

Fisheries and Oceans Canada
Fulton Reservoir – Regulating Building – Access Stair Replacement
Project Summary Sheet

Project Description:

The goal of this project is to improve site safety at the Fulton River Dam by replacing the existing stairway access to the dam regulating building (also called control room). The project scope includes the creation of a new stair system from the top of the bank to the top of the reservoir regulating building and includes the removal and disposal of the existing staircase structure.

The new stairs will be constructed mostly “in-place” at the location of the existing stairway and will be made of steel and timber. The footings, base slabs and their connections to the rock base will be significantly upgraded. Several of the existing rock anchoring locations could be changed to better locations.

Safety will be paramount to the contractor planning, preparing and executing this work. The contractor will be considered as “prime contractor” and be responsible for ensuring the highest safety standards are achieved during the work.

This project will be separated into three (3) tasks:

- Task 1 – Initial Site Visit with the Departmental Representative including contractor’s site and safety assessment as well as recommendations for rock anchoring locations
- Task 2 –shop drawings preparation and approval by DFO prior to fabrication. Each sheet shall be sealed and signed by a Professional Engineer registered in the Province of British Columbia, who will be the Specialty Structural Engineer responsible for the integrity of his/her design.
- Task 3 – Fabrication and Installation of Rock Fall Protection System

Work site location:

Fulton Spawning Channel, Via Highway 118 between Topley and Granisle, B.C.

The dam is located approximately 4km west of the Fulton River bridge on the Central Babine Lake Highway. Access is through a gravel road.

Timeline:

This contract will run until August 31st, 2020. It is expected that this project will be carried out in the Spring and Summer of 2020, but alternative schedule may be required based on weather limitations in the area at the time of construction. Schedule to be finalized upon contract award.

Expected timelines are the following (see notes below for the description of the task):

- Task 1 Site visit: within 3 weeks after award or at DFO’s convenience
- Task 2 Shop Drawings: 8 weeks
- Task 3 Fabrication and Construction: 12 weeks

Fisheries and Oceans Canada
Fulton Reservoir – Regulating Building – Access Stair Replacement

Specifications

2020

**Fisheries and Oceans Canada
Fulton Reservoir – Regulating Building – Access Stair Replacement**

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| As Built: | |
| 21-19-M46 | |
| Photos Report | |
| Photos of Existing Stairway Structure in June 2018 | |
| BGC Rock Fall Protection Field Review (November 11, 2019) | |

Division 01 - General Requirements

PART 1 GENERAL

**1.1 Work Covered by
Contract Documents**

- .1 Work of this Contract comprises and shall be further identified as “the Work” and shall include the following:
- .2 A new stair system from the top of the bank to the top of the reservoir control room, including the removal and disposal of the existing staircase structure.
- .3 The new stairs will be constructed of steel and timber, utilizing steel for long spans and where the element is exposed to sloughing from the hillside.
- .4 The staircase roof structure will be similar to the existing, as will the handrails, with minor adjustments made to them to connect to the steel stringers.
- .5 The footings, base slabs and their connections to the rock base will be significantly upgraded. Several of the existing rock anchoring locations could be upgraded to better locations.
- .6 The contractor will review and assess the existing stairway foundations locations. The existing rock anchors are assumed to be built as shown on detail D of drawing 21-19-M46 (attached at the end of the specifications package). Some of the existing anchor locations are considered too close to a cliff or in areas prone to rock scaling. It is requested that the contractor suggest new proposed location for the anchors and stairway foundations. These locations will be submitted for approval to DFO representative.
- .7 After receiving DFO approval on the anchor and foundations locations, the contractor will prepare shop drawings for general compliance review prior to fabrication. Each sheet shall be sealed and signed by a Professional Engineer registered in the Province of British Columbia, who will be the Specialty Structural Engineer responsible for the integrity of his/her design.
- .8 The power pole located on top of the valve house will need to be removed; the associated wires and cables will need to be decommissioned by the contractor for the duration of the construction. The future power service will be attached to the stairway structure and recommissioned by a certified electrician.
- .9 Safety will be paramount to the contractor planning, preparing and executing this work. The contractor will be responsible for ensuring the highest safety standards are achieved during the work.

- .10 All work is as indicated in the contract drawings and specifications.

1.2 Project Schedule

- .1 It is expected the work will be done on two phases.
 - The first phase will consist of the initial assessment and engineering work. The assessment could include some site work. At the end of the first phase, the contractor will ultimately propose an engineered shop drawing package of the future structure.
 - The second phase will consist of the construction phase. The new stairway structure will be installed and commissioned by the contractor.
- .2 DFO ideally envisions a completion date in 2019 but has the possibility to phase the project over 2019 and 2020. The site assessment of the first phase shall be completed in 2019.

1.3 Work Sequence

- .3 Construct Work to accommodate Owner's continued use of premises during construction.
- .4 Co-ordinate Progress Schedule and Occupancy with owner during construction.
- .5 Maintain fire access/control.

1.4 Contractor Use of Premises

- .1 Unrestricted use of site until Substantial Performance.
- .2 Co-ordinate use of premises under direction of owner.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

1.5 Owner Occupancy

- .1 Owner will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.6 Existing Services

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to

- existing services, give Departmental Representative 72 hours' notice for necessary interruption of Mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to vehicular traffic and tenant operations.
- .3 Provide alternative routes for personnel and vehicular traffic.
 - .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
 - .5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
 - .6 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
 - .7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
 - .8 Protect, relocate or ensure a Departmental Representative can maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
 - .9 Record locations of maintained, re-routed and abandoned service lines.
 - .10 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.7 Documents Required

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

END OF SECTION

-
- | | | |
|--|----|--|
| 1. GENERAL | .1 | Not used |
| 2. DOCUMENTS REQUIRED | .1 | Maintain at job site, one (1) copy of each of the following: <ol style="list-style-type: none">1. Contract Drawings2. Specifications3. Addenda4. Reviewed Shop Drawings5. Change Orders6. Other modifications to Contract7. Field test reports8. All reference standards required by this contract. |
| 3. WORK SCHEDULE | .1 | Submit with Tender, a construction schedule on the "Construction Schedule" form included in the Tender Documents, showing anticipated progress stages and final completion of work within time period required by Contract Documents. The schedule is to be updated monthly or as required by the Departmental Representative. |
| 4. CONTRACTOR'S USE OF SITE | .1 | Do not unreasonably encumber site with materials or equipment. |
| | .2 | Move stored products or equipment which interfere with operations of Departmental Representative or other contractors. |
| | .3 | Obtain and pay for use of additional storage or work areas needed for operations. |
| | .4 | Maintain reasonable access. |
| | .5 | Maintain a reasonably clean and safe site. |
| 5. CODES AND STANDARDS | .1 | Perform work in accordance with National Building Code of Canada, latest edition, and any other code of provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements shall apply. |
| | .2 | Observe and enforce construction safety measures required by Canadian Construction Safety Code, Provincial Government, WorkSafeBC, Workplace Hazardous Materials Information System Requirements, including training of all workers on the job site, and municipal status and authorities. |
| | .3 | Meet or exceed requirements of specified standards, codes and referenced documents. |

- .4 Where work is situated on land managed by different legislative bodies the contractor will meet the requirements set out by the authorities responsible. In any case of conflict between the requirements set out by the authorized body and these contract documents, the more stringent requirements shall apply.
- 6. PROJECT MEETINGS** .1 Departmental Representative will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.
- 7. EXISTING CONDITIONS** .1 Inspect surfaces and conditions before commencing work and report defects to the DFO Representative. No work to commence until conditions are acceptable. Commencement of work will indicate acceptance of surfaces and conditions.
- 8. SETTING OUT OF WORK**
- .1 Locate and preserve general reference points.
- .2 Employ competent person to lay out work in accordance with control lines and grades provided by Departmental Representative.
- .3 Supply stakes and other survey markers required for this work.
- .4 The detailed layout is the responsibility of the Contractor.
- 9. LOCATION OF EQUIPMENT AND FIXTURES** .1 Location of equipment, fixtures and outlets indicated or specified is to be considered as approximate.
- 10. ADDITIONAL DRAWINGS** .1 Departmental Representative may furnish additional drawings to assist proper execution of work. These drawings will be issued for clarification only. Such drawings shall have same meaning and intent as if they were included with plans referred to in Article 1 of Articles of Agreement.

- 11. RELICS AND ANTIQUITIES**
- .1 Relics and antiquities such as cornerstones and similar objects found on site or in buildings to be demolished, shall remain property of the Owner. Protect such articles and request directives from Departmental Representative.
 - .2 Give immediate notice to Departmental Representative if evidence of archaeological finds are encountered during construction, and await his written instructions before proceeding with work in that area.
- 12. SITE MAINTENANCE AND CLEAN-UP**
- .1 Maintain the working area in an orderly manner and not encumbered with equipment, materials, or debris.
 - .2 Clean-up to be a continuing process from the start of the work to final acceptance of the project. At all times, and without further order, keep property on which work is in progress free from accumulations of waste materials or rubbish caused by employees or by the work. Accumulations of waste materials which might constitute a fire hazard will not be permitted. Spillage from the Contractor's hauling vehicles on traveled public or private roads to be promptly cleaned up. On completion of construction, remove all temporary structures, rubbish, and waste materials resulting from construction operations.
- 13. AMBIGUITIES**
- .1 In the event of discrepancies and ambiguity in the contract document, manufacturers guidelines and relevant provincial and federal regulations the Contractor shall notify the Departmental Representative for clarification. The more stringent requirement shall apply unless otherwise instructed in writing by the Departmental Representative.

END OF SECTION

1. GENERAL

1. Read structural drawings in conjunction with all other consultants' drawings, contract documents and specifications.
2. Check and verify all dimensions, quantities and site conditions with drawings before commencing with any work. Notify DFO representative of any discrepancies.
3. The latest edition of the standards and codes referenced in these notes and on the Structural Drawings shall apply.
4. Do not construct from these drawings unless marked "Issued for Construction".
5. In the event of discrepancies in the specifications, drawings or contract documents, the more stringent requirement shall apply.
6. Notes and details specified on the plans and details take precedence over those in General Structural Notes, except for minimum requirements.
7. For conditions not explicitly shown, Contractor shall immediately request clarifications from the Departmental Representative.
8. Contractor to submit to Departmental Representative in writing all proposed alternate products, materials and structural systems for review at least 4 weeks prior to the start of construction.

2. FIELD REVIEW

1. Contractor is responsible for pre-inspecting the work and confirming completeness and conformity with the Structural Contract Documents prior to field review by Departmental Representative.
2. Notify Departmental Representative at least 72 hours in advance for field review of the following:
 - a) Concrete reinforcement: Prior to each concrete pour
 - b) Structural steel: Prior to concealment
 - c) Wood framing: Prior to concealment
3. Work found to be incomplete or deficient may require additional field reviews at additional cost to the Contractor.
4. Our field review consists of a periodic review of the structural work only. It is not carried out for the Contractor's benefit, and it does not make the structural Engineer or DFO Departmental Representative guarantors of the Contractor's work. The Contractor is responsible for his own quality control and shall perform the work with good workmanship in the conformance with the Contract Documents.

3. SUBMITTALS AND SHOP DRAWINGS

1. Contractor is responsible for overall coordination of sub-trades.
2. Submittals are items required by the Contract Documents to be submitted by the General Contractor, such as (but not limited to) request for payment, progress reports, shop drawings, manufacturer's literature on equipment, concrete mix designs, concrete test results, aggregate gradation reports, schedules, etc.
3. Suppliers shall prepare for the Departmental Representative and submit to the General Contractor an electronic copy of Shop Drawings for general compliance review prior to fabrication. Each sheet shall be sealed and signed by a Professional Engineer registered in the Province of British Columbia, who will be the Specialty Structural Engineer responsible for the integrity of his/her design.

4. The Departmental Representative will NOT review or assume responsibility for such matters as dimensions or quantities or the Contractor's safety measures or methods of construction.
5. Incomplete sets of Shop Drawings, or Shop Drawings prepared using reproductions of the Departmental Representative Structural Drawings will NOT be accepted,
6. Shop drawings and other submittals of pre-engineered or proprietary structural elements shall clearly indicate type, position, and connection to elements of the Primary Structural System as well as the criteria and loads used for the design.
7. Submittals must be reviewed by the General Contractor prior to the Departmental Representative review.
8. Where required by the following sections of these General Structural Notes, proprietary products, connections and other structural elements which have been designed by Specialty Structural Engineers shall be inspected by those engineers at the appropriate stage of construction, at which time observations and deficiencies in the work shall be reported in writing to the Departmental Representative.
9. Where required by the following sections of these General Structural Notes, each Specialty Structural Engineer shall submit to the Departmental Representative Letters of Assurance Schedules B and C-B, or S-B and S-C, sealed and signed, clearly outlining areas of responsibility.
10. Refer to the following sections for specific Shop Drawing requirements.
11. After review, the drawings will be stamped and initialed to show one of the following:
 - NOT REVIEWED - Shows work not within Structural consultant's scope of work,
 - REVISE AND RESUBMIT - Correct and resubmit for review prior to fabrication,
 - REVIEWED AS MODIFIED - Released for fabrication after revisions noted are made.
 Submit final shop drawings for DFO's records.
 - REVIEWED - Released for fabrication.

4. STRUCTURAL DESIGN

1. The new construction for this base building has been designed by DFO representative in accordance with: Part 4 of the 2015 National Building Code [NBC].
2. Climatic Design Criteria:

| | | |
|-------------------------------------|----------------|----------|
| a) Ground Snow Load (1 in 50 year) | $S_s (1/50) =$ | 3.5 kPa |
| Rain Load (1 in 50 year) | $S_r (1/50) =$ | 0.2 kPa |
| Importance Factor for Snow Load | $I_s =$ | 1.0 |
| b) 24-Hour Rain | | 60 mm |
| c) Hourly Wind Pressure (1/10 year) | $q (1/10) =$ | 0.31 kPa |
| Hourly Wind Pressure (1/50 year) | $q (1/50) =$ | 0.40 kPa |
| Importance Factor for Wind Load | $I_w =$ | 0.8 |
| Wind Internal Pressure Category | Category = | N/A |
3. Minimum Design Live Loads:

| Area | Occupancy/Notes | Specified Load |
|----------------------|-----------------------------|---------------------------------|
| Landings and Stairs | | 2.4 kPa assumed |
| Basic Roof Snow Load | + Build up where applicable | 2.7 kPa |
| Handrails and Guards | | Per Part 4 of the Building Code |

10. Compact fills in maximum lifts and to densities as per Sound Practice or as directed by a Geotechnical Engineer, and test for compaction at sufficient intervals to verify conformance.
11. Provide a minimum of 150mm (6") of well graded sand and gravel below all interior and exterior slabs-on-grade on prepared sub-base. Compacted to approval of a Geotechnical Engineer.
12. Securely tie down all anchor bolts and embedded items to formwork prior to concrete pour.
13. Centre footings under columns/walls unless noted otherwise.
14. Retaining wall and basement wall backfill requirements:
 - a) Backfill material behind retaining walls to be compacted, clean free-draining granular backfill.
 - b) Install drainage system behind wall designed by others.
 - c) Do not backfill behind retaining walls until concrete has achieved a minimum strength of 25 MPa.
 - d) Do not backfill behind basement walls, or other walls to be connected to the floor or roof structure, until after completion of the floor and roof system to approval of DFO representative.

6. CONSTRUCTION

1. Drawings show completed structures only. Contractor is responsible for temporary bracing for all building elements against construction loading conditions and for construction erection procedures. Temporary support to be designed by a Professional Engineer registered in the Province of British Columbia in accordance with WorkSafeBC regulations and as required by local building authorities.
2. It is the sole responsibility of the Contractor to ensure that no part of the work is subjected to a load which will endanger the safety of the building or workers.
3. Protect structural work from adverse weather conditions and moisture prior to, during and after installation.
4. Contractor to compare all design drawings, dimensions and site conditions and notify DFO representative of any discrepancies prior to proceeding with the work.
5. Contractor to submit to DFO representative in writing all proposed alternate products and structural systems, including technical specifications where required, for review and approval.
6. Contractor shall review the concrete pour plan with DFO representative prior to construction.

