SECTION 3: CONSTRUCTION AND MAINTENANCE

3.1 CONSTRUCTION PHASE

3.1.1 Introduction - The Bridge Section is responsible for providing engineering services to the Regions and Project Managers during the life of the project contract. These services may include some or all of the following:

- Checking shop drawings.
- Review of temporary construction drawings.
- Interpretation of plans and specifications.
- Resolving conflicts in the plans.
- Providing recommendations on construction problems.
- Field trips to resolve construction problems.
- Field trips to review construction.
- Review of price agreements.
- Review of Contractor proposals for resolving construction problems.
- Review of Contractor value engineering proposals.

Project Managers are usually under a great deal of pressure to complete the project on time and within the contracted price and according to specifications. Requests for assistance should be given high priority and a timely response.

3.1.2 Construction Phase Communications

3.1.2.1 General - Final authority on project construction issues rests with the Project Manager. The Bridge Section acts as consultant to the Project Manager (PM) and provides technical advice and recommendations when asked. **However, the designer still has final responsibility for the structural adequacy and any proposed changes to the plans should be reviewed and approved by the designer.**

Conversations between the Contractor's personnel and the Bridge Section are permissible to answer questions regarding interpretation of the plans or to explain or elaborate on remarks made on construction reviews that have been returned to the contractor through the PM's office. No agreements should be made between the contractor and Bridge Section, and the PM's office must be kept fully informed of any interpretations we have provided to the contractor. Our conversations must not jeopardize the overall project strategy being used by the Project Manager.

The contents of any conversations with the contractor's personnel regarding issues of significance to the project should be documented on a Project Discussion Memo and forwarded to the Project Manager.

3.1.2.2 Project Discussion Memos - The Project Discussion Memo form was originally created to permanently document conversations or interactions between our personnel and the field during the construction phase of the project.

For conversations with the Project Manager, Contractor or Supplier that could result in a change to the plans or specifications, delay the completion of the project, or involves structure details that have been misinterpreted in the field, complete a Bridge Project Discussion Memo. Sign your name at the end of the memo and date it. Give it to the Design Team Supervisor for their review, Signature and date. Send a copy to the Project Manager if appropriate.

Further, Designers and Supervisors have found the format useful for recording field trip notes or personal exchanges with other ODOT employees, public agency personnel, or private individuals during all phases of a project.

Keep a copy of the Memo in the job record folder for reference. Send the original to the Correspondence File. If it relates to an important design decision, include it in the project calculation book.

Project Discussion Memo forms, for handwritten memos, are located in each Design Team supply of forms. A template file form, “DISCMEMO”, is available on each personal computer.

3.1.2.3 Design and Plan Revisions after Letting - If design changes are necessary during the progress of the contract, agreement on the change must be reached with the Project Manager. Significant changes on Federal-Aid projects may require discussion and agreement with the FHWA before implementation. The Design Team Supervisor will determine if the discussion is needed.

A memo to the Region and revised drawings are required. Check with the Front Office before ordering the full-size and reduced sets of prints needed to accompany the transmittal to the Region Engineer. This will allow ordering and distribution of prints necessary to update the stock of plans held by the Contractor Plans Unit. An example memo is shown in Figure A3.1.2.3A.

Notify the Roadway Section if changes result in additional drawings in the contract plans. A memo to the Roadway Design Supervisor and a marked portion of the title sheet are required, as shown in an example memo Figure A3.1.2.3B and Figure A3.1.2.3C.

Do not show changes to the contract on any shop drawings until the procedure above has been completed.

3.1.2.4 Construction Project Status Report - A Construction Project Status Report is distributed periodically by Operation Support Services. The Design Team Supervisor should keep a copy of the latest report for room use. The report includes the following information:

- County
- Contract Number
- Project Name
- Construction Type
- Contractor
- Project Manager
- Funding Source
- Total Authorized Funds
- Estimated Project Cost
- Percent Completed to Date
- Scheduled Completion Date

3.1.2.5 Coast Guard Permit Reports - The Coast Guard requests three types of reports during construction that are of concern to the Project Manager. These should be initiated by the Project Manager and a copy sent to the Bridge Section. The reports are:

- Notification of start of construction - This is necessary so that the Coast Guard may alert navigation interests through their weekly news letter called *Notice to Mariners*. The Project Manager should notify the Bridge Section at least two weeks prior to beginning work.

- Monthly Progress Reports - These reports consist of the permit drawing colored to show the work done to date in blue and the work anticipated for the next six weeks colored in red. A legend at the bottom should indicate which color is completed work and which is anticipated work. Two colored copies of the report should be sent to the Bridge Section before the first of each month.

- Notice of Completion - The Project Manager should notify the Bridge Section that the structure has been completed in accordance with the Coast Guard permit and that all obstructions have been removed from the river, or channel, etc..

3.1.3 Construction Phase Field Trips

3.1.3.1 Informational - Informational field trips may be made during the contract period to inspect the progress or view a particular phase of construction. Because this type of field trip is normally not requested by the Project Manager, the cost of the trip should not be charged to their construction support prefix. For more complex structures where a site visit by the design engineer at a particular phase of the work may be helpful to the project, then charging to the contract may be appropriate.

3.1.3.2 Construction Problems - It may be necessary at some time during a project to make a field trip to inspect and discuss a construction problem. The Project Manager will request or agree to this type of field trip and it should be charged to the contract expenditure account number with appropriate construction support activity code.

It may be necessary to return to the office to discuss the problem with the managers, section specialists, or the Structure Quality Coordinator before a recommendation can be given to the Project Manager. Complete a Project Discussion Memo if it is appropriate.

3.1.3.3 Final Walk-through - Near the end of a construction project, it may be beneficial to schedule a project walk-through to review and discuss any problems that occurred relating to details, construction staging, and potential maintenance problems. Discuss whether the deck joints and deck drains were installed correctly, tested, and function properly. Also discuss if the approaches and deck surface meet specifications. Any discussions should include potential solutions to the problems. This should not be an exchange of complaints. The purpose is to try to avoid the same construction problems on future projects.

Contact the Project Manager and request a meeting and walk-through that may include: Project Manager, Project Inspectors, Designers, District Manager, etc.

After the walk-through, write a summary memo to the file addressing the problems and possible solutions. If the problem is a recurring one and a good solution has been agreed upon, develop an office practice proposal to implement it. Circulate the memo around the Bridge Section to alert other designers of potential problems.

3.1.4 Structure Cost Data Preparation - Complete the Structure Cost Data procedures as soon as possible after the award of contract, but no later than three months after the bid date. Information and guidelines regarding structure cost data preparation are available in each design room in the "Structure Cost Data Instruction Manual".

Include the Structure Cost Data Sheets in the final disposition of the Job Record Folder, (see Section 3.1.6). Also make a copy of all the sheets and include them in the calculation book.

3.1.5 Design Cost Data Preparation - The Design Cost Data information is now being transferred automatically into a database and no longer needs to be processed by designers.

3.1.6 Disposition of the Job Record Folder

3.1.6.1 Disposition of the Job Record Folder, General - To prepare the Job Record Folder for disposition, extraneous materials should be removed and required information added.

The following material should be removed:

- Copy of Job Record Sheet
- Extra prints of plans or Vicinity Maps without notes.
- Copies of any material (including correspondence and foundation report) of which the original will be in the Project Contract File.
- Other non-essential data.
- Any original memos or project discussion memos should be sent to the correspondence file.

The following material should be included:

- Letter size copy of the Plan and Elevation drawing
- Plans or Vicinity Maps with notes critical to design (see Section 2.2.2.2)
- Original of Checked Final Estimate Sheet (see Section 2.4.3.7)
- Structure Cost Data Sheets (see Section 3.1.4)
- Overhead Sign Inventory Sheet (see Section 3.1.6.2)
- Seismic Design/Retrofit Data Sheet (see Section 3.1.6.5)

3.1.6.1 Disposition of the Job Record Folder, General – (continued)

When completed, submit the Job Record Folder to the Design Team Supervisor for review. It will then be given to the Design Team Cost Data Coordinator for review of the structure cost data. The Job Record Folder will then be sent to the Bridge Section Cost Data Coordinator for distribution of the various sheets and for verifying the completeness of the cost data. When the coordinator is satisfied that the cost data are complete, the designer will be given notice to export the electronic versions of the completed cost data forms to the network database. Do not export the files until you have received approval from the section coordinator. The folder is submitted to the Front Office to be retitled "Work Folder Prior To Contract" and filed with the contract records.

3.1.6.2 Overhead Sign Inventory - For sign bridges, cantilever sign supports, and structure mounts, complete an Overhead Sign Inventory sheet. A template file form “Sign Support“ is available on each personal computer.

Completed forms should be included in the final Job Record Folder. Forms will be filed by county and the information on the forms will be added to a database.

In addition, when checking or designing truss sign support structure using a 3-dimensional STRUDL model, give a copy of the input data set to the Sign/Signal/& Luminaire Pole Specialist. These data sets will be available to designers for use on future projects.

3.1.6.3 Bridge Rail Data Sheet –This sheet is no longer needed. The data can be obtained from the cost database.

3.1.6.4 Impact Attenuator Data Sheet - This information is no longer tracked.

3.1.6.5 Seismic Design/Retrofit Data Sheet - For new structure designs or retrofits of existing structures, complete a Seismic Design/Retrofit Data Sheet. A template file form “RETRODAT” is available in each personal computer. Completed forms should be forwarded to Dick Groff. Include this data sheet in the final Job Record Folder disposition.

The form information will be added to a database to track the progress of the State's seismic retrofit program.

3.1.7 Handling Construction Problems

3.1.7.1 Responding to Problems - Requests for advice on construction problems typically come from the Project Managers and recommendations should be submitted to them.

(1) Responding to Problems - General inquiries by the contractor or their representatives should be directed to the Project Manager. However, requests for information or clarification by suppliers or fabricators may be answered directly, if we have received written permission from the contractor to deal directly with the supplier and the Project Manager agrees. If the request involves a matter that might be a point of disagreement with the supplier and inspector or Project Manager, the Project Manager should be consulted before responding.

Before making recommendations on problems or answering questions, consider the following:

- Review the plans for potential conflicts and consequences from problems or proposals.
- Review contract specifications for potential conflicts, restrictions to and/or conformance of proposals.
- Discuss the problem or proposal with the checker, section specialist, materials lab and/or Design Team Supervisor as needed. In rare cases, the supervisor may recommend consultation with the Bridge Engineer.
- Discuss the problem with the Structure Quality Coordinator; it may have happened before and a good solution may have already been developed.
- Some problems and proposals may require concurrence from the FHWA on Federal-Aid projects when changes to the contract are under consideration.

(2) Low Strength Cast-in-Place Members -

- For strengths between 85 and 100 percent of specified - Concrete will normally be accepted by the Operations Section at a reduced price.
- For strengths below 85 percent of specified - The structural adequacy will be determined by the Bridge Section. The Designer and Supervisor will review each case and send a written recommendation to the Project Manager to remove or leave the concrete in place.

(3) Low Strength Precast Members - Low strength procedures are specified in the Standard Specifications Section 00550.16(e). Strengths below 85 percent are rejected. Strengths between 85 and 100 percent are reviewed by the Project Manager, with recommendations from Bridge, for acceptance at a reduced price or rejection.

