Arizona Department of Transportation

Bridge Group

BRIDGE PRACTICE GUIDELINES

SECTION 16 - BRIDGE CONSTRUCTION

SCOPE

This section provides supplemental information regarding the responsibilities of the bridge designer during the construction phase of the project and provides procedural and technical guidance. This information does not replace or supersede the Standard Specifications, Project Plans, Special Provisions or other official contract documents. The ADOT Construction Manual is also referred to as an excellent source for bridge construction information. This information is for general application so that information for specific projects may vary.

DEFINITIONS

Bridge Designer: The design team who produced the structural drawings and supporting documents for the bridge.

Bridge Design Engineer: The Arizona registrant who signed and sealed the structural drawings for the bridge.

Bridge Project Engineer: The Bridge Group engineer assigned to the project during the construction phase for both in-house and consultant designed projects.

Bridge Design Section Leader: The Bridge Group Section Supervisor assigned to the project.

State Bridge Engineer: The administrator of Bridge Group.

POST DESIGN SERVICES

General Provisions

The bridge design teams are advisors to the Resident Engineers for the construction of bridges and other structural related work. All communication, documents and correspondence should flow from and back to the Resident Engineer. The Resident Engineer or designated representative shall be kept informed of all pertinent structural information related to the project.

For all projects with major structures, the assigned Bridge Design Section Leader will assign a Bridge Project Engineer and issue a “Project Liaison Notice” to the Resident Engineer. For projects designed by consultants, the “Project Liaison Notice” will also identify the consultant Bridge Designer.

Pre-Construction Conference

The Resident Engineer holds a conference following award of the contract to review with the contractor and other stakeholders the requirements of the construction contract and to establish lines of communication. The Bridge Project Engineer will attend the meeting for all assigned projects containing major structures. The bridge designers and/or the Bridge Design Section Leader may also attend depending on the complexity of the project. For consultant designed projects, the Bridge Project Engineer will attend along with consultant bridge designers as appropriate. Proposed attendees will be indicated on the “Project Liaison Notice.”

Partnering Conference

ADOT and Bridge Group encourages the foundation of a cohesive partnership with the contractor and its principal sub-contractors. The objectives of Partnering are effective and efficient contract performance and completion within budget, on schedule, and in accordance with the project plans and specifications. In accordance with Section 104 of the Standard Specifications and various policies, the Partnering Conference is usually held prior to the Pre-construction Conference. Attendance guidelines for bridge personnel will be the same for both of these conferences. Proposed attendees will be indicated on the “Project Liaison Notice.”

Working Drawings

Working drawings are furnished by the contractor and shall include such detailed drawings and design sheets as may be required to perform the work that is not included with the contract documents furnished by the department. Examples of working drawing types related to structures include:

Falsework drawings
Forming plans for cast-in-place concrete
Precast girder details
Structural steel fabrication drawings
Temporary works, shoring, cofferdams, temporary bridges
Post-tensioning details
Sign structure details
Expansion joint details
Bearing details
Bridge railing details
Proprietary retaining wall details
Proprietary sound barrier wall details
Precast and stay-in-place deck panels
Miscellaneous proprietary details

General Provisions

The ADOT Standard Specifications, Section 105.03 describes the time allowed for the review of working drawings. This time does not include the time drawings are being revised by the contractor. The time period begins each time the contractor submits the original drawings or revised drawings to the Resident Engineer. In the spirit of "partnering", the Bridge Project Engineer can usually commit to a review period of two weeks or less if the project is not complex.

Working drawings which include drawings for falsework, shoring, soldier piles, cofferdams, temporary bridges and other major temporary support structures shall be prepared by and bear the seal and signature of a Professional Engineer.

All working drawings for in-house designs will be reviewed and approved by the appropriate Bridge Design Section team. All working drawings for consultant designs will be reviewed and approved by the appropriate consultant design team. "Approval" by the designer for the Engineer means approved for construction, fabrication or manufacture subject to the contractor's responsibility for the accuracy of the detailed contents. Refer to Sections 105.03 and 105.04 of the standard specifications for explanation of this important distinction.

Working drawings for bridges over or adjacent to railroad tracks shall be sent to the Project Manager who will then forward the drawings to the appropriate railroad company for their review and approval and return to the Project Manager and Engineer. The contractor should allow a minimum of three months for the review of complex working drawings such as falsework submitted for structures involving railroads.

Selected working drawings will become part of the final as-built structure drawings for permanent retention and microfilming. The selected working drawings include:

1. Post-tensioning details
2. Expansion joint details (non-standard only)
3. Proprietary bearing details
4. Proprietary retaining wall details
5. Proprietary sound barrier wall details
6. Precast and stay-in-place deck panels
7. Other working drawings for atypical structures as specified in the special provisions.

Drawing and submittal requirements are according to Section 105.03 of the Standard Specifications. All other working drawings will follow the review and approval process but will not require positive reproducibles for permanent retention and microfilming.

Upon completion of the Engineer's review of the working drawings, the drawings shall be stamped per the requirements of Section 105.03 of the Standard Specifications. All red lined revisions shall be made in red ink pen. The "approved" stamp should be applied with black ink, and all other stamps with red ink.

All positive reproducibles of selected working drawings for in-house designs shall be sent through the Resident Engineer to the appropriate Bridge Design Section. Positive reproducibles shall be stamped and noted the same as the approved working drawings and filed for future as-building. The design consultant will follow the same procedure for consultant designed projects, and hold the reproducibles in their files for future as-building by the consultant. (NOTE: working drawings for falsework, form work, other temporary works, standard details, structural steel fabrication, sign structures, bridge railings or other miscellaneous details do not need reproducibles or permanent retention unless specified in the Special Provisions because of their atypical nature.)

The Bridge Design Section red lined office copies of working drawings and calculations returned for corrections shall be kept (for reference) until the project has been completed. After a "Project Completion Notice" is received from Field Reports, the review copies may be discarded assuming no claims are still pending regarding the drawings. A copy of the "Completion Notice" will be given to the Bridge Project Engineer assigned to the project for this purpose. The final approved copy of the working drawings may remain in an example file for future reference, or it may be discarded if similar examples exist, as determined by the Bridge Project Engineer.

Falsework Drawings

Refer to sections 601-03.02 of the Standard Specifications and the ADOT Construction Manual for guidance.

Section 601 of the "Standard Specifications for Road and Bridge Construction" shall be used for determining the allowable stresses in falsework elements, allowable deflections, etc.

The reviewer should use the following general references in reviewing falsework drawings.

1995 AASHTO publication: “Guide Design Specifications for Bridge Temporary Works”

1995 AASHTO publication: “Construction Handbook for Bridge Temporary Works”

National Design Specification for Wood Construction (ANSI/NFoPA NDS-1991)

Design Values for Wood Construction (supplement to NDS)

California Falsework Manual

ACI “Formwork for Concrete” manual (Publication SP-4)

FHWA publication: “Guide Standard Specification for Bridge Temporary Works” (FHWA-RD-93-031)

Proprietary products shall be used in accordance with the manufacturer’s instructions and recommendations. Any deviation from such instructions or recommendations must be approved in writing by the manufacturer and submitted with the drawings.

Unbalanced temporary loading, caused by the concrete placement sequence, shall be considered during the review of falsework drawings.

