Chapter 2: Preconstruction Planning

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2-1 Introduction

Reinforced concrete construction requires extensive planning, preparation, and cooperation to ensure the timely completion of a quality product. It is necessary to thoroughly understand the contract documents and enforce the contract requirements. Review *Contract Specifications,* Section 51, *Concrete Structures;* Section 52, *Reinforcement*; and Section 90, *Concrete.*

This chapter provides general guidelines to prepare for projects involving the construction of reinforced concrete structures. Subsequent chapters of this manual give additional guidance for the construction of specific reinforced concrete members.

2-2 Contract Documents

The *Contract Specifications* and project plans are the primary components of the contract documents. Review of these documents will be discussed later in this chapter.

Before their release, Structure Construction (SC) staff should have been given an opportunity to perform a constructability review of the contract documents. Obtain a copy of the constructability review to become familiar with issues that were raised during project development and how, or if, they were addressed.

Another resource that SC staff should also review is the project's supplemental project information; this may include an *Information Handout* which is available to the Contractor as part of the contract bid documents. It typically includes copies of permits and agreements the Department has made with local agencies. It may also include reports from previous site investigations. The Contractor must take into consideration the material in the *Information Handout* when planning for construction. For example, the *Information Handout* may govern how the Contractor is allowed to stage their work.

Other project-related documents worth reviewing include the Resident Engineer's (RE) Pending File and bidder inquiries. The RE Pending File may contain design assumptions or recommendations that SC staff should be aware of. Bidder inquiries may reveal potential discrepancies in the contract documents that potential bidders encounter during the bidding process.

2-2.01 Plans and Specifications

Whether or not SC staff performed a constructability review of the contract documents, it is good practice to look out for issues that should have been addressed during the development of the project. Specifically, for bridge construction projects, verify that the roadway plans and structure plans agree with each other, including the following:

1. For utilities:
    a. Verify the locations of utility tie-in between both sets of plans are coordinated. For new bridge construction, utilities are typically placed within bridge cells, utility openings, and concrete barriers.
    b. Verify that the specified material type called for is consistent between both sets of plans and meets the material requirements.
2. Verify that the elevation where roadway and approach slab or other structural improvements meet, matches and results in a smooth continuous profile (refer to Chapter 7, *Bridge Deck Construction,* for additional discussion).
3. Verify that the stage construction plans in both plan sets match and are realistic.

Bring any discrepancies found to the Resident Engineer's attention and discuss means to mitigate, if necessary.

Perform a preliminary review of the project plans for items that could complicate the Contractor's work, or require coordination between different bridge elements, which may include:

1. Complex forming details.
2. Special requirements or restrictions for construction joints.
3. Bar reinforcing steel (rebar) congestion.
4. Difficult geometry, e.g., high skews, small radius curves, high cross slope or superelevation, varying section dimensions, etc.
5. Added embeds, blockouts (see Figure 2-1), drainage facilities, and utility facilities.
6. Areas with limited access for placing rebar or pouring concrete.

The Contractor may need to plan ahead of time to ensure these items are addressed. Procuring accessories for utility facilities, in particular, may require additional planning if they need to be obtained by the utility owner.

Figure 2-1. Blockout for Soffit Access Opening

For projects with structural concrete members, the minimum specified yield strength of rebar and the required 28-day compressive strength for structural concrete are usually shown in the project plans. These can be found in the “General Notes” section of the project plans (Figure 2-2).

REINFORCED CONCRETE:	fy = 60 ksi f'c = 3.6 ksi (unless noted otherwise)

Figure 2-2. Specified Rebar and Concrete Strength

However, projects with multiple structural concrete members, or types, may have varying 28-day compressive strength requirements. These different strength requirements are usually reflected graphically in the project plans. Figure 2-3 is an excerpt from a project plan sheet showing the different concrete strength requirements and concrete types for the structure. Verify that the Contractor submits concrete mix designs for the various types and requirements shown. A single concrete mix design may be used for multiple concrete types, provided it meets the requirements for all. Refer to Section 2-6 for additional discussion regarding concrete mix designs.

