Chapter 7: Bridge Scaffolding

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7-1 Introduction

This chapter addresses bridge scaffolding defined by *Contract Specifications* Section 7-1.02K(6)(e), *Legal Relations and Responsibility to the Public – Laws – Labor Code – Occupational Safety and Health Standards – Scaffolding*, as scaffolding constructed on or suspended from a bridge. Bridge scaffolding provides temporary access to areas of the bridge for workers and materials during bridge repair, retrofit, painting, and other construction activities. Bridge scaffolding is typically a contractor designed system or a proprietary system designed by a third party. Bridge scaffolding can take many forms from traditional scaffolding rigid brackets (Figure 7-1) mounted to the structure, to flexible systems hung by cables below the bridge (Figures 7-2 and 7-3). Walkways for falsework systems are not considered a scaffold system.

Figure 7-1. Conventional Scaffold System Supported by Structure

Figure 7-2. Suspended Scaffold System - Quikdeck

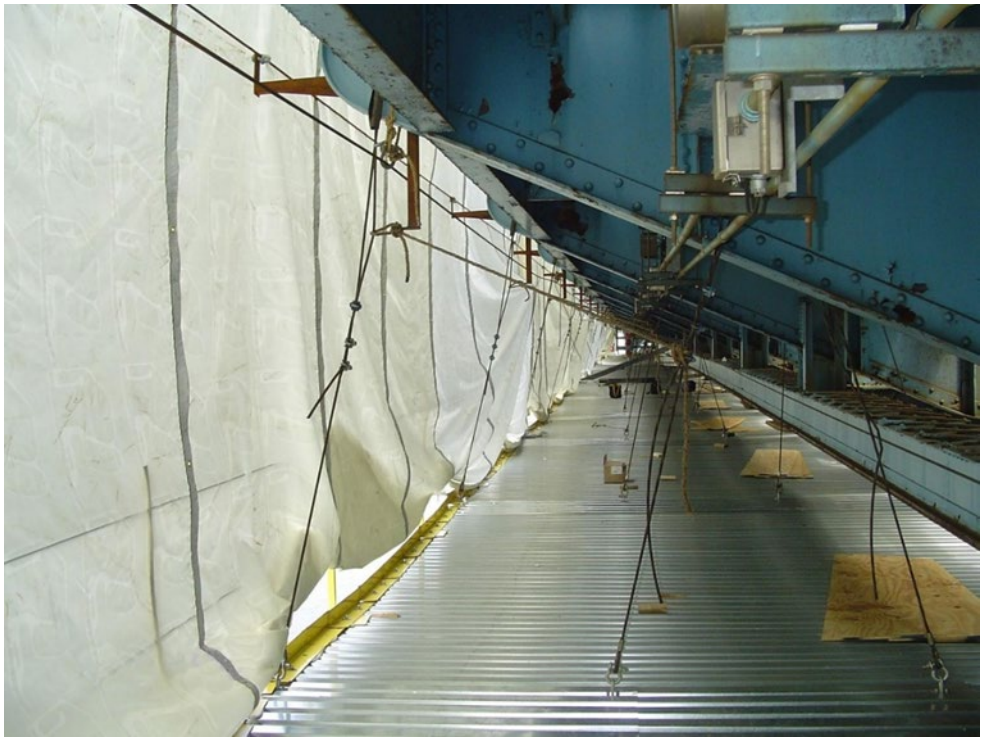

Figure 7-3. Suspended Scaffold System - Safespan

7-2 Contractual Requirements

The *Contract Specifications* Section 7-1.02K(6)(e), *Scaffolding,* requires the Contractor to submit to the Engineer for review and authorization, scaffolding shop drawings and calculations. In addition, an independent check is required by an engineer not employed by the same entity that prepared the drawings.

The scaffolding shop drawings and calculations, along with the independent check, must be sealed and signed by an engineer who is registered as a civil engineer in the State.

The available bridge uniform load, in pounds per square foot (psf), is the available bridge load capacity in excess of the vehicular live load and is typically found in Section 7-1.02K(6)(e), *Scaffolding,* of the *Contract Specifications*; refer to Figure 7-4 for an example. The available bridge uniform load is used to calculate the available shear and moment capacity envelopes. The shear and moment demand envelopes are determined using the actual scaffold loads. The live load increases required by Cal/OSHA are not considered when determining the demand on the existing structure. If the demand envelope for each bridge member is less than the available capacity envelope, the proposed scaffold system is acceptable for the global check of the existing structure. Investigation of member stresses is not required, provided the applied loading is compared to the available bridge load capacity.

