

## Part 1 General

### 1.1 SOILS REPORT

- 1.1.1 A site specific Geotechnical Report for this project has not been prepared. Assumed design values are based on a nearby well drill hole logs. To obtain a copy of the drill hole log, please contact the Structural Engineer at:

Walker Projects Inc.  
109 - 1621 Albert Street  
Regina, SK S4P 2S5

Attention: Daniel Welch

Tel: 1-306-522-9434

Fax: 1-306-522-9431

e-mail: [dwelch@walkerprojects.com](mailto:dwelch@walkerprojects.com)

- 1.1.2 The assumed design values for the project (referenced to finished grade) are as follows:

0 m to 5 m	-7.2 kPa (-150 psf)
Below 5 m	23.9 kPa (500 psf)

- 1.1.3 Soil conditions must be confirmed by the Contractor. Should the sub-surface conditions be found to vary substantially from those assumed, the Contractor shall advise the Consultant immediately. Changes in the design and construction of foundations will be made accordingly, with resulting credits or expenditures accruing to the Owner.

\*\*\*\*\* END OF SECTION 00 31 34 \*\*\*\*\*

**Part 1           General**

**1.1           EXISTING SERVICES**

- .1   Notify Owner of intended interruption of services and obtain required permission.
- .2   Where Work involves breaking into or connecting to existing services, give Owner 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions to a minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3   Existing steam service is to remain fully operational.

**1.2           ACCESS TO THE SITE**

**.1   NOTICE**

- .1   The Contractor shall inform all construction and ancillary personnel of security requirements and shall prominently display a copy of these requirements at the job site.
- .2   It shall be the responsibility of all personnel on site to follow these requirements. Failure to do so will result in expulsion from the site, and may result in permanent expulsion from the site.

**.2   SECURITY**

- .1   The Contractor is expected to become informed about the rules concerning security that the Government of Canada has in place and furthermore shall follow these rules.
- .2   In carrying out the Work, the Contractor shall co-operate with the Government of Canada staff in any and all matters affecting security.

**.3   SECURITY CLEARANCE**

- .1   All personnel employed or otherwise working on this project will be subject to an Government of Canada Facility Access check by the Government of Canada.
  - .1   The Government of Canada reserves the right to reuse access to the site to anyone failing the screening check process.
  - .2   The screening check process will include (but is not limited to) the following: full name (no initials), address, and birth date.
- .2   All personnel employed or otherwise working on this project within an occupied building shall have the requisite Government of Canada Facility Access check prior to the commencement of any on-site activities.
- .3   Immediately upon award of the Contract, the Contractor shall prepare and submit the requisite forms as provided by the Owner for each employee and sub-trade employee to be engaged in the work. The Contractor can mobilize on site only once the Government of Canada Facility Access has been granted.
- .4   The Contractor should batch the fully completed submissions, based on priority work on site and allow for a 12 working day processing time for the review to

occur. The inability to submit the fully completed requisite forms will not be considered an acceptable reason for extending the project schedule, or for additional compensation.

.4 **WORKING REQUIREMENTS**

- .1 All people who will be accessing the site will be required to wear photo ID issued by the Government of Canada.
- .2 People without Government of Canada Facility Access Check and Photo ID will not be granted access to the site.
- .3 Contractors will be escorted by security personnel to work each day for the duration of the contract. Government of Canada will coordinate and schedule security personnel, as well as bear the cost for this function. No work shall be executed outside of the jurisdiction of on-site security (no access to other parts of the building or site without approval).

**1.3 HOURS OF WORK**

- .1 Work shall be allowed on this site only between the hours of 07:00 to 19:00 daily, Monday through Friday. Work shall not be allowed on statutory holidays.
- .2 Exception to these hours of work may be granted by the Owner only upon receipt of a written request from the Contractor, at the Owner's discretion. The written request from the Contractor must be submitted 3 working days prior to the start of the exception period, and must include the reason for the exception, duration, and scope of work to be carried out. Work may proceed during exception periods only upon written approval from the Owner.
- .3 With specific and written permission from the Owner.

**1.4 BUILDING SMOKING ENVIRONMENT**

- .1 Smoking is not allowed on an part of the Government of Canada site, including both indoors and outdoors.

**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                SECTION INCLUDES**

- .1     Shop drawings and product data.
- .2     Samples.
- .3     Certificates and transcripts.

**1.2                ADMINISTRATIVE**

- .1     Submit to Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2     Work affected by submittal shall not proceed 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 Consultant. 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 shall be considered rejected.
- .6     Notify Consultant, 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 coordinated.
- .8     Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .9     Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
- .10    Keep one reviewed copy of each submission on site.

**1.3                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     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.
- .3     Allow 14 days for Consultant's review of each submission.

- .4 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Consultant prior to proceeding with Work.
- .5 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of any revisions other than those requested.
- .6 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.
- .7 Submissions shall 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.
- .8 After Consultant's review, distribute copies.
- .9 Submit 6 prints of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.
- .10 Delete information not applicable to project.
- .11 Supplement standard information to provide details applicable to project.
- .12 If upon review by Consultant, 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.

**1.4 SAMPLES**

- .1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Consultant.
- .3 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .6 Make changes in samples which Consultant may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

Approved: 2002-12-04

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Product quality, availability, storage, handling, protection, and transportation.
- .2    Manufacturer's instructions.
- .3    Quality of Work, coordination and fastenings.
- .4    Existing facilities.

**1.2                PRECEDENCE**

- .1    For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

**1.3                RELATED SECTIONS**

- .1    None

**1.4                REFERENCE STANDARDS**

- .1    Canadian Construction Documents Committee (CCDC)
  - .1    CCDC 2-94, Stipulated Price Contract.
- .2    Within text of each specifications section, reference may be made to reference standards.
- .3    Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .4    If there is question as to whether any product or system is in conformance with applicable standards, Consultant reserves right to have such products or systems tested to prove or disprove conformance.
- .5    Cost for such testing will be born by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.
- .6    Conform to latest date of issue of referenced standards in effect on date of submission of Tenders, except where specific date or issue is specifically noted.

**1.5                QUALITY**

- .1    Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

## **1.6 AVAILABILITY**

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

## **1.7 STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Consultant.

- .9 Touch-up damaged factory finished surfaces to Consultant's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### **1.8 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of Work.

#### **1.9 MANUFACTURER'S INSTRUCTIONS**

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

#### **1.10 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Consultant reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.

#### **1.11 CO-ORDINATION**

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

#### **1.12 CONCEALMENT**

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform Consultant if there is interference. Install as directed by Consultant.

#### **1.13 REMEDIAL WORK**

- .1 Refer to Section 01 73 03 - Execution Requirements.

- .2 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

#### **1.14 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Consultant of conflicting installation. Install as directed.

#### **1.15 FASTENINGS**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

#### **1.16 FASTENINGS - EQUIPMENT**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

#### **1.17 PROTECTION OF WORK IN PROGRESS**

- .1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Consultant.

**1.18 EXISTING UTILITIES**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**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          SECTION INCLUDES**

- .1          Text, schedules and procedures for systematic Waste Management Program for construction, deconstruction, demolition, and renovation projects, including:
  - .1          Diversion of Materials.
  - .2          Waste Audit (WA) - Schedule A.
  - .3          Waste Reduction Workplan (WRW) - Schedule B.
  - .4          Demolition Waste Audit (DWA) - Schedule C.
  - .5          Cost/Revenue Analysis Workplan (CRAW) - Schedule D.
  - .6          Materials Source Separation Program (MSSP).
  - .7          Canadian Governmental Responsibility for the Environment Resources - Schedule E.

**1.2          RELATED SECTIONS**

- .1          Section [01 33 00 - Submittal Procedures].

**1.3          PRECEDENCE**

- .1          For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

**1.4          DEFINITIONS**

- .1          Cost/Revenue Analysis Workplan (CRAW): Based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
- .2          Demolition Waste Audit (DWA): Relates to actual waste generated from project.
- .3          Materials Source Separation Program (MSSP): Consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .4          Recyclable: Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
- .5          Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .6          Recycling: Process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

- .7 Reuse: Repeated use of product in same form but not necessarily for same purpose. Reuse includes:
  - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2 Returning reusable items including pallets or unused products to vendors.
- .8 Salvage: Removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .9 Separate Condition: Refers to waste sorted into individual types.
- .10 Source Separation: Acts of keeping different types of waste materials separate beginning from first time they became waste.
- .11 Waste Audit (WA): Detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.
- .12 Waste Management Coordinator (WMC) : Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .13 Waste Reduction Workplan (WRW): Written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

## **1.5 DOCUMENTS**

- .1 Maintain at job site, one copy of following documents:
  - .1 Waste Audit.
  - .2 Waste Reduction Workplan.
  - .3 Material Source Separation Plan.
  - .4 Schedules [A] [B] [C] [D] [E] completed for project.

## **1.6 SUBMITTALS**

- .1 Submittals in accordance with Section [01 33 00 - Submittal Procedures] [\_\_\_\_].
- .2 Prepare and submit following prior to [project start-up] [\_\_\_\_]:
  - .1 Submit 2 copies of completed Waste Audit (WA): Schedule A.
  - .2 Submit 2 copies of completed Waste Reduction Workplan (WRW): Schedule B.
  - .3 Submit 2 copies of completed Demolition Waste Audit (DWA): Schedule C.
  - .4 Submit 2 copies of Cost/Revenue Analysis Workplan (CRAW): Schedule D.
  - .5 Submit 2 copies of Materials Source Separation Program (MSSP) description.
- .3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.

- .1 Failure to submit could result in hold back of final payment.
- .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
- .3 For each material reused, sold or recycled from project, include amount [in tonnes] [quantities by number, type and size of items] and the destination.
- .4 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

#### **1.7 QUALITY ASSURANCE - SITE VISIT**

- .1 Pre-tender site visit:
  - .1 Walk-through of project site prior to completion of tender submittal is mandatory.
  - .2 Date, time and location to be arranged by Owner's representative.

#### **1.8 WASTE AUDIT (WA)**

- .1 Conduct WA prior to project start-up.
- .2 Prepare WA: Schedule A.
- .3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

#### **1.9 WASTE REDUCTION WORKPLAN (WRW)**

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include but not limited to:
  - .1 Destination of materials listed.
  - .2 Deconstruction/disassembly techniques and sequencing.
  - .3 Schedule for deconstruction/disassembly.
  - .4 Location.
  - .5 Security.
  - .6 Protection.
  - .7 Clear labelling of storage areas.
  - .8 Details on materials handling and removal procedures.
  - .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Describe management of waste.
- .5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.
- .6 Post WRW or summary where workers at site are able to review content.

- .7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

**1.10 DEMOLITION WASTE AUDIT (DWA)**

- .1 Prepare DWA prior to project start-up.
- .2 Complete DWA: Schedule C.
- .3 Provide inventory of quantities of materials to be salvaged for reuse, recycling, or disposal.

**1.11 COST/REVENUE ANALYSIS WORKPLAN (CRAW)**

- .1 Prepare CRAW: Schedule D.

**1.12 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)**

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Owner's representative.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated material[s] in area[s] which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
  - .1 Transport to approved and authorized recycling facility.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
  - .1 Ship material[s] to premises of Owner as directed by the owner's representative.
  - .2 Materials must be immediately separated into required categories for reuse or recycling.

**1.13 STORAGE, HANDLING AND PROTECTION**

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by owner's representative.

- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Consultant.
- .7 Protect surface drainage, mechanical and electrical from damage and blockage.
- .8 Separate and store materials produced during dismantling of structures in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove co-mingled materials to off-site processing facility for separation.
  - .3 Provide waybills for separated materials.

#### **1.14 DISPOSAL OF WASTES**

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of such waste as volatile materials, mineral spirits, oil, paint thinner into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
  - .1 Number and size of bins.
  - .2 Waste type of each bin.
  - .3 Total tonnage generated.
  - .4 Tonnage reused or recycled.
  - .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

#### **1.15 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility, provide temporary security measures approved by Owner's representative.