7. STRUCTURAL STEEL, MISCELLANEOUS STEEL & CONNECTIONS

1. Fabricate and erect structural steel to CSA S-16 Division 2 certification or better.
2. Structural steel shall conform to CSA G40.21 with the following grades:
 - a) W Shapes: Grade 350W
 - b) Angles & Channels: Grade 300W
 - c) HSS: Grade 350W Class C
 - d) Plates & Miscellaneous steel: Grade 300W
 - e) Connection Bolts:
 - i) Steel to steel connections: ASTM A325
 - ii) Steel to foundation anchor bolts: ASTM A307 or A325 per drawings
 - iii) Wood connections: (interior ASTM A307 hot dipped – not exposed to moisture)

galvanized to CAN/CSA
– G164

- f) Finish: One coat shop primer except embedded items, See specifications.
- g) Pipes: ASTM A53 Grade B
- 3. All welding shall conform to CSA W59, W55.3 and W186 & ANSI DI-6 - Reinforcing Bars and shall be performed by fabricators fully certified by the Canadian Welding Bureau to the requirements of CSA W47.1.
- 4. Connection Design:
 - a) Code Compliance: Supplier shall design structural steel connections on the basis of "Simple Construction" in accordance with CSA S-16 and S-136 for the design loads indicated on the drawings and in accordance with Part 4 of the Building Code.
 - b) Beams: Design beam reaction for 60% of the load given in the beam load tables in Part 5 of the Commentary on CSA S-16, or for design loads indicated.
 - c) Beam Stiffeners: Provide minimum 9.5mm (3/8") thick full height stiffeners each side of web at bearing supports, brace work points, beam and column connections and as indicated/required.
 - d) Bolts: Minimum 19mm (3/4") diameter A325 or as indicated. Minimum 2 bolts per connection.
 - e) Columns: Provide slotted shear plate beam connection through column to minimize eccentric loading to column.
 - f) Braced Frames: Design for connection loads as indicated. Field weld as required.
 - g) Lateral Bracing of Design for 2% if factored axial load resisted by column/beam.
Column/Beam
 - h) Shear Connections: Provide double side plates for all shear connections.
- 5. Supplier to confirm all dimensions and site conditions of structure prior to fabrication.
- 6. Design steel trusses for design loads as indicated.
- 7. Carry all columns continuous to roof framing U.N.O.
- 8. Erection Tolerances:
 - a) Columns: Location shall be zero inches at base and 6mm (1/4") max. out of plumb at top.
 - b) Exterior girts to be accurately aligned with columns.
- 9. All edges and corners of connections shall be ground smooth.
- 10. All steel including structural members, plates, bolts, embeds and anchors shall be stainless steel U.N.O.
- 11. All HSS sections shall be provided with 6mm (1/4") thick caps.
- 12. Submittals: Supplier shall provide the following submittals (refer to the Submittals section):
 - a) Shop Drawings sealed and signed by Supplier's Specialty Structural Engineer indicating design capacity of all connections.
 - b) Shop Drawings of trusses sealed and signed by Supplier's Specialty Structural Engineer indicating design capacity of all trusses and connections, truss design loads, truss reactions, member forces, lateral brace forces, deflections and any field splices.
 - c) Letters of Assurance B and C-B, or Schedules S-B and S-C.
 - d) Certificates showing that the fabricator is fully certified by the Canadian Welding Bureau.

8. CONCRETE

1. Specifications:

- a) Standards: CAN/CSA A23.1, CAN/SCA A23.2, CAN/CSA A23.3
- b) Cement: Portland Cement Type G.U. in accordance with CSA A3001
- c) Coarse Aggregate: 19mm (3/4") maximum U.N.O.
- d) Mix Design to Alternative 1 per Table below:

| Locations | 28 – Day Compressive Strength, MPa | W/C Ratio | Air Entrain % | Slump (mm) | Exposure Class | Cement Type | See Notes |
|---|------------------------------------|-----------|---------------|------------|----------------|-------------|-----------|
| Landing Pads (Exposed) | 30 | 0.55 | 4 to 7 | 80±30 | F-2 | G.U. | 2(A), 3 |
| Bearing Walls (Exposed) | 30 | 0.55 | 4 to 7 | 80±30 | F-2 | G.U. | 5 |
| Interior slab-on-grade | 30 | 0.55 | 1 to 4 | 80±30 | N | G.U. | 2(A), 3 |
| Exterior slab-on-grade – pedestrian traffic | 32 | 0.45 | 5 to 8 | 80±30 | C-2 | G.U. | 2(A), 3 |

Notes: Where referenced in notes column of the table above.

- 1. Slab-on-grade in exposed interior areas to be wet cured.
- 2. Slab and Floor Finish Classification as per CSA A23.1

| Class | Description | Straight edge Tolerance | F _F | F _L | SWi |
|-------|-------------------------|-------------------------|----------------|----------------|-----|
| A | Conventional (smooth) | ± 8mm | 20 | 15 | 5mm |
| B | Conventional (non slip) | ± 12mm | 15 | 15 | 8mm |
| C | Moderately Flat | * ± 3mm * | 30 | 20 | 3mm |

See CSA A23.1 for finishing procedure.

- 3. Sawcut crack control joint as soon as possible within 12 hours of slab finishing. See Structural drawings for locations and details.
- 4. Hand tool crack control joint. See drawings for locations.
- 5. Add admixtures as required to expedite setting of concrete and removal of forms to ensure completion of project within the strict time frame while also ensuring the admixtures do not have a long lasting detrimental effect on the concrete.
- 6. KRYTON KIM ADMIXTURE: Concrete strength noted is minimum required for structural design; higher strengths may be required based on KIM mix requirements. Minimum Portland cement content shall be 250 kg/m³. Maximum W/C ratio shall be 0.45. KIM waterproofing admixture to be added into the concrete mix at the time of batching at 2% by weight of the cementitious materials. Contact Kryton International Incorporated at 604-324-8280 for application instructions and specifications.
- 7. Max aggregate size of 3/8" (10mm) for masonry grout and concrete topping.

e) Admixtures: Admixtures to approval of DFO representative. Calcium Chloride not allowed. Admixtures to conform to requirements of ASTM C260 (air entrainment) and ASTM C494 (chemical).

f) Testing: Test concrete as per CSA A23.1 and A23.2: Min one test of three cylinders per Class per day. Additional tests required per A23.1 and A23.3. Additional field-cured cylinders required in hot and cold weather conditions.

g) Contractor to provide cylinders for concrete testing at 3 days as well as 7 and 28 days to ensure expedient completion of work within strict scheduled time frame.

h) Grout: Non-shrink cementitious grout, minimum 30MPa at 3 days and minimum 55MPa at 28 days.

2. Concrete to be well consolidated with mechanical vibrator.
3. Protect concrete from all harmful substances and adverse weather conditions during construction.
4. No embedded items, including blockouts, nailers, conduits, ducts, pipes, sleeves, etc., are permitted in concrete formwork unless specifically authorized by DFO representative.
5. All concrete work, including footings, walls, slabs, curbs, and topping, shall be reinforced except skimcoats unless otherwise noted.
6. Unless otherwise noted, provide minimum bottom reinforcing in slabs as below:

| <u>Slab thickness</u> | <u>Temperature reinforcing each way</u> |
|-----------------------|---|
| 150 (6") | 10M @ 300 (12") |
| 175 (7") | 10M @ 250 (10") |
| 200 (8") | 15M @ 450 (18") |
| 225 (9") | 15M @ 400 (16") |
| 250 (10") | 15M @ 400 (16") |

7. Submittals: Contractor shall pay for and provide the following submittals:
 - a) Mix designs
 - b) Concrete test results

9. REINFORCING STEEL

1. All work shall meet the requirements of the Canadian Standards Association [CSA] and the American Society for Testing and Materials [ASTM].
2. Deformed bars shall conform to CSA G30.18 Grade 400 MPa (Fy=60,000 psi) with:
 - a) Lapped tension splices in accordance with CAN3-A23.3 as follows:

| BAR SIZE | | 10M | 15M | 20M | 25M | 30M | WWM |
|---------------|--|------|------|------|------|------|------|
| BASIC TENSION | | 450 | 630 | 780 | 1290 | 1700 | 300 |
| mm | | (18) | (24) | (30) | (50) | (67) | (12) |
| LAP SPLICE | | | | | | | |
| (in) | | | | | | | |
| FULL TENSION | | 620 | 880 | 1090 | 1810 | 2400 | - |
| mm | | (24) | (36) | (43) | (72) | (94) | |
| LAP SPLICE | | | | | | | |
| (in) | | | | | | | |

b)

Detail reinforcement to stagger splices and minimize usage of splices U.N.O. on plans. Splicing of reinforcing steel shall meet the requirements of CAN3-A23.3.

- c) Horizontal reinforcement shall be continuous around corners with bends or corner bars.

- d) All concrete shall be reinforced. Concrete not explicitly detailed shall have the following minimum reinforcement:
- i) Columns: 1% of gross area of section. 15M ties spaced at least 1/2 least dimension of column.
 - ii) Beams: 0.35% of gross area of section. 15M ties spaced at 1/2 depth of beam.
 - iii) Slabs and Walls: 0.2% of gross area of section each way and perimeter beam as detailed.
- e) Maintain concrete cover to reinforcing as follows when not explicitly detailed:

| STRUCTURAL MEMBER | EXPOSURE TO WEATHER | |
|---|---------------------|---------------|
| | EXPOSED | NOT EXPOSED |
| For beams, girders, columns and piles: mm Principal reinforcement, No. 35 and smaller (in) | 50 (2) | 40 (1 1/2) |
| For ties, stirrups and spirals: m m (in) | 40 (1 1/2) | 30 (1 1/8) |
| For slabs, walls and joists, No. 20 and smaller: m m (in) | 30 (1 1/8) | 20 (3/4) |
| For shells and folded plates, No. 15 and smaller: m m (in) | 30 (1 1/8) | 15 (9/16) |
| The ratio of the cover to the nominal maximum aggregate size shall be minimum: | 1.5 d | 1.0 d |
| Formed Surface exposed to ground or weather: m m (in) | | 50 (2) |
| When cast against, and permanently exposed to, earth: m m (in) | | 75 (3) |

The cover for a bundle of bars shall be the same as that for a single bar with an equivalent area.

| CLEAR COVER TO MAIN REINFORCING | |
|---|-------------|
| OUTSIDE FACE OF PANEL mm (in) | 25 (1) |
| INSIDE FACE OF PANEL mm (in) | 20 (3/4) |
| EDGE OF PANEL mm (in) | 50 (2) |

| CLEAR COVER TO TIES & STIRRUPS | | | |
|--------------------------------|----|---------|---------------------------|
| INSIDE | OR | OUTSIDE | 20 (3/4) (in) |
| EDGE | OF | PANEL | 40 (1 1/2) (in) |

3. Placement:

- a) Openings in walls and slabs:
 - i) Do not cut typical reinforcement at openings, but shift to each side of opening.
 - ii) Provide 1 - 15M x 4'-0"LG diagonal bar 25mm (1") clear from corner of opening.
 - iii) Openings ≤ 600 (24") square: Provide 2-15M each side, extending 600 (24").
 - iv) Openings > 600 (24") square: Provide extra reinforcing as directed on Site by DFO representative.
 - b) Provide dowels to match size and spacing of vertical and horizontal reinforcement.
4. All reinforcement required to be welded to connection plates shall be Grade 400W (Weldable). Weld steel in conformance with CSA W186.
 5. All reinforcement to be bent in the field shall be Grade 400W (Weldable).
 6. Ensure all bars are securely tied and chaired to maintain specified cover and prevent displacement during concrete placement. For surfaces exposed to weather, provide non-corrosive chairs.
 7. Wet doweling of reinforcement is not acceptable unless approved in advance by DFO representative.
 8. All reinforcing steel shall be clean of substances that will affect its bond to concrete.
 9. Bars damaged in the field may require replacement as directed by DFO representative.
 10. For tension splices, no more than 50% of the bars shall be splices at any one location.
 11. Where drill and epoxy reinforcing is required the following minimum embedment must be applied, unless directed otherwise in writing by DFO representative. Drill and epoxy with Hilti RE 500 V3 to develop reinforcing.

| Reinforcing Bars | Minimum Embedment | Reinforcing Bars | Minimum Embedment |
|------------------|-------------------|------------------|-------------------|
| 10M | 240mm | 20M | 540mm |
| 15M | 400mm | 25M | 850mm |

12. Provide minimum of 200 lbs of extra reinforcement (10M + 15M) to be used as directed by DFO representative.

10. POST INSTALLED CONCRETE ANCHORAGES

1. Post installed anchors shall be used only where specified on structural drawings. The Installation of post installed anchors for missing or misplaced cast in-place anchors shall be approved by DFO representative.
2. Products
 - a) Adhesive used to install reinforcing steel and threaded rods in existing concrete shall be:
 - i) Hilti HIT-HY 200-R Adhesive System, U.N.O. or,
 - ii) Hilti HIT-RE 500 V3 Adhesive System.
 - iii) DEWALT AC200+ Adhesive System.
 - iv) DEWALT/ Powers Fasteners Pure110+ Adhesive System.
 - b) Mechanical anchors to be as specified on drawings.
 - c) A written request for the use of alternate products, with applicable technical specifications, including a current ICC-ES report, must be submitted to, and approved by DFO Representative prior to construction.
 - d) Reinforcing steel and threaded rod anchors shall be as specified in the reinforcing steel notes.
 - e) Any anchor subject to corrosion shall be hot dip galvanized, stainless steel, or coated with a corrosion resistant finish to the approval of DFO Representative. All hot dip galvanizing to be in accordance with ASTM A123 and CAN/CSA G164 U.N.O. and all stainless steel to be in accordance with ASTM A193, A320 and F593 U.N.O..
3. Documentation & Training
 - a) The Contractor shall have copies of product literature and installation guides on site.
 - b) Prior to construction, the Contractor shall arrange for manufacturer on-site training of all installers for all post-installed anchor types to be used.
4. Execution
 - a) All anchors shall be installed in strict accordance with the manufacture's printed installation instructions (MPII) in conjunction with the edge distance, spacing and embedment depth as indicated on the structural drawings. Special attention is drawn to the minimum temperature requirements.
 - b) Installation of adhesive anchors is not permitted within 21 days of concrete placement unless prior authorization is obtained from DFO Representative.
 - c) Anchor capacity is dependent upon spacing between adjacent anchors and proximity of anchors to edge of concrete. Install anchors in accordance with spacing and edge clearances indicated on the drawings and in the manufacturers literature.

- d) Drilling of holes through existing reinforced steel in concrete is prohibited. If encountered, abandon hole location and start a new hole away from reinforcing steel locations. Patch all unused holes.

5. Testing

- a) On site load testing of 10% of all post-installed anchors shall be carried out by an independent testing laboratory, retained by the Contractor, in conjunction with the manufacturer's representative.
- b) If more than 10% of all post-installed anchors fail to achieve the specified torque or proof load, all anchors of the same diameter and type shall be tested, unless otherwise instructed by Engineer on record.
- c) As an alternative to anchor testing, the Contractor may retain a Material Consultant to carry out field reviews of all post-installed anchor installations.

6. Submittals

- a) Submit to DFO Representative copies of all installers' training certificates prior to installation of post-installed anchors.
- b) Where testing is required, submit to DFO Representative certified test reports, showing compliance with specified performance characteristics and physical properties.
- c) Where the Contractor retains a Material Consultant to perform field reviews of anchor installations instead of testing, submit to DFO Representative Schedules S-B and S-C.

PART 1 GENERAL

1.1 Administrative

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.2 Shop Drawings and Product Data

- .1 The term "shop drawings" means drawings, diagrams,

illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

- .2 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia of Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 15 days for Departmental Representative review of each submission.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.

- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After Departmental Representative review, distribute copies.
- .10 Submit electronic copy and 6 prints of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .11 Submit 6 electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit 6 copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .13 Submit 6 copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

- .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit 6 copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit 6 copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit 3 copies and electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.3 Photographic Documentation

- .1 Submit electronic copy of colour digital photography in jpg format, standard resolution monthly with progress statement as directed by Departmental Representative.
- .2 Project identification: name and number of project and date of exposure indicated.

1.4 Certificates and Transcripts

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used

END OF SECTION

PART 1 - GENERAL

- 1.1 General**
- .1 Submit to the Departmental Representative, for review, shop drawings, product data and samples specified.
 - .2 Until submission is reviewed, work involving relevant product may not proceed.
- 1.2 Shop Drawings**
- .1 Drawings to be originals prepared by Contractor, Sub-Contractor, Supplier or Distributor, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate Sections.
 - .2 Identify details by reference to sheet and detail numbers shown on Contract Drawings.
 - .3 Maximum sheet size 860 mm x 1120 mm.
 - .4 Reproductions for submissions: opaque diazo prints, photocopies and original manufacturers' information.
 - .5 Shop Drawings are to be sealed before submission by a Professional Departmental Representative registered in British Columbia.
- 1.3 Product Data**
- .1 Certain Specification Sections, specify that manufacturer's standard schematic drawings, catalogue sheets, diagram, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings.
 - .2 Above will only be accepted if they conform to the following:
 - .1 Delete information which is not applicable to project.
 - .2 Supplement standard information to provide additional information applicable to project.
 - .3 Show dimensions and clearances required.
 - .4 Show performance characteristics and capacities.
 - .5 Show wiring diagrams and controls.
- 1.4 Coordination of Submissions**
- .1 Review shop drawings, product data and samples prior to submission.
 - .2 Verify:
 - .1 Field measurements.
 - .2 Field construction criteria.
 - .3 Catalogue numbers and similar data.

-
- .3 Coordinate each submission with requirements of work and Contract Documents.
 - .4 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative's review of submission, unless Departmental Representative gives written acceptance of specified deviations.
 - .5 Notify Departmental Representative, in writing at time of submission of deviations from requirements of Contract Documents.
 - .6 After Departmental Representative's review, distribute copies.
- 1.5 Submission Requirements**
- .1 Schedule submissions at least 14 days before dates reviewed submissions will be needed.
 - .2 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Number of each shop drawing, product data and sample submitted.
 - .5 Other pertinent data.
 - .3 Submission shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name of:
 - .1 Contractor
 - .2 Sub-Contractor
 - .3 Supplier
 - .4 Manufacturer
 - .5 Separate detailer when pertinent.
 - .4 Identification of product or material.
 - .5 Relation to adjacent structure or materials.
 - .6 Field dimensions, clearly identified as such.
 - .7 Specification Section number.
 - .8 Applicable standards, such as CSA or CGSB numbers.
 - .9 Contractor's stamp, initialed or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.
 - .10 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- 1.6 Samples and**

-
- Mock-ups**
- .1 Submit samples in sizes and quantities specified.
 - .2 Where colour, pattern or texture is criterion, submit full range of samples.
 - .3 Construct field samples and mock-ups at locations acceptable to Departmental Representative.
 - .4 Construct each sample or mock-up complete, including work of all trades required to finish work.
 - .5 Reviewed samples or mock-ups will become standards of workmanship and material against which, installed work will be checked on project.
- 1.7 Distribution of Submittals After Review**
- .1 Distribute copies of shop drawings and product data which carry Departmental Representative's stamp to:
 - .1 Job site file.
 - .2 Record documents file.
 - .3 Other prime Contractors.
 - .4 Sub-Contractor.
 - .5 Supplier.
 - .6 Fabricator
 - .2 Distribute samples as directed.

END OF SECTION

PART 1 - GENERAL

- | | | | |
|------------|---|----|--|
| 1.1 | General | .1 | Not used |
| 1.2 | Related Requirements Specified Elsewhere | .1 | The particular requirements for Inspection and Testing required under this contract is detailed throughout the contract document. |
| 1.3 | Contractor's Responsibilities | .1 | All Inspection and Testing required by the contract document and/or relevant provincial and federal regulations shall be completed by the Contractor at his cost. All inspections and testing shall be carried out by an independent certified testing agency. |
| | | .2 | Supply certifications for all independent testing agencies to the Departmental Representative prior to commencement of work. |
| | | .3 | The Contractor shall promptly provide copies of all inspection and tests to the Departmental Representative. |
| | | .4 | The Contractor shall notify the Departmental Representative at least 48 hours in advance of all testing, for an opportunity to be present. |
| | | .5 | All subsequent work and testing required due to unsatisfactory work shall be completed by the Contractor at his cost. |
| | | .6 | The contractor shall provide access and assistance when additional sampling / testing is required by the Departmental Representative. |

END OF SECTION

PART 1 - GENERAL

- | | | | |
|------------|--|----|--|
| 1.1 | General | .1 | Not used |
| 1.2 | Access | .1 | Provide and maintain adequate access to project site. |
| | | .2 | If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractor's use of roads. |
| 1.3 | Departmental Representative's Site Office | .1 | Not Required. |
| 1.4 | Storage Sheds | .1 | Provide adequate weather tight sheds with raised floors, for storage of materials, tools, and equipment which are subject to damage by weather. |
| 1.5 | Sanitary Facilities | .1 | Provide sanitary facilities for work force in accordance with governing regulations and ordinances. |
| | | .2 | Post notices and take such precautions as required by local health authorities. Keep areas and premises in sanitary condition. |
| 1.6 | Power | .1 | Arrange, pay for and maintain temporary electrical power supply in accordance with governing regulations and ordinances. |
| 1.7 | Water Supply | .1 | Arrange, pay for and maintain temporary water supply in accordance with governing regulations and ordinances. |
| 1.8 | Heating and Ventilating | .1 | Maintain minimum temperature of 10°C or higher where specified as soon as finishing work is commenced and maintained until acceptance of structure by Departmental Representative. |
| | | .2 | Maintain ambient temperature and humidity levels as required for comfort of office personnel. |
| 1.9 | Drainage | .1 | Refer to Section 01575 for site drainage and pumping requirements. |

END OF SECTION

PART 1 GENERAL

1.1 Related Requirements

- .1 Section 01 33 00 – SUBMITTAL PROCEDURES.

1.2 Reference Standards

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Province of British Columbia
- .1 Workers Compensation Act, RSBC 1996 – latest version.

1.3 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit Contractor Safety Program and confirm to Departmental Representative that:
- the Safety Program address WSBC OHS Regulation Part 3 key elements?
 - the contractor maintains the applicable inspection and maintenance certification records for operating equipment?
 - the Contractor's Safety Program require the creation and maintenance of a safety manual? (if yes, forward an electronic copy in Word or pdf format)
 - the Contractor's Safety Program contain standalone codes of practices or job practices e.g. fall protection practice (if yes, attach an electronic copy in Word or pdf format)
 - the Safety Program include WSBC Certificate of Recognition (and supply certificate)?
 - you will provide First Aid and/or medical services for your employees while on site and how you will do so.
 - you conduct health and safety inspections?
 - corrections of the deficiencies documented?
 - you conduct incident/accident investigations?
 - you verify understanding of the training (written test, job monitoring, oral test, competency assessment, etc)
 - you evaluate the ability of subcontractors to comply with applicable health and safety requirements as part of the selection process?
 - your sub-contractors have a written health and safety management program?
 - you include your sub-contractors in:
 - o Health and Safety Orientation?
 - o Health and Safety Meetings?
 - o Inspections?
- .3 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

- .1 How WSBC OHS Regulation Part 3 key elements are addressed.
- .2 Results of site specific safety hazard assessment.
- .3 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit 1 weekly submittal to Departmental Representative.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days.
- .8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.
- .10 SPEC NOTE: If there are specific emergency response procedures for the Building, Facility or Site, then the Departmental Representative/DCC Representative must provide the Contractor with the details for consideration of incorporation into the Contractor's on-site Contingency and Emergency Plan as a component of the site specific health and safety plan.
- .11 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.4 Filing of Notice

- .1 File Notice of Project with WorkSafeBC authorities prior to beginning of Work.
- .2 Contractor shall be responsible and assume the Principal Contractor role for each work zone location and not the entire complex. Contractor shall provide a written acknowledgement of this responsibility with 3 weeks of contract award. Contractor to submit written acknowledgement to CSST along with Ouverture de Chantier Notice.
- .3 Work zone locations include:
Fulton Dam at Spawning Channel, Via Highway 118 between Topley and Granisle, B.C.
- .4 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.5 Safety Assessment

- .1 Perform site specific safety hazard assessment related to project.

1.6 Meetings

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.7 Project Site Conditions

- .1 Work at site will involve contact with:
 - .1 Departmental Representatives.

1.8 General Requirements

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.9 Responsibility

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 SPEC NOTE: Use the following paragraph for Construction Projects in the Province of Ontario: N/A
- .3 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.10 Compliance Requirements

- .1 Comply with Workers Compensation Act, B.C.
- .2 Comply with R.S.Q., c. S-2.1, an Act respecting Health and Safety, and c. S-2.1, r.4 Safety Code for the Construction Industry.
- .3 Comply with Occupational Health and Safety Regulations, 1996 or latest edition.
- .4 Comply with Occupational Health and Safety Act, General Safety Regulations, O.I.C.
- .5 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.11 Unforeseen Hazards

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of BC having jurisdiction and advise the Departmental Representative verbally and in writing.
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise WorkSafeBC and follow procedures in accordance with Acts and Regulations of BC having jurisdiction and advise Departmental Representative verbally and in writing.

1.12 Health and Safety Co-Ordinator

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have site-related working experience specific to activities associated with the site.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of Work and report directly to Departmental Representative and be under direction of the site supervisor.

1.13 Posting of Documents

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of BC having jurisdiction, and in consultation with Departmental Representative.

1.14 Correction of Non Compliance

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.15 Blasting

.1 Not used.

1.16 Powder Actuated Device

.1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

1.17 Work Stoppage

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

PART 2 EQUIPMENTS

2.1 Records and cerification

.1 Contractor to maintain the applicable inspection and maintenance certification records for operating equipment

PART 3 EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 - GENERAL

- 1.1 General** .1 Not used
- 1.2 Traffic Management** .1 Traffic management shall comply with the requirements of British Columbia's Ministry of Transport and Infrastructure over the entire contract period, specifically the latest edition of "Traffic Control Manual for Work on Roadway".
- .2 The Contractor shall be responsible for acquiring and compiling with all required permitting required by British Columbia's Ministry of Transport and Infrastructure.
- .3 During progress of the Works, make adequate provision to accommodate normal traffic along streets and highways immediately adjacent to or crossing the Works so as to minimize inconvenience to the general public.
- .4 Inform all owners or occupants of properties where access is affected in advance of proposed works.
- .5 When working on travelled ways:
1. Place equipment in such position as to present a minimum of interference and hazard to the travelling public.
 2. Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.
 3. Do not leave equipment on travel led way overnight.
 4. Do not close any lanes of road or highway without prior approval of the Departmental Representative. Before re-routing traffic erect suitable signs and devices as approved by the Departmental Representative.
 5. Provide and maintain reasonable road access and egress to property fronting along or in vicinity of work under contract unless approved otherwise by the Departmental Representative.

END OF SECTION

PART 1 - GENERAL

- 1.1 General** .1 Not used
- 1.2 Disposal of Wastes** .1 All waste and rubbish materials shall be disposed to an approved landfill. Disposal of waste or rubbish material to land or burning will NOT be accepted.
- .2 Discharge of water containing chlorine or other chemical compounds into waterways is prohibited.
- 1.3 Drainage** .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from surface water and groundwater.
- .2 Pumping of water containing silt in suspension into waterways, sewer or drainage systems prohibited.
- .3 The Contractor shall control disposal or runoff of water containing suspended materials or harmful substances in accordance with this contract document and applicable Federal and Provincial standards.
- 1.4 Site Clearing and Plant Protection** .1 Protect trees and plants on site and adjacent properties where indicated.
- .2 Minimize stripping of topsoil and vegetation.
- .3 Restrict tree removal to those areas designated by Departmental Representative.
- 1.5 Work Adjacent to Waterways** .1 Prohibit operation of construction equipment in waterways without Departmental Representative's approval and approval of Fisheries authorities.
- .2 Do not use waterway beds for borrow material.
- .3 Do not dump excavated fill, waste material or debris in waterways.
- .4 Design and construct temporary crossings so that minimum erosion is caused to waterways.
- .5 Do not skid logs or construction materials across waterways.
- .6 Avoid indicated spawning beds when constructing temporary crossings of waterways.

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- .7 Blasting under water or within 100 m of indicated spawning beds not permitted.
- 1.6 Erosion and Sedimentation Control**
- .1 The Contractor must prepare Erosion and Sedimentation Control Plan and implement siltation control measures for all excavation to minimise siltation of ditches, watercourses and storm water systems.
- .2 Siltation control shall include but not be limited to installation of silt fences and construction of sedimentation ponds as shown in the contract documents. Siltation control shall meet the standards described in Land Development Guidelines for the Protection of Aquatic Habitat published jointly by the BC Ministry of Environment and Department of Fisheries and Oceans. Siltation control measures shall remain in place until completion of construction. Contractor shall implement erosion and sedimentation control measures during the construction process.
- .3 Contractor shall ensure that all works is performed to prevent release of sediment laden or hydrocarbon contaminated (e.g. oil, grease, hydraulic fluid, or fuel) water from the site boundary. This includes ensuring no water flows are pumped or channeled to bypass the sediment control facilities.
- .4 Erosion and sedimentation control measures shall include but not be limited to retention of existing vegetation, installation of silt fences, and construction of settlement ponds. Sedimentation control measures shall remain in place until completion of construction.
- .5 Contractor shall ensure that sediment and hydrocarbon control facilities are frequently visually inspected and repaired as necessary.
- 1.7 Hazardous Materials Handling and Storage**
- .1 Hazardous materials including, but not limited to, fuels, bitumens, cement, paints, solvents, cleaners, dust suppressants, used fuel and oil filters, and other construction materials shall be stored and handled to minimize lose and to allow containment and recovery in the event of a spill.
- .2 The Contractor shall designate area(s) for the transfer and temporary storage of hazardous materials and wastes. The designated area(s) shall be used by the Contractor as a transfer and temporary storage area for potentially hazardous materials and wastes. The

area(s) shall be clearly labeled and appropriately controlled.

- .3 The Contractor shall maintain proper Workplace Hazardous Material Information Systems (WHMIS) labels and Material Safety Data Sheets (MSDS) for all hazardous materials used and stored on site.
- .4 Discharge of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers is prohibited.
- .5 Discharge of water containing chlorine or other chemical compounds into waterways is prohibited.

1.8 Special and General Waste, Rubbish and Garbage

- .1 Special Waste generated in the course of the construction activities shall be handled and disposed of in compliance with the British Columbia Special Waste Regulation. As defined by these regulations, Special Wastes include, but are not limited to, such things as waste asbestos, oils, greases, lubricants, solvents, batteries, polychlorinated biphenyls (PCBs), paints and used spill cleanup materials.
- .2 When handling, storing, and removing Special Wastes, the Contractor shall maintain the following records: Inventories of types and quantities of Special Wastes generated, stored, or removed; manifests identifying Special Waste haulers and disposal destinations; MSDS and disposal certification documents.
- .3 Non-hazardous solid wastes, such as but not limited to, waste wood, asphalt, concrete, and metals shall be disposed of at an approved and licensed disposal facility in compliance with the British Columbia Waste Management Act.
- .4 The Contractor shall establish regular clean up and disposal programs so as to prevent the unnecessary accumulation of excessive solid waste and contain all garbage related to the project.

1.9 Equipment Operation

- .1 Contractor shall maintain construction equipment in good condition and free of excess oil and grease.
- .2 Waste oils and other materials related to equipment shall be removed from site upon completion of project.