3.1.7.2 Price Agreement Reviews - Occasionally price agreements (PA) on contracted projects involving bridge items require review. It is our responsibility to independently evaluate costs added or subtracted from the structure bid cost. Our review should be based on our understanding of bridge costs, bid items and the quantities added or subtracted from the structure.

Use sound engineering judgement and adequate back-up calculations or cost data in the cost evaluation. Use the actual cost of the Price Agreement as a guide for the maximum time spent on the review. The time spent reviewing a Price Agreement should not exceed the value of the savings in a PA that you can reasonably expect. Return completed Price Agreement reviews to your Design Team Supervisor.

3.1.7.2 Price Agreement Reviews – (continued)

When reviewing a Price Agreement, consider the following:

- Is the work covered by the PA an addition or revision to the contract? Or is the work actually part of the work the contract already requires and is being done in a different way?

- Prepare a price justification as follows:

  - Unit Price basis - Use unit prices from other contracts for similar type work of equivalent scope.

  - Force Account basis - Use labor required (hours and hourly rate), equipment required (hours and hourly rates), and materials required. Add to this the contractor's overhead and profit allowance.

  - Estimation Guides - Use cost estimating guides for similar work.

- If a credit is being given for work deleted, are the prices comparable; i.e., is $600/yd^3 concrete being deleted and $1000/yd^3 concrete added? On work deleted, include credit for the contractor's overhead and profit.

- Make calculations neat and orderly. Document sources of cost figures. Use drawings and sketches if they will clarify assumptions. Attach calculations or copies to the PA.

- If there is insufficient information, request additional data as needed.

3.1.8 Working Drawings

3.1.8.1 Working Drawings, General

(1) Definition - Working Drawings are supplementary plans that the contractor is required to submit to the Engineer, according to section 00150.35 of the standard specifications. These plans contain all details necessary to complete the work. Working Drawings come in two forms: shop drawings and temporary construction drawings.

(2) Assignment to Reviewer or Checker - The Bridge Section, when requested, will assist the Project Managers in reviewing working drawings for all projects with structures. Structural design knowledge is essential in the review of all temporary construction drawings and most shop drawings. Shop drawings for reinforcement in retaining walls, box culverts, bridge rails, culvert headwalls, aprons and collars may be reviewed and checked in the Project Manager's office if they have the expertise. Copies of checked drawings should be sent to the Bridge Section for our review and files. Bridge Section will work with each Project Manager on each project based upon the needs of the Project Manager and the expertise of the PM's staff.

For working drawings submitted to Bridge for review, the designer normally performs the review. The designer is most familiar with the structure details and can perform the check most efficiently. If the designer is unavailable, the Design Team Supervisor will assign it to the checker or another designer who is available.

Welding details and procedures for all working drawings will be reviewed by the welding specialist on the Preservation Design Team. Normally, one set of the submittal, contract plans and special provisions are required for the review.

Materials certifications and/or test results should be forwarded to the Materials Lab for review.

(3) Priority for Checking - The working drawing check should begin immediately upon their receipt. When multiple submittals are received over a period of days, confer with the PM to establish the sequence of work governed by the submittals. The chronology of the submittals is often out of sequence with the scheduled work, so the submittal received first may not be the first to be reviewed and returned. If additional information is required for checking, follow up as soon as possible to ensure the checking can be completed in a timely manner.

The standard specifications, section 00150.35(4) allow 21 calendar days, which translates into 15 working days (including holidays) for processing and return of the working drawings. This is the maximum allowed per submittal without a time extension for the project. The maximum turnaround time for the Bridge Section is 14 calendar days or 10 working days (including holidays) from the time of receipt. If checking cannot be completed in that time, notify the Project Manager, by e-mail, letter, speed memo or documented phone discussion, that the review will be delayed. Also notify the Shop Drawing Coordinator of the delay.

One exception to the 21 calendar days for processing is for drawings involving railroad structures. Specifications allow 65 days for processing. Some Railroads may require as many as 90 days for processing plans.

3.1.8.1 Working Drawings, General - (continued)

(4) Stamping and Signing Drawings - The working drawing stamp, similar to shown below, is required on all submittals. A File Copy stamp should also be placed on one copy of the drawings to be sent to the Bridge Contract files. Stamps are located in each design room.

? APPROVED WITHOUT CHANGE
? APPROVED AS NOTED
? RETURNED FOR CORRECTION
? PLANS REVIEWED

APR 09 2003

OREGON TRANSPORTATION COMMISSION
Std. Specifications for Highway Construction
Subject to Sections 00150.00 & 00150.35

By:

Stamping and signing each sheet of a submittal may not be necessary. A single stamp on the front sheet of each set may be used, if the other sheets in the set can be adequately referenced in the comments on the front sheet and the sheets are attached, bound, or part of a related unit of work. If the comments are too numerous, or when sheets are complete units by themselves, then each sheet should be stamped and signed.

The main purpose of the signature is a reference for the Project Manager, inspector, contractor, or fabricator to know who to contact regarding questions about the working drawings. Therefore, a legible first and last name is recommended.

(5) Review Calculations - If review calculations are generated, it may be appropriate to save pertinent sheets for future reference. Place these sheets in a calculation book for the subject structure and reference them in the Table of Contents. Reference the Calculation Book number in the review letter or transmittal form to make future retrieval and review possible.

3.1.8.2 Processing Working Drawings

(1) Who submits working drawings - Normally all working drawings are sent by the contractor to the Project Manager and forwarded to the Bridge Section. Drawings may be submitted directly from a supplier or sub-contractor, if we have an authorization letter from the prime contractor and the Project Manager granting the authority. Note that the Project Manager must concur with the decision to make submittals directly to Bridge Section.

3.1.8.2 Processing Working Drawings – (continued)

(2) Submittal of working drawings - Normally submittals will be sent through the front office, stamped in with a "Received Stamp", and processed by the front office. The submittal will be "logged in" and given a reference number and a routing slip with information similar to shown below.

Shop Drawing Submittal
ROUTE SLIP

Submittal ID:

Date Received:

Submitted By:

Contract No: Structure No:

Item Code:

Item Description:

Supplier:

Assigned To: Date Due:

Date Done:

Review Status

Approved	As Noted	Reviewed	Rejected	Void
?	?	?	?	?

Remarks:

If a working drawing submittal is received without a "Received Stamp" or a reference number and routing slip (e.g., hand delivery or "buck slip"), return it to the front office for processing. The logging in and out of shop drawings provides a record of when submittals came in and when they were sent out. It also provides a mechanism for tracking submittals in the unlikely event they are misplaced. These functions can be valuable, for example, in evaluating claims for contract extensions or liquidated damages.

(3) Distribution for checking - The front office will route the submittals to the appropriate Design Team Supervisor. Upon receiving the submittal, the Supervisor should:

- Review the routing slip. Fill in the Checker's initials or person routed to, if sent outside the office. Make any other corrections to the data.
- Keep the routing slip with the submittal and give the submittal to the checker.

3.1.8.2 Processing Working Drawings - (continued)

(4) After checking - **RETURN ALL CHECKED OR REVIEWED SUBMITTALS TO THE SHOP DRAWING IN-BOX! (located in the front office). This procedure ensures that the submittal is logged out and a copy is filed in the contract file.**

The return package should include the routing slip, file copy, signed review letter or transmittal form, and the marked up copies as appropriate.

For checked shop drawing submittals, complete and attach the Bridge Section's standard transmittal form, filled-out and printed using the template “SHOPDRW” available in each personal computer. If directives are given in the remarks, the checker should also sign the transmittal.

For reviewed temporary construction drawings and calculations, attach the final interoffice memo to the submittal. See Appendix Section A3.1.8.6(2) for example letters.

(5) Distribution after checking - Normally, all working drawings, except the File Copy, will be sent to the Project Manager for further distribution. In some cases the Project Manager may direct us to distribute them in some other manner.

Some exceptions to the PM’s distribution are as follows:

- The Materials Inspector's shop drawing copy for items fabricated out of state should be sent to the Materials Unit. Attach a request stating: "Please forward to the appropriate Materials Inspector".

- The Materials Inspector's shop drawing copy for structural steel, precast prestressed members (slabs, box beams, girders and concrete piling), and steel reinforced elastomeric bearings should be sent directly to the appropriate Materials Inspector. A list of inspectors in shown in the Appendix Section A3.1.8.2(5).

3.1.8.3 Shop Drawings - Shop drawings are the supplier's drawings for materials, prefabricated parts, and their final configuration, that are incorporated into the structure. Examples include:

- Structural Steel
- Welded Members
- Steel Reinforcement
- Post-tensioning
- Prestressed Members
- Bearings
- Expansion Joints
- Proprietary Walls

Shop Drawings are checked to ensure that all materials, and prefabricated parts to be incorporated into the structure conform to the specifications and their final configuration conforms to the plans.

3.1.8.4 Checking Shop Drawings

(1) Checking Shop Drawings, General - The level of effort expended checking should be based on good engineering judgement and the type of drawing being checked. Retaining wall or box culvert rebar does not need the preciseness or scrutiny that structural steel drawings warrant.

(2) Marking and Stamping - Mark shop drawings, usually with a red pencil, to show any required changes, and stamp to indicate their status after checking. On drawings requiring no corrections or only minor corrections, the stamp should be marked as "APPROVED WITHOUT CHANGE" or "APPROVED AS NOTED", respectively. On drawings requiring important corrections, the stamp maybe marked as "RETURN FOR CORRECTION". One copy of such drawings should be returned to the Project Manager and one copy to our files. Remaining copies may be discarded. If important corrections can be marked without undue effort, and the Contractor has established themselves as responsive to our comments, “APPROVED AS NOTED” can expedite the process, and eliminate the need for another review. When omissions or mistakes are of an extent that warrants return for correction, sometimes it is preferable to request an updated submittal by telephone. The complete details on the inadequate submittal can be checked while awaiting the update. When the update is received, the omission can be checked, and the updated submittal may be stamped and returned. The original submittal is voided.

Occasionally prints of shop drawings are required after they have been checked. If the original is marked with yellow pencil or text liner the reproduction will have black lines in those areas. It may be prudent to use a light blue color which will drop-out when reproduced using the blueprinting process. Photocopying will reproduce all marks, and text liner can black out highlighted text when photocopied.

(3) Items of special interest -

- Reinforcing Steel - Rebar shop drawings comprise the majority of construction reviews for most designers. The construction process can be facilitated by a designer’s attention to the review process. This effort actually begins during design when rebar details are developed. Details should be clear and unambiguous, with all essential structure dimensions shown. Anticipate the fact that you will end up checking the shop drawings for what you design, so look for the simplest way to incorporate the required steel. Accurate CADD drawings used as sketches during the design process can aid checking of rebar drawings, especially where dimensions vary nonlinearly. Inaccuracies in the drawings render them worthless for this purpose. Details that allow field adjustment to fit forming variations will not require the scrutiny of non-adjustable bars. A thorough review of those elements not easily field adjusted can eliminate future construction problems. Reviews should be sufficient to ensure that the structure is being built in conformance to the design details. As a practical matter, the ironworkers placing rebar do not use the contract drawings and work almost exclusively from the shop drawings. Be aware that field cutting of epoxy coated bars compromises the integrity of their corrosion resistance. Epoxy “touch-up” coatings are usually ineffective. For shop drawings for reinforcement for post-tensioned members, approval of details for reinforcement which could be affected by variations in post-tensioning details should be deferred until the post-tensioning details have been approved.

