

B410 - PIPE SEWERS - OPSS 410

410.1 GENERAL

A sewer network is required in an urban setting or where open ditches in combination with pipe culverts cannot accomplish drainage of a roadway system, due to restricted property limits or susceptibility of a terrain to erosion.

A sewer is an installation designed for the conveyance of storm water using preformed or pre-cast pipe sections, circular in cross section, laid end to end using suitable jointing material and connected by maintenance holes, catchbasins, ditch inlets or other appurtenances.

All design assumptions and calculations required to design a sewer network shall be retained as part of the design documentation.

410.2 REFERENCES

- MTO Drainage Management Manual
- MTO Gravity Pipe Design Guidelines (2014)
- MTO Highway Drainage Design Standards
- MTO Roadside Safety Manual
- OPSS 100, MTO General Conditions of Contract
- OPSS 209, Embankments Over Swamps and Compressible Soils
- OPSS 401, Trenching, Backfilling, and Compacting
- OPSS 403, Rock Excavation for Pipelines, Utilities, and Associated Structures In Open Cut
- OPSS 492, Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
- OPSS 517, Dewatering
- OPSS 902, Excavating and Backfilling - Structures
- OPSS 904, Concrete Structures

The designer shall also reference other design manuals (i.e., MTO Roadside Safety Manual) as required for design assistance of other roadside features associated with the pipe sewer design.

410.3 TENDER ITEMS

Item Code	Title	Col Type	U.O.M.	PQP
0410-0100	100 mm Pipe Sewer	Variation	m	Y
0410-0200	200 mm Pipe Sewer	Variation	m	Y
0410-0300	300 mm Pipe Sewer	Variation	m	Y
0410-0400	400 mm Pipe Sewer	Variation	m	Y
0410-0500	500 mm Pipe Sewer	Variation	m	Y

Item Code	Title	Col Type	U.O.M.	PQP
0410-0600	600 mm Pipe Sewer	Variation	m	Y
0410-0700	700 mm Pipe Sewer	Variation	m	Y
0410-0800	800 mm Pipe Sewer	Variation	m	Y
0410-0900	900 mm Pipe Sewer	Variation	m	Y
0410-1000	1000 mm Pipe Sewer	Variation	m	Y
0410-1200	1200 mm Pipe Sewer	Variation	m	Y
0410-1300	1300 mm Pipe Sewer	Variation	m	Y
0410-1400	1400 mm Pipe Sewer	Variation	m	Y
0410-1500	1500 mm Pipe Sewer	Variation	m	Y
0410-1600	1600 mm Pipe Sewer	Variation	m	Y
0410-1800	1800 mm Pipe Sewer	Variation	m	Y
0410-1900	1900 mm Pipe Sewer	Variation	m	Y
0410-2000	2000 mm Pipe Sewer	Variation	m	Y
0410-2100	2100 mm Pipe Sewer	Variation	m	Y
0410-2200	2200 mm Pipe Sewer	Variation	m	Y
0410-2400	2400 mm Pipe Sewer	Variation	m	Y
0410-2500	2500 mm Pipe Sewer	Variation	m	Y
0410-2600	2600 mm Pipe Sewer	Variation	m	Y
0410-2700	2700 mm Pipe Sewer	Variation	m	Y
0410-3000	3000 mm Pipe Sewer	Variation	m	Y
0410-4500	Concrete Appurtenances (for Pipe Sewers)	Normal	m3	Y
0410-6000	Service Connections	Variation	m	Y
0410-6400	Clay Seal	Normal	Lump Sum	N

410.4 SPECIFICATIONS

The requirements for the pipe sewer tender items are specified in OPSS 410. The designer shall also reference or note other OPSS documents for construction and materials as identified or required when packaging a Contract.

410.4.1 Appendices

Appendix A - describes the Pipe Sewer tender item variations to be entered by the designer for "size, type, class" on the "Quantities - Sewers" sheets for all ministry Contracts with pipe sewer designs.

Appendix B - describes the size of the Pipe Sewer tender item to be selected for applicable sewer pipe size ranges.

410.5 SPECIAL PROVISIONS

Post installation inspection work is a separate tender item detailed in SSP 499S04.

410.6 STANDARD DRAWINGS

Standard Drawings mean both OPSD and MTOD. Applicable Standard Drawings are contained in the 800 series of the Standard Drawings.; however, other series may also apply.

410.7 DESIGN

410.7.1 Pipe Sewer

The general pipe layout, size, type and class of a pipe sewer network are established by the designer based on acceptable drainage theory. The designer shall use accepted drainage design methods by which to define the pipe sewer layout that satisfies required drainage standards and criteria for the highway project.

Gravity pipe drainage design standards are applicable to sewers and are available in the MTO Highway Drainage Design Standards. Gravity pipe design requirements, analysis methods and other information are available in the MTO Gravity Pipe Design Guidelines and the MTO Drainage Management Manual.

410.7.1.1 Size

The design of a pipe sewer network involves determining the sizes of pipes, in conjunction with pipe type and class availability, which will permit the pipe sewer network to function within set design requirements and standards. The designer will also determine the maximum increase or tolerance range in the pipe size, in conjunction with pipe type and class availability, which will still permit the pipe sewer to function within the design parameters set.

The designer shall also keep in mind the following basic guidelines in laying out the pipe sewer network:

Wherever possible, the invert elevation of a pipe sewer run entering a catch basin should be slightly higher (30 mm) than the invert elevation of the pipe leaving the structure.

Pipe culverts should never flow into a pipe sewer network, but the reverse is permitted.