- .3 Maintenance of equipment shall be confined to specific areas such that spills can be contained and collected before contaminants reach ditches, watercourses, and storm water systems.
- .4 There shall be no discharge of wash water to ditches, watercourses or storm water systems from trucks and equipment related to concrete supply, pumping, or placing equipment.
- .5 Equipment operation shall be limited to hours acceptable to the community.
- .6 Any fuel spills shall be absorbed immediately.
- .7 Contractor shall have fuel absorbents on site and shall deal with any spills which should occur immediately.

**1.10 Work Adjacent
to Drainage Courses
and Waterways**

- .1 Contractor shall implement siltation control measures for all excavation. Siltation shall include but not be limited to installation of silt fences and construction of sedimentation ponds. Siltation control measures shall remain in place until completion of construction.
- .2 The Contractor must develop and implement an Erosion and Sediment Control Plan and have this plan reviewed by the Departmental Representative prior to site preparation and construction of works involving excavation and fill placement. These facilities must be maintained by the Contractor and be working effectively to control discharges from the site.
- .3 Prohibit operation of construction equipment in waterways without Departmental Representative's approval and approval of Fisheries authorities.
- .4 Do not use waterway beds for borrow material.
- .5 Do not dump excavated fill, waste material or debris in waterways.
- .6 Design and construct temporary crossings so that minimum erosion is caused to waterways.
- .7 Construction and excavation wastes, overburden, soil, or other substances deleterious to aquatic life must be disposed of or placed in such a manner so as to prevent their entry into any ditch, watercourse, or storm water system.

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- .8 All excavated material is to be side-cast as far as possible from ditches, trenches, or storm water systems to prevent its re-entry into the watercourse. Spoil must be removed offsite or spread out, levelled and seeded to promote re-vegetation and reduce surface erosion.
 - .9 Do not skid logs or construction materials across waterways.
 - .10 Avoid indicated spawning beds when constructing temporary crossings of waterways.
 - .11 Blasting under water or within 100 m of indicated spawning beds not permitted.
 - .12 Contractor shall remove any equipment from near watercourse area if not required, or broken down.
- 1.11 Revegetation and Site Restoration**
- .1 Disturbed areas adjacent to ditches, watercourses and storm water systems shall be re-seeded to prevent surface erosion and/or downstream water quality impacts.
 - .2 Ditches and newly constructed diversion channels shall be seeded and planted with grasses and/or native vegetation, to reduce surface erosion.
- 1.12 Spill Prevention and Emergency Response**
- .1 The Contractor shall develop a Spill Prevention and Emergency Response Plan and distribute it to the DFO Representative and Owners of the project prior to commencing any work.
 - .2 The Contractor shall complete a daily visual inspection of all hazardous material and equipment for signs of leakage. Daily visual inspection will include, among other things ensuring that all personal protective equipment and other emergency response equipment is in its place.
 - .3 The Contractor shall maintain a readily available supply of spill emergency response material and equipment on site at all times in effective working condition appropriate to the scale of the project.
 - .4 The Contractor shall deal with any spills which occur immediately.
 - .5 The Contractor shall report any environmental incident or spill/release of a substance to the Departmental Representative and to the Provincial Emergency

Program of the Ministry of Attorney General in accordance with the Spill Reporting Regulations of the Waste Management Act.

END OF SECTION

PART 1 - GENERAL

- 1.1 General**
- .1 Use new material and equipment unless otherwise specified.
 - .2 Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.
 - .3 Use products of one manufacturer for equipment or material of some type or classification unless otherwise specified.
- 1.2 Manufacturers' Instructions**
- .1 Unless otherwise specified, comply with manufacturers' latest printed instructions for materials and installation methods.
 - .2 Notify Departmental Representative in writing of any conflict between these Specifications and manufacturers' instructions. Departmental Representative will designate which document is to be followed.
- 1.3 Delivery and Storage**
- .1 Deliver, store, and maintain package material and equipment with manufacturers' seals and labels intact.
 - .2 Prevent damage, adulteration and soiling of material and equipment during delivery, handling and storage. Immediately remove rejected material and equipment from site.
 - .3 Store material and equipment in accordance with supplier's instructions.
 - .4 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use primer or enamel to match original. Do not paint over name plates.
- 1.4 Conformance**
- .1 When material or equipment is specified by standard or performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent testing laboratory report, stating that material or equipment meets or exceeds specified requirements.
- 1.5 Substitution**
- .1 Not Applicable

END OF SECTION

PART 1 - GENERAL

- 1.1 General** .1 Not used
- 1.2 Documents Required** .1 Maintain at job site, one (1) copy of each of the following:
- .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed shop drawings.
 - .5 Change orders.
 - .6 Other modifications to Contract.
 - .7 Field test records.
- .2 Maintain documents in clean, dry legible condition.
- .3 Make documents available at all times for inspection by Departmental Representative.
- 1.3 Workmanship Standards** .1 Make available on site one (1) copy of each workmanship standard called for under "Reference Standards" in project Specifications.
- 1.4 Record Drawings** .1 Departmental Representative will provide two (2) sets of white prints for record drawing purposes.
- .2 Maintain project "as-built" record drawings and record accurately significant deviations from Contract Documents caused by site conditions and changes ordered by Departmental Representative.
- .3 Mark "as-built" changes in red.
- .4 Record following information:
- .1 Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvement.
 - .2 Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 - .3 Field changes of dimension and detail.
 - .4 Changes made by Change Order or Field Order.
 - .5 At completion of project and prior to final inspection, neatly transfer "as-built" notations to second set and submit both sets to Departmental Representative.

END OF SECTION

PART 1 - GENERAL

- 1.1 General** .1 Not used
- 1.2 Maintenance Manual** .1 On completion of project, submit to Departmental Representative four (4) copies of Operations Data and Maintenance Manual in English made up as follows:
- .1 Bind data in vinyl hard covered, 3-ring loose leaf binder for 215 x 280 mm size paper.
 - .2 Enclose title sheet, labeled "Operation Data and Maintenance Manual", project name, date, and list of contents.
 - .3 Organize contents into applicable Sections of work to parallel project specification break-down. Mark each Section by labeled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .2 Include following information plus data specified.
- .1 Maintenance instruction for finished surface and materials.
 - .2 Copy of hardware and paint schedules.
 - .3 Description, operation and maintenance instructions for equipment and systems, including complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
 - .4 Names, addresses and phone numbers of sub-contractors and suppliers.
 - .5 Guarantees, warranties and bonds showing:
 - .1 Name and address of projects.
 - .2 Guarantee commencement date of Final Certificate of Completion.
 - .3 Duration of guarantee.
 - .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
 - .5 Signature and seal of Contractor.
 - .6 Additional material used in project listed under various Sections showing name of manufacturer and source of supply.
- .3 Neatly type lists and notes. Use clear Drawings, diagrams or manufacturers' literature.
- .4 Include one complete set of final shop Drawings bound separately indicating corrections and changes made during fabrication and installation.
- 1.3 Maintenance**

Materials

- .1 Where supply of maintenance materials is specified, deliver to Departmental Representative as follows:
 - .1 Materials in unbroken cartons, or if not supplied in cartons, they shall be strongly packaged.
 - .2 Clearly mark as to content.
 - .3 If applicable give colour, room number or area where material used.

END OF SECTION

PART 1 - GENERAL

- 1.1 **General** .1 Not used
- 1.2 **Description**
 - .1 Commissioning includes the start-up of individual systems and equipment, the start-up of the entire system as a cohesive unit, and the training of operators and turnover of the operating water treatment plant.
 - .2 Commissioning shall include the General Contractor and all necessary Sub-contractors and/or Suppliers involved in equipment or systems installation.
- 1.3 **Related Work Specified Elsewhere** .1 Operations and Maintenance Section 01730
- 1.4 **Owners Operators**
 - .1 The contractor shall have the owners operators in attendance at all system start-ups.
 - .2 The contractor is to facilitate the training of owners operator in accordance with Section 3.4 System Operation.

PART 2 - PRODUCTS

- 1.1 **General** .1 Contractor to supply all required equipment and material for startup, commissioning and hand over period of the water supply infrastructure.

PART 3 – EXECUTION

- 3.1 **Power Supply** .1 Where modifications and/or additions to existing electrical equipment or apparatus are required, ensure that all changes are made in accordance to CSA 22.2. Obtain CSA re-certification of the modified electrical equipment.
- 3.2 **Treatment System**
 - .1 Retain and pay for the services of the authorized manufacturers' representatives to be on-site for the startup of both mechanical and electrical/control systems and operator training.
- 3.3 **Supply and distribution**
 - .1 After sterilization of the supply pipe open valve on new supply line to fill storage tank.
 - .2 Take records of operation of storage tank sensors at low and high water level.
 - .3 Take records of booster pump, pressure tank and water treatment equipment functioning.
 - .4 Take records of pressure in system before and after treatment.

- .5 Departmental Representative to be informed if any component is not working as intended.

- 3.4 **Maintenance Manual** .1 Refer to Section 01730. These manuals to be prepared and reviewed and approved and distributed to the Owner, prior to turn-over.

- 3.5 **System Operation** .1 The System shall be handed over during a minimum two week period in which the contractor is to facilitate the authorized training of the proposed operator(s) and oversee the initial operation of the system. Ensuring that the system is operating as designed.
.2 Substantial Completion under the terms of the contract may be granted after, but not before, the two week hand over period with the owners operators.

END OF SECTION

Division 03 – Concrete

PART 1 GENERAL

1.1 Section Includes

- .1 Formwork for cast-in-place concrete, with shoring, bracing and anchorage.
- .2 Openings in forms for other work.
- .3 Form accessories.
- .4 Form stripping.

1.2 Related Sections

- .1 Section 01 33 00 - Submittals.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 03 30 00 - Cast-in-Place Concrete.

1.3 References

- .1 ACI 301-10 - Specifications for Structural Concrete for Buildings.
- .2 CSA S269.1-1975 (R2003) - Falsework for Construction Purposes.
- .3 CSA S269.3-M92 (R2008) - Concrete Formwork.
- .4 CSA A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .5 British Columbia Building Code 2018.
- .6 For Projects overseen by a Construction Manager in lieu of a General Contractor, references to "Contractor" shall apply to the Construction Manager and relevant Trade Contractor(s).

1.4 Performance Requirements

- .1 Design, engineer and construct formwork, shoring, and bracing to conform to design and code requirements. Resultant concrete shall conform to required shapes, lines, and dimensions.
- .2 Design formwork under direct supervision of a Professional Engineer experienced in design of this work and licensed at the place where the Project is located. Formwork design is sole responsibility of Contractor.
- .3 Conform to CSA S269.3.

1.5 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.

PART 2 PRODUCTS**2.1 Form Materials**

- .1 Non-Exposed Concrete Surfaces: Plywood, lumber, metal, or another approved material for rough-form finish in accordance with CSA A23.1. Provide lumber dressed on at least two edges and one side for tight fit.
- .2 Exposed Concrete Surfaces: Plywood with non-absorptive liner such as urethane coating, or medium density overlay plywood for smooth-form finish in accordance with CSA A23.1. Furnish in largest practicable sizes to minimize number of joints.
- .3 Pan Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- .4 Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- .5 Void Forms: Structurally sufficient to support weight of wet concrete mix and other superimposed loads until initial set. Provide forms that will crush under a sustained stress of less than 10 kPa once in service.

2.2 Formwork Accessories

- .1 Form Ties: Removable or snap-off metal or glass-fiber-reinforced plastic ties, fixed or adjustable length.
 - .1 Furnish units that will leave no corrodible metal closer than 25mm to the plane of exposed concrete surface.
 - .2 Furnish ties that, when removed, will leave holes no larger than 25mm diameter in concrete surface.
 - .3 Furnish ties with integral water-barrier plates to walls indicated to receive damp-proofing or waterproofing if required.
- .2 Form Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- .3 Chamfer Strips: Wood, metal, or rubber strips, 19mm by 19mm minimum.
- .4 Rustication Strips: Wood, metal, or rubber strips, kerfed for ease of form removal.

PART 3 EXECUTION**3.1 Erection - Formwork**

- .1 Design, erect, shore, brace, and maintain formwork, according to CSA S269.3, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- .2 Fabricate and erect false work in accordance with CSA S269.1.
- .3 Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of CSA A23.1.
- .4 Limit concrete surface irregularities, abrupt or gradual, as follows:
 - .1 3.2mm for smooth-formed finished surfaces.
 - .2 6.4mm for rough-formed finished surfaces.
- .5 Align joints and make watertight. Where concrete is to be exposed to view, keep form joints to a minimum and locate in an orderly and symmetrical arrangement.
- .6 Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - .1 Install keyways, reglets, recesses, and the like, for easy removal.
 - .2 Do not use rust-stained steel form-facing material.
- .7 Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screen strips; use strike-off templates or compacting-type screeds.
- .8 Chamfer exterior corners and edges of permanently exposed concrete.
- .9 Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- .10 Immediately before concrete is placed, carefully inspect all forms to ensure they are properly placed, sufficiently rigid and tight, thoroughly clean, properly treated, and free from snow, ice, or other foreign materials.
- .11 Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- .12 Coordinate this section with other sections of work which require attachment of components to formwork.

3.2 Application – Form Release Agent

- .1 Apply form release agent on formwork in accordance with manufacturer's recommendations.
- .2 Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

- .3 Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.3 Inserts, Embedded Parts, and Openings

- .1 Coordinate with work of other Sections in forming and placing openings, chases, offsets, keyways, slots, reglets, recesses, blocking, screeds, bulkheads, sleeves, bolts, anchors, other inserts, and components of other Work.
- .2 Notify other trades sufficiently in advance to ensure that provision is made for inserts, embedded parts, and openings.
- .3 Anchor bolts and other anchoring devices for beams, columns, and wall panels shall be supplied by the respective trade and installed under this Section in accordance with the trade-approved Shop Drawings.
- .4 Sleeves, inserts, and fastening devices required by other trades but not shown on the drawings shall be supplied by the respective trade and installed under this section. The installation shall be checked and verified by the respective trade.
- .5 Obtain approval before framing openings in structural members which are not indicated on Drawings.
- .6 Install accessories in accordance with manufacturer's written instructions, straight, level, and plumb. Use setting drawings, templates, diagrams, instructions, and directions furnished with the items to be embedded. Ensure items are not disturbed during concrete placement.
- .7 Paint exposed threads of anchor bolts with a mixture of molybdenum disulfide in oil before nuts are installed.
- .8 Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Locate openings at inconspicuous locations at bottom of forms to allow flushing water to drain.
- .9 Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- .10 Obtain approval for all openings and driven fasteners required in the concrete Work after the concrete is placed.

3.4 Form Cleaning

- .1 Clean forms as erection proceeds, to remove foreign matter within forms.
- .2 Clean formed cavities of debris prior to placing concrete.
- .3 Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- .4 During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.5 Formwork Tolerances

- .1 Construct formwork to maintain tolerances in accordance with CSA A23.1.
- .2 Camber slabs and beams (both top and bottom surfaces) as noted on the Drawings.

3.6 Form Removal and Reuse

- .1 Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads. Keep shores in place minimum 28 days after concrete placement unless noted otherwise on the Drawings. For concrete with more than 25% fly ash replacement, keep shores in place minimum 56 days after concrete placement unless noted otherwise on the Drawings.
- .2 Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- .3 Remove form ties carefully to avoid marking concrete and allow for patching. Grout bottom of form tie hole to prevent rust staining.
- .4 Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- .5 When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces.
- .6 Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION

**PART
1**

GENERAL

1.1 Section Includes

- .1 Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.

1.2 Related Sections

- .1 Section 01 33 00 - Submittals.
- .2 Section 01 74 19 - Construction Waste Management and Disposal.
- .3 Section 03 11 00 - Concrete Forming.
- .4 Section 03 30 00 - Cast-in-Place Concrete.