**1.16 SCHEDULING**

- .1 Coordinate Work with other activities at site to ensure timely and orderly progress of Work.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 APPLICATION**

- .1 Do Work in compliance with WRW.
- .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

**3.2 CLEANING**

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

**3.3 DIVERSION OF MATERIALS**

- .1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by [Departmental Representative] [Consultant] [\_\_\_\_], and consistent with applicable fire regulations.
  - .1 Mark containers or stockpile areas.
  - .2 Provide instruction on disposal practices.
- .2 On-site sale of [salvaged] [recovered] [reusable] [recyclable] material[s] [is permitted] [is not permitted].
- .3 Demolition Waste

Material Type	Recommended Diversion %	Actual Diversion %
Acoustic Tile	[50]	<input type="text"/>
Acoustical Insulation	[100]	<input type="text"/>
Carpet	[100]	<input type="text"/>
De-mountable Partitions	[80]	<input type="text"/>
Doors and Frames	[100]	<input type="text"/>
Electrical Equipment	[80]	<input type="text"/>

Material Type	Recommended Diversion %	Actual Diversion %
Furnishings	[80]	<input type="text"/>
Marble Base	[100]	<input type="text"/>
Mechanical Equipment	[100]	<input type="text"/>
Metals	[100]	<input type="text"/>
Rubble	[100]	<input type="text"/>
Wood (uncontaminated)	[100]	<input type="text"/>
Other		<input type="text"/>

.4 Construction Waste

Material Type	Recommended Diversion %	Actual Diversion %
Cardboard	[100]	<input type="text"/>
Plastic Packaging	[100]	<input type="text"/>
Rubble	[100]	<input type="text"/>
Steel	[100]	<input type="text"/>
Wood (uncontaminated)	[100]	<input type="text"/>
Other		<input type="text"/>

**3.4 WASTE AUDIT (WA)**

.1 Schedule A - Waste Audit (WA)

(1) Material Category	(2) Material Quantity Unit	(3) Estimated Waste %	(4) Total Quantity of Waste (unit)	(5) Generation Point	(6) % Recycled	(7) % Reused
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Wood and  
 Plastics  
 Material  
 Descrip.  
 Off-cuts  
 Warped  
 Pallet Forms  
 Plastic  
 Packaging  
 CardboardP  
 ackaging  
 Other

Doors and  
 WindowsMa  
 terial  
 Descrip.  
 Painted  
 Frames  
 Glass  
 Wood  
 Metal  
 Other

**3.5 WASTE REDUCTION WORKPLAN (WRW)**

.1 Schedule B

(1) Material Category	(2) Person(s) Respon- sible	(3) Total Quantity of Waste (unit)	(4) Reused Amount (units) Projected	Actual	(5) Recycled Amount (unit) Projected	Actual	(6) Material (s) Destina- tion
-----------------------------	--------------------------------------	---	---	--------	--	--------	--

Wood and  
 Plastics  
 MaterialD  
 escrip.  
 Chutes  
 Warped  
 Pallet  
 Forms  
 Plastic  
 Packag ing  
 Card-  
 board  
 Packag ing  
 Other

Doors and  
 Windows  
 MaterialD  
 escrip.  
 Painted  
 Frames  
 Glass  
 Wood  
 Metal  
 Other

**3.6 DEMOLITION WASTE AUDIT (DWA)**

.1 Schedule C - Demolition Waste Audit (DWA)

(1) Material Descrip.	(2) Quantity	(3) Unit	(4) Total	(5) Volume (cum)	(6) Weight (cum)	(7) Remarks and Assump- tions
--------------------------	--------------	----------	-----------	---------------------	---------------------	---

Wood  
 Wood Stud  
 Plywood  
 Baseboard-  
 Wood  
 Door Trim -  
 Wood



Province	Address	General Inquires	Fax
Saskatchewan	Saskatchewan Environment and Resource Management, 3211 Albert Street, Regina, SK S4S 5W6	(306) 787-2700	(306) 787-3941

**END OF SECTION**

**Part 1 . General**

**1.1 GENERAL CONDITIONS**

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

**1.2 WORK INCLUDED**

- .1 Form for all cast-in-place concrete indicated on drawings and subsequently remove all such forms.

**1.3 RELATED WORK**

- .1 Concrete Reinforcement: Section 03 20 00
- .2 Cast-in-Place Concrete: Section 03 30 00
- .3 Miscellaneous Metal Work: Section 05 50 00

**1.4 DESIGN AND CODE REQUIREMENTS**

- .1 Formwork and supporting falsework shall be designed and constructed in accordance with the requirements of CSA S269.1-1975 (R2003) "Falsework for Construction Purposes" and CAN/CSA-A23.1-04 applicable to the work.
- .2 Assume full responsibility for the design and for the adequacy and safety of all formwork and falsework.

**1.5 HANDLING AND STORAGE**

- .1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.
- .2 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.

**Part 2. Products**

**2.1 QUALITY AND STRENGTH**

- .1 The quality and strength of formwork materials shall comply with the requirements set forth in this Specification and CAN/CSA-A23.1-04.

**2.2 FINISHES**

- .1 Form materials for concrete surfaces which will be exposed to view, or which require smooth and uniform surfaces for applied finishes or other purposes, shall consist of square edges, smooth panels of plywood, metal or plastic to approval of the Consultant. The panels shall be square and made in a true plane, clean, free of holes, surface markings and defects.
- .2 Square edged, tongue and groove or shiplap lumber may be used to form concrete which will not be exposed to view or which does not require smooth uniform surface for other

purposes.

### **2.3 MATERIALS**

- .1 Form plywood: exterior grade, Douglas Fir conforming to CSA Standard 0121-M1978 (R2003). Plywood shall be resin coated one side (in contact with concrete). Use sound undamaged plywood with clean true edges. Make up or patching strips between panels shall be kept to a minimum.
- .2 Lumber for forms, falsework, shoring and bracing: conform to CSA Standard 0141-05 "Softwood Lumber", and the applicable authorized grading authority. All lumber shall be a grade to which allowable unit stresses may be assigned in accordance with the National Building Code. All lumber shall be grade marked by the authorized grading authority.
- .3 Form Ties: Fabricated units having a minimum working strength when assembled of 21 MPa and shall be adjustable in lengths to permit tightening and alignment of forms. Ties shall be made with breakback ends or other means of removing the tie and to a depth of at least 25mm from the concrete surface, after the forms are removed. Flat tie for Architectural exposed concrete to include plastic cones leaving no metal within 20mm of surface.
- .4 Form release agent: Proprietary material which will not stain the concrete or impair the natural bonding or colour characteristics of coating intended for use on the concrete.
- .5 Waterstops: Purpose made polyvinyl chloride: 12 MPa minimum tensile strength, minus 46 degrees C. to plus 70 degrees C. working temperature range, conforming to CGSB 41GP 35M (81) "Polyvinyl Chloride Waterstop," Type 2.
- .6 Tubular column forms: round spirally wound laminated fibre forms, internally treated with release material.
- .7 Dovetail anchor slots: minimum 0.6mm galvanized steel with insulation filled slots.
- .8 Premoulded joint fillers:
  - .1 Bituminous impregnated fibreboard: ASTM D1751-04.
  - .2 Vinyl Foam: to ASTM D1752-04 Type I, flexible grade.
  - .3 Standard Cork: to ASTM D1752-04 Type II.

## **Part 3 Execution**

### **3.1 CONDITION OF SURFACE**

- .1 Examine the excavations and foundations for adequate working room and support for the work of this section.
- .2 Verify lines, levels and centre lines before proceeding with the work and ensure that dimensions agree with drawings.
- .3 Report to the Consultant discrepancies in other work that affects the work of this section.

### **3.2 PREPARATION**

- .1 Coat the inside surfaces of forms with a form release agent, used in accordance with the manufacturer's instructions.
- .2 Apply the agent prior to placing reinforcing steel, anchoring devices and embedded parts.

### **3.3 ASSEMBLY AND ERECTION**

- .1 Construct the formwork and shoring and bracing to meet the design and code requirements, accurately so that the resultant finished concrete shall conform to the shapes, lines and dimensions shown on the drawings, within the specified tolerances.
- .2 Formwork shall be so arranged and assembled as to permit easy dismantling and stripping so that the concrete will not be damaged during its removal.
- .3 Review locations of ties and form panels for exposed concrete work with the Consultant.
- .4 Check and correct formwork as required, both horizontally and vertically, during the placing of the concrete.
- .5 Construct formwork to maintain the following maximum tolerances:
  - .1 Deviations from horizontal and vertical lines:  
6 mm in 3000 mm  
20 mm in 12000 mm.
  - .2 Deviation of building dimensions indicated on Drawings and position of columns, walls and partitions: 6 mm.
  - .3 Deviation in cross sectional dimensions of columns or beams or in thickness of slabs and walls: plus or minus 6 mm.
  - .4 Camber slabs and beams: 10 mm per 3000 mm of span unless indicated on drawings.
  - .5 Obtain Consultant's approval for use of earth forms.

### **3.4 JOINTS IN FORMS**

- .1 Make form joints tight in order to prevent leakage of mortar.
- .2 Clean all edges and contact surfaces before erection.
- .3 Where required, install PVC waterstop to manufacturer's instructions and without displacing reinforcement. Do not distort or pierce waterstop.

### **3.5 SHORING AND BRACING**

- .1 Provide bracing to ensure the stability of the formwork as a whole.
- .2 Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.
- .3 Arrange forms to allow stripping without removal of the principal shores, where these

are required to remain in place.

### **3.6 EMBEDDED PARTS AND OPENINGS**

- .1 Provide formed openings where required for pipes, conduit, sleeves and other work to be embedded in and passing through concrete members. Accurately locate and set in place items that are to be cast directly into the concrete. Co-ordinate the work of other sections and co-operate with the trade involved in the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. No such forming or setting of openings, slots, recesses, chases, sleeves, or parts shall be done unless specifically shown on the drawings or approved prior to installation.
- .2 Obtain Consultant's approval before framing openings in concrete beams or columns not specifically detailed on structural drawings.
- .3 Provide temporary ports or openings where required to facilitate cleaning and inspection. Openings at the bottom of forms shall be located so that flushing water will drain from the forms.
- .4 Close the temporary ports or openings with tight fitting panels, flush with the inside face of the forms, neatly fitted so that the joints will not be apparent in exposed concrete surfaces.
- .5 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval in writing of all modifications from the Consultant before placing concrete.
- .6 Install continuous vertical anchor slots where concrete walls or columns are masonry faced. Co-ordinate extent and locations of anchor slots with spacing of masonry ties as specified in Division 4.

### **3.7 FIELD QUALITY CONTROL**

- .1 Inspect and check the completed formwork, shoring and bracing to ensure that the work is in accordance with the formwork design, and that the supports, fastenings, wedges, ties and parts are secure. The Engineer responsible for the design of the formwork shall assist in this inspection.
- .2 Inform the Consultant when the formwork is complete and has been cleaned. Obtain the approval of the engineer responsible for the design of the formwork and the general approval of the Consultant before placing concrete.

### **3.8 CLEANING**

- .1 Clean the forms as erection proceeds to remove foreign matter.
- .2 Remove cuttings, shavings and debris from within the forms.
- .3 Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the cleanout ports.

### **3.9 WINTER CONSTRUCTION**

- .1 Not used.

### **3.10 REMOVAL OF FRAMEWORK**

- .1 Notify the Consultant before removing formwork.
- .2 Remove formwork progressively and in accordance with the reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.
- .3 Do not remove forms and shoring before concrete has attained sufficient strength to ensure safety of structure. If evidence to verify concrete strength is not available, the forms and shores shall not be removed before the following minimum intervals after concrete is placed.
  - .1 Footings, walls and grade beam - 4 days
  - .2 Columns - 7 days
  - .3 Beams, soffits and slabs - 7 days
  - .4 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.
  - .5 Leave forms loosely in place, against vertical surfaces, for protection until complete removal is approved by Consultant.
  - .6 Store removed forms, for exposed architectural concrete, in a manner that surfaces to be in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.
  - .7 Reshore structural members where required due to design requirements or construction conditions and as required to permit progressive construction.
  - .8 Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.
  - .9 Re-use of formwork and falsework is subject to the requirements of CAN/CSA-A23.1-04.

END OF SECTION

**Part 1. General**

**1.1 GENERAL CONDITIONS**

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

**1.2 WORK INCLUDED**

- .1 Furnish and install all bonded reinforcement and associated items required and/or indicated on the Drawings for all cast- in-place concrete and reinforced masonry work.
- .2 Furnish all deformed reinforcing bars for lintels, bond beams and masonry walls. Installation of this reinforcing by Section 04201.

**1.3 RELATED WORK**

- .1 Concrete Formwork Section 03 10 00
- .2 Cast-In-Place Concrete Section 03 30 00
- .3 Concrete Floor Finishing Section 03 34 50
- .4 Masonry Lintels and Bond Beams Section 04 20 00

**1.4 INSPECTION AND TESTING**

- .1 Upon request, provide certified copy of mill test report of steel supplied, showing physical and chemical analysis.

**1.5 REFERENCE STANDARDS**

- .1 Perform reinforcing work in accordance with CAN/CSA A23.1-04 and welding of reinforcement with CSA Standard W186-M1990(R2002).

**1.6 SUBMITTALS**

- .1 Prepare, check and submit reinforcing steel and mesh placing drawings and bar bending and cutting schedules for all steel reinforcement shown or specified in accordance with Section 01 00 00.
- .2 All drawings and schedules shall be prepared and checked under the direct supervision of a qualified professional engineer who is experienced in this work.
- .3 Clearly indicate bar sizes, spacing, location and quantities of reinforcement, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; to ACI-315 (2004) "ACI Detailing Manual" and Metric Supplement 1977 by Reinforcing Steel Institute of Ontario.
- .4 Design and detail lap lengths and bar development lengths to CSA Standard A23.3-04, unless specified on drawings.
- .5 Review of shop drawings for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail

dimension and fit, or any errors or omissions.

#### **1.7 SUBSTITUTES**

- .1 Substitution of different size bars permitted only upon written approval of the Consultant.

#### **1.8 DELIVERY AND STORAGE**

- .1 Reinforcing steel, welded wire fabric and accessories shall be delivered, handled and stored in a manner which prevents contamination from bond reducing or foreign matter and damage to its fabricated form.

### **Part 2. PRODUCTS**

#### **2.1 MATERIALS**

- .1 All reinforcing steel, unless noted otherwise on the drawings or herein shall be deformed bars of new billet steel conforming to CAN/CSA G30.18-M92 (R2002), Grade 400, plain finish for all bars. Minimum splice for 10M bars to be 450mm. Minimum lap splice for all other bars to be 36 bar diameter or 675mm, whichever is greater.
- .2 Weldable reinforcing bars: high strength ductile, deformed bars to CSA G30.18M-M92 (R2002), Grade 400.
- .3 Column ties and beam stirrups shall conform to CAN/CSA G30.18-M92 (R2002), Grade 400.
- .4 Welded wire fabric: to CSA G30.5-M1983. Provide in flat sheets only.
- .5 Tie wires shall be 1.29mm or heavier annealed wire or a patented system approved by the Consultant.
- .6 Reinforcing steel supports shall conform to ACI Standard 315 (2004) unless otherwise approved by the Consultant.
- .7 Mechanical splices subject to the approval of the Consultant.

#### **2.2 FABRICATION**

- .1 Fabricate bends, splices and ties and supply bar supports and accessories in accordance with the requirements of CAN/CSA A23.2-04. Spacing and arrangements of supports in accordance with ACI 315 (2004) unless noted otherwise.
- .2 All intermediate and high strength steel grade reinforcing bars shall be bend cold without hickeying.
- .3 Reinforcing bars shall not be straightened or rebent.
- .4 Location of reinforcement splices not shown on the drawings subject to approval by the Consultant and shall, for beams and slabs be away from points of maximum stress in the steel.

