD9 Structural Concrete of this Specification; and,

(b) The concrete shall be placed by the tremie method if the caisson excavation cannot be kept free of water.

AD19.4.6 Reinforcing Steel

(a) The reinforcing steel shall conform to AD11 Supplying and Placing Reinforcing Steel of this Specification.

AD19.5 Equipment

AD19.5.1 All equipment shall be of a type accepted by the Contract Administrator and shall be kept in good working order.

AD19.5.2 Tremie Equipment

(a) The tremie pipe shall consist of a tube, having a diameter of not less that 250mm, constructed with sections having flange couplings fitted with gaskets. The discharge end shall have a proper seal so that water will not enter the tube at any time. Tremie concrete may also be deposited by means of a bottom dump tremie bucket equipped with a closing top. The tremie bucket shall be of a type accepted by the Contract Administrator.

AD19.6 Construction Methods

AD19.6.1 Location and Alignment of Caissons

(a) The Caissons shall be installed in the positions shown on the drawings or as directed by the Contract Administrator. The Contractor will be required to remove obstructions in order to achieve the proper pile alignments; and,

(b) Alignment shall not deviate more than 2 percent of caisson length out of plump and not more than 75 mm off centre at top.

AD19.6.2 Cut-off of Steel Casings

(a) The casings shall be set to the elevations shown on the drawings. All costs associated with the casing cut-offs shall be incidental to the appropriate Contract Unit Price for "Supply Steel Casings".

AD19.6.3 Dewatering

(a) Any water present within the caisson holes shall be pumped out and removed from site;

(b) The caisson hole shall be dewatered to facilitate rock socket inspection by the Contract Administrator; and,

(c) All costs associated with the dewatering shall be incidental to the appropriate Contract Unit Price for "Supply and Install Rock-Socketed Caissons".

AD19.6.4 Rock-Socketed Caisson Installation

(a) The Contractor shall bore shaft holes to diameters indicated on the drawings at each caisson location down to bedrock surface;

(b) Upon completion of shaft to rock surface, provide and install temporary steel casing embedded into rock surface to allow for coring and inspection of rock socket. Casing to be removed during concreting operations;

(c) The Contract Administrator may determine that one or more of the temporary steel casings may be required to be changed to a permanent casing should the quality or condition of the soil and or rock indicate such a requirement at the time of construction;

(d) The Contractor shall bore rock sockets using core barrels to diameters indicated on drawings. The sockets shall be advanced a minimum of 3500 mm into sound bedrock as determined by the Contract Administrator. Ensure loose material is removed using compressed air and the caisson is free from water and foreign material. Allow the Contract Administrator to perform downhole inspection and or video camera inspection;

(e) The Contract Administrator may require extension of the rock sockets if, in the opinion of the Contract Administrator, it is necessary in order to reach an acceptable quality of sound bedrock; and,

(f) Upon acceptance of the caisson hole by the Contract Administrator the Contractor shall place the reinforcing steel as indicated on the drawings and fill the entire length of the caissons with concrete to the top elevation of the permanent 914 mm diameter steel casing as indicated on the drawings. The 1067 mm diameter steel casing shall then be placed to the elevation and positions indicated on the drawings. Install reinforcing steel and place concrete as indicated on the drawings.

AD19.6.5 Tremie Concrete Procedure

(a) Where tremie concrete is to be used, sufficient additional cement shall be added to the mix to compensate for dilution due to the depositing of concrete in the water;

(b) Tremie concrete shall be deposited in a manner accepted by the Contract Administrator. Tremie concrete shall not be placed without the Contract Administrator's approval;

(c) To prevent segregation, concrete deposited underwater shall be carefully deposited in a compact mass in its final position by means of a tremie pipe, or other approved method, and shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit. The water level shall be regulated so that there is no fluctuation of water pressure that may be injurious to the concrete;

(d) The minimum rate of depositing tremie concrete shall be 15 m3/hr. Continuous soundings shall be taken during the concrete pour and all irregularities in the concrete profile shall be corrected. If a tremie pipe is used, it shall be supported so as to permit;

(e) Free movement of the discharge end over the entire top surface of the work;

(f) Rapid lowering when necessary to retard or stop the flow of concrete;

(g) The discharge end shall be closed at the start of the Work in order to prevent water from entering the tube and it shall be sealed at all times when not within the deposited concrete;

(h) The tremie tube shall be kept full up to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it within the deposited concrete;

(i) If a bottom dump tremie bucket is used, the rate of lowering and raising shall be such that the bucket does not create undue turbulence in the caisson shaft. The bucket shall always be within the deposited concrete when the bottom is opened; and,

(j) Where tremie concrete is used, in addition to the heating and hoarding requirements in AD19.6.6, the Contractor shall heat the water inside the caisson shaft to a minimum temperature of 5°C, and shall maintain the water above the deposited concrete at this temperature for a period of at least 7 days.

AD19.6.6 Heating and Hoarding

(a) The Contractor shall make provisions for heating the concrete, the reinforcing steel and the casings to a minimum of 5 °C prior to placing any concrete. The deposited concrete shall be heated and protected against freezing in accordance with AD9.62. All costs associated with heating and hoarding shall be incidental to the Contract Unit Price for “Supply and Install Rock-Socketed Caissons”.

AD20. SUPPLYING AND DRIVING PRECAST CONCRETE PILES

AD20.1 Description

AD20.1.1 The Work shall consist of:

(a) Supplying, handling, hauling, storing, aligning, and driving precast concrete piles;

(b) Cutting off piles at the required elevations;

(c) Pre-boring of piles, if applicable;

(d) Splicing piles, if deemed necessary by the Contractor;

(e) The quality control (QC) testing of all materials, and;

(f) Building-up piles to the required elevations, where necessary.

AD20.1.2 The Contractor shall be responsible for supplying piling of sufficient length to obtain the penetration and bearing value identified on the Drawings and in the Geotechnical Report. For the purpose of determining the length of piles required, the Contractor may, at his own expense, drive test piles, complete borings or make other such other investigations as deemed necessary.

AD20.2 References and Related Specifications

AD20.2.1 All references standards shall be current issue or latest revision at the first date of tender advertisement.

AD20.2.2 References:

(a) CSA A5, Portland Cement;

(b) CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete;

(c) CSA A362, Blended Hydraulic Cement;

(d) CAN/CSA A3001, Cementitious Materials for Use in Concrete;

(e) CAN/CSA A23.4/CSA A251, Materials and Construction/Qualification Code for Architectural and Structural Precast Concrete Products;

(f) CSA G30.12, Billet-Steel Wire for Concrete Reinforcement;

(g) CSA G30.14, Deformed Steel Wire for Concrete Reinforcement;

(h) CSA G30.15, Welded Deformed Steel Wire Fabric for Concrete Reinforcement;

(i) CSA G279, Steel for Pre-stressed Concrete Tendons;

(j) CAN/CSA G30.18, Billet-Steel Bars for Concrete Reinforcement;

(k) AASHTO/AWS D1.5M/D1.5 Bridge Welding Code;

(l) AASHTO T176, Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test Nineteenth Edition;

(m) ASTM C29, Standard Test Method for Bulk Density (Unit Weight) and Voids in Aggregate;

(n) ASTM C40, Standard Test Method for Organic Impurities in Fine Aggregates for Concrete;

(o) ASTM C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete;

(p) ASTM C70, Standard Test Method for Surface Moisture in Fine Aggregate;

(q) ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate;

(r) ASTM C117, Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing;

(s) ASTM C127, Standard Test Method for density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate;

(t) ASTM C128, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate;

(u) ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine;

(v) ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates;

(w) ASTM C138, Standard Test Method for Density (Unit Weight), Yeild, and Air Content (Galvimetric) of Concrete;

(x) ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete;

(y) ASTM C295, Standard Guide for Petrographic Examination of Aggregates for Concrete;

(z) ASTM C457, Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete;

(aa) ASTM C494, Standard Specification for Chemical Admixtures for Concrete;

(bb) ASTM C535, Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the os Angeles Machine;

(cc) ASTM C1017, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete;

(dd) ASTM C1064, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete;

(ee) ASTM C1084, Standard Test Method for Portland-Cement Content of Hardened Hydraulic-Cement Concrete;

(ff) ASTM C1202, Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration;

(gg) ASTM C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method);

(hh) ASTM C1583, Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method);

(ii) ASTM C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete;

(jj) ASTM D75, Standard Practice for Sampling Aggregates;

(kk) ASTM D516, Standard Test Method for Sulfate Ion in Water;

(ll) ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m^3));

(mm) ASTM D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate;

(nn) ASTM D5821, Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate;

(oo) ASTM D6928, Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus;

(pp) AASHTO/AWS D1.5M.D1.5, Bridge Welding Code; and,

(qq) AWS D1.1, Structural Welding Code – Steel.

AD20.3 Submittals

AD20.3.1 The Contractor shall submit the following to the Contract Administrator:

(a) Proof of certification to the Canadian Precast/Prestressed Concrete Institute (CPCI) Certification Program. The Manufacturer must meet requirements of CSA A23.4, including Appendices A and B, together PCI MNL-116 and 117 and CPCI certification requirements. The Manufacturer must be certified to Group B, Category B2 at the time of tender. Proof of this certification shall be provided to the Contract Administrator prior to award of the contract;

(b) Concrete mix design that meets the minimum compressive strengths (f'c and f'ci) as shown on the Drawings shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba. Any changes to the concrete mix design shall be reviewed by the Contract Administrator prior to the Manufacturer implementing the change;

(c) Stressing calculations shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba and include the following:

(i) Copies of the stressing sequence and strand elongation calculations as well as all data required for checking these calculations. Separate elongation calculations will be required for each significant variation in the Modulus of Elasticity of the strand;

(ii) A calibration graph for each jack, calibrated not more than 6 months prior to stressing operation;

(iii) The proposed sequence of stressing and destressing operations;

(iv) The anchorage losses experienced by the Manufacturer under similar loading applications, and the proposed method of measuring the anchorage losses during the stressing operation; and,

(v) A copy of the proposed "Record of Concrete Strength" and "Record of Pre-Tensioning" forms to be used by the Manufacturer.

(d) Copies of the stress-strain curve for the prestressing steel;

(e) Copies of all reports, including but not limited to: "Record of Concrete Strength" form, "Record of Pre-Tensioning" form and material quality control test results;

(f) Details of the proposed pile driving system and Manufacturer's specifications and catalogue for the hammer(s) to be used to perform preconstruction wave equation analysis and determine the adequacy of the driving system and hammer(s) and the preliminary pile driving criteria. The results of the wave equation shall be the basis on which the Contract Administrator will determine if the proposed system is acceptable;

(g) Detailed design notes and Shop Drawings for proposed splice connections that are sealed signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba (if applicable);

(h) Proof of certification for the welders conducting the Work (if applicable). All welders shall satisfy one of the following requirements:

(i) Welders qualified in accordance with the requirements of AASHTO/AWS D1.5M/D1.5;

(ii) Valid Canadian Welding Bureau (CWB) Welding ticket, or

(iii) Valid "Welder's Licence" as issued by the Mechanical and Engineering Division, Department of Labour and Manpower, Province of Manitoba, with a minimum of 5 years of experience welding on steel structures.

(i) Welding procedures specific to the Work (if applicable).

AD20.4 Materials

AD20.4.1 Concrete

(a) Concrete in the piles shall have minimum compressive strengths (f'c and f'ci) as shown on the Drawings and meet the requirements of CSA A23.1, Exposure Class S-1 and Air Content Category 1 for hardened concrete:

(i) Coarse Aggregate:

- The Maximum nominal size of coarse aggregate shall be 20 mm and meet the grading requirements of CSA A23.1, Table 11, Group I. Coarse aggregate shall consist of crushed stone or gravel or a combination thereof, having hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter or other injurious substances.
- Tests of the coarse aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1, Table 12, for concrete exposed to freezing and thawing.

(ii) Fine Aggregate:

- Fine aggregate shall meet the grading requirements of CSA A23.1, Table 10, FA1. Fine aggregate shall consist of sand, stone, screenings, and other inert materials with similar characteristics or a combination thereof, having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances.
- Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1, Table 12.

(iii) Admixtures:

- Air-entraining admixtures shall conform to the requirements of ASTM C260.
- Chemical admixtures shall conform to the requirements of ASTM C494 or C1017 for flowing concrete.
- All admixtures shall be compatible with all other constituents. The additional of calcium chloride, accelerators and air-reducing agent will not be permitted, unless otherwise approved by the Contract Administrator.

(iv) Cementitious Materials:

- Hydraulic cement shall be Type MS/MSb (moderate sulphate-resistant/blended high sulphate resistant) in accordance with CSA A23.1.

AD20.4.2 Prestressing Strand

(a) Prestressing strands shall be seven wire uncoated, low relaxation strand, conforming to CSA G279. They shall be in accordance with the size and ultimate strength as shown on the Drawings and the following:

(i) Tagging:

- Size of strand, coil number, heat number and the mark of the Manufacturer shall be recorded on a tag attached securely to each real. The tag shall also identify the strand with its own stress strain curve.

(ii) Stress-Strain Curves:

- On stress-strain curve shall be provided by the Manufacturer for each reel.

(iii) Testing:

- Should the Contract Administrator consider it necessary, approval of the prestressing strand, in addition to the requirements of CSA G279, shall be based on tests carried out by the Manufacturer at his expense in a testing laboratory satisfactory to the Contract Administrator. The Manufacturer shall test a minimum of three representative specimens of the strands to be used in the piles. The results of these tests shall be supplied to the Contract Administrator. The Contract Administrator may also require the Manufacturer to supply additional representative specimens for independent testing.
- Where the strand has rusted in storage, the use of such material will be subject to the approval of the Contract Administrator. The Contract Administrator, at his discretion, may require physical tests at the Manufacturer's expense in order to determine whether the material is suitable to be used in the piles.
- All strands that are contaminated by substances having a deleterious effect on the steel or concrete or on the bond strength of concrete to strand or, sustain physical damage, shall be replaced either by the Manufacturer at his expense or cleaned to the satisfaction of the Contract Administrator at the Manufacturer's expense.

AD20.4.3 Reinforcement

(a) Intermediate grade bars shall conform to the requirements of CSA G30.12, CSA G30.14 and CSA G30.15; and,

(b) Reinforcing steel shall conform to the requirements of CAN/CSA G30.18 Grade 400W.

AD20.4.4 Replacement of Damaged Materials

(a) All material supplied by the Contractor that in the opinion of the Contract Administrator has been damaged or otherwise rendered unusable by improper storage or handling by the Contractor shall be replaced by the Contractor at his expense.

AD20.4.5 Replacement or Repairing Damaged Piles

(a) If piles are damaged due to the Contractor's handling operations, the Contractor shall, at his own expense, replace all damaged piles with piles that meet the requirements of this Specification and as shown on the Drawings; and,

(b) All piles excessively spalled, crushed or broken in driving operations shall be replaced by the Contractor at his own expense unless, at the discretion of the Contract Administrator, the damage is so slight that the pile can be repaired properly by the Contractor at his own expense.

AD20.4.6 Welding

(a) Welding shall conform to the requirements of the Structural Welding Code - Steel of the American Welding Society AWS D1.1 and addendum and CSA W59 Welded Steel Construction.

AD20.5 Construction Methods

AD20.5.1 Identification

(a) All piles will be marked on the side at one end clearly identifying the following information: the casting date, bed number and pile number, length and data pertaining to the manufacture of each pile.

AD20.5.2 Fabrication

(a) Tolerances:

(i) The Contractor shall fabricate the precast concrete piles to the following tolerances:

- total length: minimum variation shall be $\pm$ 3 mm per metre of length (or the greater of L/500 or 30 mm per CSA), whichever is less;
- cross-section dimensions: -6 mm to +12 mm;
- deviation from straight line: not more than 3mm/m of length to a maximum of 12 mm for full length;
- head of pile: $\pm$ 10 mm/m from a right angle plane with surface irregularities $\pm$ 3 mm;
- reinforcing steel cover: –3 mm to + 6 mm; and
- spacing of spiral reinforcing: $\pm$ 12 mm.

(b) Stressing:

(i) The submission of the stressing calculations to the Contract Administrator shall in no way relieve the Manufacturer of the full responsibility for the success or failure of the stressing operations;

(ii) Before the stressing operation begins, the Manufacturer shall have filled in on the approved "Record of Pre-Tensioning" form the calculated jack gauge reading, the required gross elongation (based on estimated anchorage losses), and the required net elongation for each strand. During stressing operations, the Manufacturer shall record the actual jack gauge reading, measured gross elongation, measured anchorage losses, and then calculate the actual net elongation for each strand;

(iii) Tensioning shall be carried out so that the jack is coaxial with the tendon or strand. If the strands are tensioned individually, care shall be taken to ensure that unravelling of the strands does not take place;

(iv) At no time shall the actual jack pressure vary from the pressure corresponding to the calculated gross elongation by more than 5 percent. If the required gross elongation is not obtained by stressing to this maximum allowable jack pressure at one end of the pile bed, it will be necessary to complete the stressing from the other end of the pile bed;

(v) The jack calibration shall be repeated at any given time that a gauging system indicates erratic results and at intervals not greater than 6 months during regular usage or not greater than 12 months for other conditions of use;

(vi) The Manufacturer shall have on hand a calibrated load cell that can be used to verify the actual load in the strand as a means of checking the elongation whenever the Contract Administrator considers it necessary;

(vii) A copy of the "Record of Pre-Tensioning" form shall be submitted to the Contract Administrator upon completion of the pre-tensioning of each pile run;

(viii) The transfer of the pre-tensioning force from the bulkheads to the piles shall not be carried out until the concrete has reached the minimum compressive strength as shown on the Drawings or as specified by the Contract Administrator. The cylinders used to determine this strength shall be cured under the same circumstances as the concrete of the piles in question;

(ix) Transfer of the pre-tensioning force shall be carried out by a method approved by the Contract Administrator. If the strands are to be cut, the destressing sequence shall be subject to approval by the Contract Administrator; and,

(x) All pre-tensioning strands shall be cut off flush with the end of the piles unless noted otherwise on the Drawings. The exposed ends of the pre-tensioning strands and a 50 mm strip of adjacent concrete shall be cleaned and painted unless noted otherwise on the Drawings. Cleaning shall be by abrasive blast to remove all dirt and residue that is not firmly bonded to the concrete surface. The surfaces shall be coated immediately with one thick coat of zinc-rich paint or other waterproofing material approved by the Contract Administrator. The paint shall be mixed thoroughly at the time of application and shall be worked into all voids in the pre-tensioning strands.

(c) Reinforcement:

(i) Reinforcement shall be placed accurately in the positions shown on the Drawings, and shall be retained in such positions by means of bar accessories and wires so that the reinforcement shall not be moved out of alignment during or after the depositing of concrete; and,

(ii) Reinforcement shall be kept free of all foreign materials in order to ensure a positive bond between the concrete and reinforcement. The Manufacturer shall remove any material that has been deposited on the reinforcement before concrete is placed.

(d) Depositing of Concrete:

(i) The temperature of the mixed concrete shall not be less than 10°C and not more than 25°C at the time of placing in the forms. Aggregates shall be heated to a temperature of not more than 65°C. The heating apparatus and the housing for the aggregates shall be sufficient to heat the aggregates uniformly without the possibility of the occurrence of hot spots which may burn the materials. The water shall be heated to a temperature of not more than 65°C;

(ii) Concrete shall be deposited carefully and vibrated so that it fills the forms completely and makes complete contact with all reinforcement, pre-stressing strands and any embedded materials;

(iii) Concrete shall be deposited at frequent locations within the forms so that there shall not be a necessity to move large quantities of concrete from place to place in the forms. The concrete shall be vibrated into place by methods that do not permit the constituent materials to segregate. The Manufacturer shall provide sufficient personnel to deposit and vibrate the concrete and shall ensure that each batch of concrete is vibrated properly into place as it is deposited;

(iv) Buckets, chutes and other equipment used to deposit concrete in the forms shall be positioned as close to the top of the forms as possible to minimize the free fall of the concrete;

(v) Depositing of concrete shall be a single continuous complete operation so that each pile shall be monolithic without joints; and,

(vi) Before any concrete shall be deposited, the interior of the forms shall be cleaned of all chips, earth, shavings, sawdust, rubbish or other foreign substances.

(e) Vibrating Concrete:

(i) Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 3,600 impulses per minute when operating under load. The vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place and to visibly affect the concrete over a radius of at least 450 mm from the vibrator when used in concrete having a 25 mm slump;

(ii) A sufficient number of vibrators shall be employed so that at the required rate of placement, vibration and complete compaction are obtained throughout the entire volume of each layer of the concrete. At least one extra vibrator shall be on hand for emergency use;

(iii) Internal vibrators shall be constantly moving vertically in the concrete and shall be applied at points uniformly spaced that are not farther apart than the radius over which the vibrator is visibly effective. Internal vibrators shall be applied close enough to the forms to vibrate the surface concrete effectively but care shall be taken to avoid displacing or damaging the forms;

(iv) Vibration shall be of sufficient duration and intensity to thoroughly consolidate the concrete but shall not be continued so as to cause segregation or draw a pool of grout from the surrounding area; and,

(v) Care shall be exercised so as not to damage the prestressing strand in any way or transfer the vibration through the strand to concrete that has already been placed and has started to set.

(f) Concrete Finish:

(i) Immediately after the removal of the forms, all defects in the concrete shall be repaired as directed by the Contract Administrator, provided the defects are not extensive enough to cause rejection of the piles. Should the top surface exhibit excessive laitance or “frothing”, or any other deleterious effects, the Manufacturer shall repair the concrete to the satisfaction of the Contract Administrator;

(ii) Honeycomb, if any, shall be repaired as soon as the forms are taken off. When approved by the Contract Administrator, repairs shall be accomplished by: removing all aggregate that is loose or that is not bonded thoroughly to the surrounding concrete, washing the sound concrete with clean water, using a wire brush to remove any loose particles, applying an approved epoxy resin to the dried areas, and applying a cementitious mortar. The cementitious mortar shall have the same quality and mix as that used for the concrete. Patched areas shall be rubbed flush with the surrounding surface after the cementitious mortar has hardened; and,

(iii) All objectionable fins, projections, offsets, streaks, and other surface imperfections shall be removed totally to the Contract Administrator's satisfaction by approved means.

(g) Curing:

(i) Concrete shall be either moist cured for a minimum of 72 hours from the time of casting or steam cured until the concrete has reached a strength (f'ci) as shown on the Drawings or as specified by the Contract Administrator. Concrete may be radiant heat cured within an enclosure to retain concrete moisture. The 100% humidity must be maintained in the enclosure;

(ii) If steam curing or radiant heat curing is used, it shall not be applied until after the initial set has taken place. Initial set will be considered to have taken place 4 hours after the completion of concrete placing. The cylinders used to determine the concrete strength shall be cured under the same conditions as the piles in question;

(iii) During steam curing, the rise in the ambient air temperature shall not exceed 20° C per hour to a maximum temperature of 70° C;

(iv) A thermocouple approved by the Contract Administrator shall be placed within the pile bed after placing of concrete is completed and the thermocouple shall not be removed until after steam curing has been completed. A graph showing the internal temperature plotted against the time of day shall be submitted to the Contract Administrator by the Manufacturer upon completion of the steam curing for each pile run and prior to any subsequent casting. The graph shall be properly identified as to the hour, day, month and year, as well as to the times of the completion of placing concrete, and of the start and completion of steam curing;

(v) Once curing has been completed, the temperature of the concrete shall not be allowed to fall at a rate exceeding 20° C per hour; and,

(vi) The Manufacturer shall not subject any pile to freezing temperatures before the pile has reached 85% of the design strength (f'c) as shown on the Drawings. The Manufacturer shall monitor the rate of cooling of the pile and avoid thermal shock from prematurely subjecting the pile to freezing temperatures.

(h) Handling and Storage:

(i) Piling shall be handled, hauled and stored in a manner that avoids damage to the piling materials. Loading and unloading shall be by crane, loader or other appropriate hoisting equipment;

(ii) Precast concrete piles shall be lifted using the lifting hooks provided on the piles. Piles at all times shall be supported at yarding points only;

(iii) The Contractor, in handling or lifting the precast concrete piles, will not be permitted to drag them along the ground; and,

(iv) If any piles are damaged due to the Contractor's handling operations, the Contractor shall, at his own expense, replace all damaged piles with piles meeting the requirements of this Specification and as shown on the Drawings.

(i) Location and Alignment:

(i) The piles shall be driven in the positions shown on the Drawings or as directed by the Contract Administrator. Piles shall be driven vertically unless shown otherwise on the Drawings, and shall not deviate more than 2 percent out of plumb. Batter piles shall be driven to the batter specified and shall not deviate more than 2 percent from the batter specified. Piles shall not be more than 75 mm off center measured at cut-off elevation; and,

(ii) Piles shall not be jacked or pulled into their final positions.

(j) Driving Precast Concrete Piles:

(i) Precast concrete piles shall be driven to the depths and in accordance with the pile driving criteria indicated in the Geotechnical Report, on the Drawings or as directed by the Contract Administrator. The Contractor shall remove any surface and/or shallow depth obstruction(s) to obtain the required penetration of the pile;

(ii) Pile driving equipment to be used by the Contractor shall be of such capacity that the required bearing and penetration will be obtained without damage being done to the piles. Drop hammers will not be permitted for driving precast concrete piles. Pile driving shall be carried out using a diesel mechanical hammer only. Driving of all piles shall be continuous and without interruption until the pile has been driven to cut-off elevation or the refusal criteria has been met;

(iii) Pile driver leads shall be used to support the piles while they are being driven and shall be braced to the supporting crane so as to hold the piles securely and accurately in the required position during driving. Leads shall be of sufficient length to be firmly supported on the ground. The use of hanging or swinging leads will not be allowed unless they can be held in a fixed position during the driving operations. Batter piles shall be driven with inclined leads;

(iv) The heads of precast concrete piles shall be protected by a cap of a design approved by the Contract Administrator. The cap shall be designed to hold the axis of the pile in line with the axis of the hammer. The bottom of the cap shall have a recess with a cushion of suitable material next to the pile head, and the top of the cap shall have a timber shock block;

(v) The Contractor shall drive all piling in the sequence as shown on the Drawings or specified by the Contract Administrator to minimize pile upheaval. If upheaval does occur, the Contractor shall re-drive the lifted piles to the specified elevations. The Contractor shall excavate material that has boiled up during pile driving operations. The elevation of all piles previously driven or redriven shall be confirmed to detect uplift. If uplift of 5 mm or more occurs in any pile, that pile shall be redriven to its original elevation and thereafter to the required final driving resistance. If cavities remain around the pile after drifting, the cavities should be filled with sand or other approved material to the satisfaction of the Contract Administrator; and,

(vi) The Contractor shall ensure the safety of all personnel during pile driving operations. In particular, overhead protection shall be provided for all personnel located adjacent to the pile driving lead and under the pile driving hammer. The overhead protection shall be designed and constructed so as to safely withstand forces from falling debris or other matter.

(k) Pile Cut Off:

(i) The concrete at the top of the pile shall be chipped off neatly and perpendicular to the axis of the pile to the required elevation. The projecting steel reinforcing and prestressing strand, shall be left to act as anchorages into the concrete substructure units, either being bent down into the unit, if necessary, or cut off of leave at least 40 bar diameter lengths for the reinforcing steel and 1.0 metres for the prestressing strand projecting into the unit, or as detailed on the Drawings or directed by the Contract Administrator.

(l) Piles Cut Off Too Low or Driven Too Low:

(i) A precast concrete pile, which at the discretion of the Contract Administrator, has had a detrimental amount of concrete broken off below the required cut-off elevation, shall be repaired by removing concrete until the entire end face of the pile is perpendicular to the longitudinal axis;

(ii) Where the top of such a pile is embedded in a footing or cap, the following procedures will apply:

- For a cap that is exposed to view, the bottom surface of the cap shall be lowered by the distance that the lowest pile is below the required cut off elevation.
- For an unexposed footing, an area 1.0 metre by 1.0 metre centered on the pile axis shall be lowered by the same distance that the pile is below the required cut off elevation.

(iii) The bottom surfaces of caps and footings shall be treated in the same manner as described above for cases where precast concrete piles have been driven below the required cut off elevations; and,

(iv) If extra reinforcing steel is required, it shall be supplied and placed by the Contractor at his expense as directed by the Contract Administrator in areas where a cap or footing has to be lowered.

(m) Splicing:

(i) The Contractor shall complete the Work in accordance with the welding procedures, Shop Drawings and the following:

- Before welding over previously deposited metal, the slag shall be cleaned off. This requirement shall apply to successive layers, successive beads, and to the cratered area when welding is resumed after any interruption.
- Material to be welded shall be preheated in accordance with CSA W59.

- The piles shall not have more than one splice per pile unless otherwise approved by the Contract Administrator. The location of the splice(s) shall be approved by the Contract Administrator.

AD20.6 Quality Control/Quality Assurance

AD20.6.1 Quality Control

(a) Quality Control For the fabrication of the precast concrete piles, the Contractor shall be responsible for all quality control testing and shall complete the minimum testing requirements to the specified frequency and test procedure as described in Tables 1 and 2. All testing shall be completed by qualified personnel who are certified at the time of testing as ACI CSA-Based Concrete Field Testing Technician – Grade 1.

AD20.6.2 Quality Assurance

(a) The Contract Administrator, at his discretion, will complete random quality assurance testing on all materials incorporated into the structure. The Contractor shall allow the Contract Administrator unhindered access to the materials and shall assist the Contract Administrator in carrying out any sampling, testing or inspection at the plant or the site, including suitable access and storage; and,

(b) All welds will be inspected visually by the Contract Administrator.

AD20.6.3 Pile Driving Records

(a) The Contractor and the Contract Administrator will keep an independent record of each and every pile driven. The records shall give the date, time, diameter, length, location, type, total depth of penetration, rate of penetration, number of blows per 300 mm, penetration of the last five blows, steam, air or diesel pressure and the kind and size of hammer used in driving. Any unusual phenomena shall be noted and recorded, especially if they indicate possible damage to the pile; and,

(b) Energy output of driving equipment at the time of final set shall be carefully recorded by the Contractor, along with the final penetration readings, and reported immediately to the Contract Administrator. The required set per blow will be subject to acceptance by the Contract Administrator, showing regard to the specified driving equipment and piles permitted.

AD21. SUPPLY AND DRIVING STEEL PILES

DESCRIPTION

AD21.1 This Specification shall cover all operations related to the pre-boring for piles, supplying, handling, hauling, storing, supplying and installing pile tips, aligning and driving, splicing, and cutting off of piles at the required elevations for steel bearing piles.

AD21.2 Steel piles, steel “H” piles, and “H” Piles shall be considered one and the same for the Drawings and this Specification.

AD21.3 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

REFERENCES

AD21.4 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) CAN/CSA G40.20M/G40.21M-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;

(b) CAN/CSA W59-13, Welded Steel Construction (Metal Arc Welding); and,

(c) AASHTO/AWS D1.5 m/D1.5 Bridge Welding Code.

SUBMITTALS

AD21.5 The Contractor shall submit the following to the Contract Administrator:

(a) Copies of Mill Test Certificates showing chemical analysis and physical tests for piling material. Piling material without this certification will be rejected;

(b) Details of the proposed pile driving system and manufacturer's specifications and catalogue for all mechanical hammers to be used to perform preconstruction wave equations analysis and determine adequacy of the driving system and hammer and the preliminary pile driving criteria;

(c) Certificate of mass for gravity or drop hammers. If this certificate is not available, the gravity or drop hammers shall be weighed in the presence of the Contract Administrator. Hammers so weighed shall have the exact mass marked on them. Gravity hammers shall weigh at least 1.5 ton but in no case shall the mass of the hammer be less than the combined mass of the pile and pile cap;

(d) Proof of certification for the welders conducting the Work (if applicable). All welders shall satisfy one of the following requirements:

(i) Welders qualified in accordance with the requirements of ASHTO/AWS D1.5M/1.5;

(ii) Valid Canadian Welding Bureau (CWB) Welding ticket; or,

(iii) Valid "Welder's Licence" as issued by the Mechanical and Engineering Division.

(e) Department of Labour and Manpower, Province of Manitoba, with a minimum of 5 years of experience welding on steel structures; and,

(f) Welding procedures specific to the Work.

MATERIALS

AD21.6 General

AD21.6.1 The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

AD21.7 Handling and Storage of Materials

AD21.7.1 Piling shall be handled, hauled and stored in a manner that avoids damage to the piling materials. Loading and unloading shall be by crane, loader or other appropriate hoisting equipment.

AD21.7.2 The method of handling and storing steel bearing piles shall be such so as to prevent any damage to the pile and to ensure that the design strength will not be affected by deterioration or deformation. The Contractor, in handling or lifting the piles, will not be permitted to drag them along the ground.

AD21.7.3 Any piles excessively damaged through negligence or improper handling operations shall be immediately removed from the Site and replaced with sound piles by the Contractor, at his own expense.

AD21.8 Steel "H" Piles

AD21.8.1 Steel "H" Piles shall be structural steel members manufactured in accordance with CAN/CSA-G40.20M/G40.21M-04, Grade 350W.

AD21.9 Pile Tips

AD21.9.1 Pile tips shall conform to CAN/CSA-G40.20M/G40.21M-04 Grade 300W. Pile tips shall be Hard-Bite Point Model No. HP-77750-B.

AD21.10 Splice Plates

AD21.10.1 Splice plates shall conform to the requirements of CAN/CSA G40.21M, Grade 300W.

AD21.11 Welding

AD21.11.1 The Contractor is responsible for supplying all welding materials. All welding materials shall conform to the requirements of Welded Steel Construction (Metal Arc Welding).

AD21.11.2 All welding shall conform to the latest CSA Standard W59, electric arc method.

CONSTRUCTION METHODS

AD21.12 Location and Alignment of Piles

AD21.12.1 The piles shall be located at the positions shown on the Drawings or as directed by the Contract Administrator. Piles shall be driven vertically unless shown otherwise on the Drawings, and shall not deviate more than 2 per cent out-of-plumb. Battered piles shall be driven to the battered specified on the Drawings, and shall not deviate more than 2 per cent from the batter specified. Piles shall not be more than 75 mm off centre measured at cut-off elevation.

AD21.12.2 Piles shall not be jacked or pulled into their final positions.

AD21.13 Driving of Piles

AD21.13.1 All piles shall be driven completely prior to the placement of cellular concrete or granular backfill for retaining or MSE walls.

AD21.13.2 All pile driving points shall be welded by the Contractor prior to commencement of pile driving operations, incidental to the works of this Specification.

AD21.13.3 The piles shall be driven to the approximate tip elevations as shown on the Drawings except when required by the Contract Administrator, the piles shall be driven to a factored capacity (ULS) of 1500 kN based on pile dynamic analyser (PDA) test. Prior to the pile construction, the acceptability of the pile driving system and the required set criteria shall be determined by the wave equation analysis. The set criteria shall be confirmed during construction by AD22 Pile Dynamic Analyser (PDA) Testing.

AD21.13.4 The method of driving shall be such as not to impair the strength of the pile and shall meet the approval of the Contract Administrator. All piles shall be driven to refusal as end bearing piles, as determined by the Contract Administrator. The Contractor will be required to remove any surface and/or shallow depth obstruction(s) to obtain the required penetration of the pile.

AD21.13.5 Piles covering a large area or in groups, shall be driven working out from the centre of the area or group to ensure that the piles at the boundaries are in their correct final positions.

AD21.13.6 For pile installation monitoring purposes, the Contractor shall paint markings on each pile at 0.25 meter intervals, with a label at each 1.0 meter interval, starting from the toe of the pile.

AD21.13.7 Pile driver leads shall be used to support the piles while they are being driven and shall be braced to the supporting crane so as to hold the piles securely and accurately in the required position during driving. Leads shall be of sufficient length to be supported firmly on the ground. The use of hanging or swinging leads will not be allowed unless they can be held in a fixed position during the driving operations. Battered piles shall be driven with incline leads.

AD21.13.8 The heads of the steel piles shall be squared and protected by a cap of a design approved by the Contract Administrator. The cap shall be designed to hold the axis of the pile in line with the axis of the hammer. The top of the cap shall have a timber shock block.

AD21.13.9 If, during the piling operations, upheaval of pile occurs, the Contractor will be required to redrive the lifted piles down to their original elevations. The Contractor will also be required to excavate material that has boiled up during pile driving operations. The elevation of all piles previously driven or redriven shall be observed to detect uplift. If uplift of 5 mm or more occurs in any pile, that pile shall be redriven to its original elevation and thereafter to the required final driving resistance.

AD21.13.10 Driving of all piles shall be continuous without intermission until the pile has been driven to final elevation.

AD21.13.11 Where boulders or other obstructions make it difficult to drive certain piles in the location shown and to the proper bearing strata or depth, the Contractor shall install the piles as directed by the Contract Administrator. Abandoned pile will be paid in accordance with this specification.

AD21.13.12 Preboring to a depth of no more than 1.5m will be permitted to facilitate driving operations. Preboring in excess of 1.5m will not be permitted unless it is approved in writing by the Contract Administrator.

AD21.13.13 If, in the judgement of the Contract Administrator, the Contractor is unable to complete properly any pile or piles driven to replace the original pile in the Contract, they shall be abandoned. Piles abandoned, because of obstructions encountered before reaching the accepted bearing strata, shall be cut off at the cut-off elevation and paid for as outlined hereinafter.

AD21.13.14 The Contractor shall ensure the safety of all personnel during pile driving operations.

AD21.14 Splicing of Piles and Installing Pile Tips

AD21.14.1 Full-length piles shall be used where practicable. In exceptional circumstances, splicing of piles may be permitted. The method of splicing shall be as shown on the Drawings, welding procedures, shop drawings and the following:

(a) The butting ends of the driven pile and its extension or the pile and the pile tip shall be cut square to give reasonable bearing between the matting surfaces;

(b) All butting surfaces shall be 100 per cent butt welded;

(c) The butting surface of the extension piece shall be bevel cut at 45º to facilitate a full-penetration butt weld. Temporary clamping plates may be used as required;

(d) Before welding over previously-deposited metal, the slag shall be cleaned off. This requirement shall apply to successive layers, to successive beads, and to the cratered area when welding is resumed after any interruption;

(e) All butt welds shall have the root of the initial weld gouged, chipped, or otherwise removed to sound metal before welding is started from the second side;

(f) The piles shall not have more than one splice per pile unless otherwise approved by the Contract Administrator;

(g) Splices should be located at least 8.0 m below the underside of the abutment seat and shall be a moment splice as detailed on the Drawings;

(h) Splices shall be located such that no more than 50 per cent of the piles are spliced at the same elevation;

(i) Material to be welded shall be preheated in accordance with CSA W59;

(j) The pile material shall be preheated to a minimum of 100ºC for a distance of 80 mm beyond the weld and shall be sheltered from the wind if the air temperature is below freezing; and,

(k) When the air temperature is below -18ºC, welding will not be permitted unless suitable hoarding is in place.

AD21.14.2 Defective Piles

AD21.14.3 The pile driving procedures shall not subject the piles to excessive and undue abuse producing deformation of the steel. Manipulation of piles to force them into proper position will not be permitted.

AD21.14.4 Piles damaged by improper driving, or driven out of proper location, or driven below the cut-off elevation, shall be corrected by one of the following methods accepted by the Contract Administrator:

(a) The piles shall be withdrawn and replaced by new, if necessary, longer piles; or

(b) Replacement piles shall be driven adjacent to defective or low piles; or

(c) The piles shall be spliced or built up, as otherwise provided herein, or a sufficient portion of the footing extended to properly embed the piles. All piles, pushed up by the driving of adjacent piles or by any other cause, shall be driven down again.

AD21.14.5 In the case of required penetration and bearing capacity are not obtained, the Contractor shall provide a hammer of greater energy, as applicable, or when accepted by the Contract Administrator, resort to pre-drilling.

AD21.15 Cut-Off of Piles

AD21.15.1 After piles have been driven to the required penetration (and, if required, redriven), the Contractor shall mark the required cut-off elevation on each pile as specified on the Drawings or as directed by the Contract Administrator. The top of all piles shall be neatly cut off (true and level) at the cut-off elevation.

AD21.15.2 Unless determined otherwise by the Contract Administrator, cut offs shall become the property of the Contractor and shall be removed from the Site.

AD21.16 Steel Pile Extensions

AD21.16.1 Steel bearing pile extensions shall be avoided, but when necessary and as directed by the Contract Administrator, they shall be made in accordance with AD21.14.

QUALITY CONTROL

AD21.17 Inspection

AD21.17.1 All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator, including all operations, from the selection and production of materials, through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given.

AD21.17.2 The Contractor shall provide a detailed survey of all of the pile locations for a pile cap (foundation) and provide that to the Contract Administrator prior to cutting off any piles for that pile cap.

AD21.17.3 The Contractor shall replace any piles, or add additional pile(s), for piles that do not meet the specified refusal criteria or do not meet the following tolerances: +/-2% out of alignment for battered piles, +/-2% out of plumb for vertical piles, and 75 mm off centre of the specified locations. Any modifications required to the pile cap, due to piles out of tolerance or due to required additional piles to compensate for out of tolerance piles, shall be carried out as specified by the Contract Administrator at the Contractor's own costs.

AD21.18 Access

AD21.18.1 The Contractor Administrator shall be afforded full-access for the inspection and control testing of the precast piles at the Site of Work to determine whether the steel piles are being supplied in accordance with this Specification.

AD21.19 Pile Driving Records

AD21.19.1 The Contract Administrator will keep a record of each and every pile driven. The records shall give the date, time, size, length, location, type, total depth of penetration, rate of penetration, number of blows per 300 mm, penetration for the last five blows, steam, air or diesel pressure, and any kind and size of hammer used in driving. Any unusual phenomena shall be noted and recorded, especially if they indicate possible damage to the pile.

AD21.19.2 Energy output of driving equipment at the time of final set shall be carefully recorded, along with the final penetration readings, and reported immediately to the Contract Administrator. The required set per blow will be subject to approval by the Contract Administrator, showing regard to the specific driving equipment and piles permitted.

AD22. PILE DYNAMIC ANALYSER (PDA) TESTING

DESCRIPTION

AD22.1 The dynamic testing shall be performed by the Contractor to monitor and confirm hammer and driving system performance, assess pile installation stresses and integrity, as well as to evaluate pile capacity. The Contractor shall secure the services on an independent Dynamic Testing Consultant with demonstrated experience in similar projects. Dynamic testing shall be performed on at least two (2) piles at each substructure unit.

AD22.2 The steel piles selected for PDA testing will become part of the permanent piling for the substructure units.

AD22.3 Dynamic testing involves attaching two strain transducers and two accelerometers to the pile approximately three (3) pile diameters below the pile head during initial driving and at a convenient location near the pile head during re-strike testing. A cable connects the gages with the Pile Driving Analyzer located at ground level and at a safe place near the pile to collect the dynamic measurements.

REFERENCES

AD22.4 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) ASTM D-4945-00, “Standard Test Method for High Strain Dynamic Testing of Piles”; and,

(b) Specification AD21 Supply and Driving Steel Piles.

SUBMITTALS

AD22.5 At least fourteen (14) days prior to driving the test piles, the Contractor shall submit Specifications for the pile driving equipment to the Contract Administrator.

EQUIPMENT AND PERSONNEL

AD22.6 The dynamic testing work will be carried out using the Contractor’s pile driving equipment and the Pile Driving Analyzer (PDA) equipment provided by the Dynamic Testing Consultant.

AD22.7 The PDA testing equipment shall conform to the requirement of ASTM D-4945-00, “Standard Test Method for High Strain Dynamic Testing of Piles”. An Engineer with documented experience shall operate the Pile Driving Analyzer in the field. A Geotechnical Engineer registered in Manitoba with at least five years related experience shall carry out the analysis of the PDA data and seal the engineering reports.

AD22.8 The Contractor shall provide the pile driving equipment, operators, labor and power supply to the test pile locations for the duration of the dynamic testing. The Contractor shall provide a step ladder or other safe lifting means to enable attachment of cables to the pile head. The pile driving equipment shall be the same as that to be used for the pile driving work. The power supply shall consist of a regular power source (line power or portable generator) providing 1,800 watts of 115 volt AC power with a frequency of 60 Hz. Direct current welders or non-constant power sources are unacceptable.

EXECUTION

AD22.9 Construction Access

AD22.9.1 Prior to lifting the pile to be dynamically tested, the Contractor shall provide a minimum of one (1) m of clear access around the pile head for pile preparation. The Dynamic Testing Consultant shall then drill and prepare holes for gage attachment.

AD22.9.2 The Dynamic Testing Consultant shall attach the gages to the pile after the pile has been driven to the depth identified by the Contract Administrator. Driving shall then continue using routine pile installation procedures. When the level of the gages is within 0.3 m of the ground surface, water surface, or a pile template, driving shall be halted to remove the gages from the pile. If additional driving is required, the pile shall be spliced and the gages shall be reattached to the head of the extension pile segment prior to the resumption of driving.

AD22.9.3 The Contractor must take good care to ensure that no damage is done to the dynamic monitoring transducers, cables, or equipment.

TESTING PROCEDURES

AD22.10 Preconstruction Wave Equation Analyses

AD22.10.1 After the Contractor had submitted Specifications for the pile driving equipment to the Contract Administrator. The Dynamic Testing Consultant shall use the submitted information to perform wave equation analysis and shall prepare a summary report of the wave equation results. The wave equation analyses shall be used to assess the ability of the proposed driving system to safely install the pile to the required capacity and/or desired penetration depth within the allowable driving stresses.

AD22.10.2 Approval of the proposed driving system by the Contract Administrator shall be based upon the wave equation analyses indicating that the proposed driving system can drive the pile to achieve the required static pile capacity of at least 2.0 times the pile design capacity at a driving resistance not greater than 20 blows per 25 mm penetration, within allowable driving stress limits for the pile material.

(a) Maximum allowable driving stresses (tension and compression) for Steel Piles:= 0.90 f_y.

AD22.10.3 A new pile driving system, modifications to existing system, or new pile installation procedures shall be proposed by the Contractor if the results of the wave equation analysis indicate that the required capacity is not achieved, excessive blows are required (i.e. greater than 20 blows per 25 mm) or driving stresses exceed the maximum allowable limits.

AD22.11 Dynamic Testing Program

AD22.11.1 Approximately two days before the pile evaluation work is to be undertaken, the Contractor and Contract Administrator shall meet on-site to select the piles that will be evaluated. The selected piles shall be driven to attain static capacity of at least 2.0 times the pile design capacity. Adjustments to the preliminary driving criteria may be made by the Contract Administrator based upon the dynamic testing results. All or part of the tested piles as determined by the Contract Administrator shall be re-struck with dynamic testing after a minimum waiting period of seven (7) days, to evaluate the setup effect on pile capacity. The recommended setup waiting period will be determined from this testing program.

AD22.11.2 The re-strike driving sequence shall be performed with a warmed up hammer and shall consist of striking the piles for about 10 blows to 20 blows or until the pile penetrates an additional 50 mm, whichever occurs first.

AD22.11.3 The Contract Administrator may request additional piles to be dynamically tested if the hammer and/or driving system is replaced or modified, the pile type or installation procedures are modified, the pile capacity requirements are changed, unusual blow counts or penetrations are observed or any other piling behaviour that differs from normal installation.

AD22.12 Dynamic Testing Reports

AD22.12.1 Within one (1) day pile testing, the Dynamic Testing Consultant shall prepare a hand written daily field report summarizing the dynamic testing results. As a minimum, the daily reports shall include the calculated driving stresses, transferred energy, and estimated pile capacity at the time of testing. Variations from previous trends in the dynamic test data shall also be noted. Daily field reports shall be faxed or emailed to the Contract Administrator.