3.1.8.4 Checking Shop Drawings – (continued)

(3) Items of special interest – (continued)

- Post-tension System or Structural Bearings - Specifications require the manufacturer to provide test results and certifications with the submittal of the shop drawings. Files containing test results and certifications of previously approved systems and devices are located in the file room. When new or updated certifications are received, place them in these files.

  If the required tests or certifications are not included or are on file, notify the Project Manager. If the shop drawings are otherwise satisfactory and certifications are not included and none are on file, they may be approved on the condition that the required data be provided prior to incorporation in the structure.

  For strand elongation calculations, the following note should be on the shop drawings: "Strand elongations should be corrected for the modulus of elasticity for each spool of wire, based upon the test results of that particular cable."

  Bearing device shop drawings submitted, which are not listed in the “Qualified Products List” as acceptable, should be returned for correction for that reason.

  Performance Specifications for approved bearings are covered by the Standard Specifications, Section 00582.

- Substituting HS fasteners for A307 materials - Higher strength materials may not be a suitable substitute. Un-proof-loaded HS fasteners are susceptible to fatigue. Proposed higher strength materials should satisfy the elongation requirements of ASTM A307. Fatigue-prone applications should use proof-loaded HS fasteners or A307 fasteners designed for a low enough stress level for the expected number and magnitude of stress cycles.

- Precast Slab and Box Rails - Post lengths and/or curb exposures may vary due to camber and/or superelevation and resulting variable wearing surface build-ups.

- Precast-Prestressed Members - If shop drawings for members show a concrete mix design, add this note to the drawing: "This office does not review concrete mix designs".

  Slabs and Boxes - Some shop drawings have shown the outer end of rail post concrete inserts recessed from the concrete surface. The outer end of the insert must be installed flush with the surface to prevent excessive bending stress in the bolt. Do not approve inserts unless they have been identified as having adequate capacity. Inserts must be identified by manufacturer and catalog number or data showing ultimate and safe working loads in shear and tension. Note that “safe working load” may reflect variable safety factors depending upon manufacturer, and that the factor of safety is not always given in the literature. Therefore, the use of ultimate loads is recommended.

  Lifting, storing, and transporting prestressed members is the responsibility of the contractor as stated in the standard specifications, section 00550.51. Shop drawings should not include a review of these considerations. If these types of details are shown, add the note: "This office does not review lifting, storage, or transportation details."

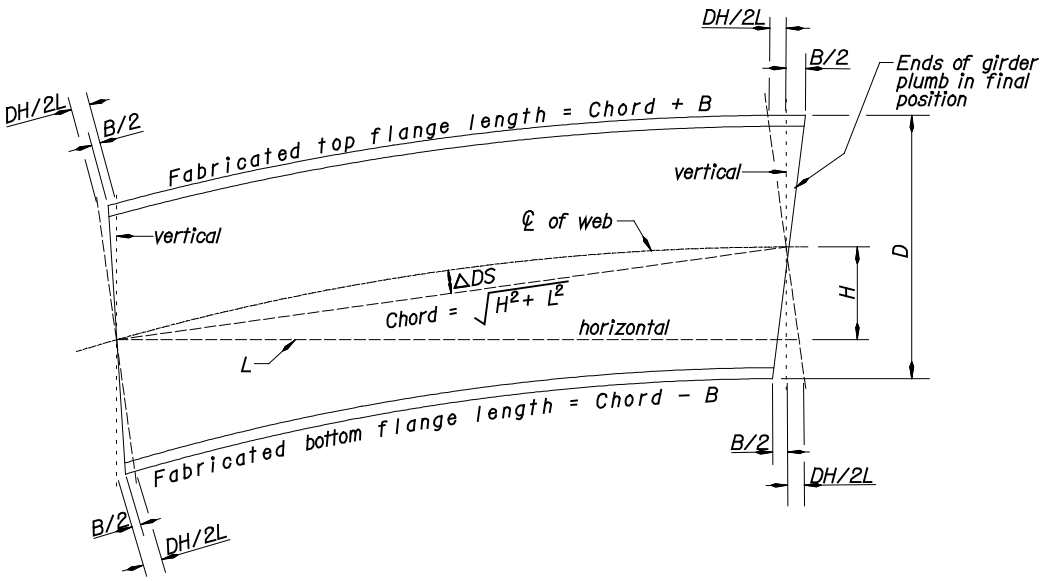
3.1.8.4 Checking Shop Drawings – (continued)

(3) Items of special interest – (continued)

- Steel Rail Posts on Precast Slabs and Box Beams - Camber or superelevation corrections with ACWS buildups may be too much for the slotted holes in the rail posts to accommodate. Some of the rail posts may have to be lengthened to compensate for the ACWS build-up.

- Structural Steel - All welding related detail, procedures, and practices should be reviewed by the welding specialist on the Facilities Design Team.

  The fabricated lengths of the top and bottom flanges of plate girders should conform to the requirements as shown below in Figure 3.1.8.4A.



Assuming uniform (circular) curvature:

$$B = 4\Delta DS \; D/CHORD$$

where ΔDS = DL + shrinkage & grade line camber

This approximate solution is valid only for simple spans or between points of contraflexure of continuous spans.

DH/2L = adjustment for grade at top and bottom at each end.

APPROXIMATE END OFFSETS AND LENGTH ADJUSTMENTS

FOR CAMBER AND GRADE

Figure 3.1.8.4A

3.1.8.4 Checking Shop Drawings –(continued)

(3) Items of special interest - (continued)

- Luminaire, Traffic, and Sign Supports - All luminaire, traffic, and sign support shop drawings should be routed through the Traffic Section for review before our check begins. Traffic Section is responsible for checking all details referring to standard drawings and/or pre-approved shop drawings, except Bridge Section still reviews all welding details on all shop drawings. Bridge Section also checks and/or reviews luminaire poles not conforming to pre-approved details. Verification procedures for luminaire and signal supports should be as follows:

    - Luminaire Supports - Pole geometry, pole lengths, number, orientation and length of arms, and arm attachment heights will be verified in the field by the Project Manager. Written verification of these items by the Project Manager should be on all pertinent shop drawings prior to submittal to the Bridge Section. If verification is missing, contact the Project Manager to check if the needed information is available. If available within a short period of time, request a verified copy of the shop drawings be sent to Bridge Section. Otherwise, return the unchecked shop drawings to the Project Manager through the Traffic Section.

      Verification of all support hub and/or tenon locations on poles for mounting hardware such as control cabinets, terminal cabinets, service cabinets, etc. are the responsibility of the Traffic Section. Written verification of these items should be on the shop drawings prior to Bridge Section review. If verification is missing, obtain it from the checker in Traffic Section prior to our checking.

    - Traffic Signal Supports - Pole and arm geometry should be verified by the Traffic Section as stated above for luminaire supports. Their verification should include pole lengths and number, orientation and length of signal and/or luminaire arms. Verification requirements, for the location of other attachments by the Traffic Section, is the same as for luminaire supports.

    - Combination Luminaire and Traffic Signal Supports - Combination supports have the same requirements as stated for Luminaire and Traffic Signal Supports.

    - Section Experts - Certain Designers are knowledgeable about and familiar with the following manufacturer's procedures and practices : Northwest Traffic Signal, Valmont, Union Metal, Ameron

      To avoid unnecessary work and provide more consistent checking and feedback to the manufacturer, consult with the appropriate designer before starting the check. Also have them review comments regarding detail changes prior to returning the shop drawings.

3.1.8.4 Checking Shop Drawings – (continued)

(3) Items of special interest - (continued)

- Luminaire, Traffic, and Sign Supports- (continued)

  - Checking Luminaire and Signal Supports - Check with the section expert if there is any doubt as to whether the subject submittal is governed by pre-approved drawings. All submittals governed by pre-approved drawings and sent to Bridge Section should be forwarded to the Traffic Section for processing. All specialty supports (such as double arms) are not pre-approved and are to be checked by Bridge Section. Weld details for all specialty supports are to be reviewed by the welding specialist on the Preservation Team. All other submittals that are not pre-approved are also to be checked by Bridge Section.

  - Checking Overhead and Roadside Sign Supports - All roadside sign support shop drawings are to be checked by the Traffic Section. Weld details are to be reviewed by the welding specialist on the Preservation Team. All fixed base sign supports (sign bridges, cantilevers, and structure mounts) are to be checked by Bridge Section.

  - P.E. Registration and Seal Requirements

    All supplier or manufacturer designed signal, luminaire, and sign support drawings (including the engineer's calculations) submitted for review on State contracts are required to be prepared, signed, and stamped with the seal of an engineer registered to practice in the State of Oregon. This requirement also includes pre-approved drawings from manufacturers, foundation details, and calculations.

  - Assignment for checking in Bridge -

    If the project involves structures - the designer or designers on the project are responsible for checking the shop drawings. Give one copy to the Welding Specialist.

    If no structure work - an available designer will be assigned to check the shop drawings. Give one copy to the Welding Specialist.

    Welding Details - the Welding Specialist on the Preservation Team will check all shop drawings with welding details.

3.1.8.4 Checking Shop Drawings – (continued)

(3) Items of special interest - (continued)

- Luminaire, Traffic, and Sign Supports- (continued)

  - Distribution of Checked Drawings - (In-house designs)

    "APPROVED" drawings - retain one copy for the Bridge Files, return one copy to the Traffic Section, and send the remaining copies to the Project Manager.

    Welding review shop drawings sent from Traffic Section should be returned to Traffic Section.

    "RETURNED FOR CORRECTION" drawings - retain one copy for the Bridge Files, send one copy to the Traffic Section and Project Manager, and discard any remaining copies.

    Welding review shop drawings sent from Traffic Section should be returned to Traffic Section.

  - Distribution of Reviewed Drawings-(Supplier or manufacturer designs)

    All designs by suppliers or manufacturers requiring a P.E. stamp shall be reviewed and stamped: "Plans Reviewed".

    All concerns must be resolved prior to stamping these types of shop drawings "Plans Reviewed". If concerns exist, write a memo to the Project Manager stating the concerns and requesting a re-submittal when the concerns are addressed. Concerns may be marked on the shop drawings and sent with the memo to the Project Manager. Retain one copy of the memo and marked shop drawings for the file and discard any remaining copies. If possible, and with prior permission of the contractor and Project Manager, the checker may talk by phone directly to the supplier to resolve concerns and decrease turn-around-time.

    When all concerns are satisfied, the checker can stamp the shop drawings "Plans Reviewed". Write a memo to the Project Manager stating the shop drawings are acceptable for the intended use. Retain one copy of the memo and shop drawings for the file, send one copy of the shop drawings to the Traffic Section and send the remaining copies to the Project Manager.

3.1.8.4 Checking Shop Drawings – (continued)

(3) Items of special interest - (continued)

- Luminaire, Traffic, and Sign Supports - (continued)

RETURN ALL CHECKED OR REVIEWED SUBMITTALS TO THE SHOP DRAWING IN-BOX (in the front office) ALONG WITH A COPY OF THE SHOP DRAWING SUBMITTAL ROUTE SLIP!

SUMMARY OF PROCEDURES AND REQUIREMENTS

Traffic Section to:

- Receive submittal from Project Manager.
- Review standard details and pre-approved details.
- Stamp accepted/not accepted all drawings they have reviewed.
- Route non-standard or non-pre-approved details to Bridge.

Bridge Section to receive from Traffic Section:

- Complete shop drawing submittal, including drawings stamped by Traffic.
- Applicable Traffic contract plans and specifications, if no structure work is involved and Bridge does not have contract plans.
- Applicable Traffic EA, if a Bridge EA is not available.
- Letter from the Project Manager verifying the required items.

