CONSTRUCTION SPECIFICATION FOR BURIED CORRUGATED STEEL STRUCTURES WITH SPAN GREATER THAN 3.0 M

TABLE OF CONTENTS

960.01 SCOPE

This specification covers the construction requirements of buried corrugated steel structures with spans greater than 3.0 m and made up of structural plate corrugated steel or deep corrugated structural plate for new structures and replacement of existing structures.

960.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction

OPSS 206 Grading
OPSS 209 Embankment Over Swamps
OPSS 404 Support Systems
OPSS 501 Compacting
OPSS 511 Rip-Rap, Rock Protection, and Granular Sheeting
OPSS 517 Dewatering and Temporary Flow Passage Systems
OPSS 539 Temporary Protection Systems
OPSS 902 Excavating and Backfilling - Structures
OPSS 904 Concrete Structures
OPSS 905 Steel Reinforcement for Concrete
OPSS 911 Coating Structural Steel and Railing Systems

Ontario Provincial Standards Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1205	Clay Seal
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1805	Corrugated Steel Structural Plate
OPSS 1860	Geotextiles
OPSS 1863	Geomembranes

Ontario Ministry of Transportation Publications

Structural Manual

MTO Laboratory Testing Manual:
LS-706 Moisture - Density Relationship of Soils Using 2.5 kg Rammer and a 305 mm Drop

MTO Designated Sources for Materials (DSM):
9.20.60 Paint Coating Systems for Galvanized Surfaces

MTO Forms:

PH-CC-701	Request to Proceed
PH-CC-702	Notice to Proceed
PH-CC-821	Manufacturer's Certificate of Conformance
PH-CC-822	Certificate of Conformance

CSA Standards

G40.20-13/40.21-13 (R2023)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G401:24	Corrugated Steel Pipe and Buried Structures
S6:25	Canadian Highway Bridge Design Code

ASTM International

A123/A123M-24	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A807/A807M-19	Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
D6938-23	Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

960.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Appurtenances means head walls, cut-off walls, aprons, collars and any other fixtures requiring individual design considerations associated with the structure and excludes concrete bedding or concrete structures covered elsewhere in the Contract Documents.

Backfill means granular material used as fill within the excavation placed beneath, around, and above a buried structure and below the subgrade elevation, including frost tapers.

Bedding means the material used to cushion and evenly distribute the soil reaction at the bottom of the structure.

Buried Corrugated Steel Structures means an open-bottom or closed-bottom structure with a span greater than 3.0 m that is typically embedded in fill and is used to convey water, pedestrians, vehicles, cyclists, or animals and is made up of structural plate corrugated steel or deep corrugated structural plate.

Camber means a deliberate adjustment required in the longitudinal profile of bedding to compensate for post-construction settlement along the longitudinal axis of the structure.

Corrugated Steel Structural Plate means corrugated steel elements satisfying the requirements for deep corrugated structural plate or structural plate corrugated steel and used for the construction of buried corrugated steel structures.

Crimping means the local buckling of a buried corrugated steel structure wall, usually near areas of higher curvature.

Cusping means the abrupt change in curvature of a buried corrugated steel structure wall, typically at a longitudinal seam, leading to lifting of adjacent plates.

Deep Corrugated Structural Plate means hot-rolled sheets or plates that are corrugated as described in the Types below, curved to radius, coated, assembled, and bolted together to form arches, round structures, horizontal ellipses, box structures, or other shapes.

a) Type I - a deep corrugated structural plate with a 381 pitch × 140 mm depth corrugation;

b) Type II - a deep corrugated structural plate with a 400 pitch × 150 mm depth corrugation; and

c) Type III - a deep corrugated structural plate with a 500 pitch × 237 mm depth corrugation.

Delivered Quality means the plate products' physical condition upon arrival at the Working Area in terms of the extent and degree of the dents, scratches, cracks, plate coating integrity, etc., that appear on the plate products delivered.

