Utility Manual

for Bridges and Other Structures

STATE OF CALIFORNIA
Department of Transportation
Division of Engineering Services & Division of Maintenance

State of California

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The Division of Engineering Services and the Division of Maintenance have prepared the contents of this guidance. Revisions are made and posted on the Department of Transportation website when necessary. All who use this guidance shall verify that it is current and relevant for the intended use, obtain any revisions, and disregard obsolete or inapplicable information.

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GLOSSARY

Access control – the full or partial access restriction to owners or occupants of abutting lands to or from a highway.

BD – DES Offices of Bridge Design

Broadband – is another term for high-speed internet access. In the United States, broadband is defined by the Federal Communications Commission (FCC) as a connection with at least 25 Mbps download speed and 3 Mbps upload speed.

Caltrans – California Department of Transportation

Cal/OSHA – Division of Occupational Safety and Health

CFR – Code of Federal Regulations

CPUC – California Public Utilities Commission

DEPO – District Encroachment Permit Office

DES – Division of Engineering Services

DPE – District Permit Engineer

EMWW – DES Office of Electrical, Mechanical, Water and Wastewater Engineering

Hazardous liquid – petroleum, petroleum products, anhydrous ammonia, chlorine, liquid natural gas, and ethanol or other non-petroleum fuel, including biofuel, which is flammable, toxic, or would be harmful to the environment if released in significant quantities.

High-priority utilities – As defined in PDPM Chapter 17, Section 1

PDPM – Project Development Procedures Manual

Right-of-Way (ROW) – A general term denoting land, property, or interest therein (usually in a strip) acquired for or devoted to transportation purposes.

SFP – DES Office of Special Funded Projects

SM&I – Division of Maintenance Office of Structure Maintenance and Investigations

Structure-related utilities – Utilities that are installed on or in a bridge or close enough to a bridge or other structure where the installation may be a concern. Structures other than bridges include retaining walls, sound walls, overhead sign structures, and pump plants.

QMAP – Quality Management Assessment Process

Utility owner – Any private entity or public body (including city, county, public corporation, or public district) that owns and/or operates a utility facility that directly or indirectly serves the public for a fee. For the purposes of this manual, the utility owner can be a utility company, Caltrans, or another entity.

INTRODUCTION

The general policies for the administration of encroachments and installation of utilities within the State highway Right-of-Way (ROW) are outlined in Chapter 17 of the Project Development Procedures Manual (PDPM). Utility encroachments on structures, should be avoided where possible. Alternatives for locating utilities outside structures should be thoroughly evaluated. The feasibility of locating the utility elsewhere can be assessed collaboratively by the District encroachment engineer and the utility company, once the utility company fully understands the associated requirements, risks, and costs installing the utility on the structure.

The *Encroachment Permits Manual and Right-of-Way* Manual each guide utility installations within highway ROW. This manual provides additional guidance on existing structure-related utilities or proposed utilities on or near Caltrans bridges and other highway structures. Other highway structures can include retaining walls, sound walls, pump plants, overhead sign structures, and others. Structure-related utilities shall not adversely affect the safety, design, construction, future widening, operation, maintenance, or stability of the bridge, surrounding highway, and properties.

The guidance and requirements in this manual apply to utility installations, regardless of whether owned and operated by utility companies, Caltrans, or others. Although a utility may be allowed on or near a structure, utility owners shall be aware of the risks and the potential for extended service outages before installing utilities in such locations.

In the event of any discrepancy between this manual and other Department manuals relating to guidance on utility installations on or near structures, this manual shall govern.

1 APPROVAL OF STRUCTURE-RELATED UTILITIES

1.1 UTILITY OWNERSHIP

1.1.1 Caltrans Owned Utilities

Caltrans installs utilities on bridges for the operational needs of the highway system. Some of the more frequent types of utilities are as follows:

- Sprinkler Control Conduits (electrical lines from controllers to irrigation valves)
- Water supply lines-usually for irrigation/sprinklers
- Conduits/wiring for lighting
- Telecommunications

The review and approval of these installations occur through the Caltrans project development process.

1.1.2 Utilities Owned by Utility Companies and Others

There are many different types of utilities that utility companies and others request to install on or near Caltrans bridges and other structures. The utilities include low and high-voltage electrical lines, fiber optic lines, waterlines, gas lines, sewer lines, and others.

For new bridges and bridge widening, the review and approval process occurs through the project development process. The Offices of Bridge Design (BD) will review in-house design projects, and the Office of Special Funded Projects (SFP) will review consultant-designed projects. For overall utility coordination, refer to *Caltrans RW Manual Chapter 13*.

The review and approval for installations on existing bridges generally occur either through the encroachment permitting process at the District Encroachment Permit Office (DEPO) or the Project Delivery Quality Management Assessment Process (QMAP). For the proposed installations, refer to “Applicant's Check List to determine appropriate review process” at *Applications & Forms*. When managed through the encroachment permitting process, the District Permit Engineer (DPE) furnishes permit application packages for proposed utility installations on or near bridges or other structures to the regional Division of Maintenance Office of Structure Maintenance and Investigations (SM&I) Permits Office. SM&I is responsible for obtaining appropriate Division of

Engineering Services (DES) reviews as necessary. These reviews and approvals are necessary before the DEPO issues an encroachment permit.

1.2 Minimum Requirements for Installation of Utilities on or Near Structures

Installing utilities on or near structures may be permitted if the following concerns are met:

- The utility owner demonstrates it is not reasonable or feasible to locate the utility elsewhere.
- The utility loads shall not downgrade the ability of the structure to safely accommodate legal loads and/or transportation permits.
- All utility installations shall be designed to accommodate bridge movements (including seismic movement for some utilities).

Additional requirements from the *Project Development Procedures Manual* (PDPM) Chapter 17 shall also be met:

- The utility is under the California Public Utilities Commission (CPUC) jurisdiction or is publicly owned and provides a dedicated service to the public.
- Maintenance access points are installed outside State ROW when feasible.
- The utility does not adversely affect operational safety on the state highway system.
- The utility can be constructed and maintained as determined by District Traffic Operations with an acceptable and minimal disruption to highway traffic.
- Planned emergency access from adjacent ROW is prohibited. The utility owner has access contingency plans in place if uninterrupted service to customers is essential.

Even if the above conditions can be met, there may be situations where the utility type will not be allowed on or near a structure due to structure type, functional sensitivities (such as traffic flow, environmental restrictions, etc.), or other factors.

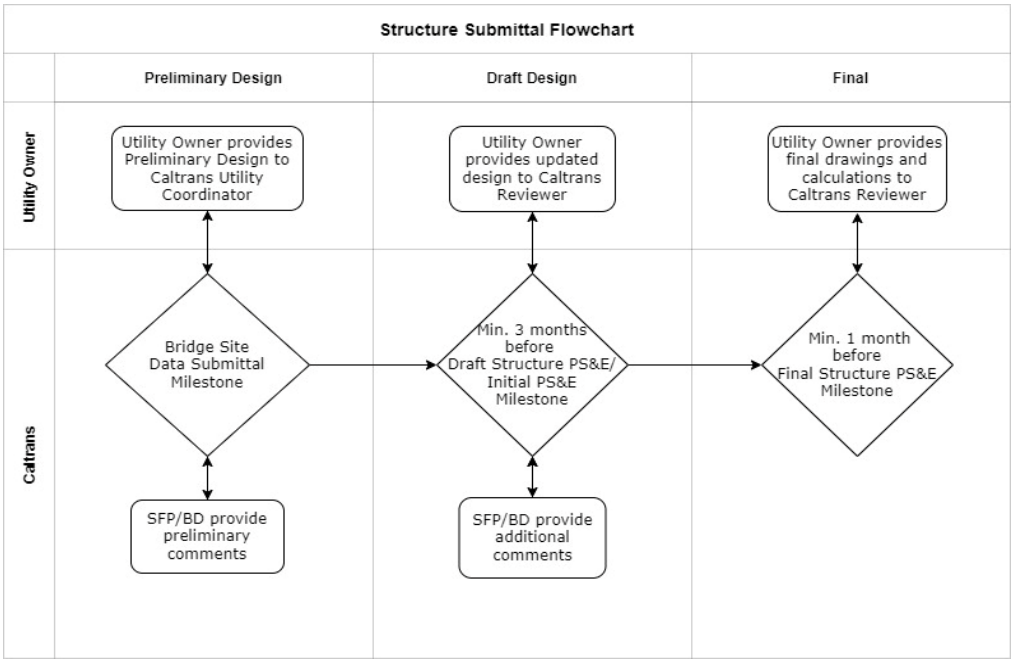
Identify utilities and manage conflicts as early as possible in the planning and design phases. Utility relocation before the construction phase of the structure is always encouraged.

1.3 Review Process for Utility Installations on New Bridges or Other Structures in the Design Phase

All proposed utility installations on or near structures shall be reviewed by the appropriate Caltrans structure functional units within the DES or SM&I, as shown in Table 1.4-1. The reviews are to ensure other viable design alternatives are considered, to ensure the design is compatible with the structure, and to ensure the utility does not pose any safety, operational, or other concerns.

Utility owners shall provide preliminary design information within the Bridge Site Data Submittal to allow Caltrans to assess if a structure can accommodate the proposed utility installation. A Caltrans-approved final utility design shall be received at least three months before Draft Structures Plans, Specifications, and Estimate (PS&E) or Initial PS&E for oversight projects. The utility owner is responsible for scheduling reviews to gain Caltrans' approval. If these deadlines are not met, Caltrans cannot ensure the utility will be accommodated. The District Project Manager will provide the project milestone dates. See Figure 1.3-1 for a flowchart of this review process. Refer to Section 3.1 and Section 3.2 for details on what to include in the design documents.

