WATER AGENCIES' DESIGN GUIDE

Design Guideline for Potable Water,
Recycled Water, and Sewer Facilities

SECTION 12.1
BRIDGE CROSSINGS

12.1.1 PURPOSE

The purpose of this section is to provide an overview and general information regarding the planning and construction methods for bridge or structure crossings.

12.1.2 GUIDELINE

Plan and profile views of all major crossings are provided in the civil drawing section of the contract drawings. Where a similar crossing is used at different location only one detail need be produced. All crossing locations to which the detail applies should be noted on the detail.

12.1.3 COORDINATION WITH AGENCIES

The design consultant coordinates with the following agencies, as applicable to the project to determine any requirements to be included in the Contract Documents for design or construction at special crossings.

Railroads:	MTS/SANDAG
State Highways:	Caltrans
County:	San Diego County Department of Public Works
Cities:	City of Jurisdiction

12.1.4 LOCATION

Pipelines and appurtenances must be located under the shoulder or sidewalk area (i.e., between the exterior and first girder; Figures 12.1.1 and 12.1.2). In box girder type bridges, no other utilities may be installed in the same cell as water and sewer pipelines and appurtenances.

Where adequate access to utilities can be provided for maintenance, pipelines and appurtenances may not be exposed to view.

Consider the use of alternative pipeline locations and configurations, such as routing the pipeline around the bridge or using multiple smaller dimension pipelines, to improve the aesthetic and/or adapt to the physical limitations of the installation.

Provide manhole access, material and equipment for operation, inspection, maintenance and repair of all pipelines and appurtenances.

12.1.5 PIPELINE REQUIREMENTS

Use proven and tested engineering and design and construction standards to increase reliability and ease of maintenance and to decrease repair frequency. Provide piping materials suitable for point load support and non-buried external exposure.

Provide pressure class and wall thickness in excess of that required for the design pressure to provide additional pipe strength and sacrificial wall material (i.e., use a safety factor of 2.25 instead of 2.0; design for pressures 100 psi greater than anticipated).

Size pipeline facilities in bridges to accommodate future needs, or provide casing to facilitate future expansion. Where required for redundancy, provide multiple pipelines.

During construction of closed cell-type bridges with (Figure 12.1.2) cells that cannot be re-entered except from a manhole, an additional 20' length of pipe per 200' of pipe installed, and of the same specifications as originally installed, shall be left in each cell. Seal both ends of the extra pipe lengths to prevent debris accumulation inside pipe.

Shut-off valves on water mains must be installed within 100' of each end of the bridge structure or before any tee or branch connection.

Provide expansion joints to accommodate relative expansion and contraction between the bridge and the pipeline, typically resulting from thermal and seismic effects. Since this type of movement is only in the axial direction, angular or transitional movement expansion joints must be anchored at one location, with the remaining supports allowing axial movement. Pipelines must be anchored at all bends, valves, tees, and other thrust producing fittings, with expansion joints located appropriately.

Design supports and spacing of supports to provide free draining conditions and avoid trapping pockets of liquid or air in the pipeline. Provide adequate spacing of the supports based on manufacturer design specifications. Prevent sagging or other unwanted movement of the pipe.

Design pipelines for all imposed loads. Calculations should include checks for internal pressure, hydraulic transients, and seismic and wind loads. Longitudinal defections should be limited to L/360. All thrust forces shall be calculated and resisted. Maximum thermal expansion and contraction shall be calculated and accommodated. Check bending, shear, and local buckling at supports.

Confirm that pipelines near an abutment to an embankment transition can accommodate differential movement of 50% of the pipeline diameter. Submit calculations with plans to the CIP Project Manager.

Through the bridge, provide and design for the disposal or elimination of water in the event of a pipe failure, and for routine maintenance dewatering.