Special attention should be given to the horizontal bracing of falsework systems since a large number of failures have been attributed to inadequate horizontal bracing. Dead loads and the associated frictional forces developed shall not be used in the analysis for the resistance to horizontal loads.

Falsework adjacent to traffic openings shall be protected from the traffic by concrete barriers, guardrail, etc. See Falsework Traffic Openings section for special requirements.

A soil bearing a pressure of 3,000 psf will normally be considered acceptable for analysis of falsework mudsills when no soils testing data is available and the soil will be in a dry condition. The use of soil pressures greater than this value must be supported by soil tests per Division II, Section 3.2.2.2. of the AASHTO Standard Specifications for Highway Bridges. The soil under mudsills must be protected from saturation by providing adequate drainage, etc.

A bearing pressure of 5,000 psf will normally be considered acceptable for mudsills supported on asphaltic pavements. Bearing pressures exceeding this value shall not be used unless data is submitted that would justify the allowance of a higher stress.

Stay-in-place expanded metal meshes shall not be used to form construction joints in bridge decks. Metal meshes may be used in other portions of a bridge structure not directly exposed to moisture as long as two inches of concrete cover is provided over the edges of the mesh.

The use of overhang brackets which require welding or any other detrimental attachment method of the bracket to any portion of a steel girder or the shear steel (slab ties) of a concrete girder will not be allowed.

The drilling of holes into a concrete girder after fabrication of the girder shall not be allowed.

A bolt hole may be formed in the top flange of an exterior concrete girder to support an overhang falsework bracket as long as the hole is cast in the girder during fabrication and the girder working drawings are coordinated with the deck falsework working drawings.

Bridge deck overhang brackets, which bolt to the web of precast girders, may be used if both the following requirements are met:

1. The bolt hole or threaded insert is cast into the girder during fabrication of the girder.
2. The deck falsework working drawings are coordinated with the girder working drawings to ensure that the hole or insert spacing will work for the specific bracket being used and the loads being applied to the bracket.

The bottom slab, web walls and diaphragms of CIP box girder bridges shall be placed monolithically unless noted otherwise on the contract plans.

The slanted exterior girders of CIP box girder bridges shall be supported laterally by external bracing until the concrete deck has been placed and has attained at least 70 percent of it's required 28 day strength.

Cast-in-place box girder bridges supported on falsework systems containing a traffic opening should be designed for zero tension. The reviewer must check with the designer to be sure that the superstructure was designed for zero tension. This applies only to those portions of the superstructure falling within the post-tensioned frame having the traffic opening. When the superstructure has been designed for zero tension, cracking of the bottom slab and girder webs during placement of the concrete deck is not critical and need not be analyzed.

However, the bottom slab and girder webs of CIP box girder bridges designed for concrete tensions greater than zero must not be allowed to crack during placement (loading) of the deck. Therefore, the falsework designer must analyze and ensure that cracking of the girder webs and bottom slab will not occur in such cases when the superstructure is being cast on conventional falsework. This is especially true at larger falsework spans such as at traffic openings.

Superstructures being cast on earthen falsework fills need not be checked for cracking.

The determination of falsework settlement/deflections and the proper adjustment of falsework grades shall be the responsibility of the Contractor and it's Professional Engineer.

For CIP, post-tensioned, box girder bridges containing hinges, the reviewer shall verify that the Contractor's falsework drawings include a method to adjust the superstructure elevation at the hinge. The adjustment may be required prior to the hinge closure pour to match the superstructure grades and provide a smooth ride. The project plans will give the dead load requirements for the adjustment locations. Adjustment methods such as jacking pits, jacking towers and counterweights may be used depending upon the superstructure falsework method. Also, the hinge must be designed to carry the additional span loading shifted to the hinge area during the post-tensioning process.

Falsework calculations submitted by the contractor are considered to be additional information for assisting in the review of the falsework drawings and therefore need not be approved. Any information or details shown in the calculations that are needed to construct the falsework properly shall be shown on the falsework drawings.

Red lined copies of the calculations may be returned to the contractor to identify where the errors were made. The Bridge Design Section's red lined office copies of the returned calculations shall be kept until the project is completed and a "Project Completion Notice" is received from Field Reports.

The Standard Specifications require that prior to concrete placement, the Contractor's Professional Engineer inspects the completed falsework and issues a properly signed and sealed certificate that the falsework has been constructed in accordance with the approved falsework drawings.

Falsework Traffic Openings

Falsework Requirements

To ensure that traffic handling is given proper consideration in the early design stages, it is necessary to identify traffic handling and falsework assumptions in the Bridge Selection Report. If falsework is to be used, the horizontal and vertical clearances shall be shown on the General Plan. Usually, one of the following listed conditions will prevail:

1. Traffic will be routed around construction site.
2. Traffic will pass through construction site.

    A. No falsework allowed over traffic. This restriction would require precast concrete or steel superstructure with field splices located clear of traffic.
    B. Stage construction required. Stage construction must be detailed on the plans. Construction joints or hinges would be required.
    C. Falsework openings required. The size and number of openings must be shown.

General discussions and a table of falsework openings are covered under "Falsework Clearances".

Falsework Use

When traffic must pass through the construction site, three possible conditions exist. Condition 2.A. is limited to sites which can be spanned by precast members or where steel is competitive in cost. The staged construction option of Condition 2.B. is not always feasible while the presence of a hinge is a permanent disadvantage. Condition 2.C. is used for all other cases when it is necessary to route traffic through the construction site. The elimination of permanent obstructions by using longer spans and eliminating shoulder piers will usually outweigh objections to the temporary inconvenience of falsework during construction.

Falsework Clearances

For cast-in-place structures, the preferred method of construction is to route traffic around the construction site and to use earth fills for falsework. This provides an economical solution, a safe working area and eliminates possible problems associated with the design, approval, construction and performance of falsework including the possible effect of excessive deflections of falsework on the structure.

When the street or highway must be kept open and detours are not feasible, falsework shall be used with openings through which traffic may pass. Because the width of traffic openings through falsework can significantly affect costs, special care should be given to minimizing opening widths consistent with traffic and safety considerations. The following should be considered:

1. Staging and traffic handling requirements.
2. The width of approach roadway that will exist at the time the bridge is constructed.
3. Traffic volumes and percentage of trucks.
4. Vehicular design speed.
5. Desires of local agencies.
6. Controls in the form of existing facilities.
7. The practical problems of falsework construction.
8. Consideration for pedestrian requirements.

The minimum width of traffic openings through falsework for various lane and shoulder requirements shall be as shown in Table 1. The resulting falsework span shown in Table 1 is the minimum span. When temporary concrete barrier is used, two feet of safety margin per side is allowed for deflection. When blocked-out “W” beam is used, four feet of safety margin per side is allowed for deflection. Refer to Figure 1. The normal spans may be reduced or increased if other forms of protection are used depending on the required space for installation and deflection. The actual width of traffic openings through falsework and the resulting falsework span to be used in design shall be determined by Traffic Design Section and shall be stated in the Bridge Selection Report.

To establish the grade line of a structure spanning an existing street or highway, allowance must be made for depth of falsework, where used, to provide the clearance needed to permit traffic through the work area during construction. The minimum allowances to be made for depth of falsework shall be as shown in Table 2 and shall be based on the actual falsework openings determined by Traffic Design Section.

The minimum vertical clearance for falsework over freeways shall be 16 feet 0 inches.

