BRIDGE WATER AND SEWER LINES

Introduction

This memo discusses the responsibilities of the water and sewer line review engineer and the design engineer performing the design for water and sewer lines installed within new or existing bridge structures.

Water and Sewer Review Engineer Responsibilities

• Provide assistance to the Bridge Engineer and Encroachment Permit Engineer reviewing the plans and specifications for water and sewer lines on the bridge.

• Provide comments to District staff or Local Agency owner of the utility.

• Determine the type of materials to be used for utility lines and casing pipes.

Design Engineer Responsibilities

• Provide plans, calculations and specifications for the water/sewer lines and their connection to the bridge structure.

Applicability

All water and sewer line installations on bridges shall comply with these requirements. The engineer shall review the installation plans for bridge design and other Department programs.

Design Principles

Water and sewer line installation plans must meet the following basic requirements which have been developed to minimize risk to the public and structure and to minimize maintenance problems in the vicinity of the structure. It should be noted that every bridge is a unique design; therefore, every water and sewer line installation is a custom design specific to the particular bridge. These requirements include:

1. The design will contain any potential leaks, within the limits of the bridge, and any liquids are to be carried away from the structure and released in a controlled manner away from the traveling public. This is a major consideration with sewer lines.

2. The interference of the utility installation during construction of the bridge should be minimized. The pipeline can be installed in the casing pipe after the bridge is constructed. In this situation the bridge contractor will often only install the casing pipe and supports.

3. Water and sewer lines shall be designed to accommodate thermal expansion and transverse seismic bridge deflection. This is accomplished by placing an expansion fitting or expansion deflection fitting inside the structure near the bridge abutment.

4. The pipeline should be designed to accommodate large lateral displacements (specific to the bridge and could be up to 12 inches) between the abutment back wall and end diaphragm by placing deflection fittings within the bridge. This information is available from the bridge designer. The deflection fittings shall not be cased.
5. All the alternatives should be explored and installing the water/sewer line on the bridge structure should be the last option.

6. Verify that the bridge structure is adequate to support the additional loads of the pipe/casing/pipe contents and weight of construction assembly.

**Design Requirements**

The following requirements for water and sewer lines are necessary to protect public safety and the structure:

1. All water and sewer pipelines in or on bridge structures must be encased. The casing should extend the greater of: 5 feet beyond the approach slab, 20 feet beyond the abutment back wall, or 5 feet beyond the wing walls. Casing must be grouted in the abutment back wall. Fully cased pipe should be wrapped with building paper before casting into bridge abutments or dry packing.

2. In single span and double span bridges, a box girder cell may be considered encasement for only waterlines if the following conditions are met:
   a. Access is made available to mechanical devices placed within the structure;
   b. Provisions are made to adequately drain the cell in the event of a pipe rupture and drainage openings shall not be located over traffic; and
   c. A thimble casing is provided from the abutment back wall into the approach fill. The limits of the thimble casing shall comply with thimble casing detail provided in Section 16 of the Bridge Design Details Manual.

3. Sewer lines must be cased for the entire length inside of box girder structures and on open girder bridges. Sewer line casings may be broken near abutments to allow for placement of expansion or expansion/deflection fittings. Soffit drainage openings must be located downhill and in the immediate vicinity of the break in casing pipe. Casing pipe limits are as noted in item number 1 above. Soffit opening shall be a minimum of 2 feet x 3 feet. Soffit opening shall be located under flexible expansion joints to allow maintenance for expansion joints and controlled discharge of water to the roadway shoulder. Soffit openings are not allowed adjacent to bent caps in order to keep leakage away from the median and traveled away.

4. Pipe supports should be designed to support the self-weight plus the weight of the pipe/casing/pipe contents and weight of construction assembly. Cast in place supports such as inserts and anchor bolts shall be shown on the contract plans. The pipe support should be provided with a strap or type of restraint to prevent the pipe assembly from falling off the support under seismic loading. The strap should provide for thermal expansion independently of the superstructure in
the longitudinal direction.

5. **Hanging supports must be fabricated from steel.** The steel should be hot dip galvanized after fabrication. Supplemental lateral supports should be provided for the water and sewer line as needed.

6. **Supports located on soffit slabs shall be made of concrete.** Concrete cradle supports should be designed to withstand the loads and cast in place with the soffit slab or after the slab has been poured, epoxy and dowels must be used for the supports. Precast concrete supports may also be used if provisions are made on the utility installation plans for the soffit slab to be ground flat prior to installation of the support. Straps on concrete supports shall not be clamped down tightly except at the support near the center of the bridge, to allow the pipe to move independently of the superstructure longitudinally as previously noted.

7. **Pipe shall conform to American Water Works Association (AWWA) specifications.**

8. **Water and sewer lines shall be welded steel or ductile iron.** Plastic pipe such as PVC, HDPE, and FRP are not allowed in State bridges due to their higher thermal expansion.