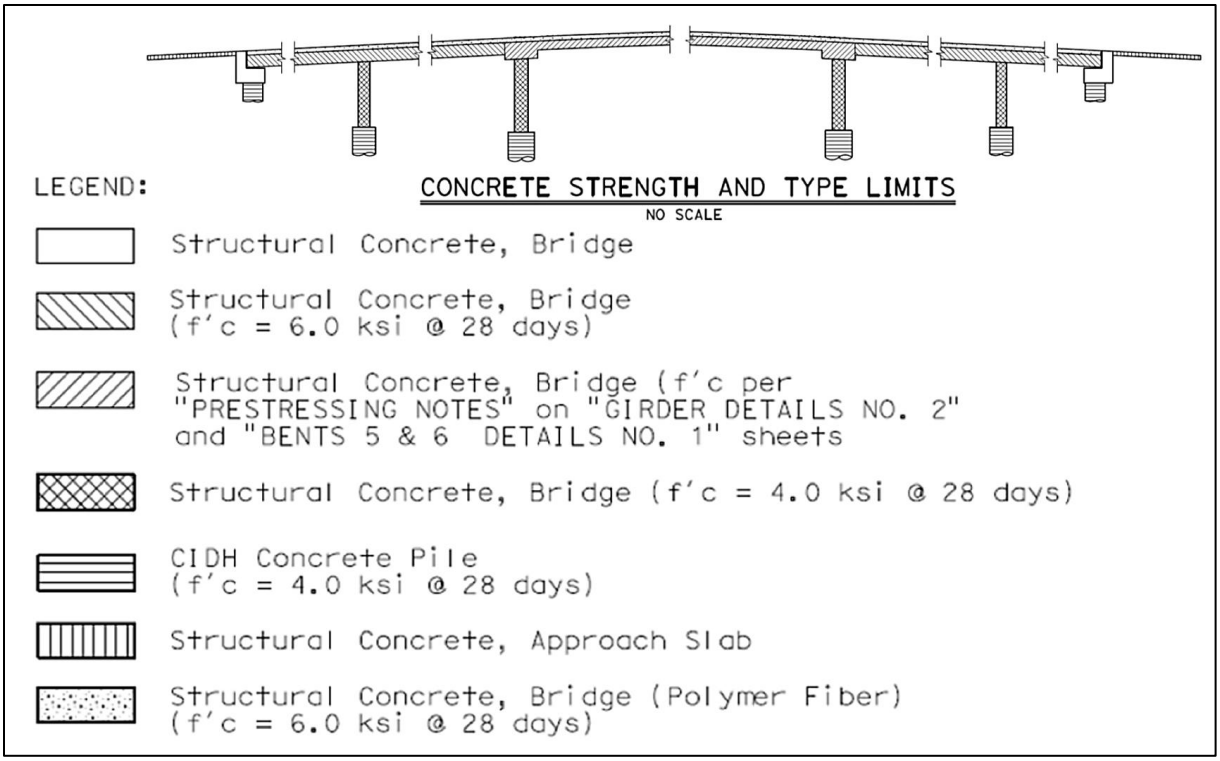

Figure 2-3. Concrete Strength and Type

Check for project-specific requirements for concrete and rebar. Below are examples of such requirements:

1. Projects in locations identified as corrosive environments or freeze-thaw areas will have concrete material-related requirements and coating requirements for rebar.
2. Projects with large-volume concrete structure(s), located in high-temperature environments, or containing other conditions that may lead to high heat of hydration for concrete may have portions of their structures identified as mass concrete. This case would trigger the requirements of *Contract Specifications*, Section 51-6, *Concrete Structures – Mass Concrete*.
3. Colored concrete may be specified for structures with architectural features, which would require a work plan complying with *Contract Specifications*, Section 51-1.01C(6), *Concrete Structures – General – Submittals – Colored Concrete*.

Make a note of unfamiliar specifications or details and discuss them with the Structure Specification Engineer or Bridge Design (BD) Project Engineer as soon as possible. This review may form the basis of early discussions with the Contractor to ensure that they understand potential challenges in the contract and have developed plans to address them.

In addition, review the contract documents to determine the quantity, type, and location of reinforced concrete in the contract. Concrete and bar reinforcing steel are usually paid as separate items. Estimate the quantities of concrete and bar reinforcing steel in the bridge elements. Compare quantity calculations with the designer's calculations, which are typically found in the RE Pending File. Resolve these quantities with the pay quantities in the contract documents. This information will be helpful in evaluating the Contractor's falsework design, forming system, placement plans, and construction schedule. Having the quantities on hand will also help with making accurate and timely progress payments.

The calculation of concrete placed in a pay period is relatively easy compared to determining the weight of various bars of differing sizes and configurations placed in the same period. To facilitate monthly partial pay estimates, establish the average pounds of rebar per cubic yard of a concrete item, commonly referred to as the "rebar factor", and pay for rebar commensurate with the estimated concrete quantity. Bar lists, which the Contractor must submit for each rebar shipment, can also be used to calculate payment for reinforcement.

