Chapter 4: Temporary Access Trestles

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4-1 Introduction

Temporary access trestles are essential in bridge construction projects where standard access methods are insufficient due to challenging terrain or environmentally sensitive areas. These structures provide the necessary support and accessibility for heavy equipment in locations such as above-water bodies, rough terrains, or environmentally sensitive areas where conventional access methods might be impractical, damaging, or prohibited according to governing agency permits. Trestles facilitate efficient and safe access to the work site, significantly reducing the reliance on floating equipment like barges or high-line systems that span canyons and valleys.

The basic makeup of a standard trestle is similar to falsework and typically includes driven or drilled piles for foundation support, steel beams for the bent caps and stringers, and wood decking for the platform. Bracing is normally provided by steel wire rope or structural steel members. These elements are designed to withstand various forces, including the weight of heavy equipment, dynamic movements, and environmental loading, such as water flow and wind. Proper design and construction of trestles are essential to ensure stability, safety, and environmental compliance during the project execution.

Contractors typically design temporary access trestles as part of their means and methods for building the permanent structure. It is worth noting that the term “trestle” is not found in the *Standard Specifications*.

Figures 4-1, 4-2, 4-3, 4-4, 4-5, and 4-12 show various examples of temporary access trestles used in bridge construction.

Figure 4-1. Antlers Bridge, I-5, CA

Figure 4-2. Shasta Viaduct Arch Bridge, I-5, CA

Figure 4-3. Dr. Fine Bridge, Smith River, U.S. 101, CA

Figure 4-4. HWY 97 at the Link River, OR

Figure 4-5. Sacramento River Bridge at Butte City, HWY 162, CA

4-2 Contractual Requirements

The *Contract Specifications* Section 7-1.04, *Legal Relations and Responsibility to the Public – Public Safety*, requires that temporary facilities which could pose a public safety hazard if improperly designed must adhere to the design requirements specified in the contract or, if not specified, follow standard design criteria or codes relevant to the facility. Shop drawings and design calculations for these facilities must be submitted to the Engineer for authorization, indicating the design criteria or codes used. All shop drawings and calculations must be sealed and signed by a registered civil engineer in the State.

Temporary access trestles fall under these public safety requirements and will be managed accordingly. The signed and sealed shop drawings and calculations will be considered an action submittal as outlined in *Contract Specifications* Section 5-1.23B, *Control of Work – Submittals – Action Submittals*. The Contractor's engineer who signed and sealed the temporary structure shop drawings is the engineer of record.

Construction projects in or near environmentally sensitive areas, such as bodies of water, wetlands, or steep terrain, often face unique environmental challenges. These areas may host protected plant, fish, and wildlife species and be subject to noise and vibration restrictions. Pile driving in riverbeds can harm fish habitats, and permit restrictions may require the use of bubble curtains or other methods to reduce vibration and sound waves in water or limit in-water work to specific timeframes.

The *Information Handout* may include project-specific permits and agreements that are part of the contract and must be adhered to. Permitting agencies that may influence the Contractor's methods, design, or installation of the trestles include:

1. US Army Corps of Engineers
2. Federal Emergency Management Agency - FEMA
3. Water Quality Control Board - WQCB
4. Department of Fish and Wildlife - DFW
5. California Coastal Commission - CCC
6. US Coast Guard
7. Other permitting agencies.

4-3 Cal/OSHA Requirements

The Construction Safety Orders issued by Cal/OSHA include various provisions which apply to the design and construction of temporary access trestles, including the following:

- Article 24, *Fall Protection:*

  § 1669, *General.*
  Employers must provide fall protection for employees exposed to falls of 7.5 feet or more. This section covers general fall protection requirements, including the use of guardrails, safety nets, and personal fall arrest systems.

  § 1670, *Personal Fall Arrest Systems, Personal Fall Restraint Systems and Positioning Devices*.
  Personal fall protection systems, such as harnesses and lanyards, must be used where fall hazards exist. This section covers using, maintaining, and inspecting personal fall protection systems, including harnesses, lanyards, and anchorage points.

- Article 13, *Work Over or Near Water*, § 1602, *Work Over or Near Water:*
  Requires the following safety measures for employees working with a risk of drowning: Personal Flotation Devices (PFDs), Ring Buoys, and Lifesaving Boats.