Figure 1.3-1 – Structure Submittal Flowchart



The utility lead design engineer should coordinate with the bridge designer to ensure that utility loads, openings, supports, and other needs are accommodated in the bridge design. The impact of installing the utility on the construction operation should be incorporated into the project schedule.

1.4 Coordination of Structure Reviews and Utility Installation

This section discusses structure review coordination and the typical scenarios of how the utilities are installed in structures, whether owned by Caltrans or others.

Structure utility installation plans are reviewed by the appropriate functional units to ensure compatibility with the structure's operational needs and that the utility meets the requirements. When the proposed plan is reviewed and concurrence by the appropriate functional unit, the DEPO can issue an encroachment permit for installation.

The structure unit responsible for performing the appropriate reviews depends on whether a utility is to be installed on a new or existing bridge. The table below shows the different cases, the possible utility designers, and the corresponding structure review leads responsible for utility coordination and obtaining the necessary reviews.

Table 1.4-1 - Structure Reviews[1]

Case	Type of Installation	Utility Designer	Structure Review Lead	Utility Reviewer
Case 1	New structure or widening designed by in-house engineers	District[2]	BD	EMWW
		Consultant or Utility Company		
	New structure or widening designed by consultants	Consultant or Utility Company	SFP	
Case 2	Existing structure	District[2]	SM&I/BD	
		Consultant or Utility Company[1]	SM&I/SFP	

Notes:

[1] Utility reviews that qualify for the Quality Management Assessment Process (QMAP) may follow a separate review path. Refer to *APPLICANT'S CHECKLIST TO DETERMINE APPLICABLE REVIEW PROCESS* to identify the applicable process for the proposed installation.

[2] For Caltrans-owned utilities.

1.4.1 Case 1 - Utility installed on a new structure or widening. The utility details will be in the project plans.

Though the BD or SFP lead also coordinates the utility with the District for lines not owned by Caltrans, utility owners shall still coordinate with the ROW Utility Coordinator to obtain design approval and an encroachment permit.

Early in the design phase, all utility owners, including Caltrans, shall coordinate with the structure designer to ensure the utility loads, openings, supports, and other needs are accommodated. If the structure lead is BD or SFP, reviews and input are obtained from the Office of Electrical, Mechanical, Water and Wastewater Engineering (EMWW) and other appropriate DES functions as the project is developed.

1.4.2 Case 2 - Utility installed in an existing structure

For this case, Caltrans-owned utilities undergo the coordination and reviews similar to those in Case 1, where the structure lead obtains reviews from the appropriate units.

For utilities owned by others, the DEPO identifies the appropriate approval process through the established criteria in the *Encroachment Permit Process Determination Memorandum.* SM&I is the lead for coordinating structure reviews for installations on existing structures through the encroachment permit process. SFP is the lead for coordinating structure reviews for installations on existing structures through QMAP.

The structure lead (SM&I or SFP) reviews and obtains input from EMWW and other appropriate DES functions.

2 GENERAL REQUIREMENTS

2.1 Location of Utilities

Location requirements for a utility on or near structures apply whether a utility is owned by Caltrans or others.

A basic requirement of utility location is that the line, as well as its casing, supports, expansion fittings, deflection fittings, and other appurtenances, shall be sized to fit within a proposed utility opening.

Other considerations for locating each utility within a structure are listed below.

The utility should be placed off-center in the utility opening, if possible, to allow for future utility additions.

Different utility types may not be allowed to be placed next to each other in the same bridge cell, such as:

- Water and sewer lines
- Gas and electrical lines

2.1.1 Utility Exposure

Utility lines can be aesthetically unappealing and shall be located out of sight. This limits access to vandalism and damage due to traffic impacts. It also limits the need for relocation due to structure widening or bridge rail/overhang replacements and allows for better visual inspection of the bridge.

Fiber optic cables are exempt from the above requirement on existing bridges.

2.1.2 Maintenance Access

The need for access shall be minimal, for example, emergency repairs or annual maintenance/inspection. The access shall be designed in compliance with Cal/OSHA requirements, ensure safety, provide safe access, and cause minimal inconvenience to the traveling public. The utility should not be located on the bridge if frequent access is required.

Access openings are required in box girder bridges in the following instances:

- Expansion fittings or other mechanical equipment require periodic inspections or maintenance. On overcrossing, approved manholes may be used to access the utilities. Manholes should be on the shoulder or sidewalk when possible. If a manhole is in a traveled lane, it shall be out of the wheel lines. Manholes are not permitted on bridges carrying an access-controlled highway.
- Soffit access openings require locking mechanisms if the opening is within 10 feet of the ground below the opening.
- Special agreements are required for access openings in structures crossing railroads.

Access openings in existing bridges shall be limited to two feet by two feet and be designed to minimally affect the structural capacity of the bridge. Structural calculations are required to demonstrate that an opening will not significantly degrade the bridge capacity.

Access openings require an approved encroachment policy exception.

2.1.3 Utility Type and Structure Type

Electrical lines with a voltage of more than 69kV are not allowed on bridges, regardless of the type. This limit has been set to minimize the interaction of the electromagnetic field with the bridge reinforcing steel and to minimize the risk to the traveling public.

High-voltage lines (over 35 kV) shall be installed in a separate bay from other utilities.

All electrical lines, including low-voltage lines, shall be in a separate bay from lines carrying flammable materials.

Installations of new high-priority utilities are rarely allowed on structures and require an encroachment policy exception.

Water and sewer lines shall not be cast into concrete bridge components, sidewalks, or barrier rails.

The following apply to slab bridges:

- Utilities may be placed in a barrier or sidewalk.
- If the slab is over water, the utility may be placed adjacent to the slab on the downstream side of the slab as long as the lowest portion of the conduit or brackets is not lower than the bottom of the slab. If the slab is not over water,

the utility shall not be placed adjacent to the slab, where it is subject to the possibility of high load hits.

- On new slab bridges, the utility may be incorporated into the slab design except for natural gas lines.

Box girder bridges often have lost deck forms that remain in the bays from construction. Placing a utility in such a bay may require the removal of these forms along the entire length of the bay for construction of the utility, as well as for future access to it.

2.2 PIPELINES

General requirements for pipelines are presented below. Requirements that are more specific for each utility type are contained in the subsections for the utility involved.

Carrier pipe materials shall conform to industry and California Public Utilities Commission (CPUC) requirements and the following minimum requirements:

2.2.1 Metal Pipe

Pipe for fluids under pressure shall conform to the American National Standards Institute (ANSI) Code for Pressure Piping.

Cast iron pipes shall conform to Caltrans' Standard Specifications.

2.2.2 Plastic Pipe

Specifications shall ensure that the type of pipe is adequate for the intended purpose (see CPUC General Orders).

A means for the detection of nonmetallic material shall be provided.

2.2.3 Pipe for high-pressure systems:

Pipes for high-pressure systems shall conform to American Petroleum Institute (API) specifications and American Society for Testing and Materials (ASTM) specifications covering sizes and types not covered by API.

If operating pressures are over 200 psi (not including natural gas):

- Wall thickness shall conform to CPUC General Orders.

- Maximum allowable hoop stresses for highly volatile fluids shall conform to ANSI, except that the maximum hoop stress under the “test pressure” shall not exceed 90 percent of the yield strength.
- A pressure test at 1.5 times the maximum operating pressure shall be conducted for 24 hours.

Radiographic inspection of all field welds shall be required.

In addition to the requirements for high-pressure systems, gas lines shall also meet the following:

The carrier pipe shall be leak and strength tested as required by CPUC General Order No. 112 and DOT 49 Code of Federal Regulations (CFR). The test pressure and test medium shall be noted on the installation drawing. In addition, the pipe shall be tested to a minimum of 1.5 times the Maximum Allowable Operating Pressure (MAOP), and all girth welds shall be nondestructively tested.

2.3 Encasement

2.3.1 Casings for Utilities on Bridges

Utilities that present a risk to the traveling public or other sensitive features at the structure's location shall be cased. This includes but is not necessarily limited to the following utilities:

Table 2.3.1-1 - Casing Requirements

Utility	Casing Requirement	Remarks
Gas Lines	Always	Casing shall be continuous and vented to prevent pressure build-up and for leak sampling
Sewer/Brine Lines	Always	Casing may be discontinuous to allow for expansion and deflection couplings
Waterlines	Whenever over a primary road or railroad	Casing may be discontinuous to allow for expansion and deflection couplings. Box Girder Cells can be considered as casing as provided in Section 4.3, Water and Sewage lines, elsewhere in this manual
Volatile Liquid Lines	Always	Casing shall be continuous
Electrical, Fiber Optic, and Telephone Lines	Conduit is the casing	Rigid metallic conduits or other approved material. All electrical conduits shall be grounded in accordance with the Electrical Safety Orders of Cal/OSHA
Other Utility Types	Varies	As determined by SM&I/SFP/BD

A rare exception to the casing requirements may be considered (except for gas lines) if the casing is not practical due to curvature or space limitations and if the proposed mitigation measures (e.g., increase the wall thickness of the carrier pipe) are determined to be sufficient.

When the casing is not otherwise required, it still may be warranted due to site conditions such as impaired clearances or if subject to unusual hazards such as frequent high stream flow, subsiding ground, or other site features.

