

1 GENERAL

- 1.1 The work of this section includes the provision of all design, labour, materials, equipment and services required to fabricate and install storm and sanitary sewer systems as required for a complete project. The work includes, but is not necessarily limited to, the items referenced herein:
- 1.1.1 Storm Sewer Systems.
 - 1.1.2 Sanitary Sewer Systems.
- 1.2 All systems to be in strict compliance with the *[Regional Municipality of Ottawa-Carleton Standards and Specifications]*, the Ontario Building Code, local Plumbing Codes and requirements of the authorities having jurisdiction.
- 1.3 Reference Standards:
- 1.3.1 *[OPSS 405 – Pipe Subdrains]*.
 - 1.3.2 *[OPSS 407 – Construction of Manholes, Catchbasins, Ditch Inlets and Valve Chambers]*.
 - 1.3.3 *[OPSS 409 – Closed Circuit Television Inspection of Pipelines]*.
 - 1.3.4 *[OPSS 410 – Pipe Sewer Installation in Open Cut]*.
- 1.4 All work to operate at best efficiency points.
- 1.5 Material certification to be obtained 2 weeks prior to commencing work. Certification to be marked on pipe.

2 DESIGN

- 2.1 *[Design Builder]* shall engage a qualified Professional Engineer licensed to practice in the Province of Ontario to design the storm and sanitary sewer systems. Each drawing and specification submission to bear the signature and stamp of the Professional Engineer. Certification of leakage testing, of the sanitary lateral, must be provided by a licensed Professional Engineer.
- 2.2 The storm and sanitary sewage systems are to commence 1.0 metre outside the subject building or group of buildings and must be designed to handle the peak flow as per the Ontario Building Code, all applicable codes and municipal standards.
- 2.3 Gravity flow storm and sanitary systems shall be sloped in the direction of flow at a minimum of *[0.5]* %.
- 2.4 In the event that lift stations are required, it will be the responsibility of this *[Design Builder]* to design such stations. Each station shall be designed for fail-safe operation with redundant pumps and emergency power supply.

- 2.5 Storm and sanitary sewage systems shall be designed complete with all accessories and appurtenances such as sanitary force mains, lift stations, manholes, catch basins, storm detention ponds, silt traps, etc.
- 2.6 Where conflicts exist between local codes and standards, plumbing code and the Ontario Building Code, design shall comply with the most stringent.

3 MATERIALS

- 3.1 Concrete Pipe:
- 3.1.1 Non-reinforced circular concrete pipe and fittings: to *[CAN/CSA-A257]* and *[ASTM C14M]*.
 - 3.1.2 Reinforced circular concrete pipe and fittings: to *[CAN/CSA-A257]* and *[ASTM C76M]*.
 - 3.1.3 Lifting holes:
 - 3.1.3.1 Pipe 900 mm and less diameter: no lift holes.
 - 3.1.3.2 Pipe greater than 900 mm diameter: lift holes not be exceed two in piece of pipe.
 - 3.1.3.3 Provide prefabricated plugs to effectively seal lift holes watertight after installation of pipe.
- 3.2 Plastic Pipe: Polyvinyl Chloride (PVC): to *[CAN/CSA B-182.2, B182.3, or B-182.4]*; joints bell and spigot with rubber gaskets.
- 3.3 Manholes: Precast manholes to: *[OPSS 407]*.
- 3.4 Frames and Covers: Cast iron frames and covers to *[OPSS 1850]*.
- 3.5 Service connections to *[CAN/CSA-B 182.2 (PVC Pipe)]*, *[CAN/CSA-B182.1 with push on joints (Plastic Pipe)]*.
- 3.6 Bedding and surround material to Section G1030 Site Earthwork.

4 INSTALLATION

- 4.1 Clean pipes and fittings of debris and water before installation and remove defective material from site. Install bedding, pipe surround and undercrossings to Section G1030: Site Earthwork.
- 4.2 Lay and join pipe in accordance with manufacturer's recommendations.
- 4.3 Handle pipe using methods approved by manufacturer. Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

- 4.4 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- 4.5 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- 4.6 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- 4.7 Do not allow water to flow through pipes during construction except as may be permitted by manufacturer.
- 4.8 Whenever work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- 4.9 Install plastic pipe and fittings in accordance with [CSA B182.11].
- 4.10 Joints:
 - 4.10.1 Concrete and PVC pipe:
 - 4.10.1.1 Install gaskets as recommended by manufacturer.
 - 4.10.1.2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - 4.10.1.3 Align pipes before joining.
 - 4.10.1.4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
 - 4.10.1.5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
 - 4.10.1.6 Complete each joint before laying next length of pipe.
 - 4.10.1.7 Make joint deflection after joint has been made to avoid joint damage.
 - 4.10.1.8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
 - 4.10.1.9 When any stoppage of work occurs, restrain pipes to prevent "creep" during down time and install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
 - 4.10.1.10 Plug any lifting holes with approved prefabricated plugs, set in shrinkage compensating grout.
 - 4.10.1.11 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

