

Chapter 1

General Design Information

Section 1.01 – Design & Checking

Introduction

The primary aim in both designing and checking is to produce a structure that will safely carry the anticipated loads.

The design team, consisting of the designers, checkers, and structural detailers, is responsible for developing a set of practical, clear, and concise design notes, plans, and specifications by the assigned due date with the allotted manpower. This section provides information on the personnel involved and their responsibilities for the design, design check, and structural details.

All electronic files (designs, details, quantities, etc.) will need to be placed in the project directory on the WYDOT servers. This includes all files from consultant designed projects

Design Calculations

The design calculations shall be prepared on 8½”x11” sheets. The cover sheet for the final design notes of record shall be stamped by the designer & checker, and shall be indexed with numbered pages. The design calculations of record and check calculations shall be microfilmed.

If the designer of record does not have a PE, but the checker does, the checker shall stamp the cover sheet. If the designer and checker both do not have a PE, the design squad leader shall stamp the cover sheet.

A sample form for stamping the design calculations is shown in Appendix A and the end of this Section. An electronic copy is available on the server in the L:\Brid\Bridge Design Manual folder.

All design computations must be checked by an engineer and references verified. All check marks and notes shall be precise and legible. The checker shall use yellow for correct computations; incorrect computations shall be circled and the checker’s corrections and notes marked in red. The checker shall initial and date the check print when the check is complete. The checker shall

not carry through minor corrections which do not appreciably affect the final result, but may note that the error is there and is disregarded. The checker is responsible for the accuracy of the design, but no checker shall discard a reasonable design arrived at by suitable methods.

When checking a design that used a BRASS program, the input shall be checked and hand calculations performed to verify loads, section properties, capacities, and required specification checks.

Structural Details

The structural detail or plans shall be completed in accordance with the *Bridge Applications Manual* (BAM).

The details should be thoroughly checked by using the examples and checklist located in BAM. Conformance of grades, alignments, and other data between roadway and bridge plans should be checked. Plans should be reviewed for completeness, constructability, compliance with current bridge program standards, and good engineering practices.

All details must be checked by an engineer or a technician, with experience with the structure being detailed, and references verified. All check marks and notes shall be precise and legible. The checker shall use yellow for correct details; incorrect details shall be circled and the checker's corrections and notes marked in red. The checker shall initial and date the check print when the check is complete.

The original detailer will back check the corrected sheet, make the appropriate changes and have the checker verify the work. This process will continue until sheet is acceptable to both the detailer and checker.

Designer

The designer's primary responsibilities include:

- Use approved Structure Selection Report and Preliminary Layout as basis for design
- Design concept and layout
- Structural design
- Design sketches
- Preparing complete and legible calculations
- Load rating new/replacement bridges using BRASS
- Calculating quantities as directed

The designer should advise and get concurrence from the Design Squad Leader whenever deviating from approved office standards and practices.

The initial load rating may be based upon the details shown in the contract plans for the PS&E submittal. The final load rating shall reflect the changes made during construction (fabrication change, field adjustment, contractor change, etc.) if they affect the load carrying capacity of the bridge.

The designer should inform the Design Squad Leader of any areas of the design that should receive special attention during checking and review.

The designer's responsibilities also include the following project planning activities:

- Preparing a Design Time Estimate
- Identifying tasks and planning order of work
- Preparing design criteria for inclusion in the front of the design calculations

Design Checker

The primary purpose of a design check is to insure that the designer has not, through an error in mathematics, misunderstanding of the specifications, or other cause, produced an unsafe design.

The design checker's primary responsibilities include:

- Verifying the design theory and correct interpretation of the design code
- Accuracy and completeness of the design calculations to confirm the structural adequacy of the components
- Independent check of major controlling geometry
- Working with Designer to prepare the Design Time Estimate
- Calculating quantities as directed

The design checker may perform an independent analysis by using a methodology different from the original design. The check notes shall be stamped and shall be returned to the designer who will coordinate changes.

For designs checked by an experienced engineer, the original calculation sheets may be initialed by the checker.

For special designs or those done by inexperienced designers, the Group Leader may require a more complete design check by the design checker.

Structural Detailer

The structural detailer's primary responsibilities include:

- Preparing neat, correct, and easy to follow plan sheets conforming to the Bridge Applications Manual.
- Drawing details to scale
- Determining dimensions and elevations as required by the designer/checker
- Calculating quantities as directed

Design Squad Leader

The Design Squad Leader should work closely with the designer, design checker, and structural detailer during the design and plan preparation phases to help avoid major changes late in the design process.

