



5500 - SPECIFICATION FOR STORM SEWERS

5500 - 1 DESCRIPTION

1.01 The work shall consist of storm sewers constructed for the removal of surface water from collection points on or adjacent to the highway. The work shall include all types and sizes of storm sewers, manholes, laterals, catch basins and outfall structures, constructed at the locations and in conformity with the lines, grades and dimensions shown in the plans or as designated by the Engineer.

1.02 In sections 1, 2 and 3 of this specification the following definitions will apply:

EARTH MATERIAL - Materials such as topsoil, peat, moss, clays, silts, sands, gravels, pavements, boulders and detached fragmentary rocks and stones having a volume less than two-tenths of a cubic metre (0.2 m^3).

ROCK MATERIAL - Materials in solid masses of igneous, metamorphic and firmly cemented sedimentary rock that would normally be removed by drilling and blasting. Rock materials will also include the actual measured volume of detached rocks and boulders having a volume of two-tenths of a cubic metre (0.2 m^3) or more.

5500-2 MATERIALS

2.01 The department will supply and pay for the following materials:

- (a) Portland cement.
- (b) Admixtures.
- (c) Reinforcing steel when required.
- (d) All types and sizes of pipes.
- (e) All types and sizes of manhole and catch basin frames and covers.
- (f) Concrete blocks and bricks for manholes and catch basin construction when required.
- (g) Manhole and catch basin steps.
- (h) Gaskets and other jointing material.

2.02 The materials for concrete shall conform to the requirements for Concrete (Specification 6500).

2.03 Granular material used for foundations and backfields shall conform to the requirements for Granular Backfield (Specification 6600).

2.04 The Contractor shall supply all forming, bracing, sheathing and shoring materials, curing compounds, and fuel for thawing out frozen earth materials.

2.05 Cement mortar for jointing shall consist of one (1) part by volume of Portland cement and two (2) parts clean sharp sand with sufficient water added to produce a stiff mix.

5500 - 3 CONSTRUCTION

- 3.01 The Contractor shall repair or replace, at no expense to the Department, any storm sewer materials damaged by his operations.
- 3.02 All materials shall be hauled in accordance with the requirements for Haul (Specification 2405).
- 3.03 A written authorisation must be obtained from the Engineer before any excavating for storm sewer work is started.

EXISTING UNDERGROUND PIPE LINES AND STRUCTURES-

- 3.04 The Contractor shall ensure that all existing underground pipe lines and structures, crossing within or adjacent to the limits of the work, are not damaged.
- 3.05 When an underground pipe line or structure is encountered during construction, the Contractor shall immediately notify the Engineer and shall take such precautions as may be necessary to protect the pipe line or structure against damage and/or interruption of service.
- 3.06 When required, alterations or improvements and realignment or relocation of existing pipe lines and structures shall be done on an "Extra Work" basis.

EXCAVATING TRENCHES AND HOLES

- 3.07 The location, elevation and excavation for all storm sewer work will be staked by the Engineer.
- 3.08 The Contractor will be provided with a line of stakes spaced at approximately fifteen metre (15 m) intervals throughout the entire length of the storm sewer work. These stakes shall be referred to as control references. The Contractor will be provided with the depth of cut from the top of each control reference to the invert of the pipe or structure. The method of transferring elevations from the control references to the invert of the pipe or structure will be subject to the approval of the Engineer.
- 3.09 Unless otherwise specified excavated materials shall be used for trench or hole backfill. Excess or unsuitable material shall be disposed of as designated by the Engineer.
 - (a) The Contractor shall set aside detached rocks or boulders for the purpose of measurement.
 - (b) Rock masses encountered in trenches and holes may be removed by blasting. All drill hole locations shall be indicated by the Contractor sufficiently in advance of the drilling so that the Engineer may stake the exact depth from the rock surface to grade elevation at each drill hole. Any drilling deeper than the specified depths shall be at the option of the Contractor and subject to the approval of the Engineer.