- .5 Welding of reinforcing bars: use only weldable bars, preheat and weld to CSA W186-M1990 (R2002).

**Part 3. EXECUTION**

**3.1 EXAMINATION**

- .1 Examine the work upon which this section depends and report any discrepancies to the Consultant.
- .2 Commencement of the work shall imply acceptance of conditions.

**3.2 PLACING**

- .1 Reinforcement of the size and shapes shown on the drawings shall be accurately placed in accordance with the approved shop drawings, the structural drawings and the requirements of the current National Building Code.
- .2 Clear distances between bars, except for columns shall be not less than the nominal diameter of the bar, or 25mm or one and one-third 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.
- .3 Clear distance between bars in columns shall be not less than one and one-half the nominal diameter of the bar or 40mm or one and one-half times the maximum size of the coarse aggregate.
- .4 Reinforcing steel shall, where not otherwise shown on the structural drawings, be protected by the clear cover of concrete over the reinforcement as follows:
  - .1 Where concrete is formed against earth, not less than 75mm.
  - .2 Where concrete placed against forms is to be exposed to the weather or be in contact with the ground, not less than 50mm for principal reinforcement, and not less than 40 mm for ties, stirrups and spirals.
  - .3 In slabs and walls not exposed to the ground or weather, not less than 50mm.
  - .4 In beams, girders and columns not exposed to the ground or weather, not less than 50 mm to principal reinforcement, ties and stirrups.The foregoing clear covers shall be maintained within 5mm.
- .5 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerance permitted and in accordance with the latest ACI Standard 315.
- .6 For slabs on grade, footings or similar construction, concrete blocks may be used in place of metal chairs.
- .7 Review with the Consultant, placement of reinforcement prior to concreting.

.8 Notify the Consultant 72 hours prior to placing concrete.

**3.3 CLEANING**

- .1 All materials shall be clean and free of all form oil or deleterious materials.
- .2 All deleterious material shall be removed from the surface of the reinforcing steel in a manner acceptable to the Consultant.

**3.4 WELDING**

- .1 Do welding to meet requirements of CSA W186-M1990 (R2002). Have welding performed by workmen qualified under CSA W47.1-03. Welding only by written authority of the Consultant.

END OF SECTION

**Part 1 General**

**1.1 GENERAL CONDITIONS**

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

**1.2 WORK INCLUDED**

- .1 Cast-in-Place concrete required for this work is indicated on drawings and includes, but is not necessarily limited to:
  - .1 Concrete Beams and Pilasters
  - .2 Concrete Slabs
  - .3 Concrete Pile Caps
  - .4 Miscellaneous Concrete
  - .5 Finishing of all Formed Concrete Surfaces.

**1.3 REFERENCE STANDARDS**

- .1 CAN/CSA A23.1-04 Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA A23.2-04 Methods of Test and Standard Practices for Concrete.

**1.4 RELATED WORK DESCRIBED ELSEWHERE**

- .1 Concrete Formwork Section 03 10 00
- .2 Concrete Reinforcement Section 03 20 00
- .3 Concrete Floor Finishing Section 03 34 50

**1.5 QUALITY ASSURANCE**

- .1 Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this Section.
- .2 For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.
- .3 Perform cast-in-place concrete work to requirements of CAN/CSA-A23.1-04 "Concrete Materials and Methods of Concrete Construction".

**1.6 PRODUCT HANDLING**

- .1 Use all means necessary to protect cast-in-place concrete materials before, during and after installation and to protect the installed work and materials of all other trades.
- .2 In the event of damage, immediately make all repairs and replacements necessary to approval of the Consultant at no additional cost to the Owner.

**1.7 INSPECTION AND TESTING**

- .1 Inspection and testing will be performed by a firm approved by the Consultant and paid for by the Owner. Payment for testing shall be included in the Testing Cash Allowance.
- .2 Provide free access to all portions of work and co-operate with appointed firm.
- .3 Submit proposed mix design for each class of concrete to Consultant for approval two weeks prior to commencement of work.
- .4 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.
- .5 One concrete test, consisting of three test cylinders, will be taken for every 50 m<sup>3</sup> or less of each class or concrete placed. One cylinder to be tested at seven days, the remaining two cylinders to be tested at 28 days.
- .6 One additional test cylinder will be taken during cold weather concreting, and be cured on jobsite under same conditions of concrete it represents.
- .7 One slump test and one air content test will be taken for each set of test cylinders taken.
- .8 Testing of concrete will be performed in accordance with CAN/CSA-A23.2-04 "Method of Test and Standard Practices for Concrete".
- .9 Test results will be issued to the Contractor, Consultant, and Owner. Test reports are to be numbered consecutively beginning with number one.
- .10 If concrete cylinder test results are not in accordance with the specifications, required retesting will be paid for the by Contractor.
- .11 The Consultant may order additional testing any time even though the required tests indicate the strength requirements have been met. In this instance, the Owner will pay for those tests that meet the specified requirements and the Contractor will pay for those that do not.
- .12 Non-destructive methods for testing concrete shall be according to CAN/CSA A23.2-04.

## **1.8 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with General Conditions.
- .2 Prepare and submit to the Consultant for review, shop drawings showing detailed layout of form dimensions, form joint fitting, form sealing and placement, location of openings and placement of form ties. Submit a detailed description of the exact construction method to be used, for all areas designated as sand blasted finish, exposed aggregate finish and architectural exposed concrete.

## **1.9 SAMPLE PANELS**

- .1 Demonstrate ability to provide all specified cast-in-place concrete finishes on approximately 50 square meter test panel of permanent wall which is to be concealed in the final work. Provide one test panel for each specified finish. Obtain approval of

Consultant for location of test panels.

- .2 Schedule casting so that a panel is approved 30 days prior to casting of architectural concrete.
- .3 Continue to prepare samples until an acceptable finish is produced. The final selection shall serve as a standard of color, texture and workmanship to be used on the project.
- .4 Test Panels shall not be concealed until all specially finished concrete work is complete.

## **Part 2 . Products**

### **2.1 CONCRETE MATERIALS**

- .1 Cement: Sulphate Resistant - Symbol 50 Portland Type, to CAN/CSA A-5-03 "Portland Cement"
- .2 Fine and Coarse Aggregates: conforming to CAN/CSA - A23.1-04 "Concrete Materials and Methods of Concrete Construction".
- .3 Fine and Coarse Aggregates: conforming to CAN/CSA -A23.1-04 "Concrete Materials and Methods of Concrete Construction".
- .4 Water: clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.

### **2.2 ADMIXTURES**

- .1 Air Entrainment: to CSA A266.1-M78 "Air-Entraining Admixtures for Concrete".
- .2 Chemical: to CSA A266.2-M78 "Chemical Admixtures for Concrete"; water-reducing, strength increasing type WN - normal setting.
- .3 Pozzolanic Mineral: to CSA A266.3-M78 "pozzolanic Mineral Admixtures for use in Portland Cement Concrete". Flyash is permitted to a maximum of 15% of the total cement content in piles and grade beams only. Fly ash is not permitted in any concrete with a finished surface such as slabs.

### **2.3 ACCESSORIES**

- .1 Vapour Barrier: 6 mil polyethylene film, to CGSB 51-GP-51M (81), Type 1 - low permeance heavy duty.
- .2 Curing Compounds: shall conform to the requirements of the latest issue of ASTM Standard C309.
- .3 Non-shrink Grout: premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 20 MPa at 3 days and 50 MPa at 28 days.
- .4 Concrete Expansion Anchors: to be Hilti Kwik-Bolt or approved equivalent. Sized as per drawings. Minimum embedment length of all Hilti Kwik-Bolt to be 150mm unless noted otherwise.

- .5 Concrete Inserts with Bolt Extension: Concrete inserts to be Hilti HKD Anchors or approved equivalent, sized as detailed on drawings. Bolt extensions to be mild steel threaded extensions sized as detailed on drawings.
- .6 Concrete Patching Material: pre-packaged, air-entrained, cementitious product containing graded natural aggregate, MasterPatch 901 - Rapid Setting Mortar as manufactured by Master Builders.
- .7 Bonding Agent: Approved high polymer polyvinyl acetate emulsion applied in strict accordance with manufacturer's recommendations for proposed application. Daraweld-C or approved equal.

**2.4 CONCRETE MIXES**

- .1 Mechanical mix concrete in accordance with the requirements of CAN/CSA-A23.1-04.
- .2 All concrete shall have the minimum properties provided on the following page.

	Compressive Strength, f <sub>c</sub> (MPa)	Cement Type	Exposure Class	Aggreg. Symbol	Slump Max (mm)	Total Air %
Cast in Place Concrete Piling	30	50	F-1	40	75 ± 25	5 ± 1
Grade Beams, Pile Caps and Walls in Contact with Soil	30	50	F-1	20	75 ± 25	5 ± 1
Sidewalks, Exterior Pads	32	50	C-2	20	50 to 75	5 ± 1
Note: Air Entrainment for interior slabs is recommended but not required.						
Miscellaneous Concrete	25	10	N	20	75 ± 25	5 ± 1

Minimum cement content for Type 50 cement to be 280 kg/m<sup>3</sup>.

Maximum free water/cement ratio for Type 50 cement to be 0.5.

- .3 Submit proposed mix design to Inspection and Testing Firm and to Consultant two weeks prior to commencement of work. Provide certification that mix proportions selected will produce concrete of specified quality and that strength will comply with CAN/CSA-A23.1-04.
- .4 Each load of ready-mixed or transit-mixed concrete delivered to the project site shall be accompanied by duplicate delivery slips providing the following information:
  - .1 Name of ready-mix batch plant
  - .2 Serial number of ticket
  - .3 Date and truck number
  - .4 Name of Contractor

- .5 Specific designation of project
  - .6 Specific class of concrete
  - .7 Amount of concrete in cubic meters
  - .8 Time of loading or first mixing of aggregate, cement and water.
- .5 Use accelerating admixtures in cold weather only when approved by Consultant. If approved, the use of admixture will not relax cold weather placement requirements. Use of Calcium chloride strictly prohibited.
  - .6 Use set-retarding admixtures during hot weather only when approved by the Consultant.
  - .7 Use plasticizers only when approved by Consultant.

**Part 3 . Execution**

**3.1 INSPECTION**

- .1 Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- .2 Verify that all items to be embedded in concrete are in place.
- .3 Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.

**3.2 DISCREPANCIES**

- .1 In the event of discrepancy, immediately notify the Consultant.
- .2 Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

**3.3 PREPARATION**

- .1 Remove all wood scraps and debris from the formed areas in which concrete will be placed.
- .2 Thoroughly clean the forms to ensure proper placement and bonding of concrete.
- .3 Thoroughly wet the forms, except in freezing weather, or oil them; remove all standing water.
- .4 Thoroughly clean all transporting and handling equipment.

**3.4 PLACING CONCRETE**

- .1 Place concrete in accordance with requirements of CAN/CSA A23.1-04 and as indicated on Drawings.
- .2 Notify Consultant and Inspection and Testing Firm a minimum of 72 hours prior to commencement of concreting operations.

- .3 Ensure all anchors, seats, plates and other items to be cast into concrete are placed, held securely and will not cause hardship in placing concrete.
- .4 Maintain accurate records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- .5 Ensure reinforcement, inserts, embedded parts, formed joints and fitments are not disturbed during concrete placement.
- .6 Prepare previously placed concrete by cleaning with steel brush.
- .7 Pour concrete continuously between predetermined construction and control joints. All construction joints subject to approval of the Consultant.
- .8 Approval to place concrete shall be contingent on the formwork and reinforcing steel placement and evidence that the Contractor can place the planned casting without stopping.
- .9 Convey concrete to the place of final deposit by methods which will prevent the segregation or loss of material.
- .10 Equipment to be such that when concreting has once started, the depositing of concrete is to proceed at a rate and sequence such that concrete is at all times sufficiently plastic to ensure proper bonding of successive layers or panels.
- .11 Conveying and placing equipment to be free of hardened concrete and foreign material. Clean at frequent intervals.
- .12 Concrete to be deposited as close as practicable to final position. Avoid segregation due to rehandling or flowing. Place in horizontal lifts to maintain a level surface.
- .13 Vertical height of free fall of concrete not to exceed maximum required for good practice. If segregation occurs, chutes and spouts to be used.
- .14 Consolidate thoroughly and uniformly by tamping, hand tools, vibrators and finishing machines. Ensure dense, homogeneous structure, close bond with reinforcement and smooth formed surfaces, Use internal vibrators wherever practicable. External-type vibrators only where satisfactory surfaces cannot be obtained with internal type.
- .15 Internal vibrators applied at the point of deposit in the areas of freshly placed concrete. Allow to sink in the concrete until penetrated into the previous layer of concrete. Withdraw immediately at the same speed at which they sank. Move about 300mm to a new location and then repeat process. Extreme care to be taken not to disturb the reinforcing steel of the forms.
- .16 Pour slabs on grade in checkerboard pattern or saw cut, as indicated on Drawings. Saw cut control joints within 24 hours after finishing. Use 3mm thick blades, cutting 20mm into depth of slab thickness. Vacuum clean saw cut prior to installation of sealant.

### **3.5 COLD WEATHER REQUIREMENTS**

- .1 When the air temperature is at or below 5 degrees C. or when there is a probability of it falling to that limit during the placing or curing period, cold weather requirements shall be applicable.
- .2 Provide heating equipment or heating plant on the job ready for use when concrete is being placed during cold weather. Such equipment shall be adequate for the purpose of maintaining the required temperature during the placing and curing of the concrete. The methods used for heating shall be approved by the Consultant. Equipment inducing carbon monoxide gas in the building shall not be accepted.
- .3 Concrete shall not be placed on or against reinforcement, formwork, ground or any surface that is at a temperature less than 5 degrees C.
- .4 The temperature of the concrete at all surfaces shall be maintained at not less than 25 degrees C for three days, or at not less than 10 degrees C for five days after placing. Means shall be provided to humidify the air within enclosures and to keep the concrete and formwork continuously moist if dry heat is used. The concrete shall be kept above freezing temperature for a period of seven days, and shall be kept from alternate freezing and thawing for at least fourteen (14) days after placement.
- .5 At the end of the specified protection period the temperature of the concrete shall be reduced gradually at a rate not exceeding that shown in CAN/CSA-A23.1-04.
- .6 Accelerator or so-called anti-freeze compounds shall not be permitted unless otherwise approved in writing by the Consultant.
- .7 All protective coverings shall be kept clear of the concrete and form surfaces to permit free circulation of air and shall be maintained intact for at least 24 hours after artificial heat is discontinued.