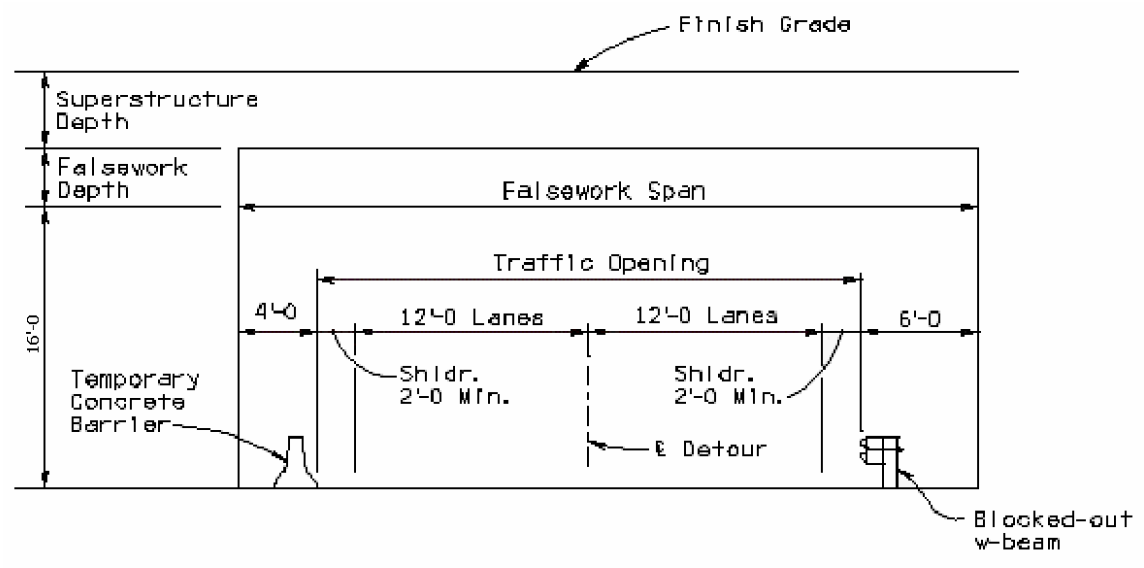


FIGURE 1

TYPICAL FALSEWORK OPENING

NOTE:
Special consideration shall be given to limit the maximum allowable tension in a precompressed tensile zone of post-tensioned box girder bridges supported on falsework with large openings.

	Detour	Roadway	Minimum Width	Resulting Falsework Span (1)	
Facility to be spanned	No. Lanes	Shoulder Widths	of Traffic Opening (1)	Temporary Conc. Barrier	Blocked-out "W" beam
Freeway & Non-Freeway	1	2' & 2'	16'	24'	28'
	2	2' & 2'	28'	36'	40'
	3	2' & 2'	40'	48'	52'
	4	2' & 2'	52'	60'	64'

TABLE 1

FALSEWORK SPAN REQUIREMENTS

NOTE: Traffic Opening and Falsework Span are measured normal to detour centerline.

Min. Required Falsework Depth \ Falsework Opening	24	28	36	40	48	52	60	64
Max 2300 lb / ft DL per girder line	1'-7	1'-8	1'-11	2'-8	3'-0	3'-6	3'-7	3'-9
2300 - 3100 lb / ft DL per girder line	1'-8	1'-10	2'-8	2'-11	3'-6	3'-8	3'-9	3'-10

TABLE 2

FALSEWORK DEPTH REQUIREMENTS

NOTES:

(1) DL based on 160 pcf concrete.
(2) Table 2 is based on the superstructure concrete being designed for zero tensile stress at the falsework openings. Superstructures designed with concrete tensile stresses can significantly increase the required falsework depths shown in the table and amount of falsework required.
(3) Structures with greater than 3100 lb / ft Dead Load per girder line will require special considerations for required falsework depths.

Forming Plans for Cast-In -Place Concrete

Refer to Sections 601-3.02 of the Standard Specifications and the ADOT Construction Manual for specific guidance. Submittal of formwork drawings and calculations are normally not required unless requested by the bridge designer for unusual applications.

Formwork drawings and calculations are required for the cast-in-place girders (webs) on box girder bridges. These drawings shall go through the same submittal and review process as falsework drawings. Formwork drawings are intended to assist the Contractor in developing a well thought-out plan and avoid unforeseen problems during the concrete pours of these very important (and difficult to repair) bridge members. As in the case of falsework drawings, reproducible and permanent retention will not be required.

Precast Girder Details

The working drawings should also include the "Fabrication Details". These details describe how the girders will be fabricated (i.e. placing and curing of concrete, jacking and releasing of the strands, etc.) and should also include calculations for the elongation of the strands during the jacking process.

Concrete mix designs that may accompany the "Fabrication Details" should be forwarded to the Structural Materials Engineer in the Materials Group for review and approval.

Strand hold-downs may vary horizontally plus or minus 10 inches from the points shown on the contract drawings.

The Bridge Design Engineer shall send two (2) sets of approved precast girder details to the Structural Materials Engineer in the Materials Group for use in field inspection.

Reproducible drawings and permanent retention will not be required.

Structural Steel Fabrication Drawings

Refer to Section 604 of the Standard Specifications and the ADOT Construction Manual for specific guidance. Reproducible drawings and permanent retention normally will not be required. For atypical structures, provisions for permanent retention should be specified in the project Special Provisions.

There are several possible scenarios regarding structural steel designs and the interrelationship of design, working drawing review and in-shop structural steel inspection. They are as follows:

1. In-house Designs --- working drawing review is provided by in-house staff and the steel inspection is provided by the ADOT on-call inspection agency.

2. In-house Designs --- working drawing review is provided by in-house staff and the steel inspection is provided by an ADOT selected inspection agency under a special contract that is project specific.

3. Consultant Designs --- working drawing review is provided by the consultant designer and the steel inspection is provided by the ADOT on-call inspection agency

4. Consultant Designs --- working drawing review is provided the consultant designer and the steel inspection is provided by a consultant selected inspection agency under a special contract that is project specific.

Generally, a special inspection contract will be negotiated for structural steel inspection on large to very large fabrication projects, especially if the steel is to be fabricated out-of-state. The specific circumstances of the project and the availability of the ADOT on-call inspection agency will be the deciding factor.

The "Project Liaison Notice" should designate who has the responsibility of providing for shop inspection of the structural steel.

The Bridge Design Sections will provide for in-shop structural steel inspection except on large fabrication projects designed by consultants and as noted herein. The inspection will be provided through the use of a certified steel inspection agency under contract with ADOT.

The ADOT Standard Specifications Section 105.03 describes the time allowed for the review of working drawings. This time does not include the time drawings are being revised by the contractor. The time period begins each time the contractor submits the original drawings or revised drawings to the Resident Engineer. In the spirit of "partnering", the Bridge Project Engineer can usually commit to a review period of (2) weeks or less if the project is not complex.

Steel Girder Details

Shop welded splices in steel girders will not be allowed unless permitted by the plans and specifications. When permitted, the locations of the welded shop splices and welding procedures for the splices must be shown on the working drawings.

Transverse welds in tension flanges will not be permitted.

Transverse welds across the ends of steel girder cover plates will not be permitted.