The Squad Leader's primary responsibilities include:

- Recommend through the Structure Selection or Structure Rehabilitation Report the most cost-effective and appropriate structure for each particular site
- Coordinate the completion of the Preliminary Layout based on the Structure Selection Report
- Coordinating design and design check
- Producing a complete set of plans and specifications
- Resolving construction problems
- Determining the number and titles of plan sheets
- Coordinating plan sheet detailing
- Coordinating computation of quantities
- Preparing the Cost Estimate and Special Provisions
- Preparing time estimates for design, detailing, and quantity calculation activities
- Compatibility of design and details within the project
- Determining the level of checking required by considering the complexity of the structure and the skill of the designer
- Approving the design criteria prepared by the designer before start of design
- Monitoring the design and detailing process and providing guidance and assistance as required
- Reviewing the design calculations for completeness and for agreement with office criteria and practices
- Reviewing the plans for completeness, constructability, and agreement with office criteria and practices

Assistant State Bridge Engineer - Design

The Assistant State Bridge Engineer provides guidance and support to assure that the bridge design and structural details meet program and department standards.

The Assistant State Bridge Engineer's primary responsibilities include:

- Review and comment on hydraulic reports
- Working with the Design Squad Leader in the structure selection to assure that the most cost-effective and appropriate structure type is selected for a particular bridge site
- Work with the Design Squad Leader and Hydraulic Engineer to resolve hydraulic issues
- Reviewing Preliminary Layout and recommending approval by the State Bridge Engineer
- Reviewing and approving project reports
- Developing and maintaining Bridge Program design and detailing standards as documented in the *Bridge Applications Manual* and *Bridge Design Manual*
- Approving the design criteria prepared by the designer and squad leader before start of design
- Reviewing final structure plans for conformance with the Bridge Applications Manual and project requirements and recommending approval by the State Bridge Engineer
- Recommend design standards, detailing standards, and LRFD specification interpretations to the State Bridge Engineer for approval
- Work with other design programs and district staff on project design issues
- Performing a structural/constructability review of the plans.
- Reviewing the project special provisions and Supplemental Specifications
- Monitoring design and detailing time requirements
- Resolving construction problems

State Bridge Engineer

The State Bridge Engineer provides leadership and support to assure quality for structural designs and details.

The State Bridge Engineer's primary responsibilities include:

- Reviewing and approving the Structure Selection Report and Preliminary Layout to assure that the most cost-effective and appropriate structure type is selected for a particular bridge site.

- Approving design and detailing standards
- Performing a structural/constructability review of the plans.
- Reviewing and approving final structural plans
- Facilitating resolution of major project design issues.
- Resolving construction problems

Consultant Projects

Consultant designs and details will be completed in accordance with the *Bridge Applications Manual* and the *Bridge Design Manual*.

The consultant shall apply his own seal and signature to the plans, and thereby assumes full responsibility for their correctness and general conformance with good engineering practice.

The following indicates the degree and type of checking to be performed by the Bridge Program:

Project Reports (Hydraulic, Structure Selection, etc.) and Layouts

All reports will be thoroughly reviewed to ensure adequate evaluation of:

- Structure types that are compatible to the site conditions
- Preliminary cost estimates
- Advantages/disadvantages of each structure type
- Economy, feasibility, and constructability
- Structure types recommended for additional study or final design

A review of the preliminary layouts will be made to ensure that span lengths, clearances, and all site conditions are adequately addressed.

Design Review

Designs should be reviewed for completeness, constructability, compliance with current WYDOT standards, and good engineering practices.

A review of major structural elements should be performed. A BRASS load rating should be run to verify girder capacity for the design vehicle.

Design calculations shall be on 8.5"x11" paper with a proper heading and placed a binder with an index. The signature, date and Wyoming seal of a registered professional engineer of the consulting firm shall be on a title sheet.

Plan Review

Plans will be checked for all changes required by the Final Design Review. Plans should be thoroughly checked by using the checklists located in BAM. Conformance of grades, alignments, and other data between roadway and bridge plans should be checked.

Pay items and Special Provisions should be reviewed for conformance with the Standard Specifications. Quantity calculations and rebar schedules are generally not checked in detail.

The signature, date and Wyoming seal of a registered professional engineer of the consulting firm shall be on the title sheet of each drawing.

Construction Documents

Working drawings shall be submitted by the contractor in accordance with the *Standard Specifications for Road and Bridge Construction*.

Checking of shop drawings is a normal duty of the Fabrication Inspector. The Bridge Design Section responsible for the project design and details will typically check fabricator designs, false work drawings, and erection drawings. For consultant designs, the consultant should do the checking as provided for in the Consultant Agreement.

Checking must be thorough, accurate, and complete. If information is incomplete, the checker shall request that the additional data be submitted in writing and shall not approve the shop drawings until the information has been received and reviewed. No verbal approval shall be given to a contractor, supplier, or fabricator. All written approvals will include a copy to the Resident Engineer.

Construction drawings will be checked promptly upon receipt of complete information and at a speed consistent with thoroughness and accuracy.

The approved shop drawings for all elements that become a permanent part of the structure shall be submitted by the Contractor and shall be retained with the contract plans for the structure for permanent archives.