

CHAPTER 8

CIVIL DESIGN

A. GENERAL

This Chapter includes standards and design considerations for other civil engineering design in structural, drainage and utilities. Design considerations for electrical and mechanical work are described and included as part of the criteria for the Station Facilities in **CHAPTER 3 - STATIONS AND FACILITIES**.

B. STRUCTURAL

Caltrain structures include bridges, grade separation structures such as pedestrian underpasses and overpasses, tunnels, retaining walls, culverts, and other structures such as buildings, signal structures, and their related facilities.

Signal structures include signal bridges and signal cantilevers are typically specification driven, manufactured product with manufacturer's recommended foundation design. The design of the structures follows Caltrain typical signal cantilevers as specified in the Caltrain Standard Drawings for Signals. The foundation of signal cantilevers follows the manufacturer's recommendations. The foundation of signal bridges is provided in the Caltrain Standard Drawings. Signal foundation is typically of gravity type.

The design of civil structures that are owned and/or maintained by Caltrain shall be in accordance with the criteria and requirements of the "*PCJPB Standards for Design and Maintenance of Structures*". The shoring requirements shall follow the criteria of the "*Caltrain Engineering Standards for Excavation Support System*".

Caltrain standards and requirements take over the precedence over other codes, such as AREMA and BDS (Caltrans' Bridge Design Specifications Manual). CBC (California Building Codes) takes precedence over ACI, AISC and AWS codes. AREMA takes precedence over BDS for structures subject to railroad loading, and BDS takes precedence over CBC for structures subject to truck loading.

The design of structures that are owned or maintained by other agencies shall be in accordance with the standards of those agencies. These are either new construction, or rehabilitation, or relocation, or modification of the existing facilities. Even though these structures do not encroach into the Caltrain ROW, the facilities however are close enough that it may have an impact on the Caltrain current and future operations and maintenance. The proposed facilities, therefore, must be consistent with Caltrain operating and maintenance requirements, as well as future

needs. The design parameters and the subsequent design shall be submitted to Caltrain for review.

Where special design cases are encountered that are not specifically covered in these criteria, a project-specific design criteria shall be submitted for the approval of Caltrain Deputy Director of Engineering.

C. DRAINAGE

The drainage design criteria and requirements are intended to protect Caltrain corridor and facilities from storm water damage, and to protect Caltrain liability for damage to other property from storm water flows caused by the construction of Caltrain improvements and to provide Caltrain passengers and maintenance personal walking surfaces that are safe and free from ponding.

Caltrain drainage system typically consists of the following:

- a. Track drainage at stations, grade crossings, and right-of-way
- b. Station drainage (station platforms and parking)
- c. Bridge deck drainage
- d. Other structures such as buildings, pedestrian underpasses, etc.

An effective drainage system is a critical element in the design of Caltrain facilities. Inadequately drained storm water damages the infrastructure and other facilities. An effective system is required to:

- a. Protect the track structure and other facilities from storm water damage
- b. Expedite drainage flow
- c. Maintain access to pedestrians and maintenance personnel.
- d. Retard vegetation growth.
- e. Prevent storm water runoff from entering into adjacent properties, and vice versa.

The design of drainage facilities belonging to another agency, that are relocated or modified because of Caltrain construction, and that does not encroach on the Caltrain ROW, shall conform to the design criteria and standards of that agency.

1.0 DESIGN REQUIREMENTS

Drainage facilities within the railroad zone of influence shall be designed in accordance with Caltrain railroad loadings. The criteria and requirements of the

loadings within the zone of influence are contained in the *PCJPB Standards for Design and Maintenance of Structures*.

The design of any drainage facility shall take into account measures to reduce erosion and control sedimentation caused by the drainage facility or construction activities.

In general, relocation of existing drainage facilities shall be “replacement in kind” or “equal construction,” unless conditions of flow, loading, or operation are altered. If conditions are altered, designs shall conform to the design criteria and the standards of the affected agencies.