### 3.6 HOT WEATHER REQUIREMENTS

- .1 When the air temperature exceeds 30 degrees C, hot weather requirements shall be applicable.
- .2 Time of initial mixing to complete discharge shall not exceed one hour and fifteen minutes and concrete placed shall not exceed 30 degrees C.
- .3 Concrete forming surfaces and reinforcing steel shall be sprinkled with removed prior to concrete placement.
- .4 Special wind protection will be required as directed by the Consultant.
- .5 Columns, walls, beams and slabs shall be kept continuously damp for twenty-four (24) hours by normal curing procedures as outlined by this Specification. Slabs cured by the applications of sealing, shall have curing compound applied immediately after finishing of the slab but before evaporation of surface moisture.
- .6 The use of water reducing agents shall be subject to the approval of the Consultant when

hot weather conditions prevail.

### **3.7 CONSTRUCTION JOINTS**

- .1 The location and detail of all construction joints not detailed on the structural drawings shall be approved by the Consultant.
- .2 Where fresh concrete is to be placed against concrete which has set or has partially set, the surface of the set or partially set concrete shall be roughened, cleaned of all laitance, and thoroughly soaked with water prior to the placement of fresh concrete.
- .3 In general the construction joints in floor and roof systems shall be located at the one third span of slabs, beams and girders. Proper key and dowels or extensions of reinforcing shall be provided at all construction joints.
- .4 Concrete placed in wall and column forms shall be struck off flush with the underside of the floor and roof systems.
- .5 Vertical construction joints in foundation walls shall be properly keyed and dowelled and constructed with an approved water stop, properly anchored against displacement during the placement of the concrete and properly sealed at all of the intersections. Splices and intersections of waterstop shall be joined by heat fusion in accordance with approved manufacturer's instructions.

### **3.8 DEFECTIVE CONCRETE**

- .1 Concrete not meeting the requirements of the specifications and/or the drawings shall be considered defective concrete.
- .2 Concrete not conforming to the lines, details and grade specified herein or as shown on the drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Consultant. Finished lines, dimensions and surfaces shall be correct and true within tolerances specified in the Formwork Section of these Specifications.
- .3 Concrete not properly placed resulting in excessive honeycombing and all honeycombing and other defects in critical areas of stress, shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Consultant.
- .4 Concrete of insufficient strength or improper consistency shall be, as required by the Consultant, subject to one or more of the following:
  - .1 Changes in mix proportions for the remainder of the work.
  - .2 Cores drilled and tested from the areas in question as directed by the Consultant and in accordance with CAN/CSA A23.2-04. The test results shall be indicative of the in-place concrete.
  - .3 Load testing of the structural elements in accordance with CSA A23.3-04.
  - .4 The changes in the mix proportions and the testing shall be at the Contractor's expense.

- .5 Concrete failing to meet the strength requirements of this Specification shall be strengthened or replaced at the Contractor's expense and to the satisfaction of the Consultant.

### **3.9 PATCHING CONCRETE**

- .1 After the removal of the forms, concrete surfaces may be subject to inspection by the Consultant.
- .2 All exposed metal form ties, nails, wires, shall be removed, fins broken off and all loose concrete removed.
- .3 Form tie pockets shall be thoroughly wetted and patched with patching concrete followed by proper curing.
- .4 Honeycombed and other defective surfaces shall be chipped away to a depth of not less than 25mm with the edges perpendicular to the surface, thoroughly wetted and patched with patching concrete followed by proper curing.
- .5 Patching concrete shall be thoroughly compacted into place and finished in such a manner as to match the adjoining concrete. The design mix of the patching concrete shall be approved by the Consultant.

### **3.10 FINISHING OF FORMED SURFACES**

- .1 All formed surfaces noted in Architect's Room Finish Schedule as receiving a paint, vinyl or other applied finish shall be final finished to remove all protrusions, ridges and other irregularities. All voids and pinholes are to be filled. Finished surface is to be smooth, straight and true, ready to receive architectural finish as noted.
- .2 On all other exposed formed concrete surfaces, except at unfinished areas: remove blemishes, formwork joint marks by rubbing with carborundum block and water. Leave finished surfaces smooth, unmarred. Complete rubbing within twenty-four (24) hours of stripping formwork.

### **3.11 ANCHOR BOLTS AND WELDMENTS**

- .1 Set anchor bolts and weldments to the following tolerances:
  - .1 Alignment:  $\pm 3$ mm of location, plumb and true.
  - .2 Projection:  $\pm 6$ mm of elevations called for.

### **3.12 BASE PLATES GROUTING**

- .1 Mix and place as per Manufacturer's specifications. Pack grout tightly under plates and leave no voids. Neatly finish edges.

### **3.13 EQUIPMENT PADS**

- .1 Provide concrete pads for equipment where and as indicated on Drawings.
- .2 Insert bolts and sleeves and pack solidly with non-shrink grout, in accordance with

setting details and templates.

.3 Steel trowel top surfaces smooth. Tool edges.

**3.14 CONCRETE TOPPING**

.1 Not used.

**3.15 FOOTINGS**

.1 Not used.

**3.16 UNDERFLOOR DUCTS**

.1 Not used.

**END OF SECTION**

**Part 1            General**

**1.1                GENERAL CONDITIONS**

- .1            The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

**1.2                WORK INCLUDED**

- .1            Slab on grade;
- .2            Apply concrete hardener, sealer.
- .3            Cure finished surfaces.

**1.3                RELATED WORK**

- .1            Cast-In-Place Concrete: Section 03 30 00

**Part 2            Products**

**2.1                COMPOUNDS/HARDENERS/SEALERS**

- .1            Clear Sealer: Solvent-based acrylic, low gloss: AC 309A VOC manufactured by Allied Products, Florseal by Sika, Sealtight CS 309 by W.R.Meadows.
- .2            Curing Compound: Conforming to ASTM C 309
- .3            Evaporation Retarder: BASF Confilm
- .4            Slip Resistant Additive for film-forming sealers: Allied Poly-Microspheres

**2.2                BONDING AGENT**

- .1.            Approved high polymer polyvinyl acetate emulsion applied in strict accordance with manufacturer's recommendations for proposed application. Daraweld - C or approved equal.

**Part 3            Execution**

**3.1                FLOOR FINISHING**

- .1            Finish concrete floor surfaces in accordance with CAN/CSA-A23.1-04
- .2            Uniformly spread, screed and float concrete. Do not use grate tampers or mesh rollers. Do not spread concrete by vibration. Bring surfaces to levels indicated on Drawings.
- .3            Unless otherwise noted, all concrete floors which are noted in Architect's Room Finish Schedule as exposed concrete, or as receiving carpeting, resilient flooring or hardener are to be final finished to a hard, smooth dense trowelled surface free from blemishes. Final finish to minimum Class A tolerances in accordance with CAN.CSA3-A23.1-04, Table 22 to produce floor surface of pleasing appearance, easily cleaned and maintained with high wear-resistance characteristics. Maintain surface flatness with maximum variation of 6 mm in 3m and absolute maximum of  $\pm 12$  mm.

- .4 In areas with floor drains, maintain floor level at walls and pitch surfaces uniformly to drain at 5 mm/m nominal unless indicated otherwise on Drawings.

### **3.2 TOPPINGS**

- .1 Not used.

### **3.3 EXTERIOR CONCRETE WALKS AND PADS**

- .1 All exterior concrete walkways and landing pads to be finished with a trowel finish plus medium hair brooming. Brooming to be perpendicular to the length of the walk. Provide surface tooled joints 10mm deep with a radius of 10 mm at a maximum spacing of 3000 mm along the length of the walk UNO on structural or architectural drawings.
- .2 Exterior pads shall be sloped away from the building as shown on the drawings.
- .3 Provide surface tooled joints 10mm thick at a maximum spacing of 3000mm o.c. each way unless noted otherwise on structural or architectural drawings.
- .4 Provide a construction joint at the beginning and end of every corner and at a maximum spacing of 25 metres. Construction joint to be 12mm asphalt impregnated fibre board.
- .5 Provide strip of 12mm asphalt impregnated fibre board around the base of all columns, pedestals, manholes or other surface installations which encroach within the sidewalk.

### **3.4 CURING AND PROTECTION**

- .1 All equipment needed for the curing and protection of the concrete shall be on hand and ready for use before actual placing is started.
- .2 Curing shall be a wet cure with burlap or purpose made curing blanket equal to Allied Micro-Perf Rewettable Curing Blanket.
- .3 All exposed non-formed surfaces shall be kept continuously moist for a minimum of seven consecutive days after placement of the concrete. The water for curing shall be clean and free from any materials that will cause staining or discoloration of the concrete. A liquid, membrane forming, curing compound shall be used under circumstances where the application of moisture is impracticable and where such compounds will not jeopardize the appearance of the concrete nor the bonding of future floor finishes.
- .4 Special curing techniques shall be employed with the concrete if subject to drying conditions such as high temperatures, low relative humidity and high winds. Concrete wall and column forms shall be kept continuously moist.
- .5 Freshly placed concrete shall be protected from the effects of direct sunshine, drying winds, cold, excessive heat and running water by the use of adequate tarpaulins or other suitable materials to cover completely or enclose all freshly finished surfaces until the end of the curing period specified.

**Part 1        General**

**1.1        REFERENCES**

- .1        American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  - .1        ANSI/NFPA 20-[1993], Centrifugal Fire Pumps.

**1.2        SHOP DRAWINGS**

- .1        Submit shop drawings in accordance with Section [01 33 00 - Submittal Procedures].
- .2        Indicate hydraulic and electrical characteristics including Net Positive Suction Head (NPSH) required, make and model number.

**1.3        ENGINEERING DESIGN CRITERIA**

- .1        Select fire pump to satisfy fire protection system requirements and ANSI/NFPA.
- .2        Water supply:
  - .1        On site storage.

**1.4        CLOSEOUT SUBMITTALS**

- .1        Provide operation and maintenance data for packaged fire pump for incorporation into manual.

**Part 2        Products**

**2.1        FIRE PUMP**

- .1        Packaged, ULC listed and labelled vertical shaft turbine fire pump and controller.
- .2        Driver: electric drip-proof motor starting equipment and controls.
- .3        Mounting: install pump and driver on common base.
- .4        Materials and construction: to ANSI/NFPA 20.
- .5        Capacity: [as indicated] [to satisfy fire protection system requirements and NFPA]:
  - .1        Flow rate: 500 US gpm.
  - .2        Pressure: 54 psi
  - .3        Speed: 1770
  - .4        Motor: 25 Hp 208/60/3

- .6 Accessories to ANSI/NFPA 20 requirements and in addition:
  - .1 Fire pump bypass fitted with shut off valves and check valves.
  - .2 Audible and visual suction side alarm.
  - .3 OS & Y valves shut off valves on discharge.
- .7 Anchor bolts and templates:
  - .1 Supply for installation by others.
  - .2 Size anchor bolts to withstand seismic zone acceleration and velocity forces.

## **2.2 PRESSURE MAINTENANCE (JOCKEY) PUMP**

- .1 General: submersible turbine electrically driven pump and controller.
- .2 Capacity: as indicated
  - .1 Flow rate: 5 US gpm
  - .2 Pressure: to ANSI/NFPA 20. – 50 psi
  - .3 Motor: 1/2 HP 120V/60/1
- .3 Accessories: to ANSI/NFPA 20.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with ULC listing, ANSI/NFPA 20 and approved shop drawings.

### **3.2 COMMISSIONING**

- .1 Field test fire pump, driver and controllers in accordance with ANSI/NFPA 20.
- .2 Testing to be witnessed by Fire Commissioner of Canada.
- .3 Develop, with Consultant assistance, detailed instructions for O & M of this installation.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standard Association (CSA)
  - .1 CAN/CSA-A23.1-[ M94], Concrete Materials and Methods of Concrete Construction.
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM D 698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft<sup>3</sup>) (600kN-m/m<sup>3</sup>).

**1.2 SOIL REPORT**

- .1 None available – water well drilling report indicates 0-8' fill 8'-24' clay.

**1.3 REGULATIONS**

- .1 Shore and brace excavations, protect slopes and banks and perform all work in accordance with Provincial and Municipal regulations whichever is more stringent.

**1.4 TESTS AND INSPECTIONS**

- .1 Testing of materials and compaction of backfill and fill unshrinkable fill will be carried out and paid for by contractor.
- .2 Not later than before backfilling or filling, provided to designated testing agency, [23] kg sample of backfill for unshrinkable fill material proposed for use,.
- .3 Do not begin backfilling or filling operations until material has been approved for use by Consultant.
- .4 Before commencing work, conduct, with Consultant, condition survey of existing structures, trees and other plants, lawns, fencing, service poles, wires, survey bench marks and monuments which may be affected by work.

**1.5 BURIED SERVICES**

- .1 Before commencing work verify and establish the location of all buried services on and adjacent to the construction site.

**1.6 PROTECTION**

- .1 Protect excavations from freezing.
- .2 Keep excavations clean, free of standing water, and loose soil.

- .3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .4 Protect buried services that are required to remain undisturbed.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Sand to OPSS1004.
- .2 Pea Gravel min 6mm max 18mm.