1.3 References

- .1 ASTM A108-07 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- .2 ASTM A1044/A1044M-05 (2010) - Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete.
- .3 ASTM A1064/A1064M-12 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .4 CSA A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .5 CSA A23.3-04 (R2010) - Design of Concrete Structures.
- .6 CSA G40.20-04/G40.21-04 (R2009) - General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .7 CSA W59-03 (R2008) - Welded Steel Construction (Metal Arc Welding).
- .8 CSA W186-M1990 (R2007) - Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .9 RSIC (Reinforcing Steel Institute of Canada) – Manual of Standard Practice (2004).
- .10 British Columbia Building Code 2018.
- .11 For Projects overseen by a Construction Manager in lieu of a General Contractor, references to “Contractor” shall apply to the Construction Manager and relevant Trade Contractor(s).

1.4 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Test Reports: Submit certified copies of mill test report of reinforcement materials analysis.

- .3 Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying CSA qualification within the previous 12 months.
- .4 Unit Prices: Provide contingency reinforcing additional to all other requirements, with "add" and "delete" unit prices included in the bid. Include reinforcing required for non-structural concrete and masonry shown on the various Drawings.

1.5 Quality Assurance

- .1 Perform Work in accordance with CSA A23.1/A23.2.
- .2 All welders employed on the Work must have passed the qualification test as set forth in CSA W47.1 within the preceding 12 months.
- .3 Design reinforcement under direct supervision of a Professional Engineer experienced in design of this Work and licensed at the place where the Project is located.

1.6 Deliver, Storage, and Handling

- .1 Deliver, store, and handle steel reinforcement, welded wire fabric, and accessories to prevent bending and damage.

PART 2 PRODUCTS

2.1 Reinforcement

- .1 Reinforcing Steel: CSA G30.18, billet steel, Grade 400, deformed, unless noted otherwise on the Drawings.
- .2 Low-Alloy Reinforcing Steel: CSA G30.18, billet steel, Grade 400W, deformed, unless noted otherwise on the Drawings.
- .3 Welded Steel Wire Reinforcement: ASTM A1064, in flat sheets.

2.2 Accessories

- .1 Chairs, Bolsters, Bar Supports, Spacers, Tie Wire: Sized and shaped for strength and support of reinforcement during concrete placement conditions, including load bearing pad on bottom to prevent vapour barrier puncture.
- .2 Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Concrete Exposed to View or Exposed to Weather: Plastic-protected steel wire or stainless steel bar supports.

2.3 Fabrication

- .1 Fabricate concrete reinforcing in accordance with:
 - .1 CSA A23.1/A23.2.
 - .2 RSIC - Reinforcing Steel Manual of Standard Practice.
- .2 Weld reinforcement in accordance with CSA W186.
- .3 Bend all reinforcing bars cold. Do not straighten or re-bend.

- .4 Locate reinforcing splices not indicated on drawings at point of minimum stress. Review location of splices with DFO representative.

PART 3 EXECUTION

3.1 Placement

- .1 Place reinforcement of the size and shapes shown on the drawings in accordance with the placement drawings, structural drawings, CSA A23.1, CSA A23.3, the RSIC Manual of Standard Practice, and the applicable building code.
- .2 Clean reinforcement of loose rust and mill scale, earth, ice, oil, paint, and other foreign materials or coatings that would reduce bond to concrete. A slight film of red rust will not be considered objectionable.
- .3 Accurately position, support, and secure reinforcement against displacement to CSA A23.1. Do not tack weld crossing reinforcing bars. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- .4 Locate and support reinforcement with bar support to maintain minimum concrete cover around reinforcing as follows, unless noted otherwise on the Drawings:
 - .1 Footings and Concrete Formed Against Earth: 75mm.
 - .2 Concrete Exposed to Weather or In Contact with Ground: 50mm for bars larger than 15M; 40mm for bars 15M and smaller.
 - .3 Walls: 32mm.
 - .4 Column Ties: 40mm.
 - .5 Slabs on Grade: 40mm (from top of slab).
- .5 Clear distance between bars, except for columns, shall not be less than 1.4 times the nominal diameter of the bar, or 25mm, or 1.3 times the maximum size of the coarse aggregate. Bars placed in two or more layers shall have a minimum clear distance between the layers of not less than 25mm and shall be placed directly above and below each other.
- .7 Clear distance between bars in columns shall not be less than 1.5 times the nominal diameter of the bars, or 38mm, or 1.5 times the maximum size of the coarse aggregate.
- .8 Tolerances for location of reinforcement shall be per CSA A23.1.
- .9 Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.2 Field Bending

- .1 Do not field bend reinforcement except where indicated or authorized by the DFO representative.
- .2 When field bending is authorized, bend without heat, applying slow, steady pressure as instructed.

- .3 Replace bars which develop cracks or splits.

3.3 Field Quality Control

- .1 Placing and reinforcement shall be reviewed by the DFO representative or the DFO representative's agent prior to any concrete being placed in the section to be cast.
- .2 All steel required for the section shall be placed before permission will be given to cast concrete.

END OF SECTION

PART 1 GENERAL**1.1 Section Includes**

- .1 Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes, for the following:
 - .1 Footings.
 - .2 Foundation walls.
 - .3 Slabs on grade.
- .2 Control, expansion and contraction joint devices associated with concrete work.

1.2 Related Sections

- .1 Section 01 33 00 - Submittals.
- .2 Section 01 74 19 - Construction Waste Management and Disposal.
- .3 Section 03 11 00 - Concrete Forming.
- .4 Section 03 20 00 - Concrete Reinforcing.
- .5 Section 05 12 00 - Structural Steel.

1.3 References

- .1 ASTM C260/C260M-10a - Standard Specification for Air-Entraining Admixtures for Concrete.
- .2 ASTM C309-11 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .3 ASTM C494/C494M-10a - Standard Specification for Chemical Admixtures for Concrete.
- .4 ASTM C881/C881M-10 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- .5 ASTM C1017/C 1017M-07 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .6 ASTM C1315-11 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
- .7 CSA A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .8 CSA A23.3-04 (R2010) - Design of Concrete Structures.
- .9 British Columbia Building Code 2018.
- .10 For Projects overseen by a Construction Manager in lieu of a General Contractor, references to "Contractor" shall apply to the Construction Manager and relevant Trade Contractor(s).

1.4 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - .1 Indicate amounts of mixing water to be withheld for later addition at Project site.
 - .2 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA A23.1/A23.2.
 - .3 Supply proposed design mixtures to testing agency and DFO representative a minimum of 14 days prior to the first concrete pour.
 - .4 Include information on all admixtures.
- .3 Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Location of construction joints is subject to the approval of the DFO representative.
- .4 Product Data: Provide data on the following:
 - .1 Admixtures.
 - .2 Curing compounds
 - .3 Repair materials.
- .5 Test Data: Submit manufacturer's test data and certification by qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Blended hydraulic cement.
 - .3 Supplementary cementing materials.
 - .4 Grout.
 - .5 Admixtures.
 - .6 Aggregates.
 - .7 Water.
- .6 Slab/Footing Base Surface Flatness and Levelness: Submit measurements indicating compliance with specified tolerances.

1.5 Quality Assurance

- .1 Perform Work in accordance with CSA A23.1/A23.2.
- .2 Conform to CSA A23.1 when concreting during hot weather.
- .3 Conform to CSA A23.1 when concreting during cold weather.

PART 2 PRODUCTS**2.1 Concrete Materials**

- .1 Cement: Type GU, Normal Portland, and Type HS, High Sulphate, shall conform to CSA A3001.
- .2 Blended Hydraulic Cement: CSA A3001, Type GUb.
- .3 Supplementary Cementing Materials: CSA A3001. Silica fume, Type SF; Natural Pozzolan, Type N; Ground Blast-furnace Slag, Type S; Fly Ash, Type CH, F, or CI.
- .4 Fine and Coarse Aggregates: CSA A23.1.
- .5 Water: CSA A23.1, clean and not detrimental to concrete.

2.2 Admixtures

- .1 Air Entrainment: ASTM C260.
- .2 Chemical Admixtures: Certified by the manufacturer to be compatible with other admixtures. Provide admixtures that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - .1 Water-Reducing Admixture: ASTM C494, Type A.
 - .2 Retarding Admixture: ASTM C494, Type B.
 - .3 Accelerating Admixture: ASTM C494, Type C.
 - .4 Water-Reducing and Retarding Admixture: ASTM C494, Type D.
 - .5 Water-Reducing and Accelerating Admixture: ASTM C494, Type E.
 - .6 High-Range, Water-Reducing Admixture: ASTM C494, Type F.
 - .7 High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
 - .8 Plasticizing and Retarding Admixture: ASTM C1017, Type II.

2.3 Joint Devices and Filler Materials

- .1 Joint Filler: ASTM D1751, asphalt impregnated fibreboard or felt, 12mm thick; tongue and groove profile.
- .2 Joint Sealant: ASTM C920, self-levelling two-part polyurethane type.
 - .1 Colour as selected by the DFO representative from the standard range.
 - .2 Primers and bond breakers as required to install the joint sealant system shall be provided in strict accordance with sealant manufacturer's recommendations.
- .3 Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 19mm by 25mm.

2.4 Curing Materials

- .1 Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- .2 Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 305 g/sq. m when dry.
- .3 Moisture-Retaining Cover: Polyethylene film or white burlap-polyethylene sheet.
- .4 Water: Potable.
- .5 Curing Compounds: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- .6 Curing and Sealing Compounds: ASTM C1315, Type 1, Class A, VOC content of 200g/L or less.

2.5 Repair Materials

- .1 Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 3.2mm and that can be feathered at edges to match adjacent floor elevations.
 - .1 Cement Binder: Portland cement or hydraulic or blended hydraulic cement.
 - .2 Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - .3 Aggregate: Well-graded, washed gravel, 3.2mm to 6mm, or coarse sand as recommended by underlayment manufacturer.
 - .4 Compressive Strength: Not less than 30 MPa at 28 days.
- .2 Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 6.4mm and that can be filled in over a scarified surface to match adjacent floor elevations.
 - .1 Cement Binder: Portland cement or hydraulic or blended hydraulic cement.
 - .2 Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - .3 Aggregate: Well-graded, washed gravel, 3.2mm to 6mm, or coarse sand as recommended by topping manufacturer.
 - .4 Compressive Strength: Not less than 35 MPa at 28 days.

2.6 Related Materials

- .1 Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 17 MPa in 48 hours and 48 MPa in 28 days.
- .2 Epoxy Bonding Agent: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.

2.7 Concrete Mixtures

- .1 Mix and deliver normal density concrete in accordance with CSA A23.1 to the criteria given in the Structural Drawings.
- .2 Use accelerating admixtures in cold weather only when approved by DFO representative.
Use of admixtures will not relax cold weather placement requirements.
- .3 Use set retarding admixtures during hot weather only when approved by DFO representative. Use of admixtures will not relax hot weather placement requirements.
- .4 Add air entraining agent to normal weight concrete mix for work exposed to exterior. The amount of air entrainment is to be 6% +/- 1%, unless noted otherwise on the structural Drawings or approved by the DFO representative.
- .5 Obtain DFO representative's approval before using chemical admixtures other than those specified.
- .6 Proportion concrete materials to provide a workable mix that can be handled, placed, and worked into angles and corners of forms and around reinforcing steel and inserts. The mix proportions shall not be such that the concrete will easily segregate or cause excessive water to collect on the surface.

PART 3 EXECUTION**3.1 Examination**

- .1 Verify existing conditions before starting work.
- .2 Verify all dimensions and locations required on drawings.
- .3 Verify requirements for concrete cover over reinforcement.
- .4 Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not impede concrete placement.
- .5 Verify locations of all openings and embedments required for other work.

3.2 Inserts, Embedded Parts, and Openings

- .1 See Section 03 11 00.
- .2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as indicated, obtain approval of all modifications from the DFO representative before placing concrete.

3.3 Placing Concrete

- .1 Preparation:
 - .1 Complete formwork, secure reinforcement in place, and position joint material, anchors, and other embedded items. DFO representative or DFO representative's agent must review the entire preparation prior to placing concrete.
 - .2 Notify DFO representative and independent testing agency minimum 48 hours prior to commencement of operations. No concrete shall be delivered to the project unless permission to pour has been obtained from the DFO representative.
 - .3 Pump all excavations for footings and all forms clear of water before placing concrete therein.
- .2 Mixing and Delivery:
 - .1 Mix concrete in a mechanical batch mixer of a type approved by the DFO representative and meeting requirements of CSA A23.1.
 - .2 Mixing time shall conform to CSA A23.1. Rotate mixers at the rate recommended by the manufacturer of the equipment.
 - .3 Transport concrete from the mechanical batch mixer to the project site in agitating or non-agitating equipment conforming to CSA A23.1.
 - .4 Transport concrete in such a fashion that no segregation occurs.
 - .5 Do not use concrete which has commenced to stiffen. Do not re-temper stiffened concrete with additional water or cement for use.
 - .6 Before test sampling and placing concrete, water may be added at Project site, subject to limitations of CSA A23.1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- .3 Conveying:
 - .1 Convey concrete in accordance with CSA A23.1.
 - .2 Convey concrete from the mixer to the place of final deposit using equipment and methods that will ensure a practically continuous flow of concrete at the delivery end without separation or loss of materials.
- .4 Depositing:
 - .1 Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated.
 - .2 Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - .3 Deposit concrete in forms as close as practicable to its final position to avoid segregation. Do not allow the vertical height of free fall of concrete to exceed 1.5 meters.
 - .4 Keep the top surface of the concrete level throughout the pour, unless camber is indicated on the Drawings. Provide additional concrete volume as required to compensate for deflection of formwork, or for deflection or camber of base building structure when casting topping slabs.

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- .5 Consolidate placed concrete with mechanical vibrating equipment according to CSA A23.1 to secure a dense, homogenous structure, close bond with reinforcing, and smooth formed surfaces.
 - .6 Use internal vibrators having a minimum frequency of 7,000 revolutions per minute. Maintain a spare vibrator on hand during all concrete placing.
 - .7 Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 150mm into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
 - .8 Ensure reinforcement, inserts, formed expansion/contraction joints, and embedded parts are not disturbed during concrete placement.
 - .9 Screed slab surfaces with a straightedge and strike off to correct elevations.
 - .10 Slope surfaces uniformly to drains where required.
 - .11 Begin initial floating of slabs using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- .5 Cold-Weather Placement: Comply with CSA A23.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
- .1 When average high and low temperature is expected to fall below 5°C for three successive days, maintain delivered concrete mixture temperature within the temperature range required by CSA A23.1.
 - .2 Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - .3 Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture design.
- .6 Hot-Weather Placement: Comply with CSA A23.1. and as follows:
- .1 Maintain concrete temperature per CSA A23.1 at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - .2 Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- .7 Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

.8

3.6 Concrete Finishing – Formed Surfaces

- .1 General: Finish formed surfaces in accordance with CSA A23.1.
- .2 Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- .3 Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- .4 Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - .1 Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- .5 Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless noted otherwise.

3.7 Curing and Protection

- .1 General: Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical damage. Cure surfaces in accordance with CSA A23.1. Comply with CSA A23.1 for cold-weather and hot-weather protection during curing.
- .2 Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 1 kg/sq. m x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- .3 Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- .4 Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- .5 Cure concrete by one or a combination of the following methods:

- .1 Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - .1 Water.
 - .2 Continuous water-fog spray.
 - .3 Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 300mm lap over adjacent absorptive covers.
- .2 Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 300mm, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- .3 Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
- .4 Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.8 Field Quality Control

- .1 All required sampling, preparation of specimens, and testing shall be performed by an independent testing agency appointed by the Contractor and approved by the DFO representative. The testing agency shall report immediately to the DFO representative when any procedure is contrary to the specifications and good practice.
- .2 Testing costs are paid by the Contractor. The testing agency shall submit all invoices for services rendered to the DFO representative for approval.
- .3 Costs of supplying materials for samples are paid by the Contractor. Contractor shall inform testing agency with sufficient notice prior to concrete pour and cooperate with the same in obtaining the required samples.
- .4 The testing agency will perform the following:
 - .1 Review mix designs for conformance with specifications, providing written report to the DFO representative.
 - .2 Test cement and aggregates for conformance with the material requirements of the Specification.
 - .3 Supply cylinder moulds, sample the concrete, make and cure test cylinders, and perform compressive strength tests in accordance with CSA A23.2. Unless permitted by the DFO representative:
 - .1 Cast a minimum of three test cylinders for each 50 cubic meters / 50 cubic yards or each day's pour, whichever is less. Test one at 7 days and two at 28 days.

