2020 - SECTION 50

DESIGN OF SANITARY SEWAGE FORCEMAINS

50.1 Forcemain Size Considerations

The design of a Sanitary sewage forcemain is to include study of the comparative costs of construction and long-term operation for alternative sizes. There are, however, practical limitations to the size options which may be considered, as flow velocities are required to exceed certain minimum values to prevent slime growth within the forcemain and to ensure solids are not deposited within the forcemain. It is also necessary to minimize the residence time of sewage within pumping station wet wells and forcemains to avoid anaerobic fermentation and the resultant production of odorous, hazardous and corrosive gases such as hydrogen sulphide.

50.2 Flow Velocity Limits

50.2.1 To prevent slime growth on the pipe walls of the forcemain and to transport solids, the minimum velocity of flow in the pipe should exceed the velocity determined by:

$V = -0.3 \log (0.1/D)$

Where: V = velocity in m/s

And: D = pipe internal diameter in mm

50.2.2 Optimum design velocities, in the range of 0.9 to 1.5 m/s, are recommended, considering both operating costs and prevention of solids accumulation. When the forcemain grade profile includes steep slopes or vertical sections, the minimum design velocity should be increased by an order of 50%. Where design flow velocities in buried forcemains exceed 3.0 m/s, any special provisions required to ensure stability of the forcemain shall be identified and incorporated in the design. A maximum flow velocity of 3.5 m/s is recommended.

50.3 Design Pressures

The pressure design for forcemains shall consider normal static and dynamic operating pressures, the potential conditions that may occur due to outlet surcharge or blockages and transient pressure (water hammer) effects. A transient pressure analysis is required to determine if protection is required and appropriate provisions are to be incorporated into the pumping system design.

50.4 Surge Protection Devices

Where necessary, surge relief valves shall be designed with a suitable discharge location and be located with a suitable method of access. Surge relief valves that regulate with external springs or counterweights and dashpots are preferred to valves regulated with pilot pressure piping systems, for sanitary wastewater and liquids with substantial solids content. Rupture discs shall not be used.

50.5 Slope

All forcemains shall be sloped sufficiently to promote the discharge of air during filling and to permit the forcemain to be drained. Forcemains shall not be installed at zero slope.

50.6 Alignment

Forcemains should have a straight alignment wherever possible. The use of 90 bends in forcemains is to be avoided. A series of 45 or smaller deflection bends are to be used where extreme direction changes are required.

50.7 Air Release

Automatic air release valves shall be provided at all relative high points along the forcemain. The need for air release valves should be minimized by establishing the grade profile to eliminate summits. Air release valves are to be installed in waterproof concrete access chambers, insulated to prevent freezing and with provisions for drainage.

50.8 Blowoff Valves

A valve for blowoff and drainage of the forcemain is to be provided at each low point.

50.9 Vacuum Relief

Provision for vacuum relief shall be made as necessary where forcemains are proposed to drain by gravity between pumping cycles.

50.10 Forcemain Outlet

50.10.1 The forcemain should enter the receiving manhole horizontally at an invert elevation no more than 300mm above the flow line of the receiving sanitary sewer. A smooth flow transition to the gravity sanitary sewer is to be designed to minimize turbulence at the point of discharge.

50.10.2 Inert materials or protective coatings shall be used for areas subject to sulphide attack.

50.10.3 IPEX Vortex Flow or Force invert shall be installed when outlets enter a sanitary gravity manhole. (see section 9 for information)

50.11 Design Documentation on Engineering Drawings

The Engineering Drawings shall include "system head" curves for each forcemain, considering the wet well water level at its lowest and highest points and for each different pump operation combinations possible. The plans shall include a notation of the design basis, which shall specify the design friction coefficients, equivalent hydraulic length and design operating conditions.

50.12 Requirements for Locating Forcemains

To facilitate locating, a tracing wire shall be placed along all forcemains at the time of construction. The wire shall be terminated in a labelled electrical box in the pump station (or appropriate secure location) and looped in any valve chambers and blow-off chambers to allow for connection of an electronic locator at intervals of not greater than every 300 m along the length of the forcemain. If a chamber is not available to provide this interval, the wire shall be looped into a cast iron valve box set at grade level. Locator wire shall be stranded 12-gauge copper with insulation for direct burial. Underground splice connections shall be minimized and shall be rated for direct burial service. Prior to acceptance of the forcemain, a continuity check shall be conducted by to verify that the wire has not been broken during installation.

50.13 Requirements for Forcemain Inspection and Cleaning

A pig launch port is to be provided at the pump station for cleaning and inspection of the forcemain. The intent of this provision is to allow cleaning using conventional pigs and inspection using smart pigs, televising or other equipment without significant pipe dis-assembly. Similar provisions are to be made wherever the forcemain changes direction with an elbow of more than 45 degrees. Inline pig launch and receiving chambers/vaults shall be installed where applicable with a minimum of one end

chamber/vault for receiving the pig or other equipment. Drain ports will also be installed, ideally with access to the drain valve from surface.

50.14 Post Construction

50.14.1 – TESTING REQUIREMENTS

It is recommended that, no mains shall be charged and no pressure tests shall be permitted between **October 15th to April 15th inclusive.**

Aquatera shall be contacted by the Contractor to schedule the meter cart installation, and operation of the boundary valve. Under no circumstances shall the boundary valve be operated by anyone other than Aquatera in accordance with City of Grande Prairie By-law C-1139 Section 8.06 and Schedule "D" Subsection 11.01.

The Consulting Engineer/contractor shall co-ordinate all turbidity & pressure tests with Aquatera Engineering Services Department at inspection@aquatera.ca.

Filling of all sanitary forcemains or low pressure sewers require an air gap between any water system.

Prior to testing low pressure and forcemains the system shall be flushed until the discharge drops below 10 NTU.

Pressure testing of HDPE low pressure and forcemains shall be in accordance with the latest version of ASTM F2164. The test pressure shall be 1.0 times the rating of the pipe, but not to exceed the pressure rating of the lowest rated component in the test section, unless these components can be isolated. An Aquatera representative shall be contacted to schedule to witness the test. When testing to a pressure lower than 1.0 times the pipe rating, the specifications for the lowest rated component shall be provided with the test results.

Pressure testing of PVC low pressure and forcemains shall be in accordance with AWWA C605-13. Please see Section 91.4.3 b) ii) of the Aquatera Construction Manual for reference.

The contractor shall supply all necessary labour, materials, equipment, tools and incidentals to complete the tests in accordance with these specifications.

After pressure test is complete for low pressure and forcemains the contractor shall leave pressure on the system of approx. 25-50 PSI.