The casing shall be welded steel pipe, and its girth welds shall develop the structural strength of the casing pipe. The casing diameter should be at least two pipe sizes larger than the carrier pipe and at least four inches larger than the largest outside diameter of the carrier pipe and joints/flanges to facilitate the removal and replacement of the carrier pipe.

For accessibility to the carrier pipe and to prevent leaks and ruptures from undermining abutments, the casing shall extend the greater of the following: 20 feet beyond the back

face of the abutment, five feet beyond the approach slab, or five feet beyond the adjacent wing walls. See Standard Plan B7-10, Note 11.

The outside of the casing shall be grouted within an abutment backwall.

Unless otherwise provided for in sections of this manual for each specific utility, spacers for carrier pipe shall be installed along the length of the carrier pipe, starting at a maximum distance of 12 inches from the ends of the casing. Spacers shall be spaced to adequately support the pipe and provide a minimum of one-inch clearance between the carrier pipe and casing. The spacers shall be electric isolating types. Exceptions to this requirement can be requested through the Structure Review Lead, provided the utility designers have an acceptable rationale for doing otherwise.

For steel carrier pipes that employ cathodic protection anticorrosion systems: (a) the carrier and casing pipes should be effectively insulated from one another; (b) carrier and casing should have cathodic protection as a unit.

Ownership and maintenance of the utility infrastructure, including the casing, shall be the responsibility of the utility owner.

Casing vents, when required, are to prevent a build-up of pressure and for leak sampling and detection. Venting into the ground is not permissible. The vents shall be located at an approved location within the vicinity of the end of the bridge, outside of wing walls, and within Caltrans ROW to prevent vandalism and to prevent interference with Caltrans maintenance and operations. Casing vents are required for all gas lines. Air release valves may be required for water and sewer lines if a high point of the carrier pipe falls within the Caltrans structure.

A dirt stop shall be provided to avoid dirt building up between the pipe and the casing.

2.3.2 Casings for Utilities Entering Abutments

The PDPM Chapter 17, Section 3, Article 4, “Clearance and Offset Requirements” requires that utilities are at least 42 inches below the finished grade or 18 inches below the grading plane of a planned project, whichever distance is greater.

Where structure depth is insufficient to accommodate utility casting requirements, an exception to the policy is required. See PDPM, Chapter 17, Section 4 “Exception Requests” for the requirements and process.

Beyond the bridge and approach slab limits, utility owners shall analyze to ensure the utility line or casing has the structural strength to sustain wheel loads. In cases where the structural strength is not adequate, the line shall be cased with a stronger casing or other structural solution utilized to prevent utility infrastructure failures. Refer to Section 4.1.13 of this manual for additional CPUC and CFR requirements.

When a portion of an approach slab needs to be removed for placement of a utility, the approach slab shall be reconstructed to current standards after installation of the utility. If replacing the entire approach slab isn't feasible, the lane section where the new utility is located shall be replaced at a minimum.

2.4 Pipeline Supports

Unless otherwise provided for in sections of this manual for each specific utility, pipe supports shall be concrete or steel and shall be designed to accommodate the pipeline weight, thermal expansion, other service level forces and movements, and seismic forces and movements in any direction. Support spacing shall be based on the capacity of the pipe support, connections, pipeline or casing, and bridge deck or soffit. Unless stated elsewhere in this manual, the spacing of the pipe supports shall not exceed 10 feet.

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 utility from falling off the support under seismic loading. The strap should provide for thermal expansion independently of the superstructure in the longitudinal direction. Steel anchors shall be hot-dip galvanized after fabrication.

Concrete anchors placed in existing bridges shall be designed in conformance to AASHTO LRFD Bridge Design Specifications and conform to the Caltrans Standard Specifications. Concrete anchors shall conform to the requirements of Section 75-3. Additionally, reinforcement shall be located by nondestructive means before installing holes for concrete anchors. Rotary drills are to be used, with no impact drills or coring. If reinforcement is encountered, the anchor hole shall be abandoned, patched, and a new hole installed. Anchors shall be on Caltrans' Authorized Materials List for Concrete Anchorage Devices Authorized Materials Lists (AML) and installed per recommendations by the manufacturer.

Hanging support assemblies shall be fabricated from steel. The steel should be hot-dip galvanized after fabrication. Supplemental lateral supports should be provided for the water and sewer lines.

Supports located on soffit slabs are to be made of concrete. Concrete cradle supports should be designed to withstand all loads. Concrete cradle supports shall be cast in place with the soffit slab or after the slab has been poured. Epoxy or dowels shall be used to secure cradles to the bottom slab of the bridge, except at the first cradle support inside the bridge abutment or hinge; that cradle shall be able to slide to accommodate lateral movement. See Attachment 2 and Attachment 3 for more information.

Precast concrete supports may also be used if provisions are made on the utility installation plans for the soffit slab to be ground flat before 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.

2.5 Shutoff Valves

The following utilities require shutoff valves on each end of the bridge. The table below shows the allowed shutoff valve types:

Table 2.5-1 – List of Required Shutoff Valve

	Manual	Automatic	Remote-Controlled
Water lines over 4"*	X	X	X
Sewer lines*	X	X	X
Gas lines	X	X	X
Pipelines carrying highly volatile fluids		X	X

* When conditions are required, Caltrans may determine if automatic or remote-controlled shutoff valves are needed to mitigate risks associated with a utility installation.

Each bridge shall be evaluated by the utility owner on a case-by-case basis to provide the quickest response time in case of an emergency and to be consistent with emergency response plans that are developed in accordance with the applicable state and local codes.

Shutoff valves shall be located off the bridge at a maximum of 600 feet from each abutment and outside the State right of way, where feasible. The shutoff valve shall be located as close as possible to the bridge and at an easily accessible location approved by Caltrans. Shutoff valves shall be located to prevent vandalism, prevent interference

with Caltrans maintenance and operations, and provide the utility owner with access to any required maintenance. Refer to PDPM Chapter 17 for more requirements.

3 UTILITY INSTALLATIONS ON STRUCTURES

The utility owner is responsible for ensuring that their facility is properly designed and installed.

When it becomes necessary to add utilities to a structure that is partially or completely designed, the effects of the utility on the structure's design capacity need to be analyzed and checked unless the weight of the added utilities is less than 10 percent of the combined weight of the closest supporting girder and the effective supporting slab element on which the utility is carried by.

For utilities installed near structures, see Section 5.1, "Utilities Near Structures (Underground or Aerial)" for a list of items to be shown.

3.1 SUBMITTALS

Utility owners shall submit plans, specifications, and calculations that provide details for the utility installation and that provide documentation that the installation is structurally adequate. Submittals shall be provided to the appropriate District Project Manager, District Utility Coordinator, or District Encroachment Permit Office as early as the design process.

3.2 PLANS AND CALCULATIONS

The following is a list of items that shall be shown on the plans for utilities mounted on or in structures.

3.2.1 General Information

The following information shall be shown in notes on the plans or associated details. It is important to note that this list only represents the minimum requirements and should not be considered as an all-inclusive guide.

- Bridge name and number
- Location of the line on or under the structure

- Type of utility
- Weight per foot of utility conveyance, including supports, encasement, etc.
- Weight per foot of utility (contents) being conveyed
- Maximum operating pressure
- Maximum flow rate of high-pressure fluid lines in the event of a full pipe rupture
- Carrier pipe size, wall thickness where applicable, and material
- Casing size, wall thickness where applicable, and material
- Type of supports, including materials, material specifications, and manufacturer
- Type of pipe spacers, including materials, material specifications, and manufacturer
- Magnitude of thermal movement and other service level movement, if any, used in the design
- Magnitude and direction of thermal and other service level movements, if any, used in the design of the utility installation
- Magnitude and direction of seismic and thermal displacements used in the design of the utility installation
- Shutoff valves and their locations (if located within Caltrans Right-of-Way). Otherwise, a note should indicate the location of the nearest shutoff valve in either direction from the bridge.
- A list of codes and standards used for the utility design
- Corrosion protection of the utility and structure carrying the utility
- For utilities mounted on the outside of a structure, list the painting schedule

3.2.2 Structure Plan Details

Structure plan details shall show how the utility will be installed regarding the structure, all the appurtenances needed for the specific utility type, and how the utility coordinates with the different structure elements. This includes, but is not limited to, details that show the following:

- All dimensions required to understand the installation of the utility in relation to the structure
- The approach to bridges and coordination with approach slabs and wingwalls
- Locations of utility at bridge abutment
- Structure modifications needed for end diaphragms, intermediate diaphragms, bents, and hinges
- Specifying the means to accommodate lateral and transverse movement (specialty pipe fittings or conduit fittings, etc.)
- Utility support types and spacing
- Locations and details of utility expansion and deflection devices
- Locations and details of utility pressure and air relief valves, and overflow features
- Location, details, and type of utility casing vents
- Location and details of bridge soffit grates for box girder cell drainage in case of utility rupture
- Location and details for structure access openings
- Any other appurtenances as needed for the specific utility

As-built plans for existing structures (including log of test borings) can be requested at the following link: Caltrans Public Records Center

Caltrans Standard Plans contain details for irrigation lines less than four inches in diameter and for utility openings, which should be called out in the plans whenever applicable. Standard Plans pages B14-3, B14-4, B14-5, B6-10, B7-10, and B7-11 are examples.

