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# Petaluma Trestle Rehabilitation Project

## Preliminary Structural Design Criteria

### A. PROJECT DESCRIPTION

The project consists of developing alternatives and preliminary and final design for rehabilitation of an existing timber trestle located in Petaluma, California. The trestle is an approximately 500 foot long timber structure constructed circa 1922 and is oriented in the east-west direction, extending from the end of Western Avenue east to the Petaluma Yacht Club. Freight rail service was discontinued in 1992 and the trestle is at the end of its usable service life and has experienced significant deterioration to the extent that it is currently unsafe for pedestrian use. Prior engineering studies have indicated that the trestle is currently not capable of supporting either pedestrian or trolley loads. The trestle structure has experienced extensive deterioration and requires rehabilitation for pedestrian and bicycle and future electric trolley use.

### B. DESIGN CODES AND STANDARDS

The design requirements of the following design codes and standards shall be incorporated into the rehabilitation design of the Petaluma Trestle structure:

1. California Department of Transportation (Caltrans), Bridge Design Specifications (BDS), 2004.
2. American Associate of State Highway Transportation Officials (AASHTO), Load Resistance Factor Design (LRFD), 5th Edition, 2010.
3. American Railway Engineering and Maintenance Association Manual of Railway Engineering
4. California Building Standards Commission, "2010 California Building Code (CBC)," California Code of Regulations, Title 24, Parts 1 and 2, 2010.
5. International Code Council, "2009 International Building Code (IBC)," 2009.
6. American Society of Civil Engineers, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-05, 2005.
7. American Concrete Institute, "Building Code Requirements for Structural Concrete," ACI 318-08 and Commentary (ACI 318R-08.)
8. National Design Specification for Wood Construction (NDS) 2005, ANSI/AF&PA.
9. American Institute of Steel Construction (AISC), "2005 LRFD Specification for Structural Steel Buildings."

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## C. DESIGN LOADS AND LOADING COMBINATIONS

Design loading combinations for the Petaluma Trestle structure are presented below. Design load combinations are summarized at the end of this section.

The substructure will be designed for governing design load combinations per the requirements of the CALTRANS BRIDGE DESIGN SPECIFICATION. This includes in-service loads consisting of operating (normal) and seismic loads. Normal or operating design conditions are those that are expected to occur frequently during the life of the structure. A summary of the recommended Project Design specifications for the Petaluma Trestle Rehabilitation Project follows:

### 1. Gravity Loading

Dead Loads – weights of deck/topping, hand railing, rail tracks, stringers, bent caps, and piles, with no allowance for future wearing surface.

Live Loads – pedestrian and future electric trolley.

Pedestrian .....100 psf
66' Long Electric Trolley .....
.....4x 23.5 kip axle loads, 6'-2" spacing, 10'-7" from ends

Unit Weights:

Timber .....50 pcf
Reinforced Concrete .....150 pcf
Steel .....490 pcf
Fiber Reinforced Polymer .....115 pcf
Miscellaneous Utilities ..... 20 plf

pcf = pounds per cubic foot
psf = pounds per square foot
kips – 1 kip = 1,000 pounds

### 2. Seismic Loading

Per AASHTO, 7% probability of occurrence in 75 years (approximately 1,000 year return period) with peak ground acceleration (PGA) of 0.614g, $S_S$ of 1.469g, and $S_1$ of 0.617g.

### 3. Load Combinations using AASHTO LRFD:

**Strength I:** U = 1.25DC + 1.75(LL+IM)
**Strength II:** U = 1.25DC + 1.35(LL+IM)
**Strength III:** U = 1.25DC + 1.40WS

**Strength V:** U = 1.25DC + 1.35(LL+IM) + 0.40WS + 1.0WL
**Extreme I:** U = (1.25,0.9)DC + 1.0EQ

LRFD = Load and Resistance Factor Design
DC = Dead Load
LL = Live Load (Strength II is trolley, others are normal vehicles)
IM = Impact Load
WS = Wind Load on Structure
WL = Wind Load
EQ = Seismic Load

## D. GEOTECHNICAL CRITERIA

All geotechnical criteria and parameters for preliminary and final design will be based on a site investigation, study and subsequent report provided by the geotechnical sub-consultant.

Site Class E has been assumed for development of the rehabilitation alternatives.

## E. PRELIMINARY REHABILITATION ALTERNATIVES

Three alternatives will be reviewed for the rehabilitation of the timber trestle. The alternatives will be refined to a conceptual level, consisting of basic calculations and analysis, sketch drawings and budgetary cost estimates. The alternatives are described as the following:

1. Prior evaluation studies have identified the timber piles are the most damaged structural trestle element. The majority of the damage is located above the mudline in the intertidal area of the piles. It may not be feasible to replace all of the timber piles in kind, due to the possibility that removal of timber piles will cause them to break, and weaken the soil bearing capacity of piles installed in close proximity. Therefore, the primary rehabilitation method may be to jacket the piles using concrete or grout-filled fiber-reinforced wraps down to the mud line, possibly combining two piles together in improve capacity and prevent continued decay.

   Decayed and substandard bent caps and stringers will be replaced with new timber members, and replace timber decking. Replacement stringers may be material other than timber, such as steel or concrete. New stringers can be

concealed with existing timber stringers at the exterior to maintain historic appearance.

2. Remove sections of the existing deck and stringers, drive new steel or concrete piles and install new bent caps between the existing pile bents. Abandon the existing piles and bent caps. Install new higher strength stringers between the new bent caps, concealed with existing timber stringers at the exterior to maintain historic visual appearance. Install new timber decking.

3. Demolish the existing trestle structure and piles and replace with new concrete, steel or timber members appropriate for anticipated vertical and lateral loads.