- Article 15, *Cranes and Derricks in Construction*, § 1610, *General Requirements.*

4-4 Review and Authorization

Temporary access trestle structures are reviewed and authorized, as required by *Contract Specifications* Section 7-1.04 *Public Safety*, in accordance with BCM C-11, *Shop Drawing Review of Temporary Structures.*

The initial review of the submittal for completeness should be performed within two working days and ensure the following items are included:

1. Legible drawings and calculations.
2. Stamped by a California licensed engineer.
3. Identification of all components, materials, and information for manufactured assemblies.
4. All controlling dimensions are shown on the shop drawings.
5. Design loads, including live loads, horizontal loads, and environmental loads including water and wind loads.
6. Design criteria or design codes used.
7. Welding design and inspection standards.
8. Foundation installation procedures for driven or drilled piles.
9. Site-specific requirements may include traffic openings, navigation openings, flood contingency plans, allowable work windows, utility restrictions, or restrictions due to a levee or railroad.
10. Erection and removal procedures.

An independent analysis by Caltrans must be performed to verify if the design of the temporary access trestle conforms to the contract specifications and permit requirements, and member stresses are within allowable limits. The analysis findings are to be presented to the Contractor in a temporary structure analysis report signed and sealed by the licensed engineer performing the review.

A detailed work plan is required for temporary access trestle submittals that involve the railroad. The work plan must include the following:

1. Crane pick plan for erection and removal of the temporary access trestle when there is a possibility the crane could foul the railroad tracks.
2. Staging areas for equipment and materials.
3. Path of travel for equipment in and out of railroad right-of-way.
4. Critical dimensions, including dimensions to the centerline of the railroad tracks.

4-5 Basic Components of a Temporary Access Trestle

Foundation: Trestles are usually supported by driven or drilled piles, such as pipe piles, H-piles, or wide-flange beams, to handle the substantial loads they bear. These foundations are essential for supporting heavy cranes.

Cap Beams: These lateral members distribute loads from stringers or girders to the supporting piles.

Stringers/Girders: Spanning between bent caps, stringers and girders are typically laterally braced to maintain stability.

Transverse and Longitudinal Bracing: Transverse and longitudinal (lateral) bracing, made from steel wire rope, structural steel members, or steel beams, handles horizontal and longitudinal loads such as equipment live loads, wind, and other forces. This bracing ensures the trestle remains stable under varying conditions.

Decking: Usually constructed from timber or precast concrete, decking supports the equipment loads. Sealing of the deck may be required to prevent debris from falling through gaps.

Figures 4-6 and 4-7 show the typical components of a temporary access trestle.