The structure plan details shall be stamped by a licensed professional civil or structural engineer in the State of California in the following cases:

- When a structural analysis needs to be performed to determine seismic movement
- When elements of the structure are added, partially removed, or invasively modified, that can affect the structural integrity

- When the structure's elements shall be checked to ensure they can still take the required design loads from the utility

3.2.3 Calculations

Calculations shall be stamped by a licensed professional engineer in the State of California and show that the utility installation and any structure modifications are adequately designed. This includes, but is not limited to, designing for the following considerations:

- A brief memo that describes the basic design approach
- Compliance with specific codes or standards for a design item
- Loads and stresses, including hoop stress in pipes, supports, and bridge parts due to service loads, line weight, utility contents, thermal expansion, support spacing, etc.
- Seismic loading
- Differential movements between pipe, superstructure, and abutments, and how the movements are to be accommodated
- A signed statement from the bridge design engineer that documents what the seismic movements and the fundamental period of the structure are
- Thermal movements and forces
- Seismic structure displacements to the ground where the utility enters the structure
- The Capacity of the structure elements to support the utility and the concentrated loads applied by the utility supports
- Utility openings and the capacity of the structure elements due to new or enlarged openings
- Capacity of the overall structure to take the added weight of the utility
- Capacity of the utility to take the loads imposed, including moments, shears, and hoop stresses from external service loads and seismic loads
- Grate flow capacity to drain box girder cells in case of water and sewer pipe ruptures in box girders

- Stray current and voltage induced in ferrous structure metal and how it is being mitigated

3.3 Movement Design

Utilities on structures shall be designed to accommodate the differential frame movement at the structure joints, such as at abutments, bents, and hinges. The modeling shall include soil-structure interactions and independent movement of the utility itself.

All utilities, their components, and the supporting structure shall safely accommodate all horizontal and vertical displacements due to all applicable loadings, including thermal and a site-specific seismic event. In case of a seismic event causing displacements larger than the utility's movement capacity, leading to damage to the utility, the utility owner(s) shall be aware of this risk and consider contingency plans for service outages. The utility owner shall consider and assess this issue to ensure the need to mount their utility on a bridge.

3.3.1 Service Level Movement

All utilities shall be designed to accommodate service and strength-limit state movements. The usual movement of concern is due to thermal changes along the length of the structure, but there may be cases where movement in other directions and due to other factors, such as shrinkage, creep, and unusual loadings, is a concern.

The utility owner shall calculate the service I and strength-limit movements for the structure as well as the utility itself. For a bridge, one may assume the longitudinal thermal movement at each joint to be the same as the joint seal movement range shown on the bridge plans. If the bridge is in the process of being designed, the joint seal movement range may be obtained from the bridge designer. If the movement range is not provided on the plans for an existing bridge, the utility owner shall provide stamped calculations.

3.3.2 Movement Due to a Design Seismic Event

The following utilities shall be designed to accommodate seismic movement:

- Toxic, hazardous, and flammable substance utilities
- Natural gas utilities
- Water utilities over 4" diameter

- Sewer utilities
- Electrical utilities 4kV or greater

Though a utility may not be listed above, utility owners should still design for seismic movement if they want to increase the probability that their utility remains in service after a seismic event.

For existing Ordinary Standard bridges, as defined in the Seismic Design Criteria (SDC) Version 2.0, utilities listed above shall be designed to accommodate a minimum of six inches of seismic displacement. Seismic displacement is defined as movement in the transverse, longitudinal, and vertical directions due to an earthquake. The utility designers shall ensure that the design includes six inches of differential seismic displacement at the expansion joints and all abutments. The bridge owner may decide, based on specific situations, to require a seismic analysis to be performed by the utility owner or their consultant. The utility owner has the option of performing a seismic analysis to justify designing for a differential seismic displacement of less than six inches.

For all new structures, the utility design shall accommodate the seismic displacements determined by the bridge designer. If this information is unavailable, at a minimum, the above requirements for existing bridges will apply with the approval of the bridge owner.

For any bridge not meeting the Ordinary Standard bridge criteria, a seismic analysis shall be performed to determine the seismic displacements required for the utility design. When a seismic analysis is performed, it shall follow Caltrans policies, practices, and procedures.

Gas lines are not allowed to be placed on bridges that are categorized as Recovery or Important bridges, as defined in the Seismic Design Criteria (SDC) Version 2.0.

In addition to bridge seismic displacements, there can be seismic movement due to the utility moving out of phase with the bridge. This movement is a function of the site seismicity of the bridge, the utility's mass, stiffness, and support spacing, which may be the most critical factor.

The utilities listed above shall not be placed on any bridge that is classified as Confidential. Confidential bridges can be verified by searching the Bridge Inspection Records Information System (BIRIS).

3.3.3 Methods to Accommodate Movement

Utility owners shall use expansion couplings, deflection couplings, other types of fittings, and possibly other methods approved by the bridge owner, in addition to adequate clearances through utility openings in the bridge, to accommodate movement that may be in the horizontal (transverse to the bridge), vertical, and longitudinal directions.

The minimum clearances through utility openings are shown in Table 3.3.3-1 below. The clearances are meant to allow for construction tolerances and small movements, except for clearances that account for seismic movement. If a casing is used, the clearances are to the casing instead of to the utility line itself.

For utilities to be installed on structures under construction, the utility owner should coordinate with the bridge designer in the design phase so that appropriately sized utility openings can be provided on the bridge.

Table 3.3.3-1 – Minimum Clearances through Utility Openings

Classification	Bridge Element	Horizontal (transverse to the bridge)	Vertical
Utilities not required to be designed for seismic	Abutments	2 inches	2 inches
	All others	2inches	2 inches
Utilities required to be designed for seismic	Expansion joints and abutments	Seismic movement	Seismic movement
	Bent caps and intermediate diaphragms	2 inches	2 inches

For existing bridges, the utility owner shall size their utility line to attain the clearances based on the existing opening size or make the opening sizes larger. The utility owner shall show the bridge will have adequate capacity by structural analysis if the existing opening is resized.

Seismic clearances are important because, in a seismic event, a utility is susceptible to being bound or restrained by the superstructure end diaphragms and abutment backwalls that are on either side of the joint. In cases where seismic clearances cannot be obtained, the utility owner can consider the following:

- The use of vault boxes that allow for larger openings in the abutment and in which to locate deflection coupling(s). Vault boxes shall be provided with a drainpipe.

- Other methods to accommodate the movement as supported by engineering calculations.

When the movements determined by the seismic analysis cannot be accommodated by the existing bridge dimensions or when a bridge spans over a fault, the following two requirements apply:

- For new bridges, the superstructure end diaphragm openings shall be made as large as reasonably possible.
- Seismically activated automatic shutoff devices shall be installed at each end of the bridge except for the following utilities:
    - Small waterlines (<4 inches diameter, not high pressure)
    - Electric lines
    - Communication and fiber optic lines

4 REQUIREMENTS FOR SPECIFIC UTILITIES

4.1 Natural Gas Pipelines

Installations of gas lines on bridges shall conform to the requirements of this section, in addition to those in the other sections of this manual. New natural gas pipelines are rarely allowed, and their installation on bridges will always require an exception to the encroachment policy.

4.1.1 Pipeline Installation Plans

In addition to the items to be shown on the plans in Section 3.2 “Plans and Calculations”, and elsewhere in this manual, the level of detail shown in the attached drawings Attachment 4 “Natural Gas Installation Details Box Girder Bridge and Attachment 5 “Natural Gas Installation Details I-Girder Bridge” shall be used to the greatest extent possible. Depending on the bridge type, some details may not apply.

4.1.2 Pipeline Installation Calculations

For calculation requirements for gas pipelines, refer to Section 3.2.3, “Calculations" elsewhere in this manual.

4.1.3 Location on Bridges

Gas pipelines typically cannot be accommodated on slab bridges. Exceptions may be approved on a case-by-case basis. Special coordination will be required in the design phase for new slab bridges. PDPM Chapter 17, Section 4, “Exception Requests,” covers the requirements and process for obtaining a policy exception.

4.1.4 Pipeline Pressure

Pipeline design pressure shall follow CPUC General Order No. 112, DOT 49 CFR, and accepted industry design criteria (maximum allowable operating pressure is 60 psig). The combined stresses, including pressure, temperature, and seismic-related stresses, shall not exceed 90 percent SMYS (Specified Minimum Yield Strength) (steel pipe) or 90 percent Yield Strength (plastic pipe) at MAOP (Maximum Allowable Operating Pressure) when calculated using a generally accepted yield failure criterion, such as the von Mises method. Hoop stresses as defined in ASME B31.8.

4.1.5 Pipe Size

Maximum carrier or casing pipe size shall be limited by the bridge design configuration. See Section 2.2 for additional information.

4.1.6 Carrier Pipe

The carrier pipe shall be medium-density polyethylene (MDPE) or welded steel pipe. The following requirements apply to MDPE pipe:

- The nominal diameter shall not exceed eight inches
- Pipe shall meet the specifications of the current versions of ASTM D2513 and ASTM D335
- Pipe shall be one continuous length or butt fused straight lengths with no fittings inside the casing

Steel carrier pipelines shall be coated according to CPUC General Order No. 112 and DOT 49 CFR, Section 192.461.

4.1.7 Casing Pipe

See Section 2.3 for detailed requirements.

4.1.8 Spacers for Carrier Pipe

Spacers shall be installed at intervals adequate to support the carrier pipe as specified by the manufacturer's installation instructions.

4.1.9 Carrier Pipe Installation

Installation of the carrier pipe into the casing shall conform to the following:

The minimum temperature of the MDPE carrier pipe at installation/tie-in shall be 40°F to ensure buckling stress is less than critical and a minimum 0.333 inches clearance between carrier pipe and casing when the maximum pipe operating temperature is 140°F.