The top of the drainage pipe, culvert, or structure shall be minimum 3 feet from the bottom of ties. If the drainage system cross the tracks, the system shall cross at a 90 degree angle to the center of tracks.

Drainage from pedestrian underpasses need to be discharged to the municipal sewer system.

The design of drainage facilities owned and maintained by other agencies that are relocated or modified because of Caltrain construction, and do not encroach on the Caltrain right-of-way, shall conform to the design criteria and standards of the Local Agency having jurisdiction of the area. In absence of the criteria, California Department of Transportation’s (Caltrans’) guidelines shall be used.

1.1 Hydrology

1.1.1 Storm Frequency

In general, a 50-year storm frequency shall be used for design of drainage ditches. However, the frequency may be modified to be in balance with the design life and damage potential of the structure or area to be protected.

The peak runoff from a 100-year storm shall be used in the design of the following:

- a. All facilities
- b. Culverts crossing beneath at-grade track
- c. Storm drain systems adjacent to tracks
- d. Drainage systems crossing under bridge structures and on the right-of-way
- e. Yard and station runoff collection systems (including those in streets and parking lots)

1.1.2 Design Discharge

The maximum expected discharge from drainage tributary areas shall be computed using the Rational Method. For facilities that will be owned and/or maintained by the

Local Agency, the design discharge shall be computed using other applicable procedures as required and approved by the Local Agency.

Precipitation, intensity, and duration data shall be based on the data either from San Francisco, San Mateo, or Santa Clara counties depending on where the project is located.

1.2 Underdrain Pipe

Underdrain pipe shall be minimum six (6) inches in diameter at minimum grade of 0.2%. If the pipe is connected to the municipal system, then it shall be compatible to the system of the Local Agency. For track drainage within the limits of the stations, and within the limits of grade crossings, use perforated PVC or HDPE of Schedule 80.

The underdrain pipe shall be bedded in aggregate filter material and the trench be wrapped in permeable geotextile. Underdrain cleanouts shall be installed every 300 feet.

Use of perforated underdrain pipe shall be minimized because of risk of clogging and difficult pipe access for maintenance. Use ditches where possible instead of perforated pipe.

Pipe cover shall be a minimum of 48 inches below top of rail for all pipes, including RCP (Reinforced Concrete Pipe) and PVC and HDPE pipes.

Manhole/inlet spacing: 500 feet max (up to 30 inches in diameter), 650 feet to 1000 feet for larger than 30 inches in diameter.

1.3 Culvert

The minimum pipe size for a storm drain pipe or culvert shall be 12 inches in diameter. For pipes directly under the track or within 15 feet from the centerline of the tracks, Caltrans Class V RCP (Reinforced Concrete Pipe) shall be used, and the minimum size shall be 24 inches in diameter.

2.0 PUMP STATIONS

Caltrain pump stations are lift stations which may consist of a sump pump or a series of sump pumps. The lift station raises the hydraulic head of storm water sufficiently to discharge by gravity to other drainage systems such as ditch, municipal storm water system, or to other lift stations, etc.

For reasons of economy of initial investment and maintenance, pump stations shall be avoided as much as possible. Where gravity systems are not practical, the pump stations shall require prior approval of the Caltrain Deputy Director of Engineering.

D. UTILITIES

This Section covers design of underground utilities for new installation and for the relocation, adjustment, and/or abandonment of existing of underground utilities including those not owned and/or maintained by Caltrain. The designer shall identify the utility envelope and coordinate the work with utility owners.

Caltrain prefers combined system duct bank to be installed wherever possible. The combined systems duct bank provides a common and coordinated underground structure for cables and wires for electrical, signals, and communications systems along the corridor. At the stations, the duct bank will be located within the designated utility corridor.

Fiber optic carriers on Caltrain corridor also prefer the combined system duct bank. This is preferred for economy and for the space constraints within the corridor.

1.0 CALTRAIN UTILITIES

Utilities owned and maintained by Caltrain consist of wires and cables for signal, electrical, communication, and piping for irrigation and drainage.

