CONSTRUCTION SPECIFICATION FOR FOOTINGS AND PADS FOR ELECTRICAL EQUIPMENT

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616.01 SCOPE

This specification covers the requirements for the installation of footings and pads required for mounting electrical equipment.

616.01.01 Specification Significance and Use

This specification has been developed for use in municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

Use of this specification or any other specification shall be according to the Contract Documents.

616.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

616.02 REFERENCES

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 501	Compacting
OPSS 603	Installation of Ducts
OPSS 610	Removal of Electrical Equipment and Materials
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1308	Joint Filler in Concrete
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
W59-13	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 53/A 53M-12	Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded, and Seamless
A 193/A 193M-17	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Services and Other Special Purpose Applications
A 563M-15	Carbon and Alloy Steel Nuts

American National Standards Institute (ANSI)

B18.22.1-1965 (R2008) Plain Washers

Society of Automobile Engineers (SAE)

J403 - 2014 Chemical Composition of SAE Carbon Steels

616.05 MATERIALS

616.05.01 Concrete

Concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

616.05.02 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

616.05.03 Granular Material

Granular materials shall be Granular A or B according to OPSS 1010.

616.05.04 Ducts and Fittings

Ducts and fittings shall be according to OPSS 603.

616.05.05 Anchorage Assemblies and Hardware

All steel components shall be hot dipped galvanized according to CAN/CSA G164.

616.05.05.01 Anchor Assembly Struts

Anchor assembly struts shall be grade SAE 1030 steel according to SAE J403.

616.05.05.02 Studs, Nuts, and Washers

Studs shall be grade SAE C1541 steel according to SAE J403, high tensile stress proof with a yield strength of 690 MPa, and a tensile strength of 860 MPa.

Hex nuts shall be steel grade B steel according to ASTM A 563.

Washers shall be according to ANSI B18.22.1.

616.05.05.03 Ferrules

Steel ferrules shall be grade AISI C12L14 rotoprobed bar according to SAE J403.

616.05.06 Steel Footings and Hardware

Steel footings and hardware shall be grade SAE 1020 steel according to SAE J403.

Steel top plates and steel equipment base plate shall be according to CSA G40.20/G40.21, Grade 260WT minimum.

Steel for footing shafts smaller than 150 mm in diameter shall be according to ASTM A 53.

Steel for footing shafts 150 mm and larger in diameter shall be hollow structural sections according to CSA G40.20/G40.21, Grade 350W minimum.

Welding of the top plate shall be according to CSA W59 minimum.

Steel footings, steel equipment base plate, and mounting hardware shall be hot dip galvanized according to CSA G164.

Stainless steel bolts, nuts, and flat washers shall be according to ASTM A 193.

616.05.07 H-Section Assemblies and Hardware

H-section assemblies and hardware shall be grade SAE 1020 steel according to SAE J403.

Steel plate for H-section and the H-section shall be according to CSA G40.20/G40.21, Grade 260WT minimum.

H-section shall be HP200x54.

All welding shall be according to CSA W59 minimum.

H-section anchorage assemblies and mounting hardware shall be hot dip galvanized according to CAN/CSA G164.

616.05.08 Joint Filler

Expansion joint filler shall be Type A or B according to OPSS 1308.

616.05.09 Grout

Grout shall consist of a mixture of one part Portland cement according to OPSS 1301 and two parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302.

616.05.10 Wooden Pads

Wooden pads for controller cabinet shall be as specified in the Contract Documents.

616.06 EQUIPMENT

Equipment for the installation of steel footings shall be according to the following minimum requirements:

a) Boom truck complete with hydraulic take-off.

b) Hydraulically operated torque head with a minimum torque rating of 16,000 N·m complete with Kelly bar drive.

c) Kelly bar adapter and universal driving plate.

d) Torque indicator.

616.07 CONSTRUCTION

616.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

616.07.02 Removal

Removals shall be according to OPSS 610.

616.07.03 Concrete Footings and Pads

616.07.03.01 General

616.07.03.01.01 Excavation

Earth excavation for footings shall be carried out by mechanical excavation or by hand digging.

Rock excavation shall be according OPSS 206.

616.07.03.01.02 Steel Reinforcement

Steel reinforcement shall be according to OPSS 905.

616.07.03.01.03 Concrete

Concrete shall be placed, finished, cured, and protected according to OPSS 904. Concrete shall be sampled and tested according to OPSS 1350.

Concrete in earth shall be placed directly against the undisturbed walls of the excavation or may be formed in place, provided that a minimum of 300 mm width is available for placing granular backfill. The upper portion of the footing shall be formed to a minimum of 75 mm below grade level.

When concrete is placed immediately adjacent to other concrete structures or pavement, expansion joint filler shall be installed around the abutting edge of the footing.

Concrete finish for footings installed in concrete barrier wall shall match the barrier wall finish.

616.07.03.01.04 Grading

The Contractor shall excavate and place fill material to the finished grade elevation according to OPSS 206.