In preconstruction meetings and discussions, verify that the Contractor is aware of the effect of bridge geometry on forming and rebar detailing particularly for bridges with a cross slope (superelevation). Measurements shown on the project plans usually show dimensions along the vertical and horizontal planes. Projects with large or transitioning cross slopes contain language within *Contract Specifications*, Section 51-1.03A, *Concrete Structures – General – Construction,* stating that fact. Consider the effects of deck cross slope with respect to the dimensioning of the typical section. As illustrated in Figure 2-4, for sloping exterior girders, the actual distance along exterior girders is different between the left and right sides. This requires different size forms and different lengths and shapes of reinforcing stirrups. Even the straight transverse bar reinforcement across the deck is longer, and the truss bars must accommodate a slightly longer interval between girders as opposed to the horizontal distance shown in the plans.

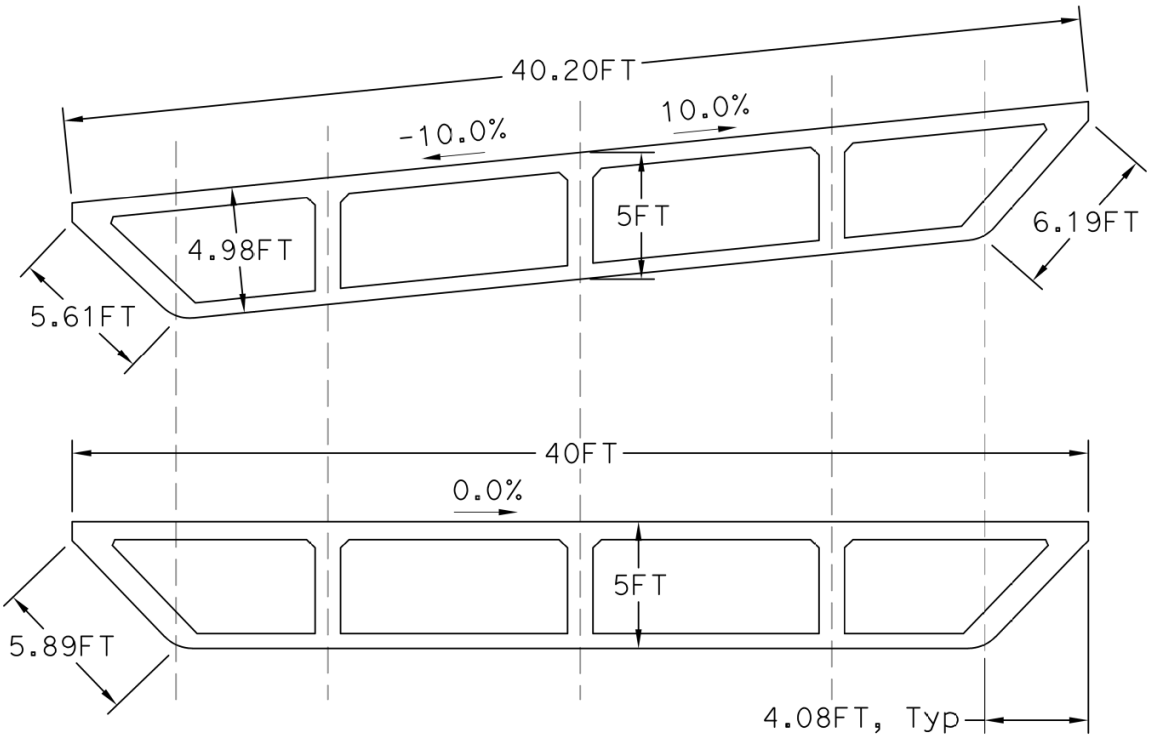

Figure 2-4. Effect of Cross Slope on Bridge Geometry

Other features that may cause errors in detailing and fabrication of rebar include varying girder spacing, varying section thicknesses, skewed features such as bents and abutments, tight horizontal curves, and varying section depths and girder heights. Refer to Chapter 4, *Reinforcement*, for further discussion regarding the effects of bridge geometry on rebar detailing.

2-2.02 Standard Plans

Make a list of all standard plan sheets referenced in the project plans. The *Standard Plans* are contractual supplements to the project plans. Project plans often list applicable Standard Plan details on an “Index to Plans” sheet. Verify that all details are incorporated during construction. For example, the “wall offset value” for Type I retaining walls, reinforcement of utility openings in concrete, and detailing on prestressing, are found in the *Standard Plans*.