AD22.12.2 The Dynamic Testing Consultant shall prepare and submit a written report not later than seven (7) days after the test completion. This report shall include the results of dynamic test(s) and shall contain a discussion of the pile capacity obtained from the dynamic testing. The report shall also discuss hammer and driving system performance, driving stress levels, and pile integrity. CAPWAP analyses shall be performed on dynamic testing data obtained from the end of initial driving and the beginning of re-strike of all tested piles or as instructed by the Contract Administrator. CAPWAP analyses shall be performed by a Geotechnical Engineer registered in Manitoba with at least five (5) years related experience.

AD22.12.3 The Contract Administrator may request additional analyses at selected pile penetration depths.

STRUCTURAL – SUPERSTRUCTURE

AD23. SUPPLY AND INSTALLATION OF BEARINGS

DESCRIPTION

AD23.1 This Specification shall cover the supply and installation of the expansion and fixed bearings.

AD23.2 The Work to be done under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

REFERENCES

AD23.3 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) AD24. Supply and Delivery of Structural Steel.

SUBMITTALS

AD23.4 The Contractor shall submit the following to the Contract Administrator, in accordance with the Specification:

AD23.4.1 Bearings

(a) The Contractor shall submit to the Contract Administrator detailed Shop Drawings for the bearings that are stamped, signed and dated by a Professional Engineer registered or licensed to practice in the Province of Manitoba in accordance with AD1. Shop Drawings;

(b) The Contractor shall submit to the Contract Administrator documentation of all Quality Control testing undertaken for bearings as specified herein;

(c) Fabrication and Supply:

(i) Bearings shall be fabricated from new materials. Bearings shall be designed and fabricated in accordance with the latest editions of AASHTO LRFD Bridge Design Manual, AASHTO LRFD Bridge Construction Specifications and AASHTO M251 “Standard Specification for Plain and Laminated Elastomeric Bridge Bearings”;

(ii) Internal steel reinforcing plates for laminated bearings shall be rolled mild steel with a minimum yield strength of 260 MPa. All other steel shall be in accordance with the latest edition of CAN/CSA G40.21, Grade 300W. Stainless steel plates shall conform to the latest edition of ASTM Standard A167, Type 304;

(iii) PTFE surface shall be unfilled flat sheets made from pure virgin PTFE resin satisfying the requirements of the latest edition of ASTM D4894. PTFE shall be resistant to all acids, alkalis and petroleum products, stable at temperatures from -220°C to +260°C, non-flammable and non-absorbing of water;

(iv) Elastomer shall be neoprene or natural rubber, AASHTO low temperature Grade 4 or 5 with a Shore A Hardness of 60 and a shear modulus (G) between 0.90 and 1.38 MPa;

(v) Recess the PTFE into the steel backing plate to a depth of one half the PTFE thickness. The shoulders of the recess shall be sharp end square. Prepare the steel surface by grit blasting and bond over the entire area using an adhesive approved by the PTFE manufacturer;

(vi) All exposed surfaces of the steel plates shall be zinc metalized. Surfaces to be metalized shall be blast cleaned in accordance with SSPC-SP5, “White Metal Blast Cleaning”;

(vii) The overall dimensions of the bearings shall be within a tolerance of +/- 3mm in plan and height. PTFE fabrication tolerances shall be in accordance with the latest edition of the AASHTO LRFD Bridge Construction Specifications. Other fabrication tolerances for the elastomeric pads shall be in accordance with the latest version of AASHTO M251;

(viii) Bearings shall be clearly marked with their position on site and direction of installation. Markings shall be clearly visible on all bearings to prevent mix-up on site. Information marked on the bearings must correspond with the information contained on the approved Shop Drawings for the bearings. Bearings shall be supplied with suitable handling devices as required. Temporary clamping devices shall be used to maintain the correct orientation of the parts during handling, transport, storage, and installation but are not to be used for slinging or suspending bearings unless specifically designed for this purpose. Bearings shall be protected during handling, transport, storage, and installation from damage, distortion, and all deleterious material and contaminants including moisture and dust; and,

(ix) The bearing Supplier shall verify the condition of the bearings supplied to the work site.

MATERIALS

AD23.5 Bearings

AD23.5.1 The bridge bearings shall be supplied and installed by the Contractor as shown on the Drawings.

AD23.6 Bearing Miscellaneous

AD23.6.1 Top plate, masonry plate and all required fittings shall be supplied and installed by the Contractor as shown on the Drawings.

AD23.6.2 Plate, stainless steel plate, and anchor studs at roof slab shall be supplied and installed by the Contractor as shown on the Drawings.

AD23.7 Grout

AD23.7.1 Grout pads and anchor bolt voids shall be SIKA 212 Flowable grout or approved equal by the Contract Administrator. Grout shall have a minimum 28 day compressive strength of 35 MPa.

AD23.8 High Strength Bolts, Nuts and Washers

AD23.8.1 The requirements of the Specification for Supply and Delivery of Structural Steel, Clause AD24.7 shall apply.

AD23.9 Welding Consumables

AD23.9.1 The requirements of the Specification for Supply and Delivery of Structural Steel, Clause AD24.9 shall apply.

CONSTRUCTION METHODS

AD23.10 General

AD23.10.1 Any structural steel components that in the opinion of the Engineer have been damaged or otherwise rendered useless by the improper handling by the Contractor shall be replaced by the Contractor at his own expense.

AD23.10.2 If the structural steel components are stored on site, the requirements of the Specification Supply and Delivery of Structural Steel, Clause AD24.13.8 shall apply.

AD23.11 Bearing Areas

AD23.11.1 Grout Pads

(a) When shown on the Drawings or described in the Specification, the Contractor shall construct grout pads using SIKA 212 flowable grout or equivalent, accepted by the Contract Administrator. Construction of grout pads shall be done by workers competent in this Work;

(b) Grouts 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;

(c) The method of forming and pouring the grout shall be submitted to the Contract Administrator for review and approval prior to the work being undertaken. Dry-pack methods of constructing grout pads will not be accepted;

(d) 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, or when there is a probability of it falling below 5°C within twenty-four (24) hours of grouting, the following provisions for cold weather grouting shall be implemented:

(i) 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;

(ii) Temperature of the grout during placing shall be between 10°C and 25°C; and,

(iii) The grout pads (and girders where appropriate) shall be enclosed and kept at 15°C to 25°C for at least five days. The system of heating shall be designed to prevent excessive drying-out of the grout.

AD23.11.2 Anchor Bolts

(a) The Contractor shall remove all anchor bolt void forming materials prior to grouting. Any residues on the concrete surface, such as oils, grease, or other contaminants that can reduce bonding characteristics, shall be removed by sandblasting; and,

(b) Anchor bolts shall be set accurately and grouted with non-shrink cement grout accepted by the Contract Administrator. All methods and materials for setting anchor bolts and building bearing pads shall be submitted to the Contract Administrator for 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.

AD23.11.3 Bearings

(a) Before erection of the bearings, the Contractor shall satisfy himself that the location of substructure units and elevations of bridge seats are in accordance with the Drawings and Specifications. All discrepancies discovered by the Contractor shall be brought immediately to the attention of the Contract Administrator;

(b) The Contractor shall accurately assemble and install the bearings as specified on the Drawings and as directed by the Contract Administrator;

(c) Bearing centrelines shall be within +/-3mm of their correct positions after installation. Threaded fixings shall be tightened uniformly to avoid overstressing any part of the bearing. Bearings and their surrounding areas shall be left clean after installation;

(d) The stainless steel surface of the bearings, the Teflon coated bearing pads and the machined surfaces of steel bearings that have been cast into the girders shall be protected from damage at all times. The plywood and polyethylene covers shall not be removed until immediately prior to the positioning of the bearings over the bearing seats;

(e) 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 the grout pockets are not detailed, the bearing plates shall be set on the property finished bearing areas in exact position and shall have a full and even bearing on the concrete;

(f) Where the design requires that the girders bear on neoprene pads placed directly on pier or abutment seat concrete, the Contractor shall supply and install shims cut from lead sheeting as determined by the Contract Administrator to ensure full and uniform bearing; and,

(g) Any bearings that in the opinion of the Contract Administrator have been damaged or otherwise rendered unusable by improper storage or handling by the Contractor shall be replaced by the Contractor at his expense.

AD23.11.4 Equipment

AD23.11.5 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

GUARANTEE

AD23.12 Fabrication Guarantee

AD23.12.1 Upon installation of the bearings the bearing Supplier shall inspect the bearings and certify in writing that the bearings have been properly installed. The Contractor shall provide a written guarantee that the bearings will perform satisfactorily within the design range of movement under the design loads for a period of five (5) years from the date of bearing installation. The supplier shall state that they have reviewed the installation procedures and find it in accordance with their recommendations. The supplier shall guarantee the replacement of the bearings at no cost to the City of Winnipeg in the event that the bearings do not perform satisfactorily within the design range of movement and under the design loads.

AD23.13 Installation Guarantee

AD23.13.1 The Contractor shall ensure that the bearings are installed in such a manner that will not void the fabrication guarantee.

AD23.13.2 The Contractor shall guarantee in writing, the performance of the bearings for a period of five (5) years from the date of issuance of the Total Performance. Provided in the guarantee for the replacement of the bearings at no cost to the City of Winnipeg in the event that the bearings do not perform satisfactorily in the range of design movement and under the design loads.

AD24. SUPPLY AND DELIVERY OF STRUCTURAL STEEL

DESCRIPTION

AD24.1 This Specification shall cover the supply, fabrication, transportation, and handling of the structural steel girders, stiffeners, diaphragms, splice plates, jacking plates, bearing sole plates, bearing anchor bolts, nuts and washers, and all incidental structural steel elements, components and fasteners, including hot-dip galvanizing, as specified herein.

AD24.2 The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, handling and storage, and all things necessary for and incidental to the satisfactory performance and completion of all Work as herein specified and as indicated on the Drawings.

REFERENCES

AD24.3 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) CAN/CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels;

(b) CAN/CSA S16 – Design of Steel Structures;

(c) CAN/CSA W47.1 – Certification of Companies for Fusion Welding of Steel Structures;

(d) CAN/CSA W48 – Filler Metals and Allied Material for Metal Arc Welding;

(e) CAN/CSA W59 – Welded Steel Construction (Metal Arc Welding);

(f) CAN/CSA W178.1 – Certification of Welding Inspection Organizations;

(g) CAN/CSA W178.2 – Certification of Welding Inspectors;

(h) Canadian Institute of Steel Construction (CISC) – Handbook of Steel Construction;

(i) CGSB 48.9712 – Non-destructive Testing – Qualifications and Certification of Personnel;

(j) ANSI B46.1 – Surface Texture (Surface Roughness, Waviness and Lay);

(k) ASTM A123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products;

(l) ASTM A325 – Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength;

(m) ASTM A325M – Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric);

(n) ASTM A490 – Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength;

(o) ASTM A490M – High Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric);

(p) ASTM A563/A563M – Carbon and Alloy Steel Nuts;

(q) ASTM A588/A588M – High-Strength Low-Alloy Structural Steel, up to 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance;

(r) ASTM F436/F436M – Hardened Steel Washers;

(s) AWS A5.XX – XX: All Applicable Filler Metal Specifications;

(t) AWS D1.1/D1.1M – Structural Welding Code – Steel;

(u) AWS D1.5/D1.5M – Bridge Welding Code; and,

(v) ISO/IEC 17025:1999 – General Requirements for the Competence of the Testing and Calibration Laboratories.

SUBMITTALS

AD24.4 The Contractor shall submit the following to the Contract Administrator for approval prior to commencing fabrication in accordance with the Specification:

AD24.4.1 Design calculations and shop drawings for all structural steel components as specified in AD1. Shop Drawings and shall bear the seal of a Professional Engineer registered in the province of Manitoba.

AD24.4.2 Further to AD1. Shop Drawings, shop drawings submitted for review shall include the following:

(a) Full detail dimensions and sizes of all component parts of the structure. Components shall be detailed to compensate for changes in shape due to weld shrinkage, camber, and any other effects that cause finished dimensions to differ from initial dimensions;

(b) Erection marks to uniquely identify all fabricated components;

(c) All necessary specifications for the materials to be used;

(d) Identification of areas requiring special surface treatment;

(e) Identification of fracture-critical and primary tension members and components parts. Attachments having a length of more than 100 mm in the direction of tension and welded to the tension zone of a fracture-critical or primary tension member shall be treated as part of that member;

(f) Bolt installation requirements, including number of fitting up bolts and drift pins required at each connection and oversized and slotted holes;

(g) Details of all welds;

(h) Identification of materials and welds requiring non-destructive testing, including the limits of the weld to be tested and the frequency and type of testing;

(i) Temporary welds; and,

(j) Location of shop welded and field welded and bolted splices.

AD24.4.3 An Erection Diagram that is stamped, signed and dated by a Professional Engineer registered or licensed to practice in the Province of Manitoba and includes at least the following:

(a) Principal dimensions of the bridge;

(b) Erection marks;

(c) Sizes of all members;

(d) Field welding requirements, including identification of welds requiring non-destructive testing;

(e) Size and type of bolts;

(f) Bolt installation requirements, including the number of fitting up bolts and drift pins required at each connection and identification of oversize and slotted holes;

(g) Bracing and all other temporary works required for erection of structural steel; and,

(h) Treatment at faying surfaces for joints designed as slip critical.

AD24.4.4 Proposed welding procedures conforming to AWS D1.5 or CAN/CSA W59 and CAN/CSA W47.1 to be used in fabricating the various components. The following shall be included in the submitted welding procedures:

(a) The welding process, position of weld, filler metal, flux, shielding gas if required, joint configurations, number and size of passes, preheat and inter-pass temperatures if required, sequence of passes, current, rate of pass, electrode size, electrical stick-out and polarity;

(b) Methods proposed for edge preparation;

(c) Measures proposed to control distortion, shrinkage and residual stresses;

(d) Proposed methods and sequence of assembly; and,

(e) Welding equipment to be used.

AD24.4.5 Mill test certificates showing chemical analysis and physical tests of all structural steel shall be submitted to the Contract Administrator for review prior to commencement of fabrication. In addition to the submission of the mill test certificates, the following shall be submitted:

(a) One copy of the mill test certification for all material to be used in the fabrication shall be available for review at the fabricating plant during fabrication;

(b) If material cannot be identified by mill test certificates, coupons shall be taken and tested and these test certificates shall be made available; and,

(c) Where mill test certificates originate from a mill outside Canada or the United States of America, the Contractor shall have the information on the mill test certificate verified by independent testing 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 appropriate working stating that the material is in conformance with the specified requirements. The stamp shall include the appropriate material specification number, testing date, and the signature of an authorized officer of the Canadian laboratory.

AD24.4.6 Proof shall be submitted to the Contract Administrator demonstrating that the bolts, nuts, and washers meet the chemical composition, mechanical properties, dimensions, workmanship, and head burst as required by ASTM A325/A325M, A563/A563M or F436/F436M. Verification of the acceptability of assemblage of zinc coated bolts shall be provided with the bolts, nuts, and washers delivered to the job site shall also be submitted to the Contract Administrator.

AD24.4.7 For bolts supplied from a manufacturer outside Canada or the United States of America, the above information shall be independently verified by testing by a Canadian laboratory as outlined in AD24.4.5.

AD24.4.8 Loading and transportation procedures for structural steel girders, including the proposed route and all traffic control procedures shall be stamped, signed and dated by a Professional Engineer registered or licensed to practice in the Province of Manitoba.

AD24.4.9 Repair procedures, if required, for repair of fabricating defects or other damage to structural steel components, prepared by a Professional Engineer registered or licensed to practice in the Province of Manitoba.

MATERIALS

AD24.5 General

AD24.5.1 The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

AD24.6 Structural Steel

AD24.6.1 Structural steel shall be new and of the grade and category specified on the Drawings and in this Specification and shall be in accordance with CAN/CSA G40.20/G40.21.

AD24.6.2 ASTM A588M may be substituted for CAN/CAS G40.20/G40.21, Grade 350A steel. When the Charpy impact energy requirements are verified by the submission of test documentation, ASTM A588M may be substituted for CAN/CSA G40.20/G40.21 grade 350AT steel.

AD24.6.3 Substitution of material for size and grade is not permitted unless approved in writing by the Contract Administrator.

AD24.7 High Strength Bolts, Nuts and Washers

AD24.7.1 High strength bolts, nuts, and hardened washers shall be in accordance with ASTM A325/A325M, A563/A563M, and F436/F436M. The nuts, bolts, and washers shall be shipped together as an assembly.

AD24.7.2 High strength bolts, nuts, and washers for use with unpainted corrosion-resistant steel shall be Type 3. Bolts, nuts, and washers used with steel specified on the Drawings or in this Specification to be painted or to be galvanized, shall be Type 1 and shall be galvanized.

AD24.7.3 Galvanized fastener nuts shall be over-tapped by the minimum amount required for assembly and shall be lubricated with a lubricant containing a visible dye.

AD24.8 Shear Connectors

AD24.8.1 Shear connectors shall be of a headed stud type supplied according to CAN/CSA W59, Appendix H.

AD24.8.2 Certified mill test reports, in accordance with AD24.4.5, for the shear connectors shall be provided.

AD24.9 Welding Consumables

AD24.9.1 The selection, supply, and storage of electrodes for SMAW and fluxes for SAW shall be according to CAN/CSA W59 requirements. Only controlled hydrogen designation electrodes and low hydrogen wire consumables shall be used for the SMAW and flux-cored arc welding processes, respectively. Electrodes and fluxes shall be strictly stored and maintained as required by CAN/CSA W59, section 5.2.

AD24.9.2 The weld filler metal in fracture critical and primary tension members shall meet the Charpy V notch impact energy requirements of Table AD24.7.

AD24.9.3 Weld metal used with corrosion resistant steels shall have similar corrosion resistance and colour to the base metal and shall be supplied according to CAN/CSA W59.

AD24.10 Replacement of Damaged Materials

AD24.10.1 All material supplied by the Fabricator that in the opinion of the Contract Administrator has been damaged or otherwise rendered unusable by improper storage or handling by the Contractor shall be replaced by the Contractor at his expense.

EQUIPMENT

AD24.11 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

CONSTRUCTION METHODS

AD24.12 Material Preparation

AD24.12.1 Straightening Material

(a) All steel shall be flat and straight according to the specified mill tolerances before commencement of fabrication. Material with sharp kinks or bends shall only be straightened with the approval of the Contract Administrator. The Contractor shall submit written procedures for approval to the Contract Administrator and shall not commence straightening work until he has received permission from the Contract Administrator;

(b) When straightening is approved, material may be straightened using mechanical means or by the application of controlled heating according to CAN/CSA W59;

(c) Details of the method of straightening shall be according to CAN/CSA W59 and submitted to the Contract Administrator two (2) weeks prior to the Contractor arranging for inspection of the straightened material and non-destructive testing; and,

(d) The Contract Administrator shall be given one (1) week notice to arrange for their inspections.

AD24.12.2 Edge Preparation

(a) Sheared edges of plates with a 16 mm thickness or greater and that carry calculated tension shall have 3 mm of edge material removed by planing, milling or grinding;

(b) Oxygen cutting of structural steel shall be done by machine except hand-guided cutting will be allowed for copes, blocks and similar cuts where machine cutting is impractical. Re-entrant corners shall be ground smooth and shall have a fillet of the largest practical radius, but in no case shall the radius be less than 25 mm;

(c) Plasma arc cutting shall only be done when approved in writing by the Contract Administrator. All nitrogen plasma arc cut edges shall be ground back by 0.5 mm when welding will be carried out on these edges;

(d) The quality of the cut edges and their repair shall be according to CAN/CSA W59. All cut edges that are not to be welded shall have a surface roughness not greater than 1000 as defined by CAN/CSA B95. Edges of all flanges shall be rounded to a 1.5 mm radius by grinding. In addition all edges of all members and plates exposed to view or weather in the finished assembly shall be rounded to a 1.5 mm radius by grinding;

(e) All steel edges that will be painted whether resulting from rolling, cutting or, shearing operations shall be rounded to a 1.5 mm radius by grinding prior to blast cleaning; and,

(f) The Brinell hardness of the edges of flanges plates for fracture critical or primary tension members shall not exceed 220. If the measured hardness exceeds 220, the edges shall be ground to remove the harder layer or annealed by means of a preheating torch.

AD24.12.3 Direction of Rolling

(a) Steel plate for main members shall be cut so that the primary direction of rolling is parallel to the direction of tensile or compressive stress.

AD24.12.4 Bolt Holes

(a) Hole Size:

(i) The nominal diameter of a hole other than oversize or slotted holes shall not be more than 2 mm greater than the nominal bolt size with the exception of the following bolt and hole combinations:

- either a 19 mm (3/4") or an M20 bolt in a 22 mm hole.
- either a 22 mm (7/8") or an M22 bolt in a 24 mm hole.
- either a 25 mm (1") bolt or an M24 bolt in a 27 mm hole.

(ii) Unless otherwise approved by the Contract Administrator, oversize or slotted holes shall only be used when specified on the Drawings or in the Specification. Non-specified oversize or slotted holes will only be considered for use in bracing and diaphragms;

(iii) Oversize holes when permitted shall not be more than 4 mm larger than the nominal bolt size for bolts 22 mm or less in diameter; 6 mm larger than the nominal bolt size for bolts between 23 and 26 mm in diameter; and 8 mm larger than the nominal bolt size for bolts 27 mm and greater in diameter;

(iv) Short slotted holes when permitted shall be 2 mm wider than the nominal bolt diameter and shall have a length not greater than the oversize hole diameters specified above plus 2 mm; and,

(v) Long slotted holes when permitted shall be 2 mm wider than the nominal bolt diameter and shall be no longer than 2.5 times the nominal bolt diameter.

(b) Punched Holes:

(i) Holes shall only be punched to finish size in material 16 mm or less in thickness;

(ii) The diameter of a hole punched to finish size shall not be more than 2 mm larger than the nominal diameter of the bolt unless oversize holes are approved; and,

(iii) The diameter of the die shall not exceed the diameter of the punch by more than 2 mm. Holes shall be clean cut without ragged or torn edges. Sharp edges shall be ground smooth without reducing the cross-section of the member. The slightly conical hole that results from this operation is acceptable.

(c) Drilled Holes:

(i) Holes which are drilled to finished diameter shall be 2 mm larger than the nominal diameter of the bolt unless oversize or slotted holes have been specified. Holes to be drilled shall be accurately located by using suitable numerically-controlled drilling equipment, or by using a steel template carefully positioned and clamped to the steel. The dimensional accuracy of holes and locations prepared in this manner shall be such that like parts are exact duplicates and require no match marking; and,

(ii) The holes for any connection may be drilled to the required finished diameter when the connecting parts are assembled and clamped in position, in which case the parts shall be match-marked before disassembling.

(d) Reamed Holes:

(i) Holes which are to be reamed to the specified finished diameter shall first be sub-drilled or sub-punched to 4 mm less than the finished hole diameter. The holes shall be reamed to 2 mm larger than the nominal diameter of the bolts with connecting parts assembled and securely held in place during reaming. The connecting parts shall be match-marked before disassembling. Reamed holes shall be truly cylindrical and perpendicular to the member. All burrs shall be removed without reducing the cross section of the member.

(e) Tolerances:

(i) Center to Center – 12 m or less: +/- 1.0 mm;

(ii) Center to Center – 12 to 18 m: +/- 1.5 mm;

(iii) Center to Center – 18 to 24 m: +/- 2.5 mm; and,

(iv) Center to Center – over 24 m: +/- 3.0 mm.

(f) Pins and Rollers

(i) Pins and rollers shall be accurately turned to the dimensions and finish shown on the Drawings and shall be straight and free from flaws. Pins and rollers more than 175 mm in diameter shall be forged and annealed. Pins and rollers 175 mm or less in diameter may be either forged and annealed or may be made from cold finished carbon-steel shaft; and,

(ii) Holes for pins shall be bored to the diameter and to the finish specified on the Drawings or in the Specification and at right angles to the axis of the member. The diameter of the pin hole shall not exceed that of the pin by more than 0.5 mm for pins 125 mm or less in diameter or by 0.75 mm for larger pins. Built up members shall be completely assembled prior to boring of pin holes.

AD24.12.5 Bent Plates

(a) General:

(i) Rolled steel plates to be bent shall be cut from the stock plates so that the bend line is at right angles to the direction of rolling except as otherwise approved for orthotropic decks; and,

(ii) Before bending, the edges of the plate within the bend region shall be rounded to a 3 mm radius by grinding in the region of the bend.

(b) Cold Bending:

(i) Cold bending shall be carried out in such a manner that no cracking or tearing of the plate occurs. Minimum bend radii for various plate thicknesses (t), measured to the concave face of the metal shall be:

TABLE AD24.1	
t (mm)	**Radius (mm)**
t ≤ 12	2 t
12 ≤ t ≤ 25	2.5 t
25 ≤ t ≤ 38	3 t
38 ≤ t ≤ 65	3.5 t
65 ≤ t ≤ 100	4 t

(c) Hot Bending:

(i) Forming radii less than that permitted for cold bending shall be done by hot bending at a plate temperature not greater than 600°C. Accelerated cooling of a hot bent component will only be permitted when the temperature of the component is below 300°C. Only compressed air or water shall be used for accelerated cooling.

AD24.12.6 Camber

(a) Girders shall be cambered before heat-curving;

(b) When rolled sections are heat cambered, the proposed method of heat cambering shall be submitted to the Contract Administrator for review one week prior to cambering;

(c) Plate girders shall have the required camber cut into the web with suitable allowance for camber loss due to cutting and welding. All Nelson studs shall be welded to the top flange in the required areas before fit-up and subsequent final welding to the web;

(d) Steel box girders fabricated with webs in an upright position shall have the fabricated camber verified by subtracting ordinates for deflections for girder segments from the relaxed camber diagram ordinates; and,

(e) The ends of cambered girders shall be trimmed to be vertical under full dead load.

AD24.12.7 Faying Surfaces

(a) All faying surfaces of weathering steel shall be cleaned by sand blasting in the shop; and,

(b) Faying surfaces of steelwork to be painted shall receive one coat of inorganic zinc primer. The slip coefficient of the primer shall be submitted to the Contract Administrator for approval.

AD24.12.8 Marking

(a) Each member shall carry a unique erection mark for identification; and,

(b) Permanent marking shall be affixed in an area not exposed to view in the finished structure.

AD24.12.9 Temporary Welds

(a) Temporary welds shall not be used on fracture-critical and primary tension members; and,

(b) Temporary welds shall not be used on flange material in compression unless approved by the Contract Administrator.

AD24.12.10 Stress Relief

(a) Flange Plate Heat Curving - The required plan curvature of welded curved I girder flanges may be accomplished by heat curving provided that the flange plan radius is not less than 45,000 mm and also exceeds both:

$$\frac{37\ bfh}{\Psi\ w\sqrt{Fy}}\ and\ \frac{51700\ bf}{\Psi\ Fy}$$

where

h = clear depth of web between flanges in millimetres

w = thickness of web in millimetres

Fy = the specified minimum yield stress of the web material in megapascals

Ψ = the ratio of the total cross-sectional area to that of both flanges

bf = width of widest flange in millimeters

AD24.13 Welded Fabrication

AD24.13.1 Fabrication Company Certification

(a) The company(ies) undertaking welded fabrication shall be fully approved and certified by the CWB as per CAN/CSA W47.1, Division 1 in fabrication of steel girders, girder components and welded steel trusses;

(b) For all other bridge components, the fabricator shall be fully approved by the CWB as per CAN/CSA W47.1, Division 1 or Division 2; and,

(c) For all field welding/repairs the fabricator shall be fully approved by the CWB as per CAN/CSA W47.1, Division 1 or Division 2.

AD24.13.2 Assembly

(a) Assembly shall be according to AWS D1.5 or CSA W59 and the following:

(i) Bearing stiffeners shall be vertical under full dead load;

(ii) Intermediate stiffeners shall be either vertical or perpendicular to fabrication worklines;

(iii) Longitudinal web stiffeners shall be cut 25 mm short of the transverse web stiffeners; and,

(iv) Tack welds of 75 mm or greater in length shall be incorporated into the final weld.

AD24.13.3 Welding of Fracture-Critical and Primary Tension Members

(a) Only welding consumables certified by the CWB to applicable CAN/CSA W48 or AWS A5 requirements shall be used which includes Charpy V-notch toughness meeting the requirements of Table AD24.7;

(b) In groove welds connecting two different grades of steel, the classification of consumables used, including CVN impact requirements shall be that applicable to the grade having the lower ultimate tensile strength;

(c) For groove welds in fracture critical and primary tension members using certified consumables where the CVN test temperature required by Table 6 is lower than the test temperature in the CAN/CSA W48 or AWS A5 classifications, or where the standards are not applicable, welding consumables shall be approved by the CWB and qualified using a verification test assembly to establish the impact properties of the weld metal:

(i) Testing Procedures shall follow those of the relevant CAN/CSA W48 or AWS A5 standard except that only CVN tests are required and that welding shall be carried out using the preheat and the maximum heat input to be used in practice;

(ii) CVN results shall meet the requirements of Table AD24.7;

(iii) Qualifications are required for each electrode diameter used and for the consumables supplied by each manufacturer; and,

(iv) The qualification is valid for consumables for all grove weld procedures of the same or lower heat input as that used in the qualification test.

(d) For groove weld procedures in fracture critical and primary tension members of 700Q and 700QT material, consumables shall be qualified by welding procedure tests approved by the Canadian Welding Bureau:

(i) Tests shall be conducted according to CAN/CSA W47.1 using 700Q or 700QT material for the base plate and shall include weld metal and heat affected zone CVN impact tests according to CAN/CSA W47.1 Appendix D;

(ii) Weld metal impact tests shall meet the requirements of Table AD24.5 and HAZ impact tests shall meet the requirements of Tables AD24.5 and AD24.6 for the base plate as appropriate;

(iii) Only consumables supplied by the manufacturer supplying those qualified shall be permitted in fabrication; and,

(iv) The qualification is valid for consumables for all groove weld procedures of the same or lower heat input as that used in the qualification test.

(e) When the welding consumables have not been previously certified by the CWB, consumables shall be qualified by welding procedure tests in accordance with the provision of clause 8.2.2.4 of CAN/CSA W47.1 and shall include CVN impact tests of the weld metal:

(i) For steel other than 700Q or 700QT, CVN tests in the HAZ are not required;

(ii) Weld metal CVN properties shall be established by qualification tests in accordance with CAN/CSA W47.1 (including Appendix D) and shall meet the requirements of Table 6;

(iii) Only consumables supplied by the manufacturer supplying those qualified shall be permitted in fabrication;

(iv) Qualification shall be done for each lot or batch of consumables; and,

(v) The qualification is valid for consumables for all groove weld procedures of the same or lower heat input as that used in the qualification test.

(f) Tack welds shall not be used on fracture critical, primary tension members and flange material in compression, unless approved by the Contract Administrator.

AD24.13.4 Welding Repairs of Fracture-Critical and Primary Tension Members

(a) General:

(i) Welding repairs shall be performed using any appropriate welding procedure approved by the CWB for the fabrication of fracture-critical members and primary tension members. All repair welding shall be subject to non-destructive testing; and,

(ii) All welding repair procedures shall be submitted to the Contract Administrator at least two (2) weeks prior to commencement of the Work.

(b) Non-Critical Repairs

(i) Repairs that may be classified as non-critical are as follows:

- The repair of welds because of rollover, undercut, or insufficient throat; those requiring excavation of defects including porosity, slag, and lack of fusion; the repair of arc strikes; and removal of tack welds not incorporated into a final weld.
- Visually detected planar and laminar discontinuities as defined in CAN/CSA W59, Table 5-2 but not deeper than 25 mm, or half of the thickness of the edge of the cut plate, whichever is less; and such discontinuities shall not be within 300 mm of a tension groove weld. There shall also be no visible planar or laminar discontinuity on any prepared face of a tensioned groove joint prior to welding.
- Gouges not more than 5 mm deep on otherwise satisfactory cut or rolled surfaces that may be repaired by machining or grinding without welding.
- Occasional gouges that may be repaired by welding, exceeding 5 mm but not more than 10 mm in depth on edges not to be welded.

(ii) Work on non-critical repair shall not commence until the Contract Administrator has verified that the repair is a non-critical repair and has given written approval to proceed. The repair of gouges not more than 5 mm on otherwise satisfactory cut or rolled surfaces that may be repaired by machining or grinding without welding does not require prior approval.

(c) Critical Repairs

(i) Repair procedures for more severe conditions than those described for non-critical repairs are considered critical and shall be individually approved by the Contract Administrator before repair welding is begun.

(ii) Critical repairs include the following:

- Repair of lamellar tearing, laminations, and cracks except those meeting the requirements of AD24.13.4(b)(i) second bullet of the Non-Critical Repairs clause;
- Repair of surface and internal defects in rolled products except those meeting the requirements of AD24.13.4(b)(i) second bullet of the Non-Critical Repairs clause;
- Dimensional corrections requiring weld removal and rewelding; and,
- Any correction by welding to compensate for a fabrication error such as improper cutting, punching, or incorrect assembly other than tack welded or temporary assemblies.

(d) Repair Procedures:

(i) Repair procedures shall be submitted to the Contract Administrator at least two weeks prior to commencement of repair work and shall include sketches or full size drawings as necessary to adequately describe the deficiency and the proposed method of repair;

(ii) Procedures for critical repairs shall also include the location of the discontinuity;

(iii) Repair procedures except for visually detected planar and laminar discontinuities described in AD24.13.4(b)(i) second bullet in the Non-Critical Repairs clause, shall include the minimum following provisions. The steps shall be listed in the order to be performed:

- Surfaces shall be cleaned and ground as necessary to aid visual and nondestructive tests to identify and quantify the discontinuities.
- The discontinuity shall be drawn as it appears from visual inspection and non-destructive testing.
- Arc-air gouging, shall be part of the approved welding procedure when required.
- Magnetic particle inspection or another inspection method approved by the Contract Administrator shall be used to determine whether the discontinuity was removed as planned.
- All air carbon-arc gouged and oxygen-cut surfaces that form a boundary for a repair weld shall be ground to form a smooth bright surface. Oxygen gouging is not permitted.
- All required run-off tabs and back-up bars shall be shown in detail.
- Preheat and interpass temperature shall be according to Table 1. Preheat and interpass temperatures shall be maintained without interruption until the repair is completed.

TABLE AD24.2	
Thickness, t (mm)	**Grade, CSA G40.21**
	260WT, 300WT, 350WT, 400WT, 480WT, 350AT, 400AT, 480AT
t ≤ 25	65°C
25 < t ≤ 40	120°C
t > 40	175°C
NOTE: For grade 700QT steel, preheat and interpass temperature shall be in accordance with steel manufacturer's recommendations.	

- The repair procedures shall make reference to the applicable welding procedure specification and the related data sheet. If both of these were approved by the CWB prior to fabrication, they need not be prequalified by test for the specific method of repair unless a change in essential variables has been made or unless otherwise required by the Contract Administrator.
- If the geometry of the repair joint or if the excavation is similar to the geometry of a prequalified joint preparation as defined in CAN/CSA W59, and permits good access to all portions of such joints or excavations during the proposed sequence of welding, the welding procedure shall not require prequalification by test unless required by the Contract Administrator.
- Peening shall be noted as part of the approved procedure when required and shall be completely described. Peening equipment shall not contaminate the joint.
- Post-heat shall be employed and shall continue without interruption from the completion of repair welding to the end of the minimum specified post-heat period. Post-heat of the repair area shall be between 200°C and 260°C and shall be for a period of one (1) hour minimum for each 25 mm of weld thickness or for two (2) hours, whichever is less.
- Faces of repairs shall be ground flush with the plate or blended to the same contour and throat dimension as the remaining sound weld. If stress-relief heat treatment is required, it shall be completely described. Final acceptance by nondestructive testing shall be performed after stress relief is complete. Repairs of groove welds in fracture critical members shall be examined by ultrasonic testing (UT) and radiographic testing (RT). Repairs to groove welds in primary tension members shall be examined by UT or RT. Fillet weld repairs shall be examined by magnetic particle testing (MT). MT, RT, and UT shall be according to CSA W59. RT may be performed as soon as the weld has cooled to ambient temperature; however, final acceptance by MT and UT methods shall not be performed until the steel welds have been cooled to ambient temperature for at least the elapsed time indicated in Table AD24.3.

TABLE AD24.3 Weld Minimum Cooling Period		
Plate Thickness	**Magnetic Particle for Fillet Weld**	**Ultrasonic Examination of Groove Welds**
t ≤ 50 mm	24 hours	24 hours
t > 50 mm	24 hours	48 hours

(iv) All repair welding and nondestructive testing shall be performed as described in the approved repair procedure; and,

(v) All repair procedures for repairs requiring approval shall be retained as part of the project records.

(e) Heat Curving Members:

(i) Steel beams, welded girders and all other structural steel members with a specified minimum yield point greater than 350 MPa shall not be heat curved;

(ii) In heat curving, using either the continuous or V-type heating pattern, the temperature of the steel shall not exceed 600°C;

(iii) A detailed procedure for the heat curving operation shall be submitted for review to the Contract Administrator. The procedure shall describe the type of heating to be employed, the extent of the heating patterns, the sequence of operations, and the method of support of the girder, including an assessment of any dead-load stresses present during the operation; and,

(iv) Transverse web stiffeners may be welded in place either before or after the heat-curving operation; however, unless allowance is made for the longitudinal shrinkage, the bracing connection plates and bearing stiffeners shall be located and welded after curving.

AD24.13.5 Bolted Construction

(a) General:

(i) ASTM A325/A325M high strength bolts shall be used for bolted connections. Bolts shall be sufficiently long to exclude threads from the shear plane.

(b) Assembly:

(i) The assembly of joints shall be according to CAN/CSA S16 except that Turn-of-Nut tightening method shall be the only installation method used;

(ii) Prior to assembly, all joint surfaces, including those adjacent to bolt heads, nuts and washers, shall be free of loose scale, burrs, dirt, and foreign material;

(iii) The faying surfaces of connections identified as slip-critical connections shall be prepared as specified below:

- For clean mill scale, the surfaces shall be free of oil, paint, lacquer, or any other coating and then blast cleaned.
- For coated surfaces other than galvanized, the surfaces shall be free of oil, lacquer, or other deleterious coatings.
- Hot dip galvanized surfaces shall be roughened after galvanizing by means of hand wire brushing. Power wire brushing is not permitted.

(iv) This treatment shall apply to all areas within the bolt pattern and for a distance beyond the edge of the bolt hole that is the greater of 25 mm or the bolt diameter.

(c) Bolt Tension:

(i) Pretensioned bolts shall be tightened to at least 70% of the specified minimum tensile strength given in the appropriate ASTM standard.

(d) Reuse of Bolts:

(i) Bolts shall not be reused once they have been fully tightened. Bolts that have not been fully tensioned may be reused up to two times, providing that proper control on the number of reuses can be established. Retightening of bolts loosened due to the tightening of adjacent bolts is not considered to be a reuse.

(e) Hardened Washers:

(i) Hardened washers shall be provided under the head and the nut of each bolt for a total of two (2) washers per bolt;

(ii) Hardened washers are required under the nut and bolt head adjacent to joint surfaces containing oversize or slotted holes; and,

(iii) When used with slotted holes the washers shall be at least 8 mm thick and of sufficient size to overlap the hole by 5 mm all around.

(f) Bevelled Washers:

(i) Bevelled washers shall be used to compensate for lack of parallelism where an outer face of bolted parts deviates by more than 5% from a plane normal to the bolt axis.

(g) Turn-of-Nut Tightening:

(i) After aligning the holes in a joint with a properly sized drift pin, sufficient bolts shall be placed and brought to a snug-tight condition to ensure that the parts of the joint are brought into full contact with each other;

(ii) Following the initial snugging operation, bolts shall be placed in any remaining open holes and brought to snug-tightness. Resnugging may be necessary in large joints;

(iii) When all bolts are snug-tight, each bolt in the joint shall be tightened additionally by the applicable amount of relative rotation given in Table AD24.4, with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench. The bolt and nut shall be matched marked to enable the amount of relative rotation to be determined.

TABLE AD24.4
Nut Rotation From Snug-Tight Condition

Outer Face Alignment of Bolted Parts	Bolt Length L_b	Turn From Snug
Both faces normal to bolt axis or one face normal other face sloped 1:20 max – bevelled washers not used.	$L_b \leq 4\ d_b$	1/3
	$4\ L_b < L_b \leq 8\ d_b$	1/2
	$L_b > 8\ d_b$	2/3
Both faces sloped 1:20 from normal axis – bevelled washers not used.	All Bolt Lengths	3/4

NOTES:
1. Bolt diameter is indicated as d_b.
2. Tolerance on rotation is 30 degrees over/under.
3. Table applies to coarse-thread. Heavy-hex structural bolts of all sizes and lengths used with heavy-hex semi-finished nuts.
4. Bolt length is measured from the underside of the head to the extreme end point.
5. Bevelled washers shall be provided when A490 or A490M bolts are used.

(h) Shop Trial Assembly:

(i) Girders and other main components shall be preassembled in the shop to prepare or verify the field splices;

(ii) Components shall be supported in a manner consistent with the final geometry of the bridge as specified in the Drawings, with allowance for any camber required to offset the effects of dead-load deflection;

(iii) Holes in the webs and flanges of main components shall be reamed or drilled to finished diameter while in assembly. The components shall be drift pinned and firmly drawn together by a sufficient number of bolts before reaming or drilling;

(iv) Drifting done during assembly shall only be sufficient to align the holes and not to distort the steel. If holes are required to be enlarged they shall be reamed;

(v) Where a number of sequential assemblies are required because of the length of the bridge, the second and subsequent assemblies shall include at least one section from the preceding assembly to provide continuity of alignment and distances for bearings; and,

(vi) Trial assemblies shall be made in the shop for all girder field-splices except as noted for holes drilled using numerically controlled machines. Each assembly shall be checked for camber, alignment, accuracy of holes, and fit-up of welded joints and milled surfaces.

(i) Numerically Controlled Drilling:

(i) As an alternative to the above shop trial assembly, when the bolt holes have been prepared by numerically controlled machines, the accuracy of the drilling may be demonstrated by a check assembly consisting of the first components of each type to be made. If the check assembly is satisfactory, further assemblies of like components are not required. If the check assembly is unsatisfactory for any reason, the work shall be redone or repaired in a manner acceptable to the Contract Administrator. Further check assemblies shall be required as specified by the Contract Administrator to demonstrate that the required accuracy of fit up has been achieved.

(j) Match Marking:

(i) Connecting parts that are assembled in the shop for the purpose of reaming or drilling holes shall be match-marked. A drawing shall be prepared for field use detailing how the marked pieces shall be assembled in the field to replicate the shop assembly.

AD24.13.6 Fracture Control

(a) General:

(i) The provisions of this clause shall apply to members designated as fracture critical and primary tension members as identified on the Drawings or in the Specification. The Fracture Control requirements shall apply to both bolted and welded construction.

(b) Identification:

(i) Shop drawings shall identify the extent of fracture critical and primary tension members;

(ii) Attachments having a length of more than 100 mm in the direction of tension and welded to the tension zone of a fracture critical or primary tension member shall be treated as part of that member;

(iii) Records shall be kept for each component of a fracture critical or primary tension member to identify the heat number of the material and its corresponding mill test certificate;

(c) Fracture Toughness Requirements:

(i) The Charpy V-notch requirements given in Tables AD24.5, AD24.6 and AD24.7 are for standard full-size specimens;

(ii) Fracture Critical Members - For fracture critical members, Charpy V-notch tests shall be specified on a per plate frequency and the steel shall meet the impact requirements given in Table AD24.5:

TABLE AD24.5 Fracture Critical Member Charpy V-Notch Impact Requirements				
Grade G40.21	**Minimum Average Energy**	**Test Temperature Tt for Minimum Service Temperature Ts**		
		Ts ≥ -30°C	**-30°C > Ts ≥ -60°C**	**Ts < -60°C**
300WT	34 J	0°C	- 20°C	- 40°C
350WT	40 J	0°C	- 20°C	- 40°C
350AT	40 J	0°C	- 20°C	- 40°C

(iii) Primary Tension Members - For primary tension members, Charpy V-notch tests shall be specified on a per heat frequency and the steel shall meet the impact requirements given in Table AD24.6:

TABLE AD24.6 Primary Tension Member Charpy V-Notch Impact Requirements				
Grade G40.21	**Minimum Average Energy**	**Test Temperature Tt for Minimum Service Temperature Ts**		
		Ts ≥ -30°C	**-30°C > Ts ≥ -60°C**	**Ts < -60°C**
300WT	20 J	0°C	- 20°C	- 30°C
350WT	27 J	0°C	- 20°C	- 30°C
350AT	27 J	0°C	- 20°C	- 30°C

(iv) Service Temperature - The applicable minimum service temperature shall be the minimum daily mean temperature taken from “Canadian Climate Normals” published by Environment Canada;

(v) Permanent Backing Bars - Permanent backing bars shall not be used unless absolutely necessary and approved for use in writing by the Contract Administrator. Steel for permanent backing bars shall meet the requirements of clause 5.5.1.1 of CAN/CSA W59 or equivalent under AWS D1.5 and in addition, shall meet the CVN requirement of Tables AD24.5 and AD24.6 as appropriate;

(vi) Weld Metal Toughness - For fracture critical and primary tension members, the weld metal shall meet the impact requirements of Table AD24.7:

TABLE AD24.7 Weld Metal Charpy V-Notch Impact Requirements			
Grade G40.21	**Minimum Average Energy**	**Test Temperature Tt for Minimum Service Temperature Ts**	
		Ts ≥ -40°C	**Ts < -40°C**
300WT	20 J	- 30°C	- 40°C
350WT and AT	27 J	- 30°C	- 40°C

AD24.13.7 Fabrication Tolerances

(a) Structural Members:

(i) Structural members consisting of a single rolled shape shall meet the straightness tolerances of CAN/CSA G40.20 except that columns shall not deviate from straight by more than 1/1000 of the length between points of lateral support;.

(ii) A variation of 1 mm from the detailed length adjusted for temperature is permissible in the length of members which have both ends finished for contact bearing; and,

(iii) Members without finished ends may have a variation from the detailed length of not more than 2 mm for members 10 m long or less, not more than 4 mm for

members over 20 m in length. The variation for members between 10 and 20 m in length shall be linearly interpolated.

(b) Abutting Joints:

(i) Where compression members are specified to bear against one another, the completed joint shall have at least 75% of the entire contact area in full bearing, defined as an area with no more than 0.5 mm of separation. The separation of the remaining area shall in no case and at no point exceed 1 mm: and,

(ii) At joints where loads are not transferred in bearing, the nominal dimension of the gap between main members shall not exceed 10 mm unless indicated otherwise on the Drawings.

(c) Bearing Plates:

(i) Rolled steel bearing plates 50 mm or less in thickness may be used without planing provided that a satisfactory contact bearing is obtained;

(ii) Rolled steel bearing plates over 50 mm but less than 100 mm in thickness may be straightened by pressing or by planing the entire bearing surface to obtain a satisfactory contact bearing; and,

(iii) Rolled steel bearing plates over 100 mm in thickness shall be planed on all bearing surfaces except for surfaces which are in contact with concrete or grouted to ensure full bearing.

(d) Bearing Surface Finish:

(i) The surface finish of bearing surfaces that are in contact with each other or with concrete, shall meet the following roughness requirements as measured according to ANSI B46.1:

Steel slabs or plates in contact with concrete	50 μm (2000 Micro inches)
Plates in contact as part of bearing assemblies	25 μm (1000 Micro inches)
Milled ends of compression members	12 μm (500 Micro inches)
Milled or ground ends of stiffeners	12 μm (500 Micro inches)
Bridge rollers or rockers	6 μm (250 Micro inches)
Pins and pin holes	3 μm (125 Micro inches)
Sliding bearings: steel and copper alloy or steel and stainless steel	3 μm (125 Micro inches)

(ii) Surfaces of flanges that are in contact with bearing sole plates shall be flat within 0.5 mm over an area equal to the projected area of the bearing stiffeners and web. Outside this area a 2 mm deviation from flat is acceptable. The bearing surface shall be perpendicular to the web and bearing stiffeners.