616.07.03.02 Concrete Footings

616.07.03.02.01 Sleeves and Ducts

Sleeves for footings shall be accurately located to suit incoming ducts or cable systems and shall be securely tied to the steel reinforcement prior to placing concrete.

All sleeves or ducts shall be cut off cleanly above the footing at the height specified in the Contract Documents.

Sleeves or ducts shall be temporarily plugged or sealed until wiring is installed. Where ducts or sleeves are specified as spare or intended for future use, the ducts or sleeves shall be plugged with plastic plugs.

Location of sleeves or ducts shall be marked on the top of the concrete footing with a 50 x 50 mm cut or formed cross.

616.07.03.02.02 Anchorage Assemblies

Anchorage assemblies shall be installed using studs as specified in the Contract Documents.

Anchorage assemblies of the size and type specified in the Contract Documents shall be accurately positioned in the pole and sign footings. The alignment of the studs shall be parallel to the edge of the driving lane. Anchorage assemblies shall be securely tied to the steel reinforcement.

Studs shall be factory inserted in the ferrules and held in place with a pre-applied thread locking compound. A wooden template shall be provided. Nuts and washers shall be installed hand tight by the fabricator. Studs shall have the exposed threads above the ferrule coated with factory applied white lithium grease. The integrity of the compound shall be maintained throughout the installation and no attempt shall be made to remove or adjust the studs.

The anchorage assembly shall be installed and adjusted level in all directions on the wooden template using a carpenter's level. Upon initial concrete set, the wooden template shall be removed and the drainage channels and other surface features shall be completed.

When the removal of the studs for repair or replacement purposes is required, the ferrules and the studs shall be cleaned to remove the old thread locking compound. New thread locking compound shall be applied to the insertion length of the studs prior to tightening to full depth.

616.07.03.02.03 H-Section Assemblies

H-section for barrier walls shall be accurately positioned in the concrete footings under the concrete barrier. The alignment of the studs shall be parallel to the edge of the driving lane. The plumb position of the anchorage assemblies shall be maintained during the placing of concrete.

616.07.03.02.04 Concrete

Concrete pole footings shall be placed so that the top of the footing is within $\pm$ 25 mm of the elevation specified in the Contract Documents.

616.07.03.02.05 Granular Backfill

When granular backfill is specified in the Contract Documents or, when granular backfill is placed around footings, it shall be compacted according to OPSS 501.

616.07.03.02.06 Concrete Footings in Earth

Concrete footings in earth shall be placed at locations specified in the Contract Documents.

616.07.03.02.07 Concrete Footings in Rock

The work for concrete footings in rock shall include placing dowels and concrete. Concrete footings in rock shall to be placed at locations specified in the Contract Documents.

616.07.03.02.07.01 Dowels in Rock

When specified in the Contract Documents, steel dowel bars shall be installed. Dowel bars shall be grouted in holes drilled into rock using non-shrink grout.

616.07.03.03 Concrete Pads

Concrete pads shall be placed at locations specified in the Contract Documents.

616.07.03.03.01 Granular Bases

Granular material shall be placed as foundation for concrete pads. Granular material shall be placed in conjunction with the installation of ducts under the concrete pads. The granular base shall be compacted according to OPSS 501.

616.07.03.03.02 Sleeves and Ducts

Sleeves and ducts shall be located within the concrete pads as specified in the Contract Documents so that cables may be installed vertically to the cable terminations in the pad mounted equipment.

Ducts shall be installed below pads according to OPSS 603 and shall be suitably aligned for connection to exterior duct or cable systems.

616.07.04 Steel Footings

616.07.04.01 Installation

The Contractor shall install steel footings larger than 150 mm diameter using the equipment as outlined in the Equipment section. Alternate methods of applying torque are permitted for 150 mm diameter or smaller steel footings.

During installation, the steel footing shall be maintained in a plumb position by use of a carpenter's level or a survey instrument. In all cases, the steel footing shall be installed so that the final location of the top plate rests on or is slightly below final grade. Steel footings to be used for poles shall be oriented such that the top plate is either perpendicular to or parallel to the edge of pavement, as required by duct orientation. Steel footings for other equipment mounting shall be oriented to suit the equipment to be mounted.

Steel footings shall be installed by turning the units into the earth at locations specified in the Contract Documents. Torque on footings larger than 150 mm in diameter shall be monitored and recorded during the turning operation and shall show a consistent and gradually increasing torque as the footing advances in depth.

When difficulties are encountered installing the steel footing due to the presence of boulders or rock fragments; or where the torque required to install the footing exceeds 20,000 N·m; or where the torque is less than 5,000 N·m when the shaft is fully driven into the ground, the footing shall be withdrawn and relocated 1.0 m minimum away from the original position, as approved by the Contract Administrator. If turning of the footing proves impractical, a pilot hole of 150 mm diameter may be predrilled and the footings then turned into the pilot hole. If this method proves impractical, a hole of 300 mm maximum diameter may be augured and the footing then installed into the hole. Compacted limestone screenings or expandable foam backfill shall be placed around the shaft to the bottom of the wiring aperture. Backfill of native material shall be placed above this level and compacted according to OPSS 501.