The spacing of the catch basins is detailed in Section B407, Maintenance Holes, Catch Basins, Ditch Inlet, and Valve Chamber Installation, such that the length of the pipe sewer may be calculated.

410.7.1.2 Type

Pipe type refers to a pipe's inside wall design, which can be smooth or corrugated. A separate hydraulic analysis of each pipe type to determine hydraulic acceptability is required to determine if both pipe types are to be specified in a Contract as alternative pipe type choices. The designer will use hydraulic flow parameters characteristic of each pipe type during the hydraulic analysis work. In some cases, only one pipe type may be achievable or conducive for the site conditions.

The designer will analyze a sewer network for hydraulic acceptance based on one pipe type for the entire sewer network. Two separate hydraulic design analysis runs are required to determine if both pipe types are hydraulically acceptable.

Where site circumstances are found that requires a sewer network that is pipe type sensitive, the designer need only perform the hydraulic analysis of the pipe sewer network for the one pipe type identified as suitable for the site conditions.

410.7.1.3 Class

Pipe class refers to the material specifications of the pipe products. These specifications include load and pressure ratings, pipe wall thickness, protective coatings, corrugations, and reinforcement. Acceptable material specifications of a pipe sewer network are established based on structural loading and material durability requirements. The designer shall use accepted structural and durability assessment methods by which to establish the pipe class that satisfies both structural and material durability criteria.

A. Structural Assessment

Pipe sewers, since they are installed underground, are subject to 'dead' and 'live' loads. The loading requirements are addressed through placement of fill material on top of the pipe sewer. Bedding, cover, embedment in the case of flexible pipes, backfill, subgrade, and pavement are to be considered in the structural loading assessment. The height of fill available will define acceptable pipe sizes, types, and classes.

B. Durability Assessment

Pipe sewer networks, for the different functional highway classifications, must be designed to specified Design Service Life (DSL) criteria. Every pipe material has an Estimated Material Service Life (EMSL) based on its material properties and the site environment. Acceptable pipe materials are those that have an EMSL greater than or equal to the DSL criteria.

Pipe materials with an EMSL less than the DSL criteria may only be considered in a strategic pipe replacement context. A Life Cycle Cost Analysis (LCCA) must be performed to support a pipe replacement design. Standards and Contract Branch approvals are required to use a pipe replacement design approach as per GPDG.

410.7.1.4 Joints

The designer, through hydraulic analysis of surface flow or through subsurface information as provided in a foundations or geotechnical report, shall assess the type of pipe joints required for the pipe sewer.

The designer shall refer to the MTO Gravity Pipe Design Guidelines for further information on pipe joint selection requirements.

410.7.1.5 Outlet Pipe End Finish

The end finishes on a pipe sewer outlet may be cut end finishes to the outlet pipe or attached prefabricated end sections. The end finish is to be decided by the designer through hydraulic analysis and final embankment slopes.

Where traffic safety is an issue, the designer may select a prefabricated safety slope end treatment section specifically designed to address the safety concern at the pipe sewer outlet.

Grating may be installed over the ends of pipe sewer outlets to prevent access by animals or children if deemed to be a concern.

The designer shall refer to relevant design manuals and/or any associated Standard Drawings for further information on warrants and design of end finishes.

410.7.1.6 Treatment

In most cases, pipe sewers are constructed below the frost line and would not require any special treatments for frost. In rock fills, frost tapers are not required, but fill material must be provided.

When the pipe sewer cannot be constructed below the frost line, special treatment will be required. Foundations or geotechnical reports shall contain information regarding recommended pipe fill materials and the configuration and extent of frost taper excavations. Where pipe fill material cannot protect the pipe sewer or frost tapers cannot be constructed, other frost protection options need to be considered. Designers may consider using extruded expanded polystyrene or other insulation materials to prevent the frost line from penetrating into the pipe sewers' critical zone.

Flow sources entering the pipe sewer carrying sediment loads under certain velocity conditions may require lining of the pipe sewer invert to prevent abrasion of the pipe material. Lining the pipe sewer invert can be done with concrete or shotcrete material. Bituminous products shall not be used to line the invert of the pipe sewer.

In lieu of a lined invert, the designer may also consider pipe products with thicker walls and/or protective coatings to provide additional protection against abrasive forces.

410.7.1.7 Concrete Appurtenances

The flow out of a pipe sewer may need to be controlled to prevent erosion damage to the area around it or to the pipe structure itself. Concrete appurtenances such as headwalls, wingwalls, energy dissipators, aprons, collars or other such types of structures are used to direct outflow, slow velocities to prevent erosion, offset buoyancy forces, etc. Concrete structures covered by OPSS 904 do not include the aforementioned concrete appurtenances.

410.7.2 Trench**410.7.2.1 Excavation**

Excavated material may be used for embankment construction or used as native backfill to the excavated pipe sewer trench as determined by the designer based on foundation or geotechnical reports. Earth and rock excavation material not used as native backfill should be managed as outlined in Section B206 of this chapter.

In view of the high unit cost for rock excavation, the designer shall endeavour to reduce the volume of excavation by relocating, pipe skewing, etc., wherever possible.

410.7.2.2 Dewatering

Dewatering refers to pumping, bailing, groundwater lowering, temporary ditching or vacuum removal of uncontaminated groundwater, rainwater, melt water, surface runoff, water pipe leakage from excavations and trenches or within sheeted cofferdams to improve the soil stability or for other construction purposes.

Where dewatering is required for the installation of a pipe sewer, the details of the operation shall comply with the requirements of OPSS 517. When recommended by the foundation engineer, a separate item for dewatering according to OPSS 902 is to be included.