Design Service Life means a period of time, specified by the Owner, during which a structure is intended to remain in service.

Engineered Fill means a backfill material which is specified to consist of prescribed characteristics, including material constituents, gradation, moisture content, and placement compaction criteria, so that it will exhibit a required engineering behaviour once in place.

Granular Cover means the material placed as a protective layer above the culvert to prevent damage to the culvert.

Heavy Equipment means any equipment or vehicles, or both, heavier than a 10-tonne static unballasted mass and typically used for grading or removal operations such as dump trucks, bulldozers, backhoes, excavators and large compaction or vibratory equipment.

Invert means the lowest interior level of a buried structure at a transverse section.

Light Equipment means any equipment which can be manually propelled such as a small-plate tamper and is not heavier than a 10-tonne static unballasted mass.

Rise means the maximum inside vertical distance at the centreline of a structure's cross-section, measured between the inside crests of corrugations for closed buried structures, or from the top of the footing to the inside crest of the corrugation at the obvert for open buried structures.

Soil means as defined in OPSS 902.

Span means the maximum inside horizontal distance between the sidewalls of a structure's cross-section, measured between the inside crests of corrugations.

Spring Line means the locus of the outermost point of the sides of a buried structure.

Structural Plate Corrugated Steel means hot-rolled sheets or plates that are Type I corrugated structural plate with a pitch of 152 mm and a depth of 51 mm, are curved to radius, coated, assembled, and bolted together to form pipes, arches, pipe-arches, or other shapes.

960.04 DESIGN AND SUBMISSION REQUIREMENTS

960.04.01 Design Requirements

960.04.01.01 Corrugated Steel Structures

The design shall meet the requirements specified in the Contract Documents, CSA S6, and the Structural Manual, Division 1.

Unless otherwise specified in the Contract Documents, the buried corrugated steel structure, coating system, structure foundation, and geomembrane, where required, shall be designed for a design service life of 75 years.

The design of joint treatment shall meet the performance requirements specified in the Contract Documents.

Unless otherwise specified in the Contract Documents, the final geometry, corrugation profile, and final plate thickness shall be designed. The final geometry shall satisfy the clearances specified in the Contract Documents.

960.04.02 Submission Requirements

960.04.02.01 Working Drawings

One electronic copy in PDF format of Working Drawings, including supporting documentation, shall be submitted to the Contract Administrator at least 14 Days prior to fabrication of the corrugated steel structural plates, for information purposes only. All Working Drawings shall bear the seal and signature of an Engineer verifying that they are consistent with the Contract Documents. Designs completed by the Contractor require the seal and signature of both a design Engineer and a design-checking Engineer.

Where multi-discipline engineering work is depicted on the same Shop Drawing and a single Engineer is unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional Engineers as necessary.

When other authorities are involved in the approval of the design or construction of the structure, the submission of Working Drawings shall be made at least 35 Days prior to fabrication of the corrugated steel structural plate elements, and one additional copy of the submission shall be provided for each authority. The requirements of each authority and the requirements of the Owner as specified in the Contract Documents shall be satisfied prior to commencement of the work.

1. The Working Drawings shall include as a minimum the following information:

a) Full detail dimensions and sizes of all components of the structure. These dimensions shall make allowance for changes in shape due to camber, and any other effects that cause finished dimensions to differ from initial dimensions;

b) Elevation, plan, and section view of the structure and any associated components;

c) Corrugation profile, wall thickness, and protective coating;

d) Plate Layout: flat view, plate lap and assembly detail, cross-section detail of all plate laps, and plate assembly guidelines;

e) Anchor bolt layout and details, if applicable;

f) Installation instructions;

i. Assembly of structure;
ii. Joint requirements between adjacent corrugated steel structural plates;
iii. Bolts - size, type, torque requirements, installation requirements, and coating;
iv. Dimensional check of structure during assembly and backfilling operation; and
v. Lifting point locations, when adjacent rings of the buried corrugated steel structure are pre-assembled and then lifted as part of the installation process.