9. **Steel lines carrying sewage or other corrosive materials shall have corrosive protection measures included.** Protection includes but is not limited to additional steel thickness, cement mortar, epoxy, polyurethane, or nylon-based polyamide lining.

10. **Water and sewer lines shall be designed to accommodate relative seismic/thermal displacements.** This is normally accomplished by:

    a. **Placing expansion deflection fittings on the water and sewer line inside the bridge or in a vault adjacent to the abutment on seat type abutments.** The Office of Electrical, Mechanical, Water and Wastewater Engineering has standard details for water and sewer line installation inside the bridge. Force balanced flanged double ball expansion joint is required for seismic expansion in the pipe. Mechanical expansion joints are not accepted as seismic expansion fitting. A seismic expansion joint at each abutment in the pipe line is required.

    b. **Using sliding supports adjacent to the abutment that will allow the water or sewer line pipe to accommodate the displacements.**

    c. **Longitudinal expansion fittings are required on end diaphragm and shear key type abutments to accommodate thermal expansion because the abutment type prevents shear movement.**

11. **Water and sewer lines shall not be cast into concrete or placed into deck slabs, sidewalks, or barrier rails.**

12. **An air release valve is required at the high point of pressurized water and sewer lines.** Air release valves must be installed within the bridge cell to allow for proper operation of the fitting and access for
maintenance. Access to this mechanical device may be required by manhole from the deck. The manhole location should be coordinated with the utility owner through the District Project Engineer.

13. Install shut off valve at the ends of the water and sewer pipes. The shut off valves should be located outside of the bridge structure.

14. Water and sewer lines with less than 40 inches of cover over the line in the traveled way require structural protection from wheel loads or an analysis showing that they can sustain wheel loads. A standard structure approach slab is not considered adequate structural protection. Providing casing pipes can offer some structural protection.

15. In box girder bridges, the structure depth must be adequate to accommodate the pipe support height, pipe diameter, pipe casing (if any) diameter and seismic expansion assembly movements.

16. A dirt stop shall be provided to avoid dirt buildup between the pipe and the casing.

17. Pipe protection shields should be stainless steel half circle and are required to allow the pipe to slide on the support cradle and shall be shown on the plans.

18. Thermal and seismic expansion calculations are required.

19. The following notes shall be shown on the bridge utility details plans:
   a. Supply line shall be installed parallel to bridge deck.
   b. Pipe shall tightly clamp at the two pipe supports nearest the center of any two expansion assemblies. At all other pipe supports, the pipe clamp shall be shimmed with steel washer plates to provide ¼” clearance and allow for expansion in both directions.

20. For sloped bridges, additional restraints are necessary to hold the pipe from sliding downhill.

21. Utility openings in end diaphragm bridges must be sized for maximum deflection.

22. Provide structural calculations and drawings for the structural integrity and adequacy of the existing bridge structure due to the new cuts in the bridge structure for the soffit openings and manhole in the deck.

23. The pipe system assembly installation should be accessible for the Department’s inspection, during and prior to completion of the job.

24. All work shall be uncovered and convenient for the Department’s inspection.

25. Provide information on adequacy of soffit opening to show how water will be carried away from the public travel way.

26. Verify that the soffit access openings are adequate for installation and
maintenance of the pipe system.
27. Abutment utility opening must be pipe diameter plus 8 inches minimum.
28. Distance between abutment and expansion assembly must not be more than 12 inches in box girder bridge.
29. Distance between expansion assembly and adjacent concrete support must not be more than 18 inches in box girder bridge.
30. Casing must be grouted in abutment wall.
31. If seismic assembly is provided outside of the bridge, provide adequate utility opening in abutment to prevent restriction of the pipe movement during seismic event.
32. If seismic assembly is provided in the vault, provide drain pipe in the vault.
33. Bent cap opening must be pipe diameter plus 2 inches minimum.
34. Casing insulators must be installed within 18" of all bell ends of supply line and within 12 inches of both ends and every 6 feet 6 inches on centers. Fill void between dirt stop and first casing insulator with foam.
35. 4 inches minimum clearance between bottom of the seismic assembly and soffit must be provided.
36. Maximum distance between two concrete pipe supports must not be more than 10 feet.
37. Provide structural calculations and drawings for the lateral restraint assembly of the pipe system. Maximum lateral restraint assembly spacing shall be 20 feet.
38. Concrete clevis plate must be installed with four mechanical expansion anchors with minimum 2 inches embedment in existing bridge in pipe hangers.
39. Standard plans B14-3, B14-4 and B14-5 are available for irrigation lines less than four inches. Standard plans B6-10, B7-10 and B711 are available for other utility details.

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