



**CONSTRUCTION SPECIFICATION FOR  
FOOTINGS AND PADS FOR ELECTRICAL EQUIPMENT**

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**TABLE OF CONTENTS**

<b>616.01</b>	<b>SCOPE</b>
<b>616.02</b>	<b>REFERENCES</b>
<b>616.03</b>	<b>DEFINITIONS - Not Used</b>
<b>616.04</b>	<b>DESIGN AND SUBMISSION REQUIREMENTS - Not Used</b>
<b>616.05</b>	<b>MATERIALS</b>
<b>616.06</b>	<b>EQUIPMENT</b>
<b>616.07</b>	<b>CONSTRUCTION</b>
<b>616.08</b>	<b>QUALITY ASSURANCE</b>
<b>616.09</b>	<b>MEASUREMENT FOR PAYMENT</b>
<b>616.10</b>	<b>BASIS OF PAYMENT</b>

**616.01 SCOPE**

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

**616.02 REFERENCES**

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
OPSS1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

### **CSA Standards**

G40.20/G40.21-13	General Requirements for Rolled or Welded Steel/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 - Dec 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 350 W 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. When additional excavation is required beyond the neat limits, such excavation shall be a minimum of 300 mm width beyond the neat dimensions of the footing to accommodate granular backfill.

When unsuitable material is encountered in the excavation, it shall be removed and replaced with material approved by the Contract Administrator.

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**

Fill material shall be excavated and placed 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**

Steel footings larger than 150 mm diameter shall be installed 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 directed by the Contract Administrator. If turning of the footing proves impractical, a pilot hole of 150 mm diameter may be pre-drilled 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