Maximum MDPE carrier pipe installation temperature shall not exceed 120°F.

Tie-in the MDPE carrier pipe a minimum of two hours after inserting the MDPE carrier pipe into the bridge steel casing to minimize tensile stresses.

Whether the carrier pipe is MDPE or steel, install casing end seals to prevent debris from entering the casing.

4.1.10 Casing Vents

Casing vents to prevent a build-up of pressure and for leak sampling and detection shall be located at each end of the bridge structure. Vent pipes shall be located within Caltrans's Right-of-Way at a Caltrans-approved location to prevent vandalism and to prevent interference with Caltrans maintenance and operations.

4.1.11 Seismic Design

Gas pipelines shall be designed to accommodate anticipated seismic displacements across bridge joints. See Section 3.3 for specific requirements.

4.1.12 Pipe Supports

Pipe supports shall be concrete or steel. The supports shall be designed to accommodate casing and pipeline seismic design displacements in any direction. See Section 2.4 for specific requirements.

4.1.13 Shutoff Valves

The locations and installations of the shutoff valves shall be designed to comply with the requirements of the CPUC and DOT. Shutoff valves shall be installed on new 8-inch diameter and smaller pipelines. See also Section 2.5. Remote-controlled shutoff valves shall be installed where practical, and other locations can use automatic or manual shutoff valves. Refer to PDPM Chapter 17 for more requirements. As an alternative, the existing area isolation system may be used if it can be shown that the system would provide a similar level of protection to the bridge as would be provided by the dedicated shutoff valves.

For MDPE carrier pipe, provide a Lateral Offset Length (A), Axial Length (B), or a combination of both, as shown in the table below, in compacted soil to develop adequate soil friction to resist tension and compression forces between the bridge and the valve. The lateral offsets shall be made perpendicular to the bridge and may be made vertically or horizontally.

Table 4.1.13-1 - MDPE Carrier Pipe Requirements

MDPE Carrier Pipe Nominal Diameter (inches)	Lateral Offset Length (A) (feet)	Axial Length (B) (feet)
2	2.5	60
3	3.5	90
4	4.5	120
6	6.5	160
8	8.5	220

4.1.14 Depth of Cover at Bridge Approaches

Pipeline installed with less than 36 inches (42 inches for pipelines over 6" diameter) of cover at bridge approaches without an approach slab to protect it shall be provided with additional protection to withstand anticipated external loads, including wheel loads, in accordance with CPUC General Order No. 112 and DOT 49 CFR, Section 192.327. Refer to Attachment 4 and Attachment 5 for more details.

4.1.15 Cathodic Corrosion Protection

Cathodic protection shall be provided in accordance with CPUC General Order No. 112 and DOT 49 CFR, Section 192.463.

4.1.16 Testing

The carrier pipe shall be leak or strength tested as required by CPUC General Order No. 112 and DOT 49 CFR. The test pressure and test medium shall be noted on the utility installation drawing. All girth welds shall be nondestructively tested.

4.2 Electrical and Fiber Optic Lines

This section addresses the installation of electrical and fiber optic lines on bridges, which includes High-Voltage electric supply lines, conductors, or cables that have a potential to ground of less than 69 kV, sprinkler controls, lighting power, and controls, fiber optics, and communication lines. These lines can be owned and operated by Caltrans, a utility company, or others.

Only installations of voltage systems up to 69 kV are permitted on bridges. Utility lines above 69 kV are highly undesirable on bridges and are rarely approved; therefore, utility companies should avoid proposing these types of systems.

In addition to the requirements below for the different systems, Attachments 1 and 2 contain example details for general guidance for use by the utility company.

4.2.1 Communication and Sprinkler Control Conduits

These systems are usually related to communication (such as telephone lines and fiber optic lines), which are usually less than 120 volts, and sprinkler control conduit lines that are installed on new and existing bridges. Conduit sizes for these lines are under four inches in diameter.

For new bridges, the installation details should be in accordance with the details in the Standard Plans and requirements in the Standard Specifications. The same procedure applies to existing bridges as much as possible and will depend upon where these lines can be installed, given that they shall be installed out of sight in accordance with Section 2.1, “Location of Utilities”.

In situations where multiple conduits are to be installed in sidewalks or bridge railings, expansion/deflection fittings shall be staggered in a manner that allows the conduits to be installed as close to each other as possible due to the limited space that is usually available. Conduit installations in sidewalks require the installation of expansion deflection fittings inside a pull box on the sidewalk with a sliding lid for the pull box to accommodate expansion and deflection.

Access covers for expansion/deflection fittings cavities shall be identified as such. Multiple conduits with fittings installed inside the sidewalk require specifically designed boxes to house those fittings.

Sidewalks slope down toward the roadway, where they are usually thicker near the barrier rail and thinner near the edge of the driving lane. For this reason, it may be necessary to install larger conduits in the portion of the sidewalk near the barrier rail and smaller conduits towards the driving lane.

4.2.2 Low Voltage Electrical Systems

Low-voltage systems are those systems of 480 volts or less that are typically single-phase or three-phase systems. They are usually installed inside four-inch diameter conduits or

smaller and have the phase conductor, neutral (grounded circuit conductor), and ground wire (equipment grounding conductor) all inside the same conduit. This system makes the net vector sum of their electric flux zero, and, therefore, no voltage and stray current are induced in ferrous bridge steel (such as reinforcement, prestressing, and steel girders) in the nearby area. Because it does not induce a voltage on the bridge steel, these system conduits do not create a concern when installed on our bridges.

Low-voltage systems through bridges should be installed using Caltrans standards for communication and sprinkler control conduits whenever possible.

4.2.3 Medium and High Voltage Electrical Systems

Electrical utility providers (e.g., PG&E, SMUD, SDG&E, and SCE) can own medium voltage systems that may start around 4 kV, but more typically, they operate high voltage systems that start around 12 kV and go into the hundreds of kilovolts, although 69 kV is the limit on the bridges.

Medium and high-voltage electrical systems are typically one-phase or three-phase systems. Like low voltage systems, systems that have all phase conductors installed inside the same duct or conduit do not produce any electric flux that can induce damaging voltages and stray current on the steel components in the bridge, and can be installed by following standard details provided in Attachments 1 and 2.

However, systems that use single-phase conductors in separate ducts (conduits)–as is sometimes done in higher voltage applications–can be problematic. When conductors are separated, their magnetic fields are not cancelled out, and each high voltage conductor generates an electric flux that can induce voltage and current in nearby bridge steel.

The geometric arrangement of medium and high-voltage conductors must be carefully studied to calculate the induced voltage in reinforcing bars or prestressing cables. This is critical to prevent Hydrogen Embrittlement and AC corrosion of steel.

For this reason, the placement and configuration of high-voltage conduits—particularly their location between girders—must be optimized to minimize induced voltage and keep it below thresholds that cause material degradation. Placing high-voltage conductors close together reduces the net flux they generate, and increasing their distance from structural steel further reduces the risk of induction.

To minimize induced voltage, the conduits should be located between girders such that the center of gravity of the duct group aligns with the vertical centerline of the duct space.

High-voltage utility lines are not permitted on steel girder bridges to protect the steel structure from induced electrical currents.

The voltage induced in the bridge steel by these systems shall not exceed the following[1]:

- Prestress cables: 0.85 volts RMS measured at the centroid of the prestressing cable group
- Reinforcing steel: 1.7 volts RMS measured at the most unfavorable location (for a 60-foot length of rebar)

4.2.4 Additional Requirements

The following requirements are for electrical lines, mainly on concrete bridges. On a case-by-case basis, they may need to be modified or supplemented for other structure types.

- In addition to the submittal requirements in Section 3.1, “Submittals” elsewhere in this manual, before installation of any kind of utilities on Caltrans Bridges, the utility owner shall first apply for an encroachment permit and submit the following:
    - Conduit/conductor installation details, inclusive of all pertinent dimensions.
    - Conduit details accommodating structures' lateral and transverse movement (conduit system expansion and deflection fitting details)
    - Details of conduits through abutments and any hinges.
    - Details of conduits through the bridge diaphragm
    - Utility Electric systems with one phase conductor in each conduit shall be evaluated for induced voltage in reinforcing steel and prestress cable.

[1] In the 1980s, Caltrans electrical engineers collaborated with major California utility companies to establish maximum acceptable value of the induced voltage limits shown.

- "Data for High Voltage Cables on Bridges". Utility companies or consultants should contact the DPE or ROW Utility coordinator to obtain the form.
- A schedule of maintenance for the servicing/testing of protective relays and switching devices. This requirement may be waived if the utility has previously submitted an identical schedule applicable to their other installation(s) and this is clearly indicated.

- Conduits shall be steel, fiberglass, or Schedule 40 or 80 PVC (which is only allowed to be installed inside box girder cells). Steel conduit shall be hot-dip galvanized inside and out and have threaded couplings and fittings. PVC conduit shall be marked for use with conductors rated 90 degrees Celsius or higher.

  Conduits on open girder bridges shall be steel or fiberglass.

Table 4.2.4-1 Conduit Support Spacing

Material	Conduit Size	Maximum Support Spacing	Other
Steel	4 to 6 inches, inclusive	10 feet	All conduits shall be supported within 3 feet of expansion deflection fittings.
PVC	4 to 5 inches, inclusive	7 feet	All conduits shall be supported within 3 feet of expansion deflection fittings.
PVC	Up to 6 inches	8 feet	All conduits shall be supported within 3 feet of expansion deflection fittings.

