

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 117-04, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 422-632002, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D 698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .5 ASTM D 1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
 - .6 ASTM D 4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 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 CSA Group (CSA)
 - .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .4 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.02 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock: solid material in excess of 1.00 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m³ bucket. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

- .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .7 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422: Sieve sizes to CAN/CGSB-8.1.
 - .2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45
 - .3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.
- .8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.03 QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Where Departmental Representative is employee of Contractor, submit proof that Work by Departmental Representative is included in Contractor's insurance coverage.
- .3 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .4 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .5 Keep design and supporting data on site.
- .6 Engage services of qualified professional Engineer who is registered or licensed in Province of Saskatchewan is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.

- .7 Do not use soil material until written report of soil test results are reviewed and approved by Departmental Representative.

1.04 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
- .2 Divert excess aggregate materials from landfill to local quarry recycling facility for reuse as directed by Departmental Representative.

1.05 EXISTING CONDITIONS

- .1 Buried services:
 - .1 Before commencing work verify establish location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to beginning excavation Work, notify applicable Departmental Representative t authorities having jurisdiction establish location and state of use of buried utilities and structures. Departmental Representative authorities having jurisdiction to clearly mark such locations to prevent disturbance during Work.
 - .6 Confirm locations of buried utilities by careful test excavations soil hydrovac methods.
 - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.
 - .8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing re-routing. Costs for such Work to be paid by Departmental Representative
 - .9 Record location of maintained, re-routed and abandoned underground lines.
 - .10 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

2 PRODUCTS

2.01 MATERIALS

- .1 Type 1 and Type 2 fill: properties to the following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 .
Sieve sizes to CAN/CGSB-8.1.

.3 Table:

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

- .2 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.
- .3 Unshrinkable fill: proportioned and mixed to provide:
 - .1 Maximum compressive strength of 0.4 MPa at 28 days.
 - .2 Maximum cement content of 25 kg/m³ with 40% by volume fly ash replacement: to CSA-A3001, Type GU.
 - .3 Minimum strength of 0.07MPa at 24 h.
 - .4 Concrete aggregates: to CSA-A23.1/A23.2.
 - .5 Cement: Type GU.
 - .6 Slump: 160 to 200 mm.
- .4 Shearmat: honeycomb type bio-degradable cardboard 100 mm thick, treated to provide sufficient structural support for poured concrete until concrete cured.

3 EXECUTION

3.01 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.02 PREPARATION/ PROTECTION

- .1 Keep excavations clean, free of standing water, and loose soil.
- .2 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .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.

3.03 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as indicated as directed by Departmental Representative after area has been cleared of brush weeds and grasses and removed from site.
- .2 Strip topsoil to depths as indicated as directed by Departmental Representative.
 - .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as indicated as directed by Departmental Representative
 - .1 Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil to location as indicated as directed by Departmental Representative off site.

3.04 DEWATERING

- .1 Keep excavations free of water while Work is in progress.
- .2 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .3 Protect open excavations against flooding and damage due to surface run-off.

3.05 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.
- .2 Excavate to lines, grades, elevations and dimensions as indicated as directed by Departmental Representative.
- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .5 For trench excavation, unless otherwise authorized by Departmental

- Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
 - .7 Restrict vehicle operations directly adjacent to open trenches.
 - .8 Dispose of surplus and unsuitable excavated material in approved location on site off site.
 - .9 Do not obstruct flow of surface drainage or natural watercourses.
 - .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
 - .11 Notify Departmental Representative when bottom of excavation is reached.
 - .12 Obtain Departmental Representative approval of completed excavation.
 - .13 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative
 - .14 Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with concrete specified for footings fill concrete Type 2 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.
 - .2 Fill under other areas with Type 2 fill compacted to not less than 95 % of corrected Standard Proctor maximum dry density.
 - .15 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative

3.06 FILL TYPES AND COMPACTION

- .1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D 698/ASTM D 1557 in accordance with Section 31 05 10 - Corrected Maximum.
 - .1 Exterior side of perimeter walls: Compact to 95% of corrected maximum dry density.
 - .2 Within building area: use Compact to 100 % of corrected maximum dry density.
 - .3 Under concrete slabs: provide 150 mm compacted thickness base course of to underside of slab. Compact base course to 100 %.

