

# Chapter 1: Introduction

## 1-1 Definition of Falsework

### 1-1.01 Definition

Falsework: temporary structures used to support the permanent structure until it becomes self-supporting.

### 1-1.02 Commentary

Falsework includes steel or timber beams, girders, posts, foundations, and any proprietary equipment including modular shoring frames, post shores, and horizontal shoring.

The term “falsework” is typically associated with the construction of cast-in-place concrete structures, particularly bridge structures. In this type of construction, falsework provides a stable platform upon which the forms may be built and furnishes support for the bridge superstructure until the members being constructed have attained sufficient strength to support themselves.

The Standard Specifications 48-2.02B(1), *Temporary Structures – Materials – Design Criteria – General*, provides that the support systems for form panels supporting deck slabs and overhangs on girder bridges are considered to be falsework members and designed as such. On state highway projects all load carrying members, regardless of their location within the supporting system, must meet the design criteria included in the falsework specifications.

## 1-2 Purpose and Scope

The *Falsework Manual* has been issued by Caltrans, Division of Engineering Services, Structure Construction (SC) to fill the need for a comprehensive design and construction manual devoted exclusively to bridge falsework. Its intended purpose is to provide administrative and technical guidance to the SC field engineers who are in responsible charge of bridge construction on state highway projects. While emphasis is placed on contract administration, it is important to note that materials, design considerations, stress analysis, review criteria, construction, and inspection are covered as well.

This manual includes guidelines, instructions, and procedures which are to be followed on all projects to ensure uniform and impartial contract administration. Project personnel

who are responsible for review and authorization of shop drawings and/or inspection of falsework construction are expected to become thoroughly familiar with the contents of this manual.

Proper use of the *Falsework Manual* requires familiarity with the falsework specifications and an understanding of the principles of civil engineering design as applied to bridges and related structures.

## 1-3 Statement of Department Practice

The *Falsework Manual* sets forth Caltrans' practice for administration of the specifications governing the design and construction of falsework for bridges and related structures on state highway projects.

This manual is not intended to be a contract document. Should there be any conflict between this manual and any contract provisions, the contract provisions must be followed. This is not to say that this manual has no contractual significance. The Standard Specifications 4-1.02, *Scope of Work – Intent*, provides "the Contract intent is to provide for work completion using the best general practices." Contractually, the *Falsework Manual* represents Caltrans' opinion on what constitutes "best general practices" within the meaning of this term as it is used in the specifications.

Analytical procedure and review criteria used by SC to evaluate the adequacy of falsework designs, in this manual, are based on more than five decades of continuing study by SC engineering staff of the behavior of individual components of the falsework system, and of the behavior of the system as a whole, as the design loads are applied. These studies, which cover a wide range of typical load combinations, led to the development of simplified methods, which may be used to evaluate the adequacy of complex configurations. Where appropriate, SC has adopted a simplified approach to standardize and facilitate the review process.

For elements of the falsework system that are mathematically indeterminate, the simplified methods and procedures provide reasonably close correlation when compared to results obtained by conventional, rigorous analysis; therefore, they are applicable to the type of falsework encountered on typical bridge projects in California. Occasionally, a situation will arise where analysis using a simplified approach may be inappropriate. In these situations, the design review should include a rigorous analysis to verify stability of the falsework system. The reviewer of the falsework design will be expected to recognize these situations and consult with the SC HQ Falsework Engineer for the procedure to be followed. A falsework system composed of custom-built, multi-tiered structural steel frames or towers is a typical example where a rigorous design analysis would be warranted.

If the contractor's design of an indeterminate element of the falsework system is based on a rigorous analysis as shown by design calculations, and requested in writing by the contractor, the system adequacy will be evaluated by a similar rigorous method of frame analysis. The reviewer should contact the Falsework Engineer at the SC HQ for assistance.

## 1-4 Practice and Procedural Changes

Information and instructions in the *Falsework Manual* are as current as the publication date. It is expected that changes in practice guidelines and/or procedural direction will occur. Changes will be implemented by issuing dated revisions to the manual. Revisions will be accompanied by instruction or explanation.

To expedite implementation, changes may be applied on an interim basis by issuing falsework memos, which will supersede guidelines in the manual. Falsework memos are to be filed in Appendix C *Falsework Memos* until manual revisions are issued. To ensure that current practice is apparent, interim changes will be noted in the text by a line in the margin.

## 1-5 Specification Reference

Whenever the term "Standard Specifications", "specifications" or "falsework specifications" appear in this manual, the term is referring to the 2018 edition of the Standard Specifications including the Revised Standard Specifications issued by the California Department of Transportation.

## 1-6 Design Methodology

Falsework design is based upon Allowable Stress Design (ASD) with members remaining within the elastic range of the material.

The Standard Specifications 48-2.02B(3), *Temporary Structures – Design Criteria – Stresses, Loadings, and Deflections*, allows the use of design values from the current National Design Specification (NDS) for Wood Construction for identified grades of wood, and from the current *American Institute of Steel Construction (AISC) Steel Construction Manual* for identified grades of steel except for flexural compressive stresses, deflections, and modulus of elasticity.

Falsework over or adjacent to railroads must also comply with the current railroad guidelines.

## 1-7 System Types

A common falsework system will consist of timber posts, steel caps, timber diagonal bracing, timber or steel stringers, and timber joists. Foundation support is usually provided by timber pads set on the surface of the ground, although poor soil conditions may dictate the use of concrete footings or driven piles to ensure an adequate foundation.