The remainder of this section will refer to electrical ducts as conduits.

4.2.4.1 Expansion and Deflection Fittings

Conduits shall have adequate provisions for transverse and longitudinal movements in accordance with Section 3.3, "Movement Design", but as a minimum, they shall be designed for 0.2 feet of transverse movement at bridge abutments and hinges. Expansion and deflection fittings shall be used to allow the conduit system to move across bridge areas with movement.

When permitted, ducts cast in sidewalks shall be hot-dip galvanized rigid steel conduit and will generally be limited to a four-inch maximum size. Access covers for expansion/deflection fitting cavities shall be identified as required for manhole covers.

Conduits installed inside the bridge box cells shall be supported on a steel plate where the conduits exit the abutment backwall, as shown in Attachment 1. The steel plate is to prevent shearing of the conduits due to ground settlement. The plate shall be a minimum of one-half inch thick, be bolted to the abutment, and extend out from the abutment backwall at least five feet.

Conduit systems shall be designed to drain away from the bridge or shall be sealed with watertight plugs adjacent to both bridge abutments.

Medium and high-voltage Conductor cables shall have extruded or paper insulation in addition to other insulators and be rated for more than the voltage and current they will be carrying.

Pull boxes and splice boxes, if needed, should be located in the approaches and avoided within the bridge for medium and high voltage utilities. If the utility believes such boxes are necessary within the bridge, it shall submit drawings and descriptions completely covering the proposed installation, together with a full explanation of the reason the cables cannot be pulled the full length of the bridge without a splice or pull box. If such boxes are permitted, access covers shall be identified.

Access covers for new openings in existing bridges shall be permanently identified for the utility being accessed.

Bonding jumpers shall be installed across structural discontinuities, per Caltrans Standard Plan ES-9B details. If the utility company exposes abutments and access cells, bonding is needed to limit potential during faults. Bonding on existing bridges shall be done by the utility company.

4.3 Water and Sewer Lines

4.3.1 Applicability

All water and sewer line installations on bridges shall comply with these requirements. Brine line installations shall comply with the requirements for sewer lines.

4.3.2 Design Principles

Water and sewer line installation plans shall meet the following basic requirements developed to minimize risk to the public and structure and minimize maintenance problems in the vicinity of the structure.

4.3.3 Standard Drawings

Standard Drawings related to water and sewer lines on bridges can be found in Caltrans' Standard Plans. Examples are presented in the Attachments.

4.3.4 Additional Design Requirements

In single and double-span box girder bridges, a box girder cell may be considered encasement for only waterlines if the following conditions are met:

- Access is made available to expansion and deflection fittings, air relief valves, and other mechanical devices placed within the structure
- The grated soffit openings are provided to adequately drain the cell in the event of a pipe rupture
- The grated soffit openings shall be located so that water draining from them will not fall on traffic or other undesirable locations
- A steel casing is provided from the abutment backwall into the approach fill. The limits of the steel casing shall comply with the steel casing details shown in the Caltrans' Standard Plans

The casing for water and sewer lines may be broken near abutments to allow for the placement of flexible expansion or expansion/deflection fittings in the carrier pipe. Soffit drainage openings shall be located downhill and near the break-in casing pipe. Grated soffit openings shall be a minimum of two feet by three feet. Soffit openings shall be located under flexible expansion joints to allow maintenance for expansion joints and controlled discharge of water to the roadway shoulder or other acceptable locations.

The pipe shall comply with American National Standards Institute/ American Water Works Association (ANSI/AWWA) C151/A21.51, Class 350. Fittings shall comply with ANSI/AWWA C110/A21.10.

Water and sewer lines shall be welded steel or ductile iron. Plastic pipes, such as PVC, HDPE, and FRP, are not allowed in State bridges due to their higher thermal expansion and their loss of structural integrity in high-temperature conditions such as fires.

Steel lines carrying sewage 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.

Water and sewer lines shall be installed parallel to the profile grade. Refer to Section 2.1.3 for more requirements.

The following shall be installed to accommodate expansion and seismic movements at bridge joints:

- Water lines shall be equipped with force-balanced flanged double-ball expansion fittings
- Sewer lines shall be equipped with double-ball expansion fittings
- Mechanical expansion joints are not accepted as seismic expansion fittings
- Sliding supports adjacent to the end diaphragms

An air release valve is required at the high point of pressurized water and sewer lines. Air release valves shall 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 through a manhole from the deck.

For shutoff valves, see Section 2.5 of this manual.

If concrete cradles are used, pipe protection shields are required to allow the pipe to slide on the support cradle.

Whether pipes are hung or supported with concrete cradles, the pipe shall be tightly clamped at the two pipe supports nearest the center of any two expansion assemblies. At all other pipe supports, if they are concrete cradles, the pipe clamp shall be shimmed with steel washer plates to provide one-quarter-inch clearance and allow for expansion in both directions.

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

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

Verify that the soffit access openings are adequate for installation and maintenance of the pipe system.

The distance between the abutment and expansion assembly shall not be more than 12 inches in box girder bridges.

The distance between the expansion assembly and the adjacent concrete support shall not be more than 18 inches in the box girder bridge.

Casing insulators shall be installed within 18 inches of all bell ends of the supply line and 12 inches of both ends, and every six feet-six inches on centers. Fill the void between the dirt stop and the first casing insulator with foam.

Four inches of minimum clearance between the bottom of the seismic assembly and the soffit shall be provided.

The maximum distance between two concrete pipe supports shall not be more than 10 feet.

4.4 Hazardous Liquids or Corrosive Substances

Steel pipes 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.

Pipelines carrying hazardous liquids shall not be larger than eight inches or have an MAOP larger than 60 psig. Plans shall show the location of the nearest automatic shutoff valves on each side of the structure. Shutoff valves are required. See Section 2.5 of this manual.

Liquid petroleum pipeline designs shall conform to the currently applicable recommended practice of the American Petroleum Institute for pipeline crossings under highways.

5 MISCELLANEOUS INSTALLATIONS

5.1 Utilities Near Structures (Underground or Aerial)

Avoid placing utility crossings:

- Near bridge or retaining wall foundation, such as pile, pile cap, and spread footings,
- Near retaining wall reinforcing components, such as soil nails, ground anchors, or
- Through an abutment embankment under the bridge.

The placement and design of a new utility line within a highway corridor shall consider the potential impact on the highway and its operation. Avoid placing a new utility line at locations where:

- Relocation will be needed to accommodate future highway improvements or
- Servicing such a line will impact highway traffic.

To obtain as-built plans for structures (including a log of test borings), refer to Section 3.2.2 for instructions.

5.1.1 Permit Application Requirements

Refer to Section 3.2.1 for guidance on what should be included in plans. Additionally, include a cross-section showing the following:

- Proposed utility and existing Caltrans structures
- Horizontal clearances between the utility and the structures
- Depth of utility from the ground surface

5.1.2 Underground Utilities

Excavation is restricted in the Excavation Restricted Zone as shown in Figure 5.1.2-1. Maintain the following minimum horizontal clearances between Caltrans structures and

the utility so that the utility will not impede access to the structures or the geotechnical zone of influence:

- 15-foot horizontal clearance: Pressurized water or wastewater pipeline, volatile fluid, and gas pipeline, electrical line over 600 volts,
- 5-foot horizontal clearance: All other utilities, such as communication lines, electrical lines under 600 volts

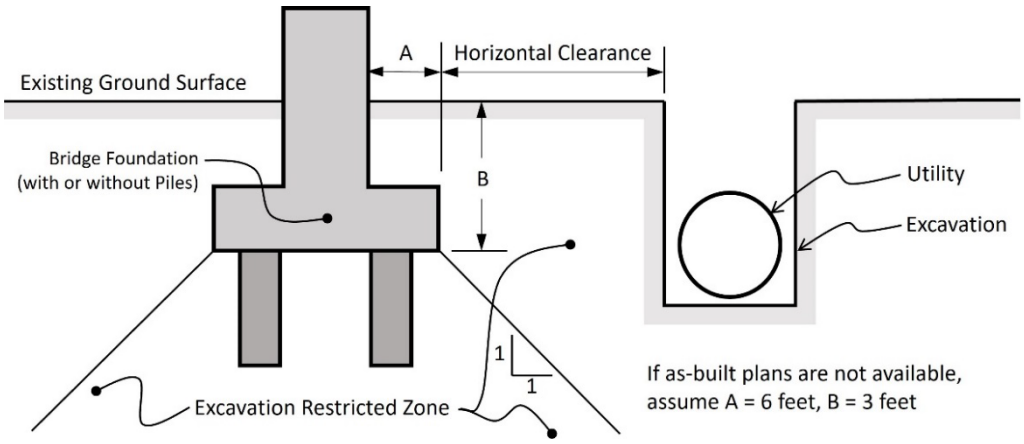


Figure 5.1.2-1 – Excavation Restricted Zone

Utilities are not allowed within the pile group of the bridge foundation as shown in Figure 5.1.2-2.