- .2 For concrete with more than 25% fly ash replacement, cast a minimum of four test cylinders for each 50 cubic meters / 50 cubic yards or each day's pour, whichever is less. Test one at seven days, one at 28 days, and two at 56 days.
- .3 Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- .4 Make all cylinders from concrete taken from the forms.
- .4 Perform slump tests and air content tests in accordance with CSA A23.2 for each concrete test.
- .5 Forward certified copies of test reports to the DFO representative, Contractor, and concrete producer within 48 hours of testing. Reports of compressive strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspection agency, location of concrete batch in Work (including grid lines and elevations), design compressive strength at 28 (or 56) days, concrete mixture proportions and materials, compressive breaking strength, and type of break for all tests.
- .5 One 28-day strength test (or 56-day strength test for fly ash concrete) shall mean the average compressive strength of two companion test specimens.
- .6 Should any test indicate concrete below strength, the DFO representative has the right to stop work on the suspect area until subsequent tests are made. The Contractor bears the cost of such required tests. Should all tests indicate below-strength concrete, the Contractor shall remove this portion of the work at the DFO representative's request. The removal and replacement of this work is at the Contractor's expense.

3.9 Concrete Surface Repairs

- .1 Allow DFO representative and Structural Engineer to inspect concrete surfaces immediately upon removal of forms. Notify DFO representative's and Structural Engineer's of any excessive honeycombing or defects upon discovery.
- .2 Repair and patch defective areas when approved by DFO representative and Structural Engineer.
Remove and replace concrete that cannot be repaired and patched to DFO representative's and Structural Engineer's approval.
- .3 Patch imperfections in accordance with CSA A23.1 and as follows:
 - .1 Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18mm) sieve, using only enough water for handling and placing.
 - .2 Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

- .1 Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 13mm in any dimension to solid concrete. Limit cut depth to 19mm. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - .2 Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - .3 Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by the DFO representative and the Structural.
- .3 Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
- .1 Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.25mm wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - .2 After concrete has cured at least 14 days, correct high areas by grinding.
 - .3 Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - .4 Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - .5 Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 6mm to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - .6 Repair defective areas, except random cracks and single holes 25mm or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 19mm clearance all

around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

- .7 Repair random cracks and single holes 25mm or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- .4 Perform structural repairs of concrete, subject to DFO representative's and Structural Engineer's approval, using epoxy adhesive and patching mortar.
- .5 Repair materials and installation not specified above may be used, subject to DFO representative's and Structural Engineer's approval.

END OF SECTION

Division 05 – Metals

PART**1****GENERAL****1.1****Section Includes**

- .1 Structural steel framing members.
- .2 Base plates.
- .3 Grouting under base plates.
- .4 Shear stud connectors.

1.2**Related Sections**

- .1 Section 01 33 00 - Submittals.
- .3 Section 01 74 19 - Construction Waste Management and Disposal.
- .7 Section 09 91 10 - Painting.

1.3**References**

- .1 ASTM A53/A53M-10 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .2 ASTM A108-07 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- .3 ASTM A123/A123M-09 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .4 ASTM A153/A153M-09 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .5 ASTM A325-10 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- .6 ASTM A370-12a - Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
- .7 ASTM A490-12 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
- .8 ASTM A563-07a - Standard Specification for Carbon and Alloy Steel Nuts.
- .9 ASTM A780/A780M-09 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- .10 ASTM F436-11 - Standard Specification for Hardened Steel Washers.
- .11 ASTM F959-13 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
- .12 ASTM F1554-07ae1 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- .13 ASTM F1852-11 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

- .14 ASTM F2280-12 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
- .15 AWS A2.1 - Welding Symbols Chart.
- .16 AWS D1.1-2006 - Structural Welding Code - Steel.
- .17 CISC - Code of Standard Practice.
- .18 CISC/CPMA 1-73a - Quick-Drying One-Coat Paint for Use on Structural Steel.
- .19 CISC/CPMA 2-75 - Quick-Drying Primer for Use on Structural Steel
- .20 CSA G40.20-04/G40.21-04 (R2009) - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.
- .21 CSA S16-09 - Design of Steel Structures.
- .22 CSA W47.1-09 - Certification of Companies for Fusion Welding of Steel.
- .23 CSA W59-03 (R2008) - Welded Steel Construction (Metal Arc Welding).
- .24 MPI (The Master Painters Institute) - Approved Products List.
- .25 SSPC (The Society for Protective Coatings) - Steel Structures Painting Manual.
- .26 British Columbia Building Code 2018.
- .27 For Projects overseen by a Construction Manager in lieu of a General Contractor, references to "Contractor" shall apply to the Construction Manager and relevant Trade Contractor(s).

1.4 Performance Requirements

- .1 Design all trusses and connections not detailed on the Drawings to the reference standards unless noted otherwise.
- .2 Design connections for the forces shown on the Drawings and allow for the effects of beam deflections. Where forces are not given, design beam end connections for minimum one-half the shear capacity of the section. Provide a minimum of two 19mm diameter A325 bolts or an equivalent weld for all beam to girder connections.
- .3 Design all column-to-beam and column-to-girder connections for a horizontal stability force in all directions equal to 2% of the design column axial load acting simultaneously with all other loads.
- .4 Detail connections of dissimilar metals to prevent galvanic corrosion.

1.5 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Shop Drawings: Show fabrication and erection of structural steel components.
 - .1 Submit erection drawings.
 - .1 Indicate member locations, elevations, and spacing. Label each member with a piece number or other unique mark.

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- .2 Do not reproduce structural Drawings for use as erection drawings.
 - .2 Submit piece drawings for each member.
 - .1 Indicate piece number or mark, member size, material specification, surface preparation, and finish.
 - .2 Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - .3 Indicate welds by standard AWS A2.1 symbols, distinguishing between shop and field welds. Show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - .4 Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical, high-strength bolted connections.
 - .3 Submit erection drawings and piece drawings together in coordinated packages for review by the DFO representative.
 - .4 Review of shop drawings constitutes review of general methods only and will not include approval of dimensions, figures, or quantities. The steel fabricator is responsible for structural design, correct fabrication, and proper fitting of various items.
 - .3 Connection Design Calculations: For connections indicated to comply with performance requirements, where requested. Calculations shall be signed and sealed by the qualified Professional Engineer responsible for their preparation, experienced in the design of this Work and licensed at the place where the Project is located.
 - .4 Mill Test Reports: For structural steel, including chemical and physical properties, where requested.
 - .5 Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying CSA qualification within the previous 12 months.
 - .6 Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Where requested.
 - .7 Weld Samples: Provide samples of fillet and butt welds of architectural (A) and standard (S) types on minimum 150mm material.
 - .1 Type A (Architectural) Welds: Continuous, formed with 'rod' or 'stick' application, with even surface, bead width not to vary by more than plus or minus 2mm. Butt welds to be filled with metal and sanded smooth. No weld splatter.
 - .2 Type S (Standard) Welds: Spot or continuous welds formed with 'wire' application.
 - .3 All visible welds within 3 meters vertically and horizontally of an accessible viewpoint are to be Type A. All other welds are Type S unless noted otherwise on the Drawings.
 - .8 Test and Inspection Reports: As required by "Source Quality Control" and "Field Quality Control" articles of this Specification Section.

1.6 Quality Assurance

- .1 Fabricate structural steel members to CISC Code of Standard Practice, CSA W47.1, and CSA W59.
- .2 All steel fabricators and erectors must have full approval of the Canadian Welding Bureau under CSA W47.1.
- .3 All welders employed on the Work must have passed the qualification test as set forth in CSA W47.1 within the preceding 12 months.
- .4 Design connections not detailed on the Drawings under direct supervision of a Professional Engineer experienced in design of this Work and licensed at the place where the Project is located. Drawings of components designed by the steel fabricator shall be signed and sealed by the Professional Engineer.
- .5 The Professional Engineer sealing the Contractor's shop drawings is also responsible for all field review of his or her Work. The Engineer shall provide signed and sealed letters of assurance to the DFO representative confirming the Work has been completed in accordance with the final reviewed shop drawings and all structural requirements.

1.7 Storage and Handling

- .1 Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - .1 Do not store materials in a manner that might cause distortion, damage, or overload to members or supporting structures.
 - .2 Report all bends and damage to the DFO representative for instructions.
 - .3 Structural steel Contractor shall repair or replace steel Work which is bent, broken, or otherwise damaged, at no cost to the Owner, at the DFO representative's request.
- .2 Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - .1 Fasteners may be repackaged provided Owner's testing and inspection agency observes repackaging and seals containers.
 - .2 Clean and relubricate bolts and nuts that become dry or rusty before use.

1.8 Coordination with Other Trades

- .1 Supply all necessary instructions and drawings to other trades for setting bearing plates, anchor bolts, and other members that are built in with the Work of other trades. Supply the necessary material in accordance with the construction schedule.

PART 2 PRODUCTS**2.1 Materials**

- .1 All steel shall be new unless noted otherwise and shall be of sizes, grades, and shapes listed in the current CISC handbook and as indicated on the Drawings.

- .2 Rolled W-Shapes, Welded Wide Flange Sections, and Channels: CSA G40.20/G40.21 Grade 350W.
- .3 Other Rolled Shapes: CSA G40.20/G40.21 Grade 300W.
- .4 Plates, and Flat Bars: G40.21 Grade 300W.
- .5 Hollow Structural Sections: CSA G40.20/G40.21 Grade 350W, Class C.
- .6 Pipe: ASTM A53/A53M, Grade B.
- .7 Shear Stud Connectors: ASTM A108, Grades 1015 through 1020, headed-stud type.
- .8 Bolts, Nuts, and Washers: ASTM A325, ASTM A490, ASTM F1852, or ASTM F2280 bolts, ASTM A563 nuts, and ASTM F436 washers, galvanized to ASTM A153 for galvanized structural members.
- .9 Direct Tension Indicator Washers: ASTM F959.
- .10 Anchor Bolts: ASTM F1554, Grade 36.
- .11 Welding Materials: Type required for materials being welded. Welding consumables for all processes shall be fully approved by the Canadian Welding Bureau and certified by the manufacturers as complying with the requirements of this Specification. Such certificates shall be no more than two years old.
- .12 Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 17 MPa in 48 hours and 48 MPa in 28 days.
- .13 Shop and Touch-Up Primer for Interior Exposure: CISC/CPMA 1-73a.
- .14 Shop and Touch-Up Primer for Interior Exposure, Exposed to View: CISC/CPMA 2-75.
- .15 Shop and Touch-Up Primer for Exterior Exposure: Compatible with substrate and with coating system as specified in Section 09 91 00 or Section 09 96 00.
- .16 Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20, high-zinc-dust-content paint with dry film containing not less than 94% zinc dust by weight.

2.2

Fabrication

- .1 Structural Steel: Fabricate to CSA S16 and in accordance with structural Drawings and reviewed shop drawings. Fabricate and assemble in shop to greatest extent possible.
 - .1 Fabricate units straight and true, without sharp kinks or bends.
 - .2 Camber structural steel members where indicated.
- .3 Fabricate beams with rolling camber up.
- .4 Close all hollow structural sections airtight with end plates sealed with welds. Provide drain hole at base.
- .5 Mark and match-mark materials for field assembly.
- .6 Complete structural steel assemblies, including welding of units, before starting shop priming operations.

- .7 If sizes of members shown on the Drawings are unavailable, provide available equivalent member next size (or thickness) larger.
- .2 Welding: Weld to CSA W59 using welders qualified in accordance with CSA W47.1.
- .3 Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- .4 Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
- .5 Shear Connectors: Prepare steel surfaces as recommended by manufacturer or shear connectors. Fillet weld connectors to steel members; fusion machine welds are not permitted, except for composite steel floor deck per Section 05 31 00.
- .6 Holes: Provide holes required for securing other Work to structural steel and for other Work to pass through steel members.
 - .1 Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - .2 Base Plate Holes: Cut, drill, mechanically thermally cut, or punch holes perpendicular to steel surfaces.

2.3 Shop Priming

- .1 Shop prime steel surfaces except the following:
 - .1 Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 50mm.
 - .2 Surfaces to be field welded.
 - .3 Surfaces of high-strength bolted, slip-critical connections.
 - .4 Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - .5 Galvanized surfaces.
- .2 Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits.
 - .1 Prepare surfaces according to primer manufacturer's written instructions, at minimum to SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
 - .2 Prepare surfaces to be primed for exterior exposure or to receive a shop or field paint finish according to primer manufacturer's written instructions, at minimum to SSPC-SP 6, "Commercial Blast Cleaning."
- .3 Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.4 Galvanizing

- .1 Hot Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123. Galvanize hardware according to ASTM A153.
 - .1 Fill vent and drain holes that are exposed in the finished Work, unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - .2 Galvanize all items permanently exposed to weather, unless noted otherwise on the Drawings.

2.5 Source Quality Control

- .1 Testing Agency: Contractor will engage and pay for the services of a qualified testing agency to perform shop tests and inspections.
 - .1 Provide a schedule of shop fabrication prior to commencement of Work.
 - .2 Provide testing agency with access to places where structural steel Work is being fabricated or produced to perform tests and inspections.
- .2 Bolted Connections: Inspect and test shop-bolted connections according to CSA S16.
- .3 Welded Connections: Visually inspect all shop-welded connections according to CSA W59. Perform ultrasonic tests of all complete joint penetration (CP) welds according to CSA W59.
- .4 Submit certified results of testing to the DFO representative.
- .5 If more than 5% re-inspection is required due to faulty workmanship, the structural steel Subcontractor is required to pay for this re-inspection.

PART 3 EXECUTION

3.1 Examination

- .1 Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - .1 Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
 - .2 Report in writing to the DFO representative all discrepancies between measurements at the building and those shown on the Drawings, prior to commencing Work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

- .1 Supervise the setting of bases, anchor bolts, and other steel-to-concrete connections. Do not cut base plates to accommodate anchor bolts.
- .2 Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against wind loads, seismic

loads, temporary construction loads, and loads equal in intensity to design loads. Any failure to make proper and adequate provisions for stresses during erection shall be solely the responsibility of the structural steel Subcontractor.

- .3 Remove temporary supports when permanent structural steel, connections, and bracing are in place unless noted otherwise.

3.3 Erection

- .1 Set structural steel accurately in locations and to elevations indicated, according to CSA S16 and reviewed erection drawings.
- .2 Base Plates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - .1 Set plates for structural members on wedges, shims, or setting nuts as required.
 - .2 Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims, but, if protruding, cut off flush with edge of plate before packing with grout.
 - .3 Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces. Protect grout and allow to cure.
- .3 Maintain erection tolerances of structural steel according to CSA S16.
- .4 Align and adjust various members that form part of the complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - .1 Level and plumb individual members of the structure.
 - .2 Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- .5 Splice members only where indicated.
- .6 Do not field cut or alter structural members without written approval of the DFO representative.
- .7 Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 Field Connections

- .1 High-Strength Bolts: Install according to CSA S16 for type of bolt and type of joint specified.
- .2 Weld Connections: Weld by the shielded metal-arc method in accordance with the requirements of CSA W59 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding Work.
 - .1 Remove all loose scale, rust, paint, or other foreign matter from surfaces to be welded.
 - .2 Where weld material is deposited in two or more layers, clean each layer

before the next layer is deposited.

- .3 Take care to minimize stresses due to heat expansion, contraction, and distortion.
- .4 Finish all exposed welding to provide the best possible visual appearance to the satisfaction of the DFO representative and the Structural Engineer.