A separate inspection contract will generally be negotiated by the Bridge Design Section (with the assistance of Engineering Consultant Services) for out-of state fabrications (except for small jobs) or large in-state fabrications. If the girders are designed by a consultant, the consultant should negotiate and monitor the contract. (see Project Liaison Notice)

Structural Steel Shop Inspection Procedures

Notification of Inspection

The Bridge Project Engineer assigned to the project shall verbally notify ADOT's on-call Inspection Agency of the need for shop inspection services when the first working drawing submittal is received by the Bridge Design Section for review and approval. The Inspection Agency shall be given the name, address and telephone number of the fabricator at this time so that the Inspection Agency can contact the fabricator and make arrangements for the shop inspection. When the design, review and approval of the working drawings are done by a design consultant, the Resident Engineer should be asked to supply the fabricator information to the Bridge Project Engineer at least two (2) weeks in advance of the need for shop inspection.

The verbal notification shall be followed up in writing by the Bridge Project Engineer as soon as the working drawings are approved or when approved working drawings are received from the design consultant. This written notification should include the standard notification letter, a copy of the working drawings, and appropriate sections of the special provisions and contract plans. When the inspection is for high-load multi-rotational bearings (pot, disc and spherical), the approved load testing requirements shall be included with the notification letter. A copy of the notification letter shall be sent to the Resident Engineer and ECS Coordinator.

Required Inspection Documents

The inspection documents shall include the following:

1. Certificates of Compliance
2. Material Certifications (includes heat reports, charpy test reports, etc.)
3. Welder Qualifications
4. Copy of Certificate(s) for Contractor's Quality Control Personnel
5. Welding Procedures
6. Welding Rod and/or Wire Certifications
7. Reports from the Inspection Agency:
   -Inspection Reports (progress reports)
      These reports should indicate what was inspected and the results of the inspection, hours of inspection, hours of travel, etc.
   - Radiographic (x-ray) Reports and X-ray Film
   -Ultrasonic Test Reports
   -Magnetic Particle Test Reports

The Inspection Agency should collect only one (1) of the three (3) original certificates of compliance from the fabricator for the Bridge Design Section project file. The remaining two (2) certificates of Compliance should be left with the fabricator for delivery to the Resident Engineer through the general contractor.

The material certifications shall be checked against the working drawings, standard details or contract plans to ensure that all the required material certifications have been received from the Inspection Agency.

Review of Inspection Invoices

The invoice shall include the hours of inspection, hours of travel, air fare and hotel charges along with receipts, amount of x-ray film used, pounds of flux powder used, etc. The number of units charged on the invoice shall agree with the number of units shown on the inspection reports.

The number of units charged on the invoice should then be multiplied by the prices given in the Steel Inspection Contract to arrive at the total costs for services rendered.

After the Bridge Project Engineer has determined that all the required inspection documents have been received for the inspection work covered by the invoices and that the invoices are correct, the Engineer shall then sign and date the "Individual Project" payment report for each project. The signed "Individual Project" payment reports should then be given to the Project Monitor in Design Section "B".

The Project Monitor will then review the "Master Projects" payment report for correctness, sign and date the "Master Projects" payment report and send it along with the invoices to Engineering Consultant Services. A copy of the "Master Projects" payment report will be given to the Bridge Design Leaders for distribution to the Bridge Project Engineers within their design sections who are assigned to the projects.

Completion of Inspection

At the completion of fabrication, the Inspection Agency should state on the inspection report that it is the final report and fabrication and inspection is complete.

At the completion of fabrication and inspection, the Bridge Project Engineer shall send copies of all the inspection documents to the Resident Engineer. In addition, copies of the material certifications and all other materials related documentation shall be sent to the Assistant State Engineer of the Materials Group for their files.

Post-tensioning Details

Refer to Section 602 of the Standard Specifications and the ADOT Construction Manual for specific guidance.

Anchorage devices shall meet the requirements of AASHTO Standard Specifications, Division I, Article 9.21.7.2. Special anchorage devices not meeting the specification may be acceptable if tested by an independent testing agency which is acceptable to the Bridge Design Engineer. The testing procedures shall be in accordance with AASHTO Standard Specifications, Division II, Article 10.3.2. This requirement supersedes the 1990 ADOT Standard Specification Section 602-3.02 and should be included with the project Special Provisions.

Post-tensioning systems which have been tested and approved by the California Department of Transportation (Caltrans), will be considered an acceptable alternate to the AASHTO testing criteria. A copy of the approval letter from the Caltrans "Division of New Technology and

Research", including any details associated with the approval, shall be submitted with the shop drawings by the post-tensioning company.

General Zone and Local Zone reinforcing requirements shall be reviewed by the Bridge Design Engineer to ensure that the original design assumptions are reflected by the post-tensioning working drawings. If the post-tensioning components shown on the working drawings are different from the original design assumptions, a change order may be required to revise the general zone and/or local zone reinforcing details to meet the requirements of AASHTO Standard Specifications, Division I, Article 9.21.2.

The duct LOL (Lay Out Line) dimensions should be accurately shown on the working drawing to within 1/8 inch of the theoretical dimension. The LOL dimensions are typically measured from the bottom of the superstructure (soffit) to the bottom of the duct. Spacing of the LOL dimensions along the tendon paths should not exceed 15 feet in order to provide adequate field layout control.

The Bridge Design Engineer shall send two (2) sets of approved post-tensioning details to the Structural Materials Engineer in the Materials Group for use in field inspection.

Sign Structure Details

Shop inspection will be provided by the appropriate Bridge Design Section on-call inspection agency for the fabrication of all truss and tubular sign structures except where a large number of signs are being fabricated out-of -state on projects designed by consultants. In such cases, the Consultant should negotiate and monitor a separate inspection contract for the project. (see Project Liaison Notice)

Review and approval of sign structure working drawings will be performed by the design consultant on projects having a large number of standard sign structures and designed by the consultant. Generally, working drawings for consultant designed projects with only two or three sign structures or projects that have been designed in-house will be reviewed and approved by the appropriate Bridge Design Section. (see Project Liaison Notice)

The Bridge Design Section is not responsible for working drawing reviews or steel inspections on tapered tube or ground mounted sign structures (i.e. breakaway signs). Those are the responsibility of the Traffic Design Sections located in the Traffic Group.

For signs placed on new highway sections, column lengths shall be based on the foundation elevations called for in the contract drawings and the working drawing column lengths approved accordingly. The new embankment slopes will be graded to match the foundation elevations per Subsection 606-3.01 of the Standard Specifications.

For signs placed on existing highway sections, a field survey of the new foundation elevation and verification of column lengths by the Traffic Group may be required. This will occur when the project does not include a contract item for grading slopes.

Shop inspection of in-house and consultant designed bridge sign mounts (mounts used to install signs on traffic bridges) will be provided by the Bridge Design Section on-call inspection agency.

Expansion Joint Details

Aluminum expansion joints of any type will not be allowed.

The top surface of the compression seal shall be located between ¼ and 3/8 inches below the top surface of the joint angles per the B-24.20 standard drawing. This will provide space between the bottom surface of the seal and the top surface of the "g" bars so that the seal can bulge downward when being compressed.

Shop inspection for expansion joints will not be provided by the Bridge Design Section on-call inspection agency unless they are fabricated at the same shop as other items requiring shop inspection on the same project. Shop inspection of the other items must have also been provided for by the Bridge Design Section on-call inspection agency. Expansion joints not inspected at the shop should be inspected by field personnel prior to installation.

