17.1 DESIGN CRITERIA FOR TEMPORARY PREFABRICATED MODULAR STEEL PANEL TRUSS BRIDGES

17.1.1 GENERAL

This policy addresses design criteria for temporary prefabricated modular steel panel truss bridges. These types of bridges are built on the project site from an engineered system of ready-to-assemble standardized prefabricated components, and usually used for emergencies, maintenance projects, and traffic detours or for construction operations.

17.1.2 DEFINITIONS

Article—An article specified in *AASHTO-CA BDS* (AASHTO, 2017; Caltrans, 2019a).

Temporary Bridge—A bridge that is anticipated to be in service less than 5 years.

Modular Bridge—A temporary prefabricated modular steel panel truss bridge.

Modular Highway Bridge—A modular bridge built for carrying vehicular traffic.

Modular Construction Bridge—A modular bridge built exclusively for carrying construction vehicular traffic, special equipment, and pedestrians during the construction of transportation projects that is not open to the public.

Modular Pedestrian Bridge—A modular bridge built for pedestrians, bicyclists, equestrian, and light maintenance vehicle traffic.

17.1.3 MODULAR BRIDGE CLASSIFICATIONS

The bridge classifications herein are used for determining the design criteria for modular bridges.

A modular bridge must be classified as either a “standard bridge” or a “minor bridge”.

A modular bridge is designated as a standard bridge when it satisfies one or more of the following:

- The bridge carries vehicular traffic.

- The bridge crosses over state highways, local roads, railroads or waterways.

A modular bridge not meeting the designation of a standard bridge should be designated as a minor bridge.

17.1.4 DESIGN REQUIREMENTS

Modular highway bridges must be designed in accordance with the current version of *AASHTO-CA BDS* (AASHTO, 2017; Caltrans, 2019) for the limit states: Strength I, Strength II, Strength III, Strength V, Fatigue I, Extreme Event I, Extreme Event II, Service I, and for Stability, as specified in this policy.

Modular construction bridges must be designed in accordance with *AASHTO-CA BDS* for the limit states: Strength I, Strength II, Strength III, Strength V, Fatigue I, Extreme Event I, Extreme Event II, and for Stability, as specified in this policy.

Modular pedestrian bridges and modular construction bridges carrying pedestrians only must be designed in accordance with the current *AASHTO GSDPB* (AASHTO, 2009 and 2015). for the limit states: Strength I, Strength III, Service I, and for Stability; Extreme Event I and Extreme Event II as specified in this policy.

Bearings, substructures, and foundations must be designed in accordance with the *AASHTO-CA BDS* for the limit states as mentioned above.

17.1.4.1 Strength I

For modular highway bridges, and modular construction bridges carrying construction vehicular traffic and crossing over state highways, local roads, railroads or waterways, the design vehicular live load must be HL-93 as specified in Article 3.6.1.2.

For modular pedestrian bridges, pedestrian loading, vehicle load, and equestrian load must be as specified in *AASHTO GSDPB* Article 3.

17.1.4.2 Strength II

For modular highway bridges, design permit vehicle must be taken as the first five axles of Permit Truck, P15 as shown in *AASHTO-CA BDS* Figure 3.6.1.8.1-1.

For modular construction bridges, the design vehicular live load and special equipment loads are specified by the contractor. Load factors for Strength II as specified in *AASHTO-CA BDS* must apply.

17.1.4.2 Strength III

For modular highway and construction bridges, wind load must be as specified in Article 3.8.1.2 multiplied by a reduction factor of 0.84 corresponding to 10% probability of exceedance in 10 years.

For modular pedestrian bridges, the wind load must be as specified in *AASHTO GSDPB* Article 3 multiplied by a reduction factor of 0.84 corresponding to 10% probability of exceedance in 10 years.

17.1.4.3 Strength V

For modular highway and construction bridges, the wind load must be as specified in Article 3.8.1.

17.1.4.4 Fatigue I

For modular highway bridges, and modular construction bridges carrying construction vehicular traffic and crossing over state highways, local roads, railroads, or waterways, the infinite fatigue life design requirements as specified in Article 6.6.1.2.2 shall apply.