**Part 3 Execution**

**3.1 CLEARING AND GRUBBING**

- .1 Remove trees, stumps, logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, exposed boulders and debris within areas designated on drawings.
- .2 Dispose of cleared and grubbed material off site daily to disposal areas acceptable to authority having jurisdiction.

**3.2 EXCAVATION**

- .1 Strip topsoil over areas to be covered by new construction, over areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil. Stockpile topsoil on site for later use.
- .2 Excavate as required to carry out work, in all materials met. Do not disturb soil or rock below bearing surfaces. Notify Consultant when excavations are complete. If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work.
- .3 Excavate trenches to provide uniform continuous bearing and support for 150 mm thickness of pipe bedding material on solid and undisturbed ground. Trench widths below point 150 mm above pipe not to exceed diameter of pipe plus 600 mm.
- .4 Excavate for slabs and paving to subgrade levels. In addition, remove all topsoil, organic matter, debris and other loose and harmful matter encountered at subgrade level.

**3.3 BACKFILLING**

- .1 Inspection: do not commence backfilling until fill material and spaces to be filled have been inspected and approved by Owner's representative.
- .2 Remove snow, ice, construction debris, organic soil and standing water from spaces to be filled.

- .3 Lateral support: maintain even levels of backfill around structures as work progresses, to equalize earth pressures.
  
- .4 Placing:
  - .1 Place backfill, fill and base course material in 150 mm lifts. Add water as required to achieve specified density.
- .5 In trenches:
  - .1 Up to 300 mm above pipe or conduit: sand placed by hand.
  - .2 Over 300 mm above pipe or conduit: native material approved by Consultant.
- .6 Under seeded and sodded areas: use site excavated material to bottom of topsoil except in trenches and within 600 mm of foundations.
- .7 Against foundations (except as applicable to trenches and under slabs and paving): excavated material or imported material with no stones larger than 200 mm diameter within 600 mm of structures.
- .8 Underground tanks: install as per tank manufacturers instructions.

### 3.4 GRADING

- .1 Grade so that water will drain away from buildings, walls and paved areas, to catch basins and other disposal areas approved by the Consultant. Grade to be gradual between finished spot elevations shown on drawings.

### 3.5 SHORTAGE AND SURPLUS

- .1 Supply all necessary fill to meet backfilling and grading requirements and with minimum and maximum rough grade variance.
- .2 Dispose of surplus material off site.

**END OF SECTION**

**Part 1. General**

**1.1 GENERAL CONDITIONS**

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

**1.2 WORK INCLUDED**

- .1 Bored friction piles with reinforcing steel as detailed.
- .2 Establish and/or verify required cut-off elevations.
- .3 Correct as directed all piles not meeting requirements of this specification at no expense to Owner.
- .4 Leave site neat, tidy, free of plant and/or equipment and in safe condition. Remove excavation material from site or deposit on site as directed.

**1.3 RELATED WORK**

- .1 Excavating and Backfilling: Section 02220
- .2 Concrete Reinforcement: Section 03200
- .3 Cast-In-Place Concrete: Section 03300

**1.4 REFERENCE STANDARDS**

- .1 CAN/CSA-A23.1-04 "Concrete Materials and Methods of Concrete Construction."
- .2 CAN/CSA-A23.2-04 "Methods of Test and Standard Practices for Concrete."
- .3 CAN/CSA-G30.18-M92 (R2002) "Billet Steel Bars for Concrete Reinforcement."
- .4 CSA-A23.3-04 "Design of Concrete Structures."

**1.5 SHOP DRAWINGS**

- .1 Submit shop drawings of pile reinforcing steel in accordance with Section 01340. Show reinforcing bar sizes and lengths for each length of pile.

**1.6 CONCRETE TESTING**

- .1 Testing of concrete is to be performed by an independent Inspection and Testing Firm approved by the Consultant and paid for by the Owner. Required retesting will be paid for by the Contractor.
- .2 Provide free access to all portions of work and co-operate with appointed firm.
- .3 Submit proposed mix design to Inspection and Testing Firm and Consultant two weeks prior to commencement of work.
- .4 Tests for cement and aggregate may be performed to ensure conformance with

requirements stated herein.

- .5 One set of 3 concrete test cylinders will be taken for each day's pour, or for each 50 m<sup>3</sup>, whichever is lesser. One cylinder shall be tested at 7 days, the remaining two cylinders shall be tested at 28 days.
- .6 One additional test cylinder will be taken during cold weather concreting, and be cured on jobsite under same conditions of concrete it represents.
- .7 One slump test and one air content test will be taken for each set of test cylinders taken.
- .8 Testing of concrete will be performed in accordance with CAN/CSA-A23.2-04.

#### **1.7 FIELD RECORDS/DRAWINGS**

- .1 Maintain accurate records of all piles poured. Records are to include the following incorporated on the Contractor's record drawings:
  - .1 Date and time of casting.
  - .2 Sizes, depths and location of piles.
  - .3 Sequence of placing.
  - .4 Final cut-off elevation.
  - .5 Reinforcement, size and length.
- .2 Submit 3 copies of record drawings to the Consultant.
- .3 Drawings to be to the same scale and line reference as the contract drawings.

#### **Part 2. Products**

##### **2.1 REINFORCING STEEL**

- .1 Reinforcing Steel: deformed steel bars conforming to requirements of CAN/CSA-G30.18-M92 (R2002); 400 MPa yield strength.
- .2 Reinforcement to conform to standards as specified under Section 03200 Concrete Reinforcement. Submit shop drawings of reinforcing steel to Consultant in accordance with the requirements of Section 03200.
- .3 Length of reinforcement to be as shown on drawings.
- .4 No splicing in reinforcement permitted unless specifically shown on drawings or approved by Consultant. Where splices permitted length is equal to 36 bar diameters minimum; adjacent splices staggered minimum full lap length.
- .5 Welding ties to main reinforcement not permitted.

##### **2.2 CONCRETE MATERIALS**

- .1 Cement: Sulphate Resistant Symbol 50 Portland, conforming to CAN/CSA A5-03.

- .2 Coarse and Fine Aggregates: Standard concrete type, conforming to CAN/CSA-A23.1-04.
- .3 Water: Clean and free of injurious amounts of oil, alkali, organic matter or other deleterious material.

**2.3 ADMIXTURES**

- .1 Air Entrainment: to CSA A266.1-M78 "Air Entraining Admixtures for Concrete."
- .2 Chemicals: to CSA A266.2-M78 "Chemical Admixtures for Concrete"; water reducing, strength increasing Type WN - normal setting.
- .3 Pozzolanic Mineral: to CSA A266.3-M78 "Pozzolanic Mineral Admixtures for use in Portland Cement Concrete." Fly ash is permitted in piles only to a maximum of 15% of the cement content.
- .4 Use of calcium chloride in concrete is strictly prohibited.

**2.4 CONCRETE MIX**

- .1 Concrete to conform to CAN/CSA A23.1-04 Class C-3 as follows:

Unit	Measurement
Minimum compressive strength (28 days)	30 Mpa
Aggregate size (maximum)	40 mm
Air Content	40 mm
Slump	75 ± 25 mm
Cement Symbol	Type 50
Maximum free water/cement to be 0.50 by weight.	

**2.5 CASING**

- .1 Removable steel protective casing adequate for its function.

**Part 3. Installation**

**3.1 LAYOUT**

- .1 Place piles accurately in locations as called for on drawings. A qualified surveyor experienced in the work shall carry out the pile location survey.
- .2 Maximum permissible error in location 40 mm in any direction. Place piles not more than 2% of their lengths out of plumb or batter called for on drawings. Elevation of top of piles to be within 25 mm of elevation called for on drawings. Reinforcing steel clearances within 15 mm of dimensions called for on drawings.

- .3 Minimum pile diameter as per drawings.
- .4 Piles placed outside above tolerances may be rejected by the Consultant. Place additional piles and pile caps as directed by the Consultant to replace rejected piles entirely at the Contractor's expense.

### **3.2 PROCEDURE FOR BORING PILES**

- .1 Bore piles using power augers to suit diameters and lengths of piles indicated on Drawings. Use only personnel well experienced in this trade and provide to the Consultant on request, experience record of personnel actually engaged in the work.
- .2 Boulders encountered in drilling shall be removed and pile continued to full depth. Should removal of boulders be impractical, advise the Consultant.
- .3 Casings shall be installed in shafts as required to prevent sloughing during drilling and for the retention of ground water.
- .4 Provide dewatering as necessary before any concrete is placed.
- .5 Remove all tailings and debris from area of bore holes prior to casting concrete. Cover bore hole to prevent loose materials falling in during removal.
- .6 After hole drilled, place reinforcing steel and concrete. Do not drill any holes that cannot be reinforced and filled with concrete the same day as drilled.

### **3.3 PLACING REINFORCING STEEL**

- .1 Place reinforcing steel in such a manner to prevent loose earth and debris from falling into the hole.
- .2 Place reinforcing at proper elevation and hold during course of placing concrete. Placing of steel will not be allowed after the concrete is poured.

### **3.4 PLACING CONCRETE**

- .1 De-water all holes, whether sleeved or not, before any concrete is placed.
- .2 Before commencing placing concrete obtain Consultant's approval of proposed method of transporting and placing concrete.
- .3 Form piles projecting above grade with removable steel sleeves or wax coated cardboard fibre forms.
- .4 Place concrete continuously to final cut-off elevation as soon as possible after hole drilled, cleaned out and reinforcing steel secured in position. Take every care to ensure that hole is completely filled with concrete. Concrete must be placed in the dry. Under no circumstances will tremie concrete be permitted.
- .5 Where steel casings are used they shall be withdrawn as the concrete is deposited,

keeping the concrete at a level above bottom of the sleeve.

- .6 Protect tops of piles against loss of moisture.
- .7 Cold weather provisions of CAN/CSA-A23.1-04 shall apply. Protect tops of piles against freezing during curing period with adequate insulation and covering. Provide supplementary heat as temperatures dictate.
- .8 When concrete is being placed through a frozen ground surface, the diameter of the portion of the pile surface passing through the frozen ground shall be increased by 100 mm.
- .9 Concrete be placed as soon as possible after the boring of holes. In no case shall concrete be installed more than 24 hours after the drilling of the hole.

### **3.5 CUTOFF AND LENGTH**

- .1 Length of friction piles indicated on drawings to be from cutoff elevation.

END OF SECTION

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1        Materials and installation for water mains, hydrants, valves, valve boxes, and valve chambers, including service connections.

**1.2            RELATED SECTIONS**

- .1        Section [01 33 00 - Submittal Procedures].
- .2        Section [01 78 00 - Closeout Submittals].
- .3        Section [31 14 11- Earthwork and Related Work].
- .4        Section [31 14 13- EarthworkSoil Stripping and Stockpiling].
- .5        Section [31 23 13- Earthwork and Rough Grading].
- .6        Section [03 10 00- Concrete Formwork]
- .7        Section [03 20 00 - Concrete Reinforcing].
- .8        Section [03 30 00 - Cast-in-Place Concrete].

**1.3            MEASUREMENT PROCEDURES**

- .1        Measure water main [including trenching and backfilling], in metres of each size of pipe installed.
  - .1        Horizontal measurement will be made over surface, through valves and fittings, after work has been completed.
  - .2        Measure lateral connections from water main to hydrants as water main and include curb valve and adjustable valve box.
- .2        Measure tunnelling, boring or jacking for under crossings, including encasing pipes and grouting, in metres, as indicated.
- .3        Measure hydrants including excavation and backfilling, in units installed.
- .4        Measure service connections including trenching and backfilling, in metres of each size of pipe installed.
- .5        Measure valves in units installed including excavation and backfilling, valves and valve boxes and thrust blocks.

**1.4            REFERENCES**

- .1        American National Standards Institute/American Water Works Association (ANSI/AWWA)

- .1 ANSI/AWWA C500-[02], Metal-Seated Gate Valves for Water Supply Service (Includes Addendum C500a-95).
  - .2 ANSI/AWWA C504-[00], Rubber-Seated Butterfly Valves.
  - .3 ANSI/AWWA C651-[99], Disinfecting Water Mains.
  - .4 ANSI/AWWA C900-[97], Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Distribution.
  - .5 ANSI/AWWA C906, High density Polyethylene Pressure Pipe and fittings (HDPE) – 1 ¼” – 2” for Domestic Water Distribution.
- .2 American Society for Testing and Materials International, (ASTM)
    - .1 ASTM A307-[02], Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
    - .2 ASTM C136-[01], Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
    - .3 ASTM D698-[00a], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m<sup>3</sup>)).
    - .4 ASTM D2657-[97], Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
    - .5 ASTM F714-[01], Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on IPS Sizing.
- .3 American Water Works Association (AWWA)/Manual of Practice
    - .1 AWWA M17-[1989], Installation, Field Testing, and Maintenance of Fire Hydrants.
- .4 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
    - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
    - .3 CAN/CGSB-1.88-[92], Gloss Alkyd Enamel, Air Drying and Baking.
    - .4 CGSB 41-GP-25M-[77], Pipe, Polyethylene, for the Transport of Liquids.
- .5 Canadian Standards Association (CSA International)
    - .1 CSA B137 Series-[02], Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
      - .1 CSA B137.1-[02], Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
      - .2 CSA B137.3-[02], Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
- .6 Department of Justice Canada (Jus)
    - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .7 Transport Canada (TC)
    - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)

- .8 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - [March 1998(R2002)].
- .9 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S520-[1991], Hydrants.
  - .2 CAN4-S543-[1984], Internal-Lug, Quick Connect Couplings for Fire Hose.

#### **1.5 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit complete shop drawings and construction schedule for water mains 150 mm (6") diameter and larger. Include method for installation of water main.
- .3 Submit complete shop drawings and construction schedule for water mains 50 mm diameter and less. Include method for installation of water main.
- .4 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .5 Inform Consultant of proposed source of bedding materials and provide access for sampling at least [4] weeks prior to commencing work.
- .6 Pipe certification to be on pipe.

#### **1.6 CLOSEOUT SUBMITTALS**

- .1 Provide record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, hydrant details, maintenance and operating instructions in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.