3.07 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and approved installations.
 - .2 Departmental Representative has inspected and approved of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
 - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Backfilling around installations:
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading..
 - .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Departmental Representative.

3.08 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 21 - Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as directed by Departmental Representative.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by Work as directed by Departmental Representative
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

END OF SECTION

1 General**1.01 MEASUREMENT PROCEDURES**

- .1 Provide unit price for each category of pile being driven for Pile Driving Analyzer and Wave Equation Analysis procedure.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit manufacturer's printed product literature, specifications and datasheet.
- .3 Sub-surface investigation report: when site conditions differ from those indicated, submit written notification to Departmental Representative and await further instructions.
- .4 Submit schedule of planned sequence of driving to Departmental Representative for review, as specified.
- .5 Equipment:
 - .1 Submit prior to pile installation for approval by Departmental Representative, list and details of equipment for use in installation of piles.
 - .2 Impact hammers: submit manufacturer's written data as specified.
 - .3 Non-impact methods; submit characteristics to evaluate performance.
- .6 Submit driveability analysis as specified, to Departmental Representative for approval of hammers.
- .7 Quality assurance submittals:
 - .1 Test reports: submit 3 copies of certified test reports for piles from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements
- .2 Protect piles from damage due to excessive bending stresses, impact, abrasion or other causes during delivery, storage and handling.
- .3 Replace damaged piles as directed by Departmental Representative.

1.04 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
- .2 Divert unused, or cut off concrete materials from landfill to local quarry facility as approved by Departmental Representative.

1.05 EXISTING CONDITIONS

- .1 Notify Departmental Representative in writing if subsurface conditions are unacceptable and await further instructions from Departmental Representative.

1.06 SCHEDULING

- .1 Provide schedule of planned sequence of driving to Departmental Representative for review, not less than two weeks prior to commencement of pile driving.

2 Products**2.01 MATERIALS**

- .1 Material requirements for piles are specified in Section 31 63 24.
- .2 Supply or fabricate full length piles as indicated and provide equipment to handle full length piles without cutting and splicing.

2.02 EQUIPMENT

- .1 Impact hammers: provide manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer, mass of driving cap and type and elastic properties of hammer and pile cushions.
- .2 Hammer:
 - .1 Hammers to be selected on basis of driveability analysis using wave equation theory, performed to show that piles can be driven to levels indicated.
 - .2 Driveability analysis to include, but not be limited to, following: hammer, cushion and cap block details; static soil parameters; quake and damping factors, total soil resistance, blow count, pile stresses and energy throughput at Representative penetrations.
 - .3 When required criteria cannot be achieved with the proposed hammer, use larger hammer and take other measures as required.

3 Execution**3.01 PREPARATION**

- .1 Protection:
 - .1 Protect adjacent structures, services and work of other sections from hazards due to pile driving operations.

- .2 Arrange sequencing of pile driving operations and methods to avoid damages to adjacent existing structures.
- .3 When damages occur, remedy damaged items to restore to original or better condition at own expense.
- .2 Ensure that ground conditions at pile locations are adequate to support pile driving operation and load testing operation.
 - .1 Make provision for access and support of piling equipment during performance of Work.

3.02 INSTALLATION

- .1 Leads: construct pile driver leads to provide free movement of hammer.
 - .1 Hold leads in position at top and bottom, with guys, stiff braces, or other means reviewed by Departmental Representative to ensure support to pile while being driven.
 - .2 Length: provide sufficient length of leads to ensure that use of follower is unnecessary.
 - .3 Swing leads:
 - .1 Not permitted.
- .2 Allowable design load capacity of pile at as indicated.
- .3 Installation of each pile will be subject to review of Departmental Representative.
 - .1 Consultant will be sole judge of acceptability of each pile with respect to final driving resistance, depth of penetration or other criteria used to determine load capacity.
 - .2 Consultant to review final driving of all piles prior to removal of pile driving rig from site.
- .4 Drive each pile to practical refusal in bedrock.
 - .1 Do not overdrive to cause damage to piles in bedrock.
 - .2 Departmental Representative will determine refusal criteria for piles driven to rock based on type of pile and driving equipment.