Incomplete submittal from Traffic Section:

- If no Traffic plans or Traffic EA, contact the Traffic Section designer.
- If no letter from Project Manager, attach a transmittal letter with a brief paragraph explaining the situation and return all material received to the Traffic Section. Return material through the front office with the submittal routing slip, so it can be properly logged-out of Bridge Section.

Bridge Section to:

- Check non-standard and non pre-approved details.
- Check weld details.
- Stamp the plans according to status after check or review.
- Keep one set for our files, send one set to Traffic, and send remainder to the Project Manager.
- Return material through the front office with the submittal routing slip.

3.1.8.5 Temporary Construction Drawings - Temporary construction drawings are drawings of any temporary work necessary to construct the structure, but not incorporated into the final structure. Examples include:

- Falsework
- Shoring and Cribbing
- Work Bridges
- Cofferdams
- Contractor Designed Detour Bridges
- Erection Plans for:
  - Steel Structures
  - Unusual Precast Prestressed Structures
- Demolition Plans

Temporary construction drawings are reviewed to ensure the safety of the public, state and contractor personnel, and to protect the State's investment in the structure during construction. The review does not relieve the Contractor of any responsibilities for the safety and satisfactory performance of the falsework. This is stated in Section 00540.40 of the Standard Specifications. Bridge Section acts as a consultant to the Project Manager who is responsible for ensuring that the temporary construction is executed in conformance with the contract. The authority to accept or reject temporary construction lies with the Project Manager.

A thorough review and analysis of temporary construction designs can be complex and time consuming, and the level of review is governed by the judgement of the reviewer. However, it is good engineering practice to have an independent analysis of engineered structures where high monetary and human costs are at stake. In the absence of a State review, it is likely that no review will be performed. The recommended approach is that each designer conducts a comprehensive analysis of each category of temporary construction (falsework, cofferdams, shoring, etc.). When the designer has established a sound "baseline" from which to judge similar designs, the numerical analyses can be substituted by judgement based on experience. Each reviewer is responsible for deciding when and to what extent the review is according to judgement or numerical analyses.

3.1.8.6 Checking Temporary Construction Drawings

<u>(1) Marking and Stamping</u> - Temporary construction drawings are stamped "REVIEWED". Because all temporary construction drawings are to be stamped by a registered engineer, it is recommended that no markups be made on the drawings. Following this guideline avoids any question as to whether the reviewer accepted any responsibility for the design. A review memo is written to the Project Manager outlining the areas of concerns and any recommendations. The review memo is in the form of an Interoffice Memo as described in section 1.4.1.3. Example review memos are shown in the Appendix, Section A3.1.8.6(2).

Exceptions to the above involve temporary construction drawings for railroad related construction.

The Union Pacific Railroad requires an ODOT "APPROVED" stamp on falsework plans involving their facilities before they will begin to process a proposal. Our process of review sometimes involves calling for specific improvements believed necessary to expedite railroad acceptance. In these cases, Union Pacific requires that the modifications be marked on the drawings sent to them.

3.1.8.6 Checking Temporary Construction Drawings –(continued)

(1) Marking and Stamping – (continued)

No temporary construction plans are to be sent to the railroad until the checker can recommend them (with the modifications, if necessary) as appearing adequate for the intended purpose.

Where railroad approval is required, 9 copies of temporary construction plans and 5 sets of calculations should be obtained from the contractor. Four of these plan sets and 2 calculation sets should be sent to the railroad with our comments and a request that they return 2 sets with their comments. Hold the other 5 copies until the railroad has returned the requested copies. One of the copies returned by the railroad should be kept as our file copy. Mark the 5 held copies with ODOT and railroad comments so that at least 5 copies (including the second railroad copy, if there is one) can be sent to the Project Manager.

A list of who and where to send the drawings and calculations is in the Appendix, Section A3.1.8.6(1).

(2) Processing Temporary Construction Drawings -

Sections 00510, 00540, and 00560 of the Standard Specifications, as modified by the special provisions, requires temporary construction to be designed and stamped by an engineer registered to practice in Oregon and to be submitted for review along with design calculations to the Project Manager. Plans and calculations are developed and processed in the following manner:

1. The contractor uses an in-house engineer or hires a consulting engineer, hereafter referred to as the contractor's design engineer, to develop drawings and calculations.

2. The design engineer submits at least 5 copies of the plans (9 copies if railroad approval is required) and 3 copies of the calculations (5 copies if railroad approval is required) each with a Design Checklist and Design Summary to the contractor.

3. The contractor submits all copies of the plans, calculations, checklists and summaries to the Project Manager.

4. The Project Manager may keep one copy of the plans for their files and submit the remainder to the Bridge Design Section for review.

5. The Bridge Section reviews the plans for structural adequacy, constructability, and compliance with the contract documents.

6. If railroad companies are involved, copies of plans and calculations are sent to them for review. See Section 3.1.8.6(1) for additional comments.

7. The Bridge Section sends a memo describing the results of the review to the Project Manager along with copies of the reviewed drawings. The Railroad's comments are to be included. See Appendix Section A3.1.8.6(2) for example memos, Figures A3.1.8.6(2)A through A3.1.8.6(2)E

8. The Project Manager returns 1 copy of the reviewed plans to the contractor.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(3) Design Checklists and Design Summaries - Checklists were developed to facilitate the design, review, and erection of falsework, cofferdams and shoring to be used on Oregon Department of Transportation construction projects.

It will benefit the State and the contractor if the first submittal is thorough and complete, minimizing the need for re-submittals. The checklist is to be used by the engineer preparing the plans and is to accompany the plans and calculations that are submitted to the Project Manager. The purpose of the checklist is to:

- Help the contractor's design engineer prepare a complete set of plans and calculations, to ensure safety, to reduce review time, and reduce the potential for multiple submittals.
- Help the contractor identify possible design deficiencies before submittal to the Project Manager.
- Help the Project Manager identify possible design deficiencies before submittal to the Bridge Design Section.
- Help the Bridge Section make a complete and timely review of the plans and calculations.

The Design Checklist is to be used by the contractor's design engineer to help ensure the design is complete and to facilitate a quick initial review of the plans and calculations. For each question, the contractor's design engineer is to give a "yes", "no" or "not applicable" response. Upon completion of the checklist, the contractor's design engineer should review all areas where a negative response was given and make necessary changes and/or additions to the plans and calculations. The engineer is required to include an explanation of each remaining negative response with the checklist that accompanies each set of calculations.

Occasionally, inappropriate responses are given on the checklist. For example, “not applicable” or “no” are not appropriate for question A1 which asks if the plans have been stamped by a registered engineer. Responses of this nature are not acceptable and constitute a basis for rejection of the submittal. The responsive completion of temporary construction checklists is required by contract.

A Design Summary to accompany the Design Checklist is required. The Design Summary includes:

- A list of members with assumptions for dead and live loads, material allowable stresses, design stresses, allowable deflections and calculated deflections.
- Design references and/or derivations for all design formulas.
- Documentation of computer generated calculations.

See Sections 00510 and 00540 Special Provision template sheets for requirements.

(4) Special Provisions Requirements - The requirement to complete the checklists as part of the work should be included in the project Special Provisions. There are several falsework items that may be covered in the Special Provisions. (See Section 2.4.5.2, "Special Provision Guides”).

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(5) Checking Falsework Plans

Falsework proposals should be checked for compliance with all applicable contract documents including plans, Standard Specifications and special provisions. Some of these requirements are general in nature, and judgment decisions are necessary in assuming the magnitude and distribution of loads.

A copy of the Falsework Design Checklist form is to be included in the Special Provisions of each project requiring significant falsework as determined by the designer. The contractor includes the Checklist and Falsework Design Summary with the falsework plans and calculations.

Procedures for Reviewing Falsework Details

1. Determine job requirements

a. Section 00150.50 requires the contractor to protect utilities.

b. Section 00170.91 requires the contractor to protect property.

c. Section 00180.30 requires the contractor to employ equipment of sufficient size and in such condition as to produce satisfactory work.

d. Section 00540.40 requires falsework plans to be prepared stamped and signed by an engineer registered to practice in the State of Oregon. Design calculations are required with these drawings. The parts of section 00540 relevant to falsework reflect the requirements contained in the latest edition of the *Guide Design Specifications for Bridge Temporary Works*, and the *Construction Handbook for Bridge Temporary Works*, published by AASHTO.

e. Sections 00540.44(d) & (e) require deck forms for box girders to be supported from the girder stems rather than from the bottom slab, unless specific criteria are met for accessible cells.

f. Section 00540.24 addresses the supports required for deck finishing machines.

g. Chapter 437, Division 83 of the Oregon Occupational Safety and Health Code, Accident Prevention Division, Department of Insurance and Finance requires that equipment and materials meet the design and construction requirements of American National Standards Institute publication A 10.9 - 1970 *Safety Requirements for Concrete Construction and Masonry Work*. This publication refers to the requirements of ACI 347 *Recommended Practice for Concrete Formwork*, which in turn refers to the allowable stresses and design procedures of such industry associations as the American Institute of Steel Construction, the National Forest Products Association, the American Plywood Association, and the Scaffolding and Shoring Institute.

   Falsework should, therefore, be designed according to ordinary "working stress" practices, except for manufactured assemblies that are rated on the basis of full-scale load tests and an applied safety factor. (See *Recommended Safety Requirements for Shoring Concrete Formwork*, published by the Scaffolding and Shoring Institute.) The allowable stresses used for the falsework design should be listed in the Falsework Design Summary that accompanies the falsework drawings and calculations.

h. Additional requirements may be found in the Special Provisions, the general notes for the entire contract, title sheet notes for a specific structure, and in the structural details.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(5) Checking Falsework Plans

Procedures for Reviewing Falsework Details - (continued)

1. Determine job requirements - (continued)

i. Where navigable waters are involved, determine Coast Guard Permit requirements for construction of falsework. (This information will be in the contract correspondence file).

j. Falsework lighting may be called for on the plans and in the special provisions. For traffic openings under falsework spans, lighting is usually required.

k. Railroads have their own requirements for approval where falsework supports construction over or adjacent to their tracks. See Section 5 “Railroad Clearances” and “Union Pacific Railroad Guidelines for Structures”, for construction clearances, collision posts, sheathing of falsework, demolition requirements, etc.. These and other requirements should also be included in the Special Provision Falsework Design Checklist.

2. Check clearance requirements for traffic under or adjacent to the falsework.

If clearances appear to be less than those called for on the contract plans, consult the Project Manager by telephone to determine the field dimensions involved or to initiate a complete field check of the clearances.

3. Review foundation requirements.

Falsework that is to be supported on driven piles will be so stated on the contract plans.

Where falsework is supported on piling driven through soft material to end bearing, the upper soil layer may not provide adequate lateral support for the piles. Lateral support of the piles may be required to ensure stability.

Where falsework is not supported on driven piling, calculations for allowable bearing pressures for falsework footings on soils shall be included in falsework design submittals.

Surface soils at a construction site can be highly disturbed, vary greatly in moisture content, composition and density, and bear little resemblance to soils originally logged at the site. These conditions could result in excessive settlement of falsework footings, or even bearing capacity failure that could lead to falsework collapse. Actual soil conditions should be confirmed at the site by the contractor's design engineer and accounted for in falsework design calculations.