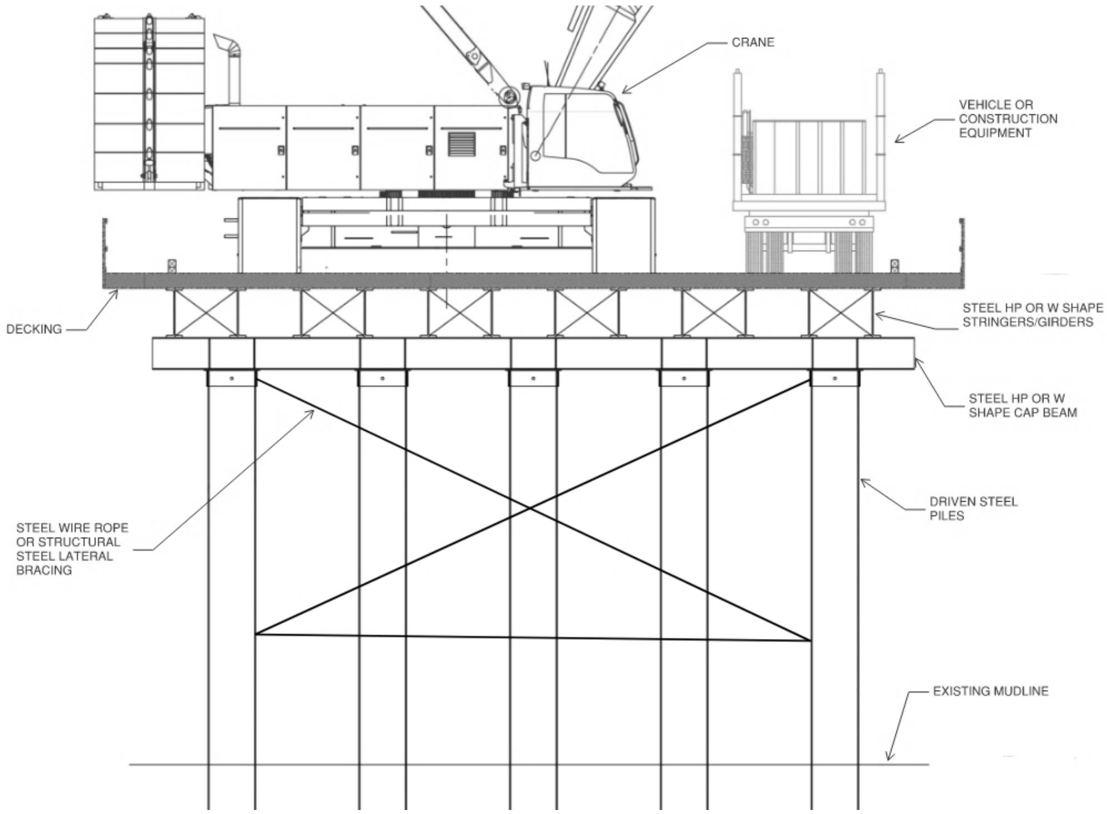

Figure 4-6. Typical Trestle Components, Section View

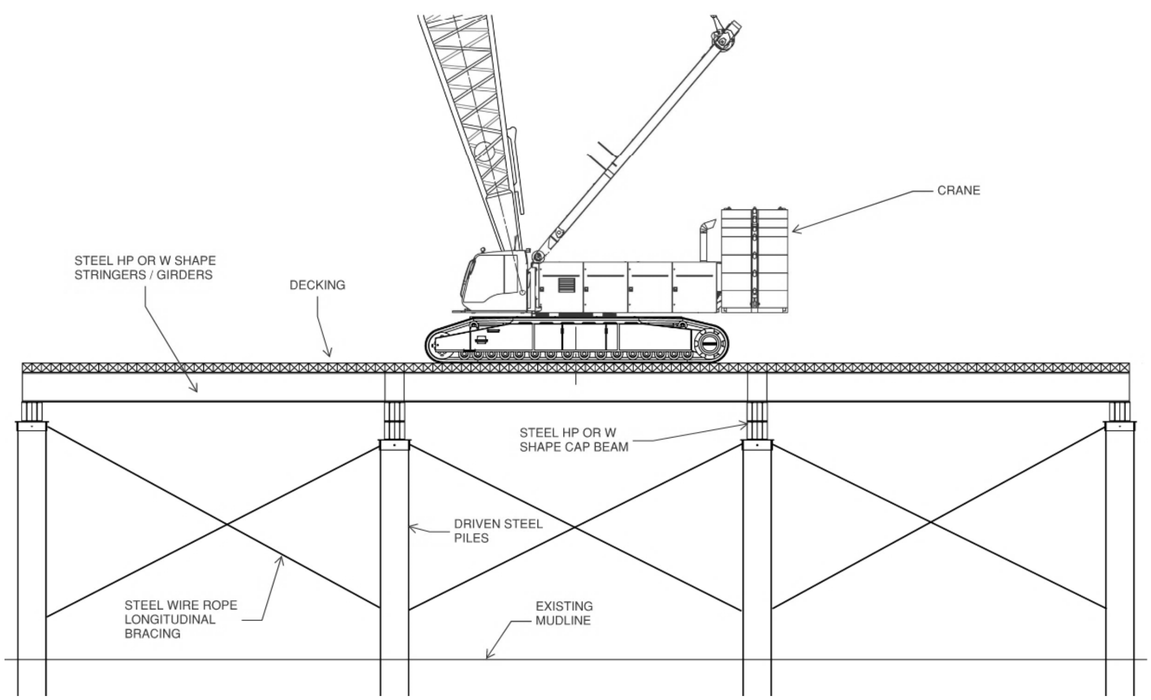

Figure 4-7. Typical Trestle Components, Elevation View

4-6 Loads

Temporary access trestles are generally designed to support the following loads:

1. Dead load: Gravity weight of all the trestle components.
2. Live load: The total weight of the crane plus its maximum lifting load along with other equipment, vehicles and material storage.
3. Live load lateral forces: Arising from the dynamic movements of the crane or other equipment.
4. Water-induced lateral forces: Resulting from water movement, such as waves or currents in a river.
5. Wind lateral forces.
6. Minimum lateral load: Designated by the trestle design engineer.

Access trestles are generally designed to support substantial equipment loads. The design must consider the type of construction equipment, its placement on the trestle, and the sequence of operations to ensure that the supporting members can handle the maximum expected stresses.