g) Any other details required to complete the fabrication and erection of the structure according to the design;

h) Details for:

i. Bedding, Backfill, Engineered Backfill:

(1) type of material to be used,
(2) method of installation,
(3) material gradation and chemical properties,
(4) material unit weight,
(5) material test results, according to OPSS 1010.

ii. Geomembrane System: type of geomembrane system to be used, and extent of installation; and
iii. Joint requirements between structure units, at construction joints, seams, and bolts.

i) Any other applicable details.

2. The supporting documents shall include, as a minimum, the following information:

a) Handling and installation procedures, including supporting calculations and lifting point locations;

b) Transportation and storage of components;

c) Details of any bracing if required to provide stability to the elements during transportation and construction; and

d) Design calculations for any components altered from or not specified on the Contract Documents.

A copy of the Working Drawings and supporting documents shall be kept at the Working Area at all times.

960.04.02.02 Manufacturer's Representative

The name(s) of the manufacturer's representatives shall be submitted in writing to the Contract Administrator at least 14 Days prior to the commencement of fabrication of the corrugated steel structural plates.

960.05 MATERIALS

960.05.01 Appurtenances

Supply and installation of appurtenances and all associated hardware required for installation shall be as specified in the Contract Documents.

All steel used for appurtenances shall be according to CSA G40.20/G40.21 and have a minimum thickness of 3.4 mm.

The steel components for appurtenances shall be hot dip galvanized after fabrication according to ASTM A123, when specified in the Contract Documents.

Steel appurtenances shall be coated with a thermoplastic copolymer coating according to CSA G401, when specified in the Contract Documents.

Steel appurtenances shall be coated with an epoxy duplex system coating according to OPSS 911, when specified in the Contract Documents.

Cast-in-place concrete used for appurtenances shall be according to OPSS 1350 and as specified in the Contract Documents. Precast concrete used for appurtenances shall be according to OPSS 1355.

Reinforcement used in concrete shall be according to OPSS 1440 and as specified in the Contract Documents.

960.05.02 Backfill

960.05.02.01 Backfill to Structure

Backfill to the structure shall be engineered fill as specified in the Contract Documents and shall satisfy the requirements of the buried corrugated steel structure manufacturer.

When Granular A is specified in the Contract Documents, the Granular A shall be according to OPSS 1010.

When Granular B is specified in the Contract Documents, the Granular B shall be Type I or II, with 100% passing the 26.5 mm sieve, according to OPSS 1010.

When applicable, the 19.0 mm clear stone to be used for geomembrane drainage shall be according to OPSS 1004.

912.05.02.02 Backfill Beyond Engineered Fill

Backfill beyond the engineered fill shall as specified in the Contract Documents.

When Granular A is specified in the Contract Documents, the Granular A shall be according to OPSS 1010.

When Granular B is specified in the Contract Documents, the Granular B shall be Type I or II, with 100% passing the 26.5 mm sieve, according to OPSS 1010.

When rock backfill is specified in the Contract Documents, it shall be according to the Rock Backfill to Structure subsection of OPSS 206.

When native material is specified in the Contract Documents, the native material shall be as specified in the Native Material subsection.

960.05.03 Bedding Material

Bedding shall be as specified in the Contract Documents. The nominal maximum aggregate size for bedding shall not exceed 26.5 mm in diameter, unless the bedding layer has a thickness of 150 mm or greater, in which case the nominal maximum aggregate size shall not exceed 37.5 mm in diameter.

Granular aggregate materials shall be according to OPSS 1010.

960.05.04 Clay Seal

Clay seal shall be according to OPSS 1205.

960.05.05 Corrugated Steel Structural Plate

The corrugated steel structural plate for buried corrugated steel structures shall be according to OPSS 1805 and shall be as specified in the Contract Documents.