The assumptions and methods used in determining the soil's capability to support the footing loads should be shown in the calculations, as well as expected falsework footing settlement based on these allowable soil bearing values.

Footings may be timber mudsills or concrete pads (plain or reinforced). Pads of granular structural fill are sometimes used to enlarge the area of soil to which load is transferred.

The Project Manager should ensure that falsework footings are constructed in accordance with the contractor's plans and that the soil in each footing location is consistent with the soil type for which the footings were designed. If the bearing capacity of the soil appears inferior to the assumed soil bearing layer used for the footing design, the falsework engineer must address the changed design conditions.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(5) Checking Falsework Plans

Procedures for Reviewing Falsework Details - (continued)

4. Determine properties of the falsework material.

a. Timber grades should be noted in the Falsework Design Summary. If they are not, one may determine from the calculated stresses the minimum grade of Douglas fir which should be used and report this in the review memo. If No. 1 does not provide sufficient capacity, report the design as appearing inadequate. Report the level of overstress to give the Project Manager a good idea of the magnitude of the under-design. Better grades are not likely to be provided for falsework. Dense grades are not generally available so it is reasonable to question the use of timber identified as such on the drawings.

   In calculating properties for timber identified as "rough", add only 1/8" to dimensions of finished sizes. Rough lumber is not full nominal size unless specifically ordered that way from the mill.

   Increases in allowable stresses for short duration of load should be allowed where appropriate. Note that load duration factors for bearing stresses perpendicular to the grain are not permitted because the basis for the stress limit is the corresponding deformation.(Subsection 2.3.2.1 and 4.2.6 of the *National Design Specification for Wood Construction* (NDS)). Increases in allowable stresses for repetitive members shall not be used concurrently with increases in allowable stresses for load duration (ACI 347 *Recommended Practice for Concrete Formwork*). This restriction is not given in NDS. Seven days' load duration for supporting conventional reinforced sections and two months' load duration for supporting post-tensioned sections are reasonable assumptions. Load duration factors are given in NDS.

   Allowable stresses shall be as specified in the *National Design Specification for Wood Construction*.

b. Steel structural shapes and plates should be identified by their AASHTO or ASTM number. If they are not, assume ASTM A36 will be used and note this in the review memo.

c. Manufactured items such as tower assemblies, single shores, deck form overhang brackets, screw jacks, bolts, and inserts should be identified as to manufacturer, model, rated working capacity, and ultimate capacity. Check the factor of safety (FS) used in establishing the allowable working load. Determine whether it is appropriate for the contractor's proposed use of the item. The minimum FS for manufactured components is 2. A reduction in the normal rated capacity may be required if screw jacks are used on tower legs or if extension frames are fully extended. (Extending frames to their limit of 5 feet reduces the working load of the legs from 11 k to 9.5 k.) Do not accept rated capacities without verifying that the conditions of use correspond to those assumed for establishing the rating.

5. Determine design loads

Design loads should comply with the *Guide Design Specifications for Bridge Temporary Works*, published by AASHTO. Include the self weight of the falsework.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(5) Checking Falsework Plans

Procedures for Reviewing Falsework Details - (continued)

5. Determine design loads - (continued)

Precise determination of loading on a member is frequently complicated by tapering structural dimensions (slabs, stems, haunches) and by falsework layouts which do not duplicate the girder stem layout. Consideration must be given to the worst loading condition that can occur, not just the average condition. Loading can be further complicated by construction sequences and stages of concrete pours and live loading. For example, CIP box girder falsework may be designed such that the falsework decking is designed for bottom slab concrete and live load only. The cured deck carries subsequent loads to falsework beams. Falsework beams may not be designed for the total concrete forces if falsework bents are arranged such that concrete girder stems can carry the deck load over falsework spans. Depending upon construction sequence and falsework layout, total concrete forces plus live load may be unnecessarily conservative. Substituting simplified approximations of the true loading (equivalent concentrated loads or maximum girder section loads in place of a varying load or tapered section) can reduce the complexity of calculations. Rough approximations may be sufficient to verify the adequacy of a conservative design, while progressively refined models may be necessary to evaluate a close or inadequate design.

Lateral loads are the actual loads anticipated but not less than 2% of the dead load. The special provisions specify particular lateral load connections at falsework traffic openings.

6. Review analysis of loads and stresses.

a. Plywood sheathing is often considered part of the formwork and not detailed in the falsework plans. The plywood deck constructed to support a box girder or tee-beam soffit may be checked as a part of the falsework system, if sufficient detail is shown to permit a design review.

   Plywood spans are frequently governed by the allowable spacing of supporting joists rather than the strength and stiffness of the plywood itself. When ¾" plywood is shown and supports are spaced at relatively close intervals (16" for 12" slabs or 5" for 8' deep girders), stress calculations can usually be omitted. If plywood spans are long or the thickness appears questionable, check the allowable stress shown in the Falsework Design Summary with the allowable stresses found in ACI SP-4, *Formwork for Concrete* or American Plywood Association literature.

   Plywood sheathing is typically submitted with falsework plans. Section properties are dependent on factors other than dimensions and should be taken from tables in the *Plywood Design Specification* (PDS) published by the American Plywood Association (APA). The importance of finished appearance should be considered when applying recommended span lengths based on expected deflection. Thinner plywood sheathing may be used inside box girder cells than on exterior surfaces for concrete deck forms because deflection is unimportant in regard to appearance inside the cells.

b. Timber joists supporting sheathing are usually 4x 6's but may be other sizes. Check bending, shear and bearing stresses. Assume that load from girder stems is distributed over the width of the stems, plus twice the thickness of the bottom slab (if any). Assume that joists are simple span unless clearly identified as being continuous over 3 or more spans.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(5) Checking Falsework Plans

Procedures for Reviewing Falsework Details - (continued)

6. Review analysis of loads and stresses - (continued)

c. Timber stringers set on posts or steel tower legs are often used as supports for the joists. They should be checked for bending, shear and deflection. Bearing stresses are usually not high, but should be spot-checked. Consider load as uniformly distributed unless the concrete section varies considerably over the span or the joists are few and widely spaced.

d. Steel beam spans are commonly used to support the joists, especially over traffic openings. For longer spans, the allowable load may be governed by the buckling strength of the compression flange. Lateral bracing may be required to ensure against beam buckling at stress levels that appear quite conservative.

   Wedges may be required between the longitudinal beam and cap beams to accommodate longitudinal slope and reduce eccentric loading. Welded or bolted connections between longitudinal beams, cap beams and falsework bents are required for falsework spans over traffic.

   Welding related details are to be reviewed by the welding specialist.

   The falsework designer may propose a steel stringer layout such that stringers are positioned directly under the box girder stems and also in between the stems. When the stem concrete is placed, the stringers underneath the stems will support more of the stem weight than the stringers between the stems. Thus, the stringers underneath the stems will deflect more than the stringers between the stems. If the stem concrete is placed soon after the bottom slab was cast, the differential stringer loads may overstress the green bottom slab concrete. Therefore, a check should be made as to the adequacy of the bottom slab to resist this differential loading.

e. Where posts support stringer or beam systems, a cap beam is usually employed to transfer loads, integrate the post bent, and provide a base from which grade adjustments can easily be made. When the beams or stringers are located directly over the posts, check bearing stresses perpendicular to the grain at both the stringer to cap beam and cap beam to post surfaces. If caps are loaded as beams, check bending and shear stresses as well.

f. Timber posts should be checked as columns. For effective lengths less than the post length, bracing in two orthogonal directions should be clearly detailed.

g. If stringers are supported by steel shoring towers, the legs are checked against rated capacity rather than allowable stress.

h. Investigate the adequacy of bracing and connections.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(5) Checking Falsework Plans

Procedures for Reviewing Falsework Details - (continued)

6. Review analysis of loads and stresses - (continued)

i. As newly placed deck concrete shrinks during the curing period, the deck shrinkage causes additional vertical load to the supporting falsework. This downward force is greatest at the center of the concrete span. It reaches a maximum in four to seven days after the deck concrete has been placed. This increase in falsework load is of greatest concern in the case of cast-in-place post-tensioned structures, because the load carrying capacity is not provided until the concrete reaches design strength. Caltrans research showed that this increase in falsework load varied from 110 to 200 percent of the concrete dead load.

Vertical loads used for the design check of vertical load-carrying components that support falsework over traffic are to be increased by 150 percent of the load that would otherwise be calculated. This increase shall not be applied to caps or footings or be used to check the bearing capacity of the soil.

For cast-in-place post-tensioned structures, falsework bents at points of two-stage post-tensioning should be checked for the additional load due to load transfer to the temporary end reaction point.

7. Review general features of the falsework for potential problems which should be called to the attention of the Project Manager.

a. Concrete cast against sloping surfaces may produce uplift forces on the falsework. Bracing or ties should be provided to resist these uplift loads.

b. Footings that are set on or near sloping ground surfaces may be unstable and should be set on benches cut into the slope.

c. Beams and stringers may be unstable if their height/width ratio exceeds 2.5:1.

d. Beams with cantilevers may be unstable if the cantilever is loaded before the main span. With some span arrangements it may be necessary to make provision for upward deflection of a cantilever produced by load on the main span.

e. Falsework footings should be located or protected so they will not be subjected to the effects of standing or running water.

f. If deck overhang brackets are attached to non-stiffened steel girder webs, temporary bracing will usually be required to prevent lateral distortion of the girders.

g. Note the plans and specifications for requirements for falsework connections for members used over traffic.

h. Beams butted against skewed piers or abutments should not be considered longitudinally supported by this contact when the intersection angle is less than 75 degrees.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(5) Checking Falsework Plans

8. Mark falsework drawings to indicate that they have been reviewed.

Mark the "Reviewed" box on the working drawing stamp. Recommendations or corrections should be discussed in the review memo.

9. Write an Interoffice Memo to the Project Manager.

a. State clearly an opinion that the details as shown are either satisfactory or unsatisfactory. Specific reasons should be given to support a negative opinion. There is no value in being vague about the elements that have not passed a critical review. If elements are overstressed, indicate the level, location, and loading. Discrepancies in allowable stresses should be noted, with the governing specification cited. Failure to abide by the specifications for the contract is a valid basis for an opinion of inadequacy of the falsework, if such failures are the result of not providing information that is required for a complete review. For example, if soil properties and bearing capacity calculations, for the design soil layer for the footings are not included in the submittal, the adequacy of the design can not be determined. Enough information should be provided to allow the Project Manager to discuss and evaluate the degree of any apparent deficiencies and the adequacy of any improvements proposed by the contractor. The “tone” of the review memo should allow for the possibility of results other than our own. This can be accomplished by using clauses such as “Our analysis indicates...”

b. Identify any features of the plans that were not checked, so that the Project Manager and the contractor will not assume these details have passed a critical review. State the level of analysis performed for items addressed in the review memo.

c. Point out any areas where special attention (field review or inspection) appears to be in order, such as described under Item 7.

d. Send a copy of any correspondence concerning railroads to the Railroad and Utility Engineer.