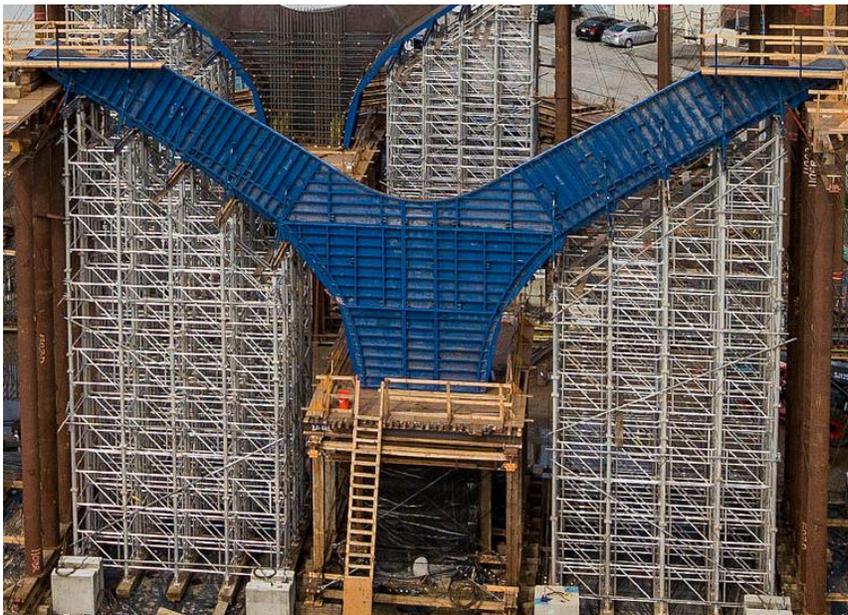
**Figure 1-1. Common Falsework System**

Pipe posts are commonly used for greater loads and taller falsework. Typical pipe diameters range from 12 to 18 inches. The pipe posts are framed with steel caps, and diagonally braced with small diameter steel rods, reinforcing steel bars, or steel cables.



**Figure 1-2. Pipe Post Falsework System**

Proprietary shoring systems consist of metal components that may be assembled into modular units and erected in place. When erected, the shoring consists of a series of internally braced towers which support the stringers. The higher capacity of these heavy duty systems will permit longer falsework spans. In most cases, the larger loads associated with heavy duty shoring will require reinforced concrete footings or pile foundations to ensure adequate support.



**Figure 1-3. Proprietary Shoring System**

Other systems will sometimes be used for complex falsework. These systems can consist of moment resisting frames, steel I-beam posts, steel trusses, and others.

The systems mentioned above can be used as building components for larger and more complex falsework constructions.

## 1-8 Contractual Relationships

In accordance with contract requirements, the contractor is responsible for the design, construction, and maintenance of falsework. See Standard Specifications 5-1.23B, *Control of Work – Submittals – Action Submittals*, 48-2.01A, *Temporary Structure – Falsework – Summary*, and 48-2.01C(2), *Temporary Structure – Falsework – Shop Drawings*.

The contractor determines the type of falsework to be used and the erection and removal methods to be employed, subject to compliance with the design criteria, safety, and the conditions of use found in the specifications.

Under Department of Transportation policy, review and authorization of the contractor's shop drawings is the responsibility of SC. This responsibility is delegated to the structure representative at the project site. The structure representative or a civil engineer registered in the State of California performs the review. The reviewer is responsible for performing an independent engineering analysis and verifying that the design meets all contract requirements before authorizing the shop drawings.

Authorization of the shop drawings constitutes acceptance of the falsework design by the State and construction details shown on the drawings, and an acknowledgment that the design meets contract requirements.

## 1-9 Cal-OSHA Requirements

The *Construction Safety Orders* issued by Cal-OSHA include various provisions which apply to the design and construction of falsework or vertical shoring, including falsework or shoring for structures being constructed on state highway projects.

Applicable *Construction Safety Orders*, and the engineer's responsibility with respect to authorization of shop drawings and falsework inspection, is discussed in Chapter 2 *Review of Shop Drawings* and Chapter 9 *Inspection*, respectively.

The term falsework is used in conjunction with both bridge and building construction. However, the temporary supports used in building work are commonly referred to as shores and the support system as shoring.

## 1-10 State Statutes

The *Streets and Highways Code*, Division 1, Chapter 1, Article 3, Section [137.6](#) requires that the review and approval of contractor's shop plans for temporary structures in connection with the construction of state highways shall be performed by a civil engineer registered in the State of California. Excerpt from the code are as follows:

- "The design of, the drafting of specifications for, and the inspection and approval of state highway structures shall be by civil engineers licensed pursuant to the Professional Engineers Act (Chapter 7 (commencing with Section 6700), Division 3, Business and Professions Code)."
- "The approval of plans for, and the inspection and approval of, temporary structures erected by contractors in connection with the construction of state highway structures shall also be by such licensed civil engineers."

The Professional Engineers Act (Business and Professions Code), Section [6735](#), requires all engineering documents be prepared by, or under the responsible charge of, a civil engineer registered in the State of California and be signed and sealed by the engineer. Excerpt from the code are as follows:

- "All civil (including structural and geotechnical) engineering plans, calculations, specifications, and reports (hereinafter referred to as "*documents*") shall be prepared by, or under the responsible charge of, a licensed civil engineer and shall include his or her name and license number."