17.1.4.5 Extreme Event I

For modular bridges designated as “standard”, seismic load must be taken as design spectra based on 10% probability of exceedance in 10 years. Elastic Dynamic Analysis as specified in Caltrans *Seismic Design Criteria* (Caltrans, 2019b) must be used to determine force demands. Force demands may be divided by a response modification factor of 2.0. Force capacities must be based on the expected material properties in accordance with Caltrans *Seismic Design Specifications for Steel Bridges* (Caltrans, 2016).

17.1.4.6 Extreme Event II

17.1.4.6.1 Vehicular Railing

In the interim during the development of MASH-compliant physically crash-tested and approved bridge railing systems for modular bridges, the following criteria are required:

Vehicular railing shall be designed for TL-4 design forces as specified in Article A13.2. The regulatory speed limit must be posted for 45 MPH or less.

All components in the load path of the modular bridge system shall be designed for TL-4 design forces as specified in Article A13.2.

The post spacing of the vehicular railing must not exceed 10 feet as shown in Figure 17.1.1. The top surface of the top railing must be a minimum of 3 feet above the roadway surface and the top traffic side face of the railing must be set a minimum offset distance of 15 inches in front of the truss as shown in Figure 17.1.2. If the top surface of the top railing is 4 feet or higher above the roadway surface, the top traffic side face of the railing must be set a minimum offset distance of 8 inches in front of the truss as shown in Figure 17.1.3. If the transom spacing exceeds 10 feet but is less than or equal to 15 feet, an additional post must be installed at the midpoint and designed for TL-2 loading. The maximum clear opening below the bottom rail, the setback distance, and the maximum opening between rails must satisfy requirements in Article A13.1.1.