10. Recommended references

a. *Guide Design Specifications for Bridge Temporary Works*, AASHTO.

b. *Construction Handbook for Bridge Temporary Works*, AASHTO.

c. *Plywood Design Specification* (PDS) American Plywood Association.

d. *National Design Specification for Wood Construction* (NDS) American Forest & Paper Association

e. *Specification for Structural Steel Buildings - Allowable Stress Design* AISC.

f. SP-4, *Formwork for Concrete*, CI (especially "Recommended Practice for Concrete Formwork", located in the back of the book) - filed in Bridge Section Library.

g. *Falsework Manual, 1988*, California Department of Transportation - copy in each Design Team room.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(6) Checking Cofferdam Plans

Review of the contractor's proposed cofferdam design and details is intended to protect the State's investment without relieving the contractor of responsibility for the safety and satisfactory performance of the cofferdam. Special provision section 00510.44 which modifies the standard specifications states that the contractor shall prepare and submit for review details and calculations for the cofferdams necessary to accomplish the contract work in conformity with the requirements of the contract.

Cofferdam proposals should be checked for compliance with applicable contract documents including plans, standard specifications and special provisions. Some of these requirements are general in nature, and judgement decisions are frequently necessary in assuming the magnitude and distribution of loads applied to the cofferdam.

Procedures for Reviewing Cofferdam Details

1. Determine job requirements

a. Special Provision Section 00510.02 require that the cofferdam plans are to be prepared by an engineer registered to practice in the State of Oregon. Design calculations, summary, and checklist are required with these drawings.

b. Section 00150.50(c) requires the contractor to protect utilities.

c. Section 00170.91 requires the contractor to protect property.

d. Section 00180.30 requires the contractor to employ equipment of sufficient size and in such condition to produce satisfactory work.

e. Chapter 437, Division 83 of the Oregon Safety Code (Workman's Compensation Board) requires that equipment and materials meet the design and construction requirements of American National Standards Institute publication A 10.9 - 1970. This publication refers to the requirements of *Recommended Practice for Concrete Formwork* (ACI 347-68), that in turn refers to the allowable stresses and design procedures of such industry associations as the American Institute of Steel Construction, the National Forest Products Association, the American Plywood Association, and the Scaffolding and Shoring Institute. Cofferdams should, therefore, be designed according to ordinary "working stress" practices utilized for the design of permanent construction, except for manufactured assemblies that are rated on the basis of full-scale load tests and an applied safety factor.

f. Additional requirements may be found in the Special Provisions, the General Notes for the entire project, title sheet General Notes for a specific structure, or on the detail plans.

g. Where navigable waters are involved, determine if a Coast Guard permit is required, and if it has been obtained for the construction of cofferdams. If so, check the permit requirements. (This information will be in the contract correspondence file.)

h. Steel structural shapes and plates should be identified by their AASHTO and ASTM number. If they are not, assume that AASHTO M270 (ASTM A709) Grade 36 will be used and note this in the review memo.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(6) Checking Cofferdam Plans

Procedures for Reviewing Cofferdam Details - (continued)

2. Determine design loads.

Cofferdam loads consist primarily of lateral soil pressure and water pressure both inside and outside of the cofferdam cell. Less frequently, cofferdams may be required to resist loads from moving water, drift ice, drift debris, and breaking waves. Horizontal soil pressure acts from the mud line to the bottom of the cofferdam on the outside and from the bottom of the excavation to the bottom of the cofferdam on the inside of the cell. Water pressure acts from the top of the cofferdam or from the elevation at which the cell is vented to the bottom of the cofferdam. Cofferdams may be required in cohesionless soils with a high water table, where lateral loads from saturated soil, live load surcharge, hydrostatic pressure, and submerged soil may all contribute. Additional loading may occur from construction equipment attached to the cofferdam cell or from bracing falsework or formwork from the cofferdam.

The soil pressure distribution on a cofferdam may be triangular, trapezoidal, or rectangular, in an active or at rest state of stress, depending upon the type of soil and the configuration of the wales in relation to the soil level. The CALTRANS *Trenching and Shoring Manual* can provide guidance on which soil loading to use for a particular soil type and cofferdam configuration.

The height of the cofferdam cell is dependent upon the expected or design high water level, the elevation of the bottom of footing or seal to be constructed and the type of material present below the bottom of the excavation. A seal pour is required before the excavation is dewatered when the underlying material will not resist the buoyancy force of the head differential between the water surface and the bottom of the excavation.

3. Review foundation requirements.

Cofferdams are often designed by a structural engineer with little or no consideration given to geotechnical aspects of the site, such as drivability of the sheet pile selected, permeability of the soil, or the depths the sheets must be driven to cut off water flow through the soil into the proposed excavation. This is particularly important when a cofferdam is dewatered without the use of a seal. Heavy sections of sheets may be required in order to drive the sheets an adequate distance beyond the bottom of footing elevation in order to create adequate head loss of water infiltrating beneath the sheets and into the bottom of the excavation. Subsurface soils may be highly disturbed due to the installation of the cofferdam sheets. Actual soil conditions at each cofferdam may vary from the soil conditions defined on the Foundation Data Sheet. Actual soil conditions at each cofferdam should be verified to be generally the same as those used in the cofferdam design. The Project Manager should ensure that the cofferdams are constructed in accordance with the contractor's plans, and that the subsurface soils are consistent with the soil parameters used for the cofferdam design.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(6) Checking Cofferdam Plans

Procedures for Reviewing Cofferdam Details - (continued)

4. Review analysis of loads and stresses.

Lateral soil pressure and differential water pressure loads on the cofferdam walls are typically resisted by horizontal rings or wales, and by passive earth pressures below the excavation depth. Wales need to be checked for bending and shear.

NOTE: The most critical item to check is the wale corner connections. Most often opposite wales end bear on the adjacent wales. The opposite wales rely on the corner connections to resist lateral loads. Therefore, wales are compression members designed for combined axial and bending with pinned or fixed end conditions. Fixed corner connections are usually constructed by either welding or bolting. Such connections may be overstressed when the wale and connection are designed assuming a pin connection.

5. Review general features of the cofferdam for potential problems which should be called to the attention of the Project Manager.

6. Mark cofferdam drawings to indicate that they have been reviewed.

Mark the "REVIEWED" box on the working drawing stamp. Recommendations or concerns should be discussed in the review memo.

7. Write an Interoffice Memo to the Project Manager.

State clearly an opinion that the details are either satisfactory or unsatisfactory. Specific reasons should be stated to support a negative opinion. There is no value in being vague about the elements that have not passed a critical review. If elements are overstressed, indicate the level, location, and loading. Discrepancies in allowable stresses should be noted, with the governing specification cited. Failure to abide by the specifications for the contract is a valid basis for an opinion of inadequacy of the cofferdam, if such failures are the result of not providing information that is required for a complete review. For example, if wale end connections are not detailed, the adequacy of the structure can not be determined. Enough information should be included in the review memo so that the Project Manager is able to discuss with the contractor the degree of concern for any apparent deficiencies and any improvements proposed by the contractor. The “tone” of the review memo should allow for the possibility of results other than our own. This can be accomplished by using clauses such as “Our analysis indicates...”

8. Recommended References:

Steel Sheet Piling Design Manual, U.S. Steel Corporation.

Shoring and Trenching Manual, CALTRANS

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(7) Checking Shoring Plans

Investigation of the contractor's proposed shoring plans should follow the same general procedures and guidelines as the cofferdam review. Some aspects of the review particular to shoring are addressed below.

The special provision reference for the submittal of shoring plans is Section 00510.03.

Procedures for Reviewing Shoring Details

1. General Considerations

The unique aspect of shoring is that unlike gravity, wind, or hydrostatic loads, the *loads* for which shoring is designed are dependent upon the tolerable deflection of the shoring over its anticipated service life. The lateral earth pressure load varies form a minimum active earth pressure to higher than active, near at-rest or at rest conditions. Any shoring type can be designed for active earth pressure, but active pressure can only be assured for flexible systems. For restrained systems, which are often designed for active pressure, the actual pressure in the field is a function of the load in the tie-backs. Although any shoring type can be designed for at-rest soil pressure, fixed systems usually employ prestressed tie-backs that are “locked off” at a load equal or greater than what would occur in the tie-back if the shoring were subjected to at-rest soil pressure and the tie-back was not prestressed.

2. Determine tolerable deflection of shoring

The tolerable movement of the shoring system depends upon the nature of the improvements to be supported by the shoring. Where shoring is used primarily to limit the extent of open excavations, the shoring is designed for active earth pressure. The deflections necessary to establish this state may result in settlement of the ground surface of the shored material. If the shored material supports spread footings or a roadway where the grade conforms to a precise vertical alignment, the potential for damage precludes the shoring being designed for active earth pressure. Shoring adjacent to pile supported structures may be designed for active earth pressure, but if portions of the piles are in the active zone, they will also be subjected to an active lateral earth pressure load. Be aware that discrete elements resist earth pressure that may act across some multiple of their width, because of “arching” action across pile spaces in the case of active pressure. For shoring that supports the spread footings of a permanent structure, and no settlement is tolerable for the footing, a fixed system must be used.

3. Fundamental shoring types

Shoring systems can be grouped into three general categories:

1. Continuous vertical elements, either cantilevered or tied-back, where the lateral load is resisted either by the passive resistance of the embedded portion of the vertical element alone or in combination with tie-backs that derive their capacity from the shear strength of soil behind the affected zone. An example is a sheetpile wall.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(7) Checking Shoring Plans

Procedures for Reviewing Shoring Details - (continued)

3. Fundamental shoring types – (continued)

2. Gravity systems, where lateral load is resisted by the base friction associated with the dead weight of a reinforced soil block. Examples include geotextile, MSE, and soil nail walls. Geotextile and other MSE systems, where facing elements are combined with attached reinforcing elements that extend into the soil perpendicular to the facing, are best suited for fill applications. Soil nail shoring is appropriate for cuts.

3. Soldier pile and lagging consists of cantilevered or tied-back vertical elements spaced at intervals. Lagging bridges the spaces and carries load to the soldier pile through simple or continuous horizontal spans. Soldier piles are typically steel HP sections with lagging of either steel plates or dimension lumber in simple spans across the fill sides of the exposed face flanges of adjacent piles. Sometimes, timber is placed in continuous spans across the exposed side of the exposed face flanges and attached to the flanges with bolts. This latter arrangement eliminates the need to cut the timber lagging into short pieces equal to the pile spacing. The soldier piles resist loads in the same manner as vertical elements described in item 1 above.

4. Determine earth pressure distribution

Earth pressure distribution will vary according to whether the shored material is cohesive or cohesionless, and with the number of rows of tie-backs. Cantilevered or single row tie-back systems have a triangular distribution in both cohesive and cohesionless shored material, but for cohesive material, the elevation of positive lateral pressure on the fill face may occur at some distance down from the soil surface. Cantilever, gravity, and single tier tie-back systems are flexible systems.

For tied-back systems with two or more tiers of tie-backs, the driving pressure distribution is trapezoidal, bilinear, or rectangular depending on the soil type, and its corresponding stiffness or density.

5. Calculate magnitude of shored material lateral earth pressure

For cantilever and gravity shoring, the maximum pressure is based on either an active or at-rest condition depending upon the deflection permitted. However, cantilever systems are rarely designed for at rest pressure. A different system would be used.