(e) Fabricated Components:

(i) Tolerances for welded components shall conform to Clause 5.4 of CAN/CSA W59;

(ii) Dimensional tolerances for welded built-up structural members shall conform to those prescribed by Clauses 5.8 and 12.5.3 of CAN/CSA W59;

(iii) Built-up bolted structural members shall satisfy the straightness tolerances for rolled wide flange shapes prescribed by CAN/CSA G40.29;

(iv) Bearing stiffeners fitted to bear shall have a minimum bearing contact area of 75% with a maximum separation not exceeding 1 mm over the remaining area; and,

(v) Fitted intermediate stiffeners shall have a minimum bearing contact area of 25% and a maximum separation of 2 mm over the remaining area.

AD24.13.8 Handling, Storage and Loading:

(a) Structural steel, either plain or fabricated, shall be stored upright above ground in a shored position on platforms, skids or other similar supports and shall be kept free from dirt and other foreign matter;

(b) Structural material, either plain or fabricated, shall be protected from corrosion; and,

(c) Long members shall be so supported as to prevent deflection:

(i) Structural Steel Girders:

- The lifting devices shall be of such a nature as to avoid twisting, racking, or other distortions while handling, storing, moving and erecting the girders. The devices shown on the Drawings are minimum requirements and the Contractor and the Fabricator shall satisfy themselves as to the adequacy of the devices. The girders shall be picked up only by the lifting devices.
- The Fabricator shall be responsible for storage of the girders from the completion of their fabrication until they are required by the Contractor.
- During storage and hauling, the girders shall be maintained in an upright position and shall be supported at the bearing areas only unless otherwise approved in writing by the Contract Administrator. Extreme care shall be exercised during the handling and storage of the structural steel girders to avoid twisting, deflection or other distortion that may result in damage to the girder.

AD24.13.9 Transportation and Delivery:

(a) The structural steel fabricator shall schedule, coordinate and sequence structural steel transportation and delivery in cooperation with the erection of the structural steel by the structural steel erection contractor;

(b) The Contractor shall perform all work necessary to ensure safe loading, transportation, unloading and storage of structural steel. The Work shall consist of loading the structural steel at the Fabricator's plant, transporting the structural steel to the Site, and unloading and storing the structural steel at the Site, including temporary works for access;

(c) Structural steel shall be loaded for shipping in such a manner that it can be transported and unloaded at its destination in the correct orientation for erection without being excessively stressed, deformed, or otherwise damaged;

(d) Structural steel shall be stockpiled to avoid excessive stress deformation or other damage while stored; and,

(e) The transportation plan and schedule shall be provided to the Contract Administrator not less than seven (7) Days before any shipping begins.

(f) Structural Steel Girders:

(i) When transporting bridge girders, the Contractor shall be responsible for ensuring that all of the required permits have been acquired and the conditions of all permits are met;

(ii) The Contractor shall submit his proposed route for transporting the girders including traffic control procedures as part of the proposed loading and transporting procedure. In all traffic control situations, the flagmen must be trained and properly attired in flagman's vest and approved headgear with approved flagman's stop/slow paddle or fluorescent red flag. The proper advance signing must also be in place;

(iii) No loose timber blocking will be permitted for use as temporary works for any aspect of girder handling, storage and transportation. Plate girders shall be transported with their webs in a vertical plane unless otherwise approved by the Contract Administrator; and,

(iv) It is the Contractor's responsibility to ascertain the actual weight of the girders.

QUALITY CONTROL

AD24.14 Non-Destructive Testing Agency

AD24.14.1 The Contractor shall engage an independent testing organization certified by the Canadian Welding Bureau (CWB) to the requirements of CAN/CSA W178.1 for bridge structures by radiographic, ultrasonic, magnetic particle, and liquid penetrant test methods to perform all non-destructive testing of the welds.

AD24.14.2 All visual inspection of welds shall be performed in accordance with CAN/CSA W59 by a welding inspector certified by the CWB to the requirements of CAN/CSA 178.2 (Level II minimum) for bridges and structures.

AD24.14.3 Non-destructive testing shall be done by a non-destructive testing technician certified to the Canadian General Standards Board (CGSB) in the test method specified and being performed by the Inspector.

AD24.14.4 Neither the technician nor the independent testing organization shall be changed without the approval of the Contract Administrator.

AD24.15 Non-Destructive Testing of Welds

AD24.15.1 Radiographic, ultrasonic, or magnetic particle testing shall be completed by the Contractor using procedures and frequency of testing according to CAN/CSA W59 however, notwithstanding the CAN/CSA W59 requirements, the amount and location of welding to be tested shall be at least:

(a) All welds shall be visually inspected;

(b) The frequency of radiographic or ultrasonic inspection of groove welds in flanges and webs of built-up girders shall be:

(i) Flange splices in tension or stress reversal zones: 100% of all welds;

(ii) Flange splices in compression zones: 100% of the weld of 1 in 4 splices;

(iii) Web splices for 1/2 the depth from the tension flange: 100% of the weld length for each weld; and,

(iv) Web splices for 1/2 the depth from the compression flange: 100% of the weld length of 1 in 4 splices.

(c) If defects are found during testing, two additional splices shall be tested for each splice exhibiting defects;

(d) Magnetic particle inspection of web-to-flange fillet welds:

(i) Submerged-arc welds: 25% of length of each weld;

(ii) Semi-automatic welds: 50% of length of each weld; and,

(iii) Manual welds: 100% of length of each weld.

(e) Magnetic particle inspection of fillet welds in connection plates and stiffeners to which diaphragms or cross bracing are attached:

(i) For 1/2 the depth from the tension flange: 100% of weld length of each weld; and,

(ii) Transverse welds on tension flanges: 100% of weld length of each weld.

(f) Arc strikes outside of the completed welds shall be lightly ground and checked for cracks by Magnetic Particle Inspection; and,

(g) Radiographic and ultrasonic testing shall be performed prior to the assembly of the flanges to the webs after splice welds have cooled as per CSA W59.

QUALITY ASSURANCE

AD24.16 Visual inspection and sampling will be done in the fabricating shop and in the field by the Contract Administrator to confirm the material supplied and the fabrication has been done as specified on the Drawings and in this Specification. The Contractor shall supply material specimens for testing when requested by the Contract Administrator.

AD24.17 The Contractor shall provide full facilities for the unencumbered inspection of material, workmanship and all parts of the Work at all stages of the Work by the Contract Administrator in the shop, in storage facilities and in the field. The Contract Administrator shall be allowed free access to the Work.

AD24.18 The Contract Administrator will perform non-destructive testing of the works, destructive testing of samples obtained of materials to be incorporated into the Work and any other additional inspection at their discretion.

AD24.19 Inspection

AD24.19.1 The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.

AD24.20 Access

AD24.20.1 The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times.

AD24.21 Inspection Requirements for Fabrication Outside of the Province of Manitoba.

AD24.21.1 Should all or any part of the structural steel fabrication be undertaken at a facility outside of the Province of Manitoba, expenses incurred by the City and/or the City's representative to carry out audit testing will be deducted as incurred by the City from payments made to the Contractor. Expenses will include, but are not limited to all travel, boarding, lodging and the retention of services from a CWB certified inspection agency of the Department's choice for audit inspections at the fabrication plant of all related works.

AD25. ERECTION OF STRUCTURAL STEEL

DESCRIPTION

AD25.1 The Work shall consist of:

AD25.1.1 Unloading and erecting structural steel components (e.g. structural steel girders, stiffeners, diaphragms, splice plates, jacking plates, bearing sole plates, bearing anchor bolts, nuts and washers, and all incidental structural steel elements.) as shown and described on the Drawings and in this Specification.

AD25.1.2 Design, supply, fabrication, installation, maintenance and removal of temporary falsework (where applicable).

AD25.1.3 Design, supply, delivery, installation, maintenance and removal of erection bracing, temporary wind bracing, lateral stability bracing, longitudinal ties and other temporary works for structural steel girders.

AD25.1.4 The quality control (QC) testing of all materials and the Work.

AD25.2 The Contractor shall not erect the structural steel girders until the substructure concrete has cured a minimum of seven days and achieved 80% of the 28 day specified concrete strength requirements.

REFERENCES

AD25.3 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) Section AD24. Supply and Delivery of Structural Steel.

SUBMITTALS

AD25.4 The Contractor shall submit the following to the Contract Administrator, in accordance with the Specification:

AD25.4.1 Girder Erection Procedure

(a) A schedule and detailed plan clearly illustrating the method and sequence by which the Contractor proposes to unload and erect the structural steel girders. The girder erection procedure shall include detailed design notes and shop drawings in accordance with AD1 Shop Drawings and shall bear the seal of a Professional Engineer registered in the province of Manitoba;

(b) The girder erection procedures shall be sealed, signed and dated by a Professional Engineer, registered or licensed to practice in the Province of Manitoba necessary to describe the following and assume full responsibility that the design is being followed:

(i) Access to work, including earth berms, work bridges, or rock berms. The Professional Engineer shall confirm that the temporary works can fully support all loads during girder erection;

(ii) Type and capacity of proposed equipment;

(iii) Sequence of operation, including position of cranes, trucks with girders, and traffic accommodation;

(iv) Detailed crane position and location, particularly adjacent to substructure elements, such as piers and abutment backwalls, with details of load distribution on wheels and outriggers throughout each lift. If the Contract Administrator, approves the crane positioned on the structure during a portion of the Work, details of crane position on the structure showing wheel loads and axle spacing of equipment moving on structure shall also be submitted;

(v) Loads and their position from crane wheels and outriggers during all positions of lifting when the crane(s) is on or adjacent to the structure;

(vi) Details of temporary falsework, including proposed methods to be used to ensure stability and the required splice elevations and structure shape and details of release (if applicable);

(vii) Method of providing temporary supports for stability;

(viii) Details of lifting of girders, showing vertical forces at lifting points and on the lifting devices;

(ix) Complete details of blocking for bearings where necessary to constrain movement due to horizontal forces and/or gravity effects;

(x) When applicable, complete details of longitudinal ties between the ends of girders at locations where the bridge will be made continuous. These ties shall be capable of resisting tension or compression that will develop due to temperature change, creep, and shrinkage. These shall be kept in place until the diaphragms have been installed and a majority of bridge deck concrete has been cast and reached specified strength;

(xi) Grout Pad Construction, if applicable; and,

(xii) Provide an “As Constructed” detailed survey of the substructure showing the following:

- Location and elevation of all bearing seats.
- Shim height at each bearing location, if applicable.
- Top of girder elevations at each bearing (and each splice location where applicable).
- Safety and compliance with Manitoba Workplace Health and Safety Act and Regulations shall be integral to the girder erection procedure.

AD25.4.2 Temporary Works

(a) Detailed design notes and shop drawings for proposed temporary works, including but not limited to erection bracing, temporary wind bracing and lateral stability bracing for structural steel girders shall be sealed signed and dated by a Professional Engineer, registered or licensed to practice in the Province of Manitoba.

CONSTRUCTION METHODS

AD25.5 General

AD25.5.1 The Contractor shall schedule, coordinate and sequence structural steel erection in cooperation with the delivery of the structural steel by the structural steel fabricator.

AD25.5.2 Any structural steel components that in the opinion of the Contract Administrator have been damaged or otherwise rendered useless by the improper handling by the Contractor shall be replaced by the Contractor at his own expense.

AD25.5.3 If the structural steel components are stored on site, the requirements of the Specification for Supply and Delivery of Structural Steel, Clause AD24.13.8 shall apply.

AD25.6 Erection of Structural Steel Girders

AD25.6.1 General

(a) Before taking possession and erecting the girders, the Contractor shall verify that the lengths of the girders, the layout of the substructure units, the elevations of the bearings seats, and the location of the anchor bolts are in accordance with the Drawings. All discrepancies discovered by the Contractor shall be brought immediately to the attention of the Contract Administrator;

(b) It is essential that the girders be erected with utmost attention being given to girder positioning, alignment, and elevation. The Contractor shall adjust girder position, bearing location, and bearing elevation in order to achieve as closely as possible the lines and grades shown on the Drawings. The Contractor shall minimize any differential camber (girder to girder), and the sweep of the girders by jacking, loading of girders, winching, or whatever means are necessary, and shall provide the necessary temporary attachments to hold the girders in position. The Contract Administrator shall approve of all proposed methods of jacking, loading, winching, etc. prior to the work being undertaken;

(c) Unloading and erection of the structural steel girders shall be under the direction of a Professional Engineer, registered or licensed to practice in the Province of Manitoba. The Professional Engineer shall be experienced in bridge girder erection and be present for all stages of the girder erection;

(d) Loose timber blocking will not be permitted for use as temporary works for any aspect of girder erection; and,

(e) It is the Contractor's responsibility to ascertain the actual weight of the girders.

AD25.6.2 Equipment

(a) All cranes, rigging and equipment shall be in good condition and properly maintained at all times during the period of the work. All cranes, rigging and equipment shall be of sufficient capacity to complete every stage of the erection Works; and,

(b) The Contract Administrator shall, at his/her discretion, verify capacity and state of equipment provided and any equipment found not meeting the requirements for erection work shall be removed and replaced. Slings and other lifting devices that will be in contact with structural steelwork shall be of a type which shall not damage shop primed or painted surfaces.

AD25.6.3 Erection

(a) The Contract Administrator shall be notified in writing of the starting date at least two (2) weeks prior to the commencement of field operations. Work shall not be carried out until the Contract Administrator is on the Site;

(b) Components shall be lifted, placed, and maintained in position using appropriate lifting equipment, temporary bracing, guys, or stiffening devices so that the components are at no time overloaded, unstable, or unsafe. Additional permanent material may be provided, if approved by the Contract Administrator, to ensure that the member capacities are not exceeded during erection. The additional material shall be shown in the erection diagram;

(c) Release of temporary supports or temporary members, etc. must be gradual, and under no circumstances will a sudden release be permissible;

(d) Unless otherwise approved by the Engineer, at least 50% of the holes in the joints shall be filled with drift pins or hand tightened bolts prior to removing the crane. At least 50% the bolts required in the flanges shall be installed. For roadway or railway overpass structures, drift pins shall not be left in place over traffic when the crane is removed;

(e) For temporary fit ups, main girder splices and connections shall be aligned with drift pins and a sufficient number of fitting up bolts shall be installed to maintain the integrity of the connection;

(f) The fitting up bolts may be the high strength bolts used in the installation. Drift pins shall be 1 mm larger in diameter than the required bolts. Excessive drifting that distorts the metal and enlarges the holes is not allowed. Reaming up to 2 mm over the nominal hole diameter is permitted, except for oversize or slotted holes;

(g) Repairs to erected material will only be permitted after the repair procedure has been approved by the Contract Administrator;

(h) Filling of misplaced holes by welding is permitted only with the written approval of the Contract Administrator;

(i) Material intended for use in the finished structure shall not be used for erection or temporary purposes unless such use has been shown on the shop drawings, erection diagram, or authorized by the Contract Administrator;

(j) Hammering that will damage or distort the members is not permitted; and,

(k) Surfaces that will be in permanent contact shall be cleaned immediately prior to assembly.

AD25.6.4 Temporary Stresses

(a) The Contractor shall assume full responsibility for ensuring that all bridge member and component stresses are within permissible limits at all stages of the construction work. The Contractor shall provide all necessary additional steel reinforcement, bracing or other measures required to ensure that the erection procedures do not overstress any temporary or permanent member or component at any stage of the Work.

AD25.6.5 Alignment and Camber

(a) The structural steel girders shall be erected to the proper alignment in plan and in elevation, taking into account the dead load camber shown on the Drawings. Members shall be aligned to the dimensional tolerances specified in CAN/CSA W59-M, but in no case, shall it deviate by more than 50 mm from the theoretical location.

(b) Alignment shall be measured from survey lines joining the ends of any test length of a member.

AD25.6.6 Temporary Bracing

(a) The Contractor shall be responsible for the design, supply, installation and removal of all:

(i) erection bracing;

(ii) temporary wind bracing;

(iii) lateral stability bracing; and,

(iv) longitudinal ties.

(b) As may be required during and immediately following the erection of structural steel girders; and,

(c) The bracing shall be designed and installed so that it will not interfere with the installation of steel diaphragms.

AD25.6.7 Lifting Devices

(a) After the Contract Administrator has approved the erection positions of the girders, all lifting devices shall be removed to the satisfaction of the Contract Administrator.

AD25.7 Connections

AD25.7.1 Holes made in the field shall be drilled or reamed. Shop reamed holes shall not be re-reamed in the field.

AD25.7.2 At the time of erection, all splice plates shall be free of loose mill scale, burrs, and all contamination such as drilling shavings, oil, dirt, and paint.

AD25.7.3 Surfaces to be in permanent contact shall be cleaned immediately prior to assembly.

AD25.7.4 Any error in shop fabrication or any deformation resulting from handling or transportation that prevents the proper assembly and fitting of parts, especially splices of main structural members, shall be reported and the proposed method of correction shall be submitted to the Contract Administrator. Corrective measures shall not commence until the submitted proposal is accepted by the Contract Administrator.

AD25.8 Cantilever Erection

AD25.8.1 When members or components to be erected will be cantilevered, splices that support the cantilevering member or component shall be fully bolted before extending.

AD25.9 Attachments

AD25.9.1 The use of tack welds for securing temporary or permanent attachments that are not shown on submitted shop drawings, erection drawings or fabrication drawings shall not be permitted on any portion of girders or any other structural members.

AD25.10 Field Welding

AD25.10.1 The company undertaking field-welding shall be certified to Division 1 of CAN/CSA W47.1.

AD25.10.2 The requirements of the Specifications for Supply and Delivery of Structural Steel, Clause AD24.12.2 shall apply.

AD25.11 Bolted Construction

AD25.11.1 The requirements of the Specifications for Supply and Delivery of Structural Steel, Clause AD24.12.4 shall apply.

(a) Bolt heads shall be located on the outside faces of exterior girder webs; and,

(b) Bolt heads in field splices for box girders shall be located on the exterior surfaces.

AD25.12 Removal of Falsework and Site Clean-up

AD25.12.1 Upon completion of the erection and before final acceptance, the Contractor shall remove all temporary falsework. He shall remove all piling, excavated or surplus materials, rubbish and temporary supports, replace or renew any damaged fences, and restore in an acceptable manner all property damaged during the execution of the Work. Disposed of surplus materials shall be in a manner and at a location satisfactory to the Contract Administrator.

AD25.12.2 The Contractor shall leave the bridge site, roadway and adjacent property in a neat restored and presentable condition, satisfactory to the Contract Administrator. When requested by the Contract Administrator, the Contractor shall provide written evidence that affected property owners and/or regulatory agencies have been satisfied.

AD25.13 Protection of Concrete Components

AD25.13.1 If the coating system is to be applied in the field, the substructure shall be protected during construction against rust-staining by water runoff until the structural steel has been coated.

AD26. POLYURETHANE SEAL COATING

DESCRIPTION

AD26.1 This Specification shall cover the surface preparation and application of a polyurethane coating on structural steel components in the fabrication shop as specified herein and shown on the Drawings.

AD26.2 The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, handling and storage, and all things necessary for and incidental to the satisfactory performance and completion of all Work as herein specified and as indicated on the Drawings.

REFERENCES

AD26.3 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) SSPC – The Society for Protective Coatings;

(b) ASTM – American Society for Testing and Materials;

(c) Section AD24. Supply and Delivery of Structural Steel;

(d) Section AD27. Hot-Dip Galvanizing; and

(e) Section AD28. Zinc Metallizing of Structural Members.

SUBMITTALS

AD26.4 The Contractor shall submit the following to the Contract Administrator, in accordance with the Specification:

AD26.4.1 Submit fourteen (14) days prior to abrasive blasting, a written certification from a certified laboratory, stating that abrasive media meets the material requirements recommended by the coating Manufacturer;

AD26.4.2 Submit fourteen (14) days before commencing the application of the coating, a written certification from the coating Manufacturer, stating that all material supplied are as specified on the Drawings, described in this Specification and in accordance with the Manufacturer's current product data sheets;

AD26.4.3 Submit the coating Manufacturer's product data sheets describing the following:

(a) Confirmation that the coating product is compatible with hot-dip galvanized or zinc metallized surfaces, as applicable;

(b) Recommended minimum and maximum dry film thicknesses;

(c) Recommended surface profile prior to coating application;

(d) Product storage, handling, mixing, preparation, and application requirements;

(e) Recommended application equipment and pressures;

(f) Acceptable humidity level and temperature range for application; and,

(g) Minimum acceptable recoat time period for temperatures between 5°C to 30°C in intervals of 5°C, including the acceptable range of relative humidity for each temperature interval.

AD26.4.4 Details of surface preparation and coating application to areas difficult to access;

AD26.4.5 A written guarantee from the supplier of the coating within fourteen (14) days of completion of coating operations stating that the product will perform satisfactorily for a minimum period of five (5) years from the Total Performance date, provided that both the surface preparation and application of the coating has been carried out in accordance with the Manufacturer's recommendations. The supplier shall state that they have reviewed this Specification and the surface preparation and application procedures and find them in accordance with their recommendations. The supplier shall guarantee the replacement of the coating, including any surface preparation, touch-ups, and final overcoats, at no cost to the City of Winnipeg in the event that the coating does not perform satisfactorily over the five (5) year guaranteed time period; and

AD26.4.6 The Contractor shall provide to the Contract Administrator a guarantee in writing, stating that the coating will perform satisfactorily for a period of five (5) years from the date of Total Performance. The Contractor shall provide in the guarantee for the reapplication of the coating at no cost to the City of Winnipeg in the event that the coating does not perform satisfactorily. This shall include, but not necessarily be limited to: the supply and installation of the working platform, hoarding, scaffolding; removal, and disposal of the unacceptable coating; surface preparation; coating; and all other items necessary to reapply a coating.

MATERIALS

AD26.5 Abrasive Media

AD26.5.1 The abrasive media shall be as per coating Manufacturer's recommendations.

AD26.6 Polyurethane Coating

AD26.6.1 The polyurethane coating shall be as per coating Manufacturer's recommendations. The Contractor shall provide a written statement clearly identifying that the proposed product is suitable for its intended use and is being applied in an acceptable manner prior to undertaking the work.

AD26.6.2 Only coatings contained in the original containers sealed by the Manufacturer shall be used.

AD26.6.3 The coating colour shall match the color of the finished steel. The Contractor shall supply a dry colour sample for the proposed coating, a minimum of 300 mm x 300 mm in size, to the Contract Administrator fourteen (14) days for verification and approval prior to commencing coating operations.

AD26.7 Incidental Materials

AD26.7.1 Incidental materials needed to complete the surface preparation and coating works shall be strictly in accordance with the Manufacturer's guidelines and recommendations.

CONSTRUCTION METHODS

AD26.8 Surface Preparation and Surface Profile

AD26.8.1 The hot-dip galvanized or metallized structural steel shall be abrasive blast cleaned as required by the coating Manufacturer.

AD26.8.2 Surfaces adjacent to areas to be abrasive blast cleaned shall be protected from damage during surface preparation.

AD26.8.3 Fins, slivers, burred or sharp edges, protrusions, weld splatter and slag shall be removed by power grinding prior to surface preparation. Areas that received grinding shall be touched up hot-dip galvanized or metallized, as applicable, prior to coating application.

AD26.8.4 Surface preparation of areas difficult to access, shall be carried out to the extent practical as detailed in the Contractor's submission for areas difficult to access. The surface preparation standard for these areas shall be based on reasonable effort and found to be acceptable by the Contract Administrator.

AD26.9 Application of Coating

AD26.9.1 General

(a) The coating shall be stored, handled, mixed and applied in accordance with the recommendations on the Manufacturer's product data sheets.

(b) When there is a drop in temperature after the coating is applied, the recoat time period, if applicable, shall be as per the Manufacturer's product data sheets for the lower temperature.

(c) Application of coating onto areas difficult to access shall be carried out to the extent practical as detailed in the Contractor's submission for areas difficult to access. The coating application standard for these areas shall be based on reasonable effort demonstrated in the field and found to be acceptable by the Contract Administrator. Where limited access precludes the successful use of spray equipment, all areas and edges of structural steel and fastener components shall be coated by brush or other application methods appropriate to the particular area as recommended by the coating Manufacturer.

AD26.9.2 New Structural Steel

(a) Coating application must be completed within the timeframe recommended by the coating Manufacturer.

(b) The surface prepared hot-dip galvanized or zinc metallized steel shall be clean and dry prior to coating application.

(c) The coating shall be shop applied.

AD26.9.3 Dry Film Thickness

(a) The coating shall meet the dry film thickness recommended by the coating Manufacturer.

AD26.9.4 Repair of Coating

(a) Damaged or unacceptable areas of coated surface shall be prepared and recoated as per coating Manufacturer's recommended procedures.

QUALITY CONTROL AND QUALITY ASSURANCE

AD26.10 General

AD26.10.1 The Contractor shall be responsible for quality control testing required to ensure the Work meets the requirements shown on the Drawings and described in this Specification, including the required surface preparation.

AD26.10.2 The Contractor may arrange, as required, a visit for the coating Manufacturer to provide technical assistance prior to and during the coating application operations. The Contractor may arrange, as required, a visit for a representative of the coating supplier to visit the shop during coating operations so as to ensure that the surface preparation and coating application is in accordance with the coating Manufacturer's recommendations. The Contract Administrator shall be notified of each such visit.

AD26.10.3 The Contract Administrator shall be immediately advised of any proposed deviation from this Specification based on the requirements of the coating Manufacturer.

AD26.10.4 The Contractor shall record the quality of surface preparation, measurements of surface profile, temperature, humidity, dew point and dry film thickness. Written documentation of the results of quality control inspection shall be submitted to the Contract Administrator.

AD26.10.5 Acceptability of surface preparation will based on the applicable SSPC surface preparation specifications and pictorial standards given in SSPC-VIS 1. Surface profile measurements will be made using a spring micrometer and an extra coarse pressure sensitive replica tape in accordance with ASTM D4417.

AD26.10.6 Testing of ambient and surface temperature, relative humidity and dew point will be done by means of thermometer, surface thermometer or recording hygro-thermograph and digital or sling psychrometer with recognized psychometric tables.

AD26.10.7 Dry film thickness (dft) measurements shall be measured using Type 2 constant pressure probe magnetic gauges. Dft measurements shall be undertaken in accordance with SSPC-PA 2. Determination of the acceptability of the dft of each coat shall be made in accordance with SSPC-PA 2. The specified minimum and maximum dft used to determine acceptability of coating thickness according to SSPC-PA 2 shall be the Manufacturer's recommended minimum and maximum dft as shown on the submitted product data sheets. To facilitate the calibration procedure, the Contractor, at a location selected by the Contract

Administrator, shall mask off a 75 mm x 75 mm area of the prepared steel. After all tests are completed, this area shall be coated as specified for the coating.

AD26.11 Inspection Requirements for Coating Application Outside of the Province of Manitoba

AD26.11.1 Should all or any part of the coating application be undertaken at locations outside of the Province of Manitoba, expenses incurred by the City of Winnipeg and/or the City's representative to carry out testing and inspection will be deducted as incurred by the City of Winnipeg from payments made to the Contractor.

AD26.11.2 Expenses will include, but are not necessarily limited to, all travel, boarding, lodging and the retention of services from a certified agency of the City of Winnipeg's choice for testing and inspection at the coating application location.

AD27. HOT-DIP GALVANIZING

AD27.1 Description

AD27.1.1 This Specification shall cover the surface preparation and hot-dip galvanizing of structural steel members as specified herein.

AD27.1.2 The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

AD27.2 Submittals

AD27.2.1 The Contractor shall submit to the Contract Administrator for review, at least fourteen (14) Days prior to the commencement of any Work on Site a Certificate of Compliance from the Manufacturer stating that the galvanizing operations comply with the provisions of ASTM A767M and these Specifications.

AD27.3 Materials

AD27.3.1 General

(a) The Contractor shall be responsible for the supply, safe storage, and handling of all materials as set forth in this Specification. All materials shall be subject to inspection and approval of the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes.

AD27.3.2 Abrasive for Blast Cleaning

(a) The blast cleaning abrasive shall be free of corrosion-producing contaminants. Sand abrasive shall be oil free. Slag abrasive shall contain no more than 0.1% oil by weight. The blast cleaning abrasive and grit size employed shall be capable of achieving an average profile peak-to-valley height not exceeding 76.2 µm (3.0 mils).

AD27.3.3 Incidental and Miscellaneous Materials

(a) Incidental and miscellaneous materials utilized in undertaking the surface preparation and hot-dip galvanizing works shall be supplied strictly in accordance with the manufacturer's guidelines, as approved in advance by the Contract Administrator, and in accordance with these Specifications.

(b) The use of all such materials shall be reviewed with the Contract Administrator to ensure conformance with the Specification, prior to the use of same in the works. The Contract Administrator's decision in these matters shall be final.

AD27.4 Equipment

AD27.4.1 Surface Preparation Equipment

(a) All equipment shall be of a type approved by the Contract Administrator and capable of preparing the steel surfaces in accordance with these Specifications.

(b) All compressed air services shall have oil and moisture separators, attached and functional, properly designed and sized to allow delivered air at the blasting or coating nozzle to be free of oil and moisture, and of sufficient pressure to accomplish the associated work efficiently and effectively. The tanks on the air compressors and the moisture separators shall be drained at the end of each working shift. Prior to abrasive blast cleaning, the Contractor shall demonstrate to the Contract Administrator that the air is moisture free. Air-driven power tools shall be properly lubricated in accordance with the respective manufacturer's instructions, but in such a manner that lubrication is not deposited onto the surface being prepared.

AD27.4.2 Hot-Dip Galvanizing Equipment

(a) The hot-dip galvanizing equipment shall be designed such that the coating material will be applied uniformly to all surfaces in the locations required, as shown on the drawings and approved by the Contract Administrator, and shall be kept in good working order.

AD27.5 Construction Methods

AD27.5.1 Surface Preparation

(a) General

(i) Prior to actual work commencement, representative trial areas shall be cleaned in accordance with SSPC Specifications SP:10.

(ii) The degree of cleaning and surface profile (where required) achieved, once accepted by the Contract Administrator, will become the standard for all subsequent surface preparations. Furthermore, the Contractor shall prepare and maintain blasted reference panels for the purpose of calibrating magnetic dry film thickness gauges as specified in SSPC Specification PA2.

(b) Surface Cleaning

(i) All oil and grease shall be removed manually with solvent cleaning in accordance with SSPC Specification SP:1, "Solvent Cleaning," before any blast cleaning operations or any hot-dip galvanizing application.

(c) Blast Cleaning Operation

(i) The Contractor shall prepare the structural steel prior to hot-dip galvanizing by blast cleaning, in accordance with current SSPC Specifications SP:10. The prepared surface shall have a 50.8 to 76.2 µm (2 to 3 mils) profile.

(ii) No rust scale shall remain within the designated areas.

(iii) Use dry abrasive blasting only in accordance with all applicable regulations.

(iv) Wet blasting will not be permitted.

(v) Any areas shielded or hidden from the effects of sandblasting shall be cleaned manually or by other means to the satisfaction of the Contract Administrator, and must meet SSPC SP:11.

(vi) The blasting shall be performed so as not to damage or contaminate any previously coated areas.

(vii) Freshly prepared steel shall be hot-dip galvanized within a reasonable time after cleaning, but no later than one week later. If the freshly prepared steel begins to rust prior to application of the hot-dip galvanizing, the steel must be reblasted to meet the specified SSPC Specification.

(viii) Where the hot-dip galvanized surface has been damaged or rejected, remove loose or nonadherent coating by hand cleaning or other approved techniques. Cleaning shall be performed approximately 20 mm beyond the damaged areas in all directions or until a soundly adhered hot-dip galvanized coating is obtained.

(d) Blast Clean-up Operations

(i) Following all blast cleaning operations and prior to the Contract Administrator's inspection, all surfaces involved shall be blown off with compressed air or cleaned by vacuum for the purpose of removing any and all traces of blast products from the surface, and for the removal of abrasive from all pockets and corners.

(ii) Following surface preparation clean-up operations, the Contractor shall notify the Contract Administrator so that an inspection can be made prior to any galvanizing operations.

(iii) No hot-dip galvanizing shall be applied to any prepared surface until the Contract Administrator has been able to inspect the element(s).

AD27.5.2 Application of Hot-Dip Galvanizing

(a) The hot-dip galvanizing plant shall be a Regular Member of the American Galvanizers Association, Inc.

(b) The hot-dip galvanizing shall be shop applied and strictly in accordance with ASTM A123 to a minimum net retention of 610 g/m^2.

(c) Preclean structural steel using acceptable methods to produce an acceptable surface for quality hot-dip galvanizing. If sulfuric acid or hydrochloric acid is used as a pickling bath for recleaning, care shall be exercised to minimize the immersion time. If signs of hydrogen embrittlement are present after pickling due to excessive immersion time, all steel in that shipment will be rejected and shall be replaced at no additional cost to the Contract.

(d) Handle all articles to be hot-dip galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

(e) The surface finish shall be continuous, adherent, as smooth and evenly distributed as possible, and free from any defect detrimental to the stated end use of the coated article.

(f) Coating adhesion shall withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

(g) Furthermore, no underlying cracking and other visible damage or deterioration of the hot-dip galvanizing as a result of handling or bending operations, or any other cause, shall be galvanize-coated with field applied galvanizing touch-up material as specified hereinafter.

AD27.6 Field Applied Touch-up Galvanizing

(a) Any areas of damaged hot-dip galvanizing shall receive field applied touch-up galvanizing.

(b) All field applied galvanized coatings shall be applied in accordance with ASTM A780M.

(c) Further to ASTM A780M, paints used for field applied galvanizing shall contain zinc dust above 92% in the dried film.

(d) At least seven (7) days prior to any field applied galvanizing, the Contract shall submit the galvanizing product and application details to the Contract Administrator for review.

(e) Surfaces to receive touch-up galvanizing shall be cleaned using a wire brush, a light grinding action, or mild blasting to remove loose scale, rust, paint, grease, dirt, or other contaminants.

(f) For self-fluxing, low temperature, zinc based alloy rods, preheat the surface to 315°C and wire brush the surface during preheating. Rub the cleaned preheated area with the repair stick to deposit an evenly distributed layer of zinc alloy. Spread the alloy with a wire brush, spatula, or similar tool. Field applied galvanizing shall be blended into existing galvanizing of surrounding surfaces. Care shall be taken to not overheat surfaces beyond 400°C and to not apply direct flame to the alloy rods.

(g) Spray applied field galvanizing will not be permitted. Where restrictions occur that brush applied field galvanizing is not possible, spray applied field galvanizing may be permitted if accepted in writing by the Contract Administrator prior to application.

(h) For pure zinc paint, the approved product shall be applied by either a brush or roller and shall be applied in three (3) coats, with each coat having a dry film thickness of 60 µm (2.36 mils). Each coat shall be left to dry for a minimum of one (1) hour before the application of the next coat.

(i) The maximum area to be repaired in the field on a single repair shall be 5,000 mm^2. Any damaged article with a damaged area greater shall be rejected, removed, and replaced at the Contractor's expense.

(j) All repairs and field touch-ups shall be carried out at the Contractor's expense.

AD27.7 Quality Control

AD27.7.1 General

(a) The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes, from time to time as required. There shall be no charge to the City for samples taken.

(b) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator, including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given.

AD28. ZINC METALLIZING OF STRUCTURAL MEMBERS

AD28.1 Description

AD28.1.1 This Specification shall cover the surface preparation and zinc metallizing of structural steel members as specified herein.

AD28.1.2 The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

AD28.2 Materials

AD28.2.1 General

(a) The Contractor shall be responsible for the supply, safe storage, and handling of all materials as set forth in this Specification. All materials shall be subject to inspection and approval of the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes.

AD28.2.2 Zinc Metallizing

(a) The zinc metallizing shall consist of 99.9% zinc wire 3 mm in diameter, as approved by the Contract Administrator.

(b) All zinc metallizing material shall be delivered in the original unopened spools with manufacturer's labels intact. Any material that has been damaged, livered, jelled, or otherwise deteriorated shall not be used. The Contractor shall provide, if and when requested by the Contract Administrator, a listing, updated weekly, of the weight and number of spools and the type of zinc metallizing material (as identified by a mill test report and corresponding heat number for each spool) received from the zinc metallizing manufacturer on this project.

(c) All material shall be stored under cover in a secured place as approved by the Contract Administrator, and shall be kept within storage temperature limitations recommended by the manufacturer.

AD28.2.3 Abrasive for Blast Cleaning

(a) The blast cleaning abrasive shall be free of corrosion-producing contaminants. Sand abrasive shall be oil free. Slag abrasive shall contain no more than 0.1% oil by weight. The blast cleaning abrasive and grit size employed shall be capable of achieving an average profile peak-to-valley height not exceeding 76.2 µm (3.0 mils).

AD28.2.4 Incidental and Miscellaneous Materials

(a) Incidental and miscellaneous materials utilized in undertaking the surface preparation and zinc metallizing works shall be supplied strictly in accordance with the manufacturer's guidelines, as approved in advance by the Contract Administrator, and in accordance with these Specifications.

(b) The use of all such materials shall be reviewed with the Contract Administrator to ensure conformance with the Specification, prior to the use of same in the works. The Contract Administrator's decision in these matters shall be final.

AD28.3 Equipment

AD28.3.1 Surface Preparation Equipment

(a) All equipment shall be of a type approved by the Contract Administrator and capable of preparing the steel surfaces in accordance with these Specifications.

(b) All compressed air services shall have oil and moisture separators, attached and functional, properly designed and sized to allow delivered air at the blasting or coating nozzle to be free of oil and moisture, and of sufficient pressure to accomplish the associated work efficiently and effectively. The tanks on the air compressors and the moisture separators shall be drained at the end of each working shift. Prior to abrasive blast cleaning, the Contractor shall demonstrate to the Contract Administrator that the air is moisture free. Air-driven power tools shall be properly lubricated in accordance with the respective manufacturer's instructions, but in such a manner that lubrication is not deposited onto the surface being prepared.

AD28.3.2 Zinc Metallizing Equipment

(a) The zinc metallizing coating equipment shall be designed such that the coating material will be applied uniformly to all surfaces in the locations required, as shown on the drawings and approved by the Contract Administrator, and shall be kept in good working order.

AD28.4 Construction Methods

AD28.4.1 Scope of Work

(a) The works include surface preparation and application of zinc metallizing of the structural steel truss as shown on the drawings and described in this Specification.

AD28.4.2 Surface Preparation

(a) General

(i) Prior to actual work commencement, representative trial areas shall be cleaned in accordance with SSPC Specifications SP:10.

(ii) The degree of cleaning and surface profile (where required) achieved, once accepted by the Contract Administrator, will become the standard for all subsequent surface preparations. Furthermore, the Contractor shall prepare and maintain blasted reference panels for the purpose of calibrating magnetic dry film thickness gauges as specified in SSPC Specification PA2.

(b) Surface Cleaning

(i) All oil and grease shall be removed manually with solvent cleaning in accordance with SSPC Specification SP:1, "Solvent Cleaning," before any blast cleaning operations or any zinc metallizing application.

(c) Blast Cleaning Operation

(i) The Contractor shall prepare the structural steel immediately prior to zinc metallizing by blast cleaning, in accordance with current SSPC Specifications SP:10. The prepared surface shall have a 50.8 to 76.2 µm (2 to 3 mils) profile.

(ii) No rust scale shall remain within the designated areas.

(iii) Use dry abrasive blasting only in accordance with all applicable regulations.

(iv) Wet blasting will not be permitted.

(v) Any areas shielded or hidden from the effects of sandblasting shall be cleaned manually or by other means to the satisfaction of the Contract Administrator, and must meet SSPC SP:11.

(vi) The blasting shall be performed so as not to damage or contaminate any previously coated areas.

(vii) Freshly prepared steel shall be zinc metallized as quickly as practical thereafter. However, if the freshly prepared steel begins to rust prior to application of the zinc metallizing, the steel must be reblasted to meet the specified SSPC Specification.

(viii) Where the zinc metallized surface has been damaged or rejected, remove loose or nonadherent coating by hand cleaning or other approved techniques. Cleaning shall be performed approximately 20 mm beyond the damaged areas in all directions or until a soundly adhered zinc metallizing coating is obtained.

(ix) The Contractor shall prepare only as much surface as can be zinc metallized the same day. If unusual circumstances occur which prevent all prepared surfaces from being zinc metallized the same day, a light sandblast will be required over all nonzinc metallized surfaces to achieve specified surface preparation.

(d) Blast Clean-up Operations

(i) Following all blast cleaning operations and prior to the Contract Administrator's inspection, all surfaces involved shall be blown off with compressed air or cleaned by vacuum for the purpose of removing any and all traces of blast products from the surface, and for the removal of abrasive from all pockets and corners.

(ii) Following surface preparation clean-up operations, the Contractor shall immediately notify the Contract Administrator so that an inspection can be made prior to the application of any zinc metallizing material.

(iii) The zinc metallizing material shall be applied as soon as possible after the surface preparation cleanup operation as approved by the Contract Administrator.

(e) Surface Testing and Inspection

(i) The Contractor shall provide the Contract Administrator with a minimum of four hours' notice prior to zinc metallizing to allow for testing and inspection of prepared surfaces.

(ii) Immediately following blast cleaning and clean-up operations, the Contractor shall notify the Contract Administrator in order that a chemical analysis of the blasted steel and that a surface profile inspection will be carried out. No zinc metallizing shall be applied to any prepared surface until written acceptance of complete surface preparation of any area has been given by the Contract Administrator.

AD28.4.3 Application of Zinc Metallizing

(a) The zinc metallizing coating is to be applied to all structural steel to a minimum thickness of 304.8 µm (12 mils) for all components of the steel truss. The full coating thickness shall be achieved in two (2) or more applications.

(b) Absolutely no zinc metallizing shall be applied until the prepared surface has been inspected by the Contract Administrator and approved. Failure to follow this requirement will necessitate the complete removal, by blast cleaning, of all coating placed over surfaces not inspected and approved.

(c) No deviation from this requirement will be tolerated.

(d) Zinc metallizing shall be applied as soon as possible after the surface preparation cleanup operation, as approved by the Contract Administrator, and the system manufacturer's representative.

(e) Zinc metallizing shall be applied in accordance with the manufacturer's instructions. The zinc metallizing manufacturer's representative shall be available at the site to provide guidance and solve problems as required. The manufacturer's representative is to certify in writing that prepared surfaces meet their requirements and are suitable for application of their product before zinc metallizing is to proceed. The specified zinc metallizing system shall be applied as soon as possible after the surface preparation clean-up operation and the manufacturer's representative has approved the surface.

(f) No zinc metallizing shall be applied when the air and/or steel temperatures are at or below 4°C or when the metal has absorbed sufficient heat (above 50°C) to cause the zinc metallizing to blister and produce a porous film or when it is possible the air temperature may drop below 0°C before the zinc metallizing is dry.

(g) Zinc metallizing shall not be applied to damp or frosty surfaces, nor when there is a risk of dew on the surfaces to be coated. Using a sling powdered wet and dry bulb psychrometer at the site, zinc metallizing shall not commence unless the dry bulb temperature exceeds the wet bulb temperature by more than 3°C (5°F) and the ambient temperature is rising.

(h) Zinc metallizing that becomes oxidized, thickened, ropy, lumpy, or dirty shall be discarded.

(i) The zinc metallizing thickness specified herein shall be the thickness over the peaks of the blast profile. To ensure this thickness is being measured, dry film thickness measurements and gauge calibration methods shall be as described in SSPC Specification PA2.

(j) Electrical arc equipment is the zinc metallizing coating equipment preference for this work. The steel shall not be heated to a temperature exceeding 350°C. The zinc metallizing shall be applied at a minimum thickness of 304.8 µm (12 mils). The zinc metallizing thickness specified herein shall be the thickness over the peaks of the blast profile. To ensure this thickness is measured, thickness measurements and gauge calibration methods shall be as described in SSPC Specification PA2. Additional layers of zinc metallizing material shall be applied until the minimum specified thickness is attained. After zinc metallizing is completed and approved by the Contract Administrator, a clear seal coat shall be applied to the surface as specified hereinafter.

AD28.5 Repair and Field Touch-up

AD28.5.1 General

(a) Repair and field touch-up areas, including truss splices shall be cleaned of all damaged zinc metallizing and the system reapplied using all zinc metallizing material similar to the original materials. Each coat shall be dry before applying subsequent coats.

(b) All repairs and field touch-ups shall be carried out at the Contractor's expense.

AD28.6 Quality Control

AD28.6.1 General

(a) The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes, from time to time as required. There shall be no charge to the City for samples taken.

(b) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator, including all operations from the selection and production of materials through to final

acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given.

AD29. PRECAST CONCRETE GIRDERS

AD29.1 Description

AD29.1.1 This Specification shall cover the supply of all material, labour, plant, and equipment required to complete the work as hereinafter specified and as shown on the Drawings including but not necessarily confined to the following:

(a) Supply of all materials and the fabrication of prestressed precast concrete girders as shown on the drawings, including delivery and erection;

(b) Design and implementation of temporary bracing for lateral stressing;

(c) The supply of all cables, anchorages and other incidental materials for lateral stressing (when applicable); and,

(d) Storage of fabricated girders until delivered to the Site for erection.

AD29.2 References and Related Specifications

AD29.2.1 References

(a) CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction;

(b) CAN/CSA-A23.2, Methods of Test and Standard Practices for Concrete;

(c) CAN/CSA-A23.4/CSA-A251, Materials and Construction/Qualification Code for Architectural and Structural Precast Concrete Products;

(d) CAN/CSA-A3001, Cementitious Materials for Use in Concrete;

(e) CAN/CSA – G30.14, Deformed Steel Wire for Concrete Reinforcement ;

(f) CAN/CSA – G30.18, Billet-Steel Bars for Concrete Reinforcement;

(g) CAN/CSA – G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel;

(h) CAN/CSA G 164, Hot Dip Galvanizing of Irregularly Shaped Articles;

(i) CAN/CSA G 279, Steel for Pre-stressed Concrete Tendons;

(j) CAN/CSA W47.1, Certification of Companies for Fusion Welding of Steel;

(k) ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished;

(l) ASTM A496 Standard Specification for Steel Wire, Deformed for Concrete Reinforcement;

(m) ASTM C 260, Standard Specification for Air-Entraining Admixtures for Concrete;

(n) ASTM C 494, Standard Specification for Chemical Admixtures for Concrete; and,

(o) ASTM C 1017, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

AD29.2.2 Related Specifications

(a) Specification AD9 Structural Concrete; and,

(b) Specification AD11 Supplying and Placing Reinforcing Steel.

AD29.3 Submittals

(a) The Contractor shall submit the following to the Contract Administrator:

(i) Certificate of Compliance with the CPCI Precast Concrete Certification Program for Structural, Architectural And Specialty Precast Concrete Products and Systems, Group B, Bridge Products. Proof of this certification shall be provided to the Contract Administrator;

(ii) Concrete mix design that meets the minimum compressive strengths (f'c and f'ci) as shown on the Drawings shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba. Any changes to the concrete mix design shall be reviewed by the Contract Administrator prior to the Contractor implementing the change;

(iii) Stressing calculations shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba and include the following:

- Copies of the stressing sequence and strand elongation calculations as well as all data required for checking these calculations. Separate elongation calculations will be required for each significant variation in the Modulus of Elasticity of the strand.
- A calibration graph for each jack, calibrated not more than 6 months prior to stressing operation.
- The proposed method of tensioning the draped strands, including a comprehensive description and drawing of the proposed hold-up and hold-down devices.
- The proposed sequence of stressing and destressing operations.
- The anchorage losses experienced by the Contractor under similar loading applications, and the proposed method of measuring the anchorage losses during the stressing operation.
- A copy of the proposed "Record of Concrete Strength" and "Record of Pre-Tensioning" forms to be used by the Contractor.