3.10 The excavation for storm sewer work shall generally have the following dimensions:

- (a) Trenches for pipes shall have a clear width of not greater than the outside diameter of the pipe plus thirty centimetres (30 cm) except that the trench width shall not be less than sixty centimetres (60 cm). Where more than one (1) pipe is to be placed at approximately the same elevation, in a trench, the trench width shall be increased to provide a forty-five centimetre (45 cm) clearance between the outside surfaces of the pipes.
- (b) Holes for manholes, catch basins or any other structures shall be of sufficient size to provide a clear distance of thirty centimetres (30 cm) from all outside surfaces of the structures.
- (c) The depth of all holes and trenches shall be sufficient to allow the construction of a compacted granular bed, not less than ten centimetres (10 cm) in depth, under all pipes and structures.
- (d) All holes and trenches shall have vertical sides unless otherwise specified on the plans or designated by the Engineer.

3.11 When the foundation material is soft or otherwise unsuitable, the bottom of the bed for pipes and structures shall be subcut to the depth required by the Engineer. The subcut shall be backfilled with granular material in accordance with the requirements for Granular Backfill (Specification 6600).

3.12 Excavated material shall generally be deposited on the right-of-way adjacent to the trench or hole in such a manner as to cause a minimum of obstruction to the streets, lanes, driveways and/or sidewalks.

3.13 The excavated material shall not be deposited closer than sixty centimetres (60 cm) from the edge of the trench or hole.

3.14 Sufficient bracing, sheating or shoring shall be provided to prevent the sides of the trench or hole from falling, sliding or caving-in.

3.15 Unless otherwise permitted by the Engineer, trenches shall not be excavated farther than one hundred metres (100 m) in advance of pipe-laying operations.

3.16 The contractor may over-excavate trenches and holes below the grades staked by the Engineer. All over-excavation below grade shall be backfilled with granular material at no expense to the Department.

- (a) The Contractor may over-excavate trenches and holes beyond the widths specified except that over-excavation in width will not be allowed where an existing pavement is affected.
- (b) All over-excavation shall be done at no expense to the Department.

- 3.17 The Contractor shall during construction, keep all trenches and holes free from water. Water shall be removed by pumping, bailing or other methods approved by the Engineer. Completed sections of a storm sewer system shall not be used for the removal of water unless a written authorization is issued by the Engineer.
- 3.18 All loose or disturbed material shall be removed from the bottom of the trench or hole before the preparation of the granular bed is started.
- 3.19 The Contractor shall be responsible for the erection and removal of temporary fences and barricades where required for the protection of animal, pedestrian and vehicular traffic and public and private property.
- 3.20 During winter operations, fuel may be used to thaw out frozen earth material to facilitate excavating trenches and holes.

PLACING PIPES

- 3.21 All pipes shall be placed on a granular bed not less than ten centimetres (10 cm) in depth constructed in accordance with the requirements for Granular Backfill (Specification 6600).
- 3.22 The pipes shall not be placed on frozen foundation material.
- 3.23 The pipe shall be placed starting at the downstream end and laid upgrade from structure to structure.
 - (a) When concrete pipe is used the bell or groove end of the pipe shall be placed upgrade. Metal pipes shall be placed with the inside circumferential laps pointing downstream and with the longitudinal laps at the sides or quarter points.
- 3.24 The upgrade end of storm sewer pipes, not terminating in a structure, shall be plugged or capped as directed by the Engineer.
- 3.25 The Engineer will inspect all storm sewer pipes before placing. Any section that is damaged by handling or is found to be defective to a degree, which will materially affect the function or service of the pipe, will be rejected.

PIPE JOINTS

- 3.26 **BELL AND SPIGOT JOINTS** - The joint surfaces shall be thoroughly cleaned with a wet brush. The adjoining pipe sections shall be firmly butted. An oakum gasket shall be packed into place and shall not occupy more than one-quarter (1/4) of the total depth of the bell. The joint shall then be packed full with stiff mortar and bevelled off at approximately a forty-five (45) degree angle to the surface of the pipe.