- 4.10.1.12 Make watertight connections to manholes. Use shrinkage compensating grout when suitable gaskets are not available.
- 4.10.1.13 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Joint to be structurally sound and watertight.
- 4.10.1.14 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

4.11 Service Connections:

- 4.11.1 Install pipe to [CSA B182.11] and manufacturer's instructions and specifications.
- 4.11.2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal unless otherwise required.
- 4.11.3 Service connections to main sewer: standard Tee or Wye fittings. Do not use break-in mortar patch-type joints.
- 4.11.4 Service connection pipe: not to extend into interior of main sewer.
- 4.11.5 Make up required horizontal and vertical bends from 45° bends or less, separated by straight section of pipe with minimum length of four pipe diameters. Use long sweep bends where applicable.
- 4.11.6 Plug, service laterals with watertight caps or plugs as approved by Owner if building service is not to be immediately connected.
- 4.11.7 Place location marker at ends of plugged or capped unconnected sewer lines. Each marker shall consist of 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade. Paint exposed portion of stake red with designation SAN/STM SWR LINE in black.

4.12 Field Testing:

- 4.12.1 Repair or replace pipe, pipe joint or bedding found defective.
- 4.12.2 When directed by Owner, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- 4.12.3 Remove foreign matter from sewers and related appurtenances by flushing with water.
- 4.12.4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- 4.12.5 Carry out tests on each section of sewer between successive manholes including service connections.

- 4.12.6 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- 4.12.7 Exfiltration test:
 - 4.12.7.1 Fill test section with water in such a manner as to allow displacement of air in line. Maintain under nominal head for 24 h to ensure absorption in pipe wall is complete before test measurements are commenced.
 - 4.12.7.2 Immediately prior to test period add water to pipeline until there is a head of 1 m over interior crown of pipe measured at highest point of test section or water in manhole is 1 m above static ground water level, whichever is greater.
 - 4.12.7.3 Duration of exfiltration test: 2 h.
 - 4.12.7.4 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.
- 4.12.8 Infiltration test:
 - 4.12.8.1 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.
 - 4.12.8.2 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
 - 4.12.8.3 Install watertight plug at upstream end of pipeline test section.
 - 4.12.8.4 Discontinue pumping operations for at least 3 days before test measurements are to commence and during this time, keep thoroughly wet at least one third of pipe invert perimeter.
 - 4.12.8.5 Prevent damage to pipe and bedding material due to flotation and erosion.
 - 4.12.8.6 Place 90° V-notch weir in invert of sewer at each manhole.
 - 4.12.8.7 Measure rate of flow over minimum of 1 h, with recorded flows for each 5 min interval.
- 4.12.9 Leakage: not to exceed following limits in litres per hour per mm of diameter per 100 m of sewer including service connections:
 - 4.12.9.1 Exfiltration, based on 600 mm head: 0.175 L.
 - 4.12.9.2 Infiltration: 0.150 L.
- 4.12.10 Repair and retest sewer line as required, until test results are within limits specified.
- 4.12.11 Repair visible leaks regardless of test results.

4.13 Sewage Force Main Installation:

- 4.13.1 Lay and join pipes in accordance with manufacturer's recommendations as well as previously listed requirements.
- 4.13.2 Thrust blocks:
 - 4.13.2.1 Restrain bends, tees and fittings by concrete thrust blocks.
 - 4.13.2.2 Keep pipe couplings free of concrete.
 - 4.13.2.3 Bearing area of thrust blocks to be as required by flow.
- 4.13.3 Field Testing:
 - 4.13.3.1 Testing of main to be carried out in presence of Owner.
 - 4.13.3.2 Strut and brace caps, bends and tees, to prevent movement when test pressure is applied.
 - 4.13.3.3 Expel air from main, by slowly filling main with water. High points to be drilled and tapped and suitable cocks installed to vent air and to be shut when pressure is applied. Remove cocks after satisfactory completion of test and seal holes with tight fitting plugs.
 - 4.13.3.4 Apply hydrostatic test pressure of 1.5 x working pressure kPa based on elevation of lowest point in line and corrected to elevation of test gauge for hydrostatic test and 700 kPa for leakage test.
 - 4.13.3.5 Apply pressure for 1 h for pressure test and 2 h for leakage test.
 - 4.13.3.6 Examine exposed pipe joints and fittings while system is under pressure.
 - 4.13.3.7 Remove defective joints, pipe and fittings and replace with new sound material.
 - 4.13.3.8 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 h.
 - 4.13.3.9 Do not exceed allowable leakage as defined in *[ANSI/AWWA C600]*.
 - 4.13.3.10 Locate and repair defects if leakage is greater than amount specified.
 - 4.13.3.11 Repeat test until leakage is within specified allowance for full length of forcemain.
 - 4.13.3.12 Complete backfill to Section G1030: Site Earthwork.
 - 4.13.3.13 Repeat test after completing backfill. Locate and repair defects and backfill. Repeat tests, repairs and backfills as needed until leakage is less than amount specified.

End of Section