4-6.01 Crane Live Loads

Crane live loads are determined by calculating the forces a crane will exert on the trestle's deck during operation. As the crane moves and load configurations change, various load cases may arise, with its operation typically restricted by its position on the trestle (see Figure 4-8). It is crucial to identify the load cases that impose the maximum load on the different load-carrying members of the trestle. Ensure the crane operator is fully aware of these restrictions.

The following are some things to consider, when analyzing a crane on a temporary access trestle:

1. Crane specifications: Collect details such as the crane model, boom length, maximum rated load, and configuration (e.g., outrigger spacing for mobile cranes or track bearing dimensions for crawler cranes).
2. Lift details: Identify the weight of the lifted load and the radius (distance from the crane's center to the load).
3. Outriggers: For cranes with outriggers, compute the static loads on each outrigger based on the load and crane configuration, balancing moments around the crane's support points.
4. Crawler tracks: Calculate track bearing pressures for crawler cranes by evaluating the total load and its distribution over the tracks.

5. Software utilization: Many crane manufacturers provide ground-bearing pressure estimators or software as standalone tools or website-integrated features to help estimate the loads and pressures a crane will impose based on its configuration and the loads being lifted; see Figure 4-9 for an illustration.

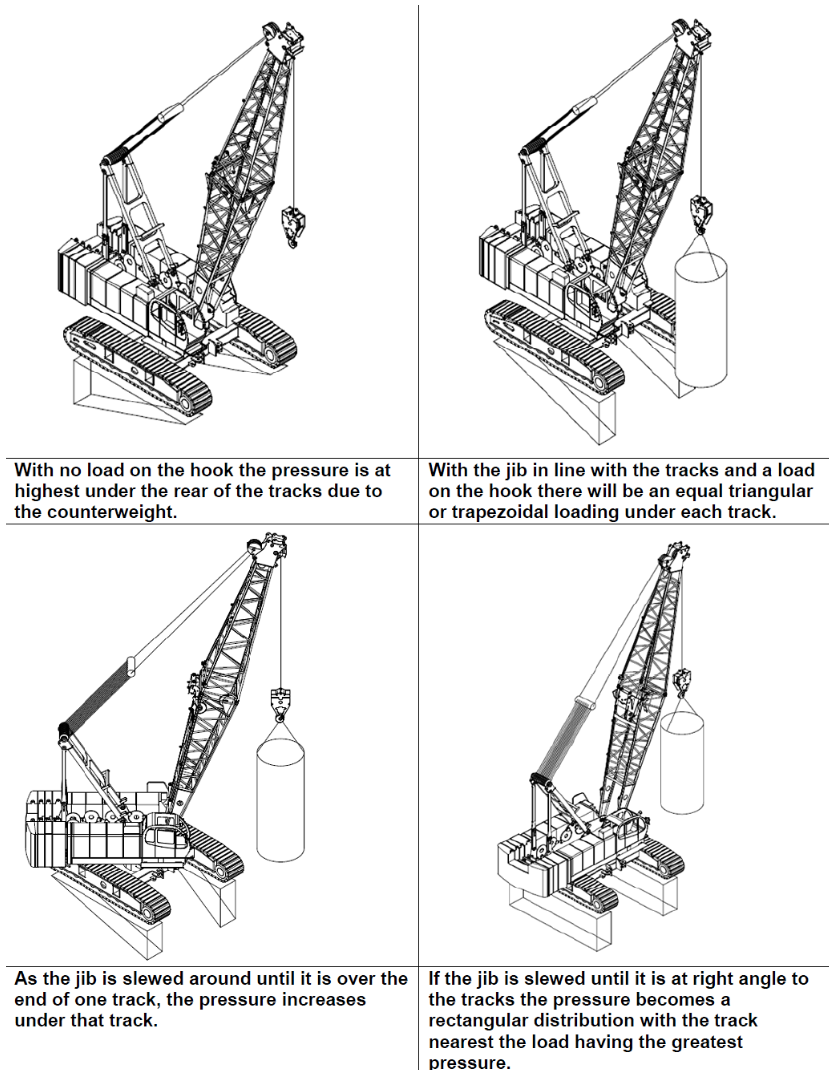

Figure 4-8. Crawler Track Pressure Change Due to Different Load Cases (Crane Industry Council of Australia)