3.03 APPLICATION / DRIVING

- .1 Use driving caps and cushions to protect piles.
 - .1 Reinforce pile heads as required by Departmental Representative.
 - .2 Piles with damaged heads as determined by Departmental Representative will be rejected.
- .2 Hold piles securely and accurately in position while driving.
- .3 Deliver hammer blows along axis of pile.
- .4 Remove loose and displaced material from around piles after completion of driving, and leave clean, solid surfaces to receive foundation concrete.
- .5 Cut off piles neatly and squarely at elevations as indicated.
 - .1 Provide sufficient length above cut-off elevation so that part damaged during driving is cut off.

.2 Do not cut tendons or other reinforcement, which will be used to tie pile caps to pile.

.6 Remove cut-off lengths from site on completion of work.

3.04 DRIVING TOLERANCES

.1 Pile heads to be within 50 mm of locations as indicated.

.2 Piles not to be more than 2% of length out of vertical alignment.

3.05 OBSTRUCTIONS

.1 Where obstruction is encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, proceed as directed by Consultant.

3.06 REPAIR AND RESTORATION

.1 Leave rejected pile in place, place adjacent pile and modify pile cap as directed by Consultant.

.2 No extra compensation will be made for removing and replacing or other work made necessary through rejection of defective piles.

3.07 FIELD QUALITY CONTROL

.1 Pile Driving Analyzer:

.1 Use Pile Driving Analyzer and Wave Equation Analysis to determine and confirm driving criteria such as hammer size and variation in impact, suitability of driving cap and cushions and penetration resistance relative to set on at least 3 piles before start of pile placement.

.2 Work to be performed by an experienced Geotechnical Engineer licensed to Practice in Province of Saskatchewan, Canada.

.2 Testing agency appointed by Departmental Representative will use Pile Driving Analyzer and Wave Equation Analysis to confirm driving criteria. Included are: hammer size and variation in impact, suitability of driving cap and cushions, and penetration resistance relative to set for initial driving and restriking.

.1 Departmental Representative to select piles for testing.

.3 Prepare piles to be instrumented by drilling and tapping holes for installation of strain transducers and accelerometers, as directed by Departmental Representative

.4 Provide assistance, as required, in instrumentation process during initial set-up and during test.

.1 Such assistance will include: attaching of test equipment leads to transducers and accelerometers when pile is positioned in leads prior to driving, replacing of transducers and accelerometers, if required, during driving

- .5 Make allowance for probable interruption in driving for:
 - .1 Changing/modifying hammer, cap, cushions, or other equipment;
 - .2 Replacing/adjusting of transducers and accelerometers;
 - .3 Assessing of monitored results.

- .6 Replace/adjust hammer and modify cap, cushions, and other equipment, as directed by Departmental Representative.

- .7 Confirm load carrying capacity of 3 instrumented piles, unless instructed otherwise by Departmental Representative by performing load test.
 - .1 Maintain accurate records of driving for each pile, including:
 - .1 Type and make of hammer, stroke or related energy.
 - .2 Other driving equipment including water jet, driving cap, cushion.
 - .3 Pile size and length, location of pile in pile group, location or designation of pile group.
 - .4 Sequence of driving piles in group.
 - .5 Final tip and cut-off elevations.
 - .6 Other pertinent information such as interruption of continuous driving, pile damage.
 - .7 Record elevation taken on adjacent piles during, before and after driving of each pile.
 - .2 All measurements, observations and calculations associated with pile driving analyzer and wave equation analysis.
 - .3 Provide Departmental Representative with three copies of records.