12.1.6 PIPELINE CONSTRUCTION

1. Pipe Material

   a. Welded Steel Pipe shall have a minimum cylinder thickness of 0.25" and shall be designed to accommodate a minimum pressure of 250 psi, or the intended test pressure, whichever is greater. Field welding shall be in accordance with AWWA C206 and the pipe shall be coated with bituminous enamel or epoxy, or other protective coating, and painted through the bridge, where installed above grade. Below grade pipe installations are cement mortar lined (minimum ¾" for all diameters) and coated (minimum 1.25 inches) per AWWA C205. In cases where water and sewer mains occupy the same cell in a closed-cell bridge, welded steel pipe only is used for the water main.

   b. Ductile Iron Pipe has a minimum design pressure of 250 psi for water and conforms to AWWA C150 and C151. Pipe is coated per AWWA C210, C213, C214, C217, or C218, depending on the service conditions. Water

service pipe is cement mortar lined (minimum thickness two times that specified in AWWA C104).

2. Encasement

A box girder cell (Figure 12.1.3) may be considered the encasement if access is available for the full length of the pipeline in the structure, the pipeline shall be constructed of steel or welded steel, and provisions shall be included to adequately drain the cell if the pipeline ruptures.

If the pipeline is buried within 12 to 24" of the finish surface, a protective concrete pad per WAS drawing WP-06, shall be poured to protect the pipeline, but in no case shall the pipeline itself be encased.

3. Available Joint Types and Characteristics

a. Flanged: Complete restraint against all movement . Limited tolerance for misalignment.

b. Welded Steel: Complete restraint against all movement. Tolerance for misalignment varies as follows:

- Butt weld – None except by trimming pipe ends
- Lap welded slip – Limited, less than 5 degrees angular
- Butt strap – Large tolerance for misalignment

c. Push On Joint: e.g., Tyton, Fastite, etc. Restraining against movement limited to friction between pipe and gasket. Restraint against axial movement can be increased by using special configurations and accessories. These configurations typically also prevent angular and translational movement, and thus are not suitable where movement other than axial is desired. The tolerance for misalignment is good. Many special configurations require special bell end casting as well; thus special pipe purchases are required.

d. Mechanical Joint: Restraint against movement is limited to friction between pipe and gasket. Restraint against axial movement is increased by using special gasket retainer glands. These configurations typically also prevent angular and translational movement, and thus are not suitable where movement other than axial is desired. The tolerance for misalignment is good.

e. Grooved Shoulder Joint: Restraint against axial movement with allowance for limited angular movement. No expansion capability. Limited tolerance for misalignment. Good noise and vibration attenuation.

f. Restrained Push-on Joint: Restraint against axial movement with allowance for limited angular and translational movement. No expansion capability Good allowance for misalignment.

4. Joint Application Considerations

a. Joint for Steel Pipe: Restrained joints may be flanged, grooved shoulder, lap-welded slip, butt strap, or butt-weld type. If restrained joints are used on bridges, the pipeline must be properly anchored and equipped with expansion joints. Intermediate supports must allow axial movement.

Sleeve couplings or rubber gasket joints may be used on bridges if each length of pipe is anchored. Joints must be capable of accommodating the expansion and

contraction of each length of pipe and must not be restrained. Anchor supports must be located at the bell end of the pipe. Intermediate supports must allow axial movement.

b. Joints for Ductile Iron Pipe: Restrained joints may be flanged or grooved shoulder type, or other types with appropriate restraint features. If joints restrained against axial movement are used on bridges, the pipeline must be properly anchored and equipped with expansion joints. Intermediate supports must allow axial movement. Sleeve couplings or mechanical and push-on joints may be used on bridges if each length of pipe is anchored. Joints must be capable of accommodating the expansion and contraction for each length of pipe and must not be restrained. Anchor supports must be located at the bell end of the pipe. Intermediate supports must allow axial movement.

c. Expansion Joints: Expansion joints may be bellows type or slip Type with packing. Bellows must be stainless steel or electrometric if available in size, pressure class, and movement capability required. Expansion joints may not require limit (long bolts spanning the joint) if pipeline sections are properly anchored and single end expansion joints are used. Piping on either side of expansion joints must be properly supported to minimize stresses on the expansion joint itself. A support directly below the expansion joint may be required.

d. Joints at Transitions: Bellows type expansion joints may provide sufficient angular and translational movement capacity for use at the bridge-to-abutment transition, if not restrained against movement in those directions.