960.05.06 Geomembrane

Geomembrane shall form an impervious waterproofing barrier and shall be according to OPSS 1863.

All seams in the geomembrane shall be welded according to OPSS 1863 and shall satisfy the requirements of the manufacturer to prevent water infiltration.

960.05.07 Geotextile

Geotextiles shall be according to OPSS 1860 and shall be of the type, class and filtration opening size (FOS) specified in the Contract Documents.

960.05.08 Granular Cover

Granular cover shall be an engineered fill as specified in the Contract Documents and shall satisfy the requirements of the buried corrugated steel structure manufacturer.

When Granular A is specified in the Contract Documents, the Granular A shall be according to OPSS 1010.

When Granular B is specified in the Contract Documents, the Granular B shall be Type I or II, with 100% passing the 26.5 mm sieve, according to OPSS 1010.

960.05.09 Hardware

Hardware shall be according to CSA G401 for structural plate corrugated steel and deep corrugated structural plate and as specified in the Working Drawings.

When required, anchor bolts for collars, headwalls, wingwalls, toe walls, cut-off walls, splash walls, and the anchorage of open-bottom structures to footings shall be according to CSA G401.

Coating for bolts, nuts, and anchors shall be according to CSA G401, the Working Drawings and supporting documentation, and as specified in the Contract Documents.

960.06 EQUIPMENT

960.06.01 General

Heavy equipment exceeding a 10-tonne static unballasted mass shall be kept at least 1000 mm away from the spring line of the structure up to a minimum granular cover of 300 mm or to a minimum cover specified by the manufacturer's requirements, whichever is greater. Fill within 1000 mm of the spring line of the structure shall be placed and compacted using hand-held or light equipment.

Exceptions to the above may only be permitted when specified by manufacturer specifications.

960.07 CONSTRUCTION

960.07.01 Manufacturer Representative

A manufacturer representative shall be present at the Working Area at the following intervals:

a) Throughout the assembly and erection of the first 10% of the buried corrugated steel structure; and

b) After completion of the structural assembly and erection and prior to backfilling operations.

A written notice shall be provided to the Contract Administrator at least 2 Business Days before each visit to the Working Area by the manufacturer's representative.

960.07.02 Storage

Storage of the elements shall be according to OPSS 1805.

960.07.03 Delivery

Delivery of elements shall be according to OPSS 1805.

Delivery shall include transportation, loading and unloading, and storage of the elements.

960.07.04 Foundations - General

The buried corrugated steel structure shall be placed on bedding as specified in the Contract Documents.

When unsuitable material is encountered during excavation for the structure foundation, the unsuitable material shall be removed to competent stratum and replaced to the foundation grade with compacted granular material, as specified in the Contract Documents.

The integrity of the founding soil or rock on which the footing, working slab, or granular pad is to rest shall be protected from environmental conditions and damage from construction operations to avoid disturbance and degradation.

Receiving members and foundations shall be square, on span, and on grade to facilitate assembly, when specified in the Contract Documents.

The final founding elevations shall be as specified in the Contract Documents.

960.07.05 Appurtenances

Concrete used for appurtenances including, but not limited to footings, pile caps, collars, headwalls, and cut-off walls shall be constructed according to OPSS 904 and as specified in the Contract Documents.

Steel reinforcement shall be constructed according to OPSS 905 and as specified in the Contract Documents.

All steel used for appurtenances shall be constructed as specified in the Contract Documents.

960.07.06 Support Systems

Support systems shall be according to OPSS 404.

960.07.07 Temporary Protection Systems

Temporary protection systems shall be according to OPSS 539.

960.07.08 Dewatering

Dewatering shall be according to OPSS 517.

960.07.09 Excavation

The excavation for the installation of the structure shall be according to OPSS 902, including frost tapers and structure end treatments.

Swamp excavation shall be according to OPSS 209.