Bearing Details

Working drawings for bearing pads and neoprene strip type bearings will generally not be reviewed by the Bridge Design Section except for in-house designs when specifically requested by the Resident Engineer.

Working drawings and load testing requirements for high-load multi-rotational bearings (pot, disc and spherical bearings) and any specially designed sliding bearings will be reviewed and approved by the Bridge Design Engineer.

Load testing of high-load multi-rotational bearings (pot, disc and spherical bearings) shall be witnessed by ADOT'S on-call Inspection Agency on all in-house designs and consultant designs with few tests. The consultant shall make arrangements with a private testing firm for witnessing of the load tests on consultant designs which contain a large number of bearing tests. A final report shall then be written by the Inspection Agency regarding the results of the witnessed load testing and submitted to the Bridge Design Engineer for approval and then to the appropriate Bridge Design Section for payment of services. Refer to the latest applicable project for an example of procedures and report requirements.

In addition to the usual notification letter, the final report requirements, approved load testing procedures, approved working drawings, copies of the specifications and plans, and all other applicable documents shall be sent to the on-call Inspection Agency for their use in implementing this procedure.

Bridge Traffic Railing and Pedestrian Railing Details

Working drawings for bridge traffic railing and pedestrian railing will be reviewed and approved by the appropriate Bridge Design Section for both in-house and consultant designs. Generally, bridge traffic railing and pedestrian railing are in-house standard designs or retrofits for existing bridges.

Shop inspection of bridge traffic railing will be provided for by the Bridge Design Section on-call Inspection Agency. Shop inspection for bridge pedestrian railing will not be required.

Change Orders, Force Accounts and Fiscal Variance Reports

The Bridge Design Section's copy of all change orders, force accounts and fiscal variance reports shall be placed in the project file.

A copy of any detail drawings that may be associated with a change order shall also be attached to the contract plans (rack set).

An office memo to the Resident Engineer will be required to initiate change order or force account, A transmittal letter or E-mail is not acceptable. The memo shall state the reason for the design change and request a copy of the executed change order or force account. If plans or details are being provided, ten (10) copies shall be provided with the memo.

Drawings or details for change orders are required to be sealed.

Change orders initiated by consultants and others shall be reviewed by the Bridge Project Engineer, and approved by the State Bridge Engineer.

Field Engineering

At the request of the Resident Engineer, the Bridge Project Engineer shall provide the Resident Engineer with field assistance on construction problems involving structures.

Arrangements for field contacts shall be made with the Resident Engineer in advance. The Bridge Project Engineer or designated representative should meet with the Resident Engineer or designated representative upon arrival at the construction site and assist in the resolution of the construction problem.

The Bridge Project Engineer shall not direct the contractor at any time. Recommendations or advisement concerning construction shall be made to the Resident Engineer or designated representative only.

The Bridge Project Engineer and/or designated team members should visit the work site of major bridge construction projects at specified milestones such as foundation pour, girder placement, deck pour, etc. according to the bridge type. The Bridge Project Engineer shall coordinate/schedule the visits with the Resident Engineer.

ADOT personnel shall wear a hard hat and safety vest while at the construction site. Personal safety should be observed at all times especially when around construction equipment.

Solutions to construction problems that will result in a change from the original design plans will require approval from the Bridge Design Engineer and shall be discussed with the Section's Bridge Design Leader. The Arizona Board of Technical Registration Rule R4-30-304 requires that the Design Engineer's seal and signature appear on drawings, details or calculations that modify the original design bearing his/her seal.

The Bridge Project Engineer is responsible for resolving field problems on all in-house designs shown in the contract drawings as well as problems associated with details in the "Bridge Group Standard Drawings". NOTE: Bridge Group is not responsible for tapered tube or ground mounted signs. Working drawings for tapered tube or ground mounted signs shall be forwarded to Traffic Group for review and the Resident Engineer so notified.

The Bridge Design Sections will play an advisory role in construction problems that affect the designs of consultants and therefore such construction problems should be referred to the consultant. However, it should be kept in mind that ADOT is the owner of the structure(s) and will have final responsibility for the integrity and maintenance of the structure(s). Therefore, it is the responsibility of the Bridge Design Sections to participate in the problem solving process to arrive at a consensus. For this reason, a copy of the consultant's solutions to such problems must be transmitted to the assigned Bridge Design Section in an expeditious manner. In addition, the Bridge Design Sections may be required to make the final decision in situations where the consultant and contractor can not agree on a timely solution to the problem.

In general, the Bridge Design Sections will provide assistance to Resident Engineers on construction problems of a structural nature.

Value Engineering Proposals

The Bridge Design Sections will participate in the review of Value Engineering Proposals submitted to the Resident Engineer if the proposal is structural in nature or may affect a structure. Participants should include the Design Section Leader, the Bridge Project Engineer, and the Bridge Designer.

Proposals to change the basic design of a bridge will not be considered. Savings solely from the elimination or reduction of a bid item will not be considered as a Value Engineering Proposal.

Accurate time records shall be maintained for all Value Engineering Proposal reviews. If the Value Engineering Proposal is accepted, the cost for review and investigation of the Proposal as well as subsequent costs that may be realized by the Bridge Designer will be deducted from the estimated savings. If the Proposal is rejected, the costs associated with the review will be shared between the Contractor and the Department. The District is responsible for preparing the necessary Change Order and determining the final net savings or costs that will be split between the Contractor and the Department.

The hourly rate(s) for review will be set by the Bridge Project Engineer.

BRIDGE CONSTRUCTION OVERLOAD POLICY

General Provisions

When economics, safety or other reasons dictate that overload vehicles be allowed to haul excavation or borrow over bridge structures during construction, the affected bridges shall be designed in accordance with the criteria contained in this policy statement. As with all design criteria, good engineering judgment must be used in applying the criteria to the unique aspects of each project.

The decision to design structures for construction overloads must be made early in the project development. Details should be included with the Bridge Selection Report. To justify such action, there must be sufficient savings identified to offset the increased cost in constructing the bridges to withstand these heavier loads. A proposed scheme for hauling must be developed including identification of affected structures, identification of design load type, location of haul and return lines and identification of the method of lane delineation (use of concrete barriers). The decision to design bridges for construction overloads and the identification of the hauling scheme details must be made prior to initiation of any final bridge design. Where feasible, haul roads should be located such that the strengthened portion of the bridge will benefit future traffic.

The bridge designer must also identity whether temporary or permanent approach slabs are to be used and the method of dealing with joints and bearings.

Construction plans shall show the axle reactions of the design overload vehicle, the overload design criteria and the location of haul lanes and details. Construction overloads different than those shown on the plans will be allowed, provided they do not produce a more critical load than that produced by the specified design overload. The plans or special provisions should indicate the any vehicle may be used, provided the induced moments and shears are not greater than that of the design overload. It should be further stated that it is the contractor's responsibility to evaluate and make his own determination as to the acceptability of such a vehicle during the bidding process. The low bidder shall submit his proposed vehicle for approval by the Engineer.