Although the Contractor is responsible for dewatering, the designer shall note any recommendations included in the foundation investigation and design report.

410.7.2.3 Fill Material

Pipe fill material for rigid pipe installations is placed in distinct bedding, cover and backfill layers. Flexible pipe installations require pipe fill material to be placed as distinct embedment, which is from the bottom of the bedding layer to the bottom of the backfill layer.

Applicable minimum or maximum height of pipe fill material limits are placed in accordance with Standard Drawings Height of Fill tables for the pipe materials identified.

A foundation or geotechnical report will include recommendations for the supply, placement, and specifications of pipe fill material or any special conditions for bedding, cover, embedment in the case of flexible pipes, and backfill layers. In addition, special consideration for scour protection at the pipe sewer outlet may be required.

The designer shall, based on the recommendations of the foundation or geotechnical report, specify the pipe fill materials required for the installation. The designer should be familiar with the various installation methods available as referenced in the 800 series of the Standard Drawings for the pipe sewer installation so that the pipe fill materials recommended are appropriately specified.

The Contractor, not the designer, is responsible for selecting the appropriate pipe sewer installation method, including excavation geometry, at the time of installation based on the soil types found on the construction site in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

410.7.2.4 Reinstatement

Where existing driving lanes must be excavated to allow the construction of the pipe sewer network, the affected roadbed must be rebuilt to acceptable standards to maintain the continuity of the pavement. This is particularly important where there is to be no resurfacing of the highway. The designer shall determine and specify bedding, cover, embedment in the case of flexible pipe, and backfill depths and materials up to subgrade. Above subgrade, the designer shall determine the types and depths of granular and pavement courses necessary to achieve roadbed integrity.

410.7.2.5 Protection Systems

In general, the Contractor determines the need for protection systems, except when the stability, safety or function of an existing roadway, railway, etc. may be threatened or impaired due to the construction of a pipe sewer or in cases where the pipe sewer will be installed at depth. In such cases the foundation engineer may recommend that the installation of protection systems be specified and paid by separate item.

The design, installation, monitoring of protection systems is the Contractor's responsibility and the Contractor should base his plan on information as found in the soils data and/or foundation reports. Problematic soils, high groundwater tables or other installation issues, if identified, will give rise to recommendations regarding the design, installation and removal and would be provided in the foundation report. Recommendations for performance levels can also be found in foundation investigation and design reports.

Requirements for field investigation, laboratory testing and engineering recommendations for protection systems are to be specified in the foundation engineering terms of reference for any specific project such that appropriate information for the Contractor is provided.

410.7.2.6 Clay Seals

Warrants for clay seals to be installed on pipe sewers can be found in the MTO Gravity Pipe Design Guidelines (GPDG).

Other physical flow control barrier options are in the GPDG.

Recommendations may also be found in a foundation or geotechnical investigation and design report.

410.8 COMPUTATION

410.8.1 Item Payment Basis

Pipe Sewer items are Plan Quantity Payment items.

Concrete Appurtenances are Plan Quantity Payment items.

Service Connections are Plan Quantity Payment items.

"Post Installation Inspection" is not a Plan Quantity Payment item.

The CCTV inspection is included in with the following items:

Post Installation Inspection – Item (OPSS PROV 410/421)

410.8.2 Sources of Information

The main sources of information for pipe sewer items are:

- a) Photogrammetric or survey plans to provide drainage areas, existing natural watercourses and other features that may impact drainage.
- b) The MTO Highway Drainage Design Standards provides the overall design criteria requirements of gravity pipe installations.
- c) The GPDG provide DSL criteria, water chemistry testing and pipe material selection procedures and requirements.
- d) The MTO Drainage Management Manual provides the overall guidance on the design of pipe sewers and other drainage systems.
- e) Foundation or geotechnical reports provide guidance and recommendations on subsurface and groundwater conditions, backfilling requirements, special foundation treatments, articulation and scour protection at the sewer outlets. The foundation or geotechnical reports should also provide recommendations regarding dewatering requirements.

410.8.3 Methods of Calculation

The unit of measurement for pipe sewers is the metre. The price per metre for placing pipe sewers includes the following operations:

- a) Supplying, placing and joining pipe lengths;
- b) Supplying and installing access prevention grates, if required
- c) Finishing or supplying and installing sewer outlet pipe end sections, as required
- b) Earth excavations for trenches, frost tapers, etc. for pipes and concrete appurtenances;
- c) Supplying, placing and compacting all bedding, cover, embedment in the case of flexible pipes, and backfill materials for pipe sewers;
- d) Dewatering operations, unless otherwise specified;
- e) Design, installation and removal of protection systems, unless otherwise specified;
- f) Reinstating or constructing any highway ancillary features, not covered under other required works in the Contract, as part of the pipe sewer installation; and
- g) Disposing of all surplus excavated materials.

410.8.3.1 Post Installation Inspection

The “Post Installation Inspection” tender item is measured based on the linear metres of pipe sewers, subdrains, outlet pipes and outlets that are inspected by Closed-Circuit Television (CCTV) Inspection. Post Installation Inspection shall be based on random sampling and to include 25% of the total pipe sewer length on the Contract.

410.8.4 Pipe Sewer

410.8.4.1 Length

Measurement for the length of the pipe sewer will be made along the invert of the pipe sewer from centre to centre of the catch basins, and no deduction in length will be made for the catch basin.

When designing a pipe sewer network, the catch basins should be placed such that the length of pipe sewer from centre to centre of the catch basins is in whole numbers. When the space is restricted or short lengths are required, the metric design length of pipe sewers may be determined as the next larger 0.1 metres.