960.07.10 Inspection after Excavation and Prior to Bedding

After excavation to the limits in the Contract Documents within a construction stage, and prior to the placement of bedding, a MTO Form PH-CC-701, Request to Proceed shall be submitted to the Contract Administrator. The next operation shall not proceed until a MTO Form PH-CC-702, Notice to Proceed has been received from the Contract Administrator.

960.07.11 Bedding

Bedding shall be placed as specified in the Contract Documents and compacted according to OPSS 501.

The bedding shall be placed in uncompacted, uniform layers not exceeding 200 mm in thickness.

Bedding shall ensure uniform support under the full width and length of the structure. The length of the structure shall be the distance measured between the ends of the assembled elements, measured along the longitudinal axis.

Bedding shall not be placed on frozen material. Deicing chemicals shall not be used.

Bedding and subgrade material shall be protected from disturbance and degradation during construction.

960.07.12 Inspection Prior to Installation of the Corrugated Steel Structural Plates

960.07.12.01 Inspection after Bedding and Prior to Installation of the Corrugated Steel Structural Plates

After placement of bedding to the limits specified in the Contract Documents within a construction stage, and prior to the installation of the structure, a MTO Form PH-CC-701, Request to Proceed shall be submitted to the Contract Administrator. The next operation shall not proceed until a MTO Form PH-CC-702, Notice to Proceed has been received from the Contract Administrator.

960.07.12.02 Inspection of Corrugated Steel Structural Plates Prior to Installation

Prior to commencing installation, the Contractor shall inspect all the corrugated steel structural plates on site for any defects or deficiencies. The Contract Administrator shall be notified immediately in writing if any of the corrugated steel structural plates contain defects or deficiencies.

A MTO form PH-CC-701, Request to Proceed shall be submitted to the Contract Administrator prior to installation. The corrugated steel structural plates shall be inspected on site by the Contract Administrator for any defects and deficiencies prior to installation. The Contract Administrator will notify the Contractor immediately in writing if any of the corrugated steel structural plates contain defects or deficiencies.

Any defects or deficiencies identified shall be addressed prior to installation according to the Defects and Deficiencies subsection of OPSS 1805, as applicable.

Installation of corrugated steel structural plates shall not proceed until a MTO form PH-CC-702, Notice to Proceed has been received from the Contract Administrator.

The Contract Administrator shall be granted access to inspect the corrugated steel structural plates after delivery to the site, and prior to installation.

960.07.13 Assembly and Installation of Buried Corrugated Steel Structure

The Contract Administrator shall be notified in writing of the installation date a minimum of 3 Days prior to the commencement of installation. The structure shall be assembled and erected according to the manufacturer's specifications.

Plates at longitudinal and circumferential seams shall be connected by bolts, with the seams staggered so that not more than three plates meet at any one point. Structures with circumferential seams shall be installed with the inside circumferential plate laps pointing downstream, unless noted otherwise on the Working Drawings and approved by the Contract Administrator.

Adjacent corrugated steel structural plates joined to form rings shall be overlapped to ensure that the bolts connecting the plates are placed in the valley of the corrugation profile closest to the visible edge.

The work shall consist of installation and stabilization of the elements. Elements shall be lifted and placed in a manner to ensure they are not overstressed, unstable, or unsafe at any time.

Plates shall not be rolled or dragged over gravel or rock and shall be prevented from striking rock or other hard objects during placement in the trench or bedding.

Unless held in shape by cables, struts, or backfill, longitudinal seams should be tightened when plates are hung. Care shall be taken to align plates to ensure properly fitted seams prior to bolt tightening.

Reinforcing ribs, when specified in the Contract Documents, shall be attached prior to backfilling.

Bolts shall be of sufficient length to provide full thread engagement in the nut when assembled plates are tightened in place and to fasten appurtenances, when specified by the Contract Documents.