2-3 Other Reference Documents

Additional construction guidance for SC staff can be found in the *Bridge Construction Records and Procedures Manual*. SC staff should review applicable memos and integrate their guidance with the contract documents. The Caltrans *Construction Manual*

provides construction administration procedures and defines quality control test requirements and acceptance testing procedures. Be familiar with applicable California Tests for checking the Contractor's quality of work.

2-4 Cooperation and Coordination

Effective bridge construction is the result of continuous communication and cooperation between the Contractor and the Department. SC staff should establish a good working relationship with the Contractor before the start of construction and develop a regular schedule for jobsite meetings.

With the Resident Engineer, schedule the preconstruction conference as outlined in *Contract Specifications,* Section 8-1.03, *Prosecution and Progress – Preconstruction Conference.* Additionally, although not always contractual, it is advisable to schedule specific pre-operation or pre-job meetings before the start of certain field activities.

Remind the Contractor that they are required to provide Form CEM-3101, *Notice of Materials to be Used,* to the Department. This document forms the basis of an orderly acceptance of material incorporated into the work. Material may require offsite inspection and release before arriving at the jobsite. Offsite inspection requires coordination with Caltrans Materials Engineering and Testing Services (METS). The Structure Representative should involve the local METS Representative in discussions with the Contractor as soon as possible, and in no case later than the preconstruction conference. Refer to *Construction Manual*, Section 6-202, *Sampling and Testing – Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products,* for a list of materials requiring offsite fabrication and inspection, including items such as epoxy-coated reinforcing and mechanical couplers.

Establish what level of inspection[1] is necessary for various concrete construction activities and critical points during the activities when inspections must be performed. Coordinate with the Contractor if any critical points require them to pause, or hold, their activities so that they can schedule work accordingly. For any type of inspection, utilizing a checklist of items to inspect is a good practice. Such a checklist can be developed based on the contract requirements, as well as other technical resources.

Determine activities that will require traffic control, work windows, or any other accommodation for public safety. Discuss Storm Water Pollution Prevention Plan (SWPPP) measures necessary for concrete pours and the location of washout facilities.

[1] Caltrans internal use only

2-5 Critical Path Method Schedule

Contract Specifications, Section 8-1.02, *Prosecution and Progress – Schedule,* requires the Contractor to submit a Critical Path Method (CPM) schedule outlining the activities necessary to complete the work. Review the CPM schedule to determine the Contractor's schedule for activities that will require preparatory work, and for review and authorization of submittals. Verify that the review times allowed per the contract for various submittals are accounted for in the CPM schedule. *Contract Specifications*, Section 5-1.23*, Control of Work – Submittals,* states the time allotted to the Department for review of submittals unless stated elsewhere within the *Contract Specifications*. Verify that there is adequate time provided for approval of mix designs, required test panels or mock-ups, and to obtain satisfactory results from test samples.

2-6 Falsework Design

Bridge construction using reinforced concrete often requires falsework. Good quality falsework is designed and built to properly handle all construction loads anticipated at every stage of construction. Furthermore, one of the greatest safety concerns on any construction project is the use of temporary structures. For these reasons, some of the most important duties of construction personnel are the review and authorization of the falsework design and ensuring its proper construction, use, monitoring, and removal. Refer to the SC *Falsework Manual* and *Contract Specifications,* Section 48-2, *Temporary Structures – Falsework,* for a thorough understanding of falsework.

2-7 Concrete Mix Designs

The requirements for concrete mix designs are in *Contract Specifications*, Section 90, *Concrete*. The Contractor must submit concrete mix designs for review. The mix design may not be used on the project until authorized by the Structure Representative. As discussed earlier in this chapter, project-specific concrete requirements may be included in the contract documents. These must be addressed, if applicable to the mix design being reviewed. The SC *Concrete Technology Manual*, Chapter 3, *Review of Concrete Mix Designs*, covers concrete mix design review in detail. The SC *Concrete Technology Manual* also contains information on concrete components, including supplementary cementitious materials, admixtures, proper batching, and delivery of concrete to the jobsite.