(iv) Copies of the stress-strain curve for the prestressing steel and the lateral stressing cables;

(v) Copies of all reports, including but not limited to: "Record of Concrete Strength" form, "Record of Pre-Tensioning" form and material quality control test results;

(vi) Letter of Validation from the Canadian Welding Bureau (CWB) and CWB approved welding procedures for the Contractor's miscellaneous metal supplier. The Contractor's miscellaneous metal supplier shall fulfill the requirements of CSA W47.1, Division 2.1 (minimum);

(vii) Loading, handling, and transportation procedures, including the proposed route and all traffic control procedures shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba; and,

(viii) Bending procedures for strands extended at girder ends.

AD29.4 Materials

(a) Manufacturer's specifications for the concrete for the precast concrete girder shall be strictly followed and shall supersede this Specification should any discrepancies exist.

AD29.4.1 Concrete

(a) Concrete shall have minimum compressive strengths (f'c and f'ci) as shown on the Drawings and meet the requirements of CSA-A23.1, Exposure Class C-1, Air Content Category 1 for hardened concrete.

AD29.4.2 Coarse Aggregate

(a) The maximum nominal size of coarse aggregate shall be 20 mm and meet the grading requirements of CSA A23.1, Table 11, Group I. Coarse aggregate shall be uniformly graded and not more than 1% shall pass a 75 um sieve. Coarse aggregate shall consist of crushed stone or gravel or a combination thereof, having hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter or other injurious substances; and,

(b) Tests of the coarse aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1, Table 12, for concrete exposed to freezing and thawing.

AD29.4.3 Fine Aggregate

(a) Fine aggregate shall meet the grading requirements of CSA A23.1, Table 10, FA1, be graded uniformly and not more than 3% shall pass a 75 um sieve. Fine aggregate shall consist of sand, stone, screenings, other inert materials with similar characteristics or a combination thereof, having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances; and,

(b) Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1, Table 12.

AD29.4.4 Admixtures

(a) Air-entraining admixtures shall conform to the requirements of ASTM C 260. The City of Winnipeg Specification; and,

(b) Chemical admixtures shall conform to the requirements of ASTM C 494 or C 1017 for flowing concrete.

AD29.4.5 Cementitious Materials

(a) Cementitious materials shall conform to the requirements of CSA-A3001;

(b) Should the Contractor choose to include a silica fume admixture in the concrete mix design, the substitution of silica fume shall not exceed 8% by mass of cement; and,

(c) Should the Contractor choose to include fly ash in the concrete mix design, the fly ash shall be Class CI and the substitution shall not exceed 15% by mass of cement.

AD29.4.6 Grout

(a) Grout shall conform to ASTM C1107 Grade C, have a compressive strength of 45 MPa @ 28 days and shall be non-shrink, non-metallic. Admixtures to be used in grout must be approved by the Contract Administrator. Grout specified within this Specification section shall be used for the grouting the post-tensioning ducts, anchor rods, precast girder shear keys and miscellaneous recesses. Grout shall be prepared and cured in accordance with the manufacturer's recommendations; and,

(b) Shear key preparation shall include light sand blasting prior to grout installation as deemed acceptable to the Contract Administrator.

AD29.4.7 Prestressing Steel

(a) Prestressing steel shall be Grade 1860 MPa and shall conform to the requirements of CSA Standard G279 and this Specification;

(b) Tagging Size of strand, coil number, heat number and the mark of the Manufacturer shall be recorded on a tag attached securely to each reel. The tag shall also identify the strand with its own stress-strain curve;

(c) Stress-Strain Curves One stress-strain curve shall be provided by the Manufacturer for each reel;

(d) Testing Should the Contract Administrator consider it necessary, approval of the prestressing strand, in addition to the requirements of CSA G 279, shall be based on tests carried out by the Contractor in a testing laboratory satisfactory to the Contract Administrator. The Contractor shall test a minimum of three representative specimens of the strands to be used in the girders. The results of these tests shall be supplied to the Contract Administrator. The Contract Administrator may also require the Contractor to supply additional representative specimens for independent testing. Where the strand has rusted in storage, the use of such material will be subject to the approval of the Contract Administrator. The Contract Administrator, at his discretion, may require physical tests at the Contractor's expense in order to determine whether the material is suitable to be used in the girder; and,

(e) All strands that:

(i) are contaminated by substances having a deleterious effect on the steel or concrete or on the bond strength of concrete to strand; or,

(ii) sustain physical damage,

shall be replaced either by the Contractor or cleaned to the satisfaction of the Contract Administrator.

AD29.4.8 Reinforcing Steel

(a) Uncoated black and stainless reinforcing steel shall be Grade 400 MPa and shall conform to the requirements of CSA Standard G30.18 and Specification AD11 Supplying and Placing Reinforcing Steel.

AD29.4.9 Materials for Lateral Stressing

(a) The Contractor shall supply all cables and anchorages with end fittings for grouting, as required for lateral stressing;

(b) Anchorages for post-tensioned work shall be capable of accommodating the number of strands specified and of sustaining, without appreciable slip, the loads that will be applied. Anchorages will be subject to the approval of the Contract Administrator; and,

(c) Ducts for enclosing the cables shall be rigid ferrous metal sheathing cast into the girders. The duct material shall be such that it is possible to obtain mortar-tight ducts following smooth curves in the correct locations in the concrete girders. The type of ferrous metal selected for the ducts shall minimize the friction between the cables and the duct walls. Duct sizes shall be as shown on the Drawings and are subject to the approval of the Contract Administrator.

AD29.4.10 Structural Inserts

(a) Structural inserts shall be Dayton Superior Type F-57 expanded coil ferrule insert, galvanized. Insert to come as a unit with 25mm diameter, 50mm long, A307 bolts, with lock washers, galvanized. Inserts shall be galvanized in accordance with ASTM A123 to a net retention of 610 g/m^2.

AD29.4.11 Anchor Rods

(a) Anchor rods shall be ASTM F1554 Grade 55 (380 MPa), galvanized in accordance with ASTM F2329.

AD29.4.12 Form Retarder

(a) Form retarder for achieving exposed aggregate finish in areas to be in contact with grout after girder erection shall be MBT Tuf-Cote or approved equal as accepted by the Contract Administrator.

AD29.4.13 Other Materials

(a) Miscellaneous metal, anchor inserts and lifting devices and all other incidental materials shall be supplied as shown on the Drawings and shall be subject to the approval of the Contract Administrator.

AD29.5 Manufacture

AD29.5.1 General

(a) All precast concrete components shall be plant manufactured by a manufacturer currently engaged in the special process of precast and prestressed concrete work. This manufacturer shall be a registered member of the Canadian Prestressed Concrete Institute;

(b) All plant casting operations for the production of prestressed and precast concrete shall be under the direct supervision of a Registered Professional Engineer in the Province of Manitoba;

(c) The casting operations of the manufacturer shall be continuously open to inspection by representatives of the Contract Administrator. Complete and up-to-date copies of all shop drawings together with a complete set of the Contract Drawings and Specifications shall be kept available for their use;

(d) During production of the precast members, weight checks shall be carried out on completed units when requested by the Contract Administrator; and,

(e) Mark each member with identifying number and date of casting.

AD29.5.2 Shop drawings

(a) Shop drawings shall be sealed by a Professional Engineer Registered in the Province of Manitoba shall be submitted to the Contract Administrator a minimum of fourteen (14) days prior to the girder fabrication.

AD29.5.3 Tolerances

(a) The distance centreline to centreline of bearings shall not vary by more than 6.5 mm from the lengths shown on the plans, when measured 12 hours after the completion of the stress transfer;

(b) Cross-sectional dimensions including the locations of the prestressing steel shall not vary from those shown on the plans by more than 3.5 mm; and,

(c) The bottom surface of members at the bearing areas shall be in a true level plan, which does not very by more than 1.5 mm from a true straight edge placed in any direction across the area or plate.

AD29.5.4 Formwork

(a) The faces of the forms shall be smooth to impart a good finish to the concrete and particular care shall be taken to ensure the verticality and rigidity of the side forms of surfaces which will be in contact with each other after erection. The faces of the forms shall be treated with a release agent to ensure that stripping may be carried out without damage to the concrete. Care shall be taken to maintain all embedded material free of the release agent;

(b) Forms shall be constructed as to allow for the redistribution of loading and the movement of the member, which will take place upon application of the prestressing force;

(c) Outside Forms:

(i) The faces of the forms shall be smooth so as to impart a good finish to the concrete. Forms shall result in precast prestressed girders that conform to the shape, lines and dimensions as shown on the Drawings and within the tolerances described in Section AD29.5.3 of this Specification. Forms shall be properly braced or tied together to maintain position and shape;

(ii) Forms shall be designed for the rate and method of concrete placement and constructed to allow for the redistribution of loading and the movement of the form that will take place upon application of the prestressing force;

(iii) The faces of the forms shall be treated with a release agent to ensure that stripping may be carried out without damage to the concrete. Care shall be taken to prevent the release agent from coming in contact with any reinforcement, pre-stressing stand or embedded materials;

(iv) Forms shall include temporary openings to facilitate the removal of all foreign substances prior to placing the concrete; and,

(v) Recesses at the ends of the girders to facilitate positioning of prestressing strands will not be allowed.

(d) Void Forms:

(i) Void forms shall be positioned accurately and be strong enough to withstand all pressures and uplift forces without excessive distortion. The void forms shall be well secured and remain in place during the operations of placing and vibrating concrete so that their correct positions with respect to the horizontal and vertical axes of the girder will be maintained within the limits of the dimensional tolerances:

(ii) All void forms shall be vented to alleviate expansion forces from occurring during curing. Each void form shall have 15 mm round vent holes in both the bottom and top slabs: and,

(iii) The void forms and retaining devices shall be tested by the Contractor and accepted by the Contract Administrator prior to the fabrication of the girders to ensure that the shape and position of the void forms are maintained throughout girder fabrication.

(e) The following formed surfaces require an exposed aggregate finish:

(i) exposed surfaces in the shear keys;

(ii) exposed surfaces in the recesses for lifting devices, etc.; and,

(iii) interior portions of the fixed end dowel holes.

AD29.5.5 Stressing

(a) The Contractor shall submit to the Contract Administrator the following at least 7 days prior to the start of stressing operations:

(i) Copies of the stressing sequence and of the strand elongation calculations as well as all data required for checking these calculations. Separate elongation calculations will be required for each significant variation in the modulus of elasticity of the strand;

(ii) A calibration graph for each jack to be used in the stressing operation;

(iii) The proposed method of tensioning the strands;

(iv) The proposed method of distressing and the distressing sequence;

(v) The anchorage losses experienced by the Contractor under similar loading applications, and the proposed method of measuring the anchorage losses during the stressing operation;

(vi) A copy of the proposed “Record of Concrete Strength” form, and the “Record of Pre-Tensioning” to be used by the Contractor; and,

(vii) Camber calculations of girder at release.

(b) The elongation calculations, distressing sequence and all other items having an effect upon the design and performance of the members shall be prepared by a Professional Engineer Registered in Manitoba and the required submissions shall be stamped by the Professional Engineer;

(c) The submission of the stressing calculations to the Contract Administrator shall in no way relieve the Contractor of the Full responsibility for the success or failure of the stressing operations;

(d) The initial force in each strand shall be as shown on the plans or as specified by the Contract Administrator. Prior to the stressing of the strands to the initial force, a 2.2 kN load shall be applied to each strand to eliminate slack and equalize stresses. For the first member stressed, the 2.2 kN load shall be applied to all strands and then rechecked before stressing any of the strands to the initial force;

(e) A pre-calibrated pressure gauge, tensionmeter or load cell shall be used as a check on the elongation, the accuracy of which shall be verified by the Contractor whenever the Contract Administrator considers it necessary;

(f) Before the stressing operation begins, the Contractor shall have filled out on the approved “Record of Pre-tensioning” form the calculated jack gauge reading, the required gross elongation (based on estimated anchorage losses), and the required net elongation of the each strand. During the stressing operation, the Contractor shall record the actual jack gauge reading, the measure gross elongation, the measured anchorage losses, and then calculate the actual net elongation for each strand;

(g) The actual net elongation of a strand shall not vary from the required net elongation by more than 3.5 mm. The actual anchorage losses encountered shall be used to modify the gross elongation required, if the actual net elongations are consistently greater or less than the required net elongation;

(h) At no time shall the actual jack pressure exceed the pressure corresponding the calculated gross elongation by the 5 percent. If the required gross elongation is not obtained by stressing to this maximum allowable jack pressure at one end of the member, it will be necessary to complete the stressing from the other end of the member;

(i) A copy of the "Record of Pre-Tensioning" form shall be submitted to the Contract Administrator upon completion of the pre-tensioning of each member;

(j) Tensioning shall be carried out in a manner such that the jack is coaxial with the tendon or strand. If the strands are tensioned individually, care shall be taken to ensure the unravelling of the strand does not take place;

(k) For pre-tensioned members, the Contract Administrator has allowed for a stress loss due to an increase in temperature of the prestressing strands from the time of tensioning to the time of initial set of the concrete. In order to verify the design value used for this stress loss, the Contractor shall keep an accurate record of the temperature of the concrete in each member from the time of placing of the concrete until the completion of the steam curing of the first three (3) members fabricated and every third member thereafter. The results shall be plotted on the graph with the ambient air temperature of the same member;

(l) Transfer of the pre-tensioning force shall be carried out by a method approved by the Contract Administrator. If the strands are to be cut, the distressing sequence shall be approved by the Contract Administrator; and,

(m) All pre-tensioning strands shall be cut off flush with the end of the member and the exposed ends of the pre-tensioning strands and a 50 mm strip of adjacent concrete shall be cleaned and painted. Cleaning shall be by abrasive blast to remove all dirt and residue that is not firmly bonded to the metal or concrete surfaces. The surfaces shall be immediately coated with 25 mm coat of zinc-rich paint approved the Contract Administrator. The paint shall be thoroughly mixed at the time of application and shall be worked into any voids in the pre-tensioning strands.

AD29.5.6 Reinforcing Steel

(a) Reinforcing steel shall be placed accurately in the positions shown on the plans, and shall be retained in such positions by means of bar accessories and wires so that the bars shall not be moved out of alignment, during or after the deposition of concrete. Bar accessories shall be galvanized or shall be made from non-rusting material;

(b) Reinforcing steel shall be kept free of all foreign materials in order to ensure a positive bond between the concrete and steel. The Contractor shall remove any material, which has been deposited on the steel before concrete is placed; and,

(c) Intersecting bars shall be tied positively at each intersection.

AD29.5.7 Placing of Anchorages

(a) The anchorages shall be centred in the positions shown on the Drawings. The anchorages shall be fastened securely to the forms to prevent displacement during the placing and vibrating of concrete. The joints between the forms and anchorages shall be taped to prevent leakage of concrete mortar. The placement tolerance shall be as per CSA A23.4.

AD29.5.8 Placing of Ducts

(a) The method of supporting the ducts shall be in accordance with CSA A23.4 requirements and shall be reviewed by the Contract Administrator. The Contractor shall ensure that the ducts are held true to the locations shown on the Drawings as specified in CSA A23.4;

(b) The ducts shall be fixed securely in place and supported at the spacing shown on the Drawings in order to prevent horizontal or vertical displacements of the ducts during the placing and vibrating of concrete. In the event that the duct support spacing is not indicated on the Drawings, the maximum spacing shall be 1 metre; and,

(c) All duct couplers and duct connections to anchorages shall be well taped with waterproof tape to prevent the entry of concrete and moisture into the ducts. The ends of the ducts shall be plugged temporarily to prevent entry of debris or other materials prior to the threading of cables.

AD29.5.9 Depositing of Concrete

(a) Concrete shall be deposited carefully and well worked by vibrating so that it shall fill the forms completely and make complete contact with all reinforcing bars, prestressing strands, and anchorages;

(b) The concrete shall be deposited in such frequent locations in the forms that there shall be no necessity for moving large quantities of concrete from place to place in the forms. The concrete shall be placed in layers not exceeding 600 mm in depth and each layer shall be vibrated into place by methods, which will not permit the ingredients to separate. The Contractor shall provide and use different personnel on the depositing equipment and on the vibrating equipment to ensure that each batch of concrete shall be properly worked into place as deposited;

(c) The buckets, chutes or any other equipment used to deposit concrete in the members shall be positioned as close to the top of the forms as possible to keep the free fall of the concrete to a minimum;

(d) The depositing of concrete in each unit shall be a single continuous complete operation so that each unit shall be monolithic without joints; and,

(e) Before any concrete shall be deposited, the interior of the forms shall be made free of all chips, earth, shavings, sawdust, rubbish or other foreign substances.

AD29.5.10 Testing of Concrete

(a) Concrete compressive strength requirements will consist of a minimum strength, which must be attainted before various loads, or stresses are applied to the concrete. With the exception of the concrete strengths required for:

(i) Transfer of the pre-tensioning forces;

(ii) Subjecting a member to freezing temperatures; and,

(iii) Hauling and erecting a member.

(b) All concrete shall attain the minimum strength as shown the Drawings and indicated in this Specification at the age of 28 days. The compressive strength of the concrete is to be determined in accordance with CSA Standard A23.2-2000;

(c) The minimum number of test cylinders that a Contractor shall mould from each separately mixed batch of concrete to be placed in a member is as follows:

(i) Two (2) cylinders to be tested prior to the transfer of the pre-tensioning forces where applicable;

(ii) Three (3) cylinders for the determination of 28 day strength; and,

(iii) Two (2) cylinders to be tested prior to the member being hauled to the site and erected, where applicable.

(d) In the event that the strength of the concrete cylinder(s) tested prior to the transfer of the pre-tensioning forces is less than the strength required for transferring the pre-tensioning forces, the Contractor shall mould and test additional cylinders from each subsequent batch of concrete. The number of additional cylinders to be moulded and tested for the purpose of establishing the required concrete strength for the transfer of the pre-tensioning forces will be determined by the Contract Administrator. All test cylinders shall be cured under the same conditions as the member until such time as the steam curing or moist curing of the member has been completed;

(e) In addition to the moulding of the specified number of test cylinders the Contractor will be required to perform the following tests on every separate batch of concrete to be placed in a member:

(i) Slump;

(ii) Air; and,

(iii) temperature and to record the results of such tests.

(f) The Contractor shall be responsible for maintaining an up-to-date record of all test results on a "Record of Concrete Strength" form approved by the Contract Administrator. A separate "Record of Concrete Strength" form is to be prepared for each member and the strengths of the test cylinders as well as the pertinent data are to be listed in the same order as the batches of concrete were placed in the forms. A complete set of test results is to be submitted to the Contract Administrator within seven (7) days after the date that the 28 day cylinders from the last member were tested. All costs involved in performing and recording the previously mentioned tests will be the responsibility of the Contractor; and,

(g) The Contract Administrator at his own discretion and at the Owner's expense may make any other tests deemed necessary on the concrete, on the components of the concrete as well as on any finished or partially finished member. The Contractor must allow the Contract Administrator unhindered access to the concrete, concrete components and members and to also assist the Contract Administrator in carrying out any test.

AD29.5.11 Vibrating Concrete

(a) Vibrators shall only be used when acceptable to the concrete supplier;

(b) External vibration shall be used when sections are too small or inaccessible for the internal type;

(c) Internal vibrators shall be used in all sections, which are sufficiently large, and they shall be supplemented by platform or screed-type vibrators in the event that satisfactory top surfaces cannot be obtained with the internal type alone; internal vibrators shall be supplemented with vibrators operated against outside of the forms to improve vertical surfaces;

(d) Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 3,600 impulses per minute when operating under load. The vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place and to visibly affect the concrete over a radius of at least 450 mm from the vibrator when used in concrete having 25 mm slump;

(e) A sufficient number of vibrators shall be employed so that at the required rate of placement, vibration and complete compaction are obtained throughout the entire volume of each layer of the concrete. At least one extra vibrator shall be on hand for emergency use. Form vibrators shall be attached to the forms in such a manner as to transmit the vibration to the concrete effectively and the vibrators shall be raised in lifts as filling of the forms proceeds; the dimension of each lift being not more than the height of concrete visibly affected by the vibration. The form vibrators shall be spaced horizontally apart at distances not greater than the radius through which the concrete is visibly affected;

(f) Internal vibrators shall be kept constantly moving vertically in the concrete and they shall be applied at points uniformly spaced that are not farther apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location long enough to draw a pool of grout from the surrounding concrete. Internal vibrators shall be applied close enough to the forms to vibrate the surface concrete effectively but care shall be taken to avoid hitting the forms with sufficient force to damage them;

(g) With form or internal vibrators, the vibration shall be such that the concrete becomes uniformly plastic and there shall be at least 20 seconds of vibration per square foot of surface of each layer of the concrete, computed on the basis of the visibly affected radius and taking overlapping into consideration. Surface vibrators shall be applied only long enough to embed the coarse aggregate and to bring enough mortar to the surface for satisfactory screeding;

(h) Care will have to be exercised so as not to damage the prestressing steel in any way, and so that the vibration is not transferred through the steel to concrete already poured and which is at the stage between the initial and final set;

(i) The tops of all members shall receive a screeded, untrowelled surface;

(j) Immediately after the removal of the forms, any defects in the concrete shall be brought to the Contract Administrator's attention and they shall be repaired as directed by the Contract Administrator, provided the defects are not extensive enough to cause rejection of the member;

(k) Honeycomb, if any, shall be repaired as soon as the forms are taken off, subject to the approval of the Contract Administrator. When approved by the Contract Administrator, repairs shall be accomplished by removing any aggregate that is loose or that is not thoroughly bonded to the surrounding concrete, washing the sound concrete with clean water, using a wire brush to remove any loose particles and by applying an approved epoxy resin to the dried areas to be patched immediately prior to the applying of cement mortar. Patched areas shall be rubbed flush with the surrounding surface after the cement mortar has hardened;

(l) Holes made by hold-up or hold-down devices or other fabrication equipment, shall be cleaned of all oil or grease, washed with clean water and then, without delay, patched flush with the surface of the member with the cement mortar; and,

(m) All objectionable fins, projections, offsets, steaks, or other surface imperfections shall be totally removed to the Contract Administrator's satisfaction by approved means.

AD29.5.12 Concrete Finish

(a) The top surfaces of the girders shall be finished to produce even indentations at right angles to the longitudinal centreline of the girders. The indentations shall be 5 mm (minimum), full amplitude, and spaced not greater than 15 mm apart;

(b) The Contractor shall construct a 25 mm deep recess around all lifting devices. These recesses shall be rectangular in shape with vertical sides, and the distance between the lifting device and the vertical sides shall not exceed 50 mm;

(c) Immediately after the removal of the forms, all defects in the concrete shall be repaired as directed by the Contract Administrator, provided the defects are not extensive enough to cause rejection of the girder. Should the top surface exhibit excessive laitance or "frothing", or any other deleterious effects, the Contractor shall repair the concrete to the satisfaction of the Contract Administrator;

(d) Honeycomb, if any, shall be repaired as soon as the forms are taken off. When approved by the Contract Administrator, repairs shall be accomplished by: removing all aggregate that is loose or that is not bonded thoroughly to the surrounding concrete, washing the sound concrete with clean water, using a wire brush to remove any loose particles, applying an approved epoxy resin to the dried areas, and applying a cementitious mortar. The cementitious mortar shall have the same quality and mix as that used for the concrete. Patched areas shall be rubbed flush with the surrounding surface after the cementitious mortar has hardened;

(e) Holes made by hold-up or hold-down devices or other fabrication equipment, shall be cleaned of all oil and grease, washed with clean water and then, without delay, patched flush with the surface of the girder with the approved cementitious mortar;

(f) All objectionable fins, projections, offsets, streaks, and other surface imperfections shall be removed totally to the Contract Administrator's satisfaction by approved means;

(g) Finally, the concrete surface shall be wetted down thoroughly and all air pockets and other surface cavities shall be filled carefully with the approved cementitious mortar. When sufficiently dry, the surface shall be rubbed down to leave a smooth and uniform finish. Cement washes of any kind will not be allowed;

(h) If, in the Contract Administrator's opinion, repairs to the concrete are not satisfactory or will be detrimental to the strength or long-term durability of the girder, the Contractor shall, and as directed by the Contract Administrator, replace the girder; and,

(i) Surfaces to be in contact with grout after girder erection (recesses for lifting devices, shear keys, etc.) shall be given an exposed aggregate finish.

AD29.5.13 Curing

(a) Concrete shall be either moist cured for a minimum of three days from the time of casting or steam cured until the concrete has reached a strength (fci) as shown on the plans or as specified by the Contract Administrator;

(b) If steam curing is used, it shall not be applied until after the initial set has taken place. Initial set shall be considered to have taken place four (4) hours after the completion of concrete placing. The cylinders used to determine the concrete strength shall be cured under the same conditions as the member in question;

(c) From the time of pre-tensioning to the time of initial set, the ambient air temperature of the member shall not vary by more than ± 3° C. During steam curing the ambient air temperature shall rise at a rate not to exceed 15° C per hour to a maximum temperature of 70 ° C;

(d) An air temperature recording thermometer approved by the Contractor Administrator shall be laced on the top of the member after placing of concrete is completed and the thermometer shall not be removed until after steam curing has been completed. A graph showing the ambient air temperature plotted against the time of day shall be submitted to the Contract Administrator by the Contractor upon completion of the steam curing for each member. The graph shall be properly identified as to the hour, day, month and year, as well as to the times of the completion of placing concrete, and of the start and completion of steam curing;

(e) Once curing has been completed, the temperature of the concrete shall not be allowed to fall at a rate exceeding 15°C per hour; and,

(f) The members shall not be subjected to freezing temperatures until reaching the design strength (f'c) as shown on the plans.

AD29.5.14 Grouting

AD29.5.15 Handling, Storage and Loading

(a) Lifting devices shall be cast into the concrete at the locations as shown on the Shop Drawings;

(b) The lifting devices shall be of such a nature as to avoid twisting, racking, or other distortions while handling, storing, moving and erecting the girders. The devices shall be anchored fully to the main body of concrete. The devices shown on the Drawings are minimum requirements and the Contractor shall satisfy himself as to the adequacy of the devices. The girders shall be picked up only by the lifting devices;

(c) The Contractor shall be responsible for storage of the girders from the completion of their fabrication until they are required for erection. The Contractor may have to store, free of charge, all or portions of the Substantial Performance date, depending upon the actual construction progress; and,

(d) During storage and hauling, the girders shall be maintained in an upright position and shall be supported within 50 mm on the inside of the bearing area. Extreme care shall be exercised during the handling and storage of the precast girders to avoid twisting, cracking or other distortion that may result in damage to the girder.

AD29.5.16 Handling and Transportation of Girders

(a) The Contractor shall load and transport all of the girders in accordance with the following:

(i) The Contractor shall be responsible for the design, supply, installation and removal of temporary wind bracing and lateral stability bracing for girders as may be required during all of the Contractor's handling operations, including loading and transporting of the girders; and,

(ii) Should the Contractor choose to transport the girders to a storage location, he shall also be responsible for the unloading procedures. The submission of design calculations and Shop Drawings for the temporary wind bracing and lateral stability bracing to the Contract Administrator shall in no way relieve the Contractor of the full responsibility for the success or failure of the design.

(b) All loading and transporting of the girders shall be under the direction of a Professional Engineer, registered in the Province of Manitoba. The Engineer shall be experienced in bridge girder loading and transporting and shall be present for girder loading and transporting;

(c) The members shall not be transported until the concrete design strength (f'c) has been reached;

(d) Extreme care shall be exercised during the handling and transportation of the precast girders to avoid twisting, cracking or other distortion that may result in damage to the girder;

(e) The Contractor shall be responsible for protecting the girders at restraint points on the vehicle. Any damaged corners or surfaces of the girders are to be regarded as honeycomb and repaired in accordance with AD29.5.12 of this Specification;

(f) The Contractor and the Contract Administrator shall visually inspect the girders once they have been loaded on the hauling equipment and immediately prior to the unloading. Extensive cracking of the girders during transportation will be basis for rejection by the Contract Administrator;

(g) When transporting bridge girders, the Contractor shall be responsible for ensuring that all of the required permits have been acquired and the conditions of all permits are met;

(h) The Contractor shall submit his proposed route for transporting the girders including traffic control procedures as part of the proposed loading and transporting procedure. In all traffic control situations, the flagmen must be trained and properly attired in flagman's vest and approved headgear with approved flagman's stop/slow paddle or fluorescent red flag. The proper advance signing must also be in place;

(i) No loose timber blocking will be permitted for use as temporary works for any aspect of girder handling, storage and transportation; and,

(j) It is the Contractor's responsibility to ascertain the actual weight of the girders. The concrete in the precast prestressed girders may be denser than regular concrete and the girders contain a high percentage of reinforcement and stressing strands that also tend to increase the weight of the girders.

AD29.6 Erection

AD29.6.1 Submittals

The Contractor shall submit the following to the Contract Administrator:

(a) A schedule and detailed plan clearly illustrating the method and sequence by which the Contractor proposes to unload and erect the precast prestressed concrete girders. The girder erection procedure shall include detailed design notes and Shop Drawings that are sealed, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba necessary to describe the following:

(i) Proposed lifting methodology, devices, their locations on girders and patching procedures after erection;

(ii) Type and capacity of equipment;

(iii) Sequence of operation, including position of cranes, trucks with girders, and traffic accommodation;

(iv) Detailed crane position on the ground, particularly adjacent to substructure elements, such as piers and abutments, with details of load distribution on wheels and outriggers. If approved by the Contract Administrator, details of crane position on the structure, showing wheel loads and axle spacing of equipment moving on structure;

(v) Loads and their position from crane wheels and outriggers during all positions of lifting when crane is on or adjacent to the structure;

(vi) Details of temporary falsework, including proposed methods to be used to ensure stability and the required splice elevations and structure shape prior to placing concrete and details of release (if applicable);

(vii) Method of providing temporary supports for stability;

(viii) Details of lifting of units, showing vertical forces at lifting devices;

(ix) Provisions for control and adjustment of errors for width and positioning of curbs or exterior units (if applicable);

(x) Complete details of blocking for bearings where necessary to constrain movement due to horizontal forces and/or gravity effects;

(xi) Provide an "As Constructed" detailed survey of the substructure showing the following:

- Location and elevation of all bearing seats;
- Shim height at each bearing location, if applicable; and,
- Top of girder elevations at each bearing (and each splice location where applicable).

(xii) Detailed design notes and Shop Drawings for the bearings that are stamped signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba.

AD29.6.2 General

(a) Written proof of the concrete strength of the precast prestressed concrete box girders shall be submitted to the Contract Administrator at least three (3) business days prior to the erection of the precast prestressed concrete box girders;

(b) Unloading and erection of the concrete girders shall be under the direction of a Professional Engineer licensed to practice in the Province of Manitoba. The Professional Engineer shall be experienced in bridge girder erection and be present for all stages of the girder erection;

(c) Any girder that in the opinion of the Contract Administrator has been damaged or otherwise rendered useless by the improper handling by the Contractor shall be replaced by the Contractor at his own expense;

(d) It is the Contractor's responsibility to ascertain the actual weight of the girders. The concrete in the precast prestressed girders may be denser than regular concrete and may contain a high percentage of reinforcing steel and stressing strands that also tend to increase the weight of the girders;

(e) Loose timber blocking will not be permitted for use as temporary works for any aspect of girder erection; and,

(f) Before taking possession or erection of the girders, the Contractor shall verify that the lengths of the girders, the layout of the substructure units, the elevations of the bearing seats, and the location of the anchor bolts are in accordance with the Drawings and Specifications. All discrepancies discovered by the Contractor shall be brought immediately to the attention of the Contract Administrator.

AD29.6.3 Box Girders

(a) All box girders shall be placed tightly against each other in order to obtain virtually no lateral movement of the bearings when the girders are pulled together during lateral stressing operations;

(b) The total erected width of the channel girders shall not exceed the sum of the individual widths of the girders by more than approximately 25 mm for each span. The Contractor shall attempt to distribute the discrepancy equally on either side of the centreline of structure;

(c) Care shall be exercised to prevent dirt from falling in between the girders. All dirt that does fall in between the girders shall be removed; and,

(d) The Contractor shall ensure that the foam rubber pads around the lateral stress ducts are placed correctly to prevent the leakage of grout during grouting operations. In the event that any leakage occurs, it will be the responsibility of the Contractor to carry out all required remedial measures.

AD29.6.4 Lifting Hooks and Lifting Holes

(a) After the Contract Administrator has approved the erection positions of the girders, all lifting hooks shall be cut off flush with the top of the girders; and,

(b) All lifting holes shall be filled with an approved grout.

AD29.6.5 Placing and Grouting of Anchor Rods

(a) The Contractor shall drill holes in the substructure unit to the size and depth as shown on the plans;

(b) Drilling shall be done through holes already provided in the designated girders. The Contractor shall exercise utmost care not to damage the girders during drilling operations;

(c) After the holes have been drilled and cleaned out by compressed air, anchor rods shall be placed and grouted as shown on the plans;

(d) Cement grout shall be prepared as specified in Section AD29.4.6 of this Specification;

(e) The Contractor shall install and grout the anchor rods for the following girder(s) prior to lateral stressing:

(i) For spans with an odd number of girders, the center girder; or,

(ii) For spans with an even number of griders, both girders on either side of the bridge centerline.

(f) After lateral stressing operations, the remaining anchors shall be installed and grouted.

AD29.6.6 Lateral Stressing

(a) The Contractor shall submit to the Contract Administrator the following at least 7 days prior to the start of lateral stressing operations:

(i) Copies of the stressing sequence and of the strand elongation calculations as well as all data required for checking these calculations. Separate elongation calculations will be required for each significant variation in the modulus of elasticity of the strand;

(ii) A calibration graph for each jack to be used in the stressing operation;

(iii) The proposed method of tensioning the strands;

(iv) The proposed method of distressing and the distressing sequence;

(v) The anchorage losses experienced by the Contractor under similar loading applications, and the proposed method of measuring the anchorage losses during the stressing operation; and,

(vi) A copy of the proposed “Record of Lateral Post-Tensioning” form to be used by the Contractor.

(b) The elongation calculations, destressing sequence and all other items having an effect upon the design a performance of the members shall be prepared by a Professional Engineer Registered in Manitoba and the required submissions shall be stamped by the Professional Engineer;

(c) The submission of the stressing calculations to the Contract Administrator shall in no way relieve the Contractor of the full responsibility for the success or failure of the stressing operations;

(d) A pre-calibrated pressure gauge, tensionmeter or load cell shall be used as a check on the elongation, the accuracy of which shall be verified by the Contractor whenever the Contract Administrator considers it necessary;

(e) Before the stressing operation begins, the Contractor shall have filled out on the approved “Record of Lateral Post-tensioning” form the calculated jack gauge reading, the required gross elongation (based on estimated anchorage losses), and the required net elongation of the each strand. During the stressing operation, the Contractor shall record the actual jack gauge reading, the measure gross elongation, the measured anchorage losses, and then calculate the actual net elongation for each strand;

(f) The actual net elongation of a strand shall not vary from the required net elongation by more than 3.5 mm. The actual anchorage losses encountered shall be used to modify the gross elongation required, if the actual net elongations are consistently greater or less than the required net elongation;

(g) At no time shall the actual jack pressure exceed the pressure corresponding the calculated gross elongation by the 5 percent. If the required gross elongation is not obtained by stressing to this maximum allowable jack pressure at one end of the member, it will be necessary to complete the stressing from the other end of the member;

(h) A copy of the "Record of Lateral Post-Tensioning" form shall be submitted to the Contract Administrator upon completion of the pre-tensioning of each member;

(i) Tensioning shall be carried out in a manner such that the jack is coaxial with the tendon or strand. If the strands are tensioned individually, care shall be taken to ensure the unravelling of the strand does not take place;

(j) Transfer of the post-tensioning force shall be carried out by a method approved by the Contract Administrator. If the strands are to be cut, the distressing sequence shall be approved by the Contract Administrator; and,

(k) All post-tensioning strands shall be cut off flush with the end of the member and the exposed ends of the pre-tensioning strands and a 50 mm strip of adjacent concrete shall be cleaned and painted. Cleaning shall be by abrasive blast to remove all dirt and residue that is not firmly bonded to the metal or concrete surfaces. The surfaces shall be immediately coated with 25 mm coat of zinc-rich paint approved the Contract Administrator. The paint shall be thoroughly mixed at the time of application and shall be worked into any voids in the pre-tensioning strands.

AD29.6.7 Removal of Falsework and Site Clean-up

(a) Upon completion of the erection and before final acceptance, the Contractor shall remove all temporary falsework. He shall remove all piling, excavated or surplus materials, rubbish and temporary buildings, replace or renew any damaged fences and restore in an acceptable manner all property damaged during the execution of the Work. Disposal of surplus materials shall be in a manner and location satisfactory to the Contract Administrator; and,

(b) The Contractor shall leave the bridge site, roadway and adjacent property in a neat restored and presentable condition, satisfactory to the Contract Administrator. When requested by the Contract Administrator, the Contractor shall provide written evidence that affected property owners and/or regulatory agencies have been satisfied.

AD29.6.8 Quality Assurance

(a) The Contractor shall provide an office within the plant facilities for the exclusive use of the Contract Administrator for the duration of the contract that is equipped with a desk, two (2) chairs, a digital telephone and an internet connection. Upon completion of the project, all equipment and the office space will be returned to the Contractor in an "as-is" condition; and,

(b) The Contract Administrator, at his discretion, may complete other tests deemed necessary on:

(i) The concrete;

(ii) The concrete constituent materials; or

(iii) Any finished or partially finished girder.

(c) The Contractor shall allow the Contract Administrator unhindered access to the concrete, concrete constituent materials and girders and shall assist the Contract Administrator in carrying out any test;

(d) During production of the precast girders, the Contractor shall weigh completed girders to verify the mass when requested by the Contract Administrator; and,

(e) Records showing details of members installed, temporary bracing installed or removed and weather conditions shall be kept daily and be available to the Contractor Administrator upon request.

AD29.6.9 Grouting of Lateral Stressing Ducts and Recesses

(a) Grout shall be mixed in accordance with the grout manufacturer's recommendations, followed by slow agitation until the grout is used up;

(b) Immediately prior to grouting each duct, compressed air shall be forced through the duct. The compressor shall be equipped to ensure that air blown through the ducts is clean and, in particular, oil free. During the forcing of air through a duct, the Contractor shall inspect carefully the opposite end of the duct to ascertain that there is a free flow of clean air through each duct;

(c) If required, spaces between the units shall be sealed to prevent loss of grout;

(d) From the mixer, the grout shall pass through a strainer into positive displacement grouting pumps equipped with a recirculating device for use when the grout is not being injected;

(e) Grouting shall be carried out quickly, completely filling a given duct within 30 min. after the cement and water are first brought together. Sufficient grout shall always be available so that each duct can be grouted completely in one operation. A generous allowance shall be made for wastage. If, for any reason, a sufficient grout is not available to complete the grouting of a duct, grout already in the duct shall be forced out and the duct cleaned out completely with water and compressed air;

(f) Grouting pressure shall be sufficiently high to cause a stream of grout to issue freely at the open end of the duct;

(g) The Contractor shall supply and install grout fittings at the grouting anchorage and open anchorage, capable of maintaining the grout in the duct under pressure, from the time the duct has been filled with grout until the grout has set;

(h) Grout shall be pumped through the duct and wasted continuously at the open anchorage until no visible slugs of water or air are ejected. Once a steady stream of pure grout is evident at the open anchorage, the grout fitting of this anchorage shall be closed and the pumping pressure shall be held for thirty seconds. Grout fittings of the grouting anchorage shall then be closed while maintaining this pressure;

(i) The Contractor must take steps as to ensure the ducts will not have air pockets upon completion of grouting;

(j) After the grout has set, all grout fittings shall be cut off inside the recesses;

(k) Before patching recesses, they shall be cleaned by abrasive blast to remove all dirt and residue which is not bonded firmly to the metal or concrete surfaces. Without delay, the recess shall be coated thoroughly with an approved epoxy resin and then patched immediately with mortar. Patched areas shall be rubbed flush with the surface of the girders after the mortar has hardened; and,

(l) The Contractor shall take not less than six (6) standard cubes at his own cost during each day of duct grouting operations for 7 and 28 day strength determinations. The results of these tests as well as the slump, air tests and grout temperature shall be supplied to the Contract Administrator.

AD29.6.10 Grouting Keys Between Girders

(a) Grout shall be mixed in accordance with the grout manufacturer's recommendations, followed by slow agitation until the grout is used up;

(b) When the roadway crown is built into the substructure units, the keys and joints on centreline of the structure or on each side of the centreline girder shall be grouted with non-shrink grout prior to lateral stressing. The crown creates a wedge type of gap between the vertical faces of these girders, therefore, sufficient grout must be used to fill the space between the girders, as well as the key. If required, Oakum or equivalent product approved by the Contract Administrator shall be placed only at the bottom of the gap in order to prevent leakage of grout from the joint at the bottom of the girders;

(c) Keys between the remaining girders shall be grouted after the completion of lateral stressing and placing of the anchor rods. If required, the bottoms of the keys shall be sealed with Oakum or an equivalent product approved by the Contract Administrator, to prevent loss of grout;

(d) Surfaces to be in contact with grout shall be prepared in accordance with the grout manufacturer's recommendations;

(e) Grouted keys shall be cured in accordance with the manufacturer's recommendations; and,

(f) The Contractor shall take not less than six (6) standard cubes at his own cost during each day of key grouting operations for 7 and 28 day strength determinations. The results of these tests as well as the slump, air tests and grout temperature shall be supplied to the Contract Administrator.

AD30. HIGH PERFORMANCE CONCRETE (HPC) OVERLAY

AD30.1 Description

AD30.1.1 This Specification shall cover all operations relating to the preparation of Portland Cement structural concrete for, and all concreting operations related to, the construction of High Performance Concrete (HPC) Overlay Works, as specified herein and as shown on the Drawings.

AD30.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

AD30.2 Scope of Work

AD30.2.1 The Work under this Specification shall involve the HPC overlay Works, placed on top of the deck concrete.

AD30.3 Submittals

AD30.3.1 General

(a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations; and,

(b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any Work on Site, the proposed materials to be used.

AD30.3.2 Concrete Mix Design Requirements

(a) The Contractor shall submit a concrete mix design statement to the Contract Administrator for the High Performance Concrete (HPC) Overlay that reflects the specified performance properties of the concrete. The mix design statement shall contain all the information as outlined on the concrete mix design statement as shown on the Manitoba Ready Mix Concrete Association website (www.mrmca.com). In addition, the mix design statement must indicate the expected method of placement (buggies, chute, or pump). If pumping methods are to be used, the method of placement must include a clear description of the pumping methods (line, vertical drop, length of hose, etc.); and,

(b) The Supplier shall submit directly, in confidence, to the City of Winnipeg, the concrete mix designs for each of the concrete types specified herein. The purpose of this confidential submission will be for record keeping purposes only. The concrete mix design shall contain a description of the constituents and proportions, and at the minimum the following:

(i) Cementitious content in kilograms per cubic metre or equivalent units, and type of cementitious materials;

(ii) Designated size, or sizes, of aggregates, and the gradation;

(iii) Aggregate source location(s);

(iv) Weights of aggregates in kilograms per cubic metre or equivalent units. Mass of aggregates is saturated surface dry basis;

(v) Maximum allowable water content in kilograms per cubic metre or equivalent units and the water/cementitious ratio;

(vi) The limits for slump;

(vii) The limits for air content; and,

(viii) Quantity of other admixtures.

(c) The concrete mix design statements must be received by the Contract Administrator a minimum of ten (10) Business Days prior to the scheduled commencement of concrete placement for each of the concrete types. The concrete mix designs must be received by the City of Winnipeg a minimum of five (5) Business Days prior to the scheduled commencement of concrete placement for each the concrete types;

(d) The mix design statement shall also include the expected slump measurement for each concrete type. The tolerances for acceptance of slump measurements in the field, by the Contract Administrator, shall be in accordance to CSA A23.1-04 Clause 4.3.2.3.2; and,

(e) Any change in the constituent materials of the approved mix design shall require submission of a new concrete mix design statement, mix design, and mix design test data. If, during the progress of the Work, the concrete supplied is found to be unsatisfactory for any reason, including poor workability, the Contract Administrator may require the Contractor to any necessary adjustments.

AD30.3.3 Concrete Mix Design Test Data

(a) Concrete:

(i) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, test data showing that the concrete to be supplied will meet the performance criteria stated in this Specification for each concrete type;

(ii) The Contractor shall submit at a minimum, the test data to prove that the minimum compressive strength, flexural strength for Fibre Reinforced Concrete (FRC) only, air content, and slump of the concrete to be supplied meets or exceeds the performance criteria. In addition, test data shall be submitted to support requirements for post-cracking residual strength index (Ri) and fibre dispersion in accordance with the Canadian Highway Bridge Design Code (CHBDC) CAN/CSA-S6-06, Section 16, Fibre Reinforced Structures, Clause 16.6;

(iii) Testing for post-cracking residual strength index (Ri) of FRC shall be tested as follows:

- One set of five concrete beam specimens, 100 mm by 100 mm by 350 mm long, shall be tested to failure in accordance to ASTM C1609-10. The average of the peak loads is the cracking load of the concrete (Pcr).
- A second set of five concrete beam specimens, 100 mm by 100 mm by 350 mm long, shall be tested to failure in accordance with ASTM C1399-04. The average of the peak loads during reloading is the post cracking load of the concrete (Ppcr).
- The Ri is equal to the ratio of Ppcr over Pcr. The Contractor shall submit a summary of the results of all post-cracking residual strength index tests. Tests conducted in accordance to ASTM C1399-04 will be considered invalid by the Contract Administrator if the initial crack in the specimen has occurred after 0.5 mm deflection. Provide all load deflection curves with test submissions (initial and reloading curves).

(iv) All tests shall be based on the concrete samples taken from the point of discharge into the formwork. For example, at the concrete chute from the delivery truck if being placed by buggies, or at the end of the pump line should the Contractor choose to pump the concrete into place.

(b) Aggregates:

(i) The Contractor shall furnish, in writing to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, the location of the sources where aggregate will be obtained in order that some may be inspected and tentatively accepted by the Contract Administrator. Changes in the source of aggregate supply during the course of the Contract shall not be permitted without notification in writing to and the expressed approval of the Contract Administrator;

(ii) The Contractor shall submit to the Contract Administrator for review and approval recent test information on sieve analysis of fine and coarse aggregates in accordance with CSA Standard Test Method A23.2-2A;

(iii) The Contractor shall submit to the Contract Administrator for review and approval recent test information on tests for organic impurities in fine aggregates for concrete, in accordance with CSA Standard Test Method A23.2-7A;

(iv) The Contractor shall submit to the Contract Administrator for review and approval recent test information on relative density and absorption of coarse aggregate, in accordance with CSA Standard Test Methods A23.2-12A;

(v) The Contractor shall submit to the Contract Administrator for review and approval recent test information on petrographic examination of aggregates for concrete, in accordance with CSA Standard Test Methods A23.2-15A. The purpose of the petrographic analysis is to ensure the aggregates provided are of the highest quality for use in the production of concrete and will produce a durable overlay. An acceptable aggregate will have an excellent rating as judged by an experienced petrographer, with a (weighted) petrographic number typically in the range of 100 to 120;

(vi) The Contractor shall submit to the Contract Administrator for review and approval recent test information on resistance to degradation of large-size coarse aggregate by abrasion and impact in the Los Angeles Machine, in accordance with CSA Standard Test Method A23.2-16A; and,

(vii) The Contractor shall submit to the Contract Administrator for review and approval recent test information on potential alkali reactivity of cement aggregate combinations (mortar bar method), in accordance with CSA Standard Test Method A23.2-27A.