Bolts shall be tightened in accordance with ASTM A807/A807M such that the torque on the bolts prior to backfilling is between 200 and 340 Nm. Five percent (5%) of the installed bolts shall be randomly selected by the Contract Administrator and tested in the presence of the Contract Administrator to ensure proper installation.

The total length of the structure shall be as specified on the Contract Drawings.

When required by the Working Drawings and supporting documentation, temporary bracing shall be installed and shall remain in place as long as necessary to protect workers and to maintain the shape of the structure during erection. Any temporary bracing or cabling shall not be removed until the backfill is placed to an elevation which provides the necessary support, according to manufacturer specifications.

Longitudinal and transverse alignment shall be maintained. If struts or cables are used to maintain the structure shape during assembly or backfilling, they shall be removed before they restrict the downward movement of the crown of the structure, according to manufacturer specifications.

The structure shall be set true to the elevations, alignment, geometry, and camber specified in the Contract Documents within the following variations:

a) The span and rise of the assembled structure shall be within 1% of the dimensions specified in the Contract Documents.

b) Variations in alignment shall not exceed ± 25 mm vertically along the length of the structure and ± 300 mm horizontally. The variations in alignment shall be measured from the invert or top of footing.

c) Side-to-side racking of the structure shall not exceed 1% of the rise.

For dimensional tolerances not specified in the Contract Documents, the maximum allowable dimensional variation shall be 1:800 or ± 5 mm, whichever is greater.

Installation and assembly shall also satisfy the dimensional tolerances specified by manufacturer specifications. In case of a conflict, the more stringent dimensional tolerances shall govern.

The span and rise of the structure shall be measured and recorded along the length of the structure after the torquing of bolts. Records shall also demonstrate that the measurements are within the specified tolerances.

960.07.14 Joints Between Elements

Field joints between successive corrugated steel structural plate sections shall form a continuous line free from appreciable irregularities in the flow line.

Each joint shall be constructed according to the manufacturer’s requirements and as specified in the Contract Documents to prevent infiltration of soil and fines.

The interface between the structure and appurtenances shall be constructed according to the manufacturer’s requirements and as specified by the Contract Documents.

960.07.15 Inspection after the Installation of the Structure and Prior to Backfilling

After installation of all elements of a structure within a construction stage, and prior to backfilling, the following documentation shall be submitted to the Contract Administrator:

a) A MTO form PH-CC-701, Request to Proceed;

b) A MTO form PH-CC-822, Certificate of Conformance from the manufacturer's representative confirming that the structure satisfies the requirements of the Contract Documents and adheres to the Working Drawings and supporting documentation;

c) The recorded span and rise of the structure after the torquing of bolts;

d) Variations in the dimensions specified in the Contract Documents; and

e) The adherence to the required tolerances.

The next operation shall not proceed until a MTO Form PH-CC-702, Notice to Proceed has been received from the Contract Administrator.

960.07.16 Backfilling

960.07.16.01 General

All backfill placement and compaction procedures shall be according to OPSS 902, the Working Drawings and as specified in the Contract Documents.

Structure components shall be monitored regularly during backfilling for evidence of cusping, crimping, or localized deformations. The upward or downward crown deflection of the structure shall not exceed:

a) For box structures: 1% of the span prior to backfilling to a maximum deflection of 80 mm.

b) For all other structural shapes: 2% of the rise prior to backfilling.

The dimensional tolerances specified in the Contract Documents for the assembly and installation of the structure shall be satisfied.

If, during backfilling operations, dimensional tolerances are exceeded, backfilling operations shall be halted, the Contract Administrator and manufacturer's representative shall be notified and a MTO form PH-CC-701, Request to Proceed shall be submitted to the Contract Administrator.

Backfilling operations shall not resume until a MTO form PH-CC-702, Notice to Proceed is received from the Contract Administrator.