- 3.27 TONGUE AND GROOVE JOINTS - The joint surfaces shall be thoroughly cleaned with a wet brush. A shallow excavation, not less than eight centimetres (8 cm) in depth, shall be made under the pipes at the joint and filled with mortar. A layer of soft mortar shall be applied to the contact surfaces of both pipe sections. The pipe sections shall be forced together, tongue in groove, until the mortar is squeezed out at both the interior and exterior joint lines for the full circumference of the pipe. The inner surface of the joint shall be brushed smooth.
- 3.28 The completed outside joints for concrete pipes shall be protected by completely covering the joints with wet sand not less than thirty centimetres (30 cm) in depth and extending not less than thirty centimetres (30 cm) to each side of the joint line.
- 3.29 Sections of metal pipe shall be joined firmly together with coupling bands. All joints shall be as water-tight as possible.

CONSTRUCTING STRUCTURES

- 3.30 All structures shall be placed on a granular bed not less than ten centimetres (10 cm) in depth constructed in accordance with the requirements for Granular Backfill (Specification 6600).
- 3.31 Where required, forms shall be constructed and removed in accordance with the requirements for Concrete (Specification 6500).
- 3.32 Concrete shall be mixed, placed, finished and cured in accordance with the requirements for Concrete (Specification 6500).
- 3.33 The base of the structure shall be thoroughly wetted with water before the concrete is placed.
- 3.34 When bricks and/or concrete blocks are used to construct the structure walls they shall not be placed on the concrete base for a minimum of three (3) days subsequent to pouring of the base.
- (a) Each layer of bricks and/or concrete blocks shall be set in a full mortar bed and all joints shall be filled with mortar. Vertical joints shall be staggered. Bricks and/or blocks shall be cut or shaped around pipe connections. All connections shall be firmly bedded into the brick or block work with stiff mortar.
- 3.35 The manhole or catch basin frame and cover shall be centered over the brick and/or block work, level and to grade, on a mortar bed approximately twenty millimetres (20 mm) in depth.
- 3.36 When required, rip-rap used at outfall structures shall conform to the requirements for Hand-Placed, Grouted and Random Rip-Rap (Specification 6000) and/or Sand Bag Rip-Rap (Specification 6005).
- 3.37 Reinforcing steel shall be placed as specified on the plans or as designated by the Engineer.

BACKFILLING PIPES AND STRUCTURES

- 3.38 Backfill material shall be free from objectionable organic matter. Unless authorized by the Engineer, frozen soil shall not be used to backfill trenches and holes.
- 3.39 All bracing, sheathing and shoring shall be removed before the backfill is completed.

- 3.40 When required, spreading and compacting sub-base, base and surface courses to replace existing surface structures removed during the excavating operation will be done on an "Extra Work" basis.
- 3.41 Backfilling of the trenches shall not be delayed more than thirty metres (30 m) behind completed sections of installed storm sewer.
- 3.42 Trenches and holes shall generally be backfilled in accordance with the requirements for the following classes of backfill. (The class of backfill to be used will be shown on the plans or designated by the Engineer.).
- 3.43 **CLASS 1 - TRENCHES AND HOLES BACKFILLED WITH GRANULAR MATERIAL ONLY -** Granular material shall be supplied and placed around the pipe to the elevation shown on the plans or designated by the Engineer in accordance with the requirements for Granular Backfill (Specification 6600).
- (a) Excavated rock and earth material shall be disposed of as directed by the Engineer.
 - (b) The ground surface of backfilled trenches and holes shall be neatly trimmed.
- 3.44 **CLASS 2 - TRENCHES AND HOLES BACKFILLED WITH EARTH MATERIAL. (DENSITY NOT SPECIFIED.)** - Granular material shall be supplied and placed around the pipe to a height of thirty centimetres (30 cm) above the top of the pipe in accordance with requirements for Granular Backfill (Specification 6600).
- (a) Excavated earth material or portions of the excavated material from the trench or hole construction shall be used as backfill material for the remainder of the trench or hole. A density requirement for the backfill will not be specified.
 - (b) The trench or hole shall be backfilled above the final grade of the trench or hole to a height in centimetres equal to sixteen times the width of the trench in metres.
 - (c) Excavated rock material and excess earth material shall be disposed of as directed by the Engineer.
 - (d) The ground surface of backfilled trenches and holes shall be disposed of as directed by the Engineer.
- 3.45 **CLASS 3 - TRENCHES AND HOLES BACKFILLED WITH EARTH MATERIAL (DENSITY SPECIFIED)** - Granular material shall be supplied and placed around the pipe to a height of thirty centimetres (30 cm) above the top of the pipe in accordance with the requirements for Granular Backfill (Specification 6600).
- (a) Excavated earth material or portions of the excavated earth material from the trench or hole construction shall generally be used as backfill material for the remainder of the trench or hole.
 - (b) The backfill shall be constructed by placing the materials in successive layers distributed over the full width of the trench or hole. Each layer shall be not greater than twenty centimetres