#### **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for [reuse] [and] [recycling] in accordance with Section [01 74 19 - Gestion et élimination des déchets de construction/démolition].
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal [paper] [plastic] [polystyrene] [corrugated cardboard] packaging material [in appropriate on-site bins] for recycling in accordance with Waste Management Plan.
- .4 Separate for [reuse] [and] [recycling] and place in designated containers [Steel] [Metal] [Plastic] waste in accordance with Waste Management Plan.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

- .7 Ensure emptied containers are sealed and stored safely.
- .8 Divert unused [metal] [and] [wiring] materials from landfill to metal recycling facility as approved by Consultant.
- .9 Divert unused concrete materials from landfill to local [quarry] [facility] as approved by Consultant.
- .10 Dispose of unused disinfection material at official hazardous material collections site approved by Consultant.
- .11 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- .12 Fold up metal banding, flatten and place in designated area for recycling.

## **1.8 SCHEDULING OF WORK**

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions to Training Centre Authorities.
- .3 Notify Training Centre Authority minimum of 24 h in advance of interruption in service.
- .4 Do not interrupt water service for more than 4 h and confirm this period with Training Centre Authorities.

## **1.9 EXTRA MATERIALS**

- .1 Provide Owner with following tools:
  - .1 2 service post wrenches for curb stops.
  - .2 2 hydrant wrenches.
  - .3 2 tee-handle operating keys for valves.

## **Part 2 Products**

### **2.1 PIPE, JOINTS AND FITTINGS**

- .1 Polyvinyl chloride pressure pipe: to [ANSI/AWWA C900], pressure class 150, DR 18, 1 MPa gasket bell end, cast iron outside diameter.
  - .1 Acceptable material: IPEX or Approved Alternate.
  - .2 CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket [coupling].
- .2 Polyethylene pressure pipe:
  - .1 NPS 1/2 to NPS 2: to CSA B137.1 type PE 3406, series 160 ASTM F714, type PE 3408, series DR 11.
  - .2 Acceptable material: IPEX or Approved Alternate.

- .3 Polyethylene to polyethylene joints: to be thermal butt fusion joined, to ASTM D2657 or socket fusion joint.
- .4 Polyethylene fittings: to [CSA B137.1], for pipe sizes NPS 4 and less.

## 2.2 VALVES AND VALVE BOXES

- .1 Valves to open counter clockwise.
- .2 Gate valves: to ANSI/AWWA C500, standard iron body, valves with non-rising stems, suitable for 1 Pa with flanged joints – Epoxy coated – Stainless Steel Bolts.
- .3 Valve boxes and covers: PVC lower section. Cast iron upper section adjustable over minimum of 450 mm complete with valve operating extension rod, 30 mm minimum diameter, 25 x 25 mm cross section, of such length that when set on valve operating nut top of rod will not be more than 150 mm below cover.
  - .1 Base to be large round type with minimum diameter of 200 mm.
  - .2 Top of box to be marked "WATER"/"EAU".

## 2.3 SERVICE CONNECTIONS

- .1 Polyethylene pressure pipe:
  - .1 To CSA-B137, type PE, series 160 ASTM F714, Type PE, series DR 11.
- .2 Polyethylene pipe joints: thermal butt fusion welded insert type serrated sleeves with four stainless steel screws and band-type clamps per joint.
- .3 Curb Valves: Brass inverted key-type curb stops: red brass to ASTM B62, compression type with drain connections for IPS PE piping both ends.
  - .1 Acceptable Material: Mueller, Ford.
  - .2 Curb stops to have adjustable service box with stainless steel stem.
  - .3 Top of cast iron box marked "WATER"/"EAU".
- .4 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.

## 2.4 HYDRANTS

- .1 Post type hydrants: compression type hydrant, to CAN/ULC-S520, designed for working pressure of 1700 kPa with two 65 mm threaded hose outlets, one 100 mm threaded pumper connection, 150 mm riser barrel, 125 mm bottom valve and 150 mm connection for main.
  - .1 Hydrants to open counter clockwise, threads to local standard, fittings to be internal lug quick-connect to CAN4-S543. Provide metal caps and chains.
  - .2 Provide key operated gate valve located 1 m from hydrant.
  - .3 Depth of bury 2.7 m.
- .2 Hydrant paint: exterior enamel to CAN/CGSB-1.88 MPI #96.

## 2.5 PIPE BEDDING AND SURROUND MATERIAL

### .1 Granular material to: following requirements:

.1 Gradations to be within limits specified when tested to [ASTM C136] [and] [ASTM C117]. Sieve sizes to [CAN/CGSB-8.1] [CAN/CGSB-8.2].

### .2 Table

Sieve Designation	Gravel/Sand
200 mm	-
75 mm	-
50 mm	-
38.1 mm	-
25 mm	-
19 mm	-
12.5 mm	[100]
9.5 mm	-
4.75 mm	[80-100]
2.00 mm	[50- 90]
0.425 mm	[10- 50]
0.180 mm	-
0.075 mm	[0- 10]

.2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

## 2.6 BACKFILL MATERIAL

.1 Sand to 150 mm above pipe.

.2 Natural material to surface.

## 2.7 PIPE DISINFECTION

.1 Sodium hypochlorite to ANSI/AWWA B300 to disinfect water mains.

.2 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.

## Part 3 Execution

### 3.1 PREPARATION

.1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.

.1 Inspect materials for defects to approval of Consultant.

.2 Remove defective materials from site as directed by Consultant.

### 3.2 TRENCHING

.1 Do trenching work in accordance with Section 31 23 10 - Excavating Trenching and Backfilling.

- .2 Trench depth to provide cover over pipe of not less than 2.7 m from finished grade.
- .3 Trench alignment and depth require Consultant's approval prior to placing bedding material and pipe.

### **3.3 CONCRETE BEDDING AND ENCASEMENT**

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
  - .1 Place concrete to details as indicated .
- .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 hours after placing.

### **3.4 GRANULAR BEDDING**

- .1 Place granular bedding material in uniform layers not exceeding 150 mm thickness below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.

### **3.5 PIPE INSTALLATION**

- .1 Terminate building water service 1 m outside building wall opposite point of connection to main. Install coupling necessary for connection to building. Make connections to building when system is in operation.
- .2 Lay pipes to manufacturer's standard instructions and specifications. Do not use blocks except as specified.
- .3 Join pipes in accordance with manufacturer's recommendations.
- .4 Bevel or taper ends of PVC pipe to match fittings.
- .5 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .6 Lay pipes on prepared bed, true to line and grade.
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
  - .2 Take up and replace defective pipe.
  - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .7 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.

- .8 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .9 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
  - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .10 Position and join pipes with equipment and methods as recommended by manufacturer.
- .11 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Align pipes before jointing.
- .13 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .14 Avoid displacing gasket or contaminating with dirt or other foreign material.
  - .1 Remove disturbed or contaminated gaskets.
  - .2 Clean, lubricate and replace before jointing is attempted again.
- .15 Complete each joint before laying next length of pipe.
- .16 Minimize deflection after joint has been made.
- .17 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .18 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by [Engineer] [Consultant].
- .19 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .20 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .21 Do not lay pipe on frozen bedding.
- .22 Do hydrostatic and leakage test and have results approved by Training Centre Authority before surrounding and covering joints and fittings with granular material.
- .23 Backfill remainder of trench.

### 3.6 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of concrete located between valve and solid ground. Valves not to be supported by pipe.

- .3 Install underground post-type indicator valves as indicated.

### 3.7 SERVICE CONNECTIONS

- .1 Terminate building water service 1 m from new main.
  - .1 Install coupling necessary for connection to building plumbing.
  - .2 Cap and seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops 5 metres from roadway.
- .4 Install Tees from PE Pipe for service connections.
- .5 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .6 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .7 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .8 Install curb stop with corporation box on services NPS 2 or less in diameter.
- .9 Place temporary location marker at ends of plugged or capped unconnected water lines.

### 3.8 HYDRANTS

- .1 Install hydrants at locations as indicated.
- .2 Install hydrants in accordance with AWWA M17.
- .3 Install 150 mm gate valve and valve box on hydrant service leads as indicated.
- .4 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm above final grade.
- .5 Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed.
- .6 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes.

### 3.9 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by Consultant.

### 3.10 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA [C600] [C603].
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Owner's Representatives at least 24 hours in advance of proposed tests.
  - .1 Perform tests in presence of Owner's Representatives.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Test both pipelines in sections at the same time.
- .6 Upon completion of pipe laying and after work has been inspected, surround and cover pipes between joints with approved granular material placed to 150 mm above pipes then backfill to grade with natural material.
- .7 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .8 Open valves.
- .9 Expel air from hydrants and service connections by slowly filling main with potable water.
- .10 Thoroughly examine exposed parts and correct for leakage as necessary.
- .11 Apply hydrostatic test pressure of 80 psi kPa based on elevation of lowest point in main and corrected to elevation of test gauge, for period of [1] hour.
- .12 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .13 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .14 Repeat hydrostatic test until defects have been corrected.
- .15 Apply leakage test pressure of 600 kPa (85 psi) after complete backfilling of trench, for period of 2 hours.
- .16 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 hours.

.17 Locate and repair defects if leakage is present.

.18 Repeat test.

### **3.11 PIPE SURROUND and BACKFILL**

.1 Upon completion of pipe laying and after [Engineer] [Consultant] has inspected Work in place, surround and cover pipes as indicated.

.2 Hand place sand to 150 mm above pipe.

.3 Place native material along pipe – material to be dry and slowly pushed down side of trench. Do not dump directly onto pipe.

.4 Do not place material in frozen condition.

### **3.12 PAINTING OF HYDRANTS**

.1 After installation, paint hydrants red or yellow as selected.

.2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

### **3.13 FLUSHING AND DISINFECTING DOMESTIC WATER SUPPLY BY LINE**

.1 Flushing and disinfecting operations: under supervision of Owner's Representatives.

.1 Notify Owner's Representatives at least 4 days in advance of proposed date when disinfecting operations will begin.

.2 Flush domestic water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.

.3 Open and close service connections to ensure thorough flushing.

.4 When flushing has been completed to Owners approval, introduce strong solution of chlorine as approved by Consultant into water main and ensure that it is distributed throughout entire system.

.5 Rate of chlorine application to be proportional to rate of water entering pipe.

.6 Chlorine application to be close to point of filling water main and to occur at same time.

.7 Operate valves, while main contains chlorine solution.

.8 Flush line to remove chlorine solution after 12 hours.

.9 Take water samples at buildings to test for chlorine residual.

.10 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 12 hours.

**3.14 SURFACE RESTORATION**

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by Owner's Representatives.

**END OF SECTION**

**Part 1        General**

**1.1**        This Section covers items common to Sections of Division 16 (Electrical Division). This section supplements requirements of Division 1.

**1.2        CODES AND STANDARDS**

- .1        Do complete installation in accordance with CSA C22.1-2012 except where specified otherwise.
- .2        Do overhead and underground systems in accordance with CSA C22.3 No.1-M1987 except where specified otherwise.

**1.3        CARE, OPERATION AND START-UP**

- .1        Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2        Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3        Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

**1.4        VOLTAGE RATINGS**

- .1        Operating voltages: to CAN3-C235-83.
- .2        Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

**1.5        PERMITS, FEES AND INSPECTION**

- .1        Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2        Pay associated fees.
- .3        Notify Engineer of changes required by Electrical Inspection Department prior to making changes.
- .4        Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Engineer.

**1.6        MATERIALS AND EQUIPMENT**

- .1        Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2        Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

- .3 Factory assemble control panels and component assemblies.

#### **1.7 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .2 Control wiring and conduit is specified in Electrical Division except for conduit, wiring and connections below 50 V which are related to control systems specified in Mechanical Division and shown on mechanical drawings.

#### **1.8 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .2 Paint indoor switchboards and distribution enclosures light grey ASA 61.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

#### **1.9 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .2 Nameplates:
    - .1 Lamecoid 3 mm thick plastic engraving sheet, black, blue, or red face, white core, mechanically attached with self tapping screws.
  - .3 Labels:
    - .1 Embossed plastic labels with 6 mm high letters unless specified otherwise.
  - .4 All nameplate wording shall be approved the Engineer prior to manufacture.
  - .5 Allow for average of twenty-five (25) letters per nameplate and label.
  - .6 Identification to be English.
  - .7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
  - .8 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
  - .9 Terminal cabinets and pull boxes: indicate system and voltage.
  - .10 Transformers: indicate capacity, primary and secondary voltages.

#### **1.10 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.

- .4 Use colour coded wires in communication cables, matched throughout system.

#### **1.11 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

#### **1.12 WIRING TERMINATIONS**

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

#### **1.13 MANUFACTURERS AND CSA LABELS**

- .1 Visible and legible, after equipment is installed.

#### **1.14 WARNING SIGNS**

- .1 As specified and to meet requirements of Electrical Inspection Department and Consultant.
- .2 Decal signs, minimum size 175 x 250 mm.

#### **1.15 SINGLE LINE ELECTRICAL DIAGRAMS**

- .1 Provide fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.
- .2 Drawings: minimum size as per tender sets.

#### **1.16 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with drawings and specifications.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

#### **1.17 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 300 mm.

- .2 Above top of counters or counter splash backs: 175 mm.
- .3 In mechanical rooms: 1400 mm.

**1.18 LOAD BALANCE**

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

**1.19 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .4 All conduit and tray sealing and all firestopping shall be the responsibility of the Electrical Contractor and shall be as per Specification sections 07 92 00 Joint Sealants and 07 84 00 Firestopping.

**1.20 FIELD QUALITY CONTROL**

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this division to be carried out by a contractor who holds a valid Electrical contractor license as issued by the Province of Alberta.
- .3 Conduct and pay for following tests:
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Lighting and its control.
  - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
  - .1 Insulation resistance testing.
  - .2 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

- .3 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- .4 Check resistance to ground before energizing.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for Consultant's review.