Where a pipe sewer pre-fabricated end section, other than safety slope end treatments, is to be installed on pipe sewer outlets, they are to be added to the pipe sewer length without rounding.

Slope flattening should also be considered when calculating the length of pipe sewers.

The length of a pipe sewer is measured horizontally, except when the pipe grade is 10% or steeper, in which case the length is measured along the slope.

410.8.4.2 Joints

Pipe joints are inclusive with the work to be done when installing a pipe sewer.

410.8.4.3 Concrete Appurtenances

The unit of measurement for concrete appurtenances is the cubic metre. The volume of each structure is computed and the payment in cubic metre covers the cost of supplying and placing both concrete and reinforcing steel. Payment for excavation and backfilling, including the supply of granular material, is included with the associated pipe sewer tender item.

410.8.4.4 Maintenance Holes, Catch Basins and Ditch Inlets

The above are covered in Section B407 of this chapter.

410.8.4.5 Connections to Existing Pipe Sewers, Drains and Service Connections

Measurement of the service connections shall be by length in metres along its horizontal centreline from the centreline of the main pipe sewer to the end of the service connection.

410.8.4.6 Pipe Culverts

Pipe culverts are covered in CDED B421 "Pipe Culverts".

410.8.5 Trench**410.8.5.1 Excavation**

Earth excavation required to place pipe sewers is part of the cost of the pipe sewer item.

Excavation in rock for placing pipe sewers is done according to Standard Drawings.

Unlike excavation in earth, which is included in the bid price of the pipe, rock excavation is tendered as a separate item. Rock excavation uses information for the computation of rock excavation quantities from the foundations or geotechnical reports and soils profile and field survey notes. The unit of measurement for this tender item is the cubic metre. Rock excavation operations shall be according to OPSS 403 when specified.

410.8.5.2 Swamp Excavations

In swamp areas where existing embankments are being widened, excavate existing embankment and swamp as per OPSS 209 and apply swamp excavation quantities to Earth Excavation (Grading) or Rental of Swamp Excavation Equipment.

410.8.5.3 Dewatering

Dewatering operations are according to OPSS 517 or OPSS 902, when specified. The designer shall ensure the requirements of OPSS 100, General Conditions of Contract, Subsection GC 7.10, Approvals and Permits, are accounted for.

Should a rare situation occur where it would be unfair to the Contractor to include an expensive dewatering operation in his pipe sewer bid price, using a non-standard tender item should be considered. Consultation with the Ministry's foundation or geotechnical staff is required prior to use of the non-standard dewatering item.

410.8.5.4 Fill Material

Granular volumes for frost tapers, bedding, cover, embedment in the case of flexible pipes, and backfill material for pipe sewers are computed as shown in Standard Drawings or from detail drawings when applicable. Granular materials for concrete appurtenances are included in the pipe sewer granular quantities.

The total granular requirement for each pipe sewer location is computed in cubic metres and may be converted to tonnes using the conversion factor according to CDED B314.8.3 of this manual. This quantity is used for Geotechnical MTO Aggregate Source List purposes only.

410.9 DOCUMENTATION**410.9.1 Drawings****410.9.1.1 Pipe Sewer****410.9.1.1.1 Location**

All pipe sewers, either with or without end sections, are to be indicated on the construction plans of the Contract Drawings. Pipe sewer profiles, drainage structure number, rock line, sub grade and original ground must be indicated where applicable on the Contract Drawings. The pipe configuration, but not the size, type or class, and a direction of flow arrow are to be indicated.

410.9.1.1.2 Connections to Existing Pipe Sewers, Drains and Service Connections

Locations of connections to existing pipe sewers, drains and other service connections are to be indicated on the construction plans of the Contract Drawings.

410.9.1.1.3 End Finish, Grates and End Sections

The applicable drawings for sewer outlet pipe end finishes are shown in the Standard Drawings. In addition, any pipe sewers with end finishes or end sections are to be indicated on the new construction plans and profiles of the Contract Drawings.

Access prevention grates at pipe sewer outlets are to be indicated on the construction plan sheets of the Contract Drawings.

The types of end treatments are listed in the CPS Master Item list and will be listed as separate tender item in a column on the "Quantities - Sewers" sheets.

410.9.1.1.4 Concrete Appurtenances

Concrete Appurtenances are identified on the Contract Plans by means of an arrowed note (e.g. - Concrete Apron), and specifying the Standard Drawing number, or a special drawing, if required, showing the layout.

410.9.1.2 Trench**410.9.1.2.1 Fill Material**

The Standard Drawings in the 800 series depict dimensions, classes or types of bedding requirements for circular pipes, of which the pipe can be either flexible or rigid.

Typical cross-sections must be included in the Contract Drawings, giving dimensions of frost depth, slope of frost tapers and depth of fill material layers. Because of the variety of possible treatments, Standard Drawings are not considered appropriate.

If special conditions for bedding, cover, embedment in the case of flexible pipes, or backfill materials are required, the appropriate dimensions must be shown on applicable MOTD and OPSDs or on detail drawings when applicable.

410.9.1.2.2 Reinstatement

A typical section, traditionally known as “trench reinstatement,” must be shown on the Contract Plans. The drawing should refer to the applicable Standard Drawing numbers for bedding, cover, embedment in the case of flexible pipe, and backfill up to subgrade specifying the types and depths of pipe fill material necessary to achieve roadbed integrity. Above subgrade, the drawing should specify the types and depths of granular and pavement courses necessary to achieve roadbed integrity. These types and depths may be shown in table format adjacent to the trench reinstatement typical section.