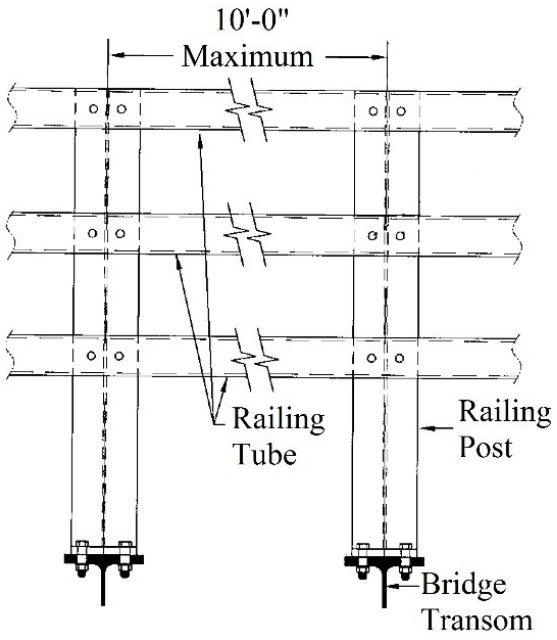

Figure 17.1.1 Vehicular Railing Elevation

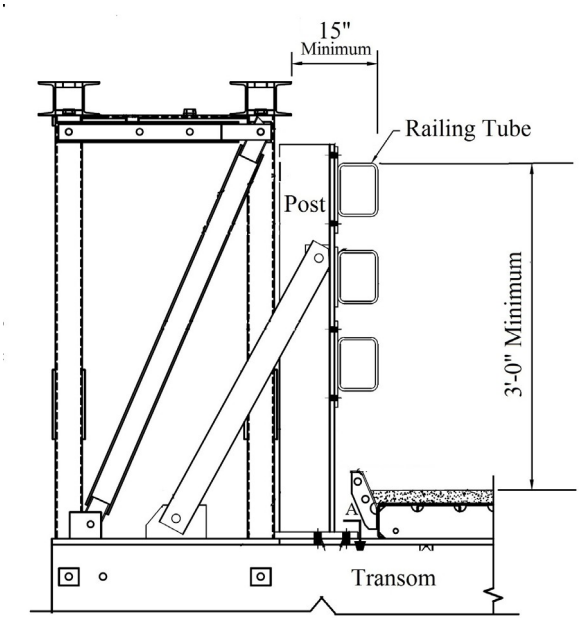

Figure 17.1.2 Vehicular Railing Offset Requirement for Railing Height of 3 feet

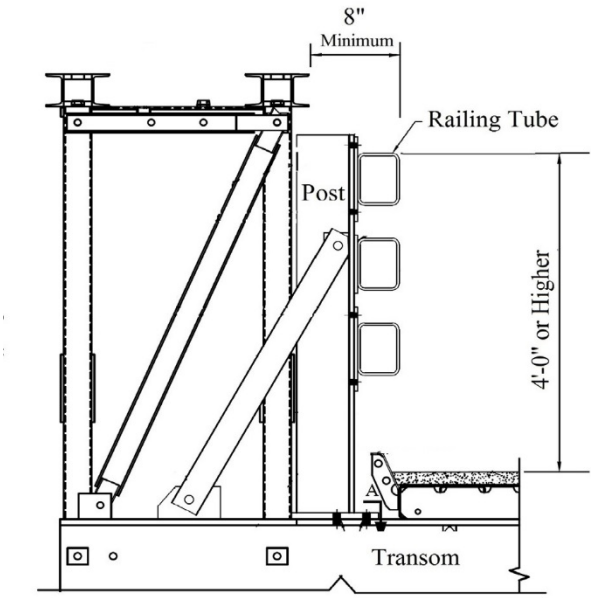

Figure 17.1.3 Vehicular Railing Offset Requirement for Railing Height of 4 feet

17.1.4.6.2 Pedestrian and Bicycle Railing

Exterior and interior pedestrian and bicycle railings for a prefabricated sidewalk must meet all geometric and load requirements specified for pedestrian and bicycle railings from the *AASHTO-CA BDS* Section 13 and the tubular handrailing, tubular bicycle railing, and chain link railing in current Caltrans *Standard Plans* (Caltrans, 2018), *Bridge Standard Detail Sheets*, and *Highway Design Manual* (Caltrans, 2020). Exterior pedestrian and bicycle railings must be a minimum of 42 inches above the bridge deck finish surface except when over a railroad for which the minimum standard is 10 feet. Exterior pedestrian and bicycle railings for bridges over a railroad must meet all railroad requirements and Caltrans *Bridge Design Details* (Caltrans, 2019c).

17.1.4.7 Service I

For modular highway bridges designated as “standard”, the vehicular live load HL-93 deflection must not exceed the limit of span length/800.

For modular pedestrian bridges designated as “standard”, the deflection and vibration requirements specified in *AASHTO GSDPB* Articles 5 and 6 must apply.

17.1.4.8 Stability

For modular highway and construction bridges, requirements specified in Article 6.14.2.9 must apply.

For modular highway and construction bridges, the top chord must be considered as a column with elastic lateral supports at the panel points. The compression resistance must be in accordance with the *AASHTO-CA BDS* using either the effective length factor or the second-order analysis procedure as specified in the Articles 4.6.2.5 and C4.6.2.5.

For modular pedestrian bridges, the stability requirements specified in the *AASHTO GSDPB* Article 7 must apply.

17.1.5 REFERENCES

1. AASHTO. (2009, 2015). *AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges*, 2nd Edition and 2015 Interim Revisions, American Association of State Highway and Transportation Officials, Washington DC.
2. AASHTO. (2017). *AASHTO LRFD Bridge Design Specifications*, 8th Edition, American Association of State Highway and Transportation Officials, Washington DC.
3. Caltrans. (2016). *Caltrans Seismic Design Specifications for Steel Bridges,* 2nd Edition, California Department of Transportation, Sacramento, CA.

4. Caltrans. (2018). 2018 *Standard Plans,* California Department of Transportation, Sacramento, CA.

5. Caltrans. (2020). *Highway Design Manual*, 7th Edition, California Department of Transportation, Sacramento, CA.

6. Caltrans. (2019a). *California Amendments to AASHTO LRFD Bridge Design Specifications*, 8th Edition, California Department of Transportation, Sacramento, CA.

7. Caltrans. (2019b). *Caltrans Seismic Design Criteria,* Version 2.0, California Department of Transportation, Sacramento, CA.

8. Caltrans. *Bridge Standard Detail Sheets*, California Department of Transportation, Sacramento, CA.

9. Caltrans. (2019c). *Bridge Design Details*, California Department of Transportation, Sacramento, CA.