If the steel footings cannot be installed due to local conditions, a concrete footing shall be installed.

616.07.04.02 Mounting Hardware and Steel Equipment Base Plate

The mounting hardware and steel equipment base plate shall be installed as specified in the Contract Documents.

616.07.05 Wooden Pads

616.07.05.01 Installation

Wooden pads for controller cabinets shall be fabricated and placed at locations specified in the Contract Documents.

616.07.05.02 Granular Bases

A granular base shall be installed as a foundation for wooden pads. Granular material shall be placed in conjunction with the installation of ducts under the wooden pads. The granular base shall be compacted according to OPSS 501.

616.07.05.03 Sleeves and Ducts

Sleeves in wooden pads shall be located so that cables may be installed vertically to the cable terminations in the pad mounted equipment. Ducts shall be installed below the pads according to OPSS 603 and shall be suitably aligned for connection to exterior duct or cable systems.

616.07.06 Quality Control

616.07.06.01 Pre-Installation Testing and Inspection

Anchorage assemblies, studs or bolts, and connection components shall be inspected prior to installation to ensure that they are according to the Contract Documents.

616.07.06.02 Proof of Performance Testing and Inspection

The work shall be inspected to ensure that it is according to the Contract Documents. The work shall be inspected to ensure that all components are installed and that all footings and pads, including anchorage assemblies, are properly oriented and in working order.

616.07.07 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except that the work shall include the removal of the installations when they are no longer required.

616.07.08 Site Restoration

Site restoration shall be according to OPSS 492.

616.07.09 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

616.08 QUALITY ASSURANCE

The Owner may perform tests for concrete according to OPSS 1350.

The Owner may perform tests for compaction according to OPSS 501.

The Owner may inspect each pole footing as specified in the Contract Documents.

616.09 MEASUREMENT FOR PAYMENT

616.09.01 Actual Measurement

616.09.01.01 Concrete Footings in Earth

For measurement purposes, a count shall be made of the number of concrete footings installed in earth.

616.09.01.02 Concrete Footings in Rock

For measurement purposes, a count shall be made of the number of concrete footings installed in rock.

616.09.01.03 Concrete Pads

For measurement purposes, a count shall be made of the number of concrete pads installed.

616.09.01.04 Steel Footings

For measurement purposes, a count shall be made of the number of steel footings installed.

616.09.01.05 Wooden Pads

For measurement purposes, a count shall be made of the number of wooden pads installed.

616.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

616.10 BASIS OF PAYMENT

616.10.01 Concrete Footings in Earth - Item
Concrete Footings in Rock - Item
Concrete Pads - Item
Steel Footings - Item
Wooden Pads - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When a specified steel footing cannot be placed due to local conditions and a concrete footing is installed in its place, such work shall be paid as Extra Work.

616.10.02 **Concrete Footings in Earth, Temporary - Item**
Concrete Footings in Rock, Temporary - Item
Concrete Pads, Temporary - Item
Steel Footings, Temporary - Item
Wooden Pads, Temporary - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Progress payment for the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation

20% for removal

Appendix 616-A, April 2018
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Wooden pad requirements. (616.05.10)

- Cut-off grade for sleeves and ducts. (616.07.03.02.01)

- Size and type of anchorage assemblies. (616.07.03.02.02)

- Top of concrete pole footing elevation. (616.07.03.02.04)

- Concrete footing in rock locations. (616.07.03.02.07)

- Concrete pad locations. (616.07.03.03)

- Steel footing locations. (616.07.04.01)

- Wooden pad locations. (616.07.05.01)

OPS standards for pole footings do not apply to cohesionless soils. The designer should confirm that the soils are cohesive soils before applying the OPS standards.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2200.010	Concrete Footing for Base Mounted Lighting and Signal Poles
OPSD 2200.020	Concrete Foundation for Direct Buried Lighting Poles Where Rock is Encountered
OPSD 2200.030	Concrete Foundation for Base Mounted Lighting Poles Where Rock is Encountered
OPSD 2200.040	Concrete Footing and Anchorage Assembly for 3.3 m Base Mounted Metal Pole
OPSD 2200.070	Pole Footing in Earth for Cast-in-Place Concrete Barrier
OPSD 2200.080	Pole Footing in Rock for Cast-in-Place Concrete Barrier
OPSD 2203.030	Steel Equipment Base Plate for Controller Cabinet
OPSD 2210.010	Local Grading at Pole Foundations
OPSD 2210.020	Installation of Direct Buried Poles in Slopes
OPSD 2215.020	Anchorage Assembly
OPSD 2215.030	Pole Mounting Details for Base Mounted Metal Pole
OPSD 2216.010	Anchorage Assembly for Pole Footing in Concrete Barrier
OPSD 2514.020	Concrete Pad for Controller Cabinet