Utilities specifically designed for the Caltrain facilities at stations and right-of-way shall conform to the standards, codes, and requirements of the CPUC and the local jurisdiction within which the utilities are located, as appropriate. All design work shall be approved by the local jurisdictions and appropriate public utility agencies.

2.0 THIRD PARTY UTILITIES

Third party utilities owners include private owners, state, and municipal government. Work shall be coordinated with and done in accordance with the standards of the utilities owner. Design, relocation, restoration, and construction shall be the responsibility of the facility owner.

Third party utilities consist of natural gas, jet fuel, electrical facilities, telephone and television cable, fiber optic cable, fire protection, water, sewers, etc.

3.0 DESIGN GUIDELINES

3.1 Regulations and Standards

- a. Applicable standards and criteria established by the utility owners
- b. CPUC GO Number 95 (Overhead Electric Line Construction)
- c. CPUC GO Number 128 (Construction of Underground Electric Supply and Communication System)
- d. Standards and criteria of the jurisdictional agencies, as appropriate

3.2 New Construction

Replacements for any existing utilities, including municipal facilities, shall be designed to provide service equal to that offered by the existing installation. No betterment shall be included, unless specifically directed by the Caltrain Deputy Director of Engineering.

The following general design guidelines shall be followed for utility work:

- a. Design Loading: All underground utilities shall be designed in accordance with Caltrain railroad loadings. This also applies to sleeves or encasement pipes.
- b. Crossing Angle: Underground utilities shall cross the railroad right-of-way at a 90 degree angle to the track centerline.
- c. Materials: Utilities shall be constructed with non-conductive materials
- d. Sleeves: Third party utilities that cross tracks shall be sleeved.
- e. Future Ducts: Additional ducts shall be installed for future crossings whenever possible.
- f. Horizontal Clearance: Utilities shall be located outside the zone of influence or at a minimum of 12 feet from the centerline of closest track. At the station area, the utilities shall be located within the designated utility corridor.
- g. Vertical Clearance: Overhead wires and other utilities crossing the tracks are not allowed. They shall be located underground.
- h. Vaults: Reconstruction, abandonment, or other work involving private vaults extending from adjoining buildings into public space shall be in accordance with codes, standards, and practices of the responsible local jurisdiction.
- i. Pipelines (water, oil, gas, or other highly flammable, volatile, or pressurized substances): The pipelines shall be encased in a larger casing pipe or conduit. Casing pipes shall be designed to withstand railroad loadings, and shall be coated with a suitable material to provide cathodic protection.
- j. Utilities (electric power transmission lines, fiber optic cables, potable water, storm water, etc.): The utilities owners shall be responsible for the relocation design of their facilities.
- k. Fire Protection Facility: The relocation design shall be performed by Caltrain's design consultant and require approval of the owner and appropriate fire agency.

3.3 Guidelines During Construction

New construction and the protection, support, restoration, and rearrangement of utilities shall be in conformance with the latest technical specifications and practices of the respective utility owner and Caltrain requirements.

Utilities encountered or located sufficiently close to be affected by the project construction shall be either:

- a. Maintained in place and in operation during and after construction
- b. Temporarily relocated and maintained in operation during and after construction
- c. Temporarily relocated and maintained, then, upon completion of facilities, replaced by a new utility
- d. Permanently relocated to a new location beyond the immediate limits of construction
- e. Abandoned and/or removed

Additionally, utilities abutting Caltrain property shall not be interrupted and, if temporarily relocated, shall be restored upon completion of work.

4.0 UTILITY SURVEY

Utility surveys include record research, potholing, and/or field surveys. The utility surveys are used by Caltrain to locate existing utilities for the following purposes:

- a. Basis for project planning and design
- b. Relocations of impacted utilities
- c. Acquisition for utility easements and/or right-of-way
- d. Information for coordination and negotiation with utility companies

Utility potholing, complemented with field surveys shall be conducted during design to develop a good understanding of the underground conditions, including confirming to the information from the record survey.

Survey limits and types of utilities to be located should be shown on the Survey Plan. The Plan shall include all utility maps and drawings and descriptions of easements.

END OF CHAPTER