960.07.16.02 Backfill to Structure

Truck end-dumping or dozer placement against the sides of the structure shall not be permitted. No material shall be dumped on top of the structure. The backfill shall be placed on both sides of the structure and spread in layers according to the manufacturer's specifications, but shall not exceed a maximum loose lift thickness of 250 mm.

Backfilling around the structure shall proceed evenly on both sides of the structure. The differential in surface elevation of the backfill material on each side of the structure and individual components shall not exceed the thickness of two compacted lifts.

Backfill shall be placed without any damage to the structure or movement of the structure beyond the acceptable tolerances specified in the Contract Documents.

960.07.16.03 Light Equipment Compaction Zone

Heavy equipment shall not be permitted in the light equipment compaction zone.

The light equipment compaction zone shall include the area shown on the Contract Documents, or as required by the manufacturer specifications, whichever is greater. The initial covering of the top of the structure shall be performed in the presence of the Contract Administrator. Engineered fill placed above the crown of the structure shall be placed evenly from both sides in a balanced fashion. Heavy equipment shall not pass over the structure prior to the completion of the light equipment compaction zone.

Material within the light equipment compaction zone shall be placed in layers having a maximum loose lift thickness of 200 mm, and each layer shall be compacted according to OPSS 501. The material shall be placed without any damage to the structure.

960.07.16.04 Backfill Beyond Engineered Fill

Backfill placed beyond and adjacent to the engineered fill zone shall be according to OPSS 902 with the addition that the maximum loose lift thickness shall be 500 mm.

960.07.17 Geomembrane

As specified in the Contract Documents, the geomembrane shall be suspended in the backfill above the structure.

The installation of the geomembrane shall be as specified in the Contract Documents and according to the requirements of the geomembrane manufacturer. Geotextile shall be placed immediately above and below the geomembrane and shall extend to the limits of the geomembrane.

The geomembrane shall be installed to ensure positive drainage away from the structure and shall be according to the manufacturer's requirements. The geomembrane shall be sloped to drain away from the high point over the centreline of the structure into an intercepted subdrain which drains out the side of the embankment. The suspended geomembrane shall extend a minimum of half the rise of the buried structure, but not less than 1.5 m, horizontally beyond the outside limit of the spring line of the structure and shall extend the full width of the roadway along the longitudinal axis of the structure.

The surface on which the geomembrane is placed shall provide sufficient support to the geomembrane and shall be prepared to remove protrusions such as large stones, sharp stones, grade stakes, etc. that could puncture the geomembrane. No objects greater than 12 mm (1/2 inch) shall protrude above the prepared surface prior to placement of the geomembrane.

Drains shall include longitudinal fabric wrapped pipes suitable to drain the prevailing surface water conditions.

No vehicular traffic shall travel on the geomembrane prior to backfilling to a depth of 300 mm, or the depth specified by the manufacturer, whichever is greater.

The geomembrane shall be protected from damage during the work, including during compaction of material in contact with the geomembrane.

960.07.18 Clay Seal

When a clay seal is specified in the Contract Documents, the clay seal shall be placed to the dimensions specified in the Contract Documents and compacted to a minimum of 95% of the maximum dry density (MDD). The MDD shall be determined according to LS-706, and carried out on a single representative sample, selected by the Contract Administrator. Field density and field moisture determinations shall be made according to ASTM D6938.

960.07.19 Markings

Permanent markings for the MTO site number shall be in accordance with OPSS 1805.

960.07.20 Inspection after Completion of Backfilling

A MTO form PH-CC-701, Request to Proceed shall be submitted to the Contract Administrator, upon completion of backfilling for each construction stage. The next operation shall not proceed until a MTO form PH-CC-702, Notice to Proceed has been received from the Contract Administrator.

960.07.21 Management of Excess Material

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

960.08 QUALITY ASSURANCE

960.08.01 Acceptance

The acceptance of the structure shall be as specified in this specification and the Contract Documents, including satisfactory completion of any repairs.