**1.21 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

**1.22 AS-BUILT DRAWINGS**

- .1 The electrical contractor shall provide as-built drawings in both electronic and hard copy formats. Maintain, on a daily basis, a complete set of marked-up white prints as record drawings that show in complete detail the final arrangement and location of all electrical components and the interconnecting wiring. These are to be maintained in a neat and substantial manner so as to properly and fully illustrate the way in which the installation has been completed.
- 2. The record drawings will be reviewed by the Consultant. Final submission of As-built Drawings shall be provided by the contractor in the form of AutoCAD drawings complete with all architectural changes incorporated into the base plans. The submission of record drawings shall include CD-ROM discs containing the AutoCAD drawing files as well as a hard set of 3 mil mylar plots.
- 3. A full Arc Fault study shall be completed. All devices and busses shall be provided with lamecoid labels denoting the relevant information relating to the arc fault hazard present. Refer to specifications on specific requirements for lamecoid labels.

**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                SECTION INCLUDES**

- .1        Materials and installation for wire and box connectors.

**1.2                RELATED SECTIONS**

- .1        Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

**1.3                REFERENCES**

- .1        Canadian Standards Association (CSA International) (Latest Editions)
  - .1        CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .2        CSA C22.2No.65, Wire Connectors.
- .2        Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1        EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3        National Electrical Manufacturers Association (NEMA)

**1.4                WASTE MANAGEMENT AND DISPOSAL**

- .1        Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2        Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**Part 2            Products**

**2.1                MATERIALS**

- .1        Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2        Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors #10 AWG or less.
- .3        Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1        Connector body and stud clamp for round copper conductors.
  - .2        Clamp for round copper conductors.
  - .3        Stud clamp bolts.
  - .4        Sized for conductors as indicated.
- .4        Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
  - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
  - .3 Install fixture type connectors and tighten. Replace insulating cap.
  - .4 Install bushing stud connectors in accordance with NEMA.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

**1.2 REFERENCES**

- .1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

**1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**Part 2 Products**

**2.1 BUILDING WIRES**

- .1 All conductors shall be copper, minimum No. 12 gauge, unless specifically noted otherwise.
- .2 All conductors # 12 AWG to # 8 AWG shall be rated for minimum 600V RW-90 XLPE. Conductors # 6 AWG and larger shall be rated for minimum 1000V RW-90 XLPE. All conductor for motor feeds from variable frequency drives, shall be rated for minimum 1000V RW-90 XLPE. Wiring in channel back of fluorescent fixtures shall be 600 volt Type GTF or TEW. Size, grade of insulation, voltage and manufacturer's name shall be marked at regular intervals.
- .3 Wiring for major feeders shall be NUAL aluminum and shall be installed only where specifically noted on the drawings.
- .4 Conductor utilized in conduit run under slab on grade or in conduit underground shall be Type 'RWU-90'.
- .5 Wire shall be as manufactured by Nexans, Alcan, Pirelli, BICC General Wire or Superior Essex.

**2.2 TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
  - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V to 1000V as noted above.

- 4 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables.
  - .3 Threaded rods: 6 mm dia. to support suspended channels.
- 5 Connectors:
  - .1 Watertight approved for TECK cable.

### 2.3 MINERAL-INSULATED CABLES

- .1 Conductors: solid bare soft-annealed copper, size as indicated.
- .2 Insulation: compressed powdered magnesium oxide to form compact homogeneous mass throughout entire length of cable.
- .3 Two hour fire rating.

## Part 3 Execution

### 3.1 INSTALLATION OF BUILDING WIRES

- .1 Termination for #8 AWG and larger shall be by means of approved solderless connector lug. For parallel conductors, a common lug with separate termination for each conductor shall be employed.
- .2 Conductor splices shall be made in accordance with specifications. Provide sufficient length for joint remake, and no less than 200 mm spare length. On through wiring, leave 300 mm loop.
- .3 Wiring in cabinets, pull boxes, panels and junction boxes shall be neatly trained and held with nylon cable ties.
- .4 Conductors shall be tag identified where passing through junction boxes.

### 3.2 INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
  - .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0-1000V.
- .3 All cables shall be terminated and spliced with suitable compression type connectors, as recommended by the cable manufacturer. The connectors shall satisfy the bonding and grounding requirements at the supply end.
- .4 All cables shall be single conductor and copper, unless otherwise specified.
- .5 All cable shall be rated for 1000 volts, insulated with cross-linked polyethylene and rated for operation at 90 degrees C. Cable shall have a FT4 rated outer jacket.
- .6 All cable shall meet the CSA requirements for cold bend and impact testing at minus 40 degrees C.

- .7 All cable shall be protected by a corrugated aluminum sheath or by interlocked aluminum armour. PVC jackets shall be required on all metallic sheathed cables.
- .8 The jackets shall meet the FT4 flame spread requirements and be identified on the P.V.C. jacket.
- .9 All cables shall be installed in accordance with the manufacturers recommendations, in suitable cable tray as specified within the specifications.
- .10 The cables shall be terminated at the supply end on a non-ferrous metallic plate and at the load end on a non-metallic rigid fibre board plate. The cable sheaths shall be bonded at the supply end only.
- .11 All cable installed in cable tray shall be installed at one diameter spacing.
- .12 When single conductor cables are direct earth buried they shall be spaced 150 mm apart.
- .13 Cables shall be manufactured by Nexans, Alcan, Superior Essex, General Wire or Pirelli.

### **3.3 INSTALLATION OF MINERAL-INSULATED CABLES**

- .1 Run cable exposed, securely supported by straps.
- .2 Support 2 h fire rated cables at 1m intervals.
- .3 Make cable terminations by using factory-made kits.
- .4 At cable terminations use thermoplastic sleeving over bare conductors.
- .5 Where cables are buried in cast concrete or masonry, sleeve for entry and exit of cables.
- .6 Do not splice cables.

### **3.4 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .3 Conductors: insulated, copper, size as indicated.
- .4 Type: AC90 - Armour: interlocking type fabricated from aluminum strip.
- .5 Type: ACWU90 - jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .6 Connectors: as required.
- .7 Multi conductor cables shall be color coded during manufacture. Single conductor cables shall be color coded with adhesive colour coding tape. The tape shall be applied for a minimum of 75 mm at all terminations. Cables shall not be painted under any condition. Color coding shall be as follows:

Phase 'A' - Red

Neutral - White

Phase 'B' - Black  
Phase 'C' - Blue

Ground - Green or Bare

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .2 Section 26 05 01 - Common Work Results - Electrical.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
  - .1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 All ground rods shall be 20 mm diameter by 3000 mm long, copper clad.
- .3 Grounding conductors: bare stranded copper.
- .4 Insulated grounding conductors: green
- .5 Ground bus: copper, complete with insulated supports, fastenings, connectors.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.
- .7 All ground conductors shall be bare or insulated, stranded, medium hard drawn copper wire. All insulated ground wires shall be green.
- .8 Exposed copper shall be cleaned to a bright surface, and shall be finished with two coats of clean, insulating varnish.
- .9 Connect ground conductor to copper water pipe at least twice (minimum 40 mm diameter), utilizing a Burndy Type GAR pipe clamp. Provide jumper across water meter.

- .10 All connections to the ground bus or risers shall be thermowelded, or shall utilize the Burndy Hy-Ground compression connections. Clamp type connections shall only be allowed to individual pieces of equipment.
- .11 Where bonds are covered with soil, the conductors are to be coated with anti-corrosion compound "Kopr-Shield" (Thomas & Betts Co.) before compression connector is applied. All bonding shall be done with 'C' tap and lug compression connectors.

### **Part 3 Execution**

#### **3.1 INSTALLATION GENERAL**

- .1 Electrical equipment and wiring shall be grounded in accordance with the Canadian Electrical Code, and local inspection authority's rules and regulations.
- .2 Provide a complete building grounding network and separate isolated equipment grounding network. The main busses shall be AWG #3/0 bare copper conductor. Copper clad ground rods shall be installed adjacent to the building and where shown on the drawings and connected to the ground busses with AWG #3/0 bare copper conductor.
- .3 All metallic raceways and conduits for communications, cable and conductors shall be grounded.
- .4 All motors with flexible connections shall have separate ground wire run bridging the flexible connections. This ground wire shall be run from the motor back to the nearest junction box or motor control centre where the termination can be readily inspected. Insulation for this wire shall be green.
- .5 Lay-in trays and feeder conduits shall be connected to the ground bus.
- .6 All 347/600 volt wiring shall be run in rigid conduit, or may be run in EMT if a separate ground wire is run from the panel or switch to each piece of equipment. The ground conductor shall be connected to the housing of each piece of equipment and the outlet box. Where rigid conduit is employed, all terminations of these conduit runs are to be with double locknuts, grounding bushings with jumper wires run between the bushing lug and the box or panel enclosure. Care shall be taken in conduit runs to ensure that all rigid pipe couplings and fittings are wrench tight.
- .7 All panel feeds at 600 volt and 208 volt shall include a building network ground conductor and an isolated equipment network grounding conductor.
- .8 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.
- .9 Install connectors in accordance with manufacturer's instructions.
- .10 Protect exposed grounding conductors from mechanical injury.
- .11 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .12 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .13 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .14 Structural steel and metal siding to ground by welding copper to steel.

- .15 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections unless indicated otherwise.
- .16 Make buried connections using copper welding by thermit process, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .17 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .18 Soldered joints not permitted.
- .19 Install separate ground conductor to outdoor lighting standards.
- .20 Make grounding connections in radial configuration only. Avoid loop connections.
- .21 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .22 Ground secondary service pedestals.

### **3.2 ELECTRODES**

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water meter shunt.
- .3 Bond separate, multiple electrodes together.
- .4 Use size #3/0 AWG copper conductors for connections to electrodes.
- .5 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

### **3.3 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral of secondary systems.

### **3.4 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, duct systems, frames of motors, starters, control panels, pool structure steel work, chair lifts, and distribution panels.

### **3.5 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.
- .4 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.
- .5 Connections to neutral points and equipment shall be made with thermowelds or brass, bronze or copper bolts and connectors.
- .6 Equipment grounds and transformer system grounds shall be connected to the building grounding network. All non-current carrying metallic parts of equipment shall be connected to the ground network.

- .7 Any equipment requiring connection to the isolated equipment grounding network shall have their circuit grounding conductor connected within their respective breaker panel. Only selective equipment and the most sensitive equipment shall be connected to this grounding network.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**Part 2 Products**

**2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted suspended or set in poured concrete walls and ceilings.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Secure equipment to poured concrete with expandable inserts.
- .2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits, use channels spaced as required by C22.1.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittal Procedures.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**Part 2 Products**

**2.1 SPLITTERS**

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters.

**2.2 JUNCTION AND PULL BOXES**

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

**2.3 CABINETS**

- .1 sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

**Part 3 Execution**

**3.1 SPLITTER INSTALLATION**

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal / bix block where indicated in cabinets.
- .4 Only main junction and pull boxes are indicated. Provide others as required by code. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.

**3.3 IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Install identification labels indicating system name, voltage and phase, Emergency or Normal power.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**Part 2 Products**

**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Provide blank cover plates for boxes without wiring devices.
- .5 Provide combination boxes with barriers where outlets for more than one system are grouped.
- .6 Each outlet box installed in steel stud and gyproc walls shall be mounted on Caddy #BHA, series SGB or TSGB screw gun brackets. Wood strapping with steel studs shall not be utilized for supporting outlet boxes
- .7 Use condulets where 90° turn required on wall mounted conduit. They shall be of the type where cover screws do not enter the wire chamber and covers are left accessible.
- .8 Each outlet box installed in acoustic tile ceilings shall be mounted on double Caddy "Tee Bar Hanger" #512 in such a manner that the outlet box will not twist in any direction.
- .9 Where boxes are surface mounted in unfinished areas, such as furnace or boiler rooms, stamped galvanized steel 100 mm square box to accept #8300 series raised covers shall be used.
- .10 Where surface wiring methods are allowed and approved in finished areas, use Hubbell or Wiremold boxes as per drawings c/w suitable adapter for wireway entrance.
- .11 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type 'FS', with threaded hubs and vapourproof covers.
- .12 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.
- .13 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .14 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.
- .15 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.
- .16 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.
- .17 Where required, provide voltage separation barriers.

## **2.2 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

## **2.3 MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

## **2.4 CONCRETE BOXES**

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

## **2.5 CONDUIT BOXES**

- .1 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type 'FS', with threaded hubs and vapourproof covers.
- .2 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.
- .3 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .4 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.
- .5 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.
- .6 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.
- .7 Where required, provide voltage separation barriers.

## **2.6 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Outlet boxes shall be supported independently of conduit capable of supporting weight of fixture or other device. Conduit entering the back of a box shall not enter the centre knockout.
- .6 For recessed fixtures in suspended ceilings, outlet box shall be accessible when fixture is removed.
- .7 Flexible conduit to fixture shall be minimum 12 mm diameter, and shall not emanate from outlet box cover. Maximum length of flexible conduit from outlet box to fixture shall be 3000 mm. Outlet box for fixture shall not be located above ducts, pipes, etc. Outlet box shall be within 750 mm (vertically) of the fixture.
- .8 Provide and set all special communications type back boxes associated with systems specified under Electrical Divisions.
- .9 In placing outlets, allow for overhead pipes, ducts, etc., and for variation in wall and ceiling finishes, door and window trim, panelling, etc.
- .10 Location of receptacle outlets in equipment rooms shall be finalized during construction to give optimum arrangement. Consultant to approve locations before installation.
- .11 Multigang boxes for use with 347 volt switches shall have each gang fully barriered from the next, or multiple single gang boxes may be used, provided they are installed in a neat, orderly fashion. Barriers shall be steel and shall be firmly held in place.
- .12 Attention is directed to special outlet box locations for 347 volt switches requiring wider mount spacing rejection feature.
- .13 Outlet boxes shall be enclosed in plastic pan when installed in a wood framed ceiling or wall and when piercing a plastic vapour barrier. Seal around plastic pan and plastic vapour barrier with acoustic sealant to ensure vapour tight installation.