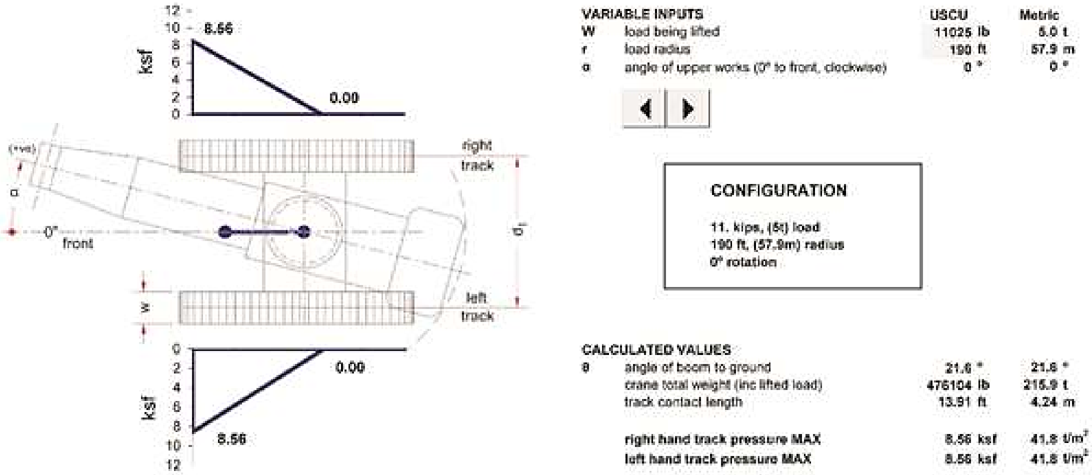

Figure 4-9. Crane Manufacturer's Bearing Pressure Estimator

4-6.02 Dynamic Loads

Various types of dynamic loading to consider on trestles include the following:

1. Vertical impact: Consider whether dynamic forces from acceleration, deceleration, or shifting loads need to be accounted for. These forces are usually minor but should be included for rapid load movements. For fast-moving equipment, live loads may be increased by up to 30 percent to account for these impacts.
2. Horizontal forces: Assess the effect of horizontal forces due to wind, moving water, swinging loads, multi-crane operations, or other equipment.
3. It's crucial to account for all potential loads, including debris buildup. Woody debris accumulating against trestles is a significant concern. Such debris can reduce the capacity of temporary trestles, lead to increased scour, and add extra lateral loading on the pier due to the increased surface area that moving water pushes against.
    a. Figure 4-10 shows an example of debris buildup against a temporary access trestle.
    b. Figure 4-11 is a sketch showing how debris buildup can increase scour (Review Scour Plan of Action for scour critical bridges; contact SM&I Hydraulics Branch for assistance).

Figure 4-10. Debris Buildup Against Trestle

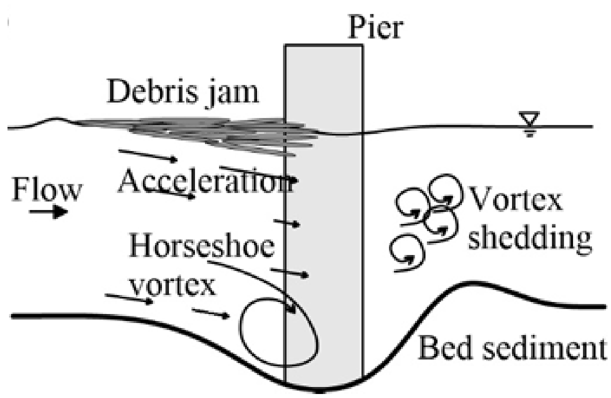

Figure 4-11. Sketch of the Physics of the Scour Process Affected by Debris Buildup

4-6.03 Minimum Lateral Load

The trestle designer will specify this minimum lateral load based on job-specific factors, including equipment types, loads, methods, and other relevant conditions. Typically, the trestle is designed to support a minimum lateral load of 4 to 10 percent of the total vertical load to accommodate dynamic forces from moving live loads.

4-7 Design of Temporary Access Trestles

Due to temporary access trestles having components and materials similar to traditional falsework, guidelines within the Caltrans *Falsework Manual* can be used to determine the trestle's structural adequacy. Like falsework, temporary trestle design typically follows Allowable Stress Design (ASD) principles, ensuring all components stay within the material's elastic range. However, the trestle designer may use any acceptable design method, including Load and Resistance Factor Design (LRFD). The plans should indicate the chosen design method to ensure the reviewer applies the same approach.

Stresses, loadings, deflections, and design values should be based on the most recent editions of the *National Design Specification (NDS) for Wood Construction* and the *American Institute of Steel Construction (AISC) Steel Construction Manual*.

Additionally, temporary access trestles situated over or near railroads must adhere to current railroad safety guidelines.

Figure 4-12. Trestle Used at Golden Gate Bridge, c.1934