1. Aiken Creek Bridge (br. no. 04-0059) and Slate Creek Bridge (br. no. 04-0061):

Bridge name/number	Available bridge load capacity (lb/sq ft)	Bridge width (ft)	HL-93 design live load			Permit design live load	
			Percentage of HL-93 loading (percent)	No. LL_{HS20} lanes		Permit vehicle	No. LL_{Permit} lanes
				Moment[b]	Shear		
Aiken Creek Bridge (br. no. 04-0059)	65	29.5	81	1.03 for exterior girders 0.99 for interior girders	0.64 for exterior girders 0.74 for interior girders	N/A	N/A
Slate Creek Bridge (br. no. 04-0061)[a]	65	29.5	70	0.64 for exterior girders 0.60 for interior girders	0.64 for exterior girders 0.67 for interior girders	N/A	N/A

[a] Denotes live load is only permitted on half of the structure at Slate Creek Bridge (br. no. 04-0061)
[b] Denotes Live Load Distribution Factors (LLDF) varies along the length of structures. The values provided in the table are for the controlling locations only. All the other locations to be verified by the Contractor.

Figure 7-4. Example Available Load Capacity Table

The adequacy of the existing bridge components at or near points of support must also be investigated. The *Contract Specifications* requires the evaluation of existing members be performed using the *AASHTO LRFD Bridge Design Specifications with California Amendments*, latest edition.

The Contractor can elect to do a more detailed analysis by not simply comparing the shear and moment envelopes using the available bridge uniform load as described above. A more detailed analysis is performed using the percentage of HL-93 live loading along with maximum number of live load HL-93 lanes given in the *Contract Specifications* Section 7-1.02K(6)(e) *Scaffolding*. The detailed analysis would be based on the *AASHTO LRFD Bridge Design Specifications with California Amendments*, latest edition. Specific load modifiers for performing the analysis are given in the aforementioned Section 7-1.02K(6)(e).

For truss type bridges, if the proposed shop drawings do not comply with the scaffold staging shown in the contract documents, the calculations must also include tension and compression force demand versus capacity of truss members during erection, movement, and removal of the scaffold. All connection must be made through stringers, floor beams, or truss panels. Connections that may cause bending stresses in a truss member are not allowed.

7-3 Cal/OSHA Requirements

Requirements from Cal/OSHA's Construction Safety Orders:

Article 21, *Scaffolds – General Requirements*, § 1637, *General Requirements,* subsection 1637(b), *Scaffold Design and Construction,* requires scaffolding to be designed and constructed using a dead load safety factor that will ensure the scaffold supports, without failure, its own weight and 4 times the maximum intended working (live) load applied or transmitted to it. Light duty scaffolds shall have a maximum working load of 25 psf, medium duty scaffold a maximum working load of 50 psf, and heavy duty scaffold a maximum working load of 75 psf.

Requirements for specific types of scaffolds can be found in Article 22, *Scaffolds – Various Types*, as follows:

§ 1644, *Metal Scaffolds*

§ 1645, *Outrigger and Bracket Scaffolds*

§ 1646, *Tower and Rolling Scaffolds, Wood or Metal.*

7-4 Review and Authorization

Scaffolds are a temporary structure and are reviewed and authorized in accordance with BCM C-11, *Shop Drawing Review of Temporary Structures.*

Initial review of the submittal for completeness should check for the following items:

1. Legible drawings
2. Stamped by a registered civil engineer in the State.
3. Independent check stamped by a registered civil engineer in the State.
4. All components identified and information for manufactured assemblies is included.
5. All dimensions shown on the shop drawings.
6. Sequence and installation/removal procedures.
7. Calculations for scaffold system and existing structure.
8. Description and values for scaffold loads during erection, movement, and removal.

An independent analysis by Caltrans (as described in Section 7-5, *Resources*) should be performed to verify the additional loading on the existing bridge structure is within the shear and moment envelopes specified in the contract documents. The scaffold system and the connections to the existing structure must also be reviewed and authorized by the Engineer. Portions of the scaffold system that are proprietary can be treated as manufactured assemblies and the allowable loads determined by adhering to the loading instructions supplied by the manufacturer.

A detailed work plan is required for scaffold submittals that involve the railroad. The work plan must include:

1. Procedures for installing, maintaining, and removing the scaffold system.
2. Path of travel for equipment in and out of railroad right-of-way.
3. Critical dimensions including horizontal and vertical dimensions to centerline of track measured from top of rail elevation.
4. Staging areas for equipment and material.
5. Equipment to be used including location and swing path.

See Appendix A Example 3, *Bridge Scaffolding,* for typical scaffold review.

7-5 Resources

The analysis of the existing bridge components using Load and Resistance Factor Design (LRFD) and Load Factor Design (LFD) may require the assistance of the Bridge Design Professional Engineer for Bridge Design projects. If the project is a Structure Maintenance and Investigation (SM&I) project, then SM&I would provide support. Software not available to SC field staff might also be required to properly analyze the existing structure. The SM&I or the Bridge Design project engineer should be contacted early in the development of the scaffold shop drawings so critical issues can be addressed.

The SC Falsework Engineer is another resource when doing the independent analysis and is the point of contact when the railroad is involved.