3.5 Field Quality Control

- .1 Testing Agency: Owner will engage and pay for the services of a qualified testing agency to perform field tests and inspections.
 - .1 Provide a schedule of steel erection prior to commencement of Work.
 - .2 Provide testing agency with access to places where structural steel Work is being erected to perform tests and inspections.
- .2 Bolted Connections: Inspect and test field-bolted connections according to CSA S16.
- .3 Welded Connections: Visually inspect all field-welded connections according to CSA W59. Perform ultrasonic tests of all complete joint penetration (CP) welds according to CSA W59. Perform magnetic particle tests of 15% of all field fillet welds.
- .4 Testing agency will report inspection results promptly and in writing to Contractor, DFO representative, and Structural Engineer.
- .5 Remove and replace work that does not comply with specified requirements.
- .6 If more than 5% re-inspection is required due to faulty workmanship, the structural steel Subcontractor is required to pay for this re-inspection.

3.6 Repairs and Protection

- .1 Galvanized Surfaces: Clean areas where galvanizing is damaged or missing. Repair galvanizing to comply with ASTM A780.
- .2 Touch-Up Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
- .3 Painting: Paint to requirements of Section 09 91 10.
- .4 Provide final protection and maintain conditions to ensure that structural steel is without damage or deterioration at time of Substantial Completion.

3.7 Cleanup

- .1 Make good to the satisfaction of the DFO representative any damage or injury to the Work of other trades. Remove all debris and scrap resulting from the execution of this trade.

END OF SECTION

Division 06 – Wood, Plastics and Composites

PART 1 GENERAL**1.1 Section Includes**

- .1 Structural floor, wall, and roof framing.
- .2 Floor, wall, and roof sheathing.
- .3 Preservative treatment of wood.
- .4 Fire retardant treatment of wood.
- .5 Miscellaneous framing and sheathing.
- .6 Connection hardware.

1.2 Related Sections

- .1 Section 01 33 00 - Submittals.
- .2 Section 01 74 19 - Construction Waste Management and Disposal.
- .3 Section 03 30 00 - Cast-in-Place Concrete.

1.3 References

- .1 APA AFG-01 - Adhesives for Field-Gluing Plywood to Wood Framing.
- .2 ASME B18.2.1-2010 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws.
- .3 ASME B18.6.1-1981 (R2008) - Wood Screws.
- .4 ASTM A153/A153M-09 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .5 ASTM A307-12 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
- .6 ASTM A563-07a - Standard Specification for Carbon and Alloy Steel Nuts.
- .7 ASTM A653/A653M-11 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
- .8 ASTM C954-11 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84mm) to 0.112 in (2.84mm) in Thickness.
- .9 ASTM D2898-10 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
- .10 ASTM D3201-08ae1 - Standard Test Method for Hygroscopic Properties of Fire-Retardant Wood and Wood-Based Products.
- .11 ASTM D3498-03(2011) - Standard Specification for Adhesives for Field Gluing Plywood to Lumber Framing for Floor Systems.
- .12 ASTM D5516-09 - Standard Test Method for Evaluating the Flexural Properties of Fire- Retardant Treated Softwood Plywood Exposed to Elevated Temperatures.

- .13 ASTM D5664-10 - Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber.
- .14 ASTM D6305-08 - Standard Practice for Calculating Bending Strength Design Adjustment Factors for Fire-Retardant Treated Plywood Roof Sheathing.
- .15 ASTM D6841-08 - Standard Practice for Calculating Design Value Treatment Adjustment Factors for Fire-Retardant Treated Lumber.
- .16 ASTM E84-12c - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .17 ASTM E488/E488M-10 - Standard Test Methods for Strength of Anchors in Concrete Elements.
- .18 AWPA M4-06 - Standard for the Care of Preservative-Treated Wood Products.
- .19 CANPLY (Canadian Plywood Association) - Grading and certification.
- .20 CSA B111-1974 (R2003) - Wire Nails, Spikes and Staples.
- .21 CSA G40.20-04/G40.21-04 (R2009) - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.
- .22 CSA O80 Series-08 -Wood Preservation.
- .23 CSA O86-09 - Engineering Design in Wood.
- .24 CSA O121-08 - Douglas Fir Plywood.
- .25 CSA O141-05 - Softwood Lumber.
- .26 ICC-ES ESR-1539 - Power-Driven Staples and Nails.
- .27 NLGA (National Lumber Grades Authority) - Standard Grading Rules for Canadian Lumber, 2007 Edition.
- .28 British Columbia Building Code 2018.
- .29 For Projects overseen by a Construction Manager in lieu of a General Contractor, references to "Contractor" shall apply to the Construction Manager and relevant Trade Contractor(s).

1.4 Submittals

- .1 Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - .1 Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - .2 Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

- .3 For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
- .4 For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- .5 Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- .6 For connectors, include installation instructions.
- .2 Samples of Exposed to View Wood Members: Submit one sample of each different type, minimum 300mm in size, illustrating wood grain, stain, and finish.
- .3 Certificates of Conformance: In lieu of grade stamping lumber and plywood exposed to view, submit manufacturer's certificate certifying that products meet or exceed specified requirements.
- .4 Weather Protection: Provide letter outlining steps to be taken during construction to ensure adequate weather protection of wood structures.

1.5 Quality Assurance

- .1 Perform Work in accordance with CSA O86 and the following agencies:
 - .1 Lumber Grading Agency: Certified by NLGA.
 - .2 Plywood Grading Agency: Certified by CANPLY.
- .2 Installer Qualifications: Company specializing in performing the Work of this Section with minimum three years of experience.

1.6 Delivery, Storage, and Protection

- .1 Protect materials from weather during transit to Project site.
- .2 Stack materials flat with spacers beneath and between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 Sustainable Design

- .1 Refer to Section 01 81 13 and Section 01 81 14 for sustainable design requirements, including FSC certified wood content.

2.2 Dimension Lumber Framing

- .1 Lumber Grading Rules: NLGA. All softwood lumber shall conform to CSA O141 and CSA O86.

- .2 Identification: Factory mark each piece of lumber with grade stamp of grading agency. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece. Deliver to site with certificates as to species, grades, stress grades, seasoning, moisture content, and other evidence as required to show compliance with the Specifications.
- .3 Maximum Moisture Content: 19% unless noted otherwise.
- .4 Studs, Joists, Built-up Posts, Built-up Beams, Nailers, and Blocking: SPF #2 or better unless noted otherwise, S4S.
- .5 Top and Bottom Plates: D.Fir-L #2 or better.
- .6 Strapping and Nailing Strips: Hem-Fir, Construction Grade, unless noted otherwise.
- .7 Solid Wood Posts and Beams: D.Fir-L #1 or better.

2.3 Sheathing

- .1 Floor Sheathing: T&G Douglas Fir plywood, exterior grade, conforming to CSA O121. Thickness as indicated, not less than 19mm.
- .2 Roof Sheathing: Douglas Fir plywood, exterior grade, conforming to CSA O121. Thickness as indicated, not less than 13mm. Provide H-clips between each joist for 13mm panels; provide T&G edge for 16mm and thicker panels.
- .3 Wall Sheathing: Douglas Fir plywood, exterior grade, conforming to CSA O121. Thickness as indicated, not less than 13mm.
- .4 Identification: Factory mark panels to indicate compliance with applicable standard.

2.4 Wood Preservative Treatment Materials

- .1 Wood Preservative (Pressure Treatment): CSA O80 Series.
- .2 Wood Preservative (Surface Application): CSA O80 Series treated by immersion (not by brush).
- .3 Oil Borne Preservatives: Material treated using oil borne preservatives shall be subjected to a vacuum expansion bath at a treatment plant according to CSA O80 Series to produce a material that is free of excessive surface oil
- .4 Water Borne Preservatives: Material treated using water borne preservatives shall have an average moisture content not exceeding 25% at 25mm depth below the surface prior to preservative treatment.
- .5 Moisture Content: Following treatment, dry material to maximum moisture content of 19% unless noted otherwise.
- .6 Identification: Identify preservative-treated wood with certification mark authorized by the Canadian Wood Preservers Bureau (CWPB).
- .7 Application: Treat items indicated on the Drawings, and the following:
 - .1 Wood cants, nailers, curbs, equipment support bases, blocking, stripping, sheathing, and similar members in connection with roofing, flashing, vapour barriers, and waterproofing.

- .2 Wood sills, sleepers, blocking, furring, stripping, sheathing, and similar concealed members in contact with masonry or concrete.
- .3 Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
- .4 Wood members that are less than 450mm above the ground in crawl spaces or unexcavated areas.
- .5 Wood floor plates that are installed over concrete slabs on grade.

2.5 Fire-Retardant-Treated Materials

- .1 General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- .2 Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 3.2 meters beyond the centerline of the burners at any time during the test.
 - .1 Use treatment that does not promote corrosion of metal fasteners.
 - .2 Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 - .3 Interior Type A: Treated materials shall have a moisture content of 28% or less when tested according to ASTM D3201 at 92% relative humidity. Use where exterior type is not indicated.
- .3 Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841. Treated plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305.
- .4 Moisture Content: Kiln-dry lumber after treatment to a maximum moisture content of 19%. Kiln-dry plywood after treatment to a maximum moisture content of 15%. Do not use material that is warped or does not comply with requirements for untreated material.
- .5 Identification: Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency. For exposed items indicated to receive a stained or natural finish, mark end or back of each piece, or omit marking and provide certificates of treatment compliance issued by testing agency.
- .6 For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

2.6 Miscellaneous Lumber

- .1 General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

- .1 Rooftop equipment bases and support curbs.
 - .2 Cants.
 - .3 Furring.
 - .4 Grounds.
 - .5 Plywood backing.
- .2 For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

2.7 Fasteners

- .1 General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153 or of Type 304 stainless steel.
- .2 Nails, Spikes, and Staples: CSA B111.
- .3 Power-Driven Fasteners: ICC-ES ESR-1539.
- .4 Lag Screws: ASME B18.2.1
 - .1 All lag screws to be machined threaded, not cast threaded.
 - .2 Pre-drilled hole sizes in wood members for lag screws to be in accordance with CSA O86.
- .5 Wood Screws: ASME B18.6.1 or as specified on the Drawings.
- .6 Timber Rivets and Steel Side Plates: CSA O86.
- .7 Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- .8 Bolts and Anchor Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers, hot dip galvanized to ASTM A153.
- .9 Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing and inspecting agency.

2.8 Metal Framing Anchors

- .1 General: Use galvanized Simpson Strong-Tie connectors or approved equal where required.
- .2 Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

- .3 Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653, Z180 (G60) coating designation. Use for interior locations unless noted otherwise.
- .4 Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); Z550 (G185) coating designation; and not less than 0.91 mm thick. Use for wood- preservative-treated lumber and where indicated.
- .5 Steel Plate: CSA G40.20/G40.21, Grade 300W. Use where indicated.
- .6 Joist Hangers: U-shaped joist hangers with 50mm long seat and 32mm wide nailing flanges at least 85% of joist depth, minimum capacity 4.5 kN.
- .7 Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
 - .1 Strap Width: 38mm.
 - .2 Thickness: 1.3mm.
- .8 Bridging: Rigid, V-section, nailless type, 1.3mm thick, length to suit joist size and spacing.
- .9 Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 25mm above base and with 50mm minimum side cover, socket 1.6mm thick, and standoff and adjustment plates 2.8mm thick.
- .10 Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
 - .1 Width: 32mm.
 - .2 Thickness: 1.3mm.
 - .3 Length: 600mm.
- .11 Rafter Tie-Downs: Bent strap tie for fastening rafters to wall studs below, 38mm wide by 1.3mm thick.
- .12 Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters to wall studs below, 57mm wide by 1.6mm thick. Tie fits over top of rafter and fastens to both sides of rafter or truss, face of top plates, and side of stud below.
- .13 Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 32mm wide x 1.3mm thick x 900mm long.
- .14 Hold-Downs: As indicated on the Drawings.

2.9 Miscellaneous Materials

- .1 Sill-Sealer Gaskets: Closed-cell foam, 6.4mm thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- .2 Adhesives for Field Gluing Panels to Framing: ASTM D3498 or APA AFG-01, approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 EXECUTION**3.1 Examination**

- .1 Examine substrates in areas to receive wood framing, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation General

- .1 Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- .2 Framing Standard: Comply with Part 4 of the British Columbia Building Code unless noted otherwise.
- .3 Provide temporary shores, guys, braces, and other supports during erection to keep wood framing secure, plumb, and in alignment against wind loads, seismic loads, temporary construction loads, and loads equal in intensity to design loads. Any failure to make proper and adequate provisions for stresses during erection shall be solely the responsibility of the Installer.
- .4 Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- .5 Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- .6 Do not splice structural members between supports unless noted otherwise.
- .7 Built-Up Columns: Where Drawings indicate compression members consisting of multiple laminations, fasten laminations in accordance with CSA O86.
- .8 Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- .9 Comply with AWPA M4 and revisions specified in CSA O80 Series, Supplementary Requirements to AWPA M2 for applying field treatment to cut surfaces of preservative- treated lumber.
 - .1 Use inorganic boron for items that are continuously protected from liquid water.
 - .2 Use copper naphthenate for items not continuously protected from liquid water.
 - .3 Use two coats of specified preservative to all fresh cuts or holes.

- .10 Securely attach to substrate by anchoring and fastening as indicated, complying with the following:
 - .1 ICC-ES ESR-1539 for power-driven fasteners.
 - .2 Table 9.23.3.4, "Nailing for Framing," in Part 9 of the British Columbia Building Code.
- .11 Use common steel wire nails unless noted otherwise. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish material.
- .12 Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless noted otherwise.
- .13 Substitution of common nails with power-driven nails of the same length and diameter is acceptable. Substitution of power-driven nails of smaller diameter is permitted only with the DFO representative's approval. Set nail gun pressure so that nail heads do not crush plywood surface; nail head penetration shall not exceed 2mm.
- .14 For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
 - .1 Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
 - .2 Use finishing nails unless noted otherwise. Countersink nail heads and fill holes with wood filler.

3.3 Ceiling Joist and Rafter Framing Installation

- .1 Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 19mm x 184mm or 38mm x 89mm actual size stringers spaced 1200mm o.c. crosswise over main ceiling joists.
- .2 Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
 - .1 At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 50mm deeper. Bevel ends of jack rafters for full bearing against valley rafters.
 - .2 At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 50mm deeper. Bevel ends of jack rafters for full bearing against hip rafter.

- .3 Provide collar beams (ties) as indicated or, if not indicated, provide 19mm x 140mm actual size boards between every third pair of rafters, but not more than 1200mm o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.
- .4 Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.4 Sheathing Installation

- .1 Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- .2 Secure floor and roof sheathing with longer edge perpendicular to framing members and with end joints staggered and sheet ends over bearing.
- .3 Fully engage tongue and groove edges where applicable. Where sheathing is not T&G, use sheathing clips between sheets.
- .4 Secure wall sheathing to wall studs, with ends over firm bearing and staggered. Long dimension of sheathing may be parallel or perpendicular to wall studs.
- .5 Cut panels at penetrations, edges, and other obstructions of work. Fit tightly against abutting construction unless noted otherwise.
- .6 Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- .7 Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the work day when rain is forecast.