For tied-back systems, the maximum pressure may vary according to the lock-off load in the tie-back. The tie-back is positioned to optimize the pile section. The minimum lock-off load would equal the load required to reach horizontal equilibrium of the system for the chosen position of the tie-back while fully utilizing the available passive resistance of the embedded length. However, this is not achieved in actual designs because 1) In practice, there should always be more embedment than that required to resist lateral load on the total embedded depth at full passive resistance. Under those conditions, the FS for kick-out of the soldier pile bottom would be 1.0, which is unacceptable. 2) The decision to use tie-backs is usually driven by the desire to use a reasonable size soldier pile at reasonable spacing without overstressing the pile in bending at the base of a cantilever.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(7) Checking Shoring Plans

Procedures for Reviewing Shoring Details - (continued)

6. Analysis of tied-back soldier pile

One method of analyzing a tied-back soldier pile is given herein. The analysis procedure differs from a design procedure, but the objective is to ascertain whether a proposed system will function in terms of structural capacity, lateral deflection, and stability in the soil. The soldier pile may be modeled as an indeterminate beam. The loads are the passive or semi-passive pressure resistance, with the driving lateral load a minimum of active earth pressure magnitude. The actual values of the driving loads are determined in the analysis, but they are bounded by the values above.

The tie-back lock-off loads are modeled as reactions to the unknown soil loads. The lock-off loads are actual loads in the field, so the analysis should not yield some other value for the tie-backs. The embedded tip of the model is either the pile tip or the depth to “stiffness fixity”, if the planned tip is below the fixity point. Support the beam with pin connections at each tie-back and at the model tip. Note that movement of the embedded length is required to mobilize passive pressure. The depth below which no movement occurs (stiffness fixity) will not participate in the model’s passive resistance. Determine Rk_p from a log-spiral nomograph and calculate the passive pressures at the top and bottom of the resisting soil column. The width of resistance may be taken as 3x (pile width). Neglect a reasonable depth below the dredge line for passive resistance. Apply the driving pressure along the pile according to the appropriate distribution. By iteration, scale the magnitudes of the driving and resisting loads until the reactions in the model equal the specified lock-off loads in the tie-backs. The lateral reaction at the model tip should be small. Check that the scaled iterated value of the driving load is at least equal to the active earth pressure plus surcharge. If not, the lock-off load is insufficient. For tied back systems supporting permanent footings where settlement is not tolerable, the scaled iterated magnitude of the driving soil pressure should be at least equal the at rest pressure. Check that the scaled iterated resisting load on the embedded length is less than full passive resistance. If not; either, the embedment is insufficient, the tie-backs are too high, or three not enough tiers, or the soldier pile spacing is too great. If the model tip is at the stiffness fixity depth, and more embedment is available, analyze the system with a deeper resisting soil column. Be aware that equations yielding depths to stiffness fixity are very approximate. When soil loads are within the expected bounds for the specified lock-off loads, the bending and shear stresses in the soldier pile may be compared to the working stress allowables.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(7) Checking Shoring Plans

Procedures for Reviewing Shoring Details - (continued)

7. Tie-back adequacy

The tie-back itself is designed for some FS applied to the lock-off load, typically 1.25. The tie-back design load should not be used to establish the magnitude of the driving and resisting soil pressures, soldier pile stresses, or wale reactions. Use the lock-off load. However, the tie-back must be tested in the field to ensure that the assumed margin of safety actually exists. Acceptance criteria are generally an allowable creep rate for a sustained load. The sustained load is usually 1.2 to 1.3 x the design load. A common practice is to test the tie-back to a "lift-off" load or the load at which the tie-back bearing plate separates from the soldier pile wale. The lift-off load is compared to the seating load and the time over which the loads are applied. These data can be converted to a creep rate of the tie-back for the difference between the seating and lift-off loads. The problem with this method is that the effect of shoring movement into the retained material cannot be separated from the movement of the tie-back relative to the soil. An independent reference point and a dial gauge measurement is a more accurate way to measure tie-back movement. These tests should be performed before grouting the unbonded length of the tie-back. Verify that the shoring plans include testing criteria consisting of number of tests, test load, test load duration, allowable creep or load loss, and the design life of the shoring. A contingency plan should be provided for tie-backs failing the test criteria. Consultation with the foundation designer is recommended for evaluating tie-back test criteria. The steel elements of the tie-back are evaluated using working stress levels. Concentrated loads at the wale, which distributes soldier pile loads to the tie-backs, may be sufficiently large to require stiffeners at the wale to soldier pile bearing interface.

8. Tie-back anchorage

Tie-backs are anchored into the retained soil, usually behind the passive failure surface. The length required to develop the tendon strength behind this plane is the bonded length. Sometimes tie-backs are anchored to concrete blocks or walls buried in the retained material. A buried anchor point of this nature is termed a "deadman". The deadman should be located behind the passive surface, or in the zone between the active and passive surfaces and above a perpendicular line intersecting the active surface at the ground line. A deadman located in this latter zone cannot develop full passive resistance. The evaluation of grouted tie-back anchorages is best evaluated by the foundation designer.

3.1.8.6 Checking Temporary Construction Drawings - (continued)

(7) Checking Shoring Plans

Procedures for Reviewing Shoring Details - (continued)

9. Recommended References:

Manuals recommended to aid in checking cantilever shoring:

- *Guide Design Specifications for Bridge Temporary Works,* AASHTO
- *Standard Specifications for Highway Bridges*, *section 5.6,* AASHTO
- *Steel Sheet Piling Design Manual*, U.S. Steel Corporation

Manuals recommended to aid in checking tied-back shoring :

- *Trenching and Shoring Manual*, California Department of Transportation

Each Structural Design Team has a copy of these manuals.

- *Manual for Railway Engineering*, American Railway Engineering and Maintenance-of-Way Association (AREMA)

Copies of these manuals are located in the Bridge Library.

Railroad Shoring - As with falsework, shoring adjacent to a railroad must be approved by the railroad. Figures in “Railroad Guidelines for Structures” manual show the limits of excavation beyond for which shoring is required. This notebook is located in each design room.

A railroad can induce a very large surcharge load. The American Railway Engineering and Maintenance-of Way Association (AREMA) specifies the Coulomb Theory and the use of a Boussinesq strip load surcharge for determining the lateral pressure on shoring. See Volume 2, Chapter 8, Section 20 of the *Manual for Railway Engineering*, (AREMA) and the California “Trenching and Shoring” manuals for additional information.

3.1.9 Construction Narrative Review - At the completion of the project, the Project Manager generally writes a construction narrative. The Project Manager discusses all segments of the project: problems with staging, procedures, construction details and any other areas that could have improved the project and/or avoided price agreements. The narrative may also contain positive feedback for those aspects of the project that proceeded smoothly.

The designer should review the narrative and respond in writing. Structure related items should be discussed with proposals for possible solutions to the problems. Office Practice proposals should be developed for good practical solutions.

FHWA's Oregon Division Bridge Engineer has requested that they be sent a copy of the Construction Narrative on Federal-aid projects. A copy of our response would also be informative.

3.1.10 As Constructed Drawings - Upon completion of the project, the Project Manager will send a set of "As Constructed" plans to the Bridge Section. These plans consist of contract plans with any changes or deviations noted that were made during construction.

Pencil “As Constructed” notations are then made on the original signed mylars as directed in section 4.7.11.

The designer is to review the "As Constructed" plans to make sure the structural changes are appropriate and/or consistent with changes agreed upon during construction.

Where contractor options were allowed, the alternate selected and installed should be noted. Some of these items include manufacturer's name for proprietary bearings and joints, type of piling selected, etc. A review of the shop drawings may be necessary to verify the products that were installed.

Final footing and pile tip elevations should also be shown. Final tip elevations can be obtained from the Foundation Unit, if they are not shown on the “As Constructed” plans from the Project Manager.

When the revisions are completed, obtain half-size copies to be sent to the Region Manager and the Bridge Operations Managing Engineer. Send City/County plans only to the Bridge Operations Managing Engineer. They can then reproduce and distribute copies to appropriate personnel. A template file form “ASCONST” is available on each personal computer.

The full-size prints sent in by the Project Manager should be sent back for their files.

For projects with structures spanning waterways, send a half-size paper copy of the "as constructed" plans to the Hydraulics Unit for their scour program records.

3.2 MAINTENANCE

3.2.1 Introduction - The Bridge Operations Team usually works with the Regions to develop maintenance or repair related details.

But, there may be times when a Bridge Design Team is requested to provide these details. Formal drawings and specifications or just sketches may be required, depending on the type of project and who will be performing the repair work. The Bridge Operations Managing Engineer will determine the level of detail needed.

3.2.2 Permit Load Reviews - The State, counties, and cities may issue permits for the movement of vehicles whose weights are in excess of those allowed by statutory limitations and whose loads cannot be readily dismantled to reduce weight.

The Permits Unit approves all State issued permits. They review and approve permit applications that are within established guidelines. If specified axle loads and/or gross weight limits are exceeded, the Bridge Section is requested to review the permit application. The structures on the proposed route are reviewed individually for structural adequacy.

Permit review requests are usually processed through the Bridge Operations Team.

SECTION 3: APPENDIX

A3.1.2.3 Design and Plan Revisions after Letting

I N T E R O F F I C E M E M O

TECHNICAL SERVICES
Bridge Engineering Section
Office Phone: (503) 986-4200
Fax Phone: (503) 986-3407

TO: _____
Region (Number) Manger or
Region (Number) Technical Services Manager (Region 4 Only)

FROM: _____
Structural Managing Engineer

SUBJECT: Subject of Revision
Bridge Name and Number
Section
Highway Name and County
Contract Number

Attached are

- Four sets of reduced prints of Drawing(s) _____.

This (these) drawing(s) has (have) been revised to (*explain reason, purpose, need, urgency and cost.*)

This revision results in (a) quantity of change(s) of _____.

The revision was discussed with the Construction Project Manager (and FHWA).

___:___

Attachments

cc: _____, Operations Support Manager
_____, Construction Project Manager /w/ 5 full-size sets and 15 reduced sets
Bruce Johnson, FHWA /w/ 3 sets

bc: _____, Bridge Engineer

Figure A3.1.2.3A

A3.1.2.3 Design and Plan Revisions after Letting

I N T E R O F F I C E M E M O

TECHNICAL SERVICES
Bridge Engineering Section
Office Phone: (503) 986-4200
Fax Phone: (503) 986-3407

TO: Roadway Engineering Section

FROM: _____**, P.E.**
Structural Managing Engineer

SUBJECT: Revision of Project Title Sheet
(Section)
(Highway)
(Bridge Name and Number)

Attached is a print of the project Title Sheet with noted drawing number(s) that should be added to the Index of Sheets.