Design Overloads

Two types of design overload vehicles are available. For projects involving major earthwork hauls where use of special overload trucks would be economical, the bridge structures shall be designed for the Load I overload as shown in Figure 1. For projects with large internal hauls where use of scrapers is anticipated, the bridge structures shall be designed for the Load II overload as shown in Figure 2. All bridges designed for construction overloads shall also be designed for the HS20-44 truck and/or the alternate military loading as required in accordance with Bridge Group design policy with the more critical loading controlling the design.

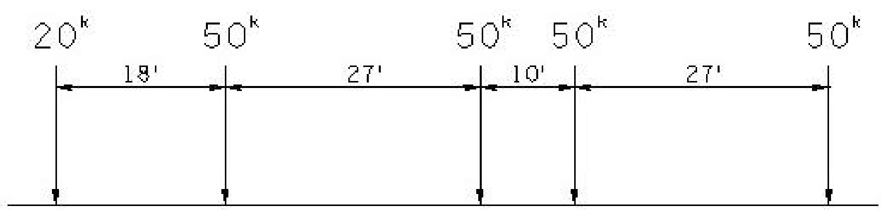


FIGURE 1
LOAD I OVERLOAD

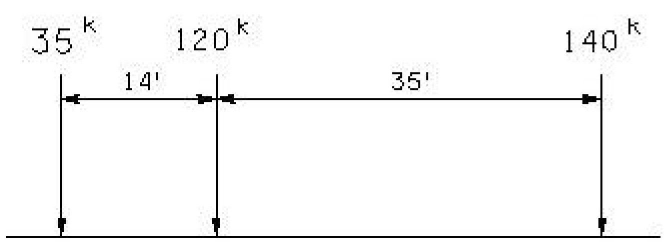


FIGURE 2
LOAD II OVERLOAD

Wearing Surfaces

The 25 psf future overlay should not be included in analyzing for overloads.

The usual procedure of treating the top ½ inch of the deck as a wearing surface is waived for design of construction overloads.

Deck Design

Bridge decks shall be designed for the following criteria:

	HS20-44/Alt Milt	Load I	Load II
Transverse reinf.	Grade 60 fs = 20 ksi	Grade 60 fs = 24 ksi	Grade 60 fs = 24 ksi
Concrete Min. Max.	f'c=4500 psi fc =1400 psi	f'c=4500 psi fc =1800 psi	f'c=4500 psi fc =1800 psi
Impact	30%	30%	50%

The deck shall also be designed for the dead load of temporary barriers. The deck shall have the same thickness across the entire width of the deck but the reinforcing may vary.

Superstructure Design

Individual girders for prestressed concrete bridges shall be designed for the following criteria:

	HS20-44/Alt Milt	Load I	Load II
Impact	AASHTO	30%	30%
Allowable Tension	(Prestressed concrete)		
DL + P/S	0	0	0
DL + ILL + I + P/S	$3\sqrt{f'c}$	$6\sqrt{f'c}$	$6\sqrt{f'c}$

Prestressed concrete bridges shall be designed for overloads on an individual girder basis, with each girder designed for the appropriate distributed live load. The composite dead load due to temporary barriers may be distributed equally to all girders under the haul lane. The girder spacing for post-tensioned box girder bridges shall be uniform across the width of the structure with the specified jacking force equal for all girders. The girder spacing for prestressed concrete girder bridges may vary across the width of the structure with closer girder spacings allowed in the region of the haul lanes. However, all girders in the bridge shall have the same design (i.e. same prestressing force and center of gravity).

Distribution of wheel loads for typical prestressed concrete bridges with maximum girder spacings less than 10 feet, shall be as contained in AASHTO Article 3.23 using the column in Table 3.23.1 for One Traffic Lane.

Haul lanes shall be located on the bridge so that construction overloads will not become the critical load for the design of exterior girders.

The special provisions shall prohibit more than one loaded overload vehicle on a bridge at a time.

In addition to the Working Strength Design Method criteria of AASHTO, prestressed concrete overload bridges shall also be designed to meet the ultimate moment capacity requirements of the Load Factor Design Method. Individual girders shall be designed using the same live load wheel distribution for ultimate strength as was used for working stress.

Shear for prestressed concrete girders shall be designed using the Load Factor Design Method in accordance with the provisions of the 1979 AASHTO Interim Specifications.

In calculating the ultimate moment and shear, the following factored load shall be used: 1.3 (DL + 5/3 (LL + I)).

For concrete structures designed for the Load I overload, a single 12 inch thick diaphragm shall be placed at the midspan for spans up to 80 feet, and 12 inch thick diaphragms shall be placed at the quarter points for spans over 80 feet. For concrete structures designed for the Load II overload, 12 inch thick diaphragms shall be placed at the quarter points.

Design criteria for steel girder superstructures must be developed on a project specific basis. The designer shall develop the criteria consistent with the intent of this policy and submit for approval prior to design.

Substructure Design

Substructure units, including bearings, pier caps, columns and footings, shall be checked for the effects of the design overload vehicle. Normal methods of live load distribution with no provisions for additional allowable overstresses should be used.

Specifications

The following specifications should be added to the Special Provisions.

The Contractor may use any construction overload vehicle to haul excavation or borrow across the designated bridges provided the induced moments and shears are not greater than those of the design overload. It shall be the responsibility of the Contractor to evaluate and make his own determination as to the acceptability of such a vehicle during the bidding process. The Contractor shall submit his proposed vehicle for approval by the Engineer.

Overload bridges have been designed assuming only one loaded overload vehicle will be on the bridge at a time. It shall be the responsibility of the contractor to develop a plan to enforce this requirement and submit to the Engineer for approval.

CONSTRUCTION JOINT GUIDELINES

General Provisions

The type of structure and method of construction, combined with sound engineering judgment, should be used in determining the number and location of superstructure construction joints. The use of construction joints should be minimized for ease of construction and subsequent cost savings. Some items which should be considered are:

1. Method of construction - earthen fill falsework, conventional falsework or girder bridge without falsework.
2. Phase construction because of physical constraints such as traffic handling.
3. Span length and estimated rotation and deflection.
4. Degree of fixity at abutments and piers.
5. Effects of locating a construction joint in a region of negative moment.
6. Volume of concrete to be poured without a joint
7. Consequences of continuous pour, including adverse effects caused by a breakdown during the pour.

Reference is made to the ADOT Standard Specifications for Road and Bridge Construction, Subsection 601-3.03 Placing Concrete and Subsection 601-3.04 Joints in Major Structures. Some important requirements regarding construction joints contained in the Standard Specifications are as follows:

1. The sequence of concrete placement shall be as shown on the project plans or as approved by the Engineer when not show on the project plans.

2. The rate of concrete placement and consolidation shall be such that the formation of cold joints within monolithic sections of any structure will not occur.

3. The rate of concrete placement for major structures shall not be less than 35 cubic yards per hour unless otherwise specified or approved in writing by the Engineer.

4. Placement of the deck concrete shall be in accordance with the placing sequence shown on the project plans.

5. The Contractor shall submit drawings showing the placement sequence, construction joint locations, directions of the concrete placement and any other pertinent data to the Engineer for his review. The drawings shall be submitted at least four weeks prior to the date of deck placement.

6. Construction joints shall be placed in the locations shown on the project plans or as approved by the Engineer.

7. All construction joints shall be perpendicular to the principal lines of stress and in general located at points of minimum shear and moment.