960.08.02 Acceptance of Installation Tolerances

The Contract Administrator shall carry out measurements on the installed structure prior to, during, and after any backfilling operations to confirm compliance with installation tolerances. Structures that do not meet the installation tolerances specified in the Contract Documents shall be deemed rejectable.

960.08.03 Field Inspection

The Contract Administrator will inspect the corrugated steel structural plates prior to assembly and installation to determine if the completed work contains any defects or deficiencies.

The Contract Administrator will inspect the assembled and erected buried corrugated steel structure prior to and after backfilling to determine if the completed work contains any defects or deficiencies.

Any defects and deficiencies identified shall be addressed by the Contractor according to the Defects, Deficiencies, and Repairs subsection of OPSS 1805, as applicable.

960.08.04 Acceptance of Bolts and Nuts

Bolts and nuts shall be torqued as specified in the Contract Documents. The bolted assembly shall be accepted when at least 90% of the bolts tested satisfy the torque requirements specified in the Working Drawings and supporting documentation.

960.08.05 Acceptance of Geomembrane

Sampling and testing of the geomembrane shall be according to OPSS 1863. Geomembranes that do not meet the requirements of OPSS 1863 are deemed rejectable and shall be replaced at no additional cost to the Owner.

The geomembrane material shall be removed and replaced if tears, perforations, leakage, and any other defects are present.

960.09 MEASUREMENT FOR PAYMENT

960.09.01 Actual Measurement

960.09.01.01 Buried Corrugated Steel Structure, Fabrication
Buried Corrugated Steel Structure, Delivery and Installation

Measurement for the fabrication, delivery, and installation of buried corrugated steel structures shall be by the horizontal length in metres along the centreline of the invert of the structure.

When multiple cells are required for a single structure, each cell of the structure shall be measured separately.

960.09.01.02 Plan Quantity Measurement

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

960.10 BASIS OF PAYMENT

960.10.01 Buried Corrugated Steel Structure, Fabrication - 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 and shall include the hot dip galvanizing coating or thermoplastic copolymer coating, when specified in the Contract Documents.

Elements deemed rejectable shall be replaced at no additional cost to the owner.

Corrugated steel structural plates that require no further fabrication and are stored at the fabricator's premises in Ontario or some other location in Ontario away from the Working Area shall be eligible to be paid for when the Contractor obtains a lease from the property owner that names the Owner as the tenant. The Owner shall provide the form of lease for this purpose that specifies payment of $1.00 for the term of the lease. The Contractor shall retain full responsibility for the Work.

960.10.02 Buried Corrugated Steel Structure, Delivery and Installation - 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.

Appurtenances and all associated hardware required for installation shall be paid for under the “Buried Corrugated Steel Structure, Delivery and Installation” item, unless otherwise noted in the Contract Documents.

Elements deemed rejectable shall be replaced at no additional cost to the owner.

960.10.03 Epoxy Duplex System Coating

Epoxy duplex system coatings shall be paid at the Contract price for the tender items “Coating New Structural Steel” according to OPSS 911.

960.10.04 Excavation of Structure

Payment for earth and rock excavation shall be at the Contract price for the tender items “Earth Excavation for Structure” and “Rock Excavation for Structure” according to OPSS 902.

960.10.05 Swamp Excavation

Payment for swamp excavation shall be at the Contract price for the tender item Earth Excavation, Grading, according to OPSS 206.

Payment shall not be made for the removal of materials that slide or slough inside the excavation limits.

960.10.06 Geomembrane - Item

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

960.10.07 Geotextile

Payment for geotextile shall be at the Contract price for the tender items “Geotextile” according to OPSS 511.

960.10.08 Granular

Granular material used for bedding, backfill, and frost tapers shall be paid for under the appropriate granular items specified in the Contract Documents.

Payment shall not be made for granular used to fill any area excavated beyond the lines specified in the Contract Documents.

960.10.09 Clay Seal - Item

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