(c) The Contractor shall submit to the Contract Administrator copies of all material quality control test results.

AD30.3.4 Notification of Ready Mix Supplier

(a) The Contractor shall submit to the Contract Administrator the name and qualifications of the Ready Mix Concrete Supplier that he is proposing to use, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement. The Contract Administrator will verify the acceptability of the Supplier and the concrete mix design requirements. Acceptance of the Supplier and the concrete mix design(s) by the Contract Administrator does not relieve or reduce the responsibility of the Contractor or Supplier from the requirements of this Specification.

AD30.3.5 Moveable Deck Hoarding

(a) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of the HPC overlay work on-site, shop drawings showing the fabricated details of the movable deck hoarding, design loads, method of construction, type and grade of materials, and any further information that may be required by the Contract Administrator; and,

(b) The movable deck hoarding shall be designed by a Professional Engineer registered in the Province of Manitoba and constructed to the following requirements:

(i) Sufficient clearances shall be provided to enable the placing and finishing the HPC overlay to proceed unhindered inside the hoarding;

(ii) The minimum length of the hoarding shall be 25 m or the length of the structure, whichever is shorter;

(iii) The hoarding shall have a clear, unsupported span of at least the clear deck width, plus room for all of the screeding and finishing operations;

(iv) The roof and sides of the hoarding shall be covered with waterproof and insulated material, with all joints overlapping and rendered waterproof and not subjected to heat loss. The material shall be strong enough to withstand the force of "driving" rain or snow, and at least two thirds of the roof and the entire sides shall be opaque in order to prevent the deck concrete from being exposed to direct sunlight;

(v) The sides of the hoarding at the junction of the hoarding with the deck shall be constructed to prevent the entrance of rain from the sides. Provisions shall be made for enclosing the ends of the hoarding on short notice in the event that closing of the ends proves necessary during the concrete placing operations; and,

(vi) The hoarding shall be constructed on wheels or rollers for ready mobility. Another acceptable method is to have stationary sides, with the roof on wheels or rollers.

AD30.3.6 HPC Overlay Pour Sequence and Schedule

(a) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of the HPC overlay placement:

(i) The proposed sequence of construction for the placement of the HPC overlay.

(b) The Contractor shall submit to the Contract Administrator for review, at least ten (10) Business Days prior to the placement of concrete, details of any proposed construction joints; and,

(c) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the scheduled commencement of concrete placement, the proposed placement schedule for the HPC overlay.

AD30.4 Materials

AD30.4.1 General

(a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator; and,

(b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

AD30.4.2 Handling and Storage of Materials

(a) All materials shall be handled and stored in a careful and workmanship like manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CSA Standard CAN/CSA-A23.1-04.

AD30.4.3 Concrete

(a) Concrete materials susceptible to frost damage shall be protected from freezing; and,

(b) Concrete shall have nominal compressive strengths (f'c) and meet the requirements for hardened concrete as specified in the following table.

TABLE AD30.1
REQUIREMENTS FOR HARDENED CONCRETE

Type of Concrete	Location	Nominal Compressive Strength [MPa]	Class of Exposure	Air Content Category	Max Aggregate Size	Special Requirements	Post Residual Cracking Index
Type 5	High Performance Concrete (HPC) Overlay	45 @ 56 Days	C-XL	1	14 mm	Crushed Granite Aggregate; Synthetic Fibres; maximum Shrinkage Strain of 450 microstrains @ 56 Days; Set Retarders permitted	0.15

AD30.4.4 Aggregates

(a) General:

(i) All aggregates shall be handled to prevent segregation and inclusion of any foreign substances, and to obtain uniformity of materials. The two sizes of coarse and fine aggregates, and aggregates secured from different sources, shall be piled in separate stockpiles. The site of the stockpiles shall be cleaned of all foreign materials and shall be reasonably level and firm or on a built up platform. If the aggregates are placed directly on the ground, material shall not be removed from the stockpile within 150 mm of the ground level. This material shall remain undisturbed to avoid contaminating the aggregate being used with the ground material;

(ii) The potential for deleterious alkali-aggregate reactivity shall be assessed in accordance with CSA A23.2-27A-04. Current (less than 18 months old) test data evaluating the potential alkali-silica reactivity of aggregates tested in accordance with CSA A23.2-14A-04 or CSA A23.2-25A-04 is required; and,

(iii) Petrographic analysis when performed shall be in accordance with MTO (Ministry of Transportation Ontario) Lab Test Method LS 609. The (weighted) petrographic number shall not exceed 130.

(b) Fine Aggregate:

(i) Fine aggregate shall meet the grading requirements of CSA A23.1-04, Table 10, FA1, be graded uniformly and not more than 3% shall pass a 75 um sieve. Fine aggregate shall consist of sand, stone, screenings, other inert materials with similar characteristics or a combination thereof, having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances; and,

(ii) Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CSA A23.1-04, Table 12.

(c) Coarse Aggregate – Granite:

(i) Only coarse crushed granite aggregate shall be used for the HPC overlay; and,

(ii) Coarse aggregate shall be 100% crushed, washed granite, low in quartz, clean and free from alkali, organic, or other deleterious matter, shall have two fractured faces, and shall have an absorption not exceeding 3%.

AD30.4.5 Admixtures

(a) Air-entraining admixtures shall conform to the requirements of ASTM C260;

(b) Chemical admixtures shall conform to the requirements of ASTM C494 or C1017 for flowing concrete; and,

(c) All admixtures shall be compatible with all other constituents. The addition of calcium chloride, accelerators and air-reducing agents, will not be permitted, unless otherwise approved by the Contract Administrator.

AD30.4.6 Cementitious Materials

(a) Cementitious materials shall conform to the requirements of CSA-A3001 and shall be free from lumps;

(b) Should the Contractor choose to include a silica fume admixture in the concrete mix design, the substitution of silica fume shall not exceed 8% by mass of cement;

(c) Should the Contractor choose to include fly ash in the concrete mix design, the fly ash shall be Class CI or F and the substitution shall not exceed 30% by mass of cement; and,

(d) Cementitious materials shall be stored in a suitable weather-tight building that shall protect these materials from dampness and other destructive agents. Cementitious materials that have been stored for a length of time resulting in the hardening, or the formation of lumps, shall not be used in the Work.

AD30.4.7 Water

(a) Water to be used for all operations in the Specification, including the mixing and curing of concrete or grout, surface texturing operations, and saturating the substrate shall conform to the requirements of CSA A23.1-04 and shall be free of oil, alkali, acidic, organic materials or deleterious substances. The Contractor shall not use water from shallow, stagnant or marshy sources.

AD30.4.8 Synthetic Fibres

(a) The synthetic fibres shall consist of 100% virgin polypropylene or 100% virgin polyolefin as accepted by the Contract Administrator. The dosage shall be designed by the Contractor to meet the requirements for post-cracking residual strength index (Ri) and fibre dispersion in accordance to the CHBDC CSA-S6-06, Fibre-Reinforced Structures, Clause 16.6 except the post-cracking residual strength index (Ri) shall be determined in accordance with ASTM C1609.

AD30.4.9 Curing Blankets

(a) Curing blankets for wet curing shall be 100 percent polyester, 3 mm thick, white in colour. An approved product is “Mirafi Geotextile P150”. Alternately, a 10 oz burlap, 5 mil polyethylene, curing blanket white in colour shall be used; “Curelap” manufactured by Midwest Canvas, together with a second layer of burlap, or approved equal as accepted by the Contract Administrator.

AD30.4.10 Bonding Agents

(a) Latex Bonding Agent:

(i) Latex bonding agent shall be Acryl-Stix, SikaCem 810, or approved equal as accepted by the Contract Administrator. Polyvinyl acetate-based latexes will not be permitted.

(b) Bonding Grout:

(i) The grout for bonding the HPC overlay concrete to the new concrete deck slab shall be mixed in an agitating hopper slurry pump and shall consist of the following constitutes, by weight:

- 1 part Water;
- 1 part latex bonding agent; and,
- 1 ½ parts Type GUSF Portland Cement.

(ii) The consistency of the bonding grout shall be such that it can be brushed onto the existing concrete surface in a thin, even coating that will not run or puddle in low spots.

AD30.4.11 Miscellaneous Materials

(a) Miscellaneous materials shall be of the type specified on the drawings or as accepted by the Contract Administrator.

AD30.5 Equipment

AD30.5.1 General

(a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

AD30.5.2 Vibrators

(a) The Contractor shall have sufficient numbers of internal concrete vibrators and experienced operators on site to properly consolidate all concrete in accordance with ACI 309. The type and size of vibrators shall be appropriate for the particular application, the size of the pour, and the amount of reinforcing and shall conform to standard construction procedures.

(b) The Contractor shall have standby vibrators available at all times during the pour.

AD30.5.3 Finishing Machine for the HPC Overlay

(a) Unless otherwise specified, an approved finishing machine complying with the following requirements shall be used;

(b) A mechanical strike-off shall be required to provide a uniform thickness of concrete in front of the screed;

(c) Design of the finishing machine, together with appurtenant equipment, shall be such that positive machine screeding to the plastic concrete will be obtained with 25 mm of at least 150 mm beyond the line where a sawcut is intended to form the edge of a subsequent placement section and shall overlap the sawn edge of a subsequent placement section and shall overlap the sawn edge of a previously-placed course at least 150 mm;

(d) Finishing machines that are approved for use for placing the HPC overlay are Bidwell Bridge Pavers and Gomaco Bridge Pavers;

(e) The finishing machine shall have a paving carriage with strike-off auger, rotating cylinders, and a finishing pan;

(f) The finishing machine shall be capable of forward and reverse motion under positive control. Provision shall be made for raising the screeds to clear the screeded surface for travelling in reverse;

(g) Supporting rails upon which the finishing machine travels will be required on all pours. The support of these rails shall be fully adjustable to obtain the correct profile;

(h) When placing concrete in a lane abutting a previously completed lane, the side of the finishing machine adjacent to the completed lane shall be equipped to travel on the completed lane;

(i) Vehicles for transporting fresh concrete from the truck to the mechanical screed shall not travel directly on the surface of the new concrete deck slab; and,

(j) The supply, set up, operation, and takedown of the finishing machine shall be considered incidental to the placement of the HPC overlay and no separate measurement or payment shall be made for this Work.

AD30.5.4 Moveable Deck Hoarding

(a) The moveable deck hoarding shall be constructed on wheels or rollers for ready mobility. Another acceptable method is to have stationary sides, with the roof on wheels or rollers;

(b) The rail system for the movable deck hoarding can be the same rail system used for the finishing machine and the Work Bridges, subject to the approval of the Contract Administrator;

(c) The roof of the hoarding shall be checked for damage and water tested before each concrete pour, and all repairs shall be made, as required, before concrete placing will be allowed to begin;

(d) The hoarding shall not be removed from overtop of a newly completed HPC overlay without first obtaining permission from the Contract Administrator; and,

(e) The supply, setup, operation, and takedown of the movable deck hoarding shall be considered incidental to the placement of the deck slab concrete and HPC overlay, and no separate measurement or payment shall be made for this Work.

AD30.5.5 Moveable Work Bridges for Bridge Deck Concrete

(a) At least two moveable Work Bridges will be required (one for finishing operations and one for curing operations), independent of the finishing machine, for the HPC overlay Works;

(b) These moveable Work Bridges shall travel guided on rails supported clear of the finished Bridge deck;

(c) The Contractor shall install a sturdy walkway with safety railing on each side of the Work area for the purpose of providing access to the Work Bridge; and,

(d) The supply set up, operation, and takedown of the moveable Work Bridges shall be considered incidental to the placement of the Bridge Deck concrete. No separate measurement or payment shall be made for this Work.

AD30.6 Construction

AD30.6.1 HPC Overlay

(a) General:

(i) The HPC overlay shall be constructed in accordance with the requirements of this Specification; and,

(ii) The new deck slab concrete, and any patching repairs thereto, shall reach a minimum compressive strength of 35 MPa, as determined by field-cured test cylinders, before the HPC overlay is placed.

(b) Surface Preparation:

(i) Following the completion of the deck slab concrete, the Contractor shall conduct a final screed survey on the top of the concrete and submit elevations to the Contract Administrator;

(ii) The Contract Administrator shall finalize and provide elevations for the top of the HPC overlay. The Contract Administrator shall provide these elevations for the Contractor within five (5) Business Days from receipt of the final screed survey;

(iii) The new concrete deck surface, onto which the HPC overlay concrete is to be placed shall be roughened as per ICRI Guidance No. 03732 CSP 6 (Medium Scarification) through the use of shot blasting techniques;

(iv) It is permissible that the concrete surface may be prepared by rotomilling, using a BobCAT-sized machine. After rotomilling operations have been completed to the satisfaction of the Contract Administrator, the entire rotomilled surface shall receive a high-pressure water blast to remove all surface microfractures to the satisfaction of the Contract Administrator;

(v) The time interval between the surface preparation and the placing of the HPC overlay concrete shall be kept to a minimum, and utmost care shall be taken to keep the prepared surfaces clean during the interval;

(vi) Immediately before proceeding with each HPC overlay concrete placement, the prepared surface shall be inspected for dirt and other deleterious materials that may have been deposited after the completion of cleaning. All such dirt and deleterious material shall be cleaned off in a manner and by procedures satisfactory to the Contract Administrator; and,

(vii) Placement of the HPC overlay concrete shall not be permitted when the surface moisture evaporation exceeds 0.75 kg/m2/h. Fog misting is mandatory regardless of drying conditions. The Contractor shall use fog misting operations as accepted by the Contract Administrator. The nomograph, Figure D1, Appendix D of CSA Standard A23.1-04 shall be used to estimate surface moisture evaporation rates.

(c) Mixing:

(i) A water-reducing admixture for improving Workability will be required. The admixture must be accepted by the Contract Administrator and shall be used in strict accordance with the Manufacturer's instructions.

(d) Dry Run of Finishing Machine:

(i) The Contractor is responsible for properly setting the screed supporting rails to ensure compliance with the specified longitudinal and transverse deck grades, without creating potential ponding areas or “bird baths.”; and,

(ii) Sufficient screed supporting guide rails to provide the required coverage for the entire pour, as approved by the Contract Administrator, shall be set out and adjusted for height the day prior to the pour. The Contract Administrator will then check the deck grades, as follows:

- That the screed supporting rail system upon which the finishing machine will travel has been placed outside the area to be concreted. Arrangements for positive anchorage of supporting rails shall provide for horizontal and vertical stability. Hold-down devices shot into the concrete will not be permitted; and,

- That the finishing machine and screed rails have been adjusted so that the height of the screed above the existing concrete at each point meets the Contract Administrator’s requirements. To confirm the Contractor’s adjustment of the machine and guide rails, the finishing machine shall be “dry run,” and screed clearance measurements taken at each support point, by the Contractor. Resetting of the machine and/or screed rails shall be done by the Contractor as required by the Contract Administrator.

(e) Placing HPC Overlay:

(i) No longitudinal or transverse joints will be allowed unless detailed on the drawings or authorized in writing by the Contract Administrator. Where transverse and longitudinal joints are allowed, the HPC overlay previously placed shall be saw cut full depth to a minimum of 50 mm horizontally back from the formed joint location, to a straight and vertical edge against which the adjacent HPC overlay is to be placed, as approved by the Contract Administrator;

(ii) Immediately before placing the HPC overlay concrete, a thin coating of bonding grout shall be scrubbed into the clean, dry surface of the joint and Bridge deck. Care shall be exercised to ensure that all surfaces receive a thorough, even coating and that no excess of grout is permitted to collect in pockets. The rate of progress in applying grout shall be limited so that the grout does not become dry before it is covered with fresh HPC overlay concrete;

(iii) The Contractor shall take every precaution necessary to secure a smooth-riding High Performance Concrete (HPC) overlay surface, within the tolerances indicated in AD30.7.7 in this Specification;

(iv) Concrete shall be placed so as to avoid segregation of constituent materials. The concrete finishing machine shall provide sufficient vibration to properly compact the mix. Excess vibration which may cause segregation shall be avoided. If over 75 mm in thickness, or if reinforcing steel is in the lift, the concrete shall be internally vibrated in advance of machine finishing;

(v) The temperature of the concrete shall not be less than 10ºC, nor more than 18ºC, at the time of placing, and shall be maintained below this maximum temperature by the inclusion of ice in the mix in place of a portion of the mix water, as approved by the Contract Administrator, taking care to maintain the design water/cementitious ratio;

(vi) The overall combination of labour and equipment for proportioning, mixing, placing, and finishing new concrete shall be of such minimum capability as to meet the following requirements, as shown on Table AD30.2, “Minimum Requirement for Placing High Performance Concrete (HPC) Overlay”, except when noted otherwise on the drawings:

TABLE E26.2
MINIMUM REQUIREMENT FOR PLACING
HIGH PERFORMANCE CONCRETE (HPC) OVERLAY

TOTAL CONCRETE AREA PER BRIDGE (Square Metre)	MINIMUM REQUIREMENTS (Cubic Metres/Hour)
0 - 275	1.0
276 - 410	1.5
411 - 550	2.0
Over 550	2.5

(vii) The finishing machine shall be so designed that, when concrete is mixed and placed at the specified minimum rate, under normal operating conditions, the elapsed time between depositing the concrete and final screeding shall not exceed 30 minutes. Similarly, the placing equipment and operations shall be such that in no case shall the elapsed time between batching of ready-mix concrete and final screeding exceed 90 minutes;

(viii) Placement of the concrete shall be a continuous operation throughout the pour. In the event of equipment breakdown, such that 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 that a gap is left in the lane or pour 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 full depth a minimum 50 mm horizontally back from the discontinued joint location, and then shall be chipped out and thoroughly cleaned before placing further HPC overlay concrete;

(ix) Screed guides shall be placed and fastened in position to ensure finishing of concrete to the required profile. Supporting rails upon which the finishing machine travels shall be placed outside the area to be concreted. Provisions for anchorage of supporting rails shall provide for horizontal and vertical stability; positive anchorage may be required by the Contract Administrator. A hold-down device shot into the lower lift deck concrete will not be permitted. Plans for anchoring support rails shall be submitted to the Contract Administrator for acceptance. The Contract Administrator's acceptance must be received in writing by the Contractor prior to the installation of any anchorage devices;

(x) The finished Bridge deck grades shown on the drawings are preliminary only and are subject to revision during construction by the Contract Administrator;

(xi) The HPC overlay shall have a minimum thickness of 50 mm. Actual HPC overlay thickness may be greater. This would be to accommodate field adjustments for camber and deflection, and to accommodate variances in grade of the underlying deck slab;

(xii) The vibratory screed of the finishing equipment shall be moved slowly and at a uniform rate, such that screeding shall be completed in no more than two passes. The screed vibrators shall not be allowed to run except when screeding is actually in progress. The screeded surface shall not be walked on or otherwise damaged;

(xiii) The HPC overlay 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 or projecting polypropylene fibres and local projections or depressions, to meet the surface tolerance specified. The Contractor shall ensure that the concrete surface is not overworked, resulting in excessive loss of air entrainment;

(xiv) During the concrete finishing operations, the Contractor shall utilize a 3.05 m (10 ft.) straightedge with a 75 mm (3 inch) semicircular shape, as supplied by Bidwell Inc., and as accepted by the Contract Administrator. It shall be used both for flattening the plastic concrete surface and for checking and verifying the surface flatness before commencing curing of the surface. The entire surface shall be checked and any areas not within the surface flatness tolerances specified under the Quality Control section of this Specification shall be corrected using the straight edge. Care shall be taken to preserve the crown and cross section of the roadway; and,

(xv) Upon completion of the straight-edge checking and final floating the joint with any previous pour (or any transverse joints) shall be sealed by the application of the bonding grout.

(f) Curing of the HPC Overlay:

(i) Immediately following finishing of the HPC overlay concrete surface, apply fog misting until the concrete has enough strength to support the placement of the predampened curing blankets. The misting device shall not be used to apply water to the concrete’s surface for finishing purposes. The misting device shall not be directed towards the concrete surface. Only a fine coating or sheen should be applied by the misting device. There should be no standing water;

(ii) After the joint painting is completed, the surface shall be promptly covered with a single layer of clean, lightly pre-dampened, curing blanket;

(iii) Care shall be exercised to ensure that the curing blanket is well drained and that it is placed as soon as the surface will support it without deformation. The Contractor shall ensure that water from the curing blankets does not run into areas where concrete placement and finishing operations are underway. If this occurs, the Contractor shall stop concrete placement operations until the problem is corrected to the satisfaction of the Contract Administrator;

(iv) The predampened curing blankets shall be a temperature of 20°C, ± 5ºC, when applied to the deck;

(v) Failure to apply wet curing blankets within 40 minutes after the deck concrete has been deposited shall be cause for rejecting the Works so affected. Concrete in the rejected area shall be removed and replaced at no additional cost to the City;

(vi) It is intended that the surface receive a wet curing blanket cure for at least seven (7) days. Water shall be applied as necessary to keep the concrete and curing blankets saturated. The Contractor must ensure the concrete and curing blankets are kept saturated with water for the entire seven (7) days;

(vii) As soon as the HPC overlay surface can be walked on without damaging the surface, as approved by the Contract Administrator, the curing blankets shall be covered with a layer of minimum 4-mil polyethylene film and a layer of insulated tarps (during cold weather) in order to maintain the concrete temperature of 10°C; and,

(viii) If, in the opinion of the Contract Administrator, curing has not been maintained sufficiently, the curing period will be extended as directed with no additional payment made.

(g) Surface Texturing of the HPC Overlay Surface:

(i) Grooves are to be parallel (within 2 mm) and cut perpendicular to traffic flow. Grooves shall only be cut into the HPC overlay surface following the curing;

(ii) Saw cuts shall be 2.5 mm wide, 6 ± 2 mm deep, and spaced 25 mm on centre;

(iii) The area 600 mm from the low side of traffic barriers, and the area 300 mm from the high side of traffic barriers is not to be grooved and the grooves shall all end in a straight line parallel to the face of the traffic barrier;

(iv) Saw cuts shall extend no closer than 150 mm to expansion joints and to any deck drains;

(v) The Contractor shall supply all water for surface texturing operations strictly in accordance with Section AD30.4.7 of this Specification. All run-off from grooving operations and suspended solids shall be collected at either end of the Bridge off the Bridge approach slabs, in collection tanks, passed through several settling and filtration processes before it is discharged into the sewer system. The final effluent shall meet the requirements of the City of Winnipeg By-Law No. 7070/97 Part 5, Control of Discharge into Sewers, for water quality; and,

(vi) All Work associated with surface texturing shall be considered incidental to the HPC overlay Works specified herein, and no additional measurement or payment shall be made for this Work.

(h) Limitation of Operations:

(i) Provisions shall be made to protect the concrete by only casting overlay concrete under good weather conditions. This means that the air temperatures shall be between 5°C and 25°C and the surface moisture evaporation rate is less than 0.75 kg/square metre per hour as determined by CSA A23.1-04, Appendix D, “Guidelines for Curing and Protection”. Also, it shall not be raining and no rain forecast for the duration of each pour. The Contract Administrator’s decision in this matter will be final.

AD30.7 Concrete Quality

AD30.7.1 Inspection

(a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work;

(b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification; and,

(c) Quality Assurance testing shall be undertaken by the Contract Administrator. Quality Control testing shall be undertaken by the Contractor.

AD30.7.2 Access

(a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

AD30.7.3 Materials

(a) All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Quality Assurance Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City of Winnipeg for any materials taken by the Contract Administrator for testing purposes;

(b) All materials shall conform to CSA Standard A23.1-04;

(c) All testing of materials shall conform to CSA Standard A23.2-04; and,

(d) All materials shall be submitted to the Contract Administrator for acceptance at least twenty (20) Business Days prior to its scheduled incorporation into any construction. If, in the opinion of the Contract Administrator, such materials, in whole or in part, do not conform to the Specifications detailed herein or are found to be defective in manufacture or have become damaged in transit, storage, or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

AD30.7.4 Quality Assurance and Quality Control

(a) The Contract Administrator shall be afforded full access for the inspection and control and assurance testing of concrete and constituent materials, both at the site of Work and at any plant used for the production of concrete, to determine whether the concrete is being supplied in accordance with this Specification;

(b) The Contract Administrator reserves the right to reject concrete in the field that does not meet the Specifications;

(c) The Contractor shall provide, without charge, the samples of concrete and the constituent materials required for Quality Assurance tests and provide such assistance and use of tools and construction equipment as is required;

(d) Quality Assurance and control tests will be used to determine the acceptability of the concrete supplied by the Contractor;

(e) The Contractor will be required to undertake Quality Control tests, of all concrete supplied. All test results are to be copied to the Contract Administrator immediately after the tests have been performed; and,

(f) The frequency and number of concrete Quality Control tests shall be in accordance with the requirements of CSA Standard A23.1-04. An outline of the quality tests is indicated below.

AD30.7.5 Concrete Testing

(a) Slump tests shall be made in accordance with CSA Standard Test Method A23.2-5C-04, "Slump of Concrete". If the measured slump falls outside the limits in AD30.3.2 of this Specification, a second test shall be made. In the event of a second failure, the Contract Administrator reserves the right to refuse the use of the batch of concrete represented;

(b) Air content determinations shall be made in accordance with CSA Standard Test Method A23.2-4C-04, "Air Content of Plastic Concrete by the Pressure Method". If the measured air content falls outside the limits in AD30.3.2 of this Specification, a second test shall be made at any time within the specified discharge time limit for the mix. In the event of a second failure, the Contract Administrator reserves the right to reject the batch of concrete represented;

(c) The air-void system shall be proven satisfactory by data from tests performed in accordance with the test method of ASTM C457. The spacing factor, as determined on concrete cylinders moulded in accordance with CSA Standard Test Method A23.2-3C-04, shall be determined prior to the start of construction on cylinders of concrete made with the same materials, mix proportions, and mixing procedures as intended for the project. If deemed necessary by the Contract Administrator to further check the air-void system during construction, testing of cylinders may be from concrete as delivered to the job Site and will be carried out by the Contract Administrator. The concrete will be considered to have a satisfactory air-void system when the average of all tests shows a spacing factor not exceeding 230 microns with no single test greater than 260 microns;

(d) Rapid chloride permeability testing shall be performed in accordance with ASTM C 1202;

(e) Testing for post-cracking residual strength index of FRC shall be conducted at the Contractor's expense as follows: one set of five concrete beam specimens, 100 mm by 100 mm b 350 mm long, shall be tested to failure using the same test set up in ASTM C 1399-04 without the steel plate. The average of the peak loads is the cracking load of the concrete (Pcr), and shall be provided to the Contract Administrator. A second set of five concrete beam specimens shall be tested to failure in accordance with ASTM C 1399-04. The average of the peak loads is the post cracking load of the concrete (Ppcr). The Contractor shall promptly submit a summary of the test results to the Contract Administrator upon the conclusion of each test;

(f) Testing for shrinkage strain shall take place for HPC overlay in accordance with ASTM C 157;

(g) Samples of concrete for test specimens shall be taken in accordance with CSA Standard Test Method CSA-A23.2-1C-04, "Sampling Plastic Concrete";

(h) Test specimens shall be made and cured in accordance with CSA Standard Test Method A23.2-3C-04, "Making and Curing Concrete Compression and Flexure Test Specimens";

(i) Compressive strength tests at fifty-six (56) days shall be the basis for acceptance of all concrete supplied by the Contractor. For each fifty-six (56) day strength test, the strength of two companion standard-cured test specimens shall be determined in accordance with CSA Standard Test Method A23.2-9C-04, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the average of the strengths of the two specimens. A compressive strength test at seven (7) days shall be taken, the strength of which will be used only as a preliminary indication of the concrete strength, a strength test being the strength of a single standard cured specimen;

(j) Compressive strength tests on specimens cured under the same conditions as the concrete Works shall be made to check the strength of the in-place concrete so as to determine if the concrete has reached the minimum allowable working compressive strength as specified in Table AD30.1 of this Specification and also to check the adequacy of curing and/or cold weather protection. At least two (2) field-cured test specimens shall be taken to verify strength of the in-place concrete. For each field-

cured strength test, the strength of field-cured test specimens shall be determined in accordance with CSA Standard Test Method A23.2-9C-04, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the strength of the specimen; and,

(k) Notwithstanding CSA A23.2-04, cores taken from HPC overlay must achieve at a minimum 85% of the specified concrete design strength.

AD30.7.6 Corrective Action

(a) If the results of the tests indicate that the concrete is not of the specified quality, the Contract Administrator shall have the right to implement additional testing, as required, to further evaluate the concrete, at the Contractor's expense. The Contractor shall, at his own expense, correct such Work or replace such materials found to be defective under this Specification in an acceptable manner to the satisfaction of the Contract Administrator.

AD30.7.7 Surface Flatness Requirements

(a) The surface of the HPC overlay shall be finished to a flatness tolerance as specified herein. The surface flatness of the finished concrete shall be determined by measuring the elevation difference between equidistant points spaced 305 mm apart, along straight or curved lines running parallel or perpendicular (radial) to the direction of travel on the Bridge deck. An acceptable surface flatness, as measured along any such line on the finished surface, shall have the absolute difference between any two consecutive readings (a reading being the difference in elevation between two consecutive points) not exceeding 5 mm;

(b) At each location(s) where the absolute difference of 5 mm is exceeded, further detailed contour survey(s) shall be conducted by and at the discretion of the Contract Administrator to determine the extent of the area requiring corrective action, all at the Contractor's expense. Corrective measures shall involve immediate removal of the surface in the areas not meeting the specified surface flatness tolerance and/or acceptable rideability, in the judgement of the Contract Administrator, and replacement of same to a minimum depth of 50 mm, with the perimeter of the area saw-cut to a depth of 25 mm (the cut face to be sloped to key-in the replacement concrete), as directed by the Contract Administrator. If more than 20 percent of the surface is rejected by the Contract Administrator based on the flatness tolerance and/or any other defect, the Contractor shall immediately remove and replace the entire area of the applicable pour;

(c) This criterion will not apply across the crown or at any deck drains, which must be constructed to meet design grades as shown on the drawings or as directed by the Contract Administrator; and,

(d) The Contract Administrator shall take readings and determine the acceptability for the surface flatness prior to the opening of the Bridge. The Contractor shall remove and replace the curing blankets, if required by the Contract Administrator, to undertake the necessary flatness testing and shall restore same immediately upon completion of the testing in each area, so as not to significantly disturb concrete curing, to the satisfaction of the Contract Administrator. The Contractor shall clear all materials and equipment from the deck surface during the testing.

AD31. RUBBERIZED ASPHALT WATERPROOFING

DESCRIPTION

AD31.1 This Specification shall cover all operations relating to the supply of labour, equipment, tools and material necessary for the application of the surface condition and the hot poured rubberized asphalt waterproofing to the bridge deck and roof slab as specified herein and as shown on the Drawings.

AD31.2 The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, handling and storage, and all things necessary for and incidental to the satisfactory performance and completion of all Work as herein specified.

AD31.3 Scope of Work:

(a) Preparing the surface of the bridge deck and roof slabs;

(b) Supplying and applying primer;

(c) Supplying and applying the hot poured rubberized asphalt waterproofing system to the bridge deck and roof slab; and,

(d) Supplying and applying polyester fabric and protection board.

SUBMITTALS

AD31.4 The Contractor shall submit to the Contract Administrator for review and approval, fourteen (14) days prior to commencement of the Work, a proposed schedule, including methods and sequence of operations.

AD31.5 The Contractor shall submit the following to the Contract Administrator for review:

AD31.5.1 Manufacturer's product data sheet indicating physical, mechanical and chemical characteristics, such as durability, resistance, strength and bonding.

AD31.5.2 Manufacturer's installation instructions and general recommendations regarding each material to be used.

AD31.5.3 Manufacturer's Material Safety Data Sheets (MSDS) for all materials used.

MATERIAL

AD31.6 General

AD31.6.1 All materials supplied under this Specification shall be of a type approved by the Contract Administrator and shall be subject to inspection and testing by the Contract Administrator.

AD31.6.2 The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

AD31.7 Primer

AD31.7.1 Primer shall receive a prime coat of CGSB37-GP-Ma, 930-18 (BAKOR) or approved equivalent by the Contract Administrator, at an application rate in accordance with the manufacturer's recommendations.

AD31.8 Hot Poured Rubberized Asphalt Waterproofing (2 layers)

AD31.8.1 Hot Poured Rubberized asphalt waterproofing shall be Bemalastic 1213 BDM by Bemac products or 6790-11 by BAKOR or an approved equivalent as accepted by the Contract Administrator.

AD31.8.2 The waterproofing membrane shall be melted, mixed and applied according to the manufacturer's recommendations. The laying operation shall be such that the waterproofing membrane is applied in two 2.0 – 3.0 mm thick layers. Discontinuities in the waterproofing membrane shall be avoided and joints lapped a minimum of 150 mm.

AD31.8.3 The Contract Administrator shall be free to take samples from kettles for testing for every 600 m^2 of area waterproofed at no additional cost.

AD31.9 Polyester Fabric

AD31.9.1 The intermediate reinforcing layer shall be spun-bonded polyester fabric such as Remay 2016 grade, BAKOR Polyester Fabric Reinforcing Sheet, McAsphalt Fabric Reinforcement BP-16 or approved equivalent as accepted by the Contract Administrator.

AD31.10 Protection Board

AD31.10.1 The protection board shall be BAKOR Asphalt Protection Board, McAsphalt Protection Board BP-Asp Pb or approve equivalent as accepted by the Contract Administrator. The protection boards shall be placed on top of the upper layer of waterproofing and rolled by means of linoleum or lawn type roller while the membrane is still warm to ensure good contact with the membrane.

AD31.11 Elastomeric Sheet Membrane

AD31.11.1 The elastomeric sheet membrane shall be a heavy duty sheet. The elastomeric sheet membrane shall be Elaso-Petrotech No. 240 or approved equal as accepted by the Contract Administrator and is to be compatible with the hot-poured rubberized asphalt waterproofing.

AD31.12 Cement

AD31.12.1 Cement shall be normal Portland Cement.

AD31.13 Surface Conditioner

AD31.13.1 Surface conditioner, to be applied to the concrete surfaces of the bridge deck and roof slabs, shall conform to the requirements of the Manufacturer of the rubberized asphalt waterproofing.

AD31.14 Melting On-Site

AD31.14.1 Cakes of rubberized asphalt waterproofing shall be melted in an approved double shell melter under continuous agitation until the material can be drawn free flowing and lump free from the melter.

AD31.14.2 The temperature of the rubberized asphalt waterproofing shall not exceed 218°C at any time during the entire melting procedure.

EQUIPMENT

AD31.15 General

AD31.15.1 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

CONSTRUCTION METHODS

AD31.16 Concrete Preparation

AD31.16.1 Following the completion of the deck slab concrete, the Contractor shall conduct a final screed survey on the top of the concrete and submit elevations to the Contract Administrator.

AD31.16.2 The Contract Administrator shall finalize and provide elevations for the top of the asphalt overlay. The Contract Administrator shall provide these elevations for the Contractor within five (5) Business Days from receipt of the final screed survey.

AD31.16.3 The new concrete deck surface, onto which the rubberized asphalt waterproofing is to be placed shall be roughened as per ICRI Guidance No. 03732 CSP 6 (Medium Scarification).

AD31.16.4 The time interval between the surface preparation and the placing of the rubberized asphalt waterproofing shall be kept to a minimum, and utmost care shall be taken to keep the prepared surfaces clean during the interval.

AD31.16.5 Immediately before proceeding with rubberized asphalt waterproofing placement, the prepared surface shall be inspected for dirt and other deleterious materials that may have been deposited after the completion of cleaning. All such dirt and deleterious material shall be cleaned off in a manner and by procedures satisfactory to the Contract Administrator.

AD31.16.6 The Contractor is responsible to ensure that the concrete surfaces onto which the hot poured rubberized asphalt waterproofing is to be applied is prepared (including supply and application of waterproofing primer) to the degree that the hot poured rubberized asphalt waterproofing can be installed in accordance with the manufacturer's requirements.

AD31.16.7 Rubberized asphalt waterproofing shall not be placed on the new concrete deck surface until a period of 28 days has elapsed since removal of the wet curing.

AD31.17 Application

AD31.17.1 After the deck slab has been cleaned and meets all manufacturers' requirements, the entire concrete bridge deck and roof slabs surface shall be covered with primer.

AD31.17.2 The quantity used shall be 160 mL/m2, or as recommended by the Manufacturer. The primer shall be allowed to dry before the application of the rubberized asphalt waterproofing.

AD31.17.3 The hot poured rubberized asphalt waterproofing shall be brought to a temperature of between 190°C and 218°C, and then applied to the deck slab.

AD31.17.4 The application of the rubberized asphalt waterproofing shall be carried out under the supervision of experienced personnel.

AD31.17.5 The Contractor shall apply the rubberized asphalt waterproofing membrane over the entire deck area and roof slab area, along the vertical face of the curb and the vertical face of the expansion joint concrete, to the required height (proposed elevation) of the bituminous pavement.

AD31.17.6 The hot poured rubberized asphalt waterproofing membrane shall be a two layer, fabric-reinforced system. Each layer shall be 2.0 to 3.0 mm thickness. The intermediate fabric reinforcing layer shall be placed between the layers of the waterproofing membrane.

AD31.17.7 The intermediate reinforcing shall be set into the first layer of waterproofing membrane to achieve a minimum of 50% bleed through. There should not be any dry sheet-to-sheet overlap and a maximum overlap or gap between sheets of 5 mm.

AD31.17.8 The Contractor shall supply and install approved protection board to cover the hot poured rubberized asphalt waterproofing membrane. The installation of the protection board shall replace the requirements of dusting the waterproofing membrane with Portland cement.

AD31.17.9 The protection board shall be a durable panel of 3 mm thickness specifically designed to provide a protective cushion between the hot mix asphalt pavement and the hot poured rubberized asphalt waterproofing membrane for bridges and shall be approved by the Contract Administrator.

AD31.17.10 The protection boards shall be placed with edges overlapping 25 mm both longitudinally and transversely. The protection board edge shall be within 5 mm of all barriers. Protection boards shall be placed such that the longitudinal (direction of traffic) joints are staggered at least 150 mm. In instances where edges of the protection board curl up, the edges shall be cemented down using asphalt waterproofing. Protection boards that are warped, distorted or damaged in any way shall be rejected.

AD31.17.11 The Contractor shall supply and install an elastomeric sheet membrane which is compatible with the hot-poured rubberized asphalt waterproofing material. The elastomeric sheet membrane shall be installed at the locations shown on the Drawings or as directed by the Contract Administrator. Installation of the heavy-duty elastomeric sheet membrane shall be in accordance with the Manufacturer's recommendations.

AD31.17.12 The finished elastomeric sheet membrane top surface shall be lightly dusted with Normal Portland Cement. The quantity used shall be one bag of cement per 45 m^2.

QUALITY CONTROL

AD31.18 Inspection

AD31.18.1 All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.

AD31.18.2 The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

AD31.19 Access

AD31.19.1 The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

AD32. ASPHALTIC CONCRETE PAVING ON BRIDGE

DESCRIPTION

AD32.1 This Specification shall cover all operations relating to the supply of labour, equipment, tools and material necessary for the application of tack coat and the placing and compaction of the asphaltic hot mix overlay on the bridge deck, roof slabs, and approach slabs. The thickness of the overlay shall be as specified on the Drawings.

AD32.2 The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, handling and storage, and all things necessary for and incidental to the satisfactory performance and completion of all Work as herein specified and as indicated on the Drawings.

AD32.3 Scope of Work:

(a) Surface preparation of the bridge deck, roof slabs, and approach slabs;

(b) Supplying and applying the tack coat;

(c) Supplying, hauling, placing and compacting of asphaltic hot mix (overlay) on the bridge deck, roof slabs, and approach slabs, including all work at the joints; and,

(d) The quality control (QC) testing of all materials.

REFERENCES

AD32.4 All related Specifications and reference Standards are in accordance with the most current issue or latest revision:

(a) City of Winnipeg's Specification CW 3410 (latest edition) - Asphaltic Concrete Pavement Works; and,

(b) AD31 Rubberized Asphalt Waterproofing.

SUBMITTALS

AD32.5 In addition to Specification CW 3410 - Asphaltic Concrete Pavement Works, the Contract shall submit the following to the Contract Administrator fourteen (14) days prior to the Work, the proposed mix design and test results for verification and approval.

MATERIALS

AD32.6 The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

AD32.7 Tack Coat and Bituminous Pavement

AD32.7.1 The tack coat and bituminous pavement for the class specified on the Drawings shall conform to the requirements of the Specification CW 3410 - Asphaltic Concrete Pavement Works

AD32.8 Caulking Compound and Miscellaneous Joint Materials

AD32.8.1 Caulking compound and miscellaneous joint materials shall be as shown on the Drawings or approved by the Contract Administrator.

CONSTRUCTIONS METHODS

AD32.9 Surface Preparation

AD32.9.1 The bridge deck, roof slabs, and approach slabs shall be thoroughly cleaned by means of a power broom and compressed air. All surfaces to which the tack coat is to be applied shall be dry and fee from scale, dirt, grime, grease, oil or other contaminants.

AD32.10 Application of Tack Coat

AD32.10.1 Tack coat shall be applied to the entire surface of the deck, roof slabs, and approach slabs. The quantity used shall not exceed 550 mL/m2. Curbs and all other like appurtenances having a vertical face shall receive a brushed-on application of tack coat to the height of the compacted asphalt mat. All puddles or other excess of the tack coat shall be thoroughly spread out by brushing the material over the surrounding surface.

AD32.10.2 The vertical surfaces of the curbs and all other like appurtenances and the bridge deck areas within one foot of such abutting surfaces, shall receive a further coating of paving grade (150/200 penetration) asphalt cement.

AD32.10.3 The treated surface shall be allowed to cure until it becomes tacky before applying the asphalt mix.

AD32.10.4 Distribution

(a) The distributor used in applying the liquid bituminous tack coat shall be of a type, size and equipped as to meet the following requirements:

(i) It shall be capable of applying bituminous tack coat on the deck, roof slabs, and approach slabs in accurately measured quantities;

(ii) It shall be equipped with:

- A heating unit capable of maintaining the asphalt in the tank at the specified temperature.
- A thermometer so placed as to accurately measure the temperature of the material in the tank.
- A tachometer operated by an independent wheel, or a similar suitable device, that will allow the operator to determine the correct travel speed for applying the specified quantity of asphaltic material.
- A pressure gauge to indicate to the operator that the required nozzle pressure is being maintained.
- Spray nozzles, with quick acting positive shutoff, of a design which will ensure a uniform fan-shaped spray.
- A strainer on the discharge line to prevent clogging.
- A spray bar of adjustable length that can be raised or lowered.
- A spray bar having a heating device, asphalt circulation system, or other device which will provide a uniform viscosity of material in all portions of the spray bar.
- A hose and nozzle attachment to be used for spraying, by hand, areas inaccessible to the distributor spray bar.

(iii) On smaller bridge decks, the use of manual spraying equipment suitable for applying the liquid bituminous material uniformly at the desired rate will be allowed.

AD32.11 Transportation of Bituminous Pavement Mixture

AD32.11.1 The mixture shall be transported from the mixing plant to the job site in vehicles with tight boxes having metal bottoms previously cleaned of all foreign materials. When directed by the Contract Administrator, the vehicles shall be suitably insulated. Each vehicle shall be equipped with a closely fitting tarpaulin of canvas or other suitable material of sufficient size to overhang the truck box on all sides when the vehicle is loaded. Tarpaulins shall be used to completely cover the mixture at all times, even during the placing of the load into the spreader.

AD32.11.2 All loads not properly covered will be rejected.

AD32.12 Placing Asphaltic Concrete Paving Mixture

AD32.12.1 The Contractor shall spread the asphalt pavement mixture by means of a self-propelled mechanical paver complete with screed. The paver shall be equipped with both automatic and manual controls capable of adjusting the screed to produce the required profile, cross section and longitudinal joint matching. Unless otherwise permitted the paver shall be operated using automatic controls. The automatic control of profile shall be accomplished by reference to a floating beam or skid. The beam or skid shall have a minimum length of 9 metres. A floating beam shall be supported by wheels or skis in a floating tandem arrangement. The number and arrangement of wheels or skis and the nature of the beam or skid shall be subject to the Engineer's approval. When paving adjacent to a newly laid lane on final lift or adjacent to a curb, control of profile may be accomplished by reference to a shoe on the adjacent final lift or curb.

AD32.12.2 The paver shall produce a uniformly textured surface free from tearing, tracking or other objectionable surface irregularities. If the surface condition is not acceptable, spreading operations shall cease until equipment adjustments, repairs or replacement are made. Spreading operations shall not recommence without the approval of the Contract Administrator. Delays and expense entailed in adjustments, repairs or replacement of equipment shall be the responsibility of the Contractor.

AD32.12.3 The paver shall proceed in the same direction as the lap of the protection board and the sequence of spreading operations with respect to lanes and lifts shall be approved by the Contract Administrator.

AD32.12.4 The spreader shall be capable of spreading the mixture true to the elevations, grades and crown as shown on the Drawings. The allowable variation in the bituminous pavement surface shall not exceed 6 mm when measured using a 3 meter straight edge. Particular attention shall be paid to the setting of the spreader when laying the mixture in the areas adjacent to protruding joints in order to avoid bumps in the areas of such joints. In correcting the areas adjacent to a joint or when removing excess mixture, the material shall be picked up and not cast on the surface of the freshly spread bituminous pavement.

AD32.12.5 Immediately after the course is screeded, and before roller compaction is started, the remainder of the surface shall be checked, all inequalities adjusted, and all high spots removed and replaced with satisfactory material. Irregularities in alignment and grade along the curb shall be corrected by the addition or removal of mixture before the edge is rolled.

AD32.12.6 The speed of the spreader shall be maintained at a uniform rate that is in balance with the amount of bituminous pavement mixture being delivered to the bridge site.

AD32.12.7 The Contractor shall apply a tack coat between successive lifts as approved by the Contract Administrator.

AD32.13 Compaction of Asphalt Overlay Mixture

AD32.13.1 The breakdown and finishing operations shall be carried out by a steel three-wheeled or tandem roller. The intermediate rolling shall be done by a self-propelled pneumatic-type roller. Delays in rolling freshly-spread mixture will not be tolerated.

AD32.13.2 All areas next to vertical curb median faces and protruding deck joints shall be worked with hot iron tampers, mechanical vibratory tempers or by other means satisfactory to the Contract Administrator.

AD32.14 Construction Joints in Asphalt Overlay

AD32.14.1 Longitudinal and transverse joints shall be made in a careful manner in order to assure a well-bonded, sealed and level joint. A transverse joint shall be cut back to its full depth perpendicular to the mat at the end of the run. On resuming laying of the paving mixture, the exposed edges shall be painted with a thin coat of hot asphalt cement.

AD32.14.2 Before placing the paving mixture against them, all contact surfaces of longitudinal joints, curbs, leaders, etc., shall be painted with a thin coat of hat asphalt cement, as well as heated with a propane joint heater.

AD32.14.3 The allowable variation in the surface across a transverse joint shall not exceed 6 mm when measured using a 3 m straight edge centred on the joint.

AD32.14.4 In raking joints, excess mix material shall be picked up and removed from the surface of the freshly spread asphalt.