(20 cm) uncompacted and shall be compacted by hand tampers or mechanical methods to not less than ninety-five (95) percent of the maximum density, as determined by Test 9200 for the material comprising the layer.

- (c) The Engineer will determine, from the test results, the section of embankment to be considered for evaluation. The density on the section will be considered satisfactory when:
 - (i) Test results average not less than ninety-five (95) percent of maximum density, and
 - (ii) all individual test results are greater than ninety-three (93) percent of maximum density.
- (d) When the moisture existing in the soil is insufficient for compacting to the specified density and for finishing, the Contractor may elect to add water. The water shall be added in accordance with the requirements for Watering (Specification 2500).
- (e) When excess moisture exists in the soil it shall be dried, at no direct expense to the Department, to a moisture content not greater than the optimum moisture content as determined by Test 9200 for the material comprising the layer.
- (f) Backfill material shall be free from stones larger than fifteen centimetres (15 cm) when measured in any direction.
- (g) When designated by the Engineer, the trench or hole shall be backfilled above the final grade of the trench or hole to a height in centimetres equal to sixteen times the width of the trench in metres.
- (h) Excavated rock material and excess excavated earth material shall be disposed of as directed by the Engineer.
- (i) The ground surface of backfilled trenches and holes shall be neatly trimmed.

3.46 CLASS 4 - TRENCHES AND HOLES BACKFILLED WITH EARTH MATERIAL (WATER CONSOLIDATED) - Granular material shall be supplied and placed around the pipe to a height not less than thirty centimetres (30 cm) above the top of the pipe in accordance with the requirements for Granular Backfill (Specification 6600).

- (a) Excavated earth material or portions of the excavated earth material from the trench or hole construction shall generally be used as backfill material for the remainder of the trench or hole.
- (b) The backfill material shall be consolidated using pressurized water. Water shall be added until the backfill material is saturated. The material shall then be tamped to eliminate any air spaces in the backfill material which may occur during the backfill operation.
- (c) When designated by the Engineer, the trench or hole shall be backfilled above the final grade of the trench or hole to a height in centimetres equal to sixteen times the width of the trench in metres.

- (d) Excavated rock material and excess excavated earth material shall be disposed of as directed by the Engineer.
- (e) The ground surface of backfilled trenches and holes shall be neatly trimmed.

5500 - 4 MEASUREMENT

4.01 TRENCH EXCAVATION - The volume of excavation will be measured in cubic metres in its original position.

- (a) The volume of trench excavation for storm sewer pipes will be computed from the centre line length and average depth and width staked by the Engineer.
- (b) The volume of trench excavation for structures will be computed from the centre line depths and end area dimensions of the holes as staked by the Engineer.
- (c) Haul distances will be measured in accordance with the requirements for Haul (Specification 2405) except that the haul distance will be measured along the designated route between a point two kilometres (2 km) from the point of loading to the designated delivery point.
- (d) Where grubbing is required, on any area to be excavated, trench excavation will be measured after the grubbing operation has been completed.
- (e) Detached rocks and boulders will be measured before they are disposed of as directed by the Engineer. Rock material that is not measured and is disposed of will be considered as Trench Excavation.