The pipeline near the abutment-to-embankment transition must be capable of accommodating differential movement of 50% of the pipeline diameter. Where a casing is required, the casing must provide sufficient rigidity to prevent pipe damage, and a flexible coupling must be provided at the end of the casing. When casing is not used, multiple flexible couplings or a ball and socket river crossing expansion joint must be used at each end.

5. Cathodic Protection

All steel pipeline sections must be cathodically protected. For further corrosion protection information, see WAS Section 13110.

12.1.7 SUPPORTS

The spacing of pipeline support depends on the beam strength and rigidity of the pipe material and on bearing considerations at the supports. Supports must be designed to provide anchorage or axial movement as required by pipeline construction (see Figures 12.1.1 and 12.1.2).

Provide neoprene and separate type 316 stainless steel plate saddle supports to electrically isolate the pipeline from the bridge in case pipeline cathodic protection is provided as part of the immediate or a future project.

12.1.8 OTHER DESIGN CONSIDERATIONS

The inside diameter of penetrations and casings through pier caps, pile caps, abutments, or other transverse structural components of the bridge must be at least 8 inches larger than the largest pipe dimension (including bells or flanges, etc.), including considerations for future required pipe sizes.

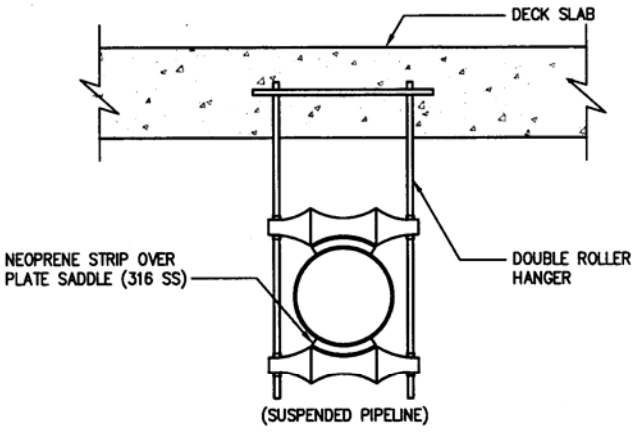
Access hatches for pipelines and other utilities shall be a least 2 ft. x 3 ft (figure 12.1.3), oriented with the long axis parallel to the pipe.

Reasonable measures must be provided to prevent unauthorized access to pipelines.

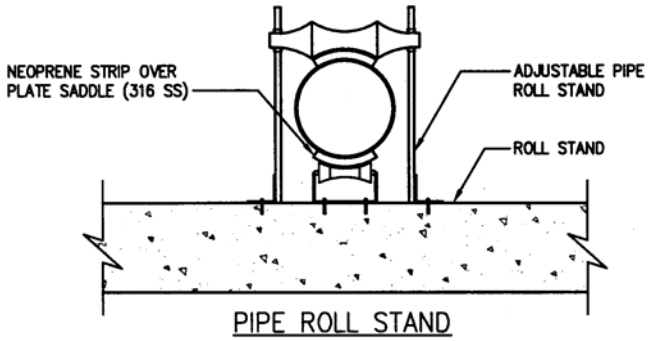
12.1.9 REFERENCE

Water Agencies Standards (WAS)

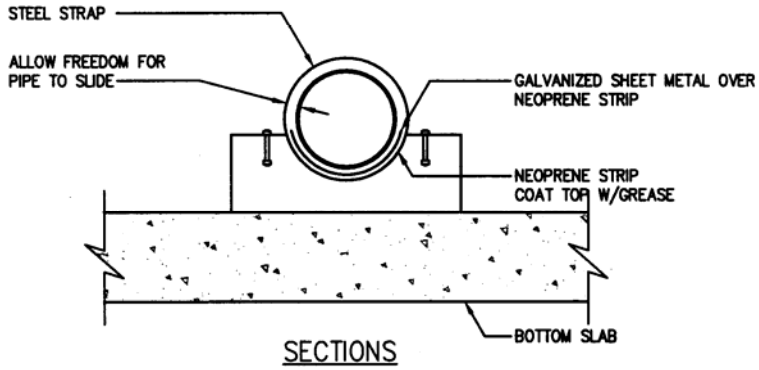
END OF SECTION



ROLLER HANGER



PIPE ROLL STAND



SECTIONS
NOT TO SCALE

NOTE:
1. ALL DETAILS SHOWN FOR EXAMPLE ONLY. DESIGNER SHALL ASSUME RESPONSIBILITY FOR COMPLETE AND ADEQUATE DESIGN OF ALL COMPONENTS.