When the Contract is for standalone pipe sewer replacements (i.e., no other pavement rehabilitation or resurfacing work), all of the work to reinstate the roadway, including granular and pavement layers above subgrade, may be included with the pipe sewer item, as per OPSS 492. In this case, the required attributes of the pavement and granular layers (e.g., Superpave traffic category, PGAC grade) shall be shown with the trench reinstatement typical section.

410.9.1.2.3 Special Foundation Treatment

A detailed typical drawing and/or a modified Standard Drawings will be necessary to show the depth of bedding and location if any special foundation treatment such as articulation, soil mixing, ground improvement, etc., is required as noted in the foundation investigation and design report.

410.9.1.2.4 Protection Systems

Where a separate item for protection systems is required, as recommended by the foundation engineer, the line of protection or a protection system shall be shown on the Contract Drawings depending on the magnitude of the protection required. Performance levels shall be included on the Contract Drawings. These are only approximate lengths or locations and it is up to the Contractor to design, install and remove with actual lengths and locations defined.

410.9.2 Quantities Sheet

The “Quantities - Sewers” sheet shall show details such as:

1. Structure Number to Structure Number: identifies the starting structure to the connecting end structure/outlet for each pipe run in the pipe sewer network.
2. Location and position: the relevant alignment control line (e.g., highway centreline) with offset positions of start structure grate and end structure grate defined as the distance in metres left (LT) and/or right (RT) from the alignment control line (e.g., C/L 0.85 LT - 1.0 LT).
3. Upstream and downstream inverts: elevation entries of pipe sewer invert at the upstream and downstream structure locations.
4. Depth to Pipe: measured from highway or ground surface directly above the upstream pipe sewer invert down to top of base pipe opening.
5. Pipe Fill Material:

Where there are no recommendations from a foundations or geotechnical report to specify any particular pipe fill material, the pipe fill materials will be specified, by default, as “G” for bedding

and by extension embedment, and “N” for backfill and cover. The designer does not have to enter any material specifications in the columns to have the default material specifications apply. However, specific pipe fill material for bedding, cover or backfill, if recommended in a foundations or geotechnical report, shall be specified in the appropriate pipe fill material column. Pipe fill materials shall be specified as follows:

- N - native material, which applies to cover and backfill layers only, and permits Granular B Type I, II or III, or Granular A to be used;
- G - only Granular B Type I, II or III, or Granular A may be used;
- B - only Granular B Type II or Granular A may be used;
- A - only Granular A may be used; and
- C - Unshrinkable Fill (Concrete).

A single letter code is used to indicate the same pipe fill material for a pipe fill layer if it is suitable for both rigid and flexible pipe options. If using the same pipe fill material is not suitable, two letter codes are used such that the first letter specifies the pipe fill material for rigid pipes while the second letter specifies the pipe fill material for flexible pipes for a pipe fill layer.

The pipe fill material codes are structured in an ascending order of quality. All higher-level codes above the code that is selected are deemed to be satisfactory for the installation. In cases where the higher-level pipe fill materials are not suitable (i.e., different frost susceptibility characteristics), a designer shall insert a contract note to alert the Contractor that only the specified pipe fill material is acceptable.

Embedment for flexible pipes is from the bottom of bedding layer to bottom of backfill layer and is specified in the bedding material column. When only flexible pipes are specified, the pipe fill material cover column is not applicable.

Clear stone may be used as bedding or embedment fill material if groundwater conditions warrant the need. Refer to the MTO Gravity Pipe Design Guidelines for details.

6. Pipe Joints: Types of joints required are to be specified in the appropriately labeled column on the “Quantities - Pipe Sewer” sheet. “S” denotes a joint that is soil tight while “F” denotes a joint that is silt or fines tight and “L” denotes a joint that is watertight. Pipe joints are specified by default as “S” regardless of whether or not the “S” code is entered into the “Pipe Joints” column.

Joint classification is hierarchal in nature so that if an “S” joint is specified, the “F” and “L” joints are also acceptable, unless otherwise stated.

7. Pipe Sewer Tender Items: are shown using a separate column for each pipe sewer tender item. Each pipe sewer tender item is a composite tender item and is to be entered as shown below:

Size mm Pipe Sewer
 Size + mm range S xxxxxx
 Size + mm range C xxxxxx

Different pipe sewer sizes will necessitate entry of separate tender items. Same pipe sewer sizes with different size tolerance ranges and pipe material codes will necessitate entry as a

separate composite tender item (e.g., more than one column is required to specify the pipe sewer tender item).

Refer to Appendix A - Pipe Sewer Tender Item for information and guidance of how to define pipe sewer tender items for entry into the "Quantities - Sewers" sheets.

8. Notes that may be required on the "Quantities - Sewers" sheet.

A contract note can be a tender item note, which makes the note applicable to all sewer locations of that pipe size category or can be a quantity item note if it is only applicable to certain sewer locations.

- a) Identified locations where the non-reinforced concrete pipe material is acceptable must be noted.
- b) When corrugated steel pipes are specified and there are two different products permitted of the same size, the product with the greater material specifications must be noted at the locations where permitted, since minimum material specifications have been identified in the pipe sewer tender item.
- c) The locations of physical flow control barriers other than clay seals are to be indicated through a note.
- d) When pipe sewer end finishes or end sections are required, a note shall be provided indicating the sewer end finish or section requirement.
- e) Wherever possible, tee and wye connections and the degree of elbows used for pipe sewer construction shall be indicated through the use of notes.
- f) If frost treatment is different than standard 10 (k-d), a note shall be provided indicating the different treatment requirements.
- g) When higher level pipe fill materials are not acceptable, a note shall be provided indicating that only the specified pipe material is acceptable.