3.5 Additional Items

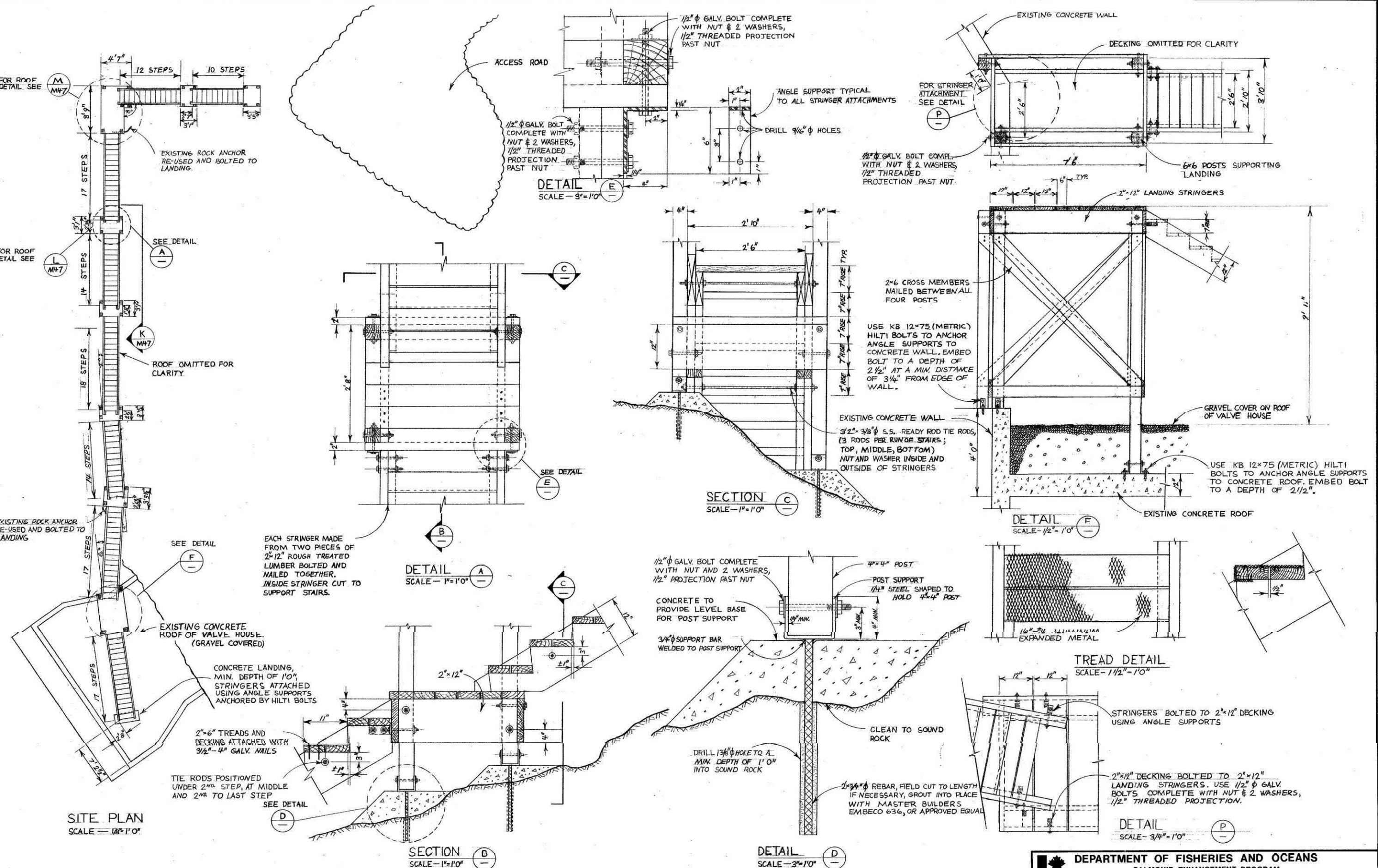
- .1 Make allowance for, provide, and install items such as blocking, bracing, backing, infill pieces, fasteners, furring, grounds, shims, bucks, dowels, bolts, washers, and other hardware. Provide such additional items, whether indicated or not, as required for strength and against movement and deflection, as directed by the DFO representative or Structural Engineer, and as required by the applicable building codes and bylaws.
- .2 No additional funds will be paid to the Contractor to provide such items to complete the Project as intended.

3.6 Erection Tolerances

- .1 Overall Squareness: For rectangular floor areas, the corner-to-corner diagonal measurements should not deviate from each other by more than 13mm or 0.25% of the length of the shortest side of the rectangle, whichever is greater.

- .2 Posts:
 - .1 Plumbness: 0.25% of post height (1:400) maximum deviation from plumb.
 - .2 Position: plus or minus 10mm from theoretical at base in both directions.
- .3 Walls:
 - .1 Plumbness: 0.25% of wall height (1:400) maximum deviation from plumb measured at any point along the wall.
 - .2 Position: plus or minus 10mm from theoretical at base.
 - .3 Length: plus or minus 10mm from theoretical.
 - .4 Stud Spacing: plus or minus 16mm from specified.
- .4 Floors and Roofs:
 - .1 Overall Surface Levelness (Floors and Flat Roofs): 6mm in 3 meters maximum measured at any two points.
 - .2 Individual Joist Levelness (Floors and Flat Roofs): 6mm in 3 meters maximum.
 - .3 Elevation: plus or minus 10mm from theoretical.
 - .4 Joist Spacing: plus or minus 16mm from specified.

END OF SECTION



1. LUMBER SHALL BE #2 OR BETTER, ROUGH DOUGLAS FIR, INCISED AND PRESSURE TREATED WITH BOLIDEN K33 PRESERVATIVE TO Q22 RETENTION OR REFUSAL.
2. ALL TREADS AND LANDINGS TO BE COVERED BY 1/2" x 36" ALUMINUM EXPANDED METAL, FASTENED WITH GALVANIZED STAPLES (SEE TREAD DETAIL).
3. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 P.S.I. AT 28 DAYS.
4. ANGLE SUPPORTS FOR STRINGER ATTACHMENTS SHALL BE 4" x 6" x 1/4" ANGLE, 2" LG.
5. TREAT ALL CUT WOOD SURFACES WITH BOLIDEN K33 PRESERVATIVE.
6. ALL NON-GALVANIZED METAL PARTS TO BE PAINTED WITH COAL TAR EPOXY - SUPPLIED BY THE DEPARTMENT OF FISHERIES AND OCEANS.

| NO. | DATE | REVISIONS |
|-----|---------|-------------------------------|
| 1 | JULY 88 | REVISED TO AS-BUILT M.P. J.B. |

DESIGNED
M.P./J.B.
DRAWN
M.P.
CHECKED
G.M.
RECOMMENDED
G.M.
APPROVED
M.P.
APPROVED
J.B.

| | |
|---|------------------|
| DEPARTMENT OF FISHERIES AND OCEANS SALMONID ENHANCEMENT PROGRAM | |
| BABINE LAKE DEVELOPMENT | |
| FULTON RIVER REGULATING WORKS | |
| STAIRS TO VALVE HOUSE | |
| (1 OF 2) | |
| SCALE AS SHOWN | DATE MAY 1988 |
| DRAWING NUMBER 21-19-M46 | |
| REVISION 1 | |



Fisheries and Oceans
Canada

Pêches et Océans
Canada

Fulton Dam Stair Replacement
Photos of
Existing Stairway Structure
in June 2018





























































FULTON RIVER ROCK FALL PROTECTION PROJECT

Geotechnical Field Review No. 02

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GFR No. 02

DATE: 2019-11-11

DISTRIBUTION: Kevin Pate, DFO (KP)

Darcy Taylor, Norpac (DT)

Sam Fougère, BGC (SF)

Chris Wouters, Norpac (CW)

Mark Pritchard, BGC (MAP)

Email: Kevin.Pate@dfo-mpo.gc.ca

darcy@norpacconstruction.com

sfougere@bgcengineering.ca

chris@norpacconstruction.com

mpritchard@bgcengineering.ca

ARRIVED: 14:00

DEPARTED: 15:30

WEATHER: Snowing, -7°C

PERSONNEL ENGAGED:

BGC Engineering Inc.

Sam Fougère (SF)

Norpac Construction

Darcy Taylor (DT)

1 STATUS OF WORKS

The site meeting was for engineering review and quality assurance and conformance to the design intent of the substantially complete rock fall mesh construction. The objectives of the site visit were to review the construction of the field fit design outlined in GFR-01 and Site Clarification Memo (SCM) 01, dated 20191104. This GFR documents construction site observations with photographs of the mesh and anchor installation, as well as conclusions on the conformance of the construction to the design requirements.

2 OBSERVATIONS AND TECHNICAL ISSUES

2.1. Design Background

The design outlined in GFR-01 and SCM-01 eliminated a mid-slope suspension in favour of suspending the system from the slope crest. The slope crest suspension cable was also divided into two systems (two suspension cables, each with their own end support posts). The second suspension cable was added to accommodate a step change of the slope crest elevation. Mesh suspended from these two cables overlapped down the slope and was clipped together. Additional proposed changes included the addition of four mesh bottom retaining cables to fasten the mesh to the lower slope and scaling of an area of dilated rock mass adjacent the ladder on the outlet structure. End cables and guy anchors were

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removed from the original design – see SCM-01 for details of the design modifications resulting from the GFR-01 site visit on October 31, 2019.

2.2. Construction Review

Observations of the installation of the rock fall mesh are listed from the crest of the slope to the base of the slope at Fulton River. Approximately 10 cm of fresh snow covered the site and obscured some sections of the work area. Site access during the construction review was restricted to areas of the slope crest adjacent to the power pole, the lower crest, the stairway to the top of the outlet structure, and the roof of the outlet structure.

2.3. Slope Crest Items

Site observations at the crest of the slope:

- The mesh system is six rolls wide (Deltax G80/2 mesh, 3.9 m wide rolls), installed on the suspension cables across the crest of the slope (from both crest suspension cable elevations), and were tied together using T3 Tecco clips.
- Upper crest elevation – two end main anchors and one intermediate main anchor. Each of these anchors were tied back with cables to end anchors or auxiliary anchors (ground anchors), respectively.
- Lower crest elevation – two end main anchors with end cables and end anchors.
- All end main anchors at both crest elevations were tied back to end anchors (ground anchors) with cables using four clamps per cable loop. The intermediate main anchor on the upper crest elevation was tied back to auxiliary anchors using three clamps per cable loop.
- The mesh was attached to the suspension cables by a thin cable looped around the main suspension cable and by cable clamps at regular intervals.
- All the anchors were 32 mm #10 galvanized Williams threadbar.
- The suspension, end main, and auxiliary cables conform to the design diameters (19 mm or 16 mm diameter).
- The eye nuts were a Williams product sized for #10 galvanized threadbar – the diameter of the ring that forms the eye of the nut for the William eye nut was 45 mm.
- Drill hole depths for all the anchors were ≥ 2 m depth (DT). Deeper holes were drilled to ensure placement of the anchors in competent rock (DT).
- All anchor grout was Baselite Microsil and was at or near the ground surface (± 50 mm) at the base of anchors.
- No thimbles were installed at any of the anchor points.

2.4. Mid-Slope Items

Site observations from the mid-slope section:

- The Deltax mesh lengths were attached together (both perpendicular and parallel to slope contour) by T3 clips. All T3 clip mesh connections observed were installed as per the manufacturer's specification.
- Brushing and removal of the vegetation within the meshed area was completed.
- 8 x 3.9 m (wide) x 30 m (length) rolls were placed on the slope – 6 x roll widths wide across the top. The remaining two rolls were added as vertical extensions to the longer roll lengths to the centre and eastern (centre right when looking upslope from the outlet structure) sections of the meshed area. Some mesh overlap was used towards the eastern crest of the slope and adjacent the outlet structures down ladders.
- Mesh area calculations were completed by SF and DT from the roof of the outlet structure. Given the uneven terrain and irregular shape of the meshed area these calculations should be considered estimates. Mesh area was calculated from the dimensions of the mesh rolls, the number of rolls placed, and tape measure:
 - Total mesh used, including any and all overlap, was 936 m² based on the 8 mesh rolls used by Norpac (DT).
 - The meshed area was calculated by SF and DT to be 24 m wide. The average length of mesh was approximately 36.6 m (120 ft) length = 878 m². SF and DT estimated this length visually based on the known 30 m length connection point (a few metres upslope of the outlet structure roof).
 - SF and DT agreed on 905 m² mesh placement (min. ~878 m² – max. 936 m²).

2.5. Base of Slope Items

Site observations from the base of the slope:

- A 16 mm bottom cable was installed and clamped to the mesh at ~ 2 m intervals.
- Five bottom cable mesh retainer #8 bolts were installed. These are rock anchors with the bottom of the slope mesh pinned to the slope using an anchor plate and nut on the rock anchor. Anchor depth was not recorded by BGC.
- The area of dilated rock identified in GFR-01 was meshed over. DT check scaled the rock mass and there was no movement.

2.6. Deficiencies

Lack of Cable Thimbles

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The rock fall system was installed consistent with the updated GFR-01 (20191031) design and specification intent with one exception. The tie in points for the anchor cables did not have thimbles installed. DT stated that thimbles are not required for Williams products. Thimbles are used to prevent the anchor cables from deforming under load where it bends around and through an eye.

Eye nut dimensions for the #10 Williams (installed) and the #10 Dywidag DSI were compared based on manufacturer's specifications. The diameter of the ring that forms the eye of the nut for the Williams eye nut was 45 mm, for Dywidag DSI it is 32 mm. The Williams eye nut ring diameter is 40% larger than the Dywidag DSI eye nut ring diameter. Given the cables on site do not appear pinched or deformed as they are tied back through the Williams eye nuts, and that the Williams eye nut ring diameter at 45 mm is 40% larger than the Dywidag DSI product this thimble deficiency appears to conform to the design intent.

Intent of Mesh Bottom Retainers

The intent of the mesh bottom retainer points was to install a rock anchor for each retaining point, then attach a 1 m to 2 m cable from the head of the rock anchor to the horizontal cable at the bottom of the mesh. The design intent of these retaining points is to allow rock to roll out of the bottom of the mesh, but not let the mesh billow out too far at the bottom when impacted by rock fall. This is so, should personnel be on the top of the valve station when a rock fall occurs, the impact point of the rock fall on the top of the valve platform are contained to near the rock slope and hence less likely to be in an area where personnel are located. The design for these retainer points was discussed between MAP and DT during the site visit that resulted in GFR-01. However, the description of this design addition in GFR-01 does not provide the intended detail. The as-built arrangement will contain rock fall close to the slope, and allow rock fall to exit out the bottom of the mesh – as intended for the design. However, as the mesh is pinned to the slope, there is some potential for rock fall to be arrested between the mesh and the slope immediately above a mesh bottom retention anchor. Essentially, the mesh is a bit more likely to pin rock fall under the mesh at the toe of the mesh, increasing the potential for the mesh to become overloaded and tear. However, the likelihood of this scenario occurring is considered low as the retained points along the bottom of the mesh are widely spaced, with ample room for rock fall to exit the mesh on either side of a bottom retention anchor point. BGC recommends that the performance of the system be monitored, and if rock fall is building up under the mesh immediately above the retention anchor points, the retention points be altered to add short (1 m to 2 m) extension cables from the anchor point to the bottom horizontal mesh cable.

3 LOGISTICAL ITEMS

None discussed.

4 SUBMITTALS, QC, AND QA

Grout cubes were collected by Norpac (DT delivered them to SF). BGC understands that DFO will provide direction if they would like these grout cubes tested for unconfined compressive strength.

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Observations from the engineering review for quality assurance and conformance to the design intent were noted in Section 2.

5 ACTION ITEMS

| Item | Responsible | Date due |
|--|-------------|----------|
| BGC to discuss thimble deficiency with DFO | SF/MAP | asap |

6 LOOK AHEAD

None.

Attachments:

Photographs 1 through 9

FULTON RIVER ROCK FALL PROTECTION PROJECT

7 PHOTOGRAPHS



Photograph 1: View of Intermediate Main Anchor and supporting Auxiliary Cables.

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Photograph 2: Close view of clamp on an End Cable.

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Photograph 3: View looking along Suspension Cable showing arrangement of wire mesh, Lacing Cable, and Cable Clamps.

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Photograph 4: View looking down mesh showing mesh connection clip arrangement.

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Photograph 5: View of an End Main Anchor and End Cables.

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Photograph 6: View looking up slope showing mesh area.

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Photograph 7: View looking along base of mesh where it is above the top of the valve house. Red circle indicates a rock anchor used to pin the mesh to the slope.

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Photograph 8: View down from top of valve platform at bottom of mesh. Fingers point to locations of rock anchors with anchor plates and nuts that are used to pin the bottom of the mesh to the slope.

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Photograph 9: Close view of a cable loop connection to an anchor eye nut.