3.08 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A252 Standard Specification for Welded and Seamless Steel Pipe Piles
 - .2 ASTM D1143 Standard Test Method for Piles Under Static Axial Compressive Load
 - .3 ASTM D3689-Standard Test Method for Individual Piles Under Static Axial Tensile Load
 - .4 ASTM D3966-Standard Test Method for Piles Under Lateral Loads
 - .5 ASTM D4945 Standard Test Method for High-Strain Dynamic Testing of Piles
 - .6 ASTM D5882 Standard Test Method for Low Strain Integrity Testing of Piles
- .2 Canadian Standards Association (CSA):
 - .1 CSA A3000 Portland Cement/Masonry Cement/Blended Hydraulic Cement
 - .2 CSA A23.1/A23.2- Concrete Materials and Methods of Concrete Construction
 - .3 CSA A23.3- Design of Concrete Structures
 - .4 CSA W59- Welded Steel Construction (Metal Arc Welding)
 - .5 CSA W117.2- Code for Safety in Welding and Cutting (Requirements for Welding Operators) Allied Processes
 - .6 CSA W178.1 Certification of Welding Inspection Organizations
 - .7 CSA W178.2- Certification of Welding Inspectors
- .3 Canadian Welding Bureau (CWB Group Industry Services):
 - .1 CWB 113E Weld Quality and Examination Methods Study Guide

1.2 DEFINITIONS

- .1 **Standard Excavation:** Includes excavation accomplished with conventional augers fitted with soil or rock teeth, drilling buckets, and under-reaming equipment attached to drilling equipment of size, power, torque, and down-thrust necessary for the Work.
- .2 **Obstruction Removal:** Includes for removal of unanticipated boulders, concrete, masonry, or other unforeseen obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or under-reaming tools attached to drilling equipment of size, power, torque, and down-thrust necessary for the Work; removal of obstructions will be administered as a change to the Contract.

1.3 SUBSTITUTIONS

- .1 Submit information and obtain acceptance from the Departmental Representative a minimum of least seven (7) working days before bid closing where an alternate piling system is proposed for use on this Project.

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit product data for each type of product use in construction of drilled concrete piles.

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- .3 Submit shop drawings for concrete reinforcement detailing fabricating, bending, and placing.
- .4 Submit letter confirming that design mix used for the project meets each class of concrete specified for use in this Section, including records of changes to mix design when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- .5 Submit of Letters of Commitment and Compliance by professional engineer responsible for design of drilled concrete piles.
- .6 Submit laboratory test reports indicating evaluation of concrete materials and mix design.
- .7 Submit a Current Letter of Validation for welding work being performed; and in addition, submit copies of the following CWB documents when requested by the Departmental Representative:
 - .1 Company specific Welding Supervisor's Certificate, backside and front side indicating proper certification.
 - .2 Individual Welder Certificate with listing for type of work being performed.
- .8 Submit record drawings at completion of work of this Tender Event in accordance with Section 01 78 00.
- .9 Submit drawings indicating pile locations, sizes, top and bottom elevations, and reinforcing.
- .10 Maintain complete placing records of all piles during installation and submit to the Consultant when the piling work is completed.

1.5 QUALITY ASSURANCE

- .1 Design drilled concrete piles in accordance with the recommendations given in the soils report; design shall be completed by a qualified professional engineer registered in the province of the Work, and install as follows:
 - .1 Design and detail drilled concrete piles in accordance with CSA A23.3; extend reinforcing to full length of pile.
 - .2 Construct drilled concrete piles in accordance with CSA A23.1 and CSA A23.3, and the Building Code.
 - .3 Perform piling work under the direct supervision of a registered professional engineer using rig and crew experienced in performing work of this work.
 - .4 Perform concrete testing as specified in Section 03 30 00 – Cast-In-Place Concrete.
- .2 Arrange for qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled concrete piles.:
 - .1 Coordinate with Departmental Representative for making arrangements with survey work required for this Section.
 - .2 Lay out each drilled concrete pile to lines and levels required before drilling operations.
 - .3 Record actual measurements of each drilled concrete pile location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

- .4 Record and maintain information pertinent to each drilled concrete pile and cooperate with testing and inspecting agency to provide data for required reports.
- .3 Comply with applicable CWB standards for classification of work being performed including, but not limited to, the following:
 - .1 Welding inspection: to CSA W178.
 - .2 Resistance welding: to CSA W55.3.
 - .3 Fusion welding: to CSA W59.
 - .4 Installing Subcontractors, if different than fabricator, shall have completed structural steel work similar in material, design, and extent to that indicated for this Project; with a record of successful in service performance; and having welders certified by CWB for classification of work being performed.

1.6 QUALITY CONTROL

- .1 Testing for this Section will be paid in accordance with requirements of Section 01 43 00 – Quality Assurance.