9. Other Associated Pipe Sewers quantity items.

To specify other pipe sewer quantity items as discussed below, the designer shall use CPS functional capabilities to enter the requirements into the Contract package. Options may include creation of appropriate tender item columns on specific identified Contract quantity sheets, attachment of standard or non-standard special provisions, or other suitable contract documentation methods.

- a) Where the installation of a pipe sewer is in a Contract that includes other highway work (i.e., asphalt pavement removal, sidewalk removal, earth excavation, granular and pavement placement), the works above subgrade required in the pipe sewer installation area is included in the tender item for the other highway work. If the Contract has no other highway work, that above subgrade work may be included in the pipe sewer item.
- b) Rock excavation for trenches and associated structures requires a separate entry for each pipe sewer in rock to be shown in the Rock Excavation column of the "Quantities - Sewers" sheet, and the total quantity transferred to the Tender document. Rock material from trenches and associated structures excavations is shown as "Material Available for Fill" on

the “Quantities - Grading” sheet. Rock shatter that must be excavated to place pipe culvert bedding is quantified for payment under this item.

Rock excavation for pipe sewers is a tender item under OPSS 403:

0403-0010 - Rock Excavation for Trenches and Associated Structures

- c) On Contracts where the excavated material is to be used for the construction of earth embankments, the quantity for pipe sewer excavation is to be calculated and the appropriate quantity indicated on the “Quantities - Grading” sheet under the “Material Available” column.
- d) Granular and pavement to be supplied and placed for trench reinstatement would be included with the granular and pavement materials as part of the highway works.
- e) Service connection locations are to be listed under an appropriately labelled column.
- f) When concrete appurtenances are to be placed on pipe sewers, they are treated as a separate item of work. Concrete appurtenances must be listed for each individual location on the “Quantities - Miscellaneous 1” sheet, or, if there are no other concrete items, they should be listed on the “Quantities - Sewers” sheet.
- g) If dewatering is tendered as a separate non-standard item, it shall be entered as a lump sum in the Contract. Ensure that any requirements as specified by OPSS 100, General Conditions of Contract, Subsection GC 7.10, Approvals and Permits, are accounted for in the Contract.
- h) Where recommended by the foundation engineer, protection systems are entered as a separate tender item.
- i) Safety slope end treatments, if required, shall be entered into a separate column.
- j) Access prevention grates, end finishes and/or end treatment sections shall be noted to the quantity affected.

10. Post Installation Inspections

Pipe sewers on ministry Contracts may be subject to post installation inspections. The following criteria shall be applied to determine if inspection is necessary and shall be included in the Contract Documents:

- a) The total combined pipe sewer length of all pipe sewer tender items is greater than or equal to 500 m; or
- b) If the total pipe sewer length of all pipe sewer tender items is less than 500 m, at least one sewer pipe run will be constructed with a pipe diameter greater than or equal to 450 mm and is greater than or equal to 100 m in length.
- c) Post installation inspection work is a separate tender item detailed in SSP 499S04.

Quantity Sheets

The Quantities - Miscellaneous 1 sheet is used to document CCTV Inspection. One column has the title “Closed Circuit Television Inspection”. The estimated total quantity of Closed Circuit Television Inspection (m) is entered in one line of the Quantities - Miscellaneous 1 sheet. If there is a need to allocate where locations of CCTV Inspection are to occur, multiple lines in the Quantities - Miscellaneous 1 sheet may be used, each with the appropriate start and end chainage.

Entry Accuracy

Stations are recorded in whole number metres. Offsets are shown to 0.1 m accuracy, as required.

410.9.3 Documentation Accuracy

Pipe sewers are to be measured by the metre. When the space is restricted, the metric design length of pipe sewers may be determined as the next larger 0.1 metres.

Invert elevations are recorded in 0.01 m.

Concrete Appurtenances should have concrete quantities and tender totals recorded to 0.1 m³.

Clay Seal is a lump sum tender unit of measurement.