____: ____

Attachments

Figure A3.1.2.3B

A3.1.2.3 Design and Plan Revisions after Letting

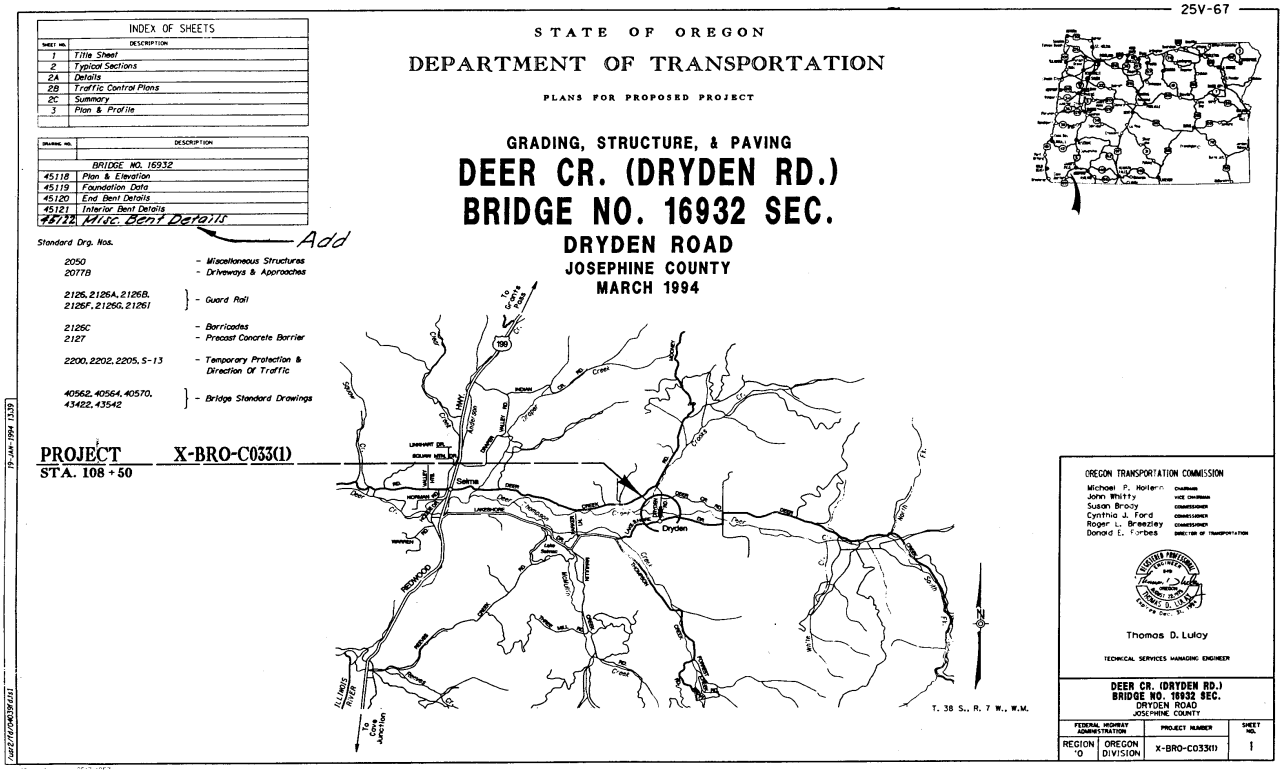


Figure A3.1.2.3C

A3.1.8.2(5) Material Inspectors to be sent a copy of the structural steel or precast member shop drawings:

PORTLAND AREA:

Roger Christensen
Portland Inspection Crew
11514 SE 37th Avenue
Milwaukie, OR 97222
Phone 503-653-3083

Attention: Mike Kleffner (For structural steel and laminated elastomeric bearings)

EUGENE AREA:

David Larson
Eugene Inspection Crew
2141 E 15th Ave
Eugene, OR 97403
Phone 541-686-7608

A3.1.8.6(1) Railroad Temporary Construction Submittals

Union Pacific Railroad Co.
Attn. John Trumbull, Manager Industry and Public Works
5425 SE McCloughlin Blvd.
Portland, OR 97202

Phone 503-220-4409

Mr. Charles A. Lundgren
Engineer. Public Works
Burlington Northern Railroad Co.
999 Third Ave, Suite 2200
Seattle, WA 98104

Phone 206-467-3318

A3.1.8.6(2) Example Temporary Construction Review Letter

I N T E R O F F I C E M E M O

TECHNICAL SERVICES
Bridge Engineering Section
Office Phone: (503) 986-4200
Fax Phone: (503) 986-3407

August 5, 2003

File Code: DES 23 07854C

TO: Project Manager

FROM: Principal Structural Design Engineer

SUBJECT: **Finishing Machine and Deck Overhang Supports**
Bridges 0785C, 07815A, 07802A, and 07847A
Algoma – Hood River Section
Willamina – Salem Highway
Baker County

The subject form and finishing machine support details have been reviewed, and four copies are attached for your use and distribution.

The findings of our review, listed by structure, are offered below.

Widening of Chemawa Overcrossing of APRR, Bridge 07854C

Calculated loads on overhang brackets are within the manufacturer's rated capacity.
Joist (4 x 4) bending stresses are within the allowable and calculated midspan deflection is approximately 1/8”.

Brooks and Woodburn Interchanges, Bridges 07815A and 07802A

Calculated loads on overhang brackets are within the manufacturer's rated capacity. Bending stresses are within the allowable for double joists (4 x 4) under finishing machine rail, but calculated deflection at midspan is excessive (approximately ½”). Bending stresses are excessive (2500 psi) in the inner single joist (4x4).

St. Louis Road Undercrossing Bridge 07847

Calculated loads on overhang brackets are within the manufacturer's rated capacity. Bending stresses are excessive (3300 psi and 2900 psi) in both the double joists (4 x 4) under rail and the single inner joist
(4 x 4). Calculated midspan deflection is excessive (approximately 2”) in the double joist under the finishing machine rail.

Means of attaching overhang brackets to prestressed beams is not clearly indicated in the sketches. According to Burke Concrete Accessories literature, brackets should be secured with ¾” diameter bolts (A307). Inserts are mentioned in the Chemawa Overcrossing structure sketch, but holes through the beam webs would be preferable, and the holes patched after the brackets are removed.

MEZ:drh

Attachments

Figure A3.1.8.6(2)A

A3.1.8.6(2) Example Temporary Construction Review Letter

I N T E R O F F I C E M E M O

TECHNICAL SERVICES
Bridge Engineering Section
Office Phone: (503) 986-4200
Fax Phone: (503) 986-3407

August 5, 2003

File Code: DES 23 212B

TO: Project Manager

FROM: Principal Structural Design Engineer

SUBJECT: Bents 2 & 4 Column Tie-Back Supports for Riley Interchange Undercrossing
Hillsboro – Coos Bay Section
Ochoco Highway
Harney County
Bridge 2121B

Attached are two copies of a sketch relating to the subject supports. They were submitted to this office during a meeting with the contractor's falsework representatives and have been reviewed as modification of the system submitted to us through your office.

Geometric sketches, force balance diagrams, and stress calculations prepared by your office indicate that the support system will not operate satisfactorily. Our Foundation Engineer reports that a working pull-out resistance of 7 psi might be developed from a steel pile, but that the expected accompanying upward movement would produce an approximately equal horizontal movement. Added to the still unresolved problem of cable stretch, this appears to produce a system with far too much yield. We believe that column loads would instead be supported by the less-yielding bottom slab once that element is poured, and produce undesirable loads and stresses which were not allowed for in design of the structures.

Connection details do not appear to be adequate and calculated bending stresses for the pile member are excessive. However, these are considered of secondary importance in relation to the problem of movement.

Considering the amount of time already expended in evaluating and revising the tie-back proposal and the lack of progress in overcoming the apparent uncertainties of its performance, we do not believe that such a system is a practical solution to the support problems of this contract.

MEZ:drh

Attachments

Figure A3.1.8.6(2)B

A3.1.8.6(2) Example Temporary Construction Review Letter

I N T E R O F F I C E M E M O

TECHNICAL SERVICES
Bridge Engineering Section
Office Phone: (503) 986-4200
Fax Phone: (503) 986-3407

August 5, 2003

File Code: DES 23 3131B

TO: Project Manager

FROM: Principal Structural Design Engineer

SUBJECT: Girder Falsework Details for Lower Boones Ferry Road Undercrossing
Yoncalla – Nevada State Line Section
Columbia River Highway
Polk County
Bridge 3131B

The subject details have been reviewed and generally appear to be satisfactory, though lacking detail in some areas. Information developed in this review is given below to assist in your field evaluation of the falsework.

Calculated load for braces supporting fluid concrete during the column pours is about 24 k per brace. The drawings state that rated capacity is 30 k per brace at a length of 14 ft.. The safety factor incorporated in this rating is not given. If the braces are installed at the angle and distance from the column shown, their length will be about 17 ft..

The concrete footings for column braces would be more effective if placed normal to the braces rather than level as shown. Footing requirements for all temporary supports should be determined in the field for soil conditions at the site. Maximum calculated load on metal towers is about 10.5 k per leg.

The drawings do not clearly show whether the 4 x 4 joists at Bent 2 and 3 crossbeams run parallel or transverse to the beams. Either direction should be all right if spans do not exceed 4 ft..

Calculated bending stresses are relatively low in the C15 x 40 beams behind the column legs (assuming A 36 steel for the channel sections), but special care should be taken to assure stability of these narrow members.

Wedges or other adjustment devices appear necessary at the stringer bearings to achieve reasonably symmetrical loading of the beams. Positive connections between the stringers, channel-beams and posts would be very desirable as insurance against collapse triggered by vibration or minor accident.

Posts under these steel beams should be braced in two directions for stability. All bracing and connections should be field-checked for adequacy.

MEZ:drh
Attachments

Figure A3.1.8.6(2)C

A3.1.8.6(2) Example Temporary Construction Review Letter

I N T E R O F F I C E M E M O

TECHNICAL SERVICES
Bridge Engineering Section
Office Phone: (503) 986-4200
Fax Phone: (503) 986-3407

August 5, 2003

File Code: DES 23 4949B

TO: Project Manager

FROM: Principal Structural Design Engineer

SUBJECT: Girder Falsework and Membrane Waterproofing Details for Tualatin U'xing
S. Tigard Interchange – Sublimity Junction Section
Elkton – Sutherlin Highway
Klamath and Lake Counties
Bridge 4949B

The subject falsework details have been reviewed by our office and by Pacific Railroad Company and appear to be generally satisfactory. A single copy of the details is attached for your use, together with two approved samples of Royal-Seal sheeting and four approved copies of APCC asphalt plank descriptive literature. You were advised of the Railroad's satisfaction with this material by a copy of their letter of March 29.

We have not attempted to evaluate the proposed falsework footings by have marked the drawings in red with calculated post loads to assist you in determining footing requirements. A possible problem of upward deflection of cantilevered ends of some steel falsework beams was discussed with your office by phone. It is our understanding that you and the contractor believe the problem can be avoided by utilizing cant strips and setting the beams about ½" low at supports adjacent to the cantilevers.

Elevations and clearances reportedly were confirmed by your office and are assumed to be correct. As usual, a field check of the falsework should be made to assure that connections and bracing are adequate and that footings are not endangered by standing or running water.

MEZ:drh

Attachments

cc: Railroad and Utilities Engineer

Figure A3.1.8.6(2)D

A3.1.8.6(2) Example Temporary Construction Review Letter

Oregon
John A. Kitzhaber, M.D., Governor

Department of Transportation
Transportation Building
Salem, OR 97310

File Code:

May 6, 1999

DES 23 0171B

J.B. Rollingstock
Pacific Railroad Company
521 Division Blvd.
Kent OR 97000

Railroad Protection for Demolition of Existing Structure
S Tigard Interchange – Sublimity Junction Section
Elkton – Sutherlin Highway
Klamath and Lake Counties
Cook Overcrossing of APRR
Bridge 1717B

Enclosed for your review are four copies of the contractor's details (sheets 1 through 4) for protection of the railroad during demolition operations.

Our review of these drawings indicates that the system will be adequate for the intended purpose. To better ensure stability of the steel beams, we will require that cross-bracing be installed between all beams (rather than adjacent pairs) and that tensile ties be added to secure the beams together at brace locations.

Please return two sets of the drawings to this office with your comments and/or approval.

Principal Structural Design Engineer

Enclosures

bc: Project Manager
Railroad and Utilities Engineer

Figure A3.1.8.6(2)E

(Blank Page)