1.7 PROJECT CONDITIONS

- .1 Existing Utilities: Locate existing underground utilities before starting work of this Section; provide protection from damage to utilities during operations where utilities are to remain in place:
 - .1 Adapt drilling procedure if necessary to prevent damage to utilities where uncharted or incorrectly charted piping or other utilities be encountered during excavation.
 - .2 Cooperate with Departmental Representative and utility companies in keeping services and facilities in operation without interruption.
 - .3 Repair damaged utilities to satisfaction of utility owner.

2 PRODUCTS

2.1 PILE CAP FORMWORK

- .1 Provide formwork materials as required for site conditions.

2.2 REINFORCING

- .1 Provide reinforcing steel in accordance with Section 03 20 00 – Concrete Reinforcement.

2.3 CONCRETE

- .1 Provide concrete in accordance with Section 03 30 00 – Cast-In-Place Concrete, and as follows:
 - .1 Minimum strength: as shown on the drawings.
 - .2 Maximum size aggregate: as shown on the drawings.
 - .3 Maximum slump: as shown on the drawings.
 - .4 Cement: Normal Portland Cement to CSA-A5, Type 10
 - .5 All other concrete materials conforming to the specification requirements for concrete.

2.4 DRILLING MUD

- .1 Drilling Mud: Proprietary mixture of pulverized sodium bentonite, pulverized attapulgite, or polymers, mixed with water to form stable colloidal suspension capable of supporting side wall pressures and preventing sloughing of pile shaft during excavation operations.

3 Execution**3.1 PREPARATION**

- .1 Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled concrete piling operations.

3.2 EXCAVATION

- .1 Excavation is classified as standard excavation and obstruction removal, and includes excavation to bearing elevations, as defined in Article 1.2 above.
- .2 Prevent surface water from entering excavated shafts, drain water to site drainage facilities, and as follows:
 - .1 Remove water from excavated shafts before placing concrete.
 - .2 Small amounts of water in the bottom of the excavation may be dried by adding the necessary amount of dry cement and mixing with the bellling tool to form a soil cement mixture.
- .3 Excavate shafts for drilled concrete piles to indicated elevations and remove loose material from bottom of excavation as follows:
 - .1 Excavate bottom of pile shafts to level plane within 1:12 tolerance and remove loose material.
 - .2 Bottom surface of the pile shaft must be dry and free of disturbed soil or soil cement.
 - .3 Case pile shaft during drilling to prevent excessive water seepage and to prevent sloughing and caving of soil; use drilling mud as required to advance the pile shaft through sand fill, clay and silt deposits.
 - .4 Excavate shafts for closely spaced drilled concrete piles, and those occurring in fragile or sand strata, only after adjacent drilled concrete piles are filled with concrete and allowed to set.
 - .5 Provide corrective construction if location or out-of-plumb tolerances are exceeded; submit design and construction proposals to Departmental Representative for review before proceeding with the work.
- .4 Notify and allow testing and inspection agency to test and inspect bottom of excavation, and as follows:
 - .1 Each drilled concrete pile must be inspected and tested by testing and inspection agency before placing concrete.
 - .2 Provide and maintain facilities with equipment required for testing and inspection of excavations.
 - .3 Cooperate with testing and inspecting personnel to expedite the Work.
 - .4 Notify Departmental Representative and testing agency at least six (6) hours before excavations are ready for tests and inspections.

- .5 Make adjustments to drilled concrete piles as determined by Departmental Representative and testing agency if unsuitable bearing stratum is encountered.
- .6 Do not excavate shafts deeper than elevations indicated, unless directed in writing by the Departmental Representative.

3.3 CASINGS

- .1 Temporary Casings:
 - .1 Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
 - .2 Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.
 - .3 Temporary casings may be left in place where accepted by the Consultant.