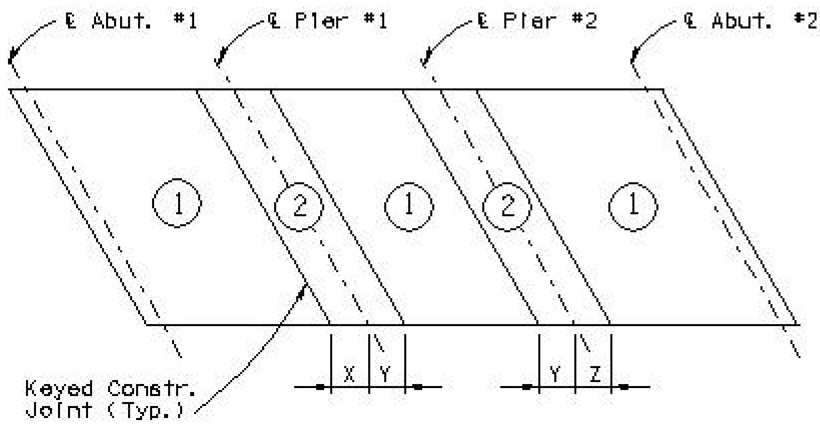
Longitudinal Construction Joints

Longitudinal construction joints in bridge decks and/or superstructures should be identified as optional unless required by construction phasing. The optional deck joints should be placed on lane lines or at center of structure. All longitudinal construction joints should be keyed.

Precast Concrete Girder Bridges

Precast concrete girder bridges made continuous over supports shall have transverse construction joints placed so that the girders undergo their positive moment deflections prior to the final pour over the negative moment areas of the fixed piers or abutments. There shall be no horizontal construction joint between fixed pier diaphragm or fixed abutment diaphragm and the deck.

Girder bridges will usually require details on the plans showing a plan view with joint locations, deck pour sequence and direction of pour, if required. There should be a minimum of 12 hours between adjacent pours. Construction joints where required should be parallel to the centerline of the pier. Their location will be near the point of minimum dead load plus live load moment and shear. This distance is generally one-quarter of the span length from the pier if the adjacent spans are approximately equal length. Following is a typical example of a deck pour schedule with notes for a typical precast concrete girder bridge with expansion seat-type abutments:



<u>DECK POUR SCHEDULE</u>
(Precast Concrete Girder)

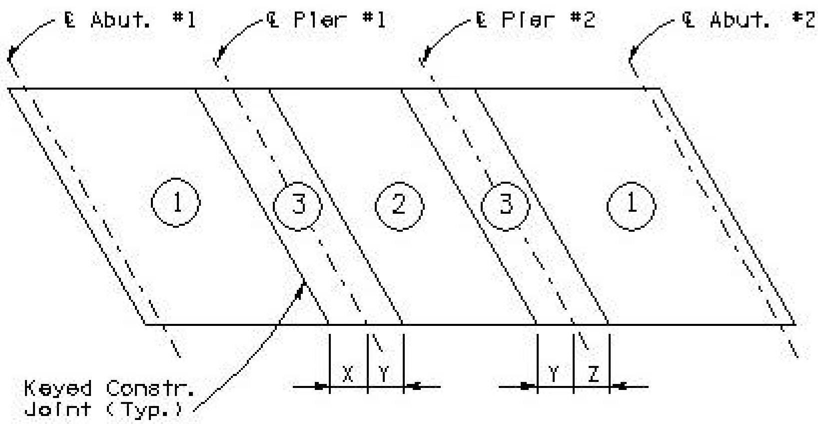
POUR NOTES:

1. Numbers ① & ② indicate placing sequence of deck concrete. Pour ② sections a minimum of 12 hours after adjacent ① sections have been poured.
2. Intermediate diaphragms, expansion pier diaphragms and expansion abutment diaphragms shall be poured prior the deck pour.
3. Fixed pier and fixed abutment diaphragms shall be poured concurrent with the deck pour.
4. Sections ① and ② may be poured consecutively but only in the direction from ① to ② and a minimum of 12 hours after the adjacent ① section has been poured.
5. The Contractor shall submit a Deck Pour Schedule to the Engineer for approval prior to placing concrete.

Steel Girder Bridges

The effects of uplift and allowing a continuous pour should be considered when developing deck pour schedules for multi-span continuous steel girder bridges. The required rate of pour should be compared to the quantity of concrete to be placed and the potential for poured sections to set up and develop tensile stresses from pours in adjacent spans shall be considered when determining the need for construction joints. Consideration must be given to the potential for negative moment stresses in the deck due to placement of positive moment pours in adjacent spans.

Girder bridges will usually require details on the plans showing a plan view with joint locations, deck pour sequence and direction of pour, if required. Except where otherwise required, there should be a minimum of 12 hours between adjacent pours. Construction joints, where required, should be parallel to the centerline of the pier. Their location should be near the point of dead load counterflexure. Following is a typical example of a deck pour schedule with notes for a typical steel girder bridge with expansion seat-type abutments:



DECK POUR SCHEDULE
(Steel Girder)

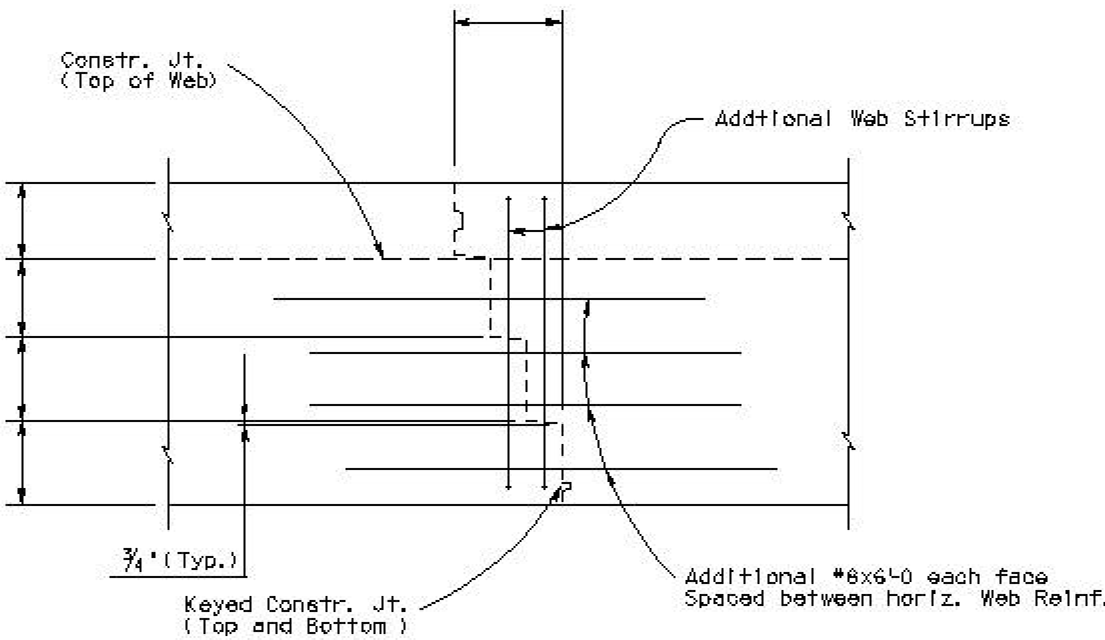
POUR NOTES:

1. Numbers ①, ② & ③ indicate placing sequence of deck concrete. Pour ② sections a minimum of 48 hours after ① sections have been poured. Pour ③ sections a minimum of 12 hours after adjacent ①& ② sections have been poured.
2. As an alternate, ① and ② sections may be poured consecutively in sequence in one direction only. The rate of pour shall be such that each new section shall be poured before the previously poured adjacent section has set.
3. Sections ② and ③ may be poured consecutively but only in the direction from② and ③ and a minimum of 48 hours after the adjacent ① section has been poured.
5. The Contractor shall submit a Deck Pour Schedule to the Engineer for approval prior to placing concrete.