AD32.15 Joints in Asphalt Overlay

AD32.15.1 When called for on the Drawings, the Contractor shall, after the completion of the asphalt paving, saw-cut the asphalt in the transverse direction for the full roadway width at every pier and abutment to the dimensions as shown on the Drawings. The joints shall then be constructed in accordance with the Drawings.

AD32.16 Weather

AD32.16.1 Paving asphalt to be laid to a compacted thickness of less than 40 mm shall not be started unless the air temperature is at least 10°C and rising, and not until all frost or moisture has evaporated to leave a dry surface. For greater thicknesses of asphalt pavement, the temperature requirement may be reduced to 5°C, providing the temperature is rising.

AD32.17 Protection of Exposed Bridge Surfaces

AD32.17.1 Utmost care shall be taken to prevent the surfaces of the curbs above the compacted asphalt mat, as well as the newel posts and approach railing, from being disfigured by materials such as tack coating, caulking compound, cement and asphalt mixture.

AD32.17.2 If the exposed surfaces are marred as a result of the Contractor's operations, restoration shall be made by the Contractor at his expense and to the satisfaction of the Contract Administrator.

QUALITY CONTROL/QUALITY ASSURANCE

AD32.18 Quality Control

AD32.18.1 The quality control testing by the Contractor shall meet the requirements specified in the Specification CW 3410 - Asphaltic Concrete Pavement Works.

AD32.19 Quality Assurance

AD32.19.1 All materials supplied by the Contractor to be permanently incorporated in the finished product are subject to the inspection and approval of the Contract Administrator.

AD32.19.2 The Contractor shall take random field samples and conduct quality assurance tests on the materials, including the asphalt hot mix as directed by the Contract Administrator. If any material or the asphalt hot mix is proven to be of inferior quality, the Contract Administrator will reject such material.

AD32.19.3 In cases where bituminous pavements have already been laid and are proven in later tests to be inferior, the Contractor shall remove such material and replace it with proper material at his own expense.

AD33. SUPPLY AND INSTALLATION OF EXPANSION JOINTS

DESCRIPTION

AD33.1 This Specification shall cover the supply and installation of expansion joints and it components, traffic barrier mounting plates, cover plates, end plates, nuts and anchors, as shown on the Drawings and as specified herein.

AD33.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory performance and completion of all Work hereinafter specified.

AD33.3 MATERIALS

AD33.4 General

AD33.4.1 The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

AD33.4.2 All materials supplied under this Specification shall be of a type acceptable to by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.

AD33.5 Epoxy Adhesive

AD33.5.1 Epoxy adhesive shall be ST 431, Dural Duralbond, Copper Capbound E, Sikadur 32 Hi-bond, Concresive 1001 LPL, or approved equal as accepted by the Contract Administrator.

AD33.6 Epoxy Adhesive Strip

AD33.6.1 Epoxy adhesive strip shall be 50 mm wide Flex-Tred nonslip adhesive strip or approved equal as accepted by the Contract Administrator.

AD33.7 Epoxy Grout

AD33.7.1 Grout shall be non-metallic, non-shrink grout of a type approved by the Contract Administrator.

AD33.8 Grout

AD33.8.1 Grout shall be nonmetallic and nonshrink grout. Acceptable grouts are: Master Builders Set Nonshrink Grout, Sika Grout 212, Sternson M-Bed Standard Grout, CPD Nonhrink Grout, or approved equal as accepted by the Contract Administrator.

AD33.9 Expansion Joints

AD33.9.1 The modular expansion joints shall be a Wabo Modular Joint System, as specified in the Drawings, and supplied by D.S. Brown, Goodco, or Watson Bowman Acme Corp., or approved equal as accepted by the Contract Administrator.

AD33.9.2 Modular expansion joints shall have fabricated cover plates and slider plates as shown on the Drawings.

AD33.9.3 The seals at each joint shall be made out of neoprene, as accepted by the Contract Administrator and shall be supplied in one continuous piece, separate from the steel extrusions or joint. No shop or field splicing will be allowed in the seals.

AD33.9.4 All fasteners and hardware of the modular bridge deck expansion joints shall be galvanized in accordance with ASTM A123 to a minimum net retention of 610 gm/m^2.

AD33.10 Steel

AD33.10.1 Steel supplied for the fabrication of the bridge deck expansion joints shall conform to CSA Standard CAN/CSA-G40.21-04, Grade 300W, or approved equal as accepted by the Contract Administrator. They shall be galvanized after shop fabrication in accordance with ASTM A123 to a minimum net retention of 610 gm/m^2.

AD33.11 Steel Extrusions

AD33.11.1 Steel for the extrusions shall conform to CSA Standard CAN/CSA-G40.21-04, Grade 230G minimum.

AD33.12 Anchor Studs

AD33.12.1 Anchor studs shall conform to the requirements of ASTM Specification A108-07, Grade Designation 1020 and shall be galvanized.

AD33.13 Miscellaneous Steel Items

AD33.13.1 Rods, cover plates, brackets and washer plates, slider plates, and all other associated steel items shown on the Drawings shall be fabricated from steel conforming to CSA Standard CAN/CSA-G40.21-04, Grade 300W and shall be galvanized in accordance with ASTM A123 to a minimum net retention of 600 gm/m^2.

AD33.14 Galvalloy

AD33.14.1 Galvalloy shall be as supplied by Metalloy Products Company, P.O. Box #3093, Terminal Annex, Los Angeles, California. Locally, this is available from Welders Supplies Ltd., 25 McPhillips Street.

AD33.15 Welding

AD33.15.1 Welding shall be of a low oxygen classification. Manual electrodes shall be E7016 or E7018. All welding shall be in accordance with CSA Standard W59-03.

AD33.16 Preformed Neoprene Joint Seals

AD33.16.1 General

(a) Preformed joint seal shall be manufactured from a vulcanized elastomeric compound using crystallization resistant polychoroprene (neoprene) as the only polymer; and,

(b) The preformed neoprene joint seal shall meet the requirements of Ontario Provincial Standard Specification (OPSS) 1210 "Material Specification for Preformed Neoprene Joint Seals", latest edition, and as amended herein; and of Table AD33.1 of this Specification. All tests will be made on specimens prepared from the extruded seals.

EQUIPMENT

AD33.17 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

FABRICATION

AD33.18 The Contractor shall submit to the Contract Administrator detailed Shop Drawings for the bridge deck expansion joints that are stamped, signed and dated by a Professional Engineer registered or licensed to practice in the Province of Manitoba in accordance with AD1. Shop Drawings. No fabrication shall commence until acceptance of the shop drawings from the Contract Administrator has been obtained. The complete expansion joint shop fabrication and installation shall be done by or under the direct supervision of a trained factory representative, who shall be responsible for the joint installation procedure.

AD33.19 Care shall be taken to ensure that all members are straight and flat and free from twists, bends, and distortions due to welding. The units shall be shop assembled and checked for matching of sliding surfaces, correct cross-fall and skew, as well as accurate positioning and alignment of supporting brackets. The Contractor shall exercise care in the handling of all units to prevent twists, bends, and warping.

AD33.20 Matching expansion joints shall be assembled and bolted together for shipping.

AD33.21 Expansion joint assemblies shall be shop checked for fit and match marked.

AD33.22 All metal surfaces to be galvanized shall be cleaned thoroughly of rust, rust scale, mill scale, dirt, paint, and other foreign material by commercial sand, grit or shop blasting, and pickling prior to galvanizing. Heavy deposits or oil and grease shall be removed with solvents prior to blasting and pickling.

AD33.23 In no case shall weldments be substituted for extrusion shapes.

CONSTRUCTION METHODS

AD33.24 Installation

AD33.24.1 The Contractor shall install expansion joints as shown on the Drawings and shall be responsible for the correct matching and seating of parts. The expansion joints shall be checked for accurate matching of sliding plates with the bridge deck expansion joints installed at the specified skews and crossfalls.

AD33.25 Galvanizing Touch-up Prior to Placement of Concrete

AD33.25.1 Any areas of damaged galvanizing and field welds are to receive field applied galvanizing.

AD33.25.2 Surfaces to receive field applied galvanizing shall be cleaned using a wire brush, a light grinding action, or mild blasting to remove loose scale, rust, paint, grease, dirt, or other contaminants. Preheat the surface to 315°C and wire brush the surface during preheating. Rub the cleaned preheated area with the repair stick to deposit an evenly distributed layer of zinc alloy. Spread the alloy with a wire brush, spatula, or similar tool. Field applied galvanizing shall be blended into existing galvanizing of surrounding surfaces and shall be buffed and polished if required to match the surrounding surfaces. Care shall be taken to not overheat surfaces beyond 400°C and to not apply direct flame to the alloy rods.

AD33.25.3 The process is to be repeated as required to achieve a thickness comparable to original galvanizing.

AD33.26 Placement of Concrete at Expansion Joints

AD33.26.1 The assemblies shall be set in position such that they will remain true to line and elevation during and after concreting.

AD33.26.2 Care shall be taken during compaction of the concrete to ensure that there are no voids in the concrete under and around the structural steel components.

AD33.26.3 Before concreting, the expansion joint opening shall be set to give the correct width for the mean concrete temperature of the deck. The width shall be obtained from the installation temperature table given on the accepted shop drawings.

AD33.26.4 Immediately prior to placement of concrete at the expansion joints, all metal contact surfaces between the expansion joint and concrete shall be coated with epoxy adhesive.

AD33.26.5 Epoxy grout shall be used to fill any bolt holes left after the removal of manufacturer's clamping channels.

AD33.27 Installation of Seal

AD33.27.1 The seal at each expansion joint unit shall be installed as one continuous piece after completion of all concreting operations, to the satisfaction of the Contract Administrator, and shall **not** be installed prior to casting of the expansion joints into the concrete.

AD33.28 Watertight Verification of Joint Seal

AD33.28.1 Prior to installing the expansion joint and barrier cover plates, the Contractor shall dyke off the expansion joints and maintain a minimum of 75 mm of water over all areas of the seal for a period of not less than four (4) hours, with no leakage. Any and all leaks shall be corrected, using mechanical or other adjustment of the expansion joints to the satisfaction of the Contract Administrator. In no case shall caulk or other temporary devices or materials be used to seal leaks in the expansion joints. The Contract Administrator's decision in this regard shall be final.

AD33.28.2 Prior to commencing the test, the Contractor shall remove all expansion joint forming materials and debris from the deck and from the substructure units below. The Contractor shall provide safe access, acceptable to the Engineer, to the pier tops for inspection of the expansion joints during testing.

GUARANTEE

AD33.29 Fabrication Warranty

AD33.29.1 Before final acceptance of the expansion joints by the Engineer, the Contractor shall provide the Department with a written warranty from the expansion joint supplier stating that they will perform satisfactorily within the design range of movement and under the design loads for a period of five (5) years from the date of Completion, provided that the expansion joints have been properly installed, acceptable to the Contract Administrator. The Supplier shall state that they have observed the installation and found it to be in accordance with their recommended procedure. The Supplier shall warranty the replacement of the joints, including removal of the defective expansion joint assemblies

and supply and installation of the replacement expansion joint, at no cost to the City of Winnipeg, in the event that the joint does not perform satisfactorily within the design range of movement and under the design loads for a period of five (5) years from the date of Completion.

AD33.30 Installation Warranty

AD33.30.1 The Contractor shall ensure that the expansion joints are installed in such a manner that will not void the fabrication warranty.

AD33.30.2 Similar to the expansion joint Supplier, and prior to final acceptance by the Contract Administrator, the Contractor shall warranty, in writing, the performance of the expansion joints for a period of five (5) years from the date of Total Performance. The Contractor shall provide in the warranty for the replacement of the expansion joints at no cost to the City of Winnipeg, including all direct and indirect costs in the event the expansion joints do not perform satisfactorily in the range of design movement and under the design loads for a period of five (5) years from the date of Total Performance.

QUALITY CONTROL

AD33.1 General

AD33.1.1 All workmanship and all materials furnished and supplied under this Specification are subject to the close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.

AD33.2 Markings

AD33.2.1 All joint seals shall be identified as to the manufacturer by means of a continuous permanent mould mark. The mould marks shall be registered with the Contract Administrator and shall be used on all seals produced by the respective manufacturer. The seal shall also be permanently marked, on the side of the seal, with the date of production and the batch/lot, at intervals of not more than 1.2 m.

AD33.2.2 The Contractor shall supply to the Contract Administrator a summary of the seals identifying the data of manufacture, the batch/lot, and the proposed installation location.

AD33.3 Samples and Testing Procedures

AD33.3.1 The Contractor shall supply sample material at no charge to the Owner for quality control testing purposes. The samples will each be 1.5 m long. Each sample will represent not more than three expansion joint seals of the same size, lot, and make and shall be continuous with same until sampled by the Contract Administrator. As soon as the seals to be used in the joint assemblies have been manufactured, they shall be available to the Contract Administrator for sampling.

AD33.3.2 Testing procedures will be in accordance with the latest revisions of the methods indicated on Table AD33.1.

AD33.3.3 All materials failing to meet the Specification requirements will be rejected.

AD33.3.4 Lots rejected may be culled by the supplier and, upon satisfactory evidence of compliance with the Specifications, will be accepted.

Table AD33.1 Physical Requirements		
PROPERTY	**PHYSICAL REQUIREMENTS**	**TEST PROCEDURE***
1.Tensile Strength	Minimum 13.5 MPa	ASTM D412 OPSS 1210.07.03.01.02
2.Elongation at Break	Minimum 250%	ASTM D412 OPSS 1210.07.03.01.02
3.Hardness, Type A Durometer	55, +7, -5	ASTM D2240 OPSS 120.07.03.01.03
4. Oven Aging Test 70 Hour at 100°C Reduction in Tensile Strength Reduction in Elongation Increase in Hardness	 Maximum 20% Maximum 20% Maximum 10 Points	ASTM D573
5. Permanent Set at Break	Maximum 10%	ASTM D412
6. Low Temperature Stiffening Hardness, Type A Durometer	Maximum 15 Points	ASTM D2240 OPSS 1210.07.03.01.03
7. Oil Swell, ASTM Oil No. 3 70 H at 40°C (wipe with toluene to remove surface contamination)	No Cracks	ASTM D1149
9.**Safe Compressibility Test (Z min.) Bridge Seal - # 63.5 mm > 63.5 mm	 Min. 50% Min. 55%	OPSS 1210.07.03.01.04
10.**Pressure Generation at 15% Deflection	Min. 20 kPa	OPSS 1210.07.03.01.04
11.**Recovery 22 h at –28°C 70 h at –10°C 70 h at +100°C	 Min. 80% No Cracking Min. 88% Splitting or Min. 85% Sticking	OPSS 1210.07.03.01.05

* ASTM - American Society for Testing and Materials
OPSS - Ontario Provincial Standard Specification

** This physical requirement not applicable to lock-in type joint seals

AD34. ALUMINUM PEDESTRIAN HANDRAIL

DESCRIPTION

AD34.1 General

AD34.1.1 This Specification covers all operations relating to the supply and installation of the aluminum pedestrian handrails, including the bicycle handrail, specified herein and as shown on the Drawings.

AD34.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

AD34.2 Referenced Specifications and Drawings

AD34.2.1 The latest edition and subsequent revisions of the following:

(a) ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate;

(b) ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes;

(c) ASTM B276 – Standard Specification for Stainless Steel Bars and Shapes;

(d) ASTM D1187 – Standard Specification for Asphalt-Base Emulsions for use as Protective Coatings for Metal;

(e) CAN/CSA W47.2 – Certification of Companies for Fusion Welding of Aluminum;

(f) CAN/CSA W59.2 – Welded Aluminum Construction; and,

(g) CAN/CSA S157 – Strength Design in Aluminum.

AD34.3 Submittals

AD34.3.1 The Contractor shall submit to the Contract Administrator for review and approval, at least five (5) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

AD34.3.2 The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the scheduled commencement of any fabrication, the proposed Shop Drawings showing all fabrication details of the aluminum pedestrian handrail. Fabrication shall take place as shown on the Drawings.

AD34.3.3 The Contractor shall submit to the Contract Administrator for review and approval, at least five (5) Business Days prior to the scheduled commencement of any fabrication, the operator's qualifications and mill certificates.

AD34.3.4 The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the scheduled commencement of any fabrication, the City of Winnipeg Specifications proposed welding procedures and welding consumable certificates.

(a) The Contractor shall submit copies of the welding procedures which he intends to use, for examination and acceptance by the Contract Administrator;

(b) Such procedures shall be accompanied by documentary proof that they have been qualified previously by the Canadian Welding Bureau at the plant where the Work is to be carried out; and,

(c) The procedures shall include the following information: joint type, welding process, welding position, base metal specification, welding consumable specification and size, preheat requirements, amperage and voltage requirements, speed, polarity, and welding equipment, including a description of travel for automatic welding

MATERIALS

AD34.4 General

AD34.4.1 The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.

AD34.5 Material for the Aluminium Pedestrian Handrail

AD34.5.1 Extruded Shapes or Drawn Tubing for Rails and Posts: shall conform to the latest edition and all subsequent revisions of CAN/CSA Aluminum Alloy and Temper HA.5 SG 11 R-T6 (ASTM B221 Alloy 6351-T6), or HA.7 GA 11 M-T6 (ASTM B221 Alloy 6061-T6). Aluminum sheet, bar, support pin, angle, and plate shall conform to the latest edition and all subsequent revisions of ASTM B221- Alloy 5083, ASTM B209 Alloy 6061-T6 or Alloy 6351-T6.

AD34.5.2 Bolts and cap screws, nylon lock nuts, and washers - stainless steel conforming to ASTM A276, Type 316.

AD34.6 Bituminous Paint

AD34.6.1 Bituminous paint shall be an alkali-resistant coating and conform to the requirements of ASTM D1187.

AD34.7 Handrail Anchorage System

AD34.7.1 The handrail anchorage system is specified on the Drawings.

AD34.8 Aluminum Shims

AD34.8.1 Aluminum shims shall conform to ASTM Standard B221, Alloy 6061-T6, and shall be supplied as required to facilitate the installation of the rail posts as shown on the Drawings.

AD34.9 Aluminum Filler Alloys for Welded Construction

AD34.9.1 Aluminum filler alloys for welded construction shall be one of the following: ER4043, ER5183, ER5356, ER5554, ER5556, or ER5654.

AD34.10 Hinges

AD34.10.1 Hinges shall be stainless steel and manufactured by Angama, Type STBB 460, or equal as approved by the Contract Administrator.

AD34.11 Equipment

AD34.11.1 All equipment shall be of a type acceptable to the Contract Administrator and shall be in good working order.

CONSTRUCTION METHODS

AD34.12 Layout

AD34.12.1 Before fabrication and/or installation of the aluminum pedestrian handrail, the Contractor shall satisfy himself of all required aluminum rail and enclosure section dimensions, by field measurements.

AD34.13 Fabrication

AD34.13.1 General

(a) No fabrication shall commence until permission to do so has been received from the Contract Administrator;

(b) All fabrication shall be carried out in accordance with this Specification and the Drawings;

(c) The Fabricator shall fabricate the entire aluminum pedestrian handrail in sections, to permit the installation of the rail sections onto the concrete;

(d) The punching of identification marks on the members will not be allowed;

(e) Any damage to members during fabrication shall be drawn to the attention of the Contract Administrator in order that the Contract Administrator may accept remedial measures;

(f) Dimensions and fabrication details which control the field matching of parts shall receive very careful attention in order to avoid field adjustment; and,

(g) Components of the railings and enclosures shall be joined by means of bolt, cap screws, and welds as called for on the Drawings.

AD34.13.2 Sample Panel

(a) The Contractor shall be required to supply one completely fabricated handrail sample panel, including at least two posts, to the Contract Administrator and receive acceptance of the sample panel from the Contract Administrator prior to proceeding with the fabrication of the remainder. The sample, once accepted, shall be identifiable for the duration of the Project, but may be incorporated into the rail system. It shall become the standard for acceptance of all aluminum pedestrian handrail panels.

AD34.13.3 Cutting

(a) Material 13 mm thick or less may be sheared, sawn, or cut with a router. Materials more than 13 mm thick shall be sawn or routed. Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Re-entrant cuts shall be avoided whenever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.

AD34.13.4 Welding

(a) Welded construction shall conform to the requirements of the latest edition and all subsequent revisions of CAN/CSA W59.2, Welded Aluminum Construction and W47.2, Certification of Companies for Fusion Welding of Aluminum;

(b) Welding will be done by qualified welders using the Metal Inert Gas (MIG) process. All areas to be welded should be thoroughly cleaned with a suitable solvent followed by wire brushing if surfaces are heavily oxidized. The size of fillet for equal leg fillet welds is defined as the leg length of the largest isosceles right angle triangle which can be inscribed within the fillet weld section. Welds must penetrate into the root corner. All butt welds should have full penetration to ensure maximum strength. Defective welds should be repaired by chipping out the defective area and rewelding. Particular care must be paid to the elimination of craters and cold starts;

(c) Welders and procedure should be qualified as agreed between the Contract Administrator and the Fabricator. The minimum requirements for mechanical test results of joints butt welded with Alcan 56S filler alloy shall be 259 MPa for Alcan D45S-H1 1A and 165 MPa for Alcan B51S-T4 alloy. In addition to the mechanical tests, soundness tests should be made as follows;

(d) Guided Bend Test: All bend tests should be fully guided through an angle of 180o. Root, face, and side bend tests in Alcan D54S parent alloy welded in Alcan 56S filler wire require a bend radius of 2T where T is the thickness of the material. For Alcan B51S parent alloy welded with 56S filler wire, a bend radius of 4T is required. Root bend and face bend specimens on material 10 mm thick and less should be 305 mm long and a minimum of 25 mm in width and cut from a plate having a minimum butt weld length of 450 mm. No test piece should be taken within 25 mm of the ends of the weld. Side bend tests should be carried out on material over 10 mm in thickness;

(e) Specimens should be 10 mm in width. Longitudinal edges should be given in 2 mm radius. There should be no crack greater than 3 mm in length. If a crack starts from an edge, the specimen should be disregarded; and,

(f) Fracture Test: The butt-welded joint shall have a notch not exceeding 2 mm in depth sawn on the four sides of the weld bend and the weld broken. Inspection of the fracture should reveal no gas pockets or inclusions greater than 2 mm in diameter and the area lost due to scattered gas, porosity or voids should not exceed 3% of the area under inspection.

AD34.13.5 Bolting

(a) Bolt holes in 10 mm or thinner material may be drilled or punched to finished size. In material thicker than 10 mm, the holes shall be drilled to finished size or subpunched smaller than the normal diameter of the fastener and reamed to size;

(b) The finished diameter of the holes shall be not more than 7 percent greater than the nominal diameter of the fastener, except;

(c) Slotted holes for expansion purposes shall be provided as required on the Drawings;

(d) Holes for anchor bolts may be up to 50 percent greater than the nominal bolt diameter with a maximum of 13 mm greater than the nominal bolt diameter;

(e) Holes shall not be drilled in such a manner as to distort the metal, but holes only slightly misaligned may be reamed to render a reasonable fit; and,

(f) In all bolts, the finished shank shall be long enough to provide full bearing, and washers shall be used under the nuts to give full grip when the nuts are tightened.

AD34.14 Installation of Aluminium Pedestrian Handrail

AD34.14.1 The aluminum pedestrian handrail shall be brought on-site and accurately installed as shown on the Drawings.

AD34.14.2 The rails shall be set true to the line and grade as shown on the Drawings or as required by the Contract Administrator.

AD34.14.3 The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged. Hammering which will injure or distort the member is not permitted. The Contractor shall report to the Contract Administrator any corrective measures.

AD34.14.4 Except where shown on the Drawings, field welding shall not be permitted unless acceptable to the Contract Administrator. The rail posts shall be set on aluminum shims, as required, to achieve the correct elevation and grade. Additional aluminum shims shall be installed as required to achieve the correct elevation and grade. The surface of the bottom shim that is in contact with concrete shall be separated with a minimum of two (2) coats of bituminous paint. A minimum 3 mm aluminum shim shall be installed under each post.

AD34.15 Quality Control

AD34.15.1 All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspecting or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.

AD34.15.2 The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

AD34.16 Access

AD34.16.1 The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required.

AD34.1 Testing

AD34.1.1 All materials supplied under this Specification shall be subject to inspection and testing by the Contractor as directed by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator.

RAILWAY

AD35. TRACK CONSTRUCTION

DESCRIPTION

AD35.1 Work Included

AD35.1.1 Provide all labour and equipment to construct trackage as shown on the Drawings and specified in this Specification. References to CN drawings within the Specifications and Drawings will be provided to any Contractor not in possession of the latest documents.

AD35.1.2 Track construction, turnout construction, ballasting, surfacing and welding shall be performed by foremen and laborers experienced in railroad track construction. Track will be constructed to the design alignment, dimensions and top of rail profile as indicated on the Drawings. Track construction consists of new trackage, turnout(s) and existing track reconfiguration in addition to removal and stockpiling of surplus material.

AD35.1.3 Obtain permits or approvals required and pay all permits and approval fees.

AD35.1.4 All other work as called for on the Drawings and/or described in the Specifications.

MATERIALS

AD35.2 Mainline rail shall be new 136 lb, CWR. All rail shall be control cooled, straight, and free of kinks and be in compliance with current AREMA Specifications, Chapter 4.

AD35.3 Taper rail shall be minimum second hand, one spot 136 lb. All rail shall be control cooled, straight, and free of kinks and be in compliance with current AREMA Specifications, Chapter 4. Rail joints are not to be located within crossing.

AD35.4 Turnout rail shall be new 136 lb. free of physical defects. All rail shall be control cooled, straight, and free of kinks and be in compliance with current AREMA Specifications, Chapter 4.

AD35.5 Wood ties for mainline usage shall be new 7” x 9” x 8.5’ track ties. All ties shall be hardwood grade ties, treated with a creosote-coal tar solution to a net retention of 9.2 lbs. per cubic foot minimum for mixed hardwoods and 7 lbs. per cubic foot minimum for oak. Wood ties shall conform to current AREMA Specifications, Chapter 30, “Ties”, for size, quality, treatment, and defects.

AD35.5.1 No ties will be accepted with the following defects;

(a) Broken tie – tie which is broken through;

(b) Split tie – tie split end to end for the entire depth of the tie;

(c) Split tie end – tie end split resulting in poor surface and gauge;

(d) Cut tie – tie which is rail or plate cut, or adzed to a depth of 1 inch or more;

(e) Crushed tie – tie which has the bearing surface under the rail crushed one inch or more;

(f) Spike killed tie – Condition is indicated by numerous splits at the tie end and/or loose or high spikes, wide gauge and poor alignment;

(g) Decayed tie – tie which is decayed and cannot hold spikes, gauge or surface;

(h) Damaged tie – tie which is damaged to a depth of 2 inches or more due to derailments, dragging equipment or fire; and,

(i) A break across the annular rings (commonly known as a "split") which is not over 8 inches long will be allowed. A split over 8” long or more than one split, or a split wider than ¼” at the face across which it occurs, will not be allowed.

AD35.5.2 Crossing ties shall be new 7” x 9”x 9’ track ties. All ties shall be hardwood grade ties, treated with a creosote-coal tar solution to a net retention of 9.2 lbs. per cubic foot minimum for mixed hardwoods and 7 lbs. per cubic foot minimum for oak. Wood ties shall

conform to current AREMA Specifications, Chapter 30, “Ties”, for size, quality, treatment, and defects.

AD35.5.3 Turnouts are to be new 136lb #12 TS-271, and must be in accordance with the current CN Standard Plans. Secondhand turnouts, if approved, must be of acceptable quality as determined by the Contract Administrator with no mismatch between rail, points or frog.

(a) All turnouts must have new hardwood switch ties;

(b) All turnouts must be equipped with adjustable braces;

(c) Minimum 14" tie plates are to be used in turnout construction;

(d) Switch machines shall be new with connecting rods, targets, and reflective tips as required; and,

(e) Secondhand turnout material is not to be painted.

AD35.5.4 Rail anchors shall be new or manufacturer certified refurbished, drive-on-type and of standard manufacture, as approved by the Contract Administrator, of the proper size to fit 136lb rail sections.

AD35.5.5 Tie plates shall be new, and measure a minimum of 7-1/2”x14” in size on tangent and 7-1/2”x16” on curves up to 6º .Curves over 6º shall have 16” plates. All plates shall have 6 spike holes. All tie plates are to be double shoulder with 1:40 cant, free of injurious defects and foreign material, and shall conform to current AREMA Specifications for 136lb rail.

AD35.5.6 Joint bars shall be new, in good condition, toeless type, free of foreign material and without injurious defects. They shall conform to current AREMA Specifications, and must be to the proper design and dimensions for the rail on which it is to be applied. 136lb joint bars shall have 6 bolt holes and measure a minimum 36” in length.

AD35.5.7 Compromise bars shall be new, in good condition, toeless type, free of foreign material and without injurious defects. They shall conform to current AREMA Specifications, and must be to the proper design and dimensions for the rails on which it is to be applied. Installed bars will be painted blue.

AD35.5.8 Track spikes must be new 5/8” square with reinforced throat design. All track spikes shall conform to current AREMA Specifications for High-Carbon Steel Track Spikes, Chapter 5, Part 2. Length of track spike under its head shall be 6 inches.

AD35.5.9 Track bolts with nuts must be new. Bolts and nuts shall conform to current AREMA Specifications. Bolts and nuts shall be to the appropriate size for the bolt holes in the rail section with length sufficient for a full nut and spring washer and 1/4” thread exposed.

AD35.5.10 New spring washers of the appropriate size to fit the track bolt used shall conform to current AREMA Specifications. Each track bolt shall receive one spring washer.

AD35.5.11 Tie plugs for softwood ties shall be new, creosote treated, and shall conform to current AREMA Specifications, Chapter 30. A chemical plug is required for hardwood ties.

AD35.5.12 Thermite field welding material for 136lb rail is to be as manufactured by Boutet or Orgotherm.

AD35.5.13 Crossing planks shall be new softwood treated 7”x10”x20’ prebored and meeting current CN standard.

AD35.5.14 Crossing lag bolts shall be new hex ¾”x12” complete with ¾” flat washer.

AD35.5.15 Track Panels shall be 136lb, in 39’ lengths, fully anchored and shall meet track standards as outlined in this Specification.

AD35.5.16 Rock ballast shall be as approved by CN. The gradation of the rock ballast is 2" minus in size with a minimal amount of fines as per CN Specification 12-20C Class 2. Walking ballast shall conform to AREMA Size No. 5, and meet the quality requirements as shown in the AREMA Table No. 1 and No. 2. All ballast shall be crushed to assure abrasive edges. Frozen ballast, at time of placement, will not be accepted.

(a) Contractor shall furnish written test results to the Contract Administrator that indicates the crushed rock ballast is accordance with the limiting values referenced above;

(b) Ballast to have a minimum count of particles with one or more fractured faces of 70% on each sieve size; and,

(c) The percent of wear due to abrasion shall be less than 30% for the ballast per ASTM C 131 "A" Grading.

AD35.6 Track Construction

AD35.6.1 Contractor shall exercise care in the unloading and distribution of track material and in the construction of trackage to avoid disturbing the surface of the subballast and the seeding and mulching on the side slopes. Any damage to either the subballast surface or side slopes caused by Contractor's operations shall be repaired at Contractor's expense to the satisfaction of the Contract Administrator. The Contractor shall provide for the movement and handling of and the laying of rail in such a manner as to avoid damage to new roadbed, subballast, and rail. Care must be exercised to avoid twisting or damaging rail. During handling, Contractor shall be responsible for damage to rail to the extent that sections thereof damaged, in the opinion of the Contract Administrator, unsuitable for use in track, such rail section shall be replaced at the sole expense of the Contractor. It is entirely up to the Contract Administrator to determine if any rails or portions thereof have been damaged.

AD35.7 Handling of Material

AD35.7.1 Contractor shall be responsible for all track material. Contractor's responsibility begins at his loading of materials, unloading of materials to ground at site locations, continues through its placement into the track structure and until final acceptance of the track by the Contract Administrator.

AD35.7.2 No additional compensation will be allowed for segregating or replacing materials of questionable quality or condition. After inspection by the Contract Administrator, the Contractor will be advised if material in question is suitable for use. If material is rejected by Contract Administrator, the Contractor will replace the rejected material at his expense.

AD35.7.3 The Contractor's responsibility for materials continues through its placement into the track structure and until final acceptance of the track by the Contract Administrator and CN. If materials are damaged, lost, or wasted through Contractor's negligence, poor workmanship or handling, Contractor shall replace said materials in kind at no additional cost.

AD35.8 Execution

AD35.8.1 Timber ties shall be unloaded and handled in such a manner as not to damage them, using approved handling equipment. Pulling timber ties into position with picks or shovels will not be permitted. Tie tongs shall be used for this purpose.

(a) Cross ties shall be placed at a design spacing of 20 ½" center to center except where crossing planks are to be installed they shall be placed at 19 ½" center to center. The cross ties shall be placed on the approved finished subballast, perpendicular to center line of track, with the right hand (in the direction of increasing stationing) ends of cross ties being parallel with and each end of the cross tie being the same distance from center line of track, except on curves, where cross ties are to be aligned to the inside of the curve. All rail joints/welds are to be suspended between ties;

(b) When both new and PW ties are being used only new ties shall be placed within 200 feet of any switch ties;

(c) If spikes are pulled from any timber tie, hole shall immediately be filled by driving in a treated wood tie plug the full depth of the hole in softwood ties or by injecting an approved chemical plug material in hardwood ties;

(d) Lay timber ties with heartwood face down, and if not possible to determine position of the heartwood, lay the widest surface of the timber tie down; and,

(e) Top surface of timber ties shall be clean and smooth to provide full bearing for tie plates. The bottom of the rail, the tie plate and the wearing surface of the timber tie shall be broom cleaned before the rail is laid.

AD35.8.2 Tie plates shall be used under running rails on all track where timber ties are placed.

(a) Tie plates should be free of dirt and foreign material when installed;

(b) Care must be exercised to see that canted tie plates are applied so as to cant the rail inward:

(i) Tie plates must be placed square with the rail and centered on the tie. Particular care must be given to see that the tie plate shoulders and spike heads are never under the base of the rail and that the tie plates are well seated with full even bearing on the ties and the rail is properly seated on the tie plate. After rails are in place, outside shoulder of tie plate shall be in full contact with outside edge of rail base.

(c) The same size tie plate must be used opposite one another on each cross tie. Plates from different manufacturers must not be intermixed;

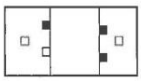
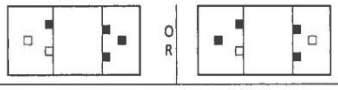
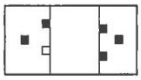
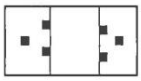
(d) Sweep off all granular material from ties prior to placement of tie plates;

(e) Sweep off all granular material from tie plates prior to placement of rail; and,

(f) Cutting or burning of tie plates is not permitted.

AD35.8.3 Cross ties shall be spiked as per Table 1.

Table 1

No.	SPIKING PATTERN Field Gauge	MGTs PER YEAR	DEGREE OF CURVE Tangent up to 2°	2° to 4°	4° to 6°	Greater than 6°
A		Other than Main Track	X	X	X	X
		0-20	X			
B		0-20		X	X	
		Greater than 20	X			
C		0-20				X
		Greater than 20		X	X	
D		Greater than20				X
		Turnouts Spiking pattern D will be applied to turnouts as per Figure 2 below 89				

AD35.8.4 Turnouts shall be spiked with Spike Pattern D from a point 39’ in front of the points to a point 39’ beyond the last switch tie on the tangent and to a point 39’ beyond the E.C. of the return curve.

AD35.8.5 Installation of joint bars complete with tightened bolts must occur before spiking rail.

(a) Uniform track gauge must be maintained when spiking and must be checked by use of standard track gauge;

(b) The right hand rail going in the direction of increasing stationing shall be spiked to cross ties, and the opposite rail shall be brought to standard gauge of 4'-8½" measured at right angles between the rails, 5/8" below the top of rail. Gauge to be checked at every third tie by using a tested and approved track gauge. Curves shall have gauge widened in accordance with the following table:

Degree of Curve	Gauge
10 degrees or less	4'-8½"
Greater than 10 degrees	Increased 1/16 inch per degree of curvature

(c) Spikes will be driven only with a standard spike maul, sledge hammer, pneumatic or hydraulic spiking hammer or spiking machine;

(d) All spikes shall be started and driven vertically with the face of the spike in contact with the base edge of the rail and so driven as to allow 1/8 inch to 3/16 inch space between the underside of the head of the spike and the top of the base of the rail. In no case shall the spikes be overdriven or straightened while being driven. When spikes are driven by machine, work shall be closely supervised to see that they are driven with a hammer centered exactly over each spike head and drive spike vertically. Set stop on the machine to prevent overdriving;

(e) No spike shall be within 2" of the end of a joint bar. Do not strike rail directly with a maul, either on top when driving, or on side to obtain track gauge; and,

(f) Withdraw spikes which are incorrectly driven and fill hole by driving a treated tie plug to full depth of hole in softwood ties or by injecting an approved chemical plug material in hardwood ties. Locate replacement spike at another hole in tie plate.

AD35.8.6 As required assemble temporary track rail joints before fastening rails to timber ties using joint bars with 4 track bolts and a spring washer for each bolt, first removing all dirt, loose mill scale, and rust from contact surfaces of joint bars and rails.

(a) Holes for track bolts shall only be drilled by an approved type of rail drill. Under no circumstances shall new holes be drilled between two holes already drilled;

(b) Rail joints shall be applied so that bars are not cocked between base and head of rail;

(c) If necessary to force joint bar into position, strike lower edge of bar lightly with 4 lb maul. Do not drive bolts in place. Under no circumstances shall rail be struck in web with tool or any metal object; and,

(d) Tighten bolts in sequence, beginning at joint center and working out to ends. Bolts to be tightened to torques required as per AD35.8.10(g). If a bolt tightening machine is not used, a standard track wrench with a 42" long handle may be used.

AD35.8.7 Insulated joints should be suspended, that is, the end post should not be over a tie.

(a) Plates must be used with all insulated joints on wood track ties. As shown on CN Plan TS-1206, insulated tie plates will be used on ties within 2" of the end post of an insulated joint;

(b) Rail ends where insulated joints are to be installed must conform to the following:

(i) The end face shall be saw cut and bolt holes drilled to the proper size and location for the rail section; and,

(ii) All rough edges and burrs shall be removed from the end face and bolt holes.

(c) All rust, scale, dirt or other foreign matter must be removed from the rail joint area and from the joint bars before the joint is installed;

(d) If the end post projects above the top of rail, it must be trimmed so that the top is below the top of rail, but not exceeding 1/8" below;

(e) Track near insulated joints shall be adequately anchored. Non-glued insulated joints will be considered as joints and will be anchored to the correct standard;

(f) Rail anchors must not be applied on the sides of ties adjacent to bootlegs; and,

(g) Rail end overflow must be removed at insulated joints by slotting in accordance with CN Plan TS-1113. The gap should be filled with silicone sealer to prevent the influx of dirt and grinding material.

AD35.8.8 Compromise Joints and Rails

(a) To determine the hand of the joint, face the joint from the center of the track. When the larger rail section is on the left side of the joint, it is a left hand joint. When the larger section is on the right, it is a right hand joint;

(b) A compromise joint consists of one gauge side and one field side. The rail sections that the compromise bar will fit are indicated at each end of the bar;

(c) Compromise joint bars must not be modified from their initial design to fit a different rail section. Rail shall only change by one rail weight per bar location;

(d) Compromise joints (except 132/136) must not be installed in turnouts, or within 20’ of an open deck bridge, turnout, highway crossing or railroad crossing; and,

(e) Compromise rails will be fully supported and tamped with the correct size tie plates under the corresponding rail section.

AD35.8.9 Derails shall be installed as per CN Plan TS 2208

(a) Derails are classified as either right or left hand. A right hand derail is installed on the right hand rail and derails toward the right:

(i) Care must be taken to ensure derails are located properly.

(b) Derails are to be installed such that in the derailing position the derail block covers the ball of the rail and lie flat on the top of the rail throughout the underside of the derailing block surface and will bear directly on sound ties;

(c) A steel shim, of the correct thickness and with holes punched or drilled for all fasteners, may be necessary under the derail to ensure the block lies flat on top of the rail;:

(i) Where 2” shims or extender/elevator plates are used, tie screws of 1” longer must be used.

(d) Ties, to which derails are fastened, must be sound and well tamped and have the top surfaces in the same plane:

(i) Tie plates are not to be installed at the derail location.

(e) Derails must be installed at right angles to the rail and will be fastened with1” x 6½” lag screws;

(f) Derails which have been manufactured to accommodate eight or more fasteners must be fastened with a minimum of eight fasteners:

(i) Where derails are manufactured to accommodate less than eight fasteners, all available holes must be used.

(g) Derails must be properly lubricated and adjusted for ease of movement;

(h) Derails must be painted yellow and have signs installed as per CN Plan TS 2208; and,

(i) Tracks equipped with a derail shall have the switch stand lever painted yellow.

AD35.8.10 The Contractor shall provide such equipment, tools, and materials necessary and required for turnout construction.

(a) Install turnouts in accordance with the appropriate standard plans;

(b) Rail gaps at turnout panels shall be welded;

(c) Minimum 14" Tie Plates are to be used in turnout construction;

(d) All switch ties must be as laid out on standard plans, properly spaced and square to through track. Switch ties are not to be cut;

(e) The turnout stock-rail must be bent horizontally, as shown on the standard plan. Only standard carbon and 3HB rail, in 115 lb section or smaller, may be field bent with an approved bender:.

For safety reasons, under no circumstances are head hardened rails or rails greater than 115 lb to be bent in the field.

(f) Ensure the switch point fits snugly against the stock rails for the entire length of the planed portion. Points will not overhang gauge plates nor be more then one inch back from front edge. Running surface of points will be ¼" above stock rail, as measured at the location where the distance between gauge face of stock rail and gauge face of switch point when tight against the stock rail is 4½";

(g) Bolt switches, frogs and guard rails fully. Provide washers and cotter pins for bolts. Grade 8 bolts are identified by six radial lines on the head of the bolt and are to be tightened as per:

Grade 8 Bolts

Size of Bolt		Torque
Inches		Ft-Lb.
1		840
1-1/4		1675
1-3/8		2500

(h) All turnouts must be fully spiked or fastened with tie screws and clips. Spikes are to be fully driven or timber tie screws drawn down;

(i) Switch stands will be located as per instructions issued by the Contract Administrator;

(j) Switch stands must be plumb, securely spiked, bolted or lagged to the head block ties. They must also be secured with lock or keeper as supplied;

(k) Standard throw of switch points as measured at the No. 1 switch rod and at the No.5 switch rod of turnouts equipped with auxiliary throw mechanism must be set in accordance with the appropriate standard plan;

(l) Switch rods and transit clips must not contact the side of the tie or the slide plate;

(m) All switch stands must be equipped with the appropriate reflectorized target assembly (in some locations a double bladed target tip is required). Target assemblies will be properly adjusted to display green when the switch is lined for the normal route and yellow when lined for the diverging route;

(n) Install switch rod bolts and connecting rod bolts, except the bolt under the switch stand, with the nut on the upper side to permit ready inspection of the cotter pin;

(o) Install the connecting rod bolt under the switch stand with the head on the upper side;

(p) Install cotter pins on all connecting and switch rod bolts;

(q) Position the handle on the switch stand so that when the switch is in the normal position it faces away from the frog and the track, and moves in the same direction as the points when the switch is lined for the diverging route. Switch handles of rigid switch stands will be adjusted such that they cannot be placed in locking position with normal pressure when 1/8" shim placed between point and stock rail at first rod;

(r) Lubricate switch stands, switch plates, connecting rod bolts and spring frogs properly after assembly;

(s) Stock rails must be properly seated in the switch plate, have no lateral movement in the plates and switch plates have no movement on the ties;

(t) Care must be taken in adjusting braces to avoid over-driving and rotating the stock rails out of the seat of the plate;

(u) Flangeways must be clear of obstructions and not less than 1½" deep, not less than 1¾" wide and not more than 2" wide;

(v) Guard Check Gauge:

(i) The minimum distance from the gauge line of a frog to the guard line of its guard rail or guarding face, as measured across the track at right angles to the gauge line is 4′-6¼″.

(w) Guard Face Gauge:

(i) The maximum distance between guard lines as measured across the track at right angles to the gauge line is 4′-5 1/8″.

(x) Fully anchor the rail on both tracks through turnouts except where anchors will interfere with switch points. Fully anchor for 200 feet in both directions beyond the turnout; and,

(y) Once installed, line new turnouts for through movement and spike the switch point. Switch points shall remain spiked until inspected by the Contract Administrator.

CONSTRUCTION METHODS

AD35.9 The method and equipment used by the Contractor in handling and movement and the laying of rail will be subject to the approval of the Contract Administrator.

AD35.9.1 Rail shall be free of dirt and foreign material when installed

AD35.9.2 Rail will only be cut square and clean by means of a rail saw with all burrs removed. Torch cut rail will not be allowed to remain in the track. When sawing rail for reuse saw cut must be made at least 4” (100 mm) from any torch mark on the rail.

AD35.9.3 The Contractor will ensure that rails are laid such that gauge faces of rail are matched according to their previous position in track such that the gauge side remains the gauge side.

AD35.9.4 Rail must not be struck with mauls, sledgehammers or other heavy objects.

AD35.9.5 Rail of different chemistries or manufacturers shall not be mixed in any given stretch. Use compromise bars to join rails of different sections. Bars which join rails of more than one weight difference are not allowed.

AD35.9.6 Jointed rail shall be laid with staggered joints. The stagger between joints of opposite rails must not be less than 12 feet. Rail joints must be kept clear of crossing planks and be a minimum of 20’ from the end of planks.

AD35.9.7 Rail temperature shall be measured periodically throughout the day with at least two accurate thermometers placed on the base of the rail near the web, away from wind and out of the direct rays of the sun and away from all sources of artificial heat or cold. The thermometer shall be left in place for at least 10 minutes prior to taking a reading. A pyrometer may also be used to measure rail temperature.

(a) When using pyrometers to determine rail temperature, the pyrometer should be pointed into the shaded portion of the web of the rail. Rail temperature must be taken at intervals of approximately 150’.

AD35.9.8 Expansion space between rail ends must be provided. Expansion space of the proper dimension between rail ends can be obtained through the use of shims of the correct thickness as per tables below.

Table 5-5-4. Rail End Openings for Allowance of Expansion

33-Foot Rail 160 Joints per Mile		39-Foot Rail 135 Joints per Mile		78-Foot Rail 68 Joints per Mile	
Rail Temperature Degrees F	**Expansion Inches**	**Rail Temperature Degrees F**	**Expansion Inches**	**Rail Temperature Degrees F**	**Expansion Inches**
Below –10	5/16	Below 6	5/16	Below 35	5/16
–10 to 14	1/4	6 to 25	1/4	35 to 47	1/4
15 to 34	3/16	26 to 45	3/16	48 to 60	3/16
35 to 59	1/8	46 to 65	1/8	61 to 73	1/8
60 to 85	1/16	66 to 85	1/16	74 to 85	1/16
Over 85	None	Over 85	None	Over 85	None

AD35.9.9 Fibre, hardwood, or metal shims may be used to obtain the proper expansion space by bringing rail ends squarely together against the expansion shims. Expansion shims must not be removed until the rail is properly spiked, the bolts tightened and rail anchors applied.

AD35.9.10 When new rail adjoins rail previously in track the old rail will be built up by welding at the joint to protect the end of the new rail.

AD35.9.11 Rail is to be placed to avoid mismatch however where rail end mismatch exceeds ¼" on the top or the gauge side of a rail joint, it shall be reduced by grinding, welding or replacement of the rail.

