

BRIDGE WATER AND SEWER LINES

Introduction

This memo discusses the responsibilities of the engineer performing the design for water and sewer lines installed within bridge structures.

Engineer Responsibilities

- Provide assistance to the Bridge Engineer and Encroachment Permit Engineer in designing or 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.
- Provide details of utility supports and their connection to the structure.

Applicability

All water (drinking and storm water) and sewer installation requirements on bridges are required to comply with these requirements. The engineer shall review the installation plans for bridge design and other Caltrans 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 on 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 (up to 12 inches) between the abutment back wall and end diaphragm by placing deflection fittings within the bridge. The deflection fittings cannot be cased.

**Design
Requirements**

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

1. All liquid carrying 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. The carrier is a metal pipe;
 - c. Provisions are made to adequately drain the cell in the event of pipe rupture and drainage openings shall not be located over traffic; and
 - d. 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 Bridge Design Details Manual.
3. Sewer lines must be cased for their 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 1 above. Distance between soffit openings and the abutment shall not be more than 10 feet. Soffit opening shall be a minimum of 2'x3'. Soffit opening shall be located under flexible expansion joints to allow maintenance for expansion joints and controlled discharge of water to the roadway shoulder.
4. Utility supports should be designed to withstand the loads and constructed of steel or concrete. Cast in place supports such as inserts and anchor bolts shall be shown on the contract plans. The utility support should be provided with a strap or type of restraint to prevent the utility from falling off the support under seismic loading. The strap should provide for thermal expansion independently from 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 carrier line.

6. Supports located on soffit slabs are to 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 should 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 carrier 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. On structures with seat type, end diaphragm, and shear key abutments, water and sewer lines under pressure (not gravity flow) shall be designed to accommodate relative seismic displacements. This is normally accomplished by:
 - a. Placing expansion deflection fittings on the carrier 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 this type of installation. Force balanced flanged double ball expansion joint is recommended 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 water supply line is required.
 - b. Using sliding supports adjacent to the abutment that will allow the carrier 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. 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.
14. In box girder bridges, the structure depth must be adequate to accommodate the pipe support height, pipe diameter, pipe casing (if any) diameter and expansion thickness.
15. A dirt stop shall be provided to avoid dirt buildup between the pipe and the casing.
16. Pipe protection shields are required to allow the pipe to slide on the support cradle and shall be shown on the plans.
17. Thermal and seismic expansion calculations are required.
18. 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 1/4" clearance and allow for expansion in both directions.
19. For sloped bridges, additional restraints are necessary to hold the pipe from sliding downhill.
20. Utility openings in end diaphragm bridges must be sized for maximum deflection.

Standard Plans

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 B7-11 are available for other utility details. These plans are attached for reference.



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