3.4 STEEL REINFORCEMENT

- .1 Coordinate fabrication of reinforcement with Section 03 20 00 – Concrete Reinforcement.
- .2 Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
- .3 Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit; extend reinforcing to full length of pile.
- .4 Accurately position, support, and secure reinforcement against displacement during concrete placement; maintain minimum cover to reinforcement.
- .5 Use templates to set anchor bolts, levelling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.
- .6 Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.5 CONCRETE PLACEMENT

- .1 Coordinate concrete placement with Section 03 30 00 – Cast-In-Place Concrete.
- .2 Place concrete and reinforcing in accordance with CSA A23.1 and the Building Code.
- .3 Pile Tolerances:
 - .1 Top of pile elevations shall be within 50 mm (2") of that shown on the Drawings.
 - .2 Tops of piles shall be within 76 mm (3") laterally of the location shown on the drawings.
 - .3 Piles shall not exceed 2.0% out of plumb over the pile length.
 - .4 Place reinforcing extending from the pile to suit the pile cap, column base, grade beam or wall without unnecessary bends.
- .4 Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by independent testing and inspecting agency:
 - .1 Construction joints will not be permitted unless specifically directed in writing from the Departmental Representative.

- .2 Construction joints will only be permitted where concrete placement is delayed more than one (1) hour, or concrete has started to set.
- .3 Construct construction joints as follows where Departmental Representative has directed requirement in writing:
 - .1 Level top surface of concrete.
 - .2 Clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1 before placing remainder of concrete.
- .5 Suspend reinforcing cage centrally in pile shaft and place concrete vertically in the centre of the reinforcing cage without striking sides of shaft or steel reinforcement; place concrete with chutes, tremies, or pumps where concrete cannot be directed down shaft without striking reinforcing.
- .6 Coordinate withdrawal of temporary casings with concrete placement to maintain at least a minimum 1530 mm (5'-0") head of concrete above bottom of casing, if used.
- .7 Vibrate the upper 2000 mm (6'-6") of shaft during concrete placing.
- .8 Screed concrete at cut-off elevation level and apply scoured, rough finish; form top section above grade and extend shaft to required elevation where cut-off elevation is above the ground elevation.
- .9 Protect and cure concrete in accordance with CSA A23.1, and as listed in Section 03 30 00 – Cast-In-Place Concrete.

3.6 PILE CAPS

- .1 Inform the Consultant and bidding Contractor before tender closing if pile caps other than as shown on the drawings are required.
- .2 Project pile shaft reinforcing to 76 mm (3") below the top of the pile cap where pile caps are shown.
- .3 Dowels from cap to a column or wall shall match the column or vertical wall reinforcement; enclose column dowels in ties of the size and spacing used for the column.

3.7 FIELD QUALITY CONTROL

- .1 Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit reports during excavation and concrete placement for drilled concrete piles.
- .2 Pile Testing: In addition to concrete testing listed in Section 03 30 00, the following tests and reports will be conducted:
 - .1 Actual top and bottom elevations.
 - .2 Description of soil materials.
 - .3 Description, location, and dimensions of obstructions.
 - .4 Final top centreline location and deviations from requirements.
 - .5 Variation of shaft from plumb.
 - .6 Shaft excavating method.
 - .7 Design and tested bearing capacity of bottom.
 - .8 Level of bottom and adequacy of cleanout.
 - .9 Ground water conditions and water infiltration rate, depth, and pumping.

- .10 Description, diameter, and top and bottom elevations of temporary or permanent casings.
 - .11 Description of soil or water movement, sidewall stability, loss of ground, and means of control.
 - .12 Date and time of starting and completing excavation.
 - .13 Inspection report.
 - .14 Position of reinforcing steel.
 - .15 Concrete placing method, including elevation of consolidation and delays.
 - .16 Elevation of concrete during removal of casings.
 - .17 Locations of construction joints.
 - .18 Remarks, unusual conditions encountered, and deviations from requirements.
- .3 Testing agency will take undisturbed hardpan or rock core samples from drilled concrete pile bottoms; test each sample for compression, moisture content, and density; and report results and evaluations.
- .4 Bottom elevations, bearing capacities, and lengths of drilled concrete piles indicated have been estimated from available soil data:
- .1 Actual elevations and drilled concrete pile lengths and bearing capacities will be determined by testing and inspecting agency.
 - .2 Final evaluations and acceptance of data will be determined by Departmental Representative.

3.8 DISPOSAL OF MATERIALS

- .1 Remove surplus excavated material and slurry, and legally dispose of off property.

END OF SECTION