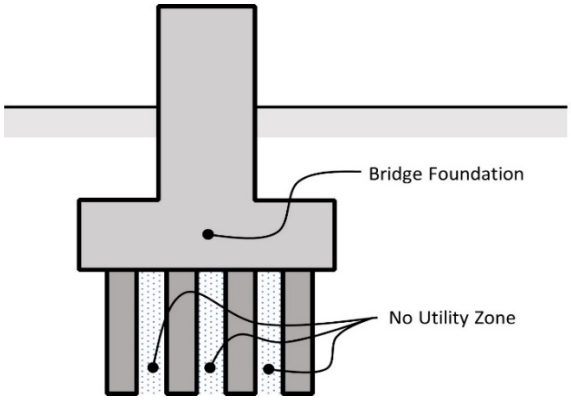


Figure 5.1.2-2 – No Utility Zone

For a utility to be placed less than 20 feet from a Caltrans structure, encroachment permit submittals shall be routed to the Division of Engineering Services (DES) for review. The submittals may also be routed through Structure Maintenance and Investigations (SM&I).

If an exception to the Excavation Restricted Zone is needed:

- Notify Caltrans and the utility company before the submittal of the Advance Planning Study (APS), and
- Submit Geotechnical reports with Boring Records.

All entities/parties shall involve their Construction, Structure, and Geotechnical engineers to resolve engineering issues such as:

- Protect-in-place measures for the existing pressurized utility pipe
- Constructability, such as soil cave-in and shoring
- Groundwater and dewatering
- Ground vibration and movement monitoring, pressurized utility pipe video plans
- Protect-in-place Caltrans bridge foundations for future trench excavation for utility inspection/ maintenance
- Post-seismic event emergency response if the bridge foundation or pressurized utility pipe is damaged

5.1.2.1 Geotechnical Report Submittal

Geotechnical reports shall be signed and stamped by a licensed civil engineer in the State.

The reports shall identify locations and conditions of difficult construction, possible temporary and permanent impacts, and construction methods.

Geotechnical investigation along the alignment of the area that requires an exception and corresponding Boring Records are required.

The geotechnical engineering work and geotechnical reports shall comply with Caltrans *Geotechnical Manual* and Federal Highway Administration (FHWA) 2003 ED-88-053, *Checklist and Guidelines for Review of Geotechnical Reports and Preliminary Plans and Specifications*.

5.1.3 Overhead Utilities

Support structures for overhead utilities, such as power poles, shall be separated from abutment foundations, wingwalls, and superstructure by a minimum of five feet.

Temporary utility pipelines over traffic are not allowed unless the utility meets all the following:

- the vertical clearance criteria in the *Highway Design Manual* Section 309.2
- accepted by Caltrans

Projects with temporary installations shall be coordinated with District Right-of-Way Utilities.

5.2 Tunnels and Tubes

New non-Caltrans utilities are not allowed in tunnels.

5.3 Utilities on State-Maintained Toll Bridges

New non-Caltrans utilities are not allowed on toll bridges.

Existing encroachments on an existing toll bridge should be relocated when feasible.

REFERENCES

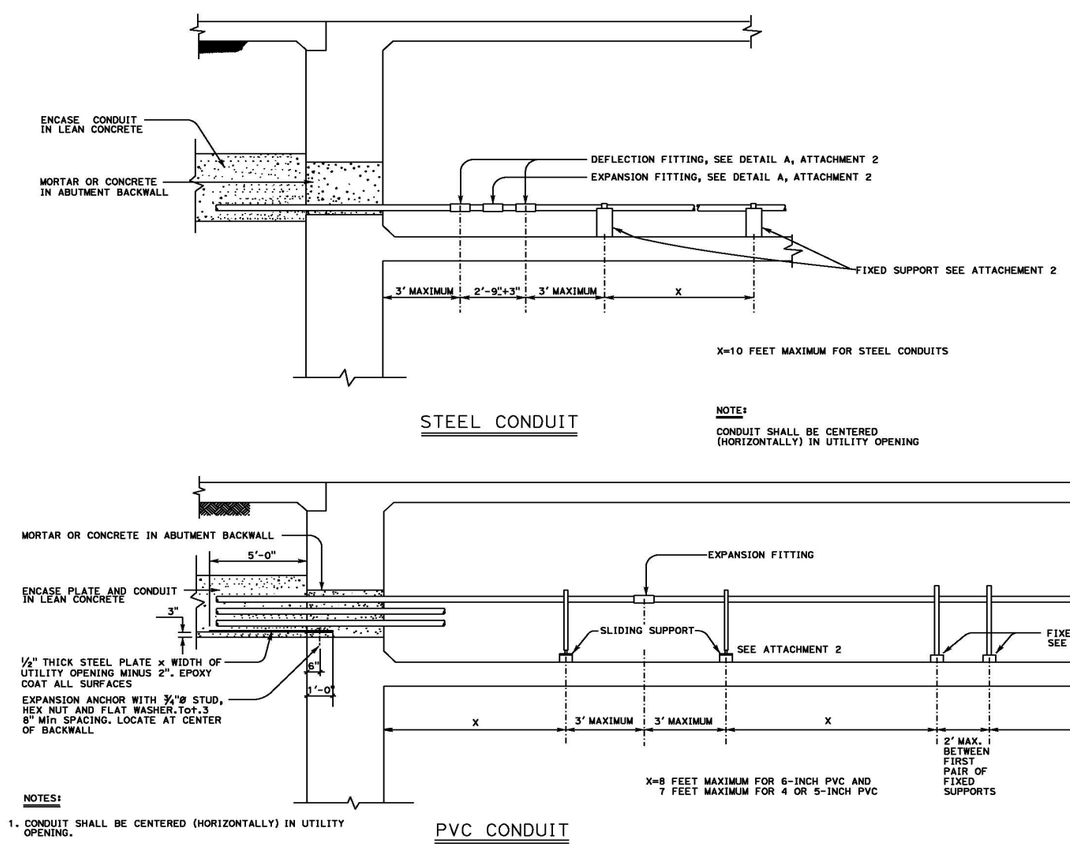
1. ANSI. The American National Standards Institute is a private nonprofit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The organization also coordinates U.S. standards with international standards so that American products can be used worldwide.
2. AWWA. The American Water Works Association is an international, nonprofit, scientific, and educational society dedicated to providing total water solutions, assuring the effective management of water
3. U.S. Department of Transportation, Research and Special Programs Administration. Code (l Federal Regulations. Title 49, Part 191-Transportation of Natural and Other Gas by Pipeline; annual reports, incident reports, and safety-related condition reports. RSPA. Washington, DC.
4. U.S. Department of Transportation, Research and Special Programs Administration. Code of Federal Regulations. Title 49, Part 192-Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards. RSPA. Washington, DC.
5. U.S. Department of Transportation, Research and Special Programs Administration. Code of Federal Regulations. Title 49, Part 195-Transportation of Hazardous Liquids by Pipeline. RSPA. Washington, DC.
6. API. American Petroleum Institute

ATTACHMENTS

The following materials are provided for general informational purposes only and should not be interpreted as Caltrans specifications, standards, policies, or procedures, nor as guidance on how such standards or policies should be applied. These materials do not represent the outcome of any past, present, or future requests. They are not legally binding and carry legal force or effect.