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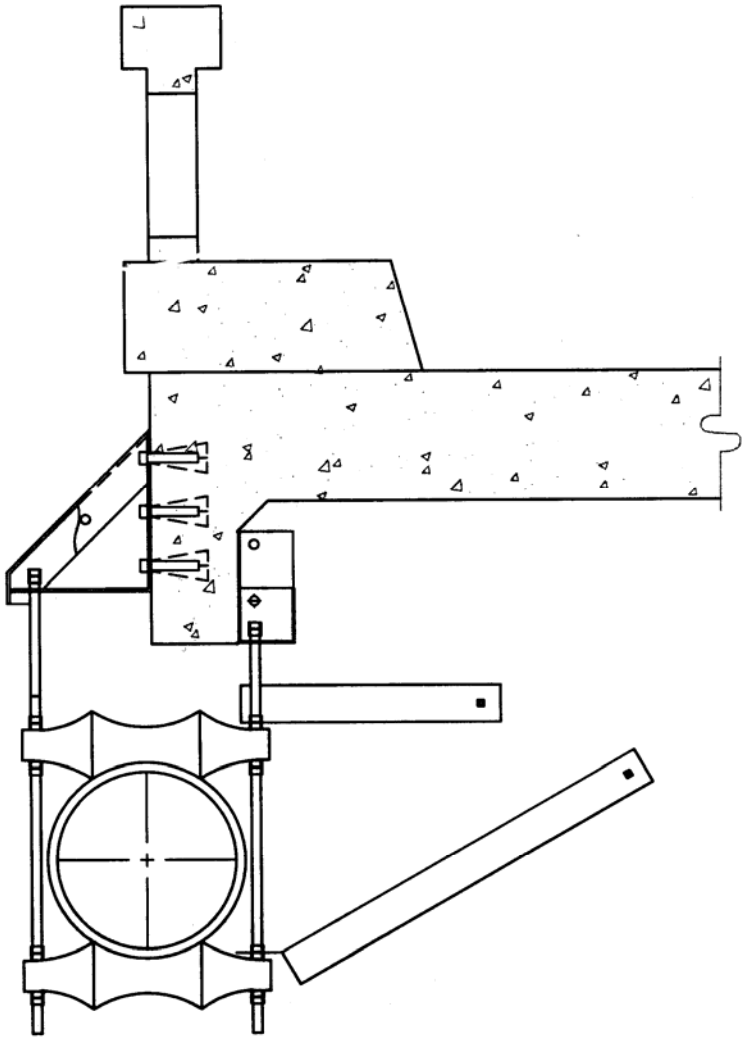
CONCRETE SADDLE

FIGURE 12.1.1



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TYPICAL DETAIL
WATER TRANSMISSION LINE
(EXAMPLE OF EXISTING INSTALLATION ONLY)

FIGURE 12.1.2

SHOULDER AREA
PROVIDE 2' x 3' MANHOLE ACCESS IN EACH SPAN
SECTION (NOT TO SCALE)
SHOULDER AREA
LOCATE PIPELINE WITHIN CELL IN SHOULDER AREA
SECTION (NOT TO SCALE)
NOTE:
1. ALL DETAILS SHOWN FOR EXAMPLE ONLY. DESIGNER SHALL ASSUME RESPONSIBILITY FOR COMPLETE AND ADEQUATE DESIGN OF ALL COMPONENTS.
NOTE ON PLANS:
1. ALL FORMING MATERIALS AND DEBRIS SHALL BE COMPLETELY REMOVED FROM CELLS WHICH CARRY WATER AND SEWER MAINS.
BOX GIRDER TYPE
03/22/99

FIGURE 12.1.3