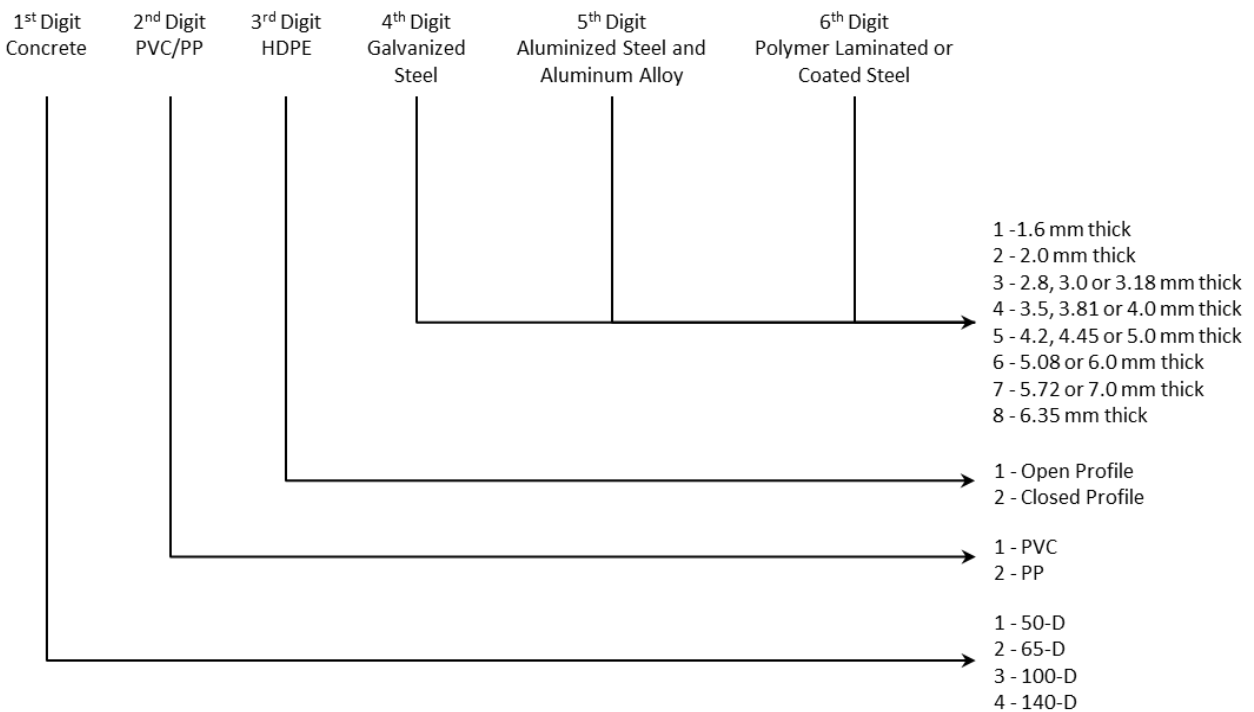
Appendix A - Pipe Sewer Tender Item Variations

Pipe sewer is a variation tender item to be entered into a Contract and has been structured to identify the acceptable circular pipe product based on size, type, and class. The tender item follows the descriptive format as noted below:

- Size mm Pipe Sewer base pipe diameter
- Size + mm range S xxxxxx minimum smooth pipe diameter + tolerance range, type, and material code
- Size + mm range C xxxxxx minimum corrugated pipe diameter + tolerance range, type, and material code

The pipe sewer material code element in the pipe sewer tender item is a 6-digit code that specifies the minimum material specifications for all acceptable pipe materials identified through design. Each digit represents a pipe material and has different values that specify pipe requirements.

The Pipe Sewer Material Code is illustrated in Figure 1.0.



Note: '0' value for any digit means that the pipe material is not acceptable.
Higher pipe material code values are also acceptable, unless otherwise stated.

**Pipe Sewer Material Code
Figure 1.0**

The Pipe Sewer Material Code is interpreted in the following manner:

a) The 1st digit represents concrete pipe. For concrete pipe, there are two product types for consideration. They are manufactured with reinforcing steel or without. To define the required reinforced concrete pipe, the designer will specify the appropriate values as:

- 1 for Class 50 D-Load; or
- 2 for Class 65 D-Load; or
- 3 for Class 100 D-Load; or
- 4 for Class 140 D-Load.

The final concrete pipe class selection shall be dependent on the bedding class that is appropriate for the type of soils encountered at the site.

When specifying any concrete pipe material, the designer should reference the pipe availability tables in Appendix C of the MTO Gravity Pipe Design Guidelines to ensure that the pipe products specified are indeed commercially available in size and load rating.

Exception:

The designer shall note the acceptability of non-reinforced concrete pipe products on the "Quantities - Sewers" sheet in the Contract. This will be done as a note to the tender item to indicate the suitability of this pipe product in all locations or as a note to a quantity if the suitability of non-reinforced concrete pipe only applies to one pipe location.

b) The 2nd digit represents PVC and PP (polypropylene) pipes.

There are two PVC product types for consideration. They are manufactured with a smooth inside and a ribbed outside (profile) wall or with a smooth inside and outside (solid) wall.

To define the required PVC pipe, the designer will specify the appropriate value as 1 for all classes (Class 210 kPa (equivalent to SDR 41) or Class 320 kPa (equivalent to SDR 35)) which defines the strength requirement for either product type.

When one of the PVC pipe products is not suitable for a given site, the designer, through a contract note, shall restrict the use of the unsuitable PVC pipe product.

PP pipe product types are manufactured as dual (open profile) and triple wall (closed profile) pipes available in 320 kPa material specifications.

To define the required PP pipe, the designer will specify the appropriate value as 2 for both product types which define the strength requirements for either product type.

The designer should be aware that the 750 mm PP pipe is available in both an open and closed profile. If one of the PP pipe products is not suitable for a given site, the designer, through a contract note, shall restrict the use of the unsuitable PP pipe product.

PP pipe products are automatically specified when the 2nd digit pipe material code is 1. If this is not the case for a given site, then the designer, through a contract note, shall restrict the use of PP pipe at the site.

When specifying any PVC or PP pipe material, the designer should reference the pipe availability tables in Appendix C of the MTO Gravity Pipe Design Guidelines to ensure that the pipe products specified are indeed commercially available in size and pipe stiffness rating.

- c) The 3rd digit represents HDPE pipes. There are two product types for consideration. They are manufactured with a smooth inside and a corrugated outside wall (open profile) or with a smooth inside and outside wall with a corrugated inner wall (closed profile).

To define the required HDPE pipe, the designer will specify the appropriate value as 1 for open profile pipes and 2 for closed profile pipes.

Closed profile HDPE pipe products are automatically specified when the 3rd digit pipe material code is 1. If this is not the case for a given site, then the designer, through a contract note, shall restrict the use of the closed profile HDPE pipe at the site.