Cast-In-Place Box Girder Bridges

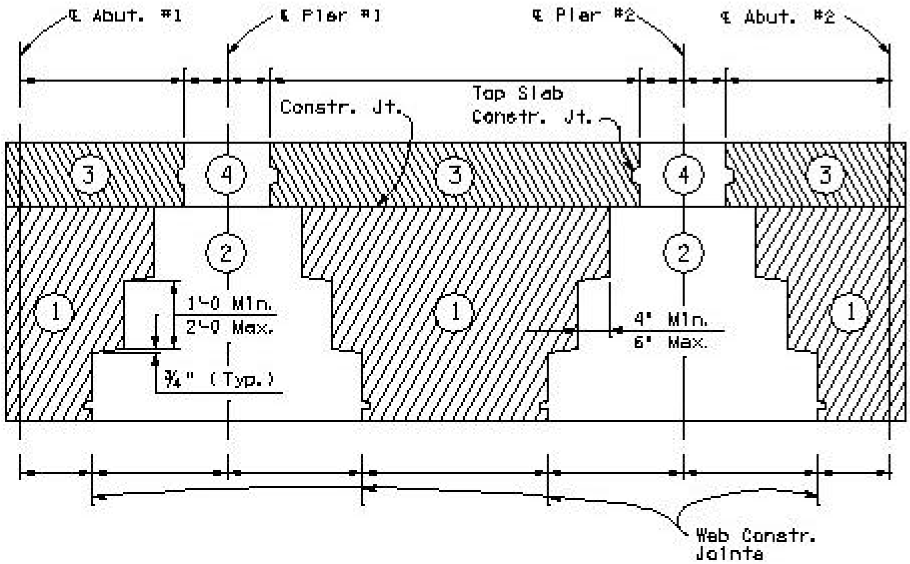
Box girder bridges made continuous over supports shall have transverse construction joints placed so that the webs undergo their positive moment falsework deflections prior to the final pour over the negative moment areas of the fixed piers or abutments if the superstructure formwork is supported on conventional falsework. The transverse construction joints may be omitted if the superstructure formwork is supported on earthen fill. The webs and all diaphragms should be poured concurrently with the bottom slab. Transverse construction joints where required should be parallel to the centerline of the pier. Their location near the inflection point is generally one-quarter of the span length from the pier if the adjacent spans are approximately equal length.

Following is a typical example of required details and notes for a cast-in-place box girder bridge with integral fixed piers and expansion seat-type abutments.



WEB CONSTRUCTION JOINT DETAIL

NOTE: Web stirrups shown in above detail are in addition to the web stirrups spacing shown on sheet ____ of ____. Adjust spacings as required to maintain minimum clearances for concrete placement and vibration.



POUR SCHEDULE

Pour Notes:

1. Numbers ① & ② indicate placing sequence of bottom slab, girder web and diaphragm concrete.
2. Numbers ③ and ④ indicate placing sequence of top slab.
3. There shall be 12 hour minimum interval between adjacent pours.
4. Sections ③ and ④ may be poured consecutively but only in the direction from ③ to ④ and a minimum of 12 hours after the adjacent ③ section has been poured.
5. For bridges constructed on earth fill, the web and top slab construction joints are optional.
6. The Contractor shall submit a Pour Schedule to the Engineer for approval prior to placing concrete.

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Structure Detail Drawings - Railings

SD Drawing Number	Description	View SD Drawing	Download DGN (Zip) File
SD 1.01	32 Inch F-Shape Bridge Concrete Barrier and Transition	sd101 (145k)	sd101 (83k)
SD 1.02	42 Inch F-Shape Bridge Concrete Barrier and Transition	sd102 (145k)	sd102 (82k)
SD 1.03	Thrie Beam Guard Rail Transition System	sd103 (109k)	sd103 (69k)
SD 1.04	Combination Pedestrian - Traffic Bridge Railing	sd104 (140k)	sd104 (65k)
SD 1.05	Pedestrian Fence For Bridge Railing SD 1.04	sd105 (134k)	sd105 (54k)
SD 1.06	Two Tube Bridge Rail (1 of 4)	sd106a (140k)	sd106a (88k)
SD 1.06	Two Tube Bridge Rail (2 of 4)	sd106b (54k)	sd106b (54k)
SD 1.06	Two Tube Bridge Rail (3 of 4)	sd106c (68k)	sd106c (59k)
SD 1.06	Two Tube Bridge Rail (4 of 4)	sd106d (64k)	sd106d (50k)
SD 1.11	Barrier Junction Box	sd111 (106k)	sd111 (284k)

The method of measurement and bid item numbers for the bridge railings described above and the accompanying transitions are summarized as follows:

Bid Item Number	Description	SD Drawing	Method of Measurement

6011130	32 Inch F-Shape Bridge Concrete Barrier and Transition	SD 1.01	Linear Foot
6011131	42 Inch F-Shape Bridge Concrete Barrier and Transition	SD 1.02	Linear Foot
9050430	Thrie Beam Guard Rail Transition System	SD 1.03	Each
6011132	Combination Pedestrian - Traffic Bridge Railing	SD 1.04	Linear Foot
6011133	Pedestrian Fence For Bridge Railing SD 1.04	SD 1.05	Linear Foot
6011134	Two Tube Bridge Rail	SD 1.06	Linear Foot
7320475	Barrier Junction Box Type I	SD 1.11	Each
7320476	Barrier Junction Box Type II	SD 1.11	Each

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Compressed documents provided in ZIP format will require Winzip to view.

Traffic Structures

Median Sign Structure (One Sided)

SD Drawing Number	Description	View SD Drawing	Download DGN (Zip) File
SD 9.02	Median Sign Structure (One Sided) Elevation & Notes (1 of 5)	sd902-1 (139k)	sd902-1 (31k)
SD 9.02	Median Sign Structure (One Sided) Foundation Details (2 of 5)	sd902-2 (132k)	sd902-2 (65k)
SD 9.02	Median Sign Structure (One Sided) Type 'A' Sign Mount Assembly (3 of 5)	sd902-3 (59k)	sd902-3 (58k)
SD 9.02	Median Sign Structure (One Sided) Type 'B' Sign Mount Assembly (4 of 5)	sd902-4 (63k)	sd902-4 (68k)
SD 9.02	Median Sign Structure (One Sided) Light Support and Misc. Details (5 of 5)	sd902-5 (68k)	sd902-5 (49k)
Download Median Sign Structure (One Sided) Drawings (1 through 5)			sd902all (269k)

The method of measurement and bid item numbers for the Traffic Median Sign Structure (One Sided) described above are summarized as follows:

Bid Item Number	Description	Method of Measurement

6060162	**Sign Structure (Median)(One Sided)**	**Each**
6060239	**Foundation for Sign Structure (Median)**	**Each**

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