AD35.9.12 Rail ends with excessive flow will be repaired by slotting. Crushed or battered rail ends will be cut off.

AD35.9.13 Nicked or gouged rail shall be rejected and replaced as determined by the Contract Administrator at the sole cost of the Contractor for any rail damage due to the Contractor's handling. This includes the cost of the replacement rail, transportation, welds, and any associated costs in the change out of the defect.

AD35.9.14 Upon completion of the days work, all rail laid must be fully spiked, bolted and anchored.

AD35.10 All cross ties shall be anchored to a minimum box pattern of 8 ties per 39'. The same ties on opposite rails shall be boxed.

AD35.10.1 Only the proper tools or machines will be used when applying or removing anchors. The use of spike mauls is prohibited. When applying anchors by machine ensure the machine is properly adjusted.

AD35.10.2 Anchors must be installed from gauge to field side of rail to insure full bearing surface against the side of the tie, bearing against the adjacent tie and remain tight on the rail. Anchors must be on the same side of the same tie on both rails. Ties are to be at right angles to the rail before applying anchors. Anchors improperly installed will be removed and applied correctly without additional charge by the Contractor. Anchors will only be removed when the rails is still in the track and done such as to prevent damage to the anchor or rail.

AD35.10.3 Anchors must be fully driven; however, care must be taken to avoid over-driving as this may fracture or spread the metal, resulting in loss of holding power. Any rail anchor that is fractured or with metal spread will be rejected and replaced with another anchor at the Contractor's expense.

AD35.10.4 Anchors shall be installed only to the rail section for which they are designed and shall only be the same type of anchor to any one tie.

AD35.10.5 Care must be exercised in the spacing of anchors to ensure that no anchors are located on any tie under or adjacent to the ends of a rail joint bar, bond wires, insulated joints or other signal or track appliances.

AD35.10.6 Anchor rail immediately after laying.

AD35.10.7 Bumping posts shall have 10 ties in front of and all ties behind fully box anchored.

AD35.11 CWR

AD35.11.1 The Contractor shall provide such equipment, tools, and materials necessary and required for welded rail track construction.

AD35.11.2 Definitions

(a) Continuous Welded Rail (CWR) is rail welded into lengths of 400 feet or more;

(b) Rail Laying Temperature (RLT) is the actual temperature at which the CWR is laid;

(c) Preferred Rail Laying Temperature (PRLT) is the target installation temperature of welded rail in a particular area. For this location the PRLT is 90 degrees F; and,

(d) Preferred Rail Laying Temperature Range (PRLTR) is the PRLT plus 25 degrees F.

AD35.11.3 It will be necessary for the Contractor to move the welded rail strings to the exact location they are to be installed. The Contractor shall furnish such additional equipment and supplies as may be required to adequately distribute welded rail strings. Care must be taken to ensure that strings are laid such that gauge faces of rail are matched according to their previous position in track.

AD35.11.4 The Contractor shall provide for the movement and handling of and the laying of welded rail strings in such a manner as to avoid damage to new roadbed, subballast, and rail. Care must be exercised to avoid twisting or damaging welded rail strings. During handling, Contractor shall be responsible for damage to welded rail strings to the extent that complete strings or sections thereof damaged, in the opinion of the Engineer, unsuitable for use in track, such rail section shall be replaced at the sole expense of the Contractor. It is entirely up to the Engineer to determine if any rail strings or portions thereof have been damaged. The method and equipment used by the Contractor in handling and movement and the laying of welded rail strings will be subject to the approval of the Engineer.

AD35.11.5 Rail shall be free of dirt and foreign material when installed. Each string of rail placed into the track structure shall be numbered at a point within ten (10) feet of each end of the rail as it is laid by the Contractor with permanent type marker prior to adjustment for temperature. Numbering shall be in accordance with Engineer's instructions.

AD35.11.6 The Contractor will not create any additional joints in a solid length of CWR without the authority of the Engineer.

(a) CWR will not end on open deck bridges or closer than 200' from the backwall of the bridge.

AD35.11.7 The welded rail strings may be delivered with torch cut ends or torch cut holes in the ends. Rail ends with torch cut holes or torched ends will have to be removed. Any removal of ends with torched areas shall be accomplished by use of a rail saw a minimum of 6" from the edge of the torch cut area. Distance is measured from the cut face to the closest edge of the torch cut or area.

AD35.11.8 Rail will only be cut square and clean by means of a rail saw with all burrs removed. Torch cut rail will not be allowed to remain in the track. CWR strings shall not be cut to facilitate laying or fitting without written approval of the Engineer.

AD35.11.9 Upon completion of the final ballast lift and after all final lining, surfacing, and brooming has taken place, the rail shall be adjusted to arrive at the PRLT for final placement.

AD35.11.10 Rail temperature shall be measured at each end of the CWR string by placing at least two rail thermometers on the base of the rail near the web, away from wind and out of the direct rays of the sun and away from all sources of artificial heat or cold.

(a) When using pyrometers to determine rail temperature, the pyrometer should be pointed into the shaded portion of the web of the rail. Rail temperature must be taken at intervals of approximately 150'.

AD35.11.11 CWR will be anchored within the PRLTR without further adjustment.

AD35.11.12 CWR below the PRLT must be de-stressed as soon as possible. CWR must be de-stressed using proper procedures.

(a) If rail temperature is below the minimum then approved rail heaters must be used to raise the rail temperature. Rail vibrators shall be used to prevent rail from hanging up in tie plates or tie pads. Rail heaters and rail vibrators are to be operated uniformly and continuously. CWR being adjusted by heating must be free to expand longitudinally towards it loose end. The rail anchoring on ties is to be done immediately behind the rail heaters when the rail is within the PRLTR. Where rail heaters are used, care must be exercised to prevent damage to the ties. A steel hammer must not be used for vibration as it will damage the rail.

AD35.11.13 A record shall be kept by the Contractor indicating the rail and air temperatures for each piece of CWR laid. This form must be completed by the Contractor and given to the Contract Administrator on a daily basis whenever CWR is placed.

AD35.11.14 To determine the proper expansion or contraction for any length of CWR for any temperature differential Contractor shall refer to Appendix C entitled "Continuous Welded Rail Thermal Expansion". The Appendix contains a table that indicates the necessary CWR expansion or contraction adjustments based on length of rail string versus the temperature differential.

AD35.11.15 The ends of welded rail strings and field cuts shall be field welded in accordance with AD35.13 Thermite Field Welding of this Specification.

AD35.11.16 The air and rail temperature at the time of laying shall be painted on the web on the field side of the rail 6' from the end of each rail string with 4" letters. As an example: A 78° R80° will indicate and air temperature of 78° and a rail temperature of 80°. Rail that is laid at a rail temperature below 90° and heated in accordance with these instructions shall have an additional marking of H 105°. As an example: A 68° R 60° H 105° will indicate an air temperature of 68°, rail temperature of 60°, and a 105° heated rail condition. Markings on the rail should be legible and made with a permanent paint type marker. Markings from previous installation must be obliterated.

AD35.11.17 Rails less than 19.5' long on curves and 12' long on tangents shall not be used except for temporary closures.

AD35.11.18 Ends of welded rail strings shall be staggered by at least 19½' unless otherwise authorized in writing by the Engineer. Plant welds will be staggered (to the extent possible) by at least 19½'.

AD35.11.19 Nicked or gouged rail shall be rejected and replaced as determined by the Engineer at the sole cost of the Contractor for any rail damage due to the Contractor's handling. This includes the cost of the replacement rail, transportation, welds, and any associated costs in the change out of the defect.

AD35.11.20 Upon completion of the days work, all rail laid must be fully spiked, bolted and anchored, unless approved protective measures are in place.

AD35.11.21 The use of eight hole splice bars may be approved if unable to complete thermite welds prior to cold weather.

AD35.12 All cross ties shall be anchored in a box pattern on every other tie except at permanent joints not welded, adjacent to jointed rail and at turnouts & non glued insulated joints they will be anchored at every tie for a distance of 200 feet. The same ties on opposite rails shall be boxed.

AD35.12.1 Only the proper tools or machines will be used when applying or removing anchors. The use of spike mauls is prohibited.

AD35.12.2 Anchors must be installed from gauge to field side of rail to insure full bearing surface against the side of the tie, bearing against the adjacent tie and remain tight on the rail. Anchors must be on the same side of the same tie on both rails. Ties are to be at right angles to the rail before applying anchors. Anchors improperly installed will be removed and applied correctly without additional charge by the Contractor. Anchors will only be removed when the rails is still in the track.

AD35.12.3 Anchors must be fully driven; however, care must be taken to avoid over-driving as this may fracture or spread the metal, resulting in loss of holding power. Any rail anchor that is fractured or with metal spread will be rejected and replaced with another anchor at the Contractor's expense.

AD35.12.4 Anchors shall be installed only after the track has been raised, lined, and ties re-spaced, following all ballast operations and de-stressing of the welded rail.

AD35.12.5 Care must be exercised in the spacing of anchors to ensure that no anchors are located on any tie under or adjacent to the ends of a rail joint bar or thermite weld.

AD35.13 Thermite Field Welding

AD35.13.1 General

(a) All rail joints between CWR strings and transition rail shall be thermite field welded;

(b) Field welds should be made at the time of rail laying regardless of temperature. When the field welding of a rail joint cannot be completed, each rail must be bolted with at least two bolts on each side of the joint before the track is placed in temporary service (four bolts per joint). The use of eight hole splice bars may be approved if unable to complete thermite welds prior to cold weather; and,

(c) Holes for complete bolting of cut rails shall be drilled by an approved type of rail drill. Under no circumstances shall new holes be drilled between two holes already drilled. Cutting rails or drilling holes in cut rails by means of acetylene or electric torch will not be permitted.

AD35.13.2 Execution

(a) All thermite field welding shall be supervised and performed by an experienced rail welding supervisor and welder certified by the manufacturer of the welding equipment;

(b) Contractor shall inform the Contract Administrator daily of the location of completed welds in order for the Contract Administrator to arrange for testing and inspection. A record shall be kept by the Contractor for each field weld made during new track construction and copied to the Contract Administrator;

(c) All equipment and material required in the production of thermite welds shall be furnished by the Contractor. Thermite welding materials and equipment shall be as manufactured by Boutet or Orgotherm;

(d) The thermite welding method and procedure shall conform to current AREMA Specification Chapter 4 and with the instructions from the welding kit manufacturer (Boutet or Orgotherm) and as specified herein. Boutet or Orgotherm self-preheating weld kits shall be applied in strict accordance with manufacturer instructions, these Specifications, and to the satisfaction of the Contract Administrator;

(e) Winter thermite welding. Hot thermite weld material has the potential to become explosive whenever it comes in contact with moisture. Under winter conditions, the source of moisture may be in the form of snow and/or frost in the ballast. It is imperative that manufacturers' procedures for welding be followed at all times. In addition, the following precautions MUST be taken when thermite welding in the presence of snow and/or frost:

In no case, shall thermite welding be performed when the temperature is below OºF (-18°C).

(i) A minimum of a 10' radius must be cleared of snow around the weld area. When this in not practical due to embankment constraints, snow must be cleared to at least the edge of the ballast section;

(ii) A hydraulic rail puller MUST be used on all closure welds;

(iii) Rail pullers will not be removed until the weld has cooled below 700°F (389°C).

(iv) It is recommended to install an approved drip pan with dry sand under the weld area to prevent any excess molten metal from contacting any moisture that may be present. It may be necessary to heat the ballast with a torch in order to facilitate removal;

(v) After igniting the charge ensure everyone is clear of the weld area by at least 40 feet and remains in the clear until the reaction and pour are complete.

(vi) All preheat and tear down times must be strictly adhered to. Note, 5 minutes is the minimum time required before the removal of slag pans, crucible and normal demolding begins;

(vii) A dry location must be secured to place the waste material. (it is recommended to use a steel drum or rack on back of a truck for disposal of the weld waste); and,

(viii) To prevent rapid cool down an approved cooling blanket or cooling box MUST be used. The weld must be covered immediately after hot grinding and remain covered until the weld has cooled below 400°F (222°C).

(f) Wearing of all protective clothing and safety equipment is required during welding operations;

(g) Prior to welding, rail must be visually examined for physical defects and must meet the criteria within this Specification for alignment and wear. Any rail not meeting the criteria must be reported to the engineer immediately;

(h) Thermite welds shall be located as close as possible to the center of tie cribs. The weld shall not be closer than 4” to the edge of the tie and in no case shall a weld be situated over a tie plate. Contractor shall re-space ties as necessary to prevent a weld from sitting on a tie. Field welded joints are to be centered between ties:

(i) Contractor shall tamp and dress track, as necessary, to provide firm support at the weld;

(ii) Contractor shall plug with the appropriate plug type for the tie and re-drive all necessary spikes; and

(iii) Contractor shall re-apply and adjust anchors as necessary to conform to specified anchor pattern.

(i) No holes closer than 6” from the weld will be permitted in the rail. Distance is measured from the cut face to the closest edge of the hole;

(j) Thermite welds will not be made within 6’ of another field weld or within 3’ of a plant weld without written approval by the Engineer;

(k) Welding gaps for thermite welds shall be 1” except where approved wide gap welds are used;

(l) All rail ends shall be saw cut. The cut must be square and perpendicular to the rail axis, with a variation not exceeding 0.03” and all scale, rust and burrs must be removed;

(m) Overflow on rails shall be ground off for 2” beyond the mold area;

(n) Vertical rail end alignment shall be made along the running surface of the rails, such that a flat running surface will result on cool down. Any difference in height of rails shall be in the vertical base offset;

(o) Vertical misalignment of rail ends on the base underside must not exceed 1/8” on thermite welds;

(p) Horizontal alignment must be straight for at least 36” through the weld area. To meet this requirement when welding in curved track, rail positioners (aligners) must be used;

(q) Horizontal rail end alignment shall be made along both sides of the head, web and base edges of the rail. Adjustments shall be made such that:

(i) On new rails, or rails with comparable gauge face wear, any difference in the width of head, web or base shall be divided equally on either side; and,

(ii) On rails with uneven head width, the bases and webs of the rails shall be aligned so that the horizontal offset in the head, web or base does not exceed 0.06". The gauge and field sides of the railhead shall be blended in by grinding.

(r) Head bond weld nuggets of exothermic rail bonds, which fall within the mold are, must be completely removed by grinding prior to thermite welding;

(s) Immediately prior to mold installation the rail ends and surface area that will be exposed to the thermite material must be cleaned a minimum distance of 6" from the end with a wire brush or a grinding wheel in order for this area to be free of grease, rust, and other foreign material, along with any other recommendations of the welding kit manufacturer;

(t) Molds must be centered over the weld gap;

(u) During sealing of the molds, cardboard inserts must be placed over the molds to prevent any foreign material from falling into the mold cavity;

(v) Check the plastic bag containing the charge, ensuring that the bag is sealed and has not been punctured in handling;

(w) Before preheating, check the rail temperature with a rail thermometer, if the rail temperature is below 60 degrees Fahrenheit both rails must have supplemental heat applied to raise the rail temperature to at least 100 degrees Fahrenheit:

(i) The length of the rail to be supplementally heated shall be between 30 and 36 inches for rail temperatures between 60 degrees Fahrenheit down to 16 degrees Fahrenheit.

(x) A rail expander will be placed on the rail to maintain the correct gap and crown unless temperature conditions are such that the possibility of rail movement is eliminated:

(i) If a change in rail temperature is anticipated while the weld is being poured or while it is cooling, the rail expander should be adjusted to compensate for any stresses which will occur at the weld due to a change in temperature;

(ii) Depending upon the type of change expected, one of the following procedures will assist in preventing temperature induced stresses from affecting the quality of the weld:

- Rail temperature is low and a raise in temperatures is anticipated, the rail expander should be set up to expand the gap and enough pressure built up to cause a slight increase in the gap. This should prevent any subsequent decrease in gap width.
- Rail temperature is high and a drop in temperature is anticipated, the rail expander should be set up to pull and enough pressure built up to cause a slight subsequent increase in width.
- Whenever either of the above procedures is required, the final gap width must be as stated in the manufacturers instructions for the rail weight being welded.
- The rail expander must remain on the rail until the weld is complete and has cooled to 700 degrees F. This is verified when the center of the weld around its entire periphery will not melt a 700 degree F tempilstick.
- When the rail expander is removed, it must be released in a gradual manner.

(y) Rail ends will be preheated prior to welding to a sufficient temperature and for a sufficient time to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld, per manufacturer's instructions. Preheating must not be interrupted and the heat shall be uniformly distributed over the rail ends. The preheat time specified for the process must be adhered to;

(z) Ignition must be performed immediately after preheating;

(aa) During the pour, the crucible must be centered over the mold. When the pour is completed the molten slag must be allowed to solidify for three minutes prior to removing the slag pot. **For the CJ One shot crucible, the slag pot must not be removed until 5 minutes after the pour. The weld must not be sheared until 6.5 minutes after the pour;**

(bb) In the event of a leak, apply molded fusal paste with the end of a wood handle at least 36" in length. Never attempt to stop a leak in any other manner;

(cc) Should the thermite reaction or the time delay of the self-tapping thimble be abnormal, the weld must be rejected;

(dd) With multi-use crucibles if the reaction is abnormal and the automatic thimble doesn't tap, the crucible should be left standing over the mold for 5 minutes. If the thimble releases during that time, the metal will pour into the mold and although the weld will have to be cut out, there is no danger of personal injury. The loaded crucible should then be carefully set aside and no attempt made to empty it until the metal has cooled. After cool down, the metal is easily dumped;

(ee) With power shears or a sledge hammer and hot cut chisel, remove the excess metal, while still hot, off the sides of the ball of the rail;

(ff) Never dump hot slag or any molten material on wet soil, wet ballast, or into water. To extinguish a metal fire, use only dry sand. The use of vapour forming extinguishing materials is forbidden;

(gg) The mold shall be left in place after tapping for a sufficient time to permit complete solidification of the molten metal and proper slow cooling to prevent cracking and provide a complete weld with the proper hardness and ductility;

(hh) Thermite welds shall be ground hot. When hot grinding, the weld shall be left at least 0.032" above the parent rail steel on the running surface, to ensure it does not shrink below the rail head upon cool down. The contour radius, gauge face and field side of the head shall be hot ground flush or blended in where necessary. Do not grind the rail head free hand;

(ii) After the weld has cooled to ambient temperature it shall be cold ground, flush with the rail surface and blended in where necessary. Do not grind the rail head free hand. Check the final contour of the rail head with a 36" straight edge;

(jj) The weld must be protected against water or any liquid for two hours after finish grinding. Welds shall be allowed to cool normally, without induced cooling;

(kk) Date and initials of welder and Contractor's name shall be placed on the web of the rail with metal marking paint and all welds shall have a number based upon a numbering system approved by the Engineer. These marks will be placed on the field side of the rail being welded;

(ll) Contractor shall not add more rail than what was removed when installing insulated joints, replacement rail, and performing welds after final de-stressing of the CWR;

(mm) Contractor shall provide sufficient time to allow welds to cool to 450 degrees Fahrenheit and have completed the finish grinding prior to any equipment movement across welds;

(nn) With the "unfinished" base of the thermite welds the Contractor will need to exercise caution when adjusting the rail so as not to bind the rail at a tie plate, or allow the ties to be skewed; and,

(oo) No additional welds shall be installed within 3'of an existing plant weld and 6' of an existing thermite weld.

AD35.13.3 Field Quality Control

(a) All welds giving fault indication by ultrasonic inspection or visible inspection, being unacceptable, shall be replaced at Contractors expense. This includes the addition of a rail plug and additional welds where required:

(i) Ultrasonic testing of all completed welds in the track shall be carried out as specified herein:

(ii) All initial testing and submittals shall be performed as directed by the Contract Administrator at no cost to the Contractor

(iii) Welds not meeting the following requirements will be rejected:

- Each weld shall have full penetration and complete fusion with no evidence of surface or internal fissures or cracks.
- Porosity or slag type defects shall not exceed 0.040 inches in any dimension and the total area of all defects shall not exceed 0.024 square inches.
- Conformance to alignment tolerances.

(iv) If a defective weld is found, it shall be cut out and a new section not less than 10' long on tangent track and not less than 20' long on curved track shall be inserted, welded with two thermite welds, and re-tested all at Contractor's expense;

(v) Ultrasonic testing will be performed by a competent material testing service as determined by the Contract Administrator; and,

(vi) All welds shall be visually inspected by the Contractor and Contract Administrator for surface cracks and alignment. Welds with surface cracks visible to the eye or not within the alignment tolerances will not be acceptable.

AD35.14 Ballasting and Surfacing

AD35.14.1 General

(a) Contractor shall supply, haul and unload all crushed rock ballast material, surface, tamp, line, finish surface, regulate, and power broom new track constructed. All track shall be surfaced and tamped as soon as possible after unloading ballast:

(i) Ballast shall be placed to a minimum depth of 12" below the bottom of the ties at grade point to the dimensions and widths (minimum 12" shoulders for CWR) as shown on the Drawings. Ballast shall be compacted by approved tamping methods to hold track firmly in place. All tamping operations shall be performed with an approved power tamper machine; and,

(ii) Placement of ballast and surfacing of track shall be done in a manner such that all tolerances and requirements of these Specifications shall be retained by the track structure for a period of 1 year from the time of acceptance.

(b) The Contractor at their expense shall provide all the plant, equipment, and labor necessary to unload and transport the ballast to the track construction site and distribute the ballast to the track structure.

AD35.14.2 Execution

(a) Contractor will direct the unloading and distribution of ballast and will be fully responsible for all aspects of the unloading and distribution, subject to approval by the Engineer. All costs associated with any equipment derailed during ballasting including repairs to damaged railway equipment will be the responsibility of the contractor;

(b) When unloading ballast in the center of the track, a plow tie may be used in order to evenly spread ballast and prevent excessive rock from accumulating on the rail and possibly derailing cars;

(c) After unloading ballast, all cars must be completely empty and doors closed and locked prior to releasing;

(d) Power tamping machines are to be used throughout all track construction. Manual tamping will not be allowed. The use of a ballast compactor together with the power tamping machines may be used with the written permission of the Engineer:

(i) Tamping machines are to be automatic multi-tooled with a minimum of 8 tamping feet per rail and having automatic profile reference beams of not less than 75';

(ii) Each tool shall have a tamping pressure sufficient to close the ballast beneath each tie. The foot of each tool shall be a minimum of 1½" x 3" at all times;

(iii) A junior tamping machine less the reference beam may be used in conjunction with a lead machine provided that all other characteristics of the lead machine are the same on the junior tamper. The tamping machine with the reference beam will tamp a minimum of every second tie; and,

(iv) Any proposed ballast compaction equipment shall be included in Form K: Equipment and is subject to acceptance of the Engineer.

(e) No part of the track structure will be raised more than 3" in any one lift. New track construction will have to be worked more than once and the Contractor will have to apply additional ballast to conform to the ballast cross section shown within the Typical Track Section drawings;

(f) Each lift is to be tamped from a line 16" inside each rail on both sides of and to the ends of the ties. Center area between these limits shall be filled lightly with ballast but not tamped. Tamping shall proceed, simultaneously; at both ends of the tie making sure ballast is forced directly under the ties and against the sides and ends of the ties:

(i) Too many insertions with a power tamper may cause a center bound track condition. Generally two squeezes per tie up to 1½" of raise with one additional insertion and squeeze for each additional 1" of raise is required with insertion depth being a minimum of 1½" below the bottom of tie: and,

(ii) When the track has been raised to within 2" of final grade, the final lift shall be made by raising the track up to grade stake elevation making necessary allowance for settlement. The ballast shall be applied under the ties for their entire length.

(g) During raising and tamping, if any crib area is void of ballast below the bottom of the tie then the area of the track is to be re-tamped following the application of additional ballast;

(h) While raising and tamping track levels shall be constantly used to insure correct surface and cross level:

(i) Contractor will finish each point on the track to within a maximum of ½" deviation from zero cross level on tangent. Average cross level on tangent and super elevation on curves will be as specified;

(ii) Contractor will finish the track so that the difference in cross level between any two points less than 62' apart on tangents and on curves between the spirals must be no more than 1". Deviation from zero cross level at any point on tangent may not be more than ½". Variations in cross level on spirals in any 31' may not be more than ¾". Track will be finished so that the deviation from uniform profile on either rail at the mid-ordinate of a 62' chord may not be more than 1¼"; and,

(iii) Contractor will finish the track so that the horizontal alignment between any two points 62' apart on tangent track will deviate from a straight line by no more than ¾". Mid ordinate of a 62' chord between two points on the gauge side of the outer rail will be one inch per degree of curve with an allowable tolerance of plus or minus 5/8".

(i) After track has been brought to true surface, elevation, and grade, it shall be given a final lining and placed in true alignment and grade conforming to the elevations and alignment according to the Drawings and the ballast dressed to the design ballast cross section;

(j) When raising track, the Contractor has a tolerance of plus or minus ½" to the design grade as long as requirements of this Section are met. If not raised to the established grade, then the Contractor will unload ballast in sufficient quantity and continue to surface the track to comply with the tolerances:

(i) All ties are to be straightened and re-spaced as necessary immediately prior to unloading ballast for the final raise; and,

(ii) If the Contractor raises the track too high to comply with the allowable tolerance, Contractor, at his expense, will excavate the ballast sufficiently to lower the track and then surface the track again to bring it into full conformity.

(k) When track is lifted or jacked, care must be exercised by the Contractor to avoid stressing or permanently bending the rail, joints, or turnout components;

(l) When surfacing through a turnout with boltless adjustable rail braces, switch points and stock rails will be blocked to prevent displacement of stock rail from the switch plate:

(m) Tamp turnout ties for 16" on each side of main and turnout rails. Headblock ties to be tamped as above with no voids under remainder of tie:

(n) Turnout tie cribs are to be full except to prevent contact with rods and for drainage as required

(o) Contractor will correct any hanging or skewed tie that is a result of his tamping and raising the track. Tie plates will be positioned so that the shoulder is against the outside base of rail for the entire length of the shoulder:

(i) Contractor will plug and re-drive all high or loose spikes and will plug and replace all spikes removed; and,

(ii) Contractor will replace and/or adjust all tie plates and rail anchors knocked off or that worked loose or were damaged during the surfacing and regulating. The anchors must remain matched across from each other on each rail. Tie plates must remain square to the tie.

(p) Contractor will provide the ballast section as shown in the Typical Track Section drawings. No dirt or foreign materials will be allowed into the ballast section;

(q) After track has been brought to true surface, elevation, and grade it shall be given a final lining and placed in true alignment conforming to design and the ballast shall be trimmed neatly to the dimensions and widths of the Typical Track Section drawings:

(i) Cribs shall be filled to top of tie; and,

(ii) No ballast will be left on top of ties, spikes, fasteners and plates.

(r) Surplus ballast shall be spread evenly along the ballast slopes. Dressing of the ballast by placing earth higher than the toe and thus preventing proper drainage will not be permitted. After all ballast placement has been completed, the track shall be given a complete power broom finish with approved machinery. Contractor shall insure that the top of ballast rock matches the top of tie surface and that no excess ballast remains on either the top of rail, top of tie, base of rail, or top of tie plate, spike or anchor or roadway crossing surface;

(s) Contractor shall exercise caution while regulating ballast shoulders so as to avoid track misalignments and to avoid obstructing adjacent drainage ditches, structures, or culverts with ballast, dirt, vegetation, or other material:

(i) If Contractor obstructs an adjacent drainage ditch, structure, or culvert, he will have to initiate the cleaning of those as soon as possible; and,

(ii) Contractor is responsible to ensure that the partially ballasted track in his work area does not buckle out of alignment. If a misalignment of the track occurs as a result of the Contractor's operations, he must correct at his expense.

AD35.15 Crossings

AD35.15.1 General

(a) This section includes the installation requirements of all softwood crossing surfaces as indicated on the Drawings;

(b) Conform to all applicable Local, Provincial and Federal laws, codes, specifications and ordinances for materials and installation of the crossings as they apply to this Specification;

(c) The Contractor will be allowed, at the Contractor's expense, to supply and install additional temporary crossings as required for convenience and shall make good, at the Contractor's expense, any track material damaged by same. This shall include all material and labour required to meet the specifications of this project. Upon completion of all work these temporary crossings are to be removed, at the contractors expense;

(d) Contractor is responsible for any and all approved detouring, detour roadways, all signage, barricading and traffic control that may be necessary to facilitate crossing installation. It shall be the sole responsibility of the Contractor to erect and maintain such detour roadways, signage, barricades and traffic control as required by during the length of time that the road is closed to traffic or while crossing protection is required; and,

(e) Track materials and construction execution associated with crossing installation to be in accordance with all parts of these Specifications.

AD35.15.2 Execution

(a) Softwood Crossing Surface:

(i) Install new 7" x 9" x 9' hardwood crossing ties at locations shown on drawings in accordance with AD35.8.1 of these Specifications except ties to be installed at 19½" centers.

(b) Install new softwood crossing planks:

(i) Planks will be cut to length as required with the outer ends of all planks beveled so to minimize the effects of dragging equipment;

(ii) Planks will be placed such that a flangeway space not less than 3" nor more than 4¾" wide shall be provided between the gauge side of the running rails and the planking. A flangeway on the field side of the running rails will not be allowed;

(iii) Planks will be fastened to the crossing ties by means of the ¾" x 12" hex lag bolts and washers through the prebored holes in the planks. Should additional pilot holes be required they will consist of a 5/8" hole drilled a minimum of 5" into the crossing plank such that they are aligned with every 4th crossing tie;

(iv) All wood surfaces exposed by either cutting or drilling must be treated with P2 - Petroleum Creosol;

(v) All cross ties within crossing planks and for a distance of 20' in each direction shall be fully anchored; and,

(vi) Remove all debris from site and leave crossing in a clean condition.

AD35.16 Track Material Removal and Purchase

(a) Track Material Removed shall include disassembling, collecting, loading and unloading, transporting, sorting and stockpiling at a location designated by the Engineer. Any material damaged either intentionally or inadvertently through this process will be replaced at the Contractor's expense with material in equal condition as approved by the Engineer; and,

(b) Track Material Purchased shall be collected and removed from the site at no additional cost. Unless otherwise specified, track removal will include all OTM and the Contractor is to ensure all loose material is collected and the site is left in an acceptable condition to the satisfaction of the Engineer.

AD35.17 Fencing Removal

(a) Fencing Removal shall include disassembling, collecting, loading and unloading, transporting, sorting and stockpiling at a location designated by the Engineer. Any material damaged either intentionally or inadvertently through this process will be replaced at the Contractor's expense with material in equal condition as approved by the Engineer.

AD36. RAILWAY PROPERTY CLEANING

DESCRIPTION

AD36.1 General

AD36.1.1 Conduct cleaning and disposal operations to comply with local ordinances and antipollution laws.

AD36.1.2 Store volatile wastes in covered metal containers and remove from premises daily.

AD36.1.3 Prevent accumulation of wastes which create hazardous conditions.

AD36.1.4 Provide adequate ventilation during use of volatile or noxious substances.

MATERIALS

AD36.2 Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.

CONSTRUCTION METHODS

AD36.3 Cleaning During Construction

AD36.3.1 On a daily basis maintain premises free from debris and waste material.

AD36.3.2 Maintain project site and public properties free from accumulations of waste materials and rubbish.

AD36.3.3 Remove waste materials and rubbish from site.

AD36.3.4 Disposal of wastes on Railway property by burial or burning shall not be permitted.

AD37. RAILWAY GRADING AND DRAINAGE

DESCRIPTION

AD37.1 General

AD37.1.1 Further to City of Winnipeg Standard Specifications the following shall apply.

AD37.2 Definitions

AD37.2.1 Embankment Fill: material placed above original ground or stripped surface to construct the sub-base for the rail bed or gravel pad.

AD37.2.2 Sub-base elevation: elevation immediately below sub-ballast or road surface gravel.

AD37.3 Requirements of Regulatory Agencies

AD37.3.1 Adhere to municipal, provincial and national government requirements relating to safety of excavations and protection of workers.

MATERIALS

AD37.4 Embankment materials require approval by Contract Administrator.

AD37.5 Material used for embankment shall not contain organic matter, frozen lumps, snow, ice, weeds, roots, logs, stumps or any other objectionable matter.

AD37.6 Embankment Fill Material

AD37.6.1 Embankment fill material from off Railway property shall consist of 100 mm crushed limestone sub-base materials with properties as specified in CW 3110.

AD37.6.2 The Contractor shall identify his proposed source of embankment fill material after award, no later than one week prior to commencement of construction.

AD37.6.3 The Contractor shall provide at no cost to the City representative samples to the Contract Administrator for approval in accordance with CW 3110.

AD37.6.4 Embankment fill material shall not be used for embankment construction prior to approval by the Contract Administrator.

CONSTRUCTION METHODS

AD37.7 Preparation of Areas for Earth Works

AD37.7.1 Strip fill areas of unsuitable materials as designated by Contract Administrator.

AD37.7.2 Stripped material shall be classified as "Topsoil Excavation".

(a) Unless specified otherwise, this material is paid under "Topsoil Excavation";

(b) Strip organic material to necessary depth or as directed by the Contract Administrator;

(c) Salvage stripping material for later re-use on embankment side slopes;

(d) The maximum depth of stripping in ditches shall be the ditch invert unless subgrade material is deemed unsuitable by the Contract Administrator; and,

(e) After completion of embankment, spread stripping uniformly against embankment cut and fill slopes or as directed by the Contract Administrator. Any excess material is to be disposed of in accordance with CW 1130.

AD37.8 Excavating

AD37.8.1 General

(a) Advise Contract Administrator sufficiently in advance of excavation operations for initial cross-sections to be taken;

(b) Remove and dispose of material off Railway property in excess of requirements for embankment construction as directed in accordance with CW 1130;

(c) Take particular note of the following:

(i) Where necessary, the Contract Administrator may design cuts and fills especially for stability, which will affect dimensions indicated on the Drawings;

(ii) Remove unsuitable materials encountered in cut sections to depth and extent directed:

- Replace with approved material and compact.

(iii) When slides occur in cuts after they are properly formed, remove the material, modify the slopes and adopt other precautions as directed:

- The materials shall be classified as "Common Excavation" and Contractor will be paid for its removal at the unit contract price for "Common Excavation".

(iv) Complete all excavation as far in advance of fill construction as practical; and,

(v) Maintain all work in a well-drained condition, free of debris and other obstructions.

(d) The City will not pay for additional excavation (borrow or common) which the Contractor may require for his convenience or movement of equipment.

AD37.8.2 Waste Material

(a) Remove and dispose of unsuitable material as directed:

(i) Refill depressions and holes from this work. This work shall be paid for at the contract unit price for “Common Excavation”.

(b) Remove and dispose of material off Railway property in excess of requirements for embankment construction as directed.

AD37.8.3 Ditch Excavation

(a) Complete ditch excavation as far in advance of embankment construction as practical, to the grades set by the Contract Administrator, to permit ready flow of surface water;

(b) Excavate ditches in cuts at the same time as the main cut in order that the excavated material can be used in adjacent embankments;

(c) Use suitable equipment to ensure cut slopes and sub-base sections are not undercut; and,

(d) Maintain and keep ditches open and free from debris and other obstructions until final acceptance.

AD37.8.4 Material Removal and Stockpiling

(a) Use suitable equipment to ensure cross contamination of nearby materials is kept to a minimum;

(b) Maintain all work in a well-drained condition, free of debris and other obstructions; and,

(c) Stockpile material at a location identified by the Contract Administrator.

AD37.9 Embankments

AD37.9.1 Where indicated or directed by Contract Administrator, bench into existing slopes to ensure a proper bond between new materials and existing surfaces.

AD37.9.2 Prior to placement of fill material, compact subgrade to 95% of Standard Proctor maximum density, in accordance with this Specification and CW 3110.

AD37.9.3 Do not place material which is frozen or place material on frozen surfaces.

AD37.9.4 Maintain a crowned surface during construction to ensure ready run-off of surface water.

AD37.9.5 Take particular note of the following:

(a) Where fills are to be placed over areas with weak formation soils, use a stage loading technique to construct embankments; and,

(b) Where significant long term settlements are expected, Contract Administrator will increase the top width of embankments from the standard dimensions indicated.

AD37.9.6 Maintain fill to typical sections indicated on drawings.

AD37.9.7 Placement of Geotextile

(a) Place geotextile in accordance with CW 3130 and this Specification;

(b) The geotextile shall be installed full width for the required length of the embankment in accordance with the manufacturer's recommended procedure. Align machine direction parallel to the rail line, free of tension, stress, folds, wrinkles, or creases. Joints in the fabric shall be overlapped not less than 600 mm (2 feet);

(c) The fabric shall be placed within a key in the existing embankment and secured as directed by the Contract Administrator;

(d) The fabric shall be placed and wrapped back upon itself at the end away from the track as directed by the Contract Administrator;

(e) Dumping of material or equipment movement directly on the geotextile will not be allowed; and,

(f) The geotextile shall not be exposed more than 48 hours before covering.

AD37.9.8 Execution

(a) Compact all embankment fill material and excavations to a density of not less than 95% maximum dry density in accordance with Standard Proctor Compaction Test (ASTM D698);

(b) Place and compact embankment fill to full width of section in uniform layers not exceeding 200 mm (8 inches) loose thickness. Contract Administrator may authorize thicker lifts if specified compaction can be achieved:
   (i) Do not place boulders exceeding 200 mm (8 inches) in diameter in the fill; and,
   (ii) Do not place boulders exceeding 150 mm (6 inches) in size within 600 mm (2 feet) of sub-base level.

(c) Scarify or disk and aerate fill material which is too wet, until proper water content for compaction is attained. With approval of Contract Administrator, blend drier material with wet material to achieve a water content satisfactory for compaction as specified in 3.4.4;

(d) Remove material not thoroughly compacted at no cost to the City;

(e) Where compaction is not being obtained, cease placing material and give additional compaction to material in place;

(f) Operate sufficient compaction equipment to thoroughly compact the fill at the rate being placed;

(g) Place and compact side slopes of fills simultaneously with core of fill:
   (i) Do not construct fill by means of central core finished off by side dumping of materials to make up the section.

(h) In areas incapable of supporting earth moving equipment, increase the cover over the areas to sufficiently support equipment:
   (i) Place the layer over full width of embankment;
   (ii) Thoroughly compact the surface;
   (iii) Build remainder of fill in layers of specified normal thickness; and,
   (iv) Use granular material for initial fill layer in soft swampy areas, as directed.

(i) Route all loaded earth-hauling equipment over entire width of embankment; and,

(j) Construct and maintain embankments in a well-drained condition.

AD37.10 Field Quality Control

AD37.10.1 To be completed in accordance with CW 3110.

AD37.11 Finishing

AD37.11.1 Remove soft or other unstable material that will not compact properly and fill resulting depressions with approved material.

AD37.11.2 Shape and compact entire rail bed to design elevations within 13 mm (0.5 inch) of design but not uniformly high or low.

AD37.11.3 Do scarifying, blading, compacting or other methods of work as necessary to provide thoroughly compacted rail bed shaped to grades and cross-sections indicated or directed.

AD37.11.4 Finish back and side slopes of common material to neat condition, true to line and grade.

AD37.11.5 Trim all waste and stockpile areas neatly and maintain in a well-drained condition.

AD37.11.6 Maintain finished surfaces in a condition conforming to this section until acceptance and surveyed by the Contract Administrator.

AD38. RAILWAY GRANULAR MATERIALS

DESCRIPTION

AD38.1 Supply, placement and compaction of granular material for sub-ballast material.

MATERIALS

AD38.2 Provide notice to the Contract Administrator of the source of granular materials to be incorporated into work. Contract Administrator will investigate quality of material prior to acceptance.

AD38.3 Materials require approval before being used in the Work.

AD38.4 Provide access for sampling.

AD38.5 The Contractor shall provide, at no additional cost, necessary equipment to obtain samples of granular materials.

AD38.6 If requested, the Contractor shall submit samples of the proposed granular material for testing and evaluation.

AD38.7 If, in opinion of Contract Administrator, materials from proposed source do not meet, or cannot reasonably be processed to meet specified requirements, locate an alternate source or demonstrate that material from source in question can be processed to meet specific requirements.

AD38.8 Should a change of material source be proposed during work, advise Contract Administrator two (2) weeks in advance of proposed change to allow sampling and testing.

AD38.9 Acceptance of a material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

AD38.10 When common excavation material is suitable for use as granular material, use such common excavation materials as granular material in preference to obtaining granular material from other sources.

AD38.11 Include in unit price for granular material entire cost of constructing and/or maintaining suitable access roads, opening work faces, clearing, grubbing and stripping of pit areas, and royalties.

AD38.12 Sub-ballast:

AD38.12.1 Material to be crushed or screened pit run gravel, containing no more than 3% organics by weight as determined by ASTM C 123.

AD38.12.2 Gradations to be within limits specified.

Sieve Size	Percent Passing
75 mm (3")	100
25 mm (1")	60 - 90
4.75 mm (#4)	35 - 60
425 micro m (#40)	10 -40
75 micro m (#200)	3 - 10

CONSTRUCTION METHODS

AD38.13 Placing

AD38.13.1 Use granular material to construct sub-ballast course and other work as indicated or directed.

AD38.13.2 Do not place granular material until finished sub-base surface is inspected and approved by Contract Administrator.

AD38.13.3 Place material only on a clean unfrozen surface, properly shaped and compacted and free from snow and ice.

AD38.13.4 Place, using methods which do not lead to segregation or degradation of material.

AD38.13.5 Place material to full width of section in uniform layers not exceeding 150 mm (6 inch) loose thickness and compact to specified density. Contract Administrator may authorize thicker lifts if specified compaction can be achieved.

AD38.13.6 Replace fouled material with approved material and compact, at no cost to the City.

AD38.14 Compaction

AD38.14.1 Compact full width to density not less than 95% maximum dry density in accordance with Standard Proctor Compaction Test (ASTM D698).

(a) Sub-ballast – 95% Standard Proctor Maximum Dry Density.

AD38.14.2 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

AD38.14.3 Apply water to reduce dust nuisance.

AD38.14.4 In areas not accessible to rolling equipment, compact to specified density with approved mechanical tampers.

AD38.15 Field Quality Control

AD38.15.1 Contract Administrator shall take representative samples at expense of Contractor and submit them to laboratory tests for approval of its quality and nature prior and/or during its use.

(a) Provide necessary personnel and equipment to permit adequate investigation and sampling;

(b) Advise Contract Administrator at least two weeks in advance of use of any material to allow sufficient time for sampling and testing; and,

(c) The City will pay for testing of material.

AD38.15.2 Contract Administrator may perform density and other tests on site, to control construction.

(a) Facilitate such work and pay for any testing apparatus damaged from the operations; and,

(b) Do not claim for delays to the operations resulting from field tests.

AD38.15.3 Final acceptance of materials made after materials dumped, spread and compacted in place.

(a) Contract Administrator may reject at source, on transportation vehicle or in place; and,

(b) Contract Administrator will not consider for payment the removal and disposal of any rejected material.

AD38.16 Finishing

AD38.16.1 Finished sub-ballast surface shall be within 15 mm (0.5 inches) of design elevations but not uniformly high or low.

AD38.16.2 Maintain surface in a clean condition, free draining and conforming to this Specification until final acceptance.

AD39. WATERPROOFING FOR RAILWAY BRIDGES

DESCRIPTION

AD39.1 General

AD39.1.1 This Specification covers all operations relating to the Waterproofing for Railway Bridges.

AD39.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

AD39.1.3 In addition to the applicable sections of AREMA Chapter 8, Part 29.

AD39.1.4 All steel decks shall be waterproofed.

MATERIALS

AD39.2 The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.

AD39.3 Unless otherwise approved in writing by the Contract Administrator, the waterproofing membrane shall be as follows:

AD39.4 Steel Deck

AD39.4.1 One layer of 0.09 in (2.4 mm) thick butyl rubber, secured with an approved adhesive.

AD39.4.2 Seamless spray applied system

(a) Two-component elastomer membrane such as bridge deck membrane as manufactured by Bridge Preservation; and,

(b) Two-component methyl methacrylate resin membrane as manufactured by Stirling Lloyd.

AD39.4.3 General Requirements

(a) All waterproofing systems to be applied in accordance to the manufacturers' specification;

(b) Surface preparation of members to be waterproofed shall be carried out in accordance to the waterproofing manufacturers' requirement; and,

(c) Steel deck to be waterproofed shall be detailed with countersunk bolt connections.

AD39.5 All deck or bridge joints shall be sealed against egress of water dropping onto bridge seats or roadways below.

AD39.6 Membrane Protection – Asphaltic Panels

AD39.6.1 Asphaltic panels shall be a minimum 3/8 in (10mm) thickness laid in two layers with staggered joints for membrane protection. Alternates must be submitted to the Contract Administrator for review with the Railway, and must be approved in writing by the Contract Administrator.

AD40. SUPPLY AND INSTALLATION OF SPHERICAL BEARINGS

DESCRIPTION

AD40.1 General

AD40.1.1 This Specification covers all operations relating to the following Work:

(a) Design, supply, fabrication, delivery and installation of self-lubricating bronze spherical bearing assemblies complete with anchor bolt assemblies, top plates, sole plates, bronze plates, bed plates, base plates, and incidental components and fasteners;

(b) Quality control of materials and fabrication;

(c) Metallizing and/or galvanizing of steel components; and,

(d) The Bearing fabricator shall be responsible for the design of the bearings; the bearing dimensions shown in the Drawings are guidelines and for reference unless specified otherwise.

AD40.1.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

AD40.2 References and Related Specifications

All related Specifications and reference standards shall be current issue or latest revision.

AD40.2.1 Related Specifications

(a) AREMA Chapter 15 – Steel Railway Bridges;

(b) CSA G40.21-13 – Structural Quality Steels;

(c) ASTM A572/A572M-12a - High-Strength, Low-Alloy Columbium, Vanadium Structural Steel;

(d) ASTM A325-10e1, Type 3 – Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength;

(e) ASTM F1554-07ae1 – Anchor Bolts, Steel, 36, 55 and 105 ksi Yield Strength;

(f) ASTM B22-13 – Bronze Castings for Bridges and Turntables;

(g) CSA W59-03 (R2008) – Welded Steel Construction (Metal Arc Welding);

(h) AWS D1.5-95/D1.5M:2010 – Bridge Welding Code;

(i) CSA W47.1-09 – Certification of Companies for Fusion Welding of Steel Structures (25a) AISC Category III Major Steel Bridges;

(j) ASTM B88-13/AWS C2.18-93/SSPC-CS 23.00 – Sprayed Metal Coatings for Atmospheric Corrosion Protection – Protection of Steel with Thermal Sprayed Coatings of Aluminium and Zinc;

(k) ASTM A123/A123M-12 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products;

(l) ASTM A153/A153M-09 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware;

(m) ASTM B695-04 (2009) – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel;

(n) AWS C2.23/C2.23M:2003 Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel; and,

(o) CN Standard Details – S15, S16 & S17.

AD40.3 Submittals

AD40.3.1 The Contractor shall submit the following documents to the Contract Administrator.

AD40.3.2 A complete set of Shop Drawings prior to commencement of fabrication:

(a) Submit within two (2) weeks from award of contract, shop drawings as detailed in this section. Submit shop drawings for review before any shop work is commenced;

(b) The Contractor shall indicate on the Shop Drawings all the necessary material specifications for the materials to be used and identify the components in accordance with the Drawings and Specifications;

(c) Applicable welding procedures, stamped as approved by the Canadian Welding Bureau, shall be attached to the Shop Drawings;

(d) In no case will the Contractor be relieved of responsibility for errors or omissions in the Shop Drawings;

(e) Clearly indicate shop and erection details, including cuts, copes, connections, holes, bearing plates, threaded fasteners, and welds. Indicate welds by CSA / AWS welding symbols;

(f) No alterations shall be made to any reviewed plan without the written consent of the Contract Administrator;

(g) Correctness of all shop drawings, irrespective of any review by the Contract Administrator, shall be the responsibility of the Fabricator; and,

(h) Any materials ordered prior to the review of the shop detail drawings shall be at the Fabricator's risk.