When specifying any HDPE pipe material, the designer should reference the pipe availability tables in Appendix C of the MTO Gravity Pipe Design Guidelines to ensure that the pipe products specified are indeed commercially available in size and pipe stiffness.

- d) The 4th, 5th and 6th digits all represent steel and aluminum alloy pipe products. There are three pipe product lines for consideration. They are manufactured as spiral rib steel pipe (SRSP), corrugated steel pipe (CSP), and structural plate pipe (SPP). The SRSP is a smooth pipe while CSP and SPP are corrugated pipes.

SRSP and CSP pipe products come in three coatings; galvanized, aluminized type II and polymer laminated. Steel SPP is available with a galvanized coating and a polymer coating. The SPP is also manufactured from aluminum alloy materials.

The 4th digit is used for specifying required galvanized SRSP, CSP and SPP products. To define the required product the designer shall specify the appropriate value for the applicable wall thickness as follows:

Product	Specified Value	Wall Thickness
Galvanized SRSP	1	1.6 mm
	2	2.0 mm
	3	2.8 mm
Galvanized CSP	1	1.6 mm
	2	2.0 mm
	3	2.8 mm
	4	3.5 mm
	5	4.2 mm
Galvanized SPP	3	3.0 mm
	4	4.0 mm
	5	5.0 mm
	6	6.0 mm
	7	7.0 mm

The 5th digit is used for specifying aluminized type II SRSP and CSP pipe products and for specifying aluminum alloy SPP products. To define the required product the designer shall specify the appropriate value for the applicable wall thickness as follows:

Product	Specified Value	Wall Thickness
Aluminized Type II SRSP	1	1.6 mm
	2	2.0 mm
	3	2.8 mm
Aluminized Type II CSP	1	1.6 mm
	2	2.0 mm
	3	2.8 mm
	4	3.5 mm
	5	4.2 mm
Aluminum Alloy SPP	3	3.18 mm
	4	3.81 mm
	5	4.45 mm
	6	5.08 mm
	7	5.72 mm
	8	6.35 mm

The 6th digit is used for specifying polymer laminated or coated SRSP, CSP and SPP products. To define the required product the designer shall specify the appropriate value for the applicable wall thickness as follows:

Product	Specified Value	Wall Thickness
Polymer Laminated or Coated SRSP	1	1.6 mm
	2	2.0 mm
	3	2.8 mm
Polymer Laminated or Coated CSP	1	1.6 mm
	2	2.0 mm
	3	2.8 mm
	4	3.5 mm
	5	4.2 mm
Polymer Laminated or Coated SPP	3	3.0 mm
	4	4.0 mm
	5	5.0 mm
	6	6.0 mm
	7	7.0 mm

When specifying any steel or aluminum alloy pipe materials, the designer should reference the pipe availability tables in Appendix C of the MTO Gravity Pipe Design Guidelines to ensure that the pipe products specified are indeed commercially available in size, protective coating, and wall thickness.

Exception: For some diameters, CSP is available with two corrugation profiles. The pipe material durability analysis may determine a single wall thickness for both CSP product lines, while the structural analysis of the pipe materials determines a different wall thickness for each CSP product lines.

The designer shall identify the minimum wall thickness through the Pipe Material Code and note the greater wall thickness requirement of the other pipe product on the "Quantities - Sewers" sheet in the Contract. This shall be done as a note to the tender item to indicate the greater wall thickness requirement of this pipe product in all locations on the Contract or as a note to a quantity if the greater wall thickness requirement of this pipe product only applies to one pipe location.

Note: Non-circular pipe sewer networks shall be specified using a non-standard special provision. Pipe material codes will be like those used for non-circular pipe culvert installations.

Appendix B - Pipe Sewer Tender Item Size Ranges

The Pipe Sewer tender items to be selected for applicable sewer pipe size ranges are as follows:

CPS Tender Item Code	CPS Pipe Sewer Tender Item Size	Sewer Pipe Size Range
0410-0100	100 mm	≥ 100 mm < 200 mm
0410-0200	200 mm	≥ 200 mm < 300 mm
0410-0300	300 mm	≥ 300 mm < 400 mm
0410-0400	400 mm	≥ 400 mm < 500 mm
0410-0500	500 mm	≥ 500 mm < 600 mm
0410-0600	600 mm	≥ 600 mm < 700 mm
0410-0700	700 mm	≥ 700 mm < 800 mm
0410-0800	800 mm	≥ 800 mm < 900 mm
0410-0900	900 mm	≥ 900 mm < 1000 mm
0410-1000	1000 mm	≥ 1000 mm < 1200 mm
0410-1200	1200 mm	≥ 1200 mm < 1300 mm
0410-1300	1300 mm	≥ 1300 mm < 1400 mm
0410-1400	1400 mm	≥ 1400 mm < 1500 mm
0410-1500	1500 mm	≥ 1500 mm < 1600 mm
0410-1600	1600 mm	≥ 1600 mm < 1800 mm
0410-1800	1800 mm	≥ 1800 mm < 1900 mm
0410-1900	1900 mm	≥ 1900 mm < 2000 mm
0410-2000	2000 mm	≥ 2000 mm < 2100 mm
0410-2100	2100 mm	≥ 2100 mm < 2200 mm
0410-2200	2200 mm	≥ 2200 mm < 2400 mm
0410-2400	2400 mm	≥ 2400 mm < 2500 mm
0410-2500	2500 mm	≥ 2500 mm < 2600 mm
0410-2600	2600 mm	≥ 2600 mm < 2700 mm
0410-2700	2700 mm	≥ 2700 mm < 3000 mm
0410-3000	3000 mm	= 3000 mm