4.02 STORM SEWER PIPES - Storm sewer pipes will be measured in metres to the nearest one-tenth of a metre (0.1 m).

- (a) Measurement will be taken along the invert parallel to the barrel of the pipe from:
 - (i) The downstream edge of pipe or face of existing structure to the upstream edge of pipe or face of existing structure or center of new manhole.
 - (ii) The center to center of new manholes.
 - (iii) The center of catch basin to center of manhole.

4.03 MANHOLES AND CATCH BASINS - Manholes and catch basins will be measured, vertically, in metres to the nearest one-tenth of a metre (0.1 m). Measurements will be taken from the top of the frame and cover to the bottom face of the concrete base as staked by the Engineer.

4.04 OUTFALL STRUCTURES - Each outfall structure will be measured as a single unit.

5500 - 5 PAYMENT

- 5.01 Payment for INSTALLING CONCRETE STORM SEWER PIPES and/or INSTALLING METAL STORM SEWER PIPES will be made at the unit price per metre, for the sizes specified on the tender form. The unit price will be full compensation for unloading, storing, handling, hauling the materials from delivery points, preparing the bed, assembling and jointing the pipes.
- 5.02 Payment for MANHOLES and/or CATCH BASINS will be made at the unit price per metre, as specified on the tender form. The unit price will be full compensation for unloading, storing, handling, hauling the materials from delivery points, preparing the bed, forming and placing reinforcing steel and steps, mixing, placing, curing and finishing the concrete and mortar, placing bricks and concrete blocks, jointing, removal of forms and placing of frames and covers.
- 5.03 Payment for OUTFALL STRUCTURES will be made at the unit price per outfall structure, as specified on the tender form. The unit price will be full compensation for unloading, storing, handling, hauling the materials from delivery points, preparing the bed, forming and placing reinforcing steel, mixing, placing, curing and finishing the concrete and mortar, placing bricks and concrete blocks when required, jointing and removal of forms.
- 5.04 Payment for TRENCH EXCAVATION FOR STORM SEWERS will be made at the unit price per cubic metre, for the class of backfill as specified on the tender form. The unit price will be full compensation for supplying water and forming, bracing, sheathing and shoring materials, removal of topsoil, unclassified rubbish, shrubs and other vegetation and excavating, loading, hauling up to two kilometres (2 km) and dumping the earth material, backfilling trenches and holes with earth material, compacting and watering the backfill material, providing and removing bracing, sheathing and shoring, disposal of surplus earth materials and shaping and trimming the surfaces.
- 5.05 Payment for ROCK TRENCH EXCAVATION FOR STORM SEWERS will be made at the unit price per cubic metre, for the class of backfill as specified on the tender form. The unit price will be full compensation for supplying all materials and equipment for drilling and blasting, removal of topsoil, unclassified rubbish, shrubs and other vegetation and drilling, blasting, excavating, loading, hauling up to two kilometres (2 km), and dumping the rock material, backfilling trenches and holes except Class 1 backfill, compacting and watering the backfill material, providing and removing bracing, sheathing and shoring, disposal of surplus rock material and shaping and trimming the surfaces.
- 5.06 Payment for HAULING EARTH MATERIAL further than two kilometres (2 km) and/or HAULING ROCK MATERIAL further than two kilometres (2 km) will be made at the unit price per cubic metre kilometre in accordance with the requirements for Haul (Specification 2405).
- 5.07 Payment for granular backfill used for all classes of backfill will be made as specified on the tender form, in accordance with the requirements for Granular Backfill (Specification 6600).
- 5.08 Payment for rip-rap will be made as specified on the tender form in accordance with the requirements for Hand Placed, Grouted and Random Rip-Rap (Specification 6000) and/or Sand Bag Rip-Rap (Specification 6005).
- 5.09 Payment for sub-base, base and surface courses used to replace excavated surface structures will be made at the unit prices included in the tender form, in accordance with the requirements for the commodities used. Spreading and compacting the commodities will be done as "Extra Work".