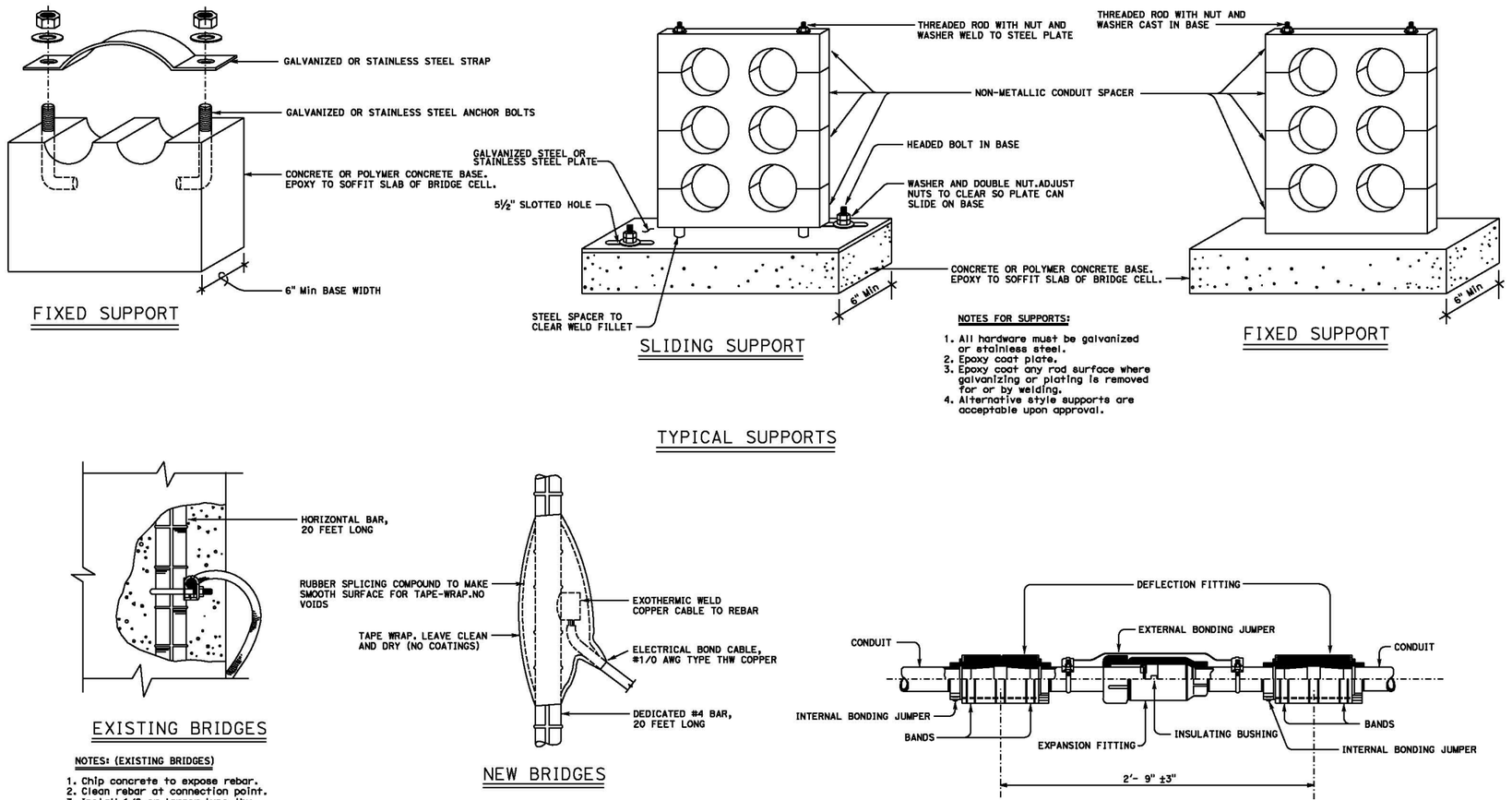
ATTACHMENT 1

Typical High Voltage Utility Installation in Diaphragm Abutment Bridge



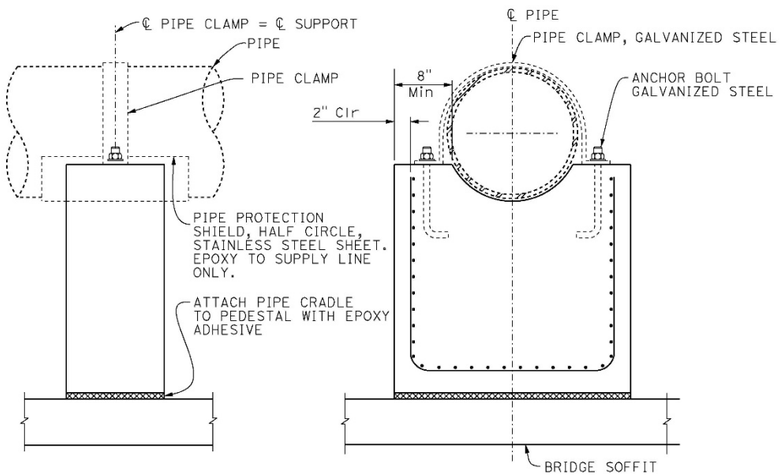
ATTACHMENT 2

High Voltage Utility Line Installation Details



ATTACHMENT 3

Water Line Installation Details



CONCRETE PIPE SUPPORT DETAILS
NO SCALE

NOTES:

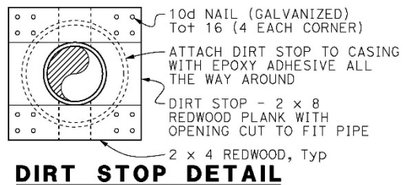
A. Water line shall be installed parallel to bridge girder.

B. For continuation of water line at abutments, see "OTHER PLANS".

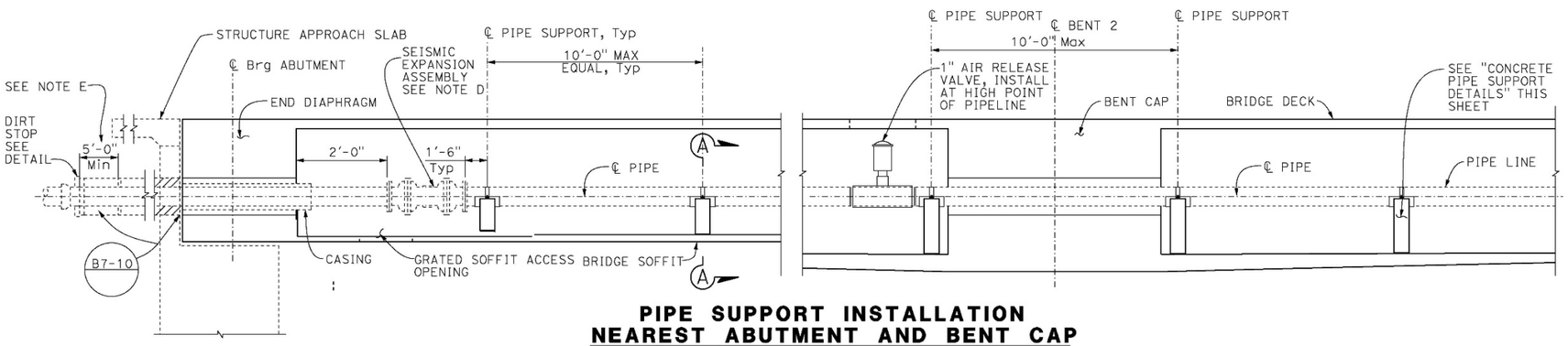
C. Water line shall be tightly clamped at the two pipe supports nearest center of bridge. At all other supports the pipe clamp shall be shimmed with steel washer plates to allow for expansion in both directions.

D. The seismic expansion assembly shall be capable of providing the calculated seismic movement in both the longitudinal (along the pipe) and transverse directions (across the pipe).

E. Casing shall extend to the greater of 5'-0" beyond the end of the approach slab, 5'-0" beyond the end of the adjacent wingwall 20'-0" beyond the back of the abutment, or to the State right-of-way limit.



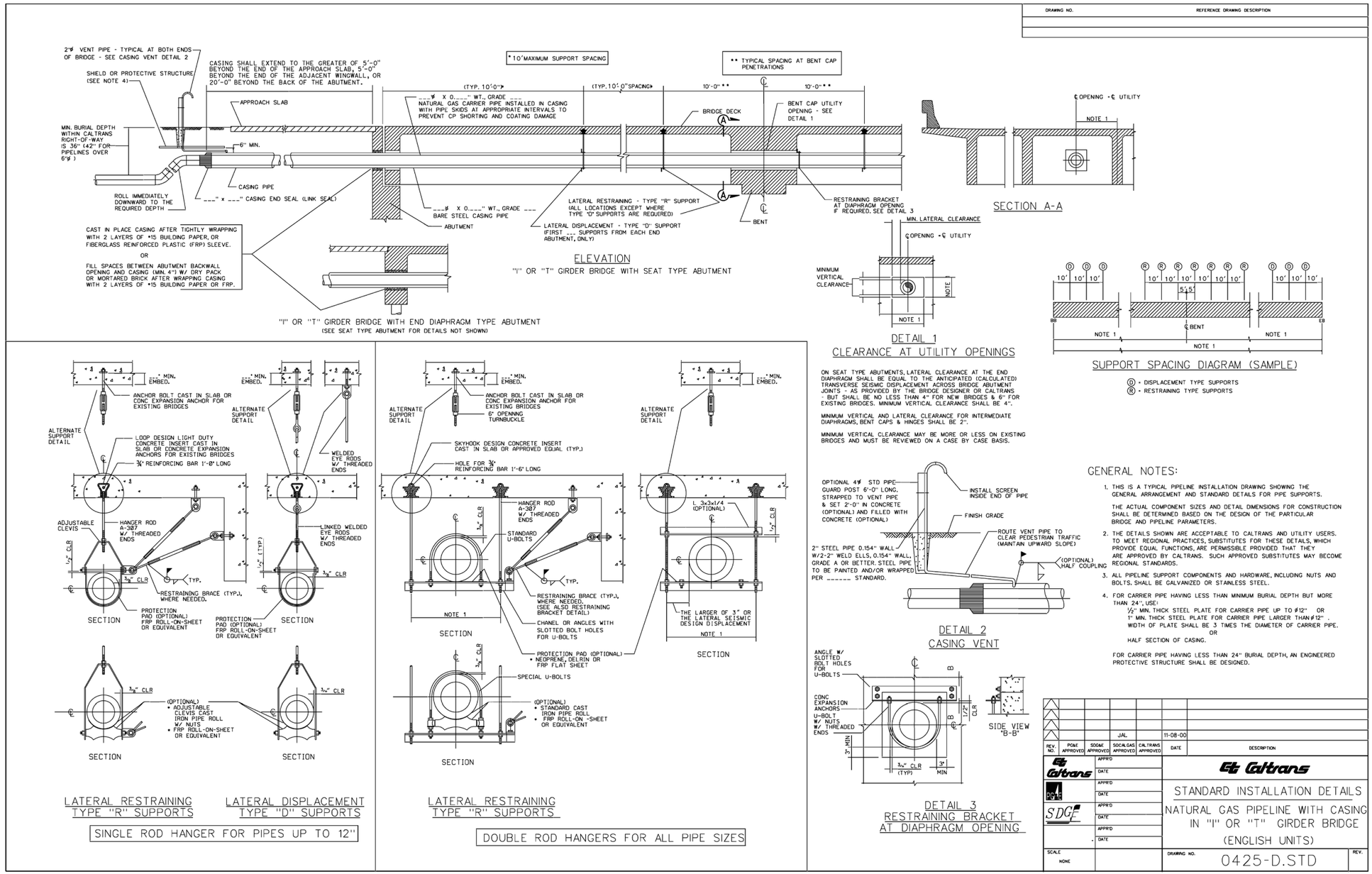
DIRT STOP DETAIL
NO SCALE



PIPE SUPPORT INSTALLATION NEAREST ABUTMENT AND BENT CAP
NO SCALE

ATTACHMENT 4

Natural Gas Installation Details I - Girder or T- Girder Bridge



ATTACHMENT 5

Natural Gas Installation Details Box Girder Bridge