**END OF SECTION**

**Part 1           General**

**1.1               REFERENCES**

- .1    latest Edition of the following Canadian Standards Association (CSA) documents
  - .1     CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
  - .2     CSA C22.2 No. 45, Rigid Metal Conduit.
  - .3     CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4     CSA C22.2 No. 83, Electrical Metallic Tubing.
  - .5     CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
  - .6     CAN/CSA C22.2 No. 227.3, Flexible Nonmetallic Tubing.

**1.2               WASTE MANAGEMENT AND DISPOSAL**

- .1    Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2    Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**Part 2           Products**

**2.1               CONDUITS**

- .1    Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2    Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3    Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4    Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .5    Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .6    Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3
- .7    Conduit for use in corrosive atmospheres shall be rigid PVC or rigid steel with extruded PVC jacketed. Refer to drawings for areas requiring PVC.
- .8    Condulets shall be of a type wherein cover screws do not enter the wire chamber.
- .9    Flexible conduit connections to all mechanical equipment shall be of 'Sealtite' manufacture.
- .10   Flexible conduit connectors shall be of the insulated throat type.
- .11   Condulets with suitable covers shall be used where condulets are exposed. Each conduit fitting shall be of a type suitable to its particular use, and of a type which will allow installation of future conduits without blocking covers of existing condulets.
- .12   Expansion joints shall be installed with ground jumper.
- .13   All conduits shall be terminated with a suitable bushing.
- .14   Flexible conduit and Rigid conduit entering boxes or enclosures shall be terminated with nylon insulated steel threaded bushings, grounded type.

## **2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit / raceway specified. Coating: same as conduit / raceway.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits / raceways.
- .3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

## **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.5 FISH CORD**

- .1 Polypropylene.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conduits and cables shall be supported, at regular intervals, with corrosion resisting clamps. Lead anchors or expansion bolts shall be used to attach clamps to masonry walls.
- .3 Conduit and cables shall be installed to avoid proximity to water and heating pipes. They shall not run within 150 mm of such pipes, except where crossings are unavoidable, in which case they shall be kept at least 25 mm from covering of pipe crossed.
- .4 Cap ends of all conduits to prevent entrance of foreign matter during construction. Manufactured caps shall be employed.
- .5 Conduit shall be installed as close to building structure as possible so that where concealed, necessary furring can be kept to a minimum.
- .6 Empty conduits, installed under this Division but in which wiring will be installed by others, shall be swabbed out with "Jet Line" foam packs, and be c/w Polypropylene pull wire or polytwine.
- .7 Conduits shall be installed at right angles or parallel to building lines, accurate in line and level.

- .8 Conduit shall not be bent over sharp objects. Improperly formed bends and running threads will not be accepted. Bends and fittings shall not be used together. Proper supports of manufactured channels shall be provided where exposed conduits and cable runs are grouped.
- .9 Under no condition will EMT be allowed exposed within 1200 mm of floor, outdoors, or in areas where explosive, corrosive or moist atmosphere exists.
- .10 Not more than four (4) 90 degree bends or equivalent offsets will be permitted between pull boxes. When maximum number of bends are used, the total run between pull boxes shall not exceed 18000 mm.
- .11 PVC conduit shall not pass through a fire partition or floor separation. Where it is necessary for PVC conduits to pass through a fire barrier, a transition to rigid steel conduit shall be provided for 2000 mm on either side of the fire barrier.
- .12 Surface mount conduits except where noted otherwise.
- .13 Use rigid PVC conduit in corrosive areas or as indicated on plans.
- .14 Use flexible metal conduit or Teck90 for connection to motors.
- .15 Use liquid tight flexible metal conduit or Teck90 for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .16 Use explosion proof flexible connection for connection to explosion proof motors.
- .17 Minimum conduit size for lighting and power circuits: 19 mm.
- .18 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Mechanically bend steel conduit over 19 mm dia.
- .19 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .20 Install pulltwine in all empty conduits / raceways and conduits / raceways that are less than 40% filled.
- .21 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .22 Dry conduits out before installing wire.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.3 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.4 CONDUITS IN CAST-IN-PLACE CONCRETE**

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.
- .8 All joints shall be made watertight and stub-ups protected against mechanical damage. Misaligned stub-ups shall be chiselled out and rebent to conform.
- .9 Expansion joints shall be provided in conduit runs where they cross building expansion joints.

### **3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE**

- .1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

### **3.6 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Service equipment and installation.

**1.2                RELATED SECTIONS**

- .1    Section 01 74 19 - Waste Management And Disposal.
- .2    Section 26 05 28 - Grounding - Secondary.
- .3    Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .4    Section 26 28 21 - Moulded Case Circuit Breakers.
- .5    Section 26 28 23 - Disconnect Switches - Fused and Non-Fused.
- .6    Section 26 24 17 - Panelboards Breaker Type.

**1.3                WASTE MANAGEMENT AND DISPOSAL**

- .1    Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2    Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**Part 2            Products**

**2.1                EQUIPMENT**

- .1    Enclosed Power circuit breaker: in accordance with Section 26 28 21 - Moulded Case Circuit Breakers.
- .2    The main service equipment shall be housed in free standing switchboards: in accordance with Section 26 24 02 – Service Entrance Board.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1    Install service equipment.
- .2    Connect to incoming service.
- .3    Connect to outgoing load circuits.
- .4    Adjust ground fault settings.
- .5    Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.
- .6    Make provision for secondary service power supply metering for the owner.

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1    Materials and installation for service entrance board.

**1.2            RELATED SECTIONS**

- .1    Section 01 33 00 - Submittal Procedures.
- .2    Section 01 74 19 - Waste Management And Disposal.
- .3    Section 01 78 00 - Closeout Submittals.
- .4    Section 26 05 01 - Common Work Results - Electrical.

**1.3            REFERENCES**

- .1    CAN/CSA-C22.2 No.31
- .2    CAN/CSA-C22.2 No.193
- .3    CSA C22.1-02
- .4    EEMAC G8-3
- .5    NEMA SG-4 and SG-5
- .6    ANSI C37.20.3, C37.20.4, C37.57 and C37.58

**1.4            SHOP DRAWINGS AND PRODUCT DATA**

- .1    Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Indicate on shop drawings.
  - .1    Floor anchoring method and foundation template.
  - .2    Dimensioned cable entry and exit locations.
  - .3    Dimensioned position and size of bus.
  - .4    Overall length, height and depth.
  - .5    Dimensioned layout of internal and front panel mounted components.
- .3    Include time-current characteristic curves for circuit breakers and fuses.

**1.5            QUALITY ASSURANCE**

- .1    Submit 3 copies of certified test results.

**1.6            CLOSEOUT SUBMITTALS**

- .1    Provide maintenance data for service entrance board for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2    Submit 3 copies maintenance data for complete assembly including components.

**1.7            WASTE MANAGEMENT AND DISPOSAL**

- .1    Meet requirements of Section 01 74 19 - Waste Management and Disposal.

- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 SERVICE ENTRANCE BOARD**

- .1 Service Entrance Board: to CAN/CSA-C22.2 No.31.
- .2 Rating: 120/208 V, 3 phase, 4 wire, 600A, short circuit current 42 kA (rms symmetrical). Both suitable for service entrance use.
- .3 Complete with required Arc Flash identification labels as required by CEC.
- .4 Cubicles: wall-mounted, free standing, dead front, size as indicated.
- .5 Barrier metering section from adjoining sections.
- .6 Provision for installation of Owners digital metering in barriered sections.
- .7 Distribution sections.
- .8 Hinged access panels with captive knurled thumb screws.
- .9 Bus bars and main connections: tin plated aluminum
- .10 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
- .11 Identify phases with colour coding.
- .12 Sprinkler guards shall be provided for the distribution equipment.

### **2.2 FUSIBLE DISCONNECTS AND FUSES**

- .1 As per Section 26 28 23 - Disconnect Switches - Fused and Non-Fused.

### **2.3 GROUNDING**

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end for size #3/0 grounding cable.

### **2.4 FINISHES**

- .1 Apply finishes in accordance with Section 26 05 01 - Common Work Results – Electrical.
  - .1 Service entrance board exterior: ASA #61 grey.

### **2.5 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Nameplates:
  - .1 Black, Blue or Red plate as required, White letters, 10mm high
  - .2 Complete board labelled: "120/208V."
  - .3 Main disconnect labelled: "Main Breaker "

- .4 Branch disconnects labelled: as indicated in the drawings.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Locate service entrance board and fasten to floor.
- .2 Connect main secondary service to line terminals of main breaker.
- .3 Connect load terminals of distribution switches to feeders.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Run two grounding conductors #3/0 AWG bare copper from ground bus to building ground.
- .6 Check trip unit settings and fuse sizes against co-ordination study to ensure proper working and protection of components.
- .7 The switchboard shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to ensure the accuracy of the wiring and the functioning of the equipment.
- .8 The Owner's operating and maintenance personnel shall be instructed in the operation and maintenance of the system for a minimum period of two (2) hours.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        Materials and installation for standard and custom breaker type panelboards.

**1.2                RELATED SECTIONS**

- .1        Section 01 33 00 - Submittal Procedures.
- .2        Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .3        Section 06 10 11 - Rough Carpentry - Short Form: Plywood Backboard.
- .4        Section 26 05 01 - Common Work Results - Electrical.
- .5        Section 26 28 21 - Moulded Case Circuit Breakers.

**1.3                REFERENCES**

- .1        Canadian Standards Association (CSA International)
  - .1        CSA C22.2No.29-M1989(R2000), Panelboards and enclosed Panelboards.

**1.4                SHOP DRAWINGS**

- .1        Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- .3        Include time-current characteristic curves for breakers with ampacity of 50 A and over and with interrupting capacity of 18,000 A symmetrical (rms) or greater.

**1.5                WASTE MANAGEMENT AND DISPOSAL**

- .1        Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2        Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**Part 2            Products**

**2.1                PANELBOARDS**

- .1        All panels shall be of the dead front, molded case circuit breaker type, as shown, sized and located on the drawings.
- .2        Panel trim shall be furnished for flush or surface mounting as indicated on the drawings. Panel trim shall be removed for painting, and allowed to dry before final placement.
- .3        Surface mounted panels shall have manufacturer's standard trim, and shall be finished with two coats of grey ASA #61.
- .4        Panels shall be equipped with a flush type combination lock-latch. Two keys shall be provided for each panel, and all locks shall be keyed alike.
- .5        Panels shall have mains of voltage and capacity and shall be complete with branch breakers, spares and spaces, as shown on the drawings. "Spaces" shall be understood to include necessary bus work such that Owners, at a later date, need buy only breakers.

- .6 Panelboards: to CSA C22.2No.29 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .7 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .8 Each panel shall be complete with a typed directory, which shall be mounted inside the door in a metal frame with clear plastic cover.
- .9 Flush panels shall have concealed hinges and flush type combination lock-latch. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed.
- .10 Cabinets shall be fabricated of code gauge steel, with ample wiring gutters for all wiring connections.
- .11 All panels shall have main bus bar equipped with solderless lug and be capable of accepting any arrangement of single, two or three pole breakers.
- .12 All panels shall have an isolated ground bus in addition to the standard ground bus. This isolated ground bus shall be used to tie critical pieces of equipment to the separate critical systems ground grid.
- .13 Branch circuit breaker shall have quick-make, quick-break toggle mechanism with single, two or three pole common trip thermal magnetic units in ampere ratings as designated on the drawings. Breaker handles shall have three positions: 'on', 'off' and 'tripped'. All circuit breakers and panel bus shall have an interrupting capacity of 10,000 amps symmetrical.
- .14 Panels for 120/208 volt, 3 phase, 4 wire systems, shall be complete with bolt-in type breakers, with a minimum nominal width of 20 mm per pole, and a bus of sufficient capacity to feed the number of branch circuit breakers indicated.
- .15 Panels for 347/600 volt, 3 phase, 4 wire systems shall be complete with bolt-in type breakers, and a bus of sufficient capacity to feed the number of branch circuit breakers indicated.
- .16 All panels shall be specification grade and of the same manufacture. Load centres are not acceptable.
- .17 All branch circuit spaces shall be fitted with filler plates.
- .18 All panels serving bedrooms shall be equipped with arc fault circuit interrupters where shown on the drawings.
- .19 Each panel shall be equipped with a ground bus suitable for terminating one ground conductor per load circuit.
- .20 Panels shall be Siemens, Cutler Hammer or Schneider Electric.
- .21 Refer to attached breaker panel schematic detail sheets attached at the end of this specification section.

## 2.2 **BREAKERS**

- .1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Lock-on devices for fire alarm circuits.

### **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results – Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 10 - Rough Carpentry. Where practical, group panelboards on common backboard.
- .3 Electrical panels shall, where possible, be mounted with top of trim at uniform height of 2000mm.
- .4 Panels, shown adjacent to other panels, shall have adjacent edges of different panels mounted parallel to each other with a gap of 75 mm.
- .5 For panels recessed in a finished wall, provide for every six branch circuit spaces and spares, or fractions thereof, one 20 mm empty conduit up to furred ceiling space, and one (1) 20 mm empty conduit down to ceiling space of floor below, and cap for future wiring.
- .6 For panels recessed in a finished wall and serving laboratory areas, provide two (2) 20 mm empty conduits up and into ceiling space of laboratory and cap for future wiring. All conduits including those left for future spare wiring shall be sealed to prevent exchange of gasses through conduit system.
- .7 Connect neutral conductors to common neutral bus.
- .8 As part of this contract, the electrical shall provide an additional thirty (30) 20 amp, single pole breakers to be turned over to the owner upon completion of the project. These shall be spare breakers to allow the owner to replace 15 amp breakers in the panelboards if new equipment is purchased.

#### **3.2 PANEL SCHEMATICS**

- .1 The following are panel schematics used throughout the project.

**END OF SECTION**