AD40.3.3 Manufacturer's test reports of mechanical tests on high strength bolts, if requested by the Contract Administrator.

MATERIALS

AD40.4 Products and Materials

AD40.4.1 The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.

AD40.4.2 Structural Steel

(a) Steel for the masonry plates, bed plates, shoe plates, transition plates, sole plates, base and top plates and bolting clips shall be in accordance with CSA G40.20-13/G40.21-13, Grade 300W (ASTM A572 / A36 Grade 42).

AD40.4.3 Bronze Plate

(a) Bronze Bearing metal shall meet the requirements of A.S.T.M Specification B22-13, Copper Alloy UNS No. C86300 as specified in the Drawings.

AD40.4.4 Finishes and Tolerances

(a) Bearing plates shall be furnished to the sizes shown on the Drawings; and,

(b) Bearings shall be machine finished and the surface roughness when measured in accordance with ASME B46.1-2009 shall not exceed the following:

(i) Expansion Bearing Plates: 125 micro inches;

(ii) Fixed Expansion Bearing Plates: 250 micro inches; and,

(iii) Top Surface of Bronze Spherical Surface: 63 micro inches.

(c) The bearing surfaces of the opposing steel plates shall also be finished in the same manner.

AD40.4.5 Lubricant

(a) Spherical surface of bronze bearing plate shall be provided with trepanned recesses which shall be filled with a lubricating compound capable of withstanding the atmospheric elements and consisting of graphite and metallic substance with a lubricating binder. The compound shall be pressed into the recesses by hydraulic presses so as to form dense, non-plastic lubricating inserts. The lubricant shall be Lubrite, or approved equal. Materials, which do not have lubricating qualities or promote chemical or electrolytic reactions, will not be acceptable. The total lubricating area (the trepanned recesses) shall comprise not less than 25% of the total bearing area of the plate; and,

(b) Coefficient of Friction: The coefficient of friction between the self-lubricating plates and the steel plates in contact with them shall not exceed 0.10 when subjected to the designed unit loading and also at twice the designed unit loading.

AD40.4.6 Corrosion Protection

(a) All non-sliding bearing surfaces shall be zinc metallized with a minimum coating of 0.25 mm in accordance with SSPC CS23.00/AWS C2.23M; and,

(b) All edges of steel (bearing plates, etc.) to be metallized shall be slightly rounded in order that metallizing will adhere.

AD40.4.7 Bolts

(a) Supply all bolts as detailed on the Drawings;

(i) Bolts shall conform to ASTM A325 Type 3 or as noted in the Drawings;

(ii) Nuts shall conform to ASTM A563 Grade DH3;

(iii) Washers shall conform to ASTM F436 Type 3; and,

(iv) Anchor bolts shall conform to ASTM F1554 Grade 105.

(b) Bolts, washers and nuts shall be hot dip galvanized in accordance with ASTM A153/153M.

AD40.4.8 Rubber Cushioning (Levelling) Pads

(a) The Fabricator shall supply and place 6 mm rubber cushioning pads under the base plates where indicated on the Drawings;

(b) Leveling pad shall be laminated fabric rubber such as Fabreeka, Sorbtex or equivalent; and,

(c) The Fabricator shall submit a certificate from his supplier to the Contract Administrator stating the requirements of the above clause have been met.

CONSTRUCTION METHODS

AD40.5 General

AD40.5.1 Finished Surfaces

(a) Metal-to-metal contact surfaces within bearings shall be prepared either by machining or fine grinding. As far as practicable, machining shall be carried out after welding has been finished. Machining of sliding contact surfaces shall be carried out only in the principal direction of movement. Care shall be taken to remove abrasive materials from finished surfaces, which shall also be cleaned with a degreasing agent. Finished surfaces shall be protected from contamination and/or mechanical damage.

AD40.5.2 Bolts and Bolt Holes

(a) Bolt holes shall be drilled or reamed. Where shown on the Drawings, bolts or screws shall be of a vibration resistant type. Taper washers of the correct angle of taper shall be provided under all heads and nuts bearing on beveled surfaces.

AD40.5.3 Welding

(a) Welding procedures shall be such as to minimize distortion of the bearing components and to avoid damage to finished work or bonded materials. All welding shall conform to the requirements of CSA Standard W59.

AD40.5.4 Final Assembly and Clamping

(a) After final inspection and acceptance of the various parts of the finished bearing they shall be assembled and clamped together. Bearings shall be preset at the time of fixing the clamping devices. All deleterious material shall be excluded from sliding and other contact surfaces; and,

(b) Unless otherwise noted, finished bearings shall be attached to the bridge span by the steel span Fabricator.

AD40.5.5 Marking

(a) Completed bearings shall have the supplier’s name (or trademark) and a serial number indelibly marked thereon. The serial number shall be unique and such as to enable other bearings manufactured at the same time to be traced through the production control records should the need arise. Where practicable the serial number shall also be visible after installation of the bearing in the structure. The top of each bearing shall be clearly marked and the size and direction or preset, if any, and the direction of installation shall be indicated.

AD40.5.6 Manufacturing Tolerances

(a) The tolerances given in this clause shall be observed unless otherwise specified or approved by the Contract Administrator; and,

(b) Types of Tolerances:

(i) Size: Tolerances for size referred to in this special provision shall be taken to be variations from the normal dimensions. They shall be used to control the overall dimensions and components with respect to length, thickness, height and diameter; and,

(ii) Fit: Tolerances for fit referred to in this special provision relate to clearance and shall be taken as the difference between the sizes of an element and the hole in which it fits, where this difference is positive.

(c) Overall Dimensions of Assembled Bearings:

(i) General: Overall dimensions of assembled bearings shall be within ± 3 mm; and,

(ii) Parallelism of Outer Surfaces: When designed to be parallel, the tolerance on parallelism of the upper surface of a bearing with respect to the lower surface of the bearing, as datum, shall be 0.2% of the diameter for surfaces circular in plan and 0.2% of the longer side for surfaces rectangular in plan.

(d) Dimensions of Bearing Parts Spherical Bearings:

(i) Tolerance on profile of surface for spherical bearings shall be 0.0002 Xh mm or 0.24 mm, whichever is the greater, where “X” is the length of the chord (in mm) between the ends of the bronze surface in the direction of rotation, and “h” is the projection of the bronze (in mm) above the top of the confining recess;

(ii) The tolerance on size with respect to the radius of the curved surface on the finished bearing shall be 3% of the intended radius; and,

(iii) The surface roughness Ra of metal curved sliding surfaces shall not exceed 0.5 µm.

AD40.5.7 Handling, Transport, Storage and Installation

(a) Care and Protection:

(i) During handling, transport and storage, bearings shall be kept clean and protected from mechanical damage, heat, contaminants and other deleterious effects.

(b) Handling Devices:

(i) Suitable handling devices shall be provided as required. Temporary clamping devices shall be used to maintain the correct orientation of the parts but shall not be used for slinging suspending bearings unless specifically designed for this purpose.

(c) Disassembly of Bearings:

(i) In order that moving surfaces are not contaminated, bearings should not normally be dismantled after leaving the manufacturer’s works, but, if for any reason they are, then this should only be done under expert supervision and the manufacturer’s assistance should be sought.

AD40.6 Quality Control/Quality Assurance

AD40.6.1 Quality Control

(a) Materials and Workmanship:

(i) Testing of complete bearings, as specified, shall be carried out in accordance with this specification; and,

(ii) The bearings shall be considered satisfactory when the results of the test comply with this specification. Testing of complete bearings shall be carried out in accordance with the requirements of AREMA Chapter 15:

- For spherical bronze bearings, this will include a minimum of one Coefficient of Friction test and one Proof Load test to 150 percent of the bearing's rated design capacity, as specified in AREMA Chapter 15 Clause 11.6.4.

(b) Testing of Complete Bearings:

(i) Testing of complete bearings, when specified or required by the Contract Administrator, shall be carried out in accordance with his instructions. The bearings shall be considered satisfactory when the results of the test comply with this special provision and any other special requirements specified by the Contract Administrator.

AD40.6.2 Quality Assurance

(a) All materials will be subject to physical inspection by the Contract Administrator and will be subject to rejection during the course of the Work and for the length of time as specified in the General Conditions, if, in the opinion of the Contract Administrator, the materials involved do not meet the requirements of the Drawings and this Specification; and,

(b) The Contractor shall furnish facilities for the inspection of material and workmanship in the mill, shop and field, and the Contractor Administrator shall be allowed free access to the necessary parts of the Works.

AD40.7 Fabrication Guarantee

AD40.7.1 Guarantee

(a) The bearing supplier shall provide a written guarantee stating that the bearings will perform satisfactorily within the design rate of movement and under the design loads for a period of 5 years from the date of Issuance of Acceptance Certificate. The supplier shall state that they have reviewed the installation procedures and that the Fabricator was present on site and that the installation was done in accordance with the Fabricator's recommendations. The Fabricator shall guarantee the replacement of the bearings at no cost in the event that the bearings do not perform satisfactory within the design range of movement and under the design loads.

OVERHEAD SIGN STRUCTURE

AD41. CAST-IN-PLACE CONCRETE PILE FOUNDATIONS

DESCRIPTION

AD41.1 The Work covered under this Item shall include all concreting operations related to construction of cast-in-place concrete pile foundations for overhead sign structures in accordance with this Specification and as shown on the Drawings.

AD41.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

MATERIALS

AD41.3 General

AD41.3.1 The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

AD41.4 Handling and Storage of Materials

AD41.4.1 All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CAN/CSA A23.1-09.

AD41.5 Testing and Approval

AD41.5.1 All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes.

AD41.5.2 All materials shall be approved by the Contract Administrator at least seven (7) days before any construction is undertaken. If, in the opinion of the Contract Administrator, such materials in whole or in part, do not conform to the Specifications detailed herein or are found to be defective in manufacture or have become damaged in transit, storage, or handling operations, then such materials shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

AD41.6 Patching Mortar

AD41.6.1 The patching mortar shall be made of the same cementitious material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2 parts sand by damp loose volume. White Portland Cement shall be substituted for a part of the grey Portland Cement on exposed concrete in order to produce a colour matching the colour of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling and placing.

AD41.7 Cement

AD41.7.1 Cement shall be Type HS or HSb, high-sulphate-resistant hydraulic cement, conforming to the requirements of CAN/CSA A23.1-14.

AD41.8 Concrete

AD41.8.1 General

(a) Concrete repair material shall be compatible with the concrete substrate.

AD41.8.2 The Contractor shall be responsible for the design and performance of all concrete mixes supplied under this specification. Either ready mix concrete or proprietary repair mortars, where applicable, may be used having the following minimum properties in accordance with CAN/CSA A23.1-09:

(a) Class of Exposure: S-1;

(b) Compressive Strength @ 56 days = 35 MPa;

(c) Water / Cementing Materials Ratio = 0.4;

(d) Air Content: Category 2 per Table 4 of CAN/CSA A23.1-04 (4-7%); and,

(e) Cement – shall be as specified in AD41.7.

AD41.8.3 Mix design for ready mix concrete shall be submitted to Contract Administrator at least two (2) weeks prior to concrete placing operations.

AD41.8.4 The workability of each concrete mix shall be consistent with the Contractor's placement operations. Self-compacting concrete may be used for pile foundations.

AD41.8.5 Any proposed proprietary repair mortar shall be subject to the approval of the Contract Administrator and must meet or exceed the properties of the ready mix concrete.

AD41.8.6 The temperature of all types of concrete shall be between 15˚C and 25˚C at discharge. Temperature requirements for concrete containing silica fume shall be between 10˚C and 18˚C at discharge unless otherwise approved by the Contract Administrator.

AD41.8.7 Concrete materials susceptible to frost damage shall be protected from freezing.

AD41.9 Aggregate

AD41.9.1 The Contractor shall be responsible for testing the fine and coarse aggregates to establish conformance to these specifications, and the results of these tests shall be provided to the Contract Administrator if requested. All aggregates shall comply with CAN/CSA A23.1.

AD41.9.2 Coarse Aggregate

(a) The maximum nominal size of coarse aggregate shall be sized to suit the Contractor's mix design. Gradation shall be in accordance with CAN/CSA A23.1, Table 11, Group 1. The coarse aggregate shall satisfy the Standard Requirements specified in CAN/CSA A23.1, Table 12, "Concrete Exposed to Freezing and Thawing";

(b) Coarse aggregate shall consist of crushed stone or gravel or a combination thereof, having hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter or other injurious substances. Coarse aggregate shall be clean and free from alkali, organic or other deleterious matter; and shall have an absorption not exceeding 2.25%;

(c) The aggregate retained on the 5 mm sieve shall consist of clean, hard, tough, durable, angular particles with a rough surface texture, and shall be free from organic material, adherent coatings of clay, clay balls, and excess of thin particles or any other extraneous material;

(d) Coarse aggregate when tested for abrasion in accordance with ASTM C131 shall not have a loss greater than 30%; and,

(e) Tests of the coarse aggregate shall not exceed the limits for standard for requirements prescribed in CAN/CSA A23.1, Table 12, for concrete exposed to freezing and thawing.

AD41.9.3 Fine Aggregate

(a) Fine aggregate shall meet the grading requirements of CAN/CSA A23.1, Table 10, Gradation FA1;

(b) Fine aggregate shall consist of sand, stone, screenings, other inert materials with similar characteristics or a combination thereof, having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam, or other deleterious substances; and,

(c) Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CAN/CSA A23.1, Table 12.

AD41.10 Cementing Materials

AD41.10.1 Cementing materials shall conform to the requirements of CAN/CSA A3001.

AD41.10.2 Silica Fume

(a) Should the Contractor choose to include silica fume in the concrete mix design, it shall not exceed 8% by mass of cement.

AD41.10.3 Fly Ash

(a) Fly ash shall be Type C1 or Type F and shall not exceed 25% by mass of cement.

AD41.10.4 Cementitious materials shall be stored in a suitable weather-tight building that shall protect these materials from dampness and other destructive agents. Cementitious materials that have been stored for a length of time resulting in the hardening or formation of lumps shall not be used in the Work.

AD41.11 Admixtures

AD41.11.1 Air entraining admixtures shall conform to the requirements of ASTM C260.

AD41.11.2 Chemical admixtures shall conform to the requirements of ASTM C494 or C1017 for flowing concrete.

AD41.11.3 All admixtures shall be compatible with all other constituents. The addition of calcium chloride, accelerators, and air-reducing agents will not be permitted, unless otherwise approved by the Contract Administrator.

AD41.11.4 Appropriate low range water reducing and/or superplasticizing admixtures shall be used in concrete containing silica fume. Approved retarders or set controlling admixtures may be used for concrete containing silica fume.

AD41.11.5 An aminocarboxylate based migrating corrosion inhibitor admixture shall be used in concrete that will be used as a repair material that will either be in contact with or adjacent to reinforcing steel in existing concrete. Proposed admixtures shall be subject to the approval of the Contract Administrator.

AD41.12 Water

AD41.12.1 Water used for mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances. It shall be equal to potable water in physical and chemical properties.

AD41.13 Concrete Supply

AD41.13.1 Concrete shall be proportioned, mixed, and delivered in accordance with the requirements of CSA A23.1, except that the transporting of ready mixed concrete in non-agitating equipment will not be permitted unless prior written approval is received from the Contract Administrator.

AD41.13.2 Unless otherwise directed by the Contract Administrator, the discharge of ready mixed concrete shall be completed within 90 minutes after the introduction of the mixing water to the cementing materials and aggregates.

AD41.13.3 The Contractor shall maintain all equipment used for handling and transporting the concrete in a clean condition and proper working order.

AD41.14 Reinforcing Steel

AD41.14.1 Reinforcing steel shall be deemed to include all reinforcing bars, tie-bars, and dowels.

AD41.14.2 All reinforcing steel shall conform to the requirements of CAN/CSA Standard G30.18, Grade 400 W, Billet-Steel Bars for Concrete Reinforcement. All reinforcing steel shall be new deformed billet steel bars. All bars, including ties, shall be hot-dip galvanized in accordance with ASTM A767 for a minimum net retention of 610 g/m^2. Reinforcing steel supply and installation will be incidental to construction of concrete pile foundation and no separate payment will be made.

AD41.15 Anchor Bolts, Nuts, and Washers

AD41.15.1 Anchor bolts, nuts, and washers shall be in accordance with ASTM F1554, and shall be hot-dip galvanized full length in accordance with ASTM F2329 for a minimum net retention of 610 g/m^2, for the entire length of the anchor bolts. The threaded portion of the anchor bolts shall be 300 mm long. Anchor bolt supply and installation will be incidental to construction of concrete pile foundation and no separate payment will be made.

AD41.16 Anchor Bolt Templates

(a) Anchor bolt templates shall be CAN/CSA G40.21 Grade 300W, minimum 10 mm thick, and will be incidental to construction of new concrete pile foundation and no separate payment will be made.

AD41.17 Miscellaneous Materials

(a) Miscellaneous materials shall be of the type specified on the Drawings or approved by the Contract Administrator.

CONSTRUCTION METHODS

AD41.18 Location and Alignment of Piles

AD41.18.1 Pile construction shall not commence until the Contractor has obtained clearance from the appropriate Utility Authorities including but not limited to Manitoba Hydro, MTS and City of Winnipeg Water and Waste.

AD41.18.2 Piles shall be placed in the positions shown on the Drawings and as directed by the Contract Administrator in the field.

AD41.18.3 The deviation of the axis of any finished pile shall not differ by more than 1 percent from the vertical.

AD41.19 Buried Utilities

AD41.19.1 The Contractor shall exercise extreme caution when constructing the pile foundations in the vicinity of existing buried utilities and buildings. The Drawings show the approximate locations of existing buried utilities. The Contractor shall be responsible for obtaining the exact location of the buried utilities from the appropriate Utility Authorities prior to installing the piles.

AD41.19.2 The proposed locations of the pile foundations may be changed by the Contract Administrator if they interfere with the buried utilities.

AD41.19.3 The Contractor shall be responsible for all costs that may be incurred for repair/rectification of any damage caused to the existing buried utilities as a result of the Contractor's operations in constructing cast-in-place concrete piles, as determined by the Contract Administrator.

AD41.20 Excavation

AD41.20.1 Pile excavation shall be accomplished by hydro-jet and/or boring for the full depth of all piles.

AD41.20.2 It may be necessary to hydro-jet excavate utilities adjacent to a pile location to adequately ascertain the location or provide enough “slack” in conduits to move them slightly to avoid interference with the pile locations. The Contract Administrator may elect to alter the location of a pile if hydro-jet excavation shows that utilities cannot be avoided.

AD41.20.3 Upon reaching the required elevation, the bottom of the excavation shall be cleaned as directed by the Contract Administrator in the field.

AD41.20.4 All excavated material from the piles shall be promptly hauled away from the Site to an approved disposal area as located by the Contractor.

AD41.20.5 Upon completion of the cleaning out of the bottom to the satisfaction of the Contract Administrator, the reinforcement and anchor bolts shall be set in place and the concrete poured immediately. Under no circumstances shall a hole be left to stand open after excavation has been completed.

AD41.20.6 If any hole is condemned because of caving, it shall be filled with lean-mix concrete and a new hole excavated as near as possible to the location shown on the Drawings. In locations where underground utilities have been exposed, the underground utilities shall be covered with clean sand to 300 mm minimum cover around the utility. Payment will not be made for condemned piles.

AD41.21 Sleeving

AD41.21.1 Steel or corrugated metal pipe sleeving shall be used to temporarily line the excavation to prevent bulging or caving of the walls.

AD41.21.2 The sleeving shall be designed by the Contractor and constructed to resist all forces that may tend to distort it.

AD41.21.3 The sleeving shall be withdrawn as the concrete is placed in the excavation. The sleeving shall extend at least 1 m below the top of the freshly deposited concrete at all times.

AD41.21.4 The clearance between the face of the excavation and the sleeving shall not exceed 75 mm.

AD41.21.5 The sleeving may remain cast in place if required to protect nearby utilities at the direction of the Contract Administrator. The top of sleeving shall be 300 mm below the top of sidewalk.

AD41.22 Inspection of Excavations

AD41.22.1 Concrete shall not be placed in an excavation until the excavation has been inspected and approved by the Contract Administrator.

AD41.22.2 The Contractor shall have available suitable light for the inspection of each excavation throughout its entire length.

AD41.22.3 Any improperly set sleeving or improperly prepared excavation shall be corrected to the satisfaction of the Contract Administrator.

AD41.23 Placing Reinforcing Steel

AD41.23.1 Reinforcement shall be:

(a) placed in accordance with the details shown on the Drawings;

(b) rigidly fastened together; and,

(c) lowered into the excavation intact before concrete is placed.

AD41.23.2 Spacers shall be utilized to properly locate the reinforcing steel cage in the excavation.

AD41.24 Placing Anchor Bolts

AD41.24.1 The anchor bolts shall be aligned with a steel template matching the bolt holes in the sign structure base plate. The setting template shall be held in place by the top and bottom nuts of the anchor bolts. The anchor bolts shall be plumb. Extreme care shall be used in this operation. Placement of anchor bolts without the steel template will not be permitted.

AD41.24.2 The threaded portion of the anchor bolts projecting above the top surface of pile shall be coated with oil, before the concrete is poured, to minimize the fouling of threads splattered by concrete residue.

AD41.25 Forms

AD41.25.1 For hydro-jet excavated piles the top of the piles shall be formed with tubular forms (Sonotube) to a minimum depth of 1500 mm below final grade.

AD41.25.2 For bored piles the top of the piles shall be formed with tubular forms (Sonotube) to a minimum depth of 1000 mm below final grade.

AD41.25.3 In locations of caving, the tubular form (Sonotube) should extend a minimum of 500 mm below where the shaft becomes uniform.

AD41.25.4 The forms shall be sufficiently rigid to prevent lateral or vertical distortions from the loading environment to which they shall be subjected. Forms shall be set to the design grades, lines, and dimensions, as shown on the Drawings.

AD41.26 Placing Concrete

AD41.26.1 Care shall be taken to ensure that anchor bolts are vertically aligned and that anchor bolts and conduits are properly positioned prior to placement of concrete.

AD41.26.2 Concrete shall not have a free fall of more than 2.0 m and shall be placed so that the aggregates will not separate or segregate. The slump of the concrete shall not exceed 110 mm. The concrete shall be vibrated throughout the entire length of the pile.

AD41.26.3 Concrete shall be placed to the elevations as shown on the Drawings. The top surface of the pile shall be finished smooth and even with a hand float.

AD41.26.4 The shaft shall be free of water prior to placing of concrete. Concrete shall not be placed in or through water unless authorized by the Contract Administrator. In the event that tremie concrete is allowed by the Contract Administrator, the concrete shall be placed as specified herein.

AD41.26.5 All concrete, during and immediately after deposition, shall be consolidated by mechanical vibrations so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into the corners of forms; eliminating all air or stone pockets that may cause honeycombing, pitting, or planes of weakness.

AD41.27 Tremie Concrete

AD41.27.1 The shaft of the pile shall be pumped clear of water so that the bottom can be cleaned. Pumping shall then be stopped and water shall be allowed to come into the excavation until a state of equilibrium is reached. Concrete shall then be placed by means of a tremie pipe. The tremie pipe shall have a suitable gate in the bottom to prevent water from entering the pipe. The bottom of the pipe shall be maintained below the surface of the freshly placed concrete. The pipe shall be capable of being raised or lowered quickly in order to control the flow of concrete.

AD41.27.2 Tremie concrete shall be poured up to a depth of 600 mm or as the Contract Administrator directs. Pumps shall then be lowered into the excavation and the excess water pumped out. The laitance that forms on top of the tremie shall then be removed and the remainder of the concrete shall be placed in the dry excavation.

AD41.28 Protection of Newly Placed Concrete

AD41.28.1 Newly laid concrete threatened with damage by rain, snow, fog, or mist shall be protected with a tarpaulin or other approved means.

AD41.29 Curing Concrete

AD41.29.1 The top of the freshly finished concrete piles shall be covered and kept moist by means of wet polyester blankets immediately following finishing operations and shall be maintained at above 10ºC for at least seven (7) consecutive days thereafter.

AD41.29.2 After the finishing is completed, the surface shall be promptly covered with a minimum of a single layer of clean, damp polyester blanket.

AD41.29.3 Concrete shall be protected from the harmful effects of sunshine, drying winds, surface dripping or running water, vibration, and mechanical shock. Concrete shall be protected from freezing until at least twenty-four (24) hours after the end of the curing period.

AD41.29.4 Changes in temperature of the concrete shall be uniform and gradual and shall not exceed 3º in one (1) hour or 20º in twenty-four (24) hours.

AD41.30 Form Removal

AD41.30.1 Forms shall not be removed for a period of at least twenty-four (24) hours after the concrete has been placed. Removal of forms shall be done in a manner to avoid damage to, or spalling of, the concrete.

AD41.30.2 The minimum strength of concrete in place for safe removal of forms shall be 20 MPa.

AD41.30.3 Field-cured test specimens, representative of the in-place concrete being stripped, will be tested to verify the concrete strength.

AD41.31 Patching of Formed Surfaces

AD41.31.1 Immediately after forms around top of pile have been removed, but before any repairing or surface finishing is started, the concrete surface shall be inspected by the Contract Administrator. Any repair of surface finishing started before this inspection may be rejected and required to be removed.

AD41.31.2 All formed concrete surfaces shall have bolts, ties, struts, and all other timber or metal parts not specifically required for construction purposes cut back fifty (50) mm from the surface before patching.

AD41.31.3 Minor surface defects caused by honeycomb, air pockets greater than 5 mm in diameter, and voids left by strutting, and tie holes shall be repaired by removing the defective concrete to sound concrete, dampening the area to be patched and then applying patching mortar. A slurry grout consisting of water and cement shall be well-brushed onto the area to be patched. When the slurry grout begins to lose the water sheen, the patching mortar shall be applied. It shall be struck-off slightly higher than the surface and left for one (1) hour before final finishing to permit initial shrinkage of the patching mortar and it shall be touched up until it is satisfactory to the Contract Administrator. The patch shall be cured as specified in this Specification, and the final colour shall match the surrounding concrete.

AD41.32 Cold Weather Concreting

AD41.32.1 Protection of concrete shall be considered incidental to its placement. The temperature of the concrete shall be maintained at or above 10ºC for a minimum of three (3) days or until the concrete has reached a minimum compressive strength of 20 MPa, by whatever means are necessary. Concrete damaged as a result of inadequate protection against weather conditions shall be removed and replaced by the Contractor at his own expense. Also, concrete allowed to freeze prior to the three (3) days will not be accepted for payment.

AD41.33 Removal and Restoration of Adjacent Surface Treatments

AD41.33.1 If the new pile being constructed is located in a concrete sidewalk/median slab, the existing slab shall be removed to the nearest existing joints. If the nearest existing joint is more than 600 mm beyond the perimeter of the pile, the Contractor shall remove a square section of the existing slab that is 300 mm beyond the pile perimeter. The surface of the slab shall be saw-cut to a depth of 50 mm around the perimeter of the square section. Care shall be taken to ensure that the saw-cut edge of the section is not chipped or broken during the removal of the concrete. Concrete slabs damaged beyond the specified limits shall be replaced at the Contractor's cost to the satisfaction of the Contract Administrator. After the pile has been constructed, the concrete sidewalk/median slab shall be restored flush with the adjacent surface level.

AD41.33.2 If the pile being constructed is located in grass boulevard/median, following pile construction disturbed areas shall be backfilled and restored with sod around the new pile as directed by the Contract Administrator

AD41.33.3 If the pile being constructed is located in a paving stone surface, the paving stones shall be temporarily removed to the extent required for new pile construction and appropriately stored by the Contractor. Following pile construction, the Contractor shall cut as required and re-set the salvaged paving stones around the new pile flush with the adjacent surface level, as directed by the Contract Administrator.

AD41.33.4 The removal and restoration of surface treatments will be considered incidental to pile construction works at each Site and no separate payment will be made.

QUALITY CONTROL

AD41.34 All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator, including all operations from the selection and production of materials, through to final acceptance of the Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works that are not in accordance with the requirements of this Specification.

AD41.35 The Contractor shall be responsible for making a thorough inspection of materials to be supplied under this Contract. All material shall be free of surface imperfections and other defects.

AD42. SUPPLY AND INSTALLATION OF STEEL OVERHEAD SIGN SUPPORT STRUCTURES

DESCRIPTION

AD42.1 The Work covered under this item shall include all operations related to the supply, fabrication, delivery, and erection of steel overhead sign support structures.

AD42.2 The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of the Work as hereinafter specified.

MATERIALS

AD42.3 General

AD42.3.1 The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

AD42.3.2 All materials used for fabrication of overhead sign support structures shall be new, previously unused material.

AD42.4 Handling and Storage of Materials

AD42.4.1 All materials shall be handled in a careful and workmanship-like manner, to the satisfaction of the Contract Administrator.

AD42.5 Structural Steel

AD42.5.1 Structural steel for all components of the overhead sign support structures shall be in accordance with CAN/CSA Standard G40.21 M, to the grades indicated on the Drawings. For purposes of hot-dip galvanizing, the silicon content in the steel shall be controlled within 0 to 0.03% or 0.15 to 0.22% for monotubular shafts and arms, and to less than 0.3% for all other steel components.

AD42.5.2 The Contractor is advised that copies of mill test certificates showing the chemical and physical properties of all structural steel to be supplied under this Specification must be supplied to the Contract Administrator and be found acceptable prior to commencement of fabrication.

AD42.5.3 Steel shall not be acceptable unless the mill test certificate states the grade to be as indicated on the Drawings. Lower grade steel shall not be acceptable (despite favourable published mill test results). Items fabricated without steel certification shall be rejected.

AD42.6 Structural Aluminum Backing Bars

AD42.6.1 Structural aluminum backing bars for sign panels shall be in accordance with ASTM B221 6061-T6.

AD42.7 Flange Bolts, Nuts, and Washers

AD42.7.1 Flange bolts, nuts, and washers shall be in accordance with ASTM A325, Type 1, hot-dip galvanized in accordance with ASTM F2329.

AD42.8 Fasteners for Handhole Covers

AD42.8.1 Fasteners for handhole covers shall be in accordance with ASTM A276 Type 316 stainless steel.

AD42.9 Hot-Dip Galvanizing

AD42.9.1 Hot-dip galvanizing of structural steel shall be in accordance with ASTM A123 for a minimum net retention of 610 g/m^2.

AD42.10 Galvanizing Touch-up and Repair

AD42.10.1 Only approved products listed below shall be used for field-applied galvanizing, to touch-up damaged hot-dip galvanizing on-site and to galvanize field welds.

AD42.10.2 Approved paints containing zinc dust is as follows:

(a) ZINGA, as manufactured by ZINGAMETALL, Ghent, Belgium, available from Pacific Evergreen Industries Ltd. Vancouver, BC, Ph. (604) 926-5564, and Centennial Mine & Industrial Supply, Saskatoon, SK., Ph. (306) 975-1944.

AD42.11 Anchor Bolts

AD42.11.1 Anchor bolts including nuts and washers shall be in accordance with ASTM F1554 Grade 55 ksi (380 MPa), hot-dip galvanized in accordance with ASTM 2329. Anchor bolts, nuts, and washers, shall be supplied and paid for under, "Cast-in-Place Concrete Pile Foundations", specified herein.

AD42.12 Setting Template

AD42.12.1 Setting template shall be in accordance with CAN/CSA G40.21 Grade 300W, hot-dip galvanized. Setting template shall be supplied and paid for under, "Cast-in-Place Concrete Pile Foundations", specified herein.

AD42.13 Non-Shrink Grout

AD42.13.1 Grout as specified hereinafter shall be used for the construction of grout pads under sign structure base plates. Grout shall consist of a pre-mixed, non-metallic non-shrink grout. Approved products are:

(a) M-Bed Standard grout by Sternson Ltd.;

(b) CPD Non-shrink grout by Master Builders;

(c) Set Non-shrink grout by Master Builders; and,

(d) Sikadur VPC grout by Sika Canada Inc. for cold weather construction (0 C to -20 C).

AD42.13.2 The grout shall be of a consistency suitable for the application intended, as approved by the Contract Administrator.

AD42.14 Sign Plates

AD42.14.1 Sign plates will be supplied and installed by the City of Winnipeg Traffic Services Branch.

AD42.15 Welding Consumables

AD42.15.1 Welding consumables for all processes shall be certified by the manufacturer to be complying with the requirements of CSA Standard W59-M1984 and the following Specifications:

(a) Manual shielded metal arc welding (SMAW): All electrodes shall be basic-type electrodes conforming to CSA W48.1-M1991 or W48.3-M1982, classification E480XX, or imperial equivalent;

(b) Gas metal arc welding (GMAW): All electrodes shall conform to CAN/CSA W48.4-M1980, classification ER480S-X, or imperial equivalent;

(c) Flux cored arc welding (FCAW): All electrodes shall conform to CAN/CSA W48.5-M1982, classification E480XT-X or imperial equivalent. Electrodes shall be controlled by hydrogen (CH) designation;

(d) Submerged arc welding (SAW): All electrodes shall conform to CAN/CSA W48.6-M1980, classification F480X-EXXX or imperial equivalent;

(e) Shielding gas shall be welding grade carbon-dioxide with a guaranteed dew point of -46ºC; and,

(f) All electrodes, wires, and fluxes used shall be of a classification requiring a minimum impact of 27 joules at -18ºC.

AD42.15.2 The proposed welding procedures and welding consumable certificates shall be submitted to the Contract Administrator for his approval at least two (2) days prior to the scheduled commencement of any fabrication.

AD42.16 Miscellaneous Materials

AD42.16.1 Miscellaneous material incidental to this Work shall be as approved by the Contract Administrator.

EQUIPMENT

AD42.17 All equipment shall be of a type approved by the Contract Administrator and shall be kept in good working order.

CONSTUCTION METHODS

AD42.18 General Requirements

AD42.18.1 Holes in the base plates shall be sized as shown on the Drawings, and provisions made for field erection must be accurate within plus or minus 13 mm between supports, without affecting final installation and load capacity.

AD42.18.2 The base plates for the sign support structures shall be constructed to be fully compatible and mountable on the anchor bolts, provided in the foundations by the Contractor.

AD42.18.3 Sufficient reinforced handholes and wiring holes shall be provided for lighting of the signs as shown on the Drawings. All wiring holes shall have threaded couplings. All unused coupling holes shall be capped with a threaded galvanized plug.

AD42.18.4 The sign support structure shall be so fabricated that erection can be achieved by means of bolted connections.

AD42.18.5 Each sign structure shall be provided with a "raised" structure identification number with a welding electrode in accordance with the details shown on the Drawings. The sign structure identification number shall be placed before hot-dip galvanizing.

AD42.18.6 Adequate venting and drainage holes shall be provided in enclosed sections for hot-dip galvanizing. The galvanizing facilities shall be consulted regarding the size and location of these holes.

AD42.18.7 Prior to fabrication, the dimensional limitations on the size and shape imposed by the galvanizing facilities shall be determined for hot-dip galvanizing the sign structures.

AD42.19 Fabrication

AD42.19.1 All fabrication shall be carried out in accordance with this Specification and the Contract Drawings, as well as AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals - 2009 - 5th Edition, plus all subsequent revisions.

AD42.19.2 The punching of identification marks on the members will not be allowed, except for the structure identification number.

AD42.19.3 Any damage to members during fabrication shall be drawn to the attention of the Contract Administrator in order that the Contract Administrator may approve remedial measures.

AD42.19.4 Dimensions and fabrication details that control the field matching of parts shall receive very careful attention in order to avoid field adjustment.

AD42.19.5 All portions of the Work shall be neatly finished. Shearing, cutting, clipping, and machining shall be done neatly and accurately. Finished members shall be true to line, free from twists, bends, sharp corners, and edges.

AD42.19.6 Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Re-entrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting.

AD42.19.7 All holes shall be free of burrs and rough edges.

AD42.20 Welding

AD42.20.1 Welding of steel structures shall be in accordance with CAN/CSA W59, "Welded Steel Construction."

AD42.20.2 All seams shall be continuously welded and free from any slag and splatter. Longitudinal welds shall be a minimum of 60% penetration, except those within 200 mm of baseplates, flanges, and circumferential welds, which shall be 100% penetration. All circumferential groove welds shall be 100% penetration, and where circumferential welds are used at a butt joint, an internal backup strip shall be provided.

AD42.20.3 Longitudinal seam welds in horizontal supports shall be located at the top of the horizontal members.

AD42.20.4 All welds shall be ground smooth and flush with the adjacent surface prior to hot-dip galvanizing.

AD42.21 Surface Preparation and Cleaning

AD42.21.1 Surface preparation and cleaning of materials prior to hot-dip galvanizing shall be in accordance with ASTM A123 and SSPC Specification SP:6, "Commercial Blast Cleaning," unless otherwise specified herein. The Contractor shall ensure that all exterior and interior surfaces of vertical support members of sign structures are blast cleaned prior to pickling to achieve the minimum zinc coating mass of 610 g/m^2. All welding and provision of holes is to be completed prior to surface preparation and cleaning, except where shown on the Drawings.

AD42.21.2 The sandblasting and cleaning of sign structures shall be done in the shop.

AD42.21.3 After the structures have been sandblasted they shall be thoroughly cleaned of all sandblasting abrasive and debris, with special attention paid to areas of the structure where sand and debris collect, including but not limited to behind the gusset plates, handholes and base plate.

AD42.21.4 After the sign structures have been sandblasted and cleaned, the Contract Administrator will carry out a visual inspection of the structures in the shop before they are shipped to the galvanizing plant.

AD42.22 Hot-Dip Galvanizing

AD42.22.1 The hot-dip galvanizing plant shall be a Regular Member of the American Galvanizers Association, Inc.

AD42.22.2 All outside surfaces of the overhead sign support structures shall be hot-dip galvanized in accordance with ASTM A123 to a minimum net retention of 610 g/m2.

AD42.22.3 Adequate venting and drainage holes shall be provided in enclosed sections for hot-dip galvanizing. The galvanizing facility shall be consulted regarding the size and location of these holes. Holes shall be provided by drilling not burning.

AD42.22.4 The galvanizing coating on outside surfaces of overhead sign support structures shall be generally smooth and free of blisters, lumpiness and runs. In particular, the outside surfaces of the bottom 2.5 m of the vertical support members shall have a smooth finish equal to the finish on hot-dipped galvanized handrails.

AD42.22.5 In addition to the provision of corrosion protection by the galvanized coating, the aesthetic appearance of the structure after hot-dip galvanizing will also be a criterion in the acceptance or rejection of the galvanized coating. The galvanized coating on the entire structure shall have a uniform “silver” colour and lustre. Galvanizing with parts of the structure having dull grey coating or streaks or mottled appearance will not be acceptable. If the galvanizing is rejected for aesthetic reasons, the Contractor shall rectify the appearance by applying spray-on molten zinc metallizing with 85/15 zinc/aluminum alloy. The metallizing shall be carried out in the shop before the structure is installed.

AD42.22.6 Minor defects in the galvanizing coating shall be repaired as specified here below for “Field-Applied Touch-Up Galvanizing”. The Contract Administrator shall be consulted before repairs are made.

AD42.22.7 Other defects and contaminants in the galvanizing coating, such as heavy dross protrusions, flux inclusions and ash inclusions shall be grounds for rejection of the galvanizing coating system.

AD42.22.8 The Contractor shall verify the thickness of galvanized coatings as part of their own quality control testing and make their results available to the Contract Administrator.

AD42.22.9 All threaded couplings shall be rethreaded after the sign structures have been hot-dip galvanized.

AD42.22.10 The sign structures shall be stored on timber blocking after hot-dip galvanizing.

AD42.23 Delivery of Sign Mounting Brackets

AD42.23.1 Contractor to deliver the sign mounting brackets to the City of Winnipeg Traffic Services Branch at 421 Osborne Street. Contact Mr. Wes Delaney (204) 986-5841 to arrange suitable delivery time.

AD42.23.2 Each mounting bracket shall be delivered complete with structural aluminum backing bars for sign panels and hardware (loosely assembled). Each bracket shall be clearly marked.

AD42.23.3 The Contractor shall prepare a record of shipping listing all items delivered and shall be signed by the Contractor and the receiver upon delivery. The Contractor shall provide duly signed copies of the record of shipping to the receiver and the Contract Administrator.

AD42.23.4 Upon delivery, the Contractor shall unload the materials and place them in a location as directed by a representative of the City of Winnipeg Traffic Services Branch.

AD42.23.5 Delivery of sign mounting brackets and all related Works shall be considered incidental to the "Supply and Installation of Steel Overhead Sign Support Structures" and no separate payment will be made.

AD42.24 Delivery and Erection of Overhead Sign Support Structures

AD42.24.1 The Contractor shall notify the Contract Administrator at least two (2) Working Days in advance of the anticipated delivery to the Site and erection of the overhead sign support structures.

AD42.24.2 The sign structures shall be lifted and secured with nylon ropes or other approved methods. Use of steel chains and steel hooks against hot-dip galvanized or powder coated surfaces will not be permitted. The structure components (shaft and arm etc.) shall be placed on timber blocking and secured with nylon ropes during their transportation to the Site.

AD42.25 Anchor Bolt Installation

AD42.25.1 Each anchor bolt shall be provided with two galvanized nuts: one nut below the base plate for levelling the structure, and one nut above the base plate for anchoring the structure. The anchor bolts shall have a minimum projection of 25 mm above the anchoring nuts. There shall be provision for maximum 50 mm thick grout pad under the base plate.

AD42.25.2 The Contractor shall plumb the shaft by adjusting the leveling and anchor nuts.

AD42.25.3 Leveling nuts and anchor nuts shall be tightened to a snug tight condition, defined as the full effort of an ironworker using an ordinary wrench, or a few impacts of an impact wrench.

AD42.25.4 The Contractor shall tighten the top anchoring nuts in an alternating "star" type pattern as follows:

(a) For anchor bolts less than or equal to 38 mm diameter: 1/3 of a turn (+20°, -0°) past a snug tight condition; and,

(b) For anchor bolts greater than 38 mm diameter: 1/6 of a turn (+20°, -0°) past a snug tight condition.

AD42.26 Structural Bolt Installation

AD42.26.1 Structural bolts for flange and splice connections shall be tightened in accordance with the turn-of-nut method as follows:

(a) Alternately tighten all bolts to achieve a snug tight condition. The mating surfaces shall be in firm contact;

(b) Tighten all bolts in accordance with Table AD42.1; and,

(c) Following tightening, check all bolts in the joint by hand using and ordinary wrench.

Table AD42.1 Required Turns Past Snug Tight for Turn-of-nut Method						
Bolt Diameter *D* (inches)	**Bolt Length up to 4*D***		**Bolt Length over 4*D* to 8*D***		**Bolt Length over 8*D* to 12*D***	
	Length up to	Required Turns	Length Range	Required Turns	Length Range	Required Turns
1/2”	2”	1/3 ± 30°	2 to 4”	1/2 ± 30°	4 to 6”	2/3 ± 45°
5/8”	2.5”	1/3 ± 30°	2.5 to 5”	1/2 ± 30°	5 to 7.5”	2/3 ± 45°
3/4”	3”	1/3 ± 30°	3 to 6”	1/2 ± 30°	6 to 9”	2/3 ± 45°
7/8”	3.5”	1/3 ± 30°	3.5 to 7”	1/2 ± 30°	7 to 10.5”	2/3 ± 45°
1”	4”	1/3 ± 30°	4 to 8”	1/2 ± 30°	9 to 13.5”	2/3 ± 45°
1 1/8”	4.5”	1/3 ± 30°	4.5 to 9”	1/2 ± 30°	10 to 15”	2/3 ± 45°
1 1/4”	5”	1/3 ± 30°	5 to 10”	1/2 ± 30°	11 to 16.5”	2/3 ± 45°

AD42.27 Installation of Sign Plates

AD42.27.1 The City of Winnipeg will be responsible for installation of sign plates.

AD42.28 Grout Pads

AD42.28.1 New grout pads shall be constructed under sign structure bases after erection has been completed to the satisfaction of the Contract Administrator incidental to the Work of this item.

AD42.29 Galvanizing Touch up and Repair

AD42.29.1 Any areas of damaged galvanizing on the sign structures shall receive field-applied touch-up galvanizing.

AD42.29.2 Galvanizing touch-up and repair shall be performed in accordance with ASTM A780 as follows:

(a) For areas requiring repair less than 100 mm x 100 mm in extent, repair using paint containing zinc dust in accordance with ASTM A780 Annex A2; and,

(b) For areas requiring repair greater than 100 mm x 100 mm in extent, repair using sprayed zinc (metallizing) in accordance with ASTM A780 Annex A3.

AD42.29.3 For pure zinc paint or spray on systems, the approved product Zinga shall be applied by either a brush or roller. The Zinga shall be applied in three (3) coats, with each coat having a dry film thickness of 50.8 µm (2.0 mils). Each coat shall be left to dry for a minimum of one (1) hour before the application of the next coat.

AD42.29.4 For sprayed zinc (metallizing) repairs, the minimum coating shall be as specified herein for hot dip galvanizing.

AD42.29.5 All costs associated with galvanizing touch up and repair shall be borne by the Contractor. No additional payment will be made.

QUALITY CONTROL

AD42.30 General

AD42.30.1 All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator, including all operations from the selection and production of materials, through to final acceptance of the Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection approval that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works that are not in accordance with the requirements of this Specification.

AD42.30.2 The Contractor shall be responsible for making a thorough inspection of materials to be supplied under this Contract. All material shall be free of surface imperfections and other defects.

AD42.31 Welding Qualifications

AD42.31.1 The Contractor shall produce evidence that the plant has recently been fully approved by the C.W.B. to the requirements of CSA W47.1 Division 2.1 for welding of steel structures.

AD42.31.2 Approved welding procedures shall be submitted to the Contract Administrator prior to fabrication of any steel items.

AD42.32 Testing

AD42.32.1 In addition to the Contractor's own quality control testing of all materials, welding procedures and steel fabrication including hot-dip galvanizing will be inspected and tested by the Contract Administrator to ascertain compliance with the Specifications and Drawings.

AD42.32.2 The Contract Administrator will hire a testing agency certified by the Canadian Welding Bureau to carry out shop fabrication inspection and testing before the overhead sign support structures are approved ready for installation of coating system. The inspector shall have access to all of the fabricator's normal quality control records for this Contract, specified herein. Inspection and testing will include:

(a) Visual inspection of 100% of welds;

(b) Ultrasonic testing of 100% of full penetration sections of longitudinal seam welds and circumferential butt welds;

(c) Magnetic particle testing of a random 10% of partial penetration sections of longitudinal seam welds;

(d) Ultrasonic testing of 25% of base plate and flange plate welds; and,

(e) Inspection of hot-dip galvanizing and coating thickness.

AD42.32.3 Welds that are found by any of the inspection and testing methods to be inadequate and unsatisfactory shall be repaired in accordance with CAN/CSA W59 and then retested. The cost of the repairs and the cost of the retest shall be paid for by the Contractor.

AD42.32.4 No repair shall be made until agreed to by the Contract Administrator.

AD42.32.5 Defects in hot-dip galvanizing shall be rectified as directed by the Contract Administrator.

AD42.33 Unacceptable Work

AD42.33.1 Any Work found to be unacceptable shall be corrected in accordance with CAN/CSA W59.

AD42.33.2 No repair shall be made until agreed to by the Contract Administrator.