2-8 Prestress Shop Drawings

Construction of reinforced concrete bridges makes extensive use of prestressing. Prestressing is a method of taking advantage of the high compressive strength of reinforced concrete by applying an eccentric compressive force to components of the

bridge, thereby reducing the tensile load when in service. The project plans will indicate the magnitude and location of the prestressing force, but the specific sequence and location of how the force is applied is left to the Contractor. The details of the prestressing system are included in the shop drawings provided by the Contractor, for the Department's review. The BD Project Engineer typically performs an in-depth review, with the Structure Representative reviewing concurrently. Components of the prestressing system, such as prestressing steel, ductwork, and anchorages, will be permanently incorporated into the reinforced concrete. Standard plan details may require additional reinforcing. Review *Contract Specifications,* Section 50, *Prestressing Concrete*, and the SC *Prestress Manual* to become familiar with prestressing as it relates to reinforced concrete bridge construction.

2-9 Line and Grade Control

District surveyors provide staking to establish line and grade for construction projects. These are often referred to as "control stakes" because they provide the location and elevation upon which the location and elevation of all bridge components and elements, and other structures are based. For the Department's policy regarding furnishing control stakes, refer to Caltrans' *Surveys Manual*, Chapter 12, *Construction Surveys*.

The first surveying responsibility of SC staff is to verify the accuracy of the control stakes. It is not necessary to recreate the entire survey, but rather spot-check stakes at each location to verify that they are correct. One method for SC staff to check the locations of control stakes is to compare the theoretical coordinates of the control stakes with the coordinates of what has been staked. Use a total station, set up with the project control points, to obtain the coordinates of the staked locations. Compare both theoretical and actual coordinates, verifying that they are within acceptable tolerances. Another method involves comparing the theoretical horizontal distance between control stakes versus their measured distance as staked in the field. This can be achieved using a total station, electronic measuring device, or even a tape measure to measure the horizontal distance accurately.

Use the bridge deck contour plots (also known as 4-scales) to compute grades and elevations for bridge components and elements. Before construction, obtain the bridge deck contour plots, verify that they are correct, and then develop grades to be used for control. The instructions for obtaining and checking the bridge deck contour plots are provided in BCM C-4, *Bridge Deck Contours and Geometrics.* The bridge deck contours may also be available as an electronic file for use in CAD software from the BD Project Engineer.

2-10 Concrete Quality Control

Adhering to a sound quality control (QC) program for concrete production ensures that concrete material incorporated into the project by the Contractor meets the contract requirements. It is also crucial for ensuring that a functional and durable concrete structure is built. Unless specified otherwise, *Contract Specifications*, Section 90-1.01D(10)(b)(i), *Concrete – General – Quality Assurance – Quality Control – Cast-In-Place Structural Concrete Members – General,* requires the Contractor to develop and follow a QC program for all concrete used in CIP structural concrete members. It also details the requirements of the QC program. The Contractor summarizes their QC program in a QC plan and then submits the plan to the Department for review and authorization. Amendments and addendums to an authorized QC plan necessitate a new round of review for authorization.

The QC plan must identify key personnel and facilities involved in the QC program, including the QC manager, QC inspectors and testers, and the testing facility. Qualifications and certifications for each must be included. The QC manager and QC inspectors are responsible for rejecting the batched concrete if it does not comply with the specified requirements. The Contractor's means of sampling, testing, and inspecting concrete during production must also be described in the plan. The required types and frequencies of testing are stated in the *Contract Specifications*, Section 90-1.01D(10)(b)(iv), *Concrete – General – Quality Assurance – Quality Control – Cast-In-Place Structural Concrete Members- Quality Control Testing Frequencies*.

The Contractor must regularly submit documentation of their QC inspection and testing. *Contract Specifications,* Section 90-1.01C(8)(b), *Concrete – General – Submittals – Testing – Cast-In-Place Structural Concrete Members,* requires the Contractor to submit concrete test results to the METS *Data Interchange for Materials Engineering (DIME)* webpage. Instructions for submitting sample and test information are explained on the webpage. Additionally, the Contractor is to provide QC summary reports complying with *Contract Specifications*, Section 90-1.01C(12), *Concrete – General – Submittals – Concrete Materials Quality Control Summary Report for Cast-In-Place Structural Concrete Members*.

Under *Contract Specifications*, Section 90-1.01D(9), *Concrete – General – Quality Assurance – Preconstruction Meeting for Cast-In-Place Structural Concrete Members*, schedule a meeting with the Contractor and representative of each concrete plant after the QC plan is authorized and before construction of CIP structural concrete members begins. In this meeting, discuss the Contractor's quality control for concrete production. Address key items from the QC plan, such as concrete sampling and testing and the roles of the QC personnel. Remind the Contractor of their responsibility to reject non-compliant material and to submit test reports and results.