

Office of Bridge Design

Technical Memorandum

Date: April 26, 2012

To: All Bridge Engineering Staff

From: Steve Johnson, PE
Bridge Design Engineer

Subject: Technical Memorandum BTM12.1
Bridge Design Quality Control/Quality Assurance (QC/QA) Practice

This Technical Memorandum is intended to formally document the SDDOT Office of Bridge Design QC/QA practice. This practice applies to all structure design performed in-house as well as all structure design for the Department performed by outside consultants.

The purpose of the SDDOT Office of Bridge Design QC/QA practice is to ensure that quality structure designs, plans, and specifications are produced. To that end, the QC/QA practice includes several checks and reviews. This process, by its very nature, can become adversarial and care must be taken to focus on the end goal of producing a quality product.

Quality Control

The structural design engineer and structural drafter both play a role in quality control. The design engineer is responsible for ensuring that appropriate specifications are used, specification interpretation is in accordance with SDDOT Office of Bridge Design practices, design assumptions are appropriate for the structure or structure component involved and calculations are accurate. In addition, the design engineer is responsible for checking drafted plans to ensure that the plans correctly depict design intent.

The drafter is responsible for the quality and consistency of the structure plan sheets. The drafter must ensure that the plan sheets follow SDDOT Office of Bridge Design drafting practices, and contain adequate information to allow for structure construction. Plans must be clear and concise, and details should be scaled such that they are easily read. When individual projects contain multiple structure plan sets, the plans must be consistent between structure sets.

Both the design engineer and the drafter must check their own work. Design calculations must be checked by the designer to eliminate errors and ensure that correct structural engineering theory and practice was applied. Drafters must check completed plans before engineer review to ensure that the plans are complete, without error and follow conventional drafting practices.

Quality Assurance

Quality assurance consists of an independent check design, a SDDOT Office of Bridge Design review of the structure plans, and a SDDOT department wide review of the structure plans as part of the complete project plans.

The independent check design is performed by a second design engineer and intended to ensure that the design calculations, plans and specifications are correct and error free. It is vital that the independent design check not be simply a check of the initial designer's calculations, but independent design calculations and computer analysis, if applicable. After completion of the design and check design, it is the responsibility of the two design engineers to resolve any differences in design calculations and details to provide a consistent set of calculations and details for drafting, as well as for future reference. Differences that cannot be resolved by the design engineer and check design engineer shall be taken to the Bridge Maintenance Engineer or the Bridge Design Engineer, as appropriate, for resolution. The check design engineer is also responsible for checking drafted plans to ensure that the plans correctly depict design intent.

Office review consists of a review of the completed structure plans by the SDDOT Chief Bridge Engineer, Bridge Maintenance Engineer, Bridge Construction Engineer, Bridge Hydraulics Engineer, Bridge Design Engineer, and for in-house prepared plans, the assigned squad leader. Plans prepared in house shall undergo office review at the 90% completion stage and plans prepared by consultants shall be undergo office review at the 30%, 60% and 90% completion stages. At the discretion of the Bridge Design Engineer or Bridge Maintenance Engineer, review of consultant plans at the 60% completion stage may be waived for simple structures. All comments generated by the Office Review(s) must be addressed by the structure designer and check designer. Review comments not incorporated into the plans must be brought to the attention of the Bridge Maintenance Engineer or Bridge Design Engineer, as appropriate. A record of the review comments and subsequent resolution must be kept with the office review plans.

Department review consists of a review of the entire project by involved SDDOT offices and personnel. Plans shall undergo department review at the 95% completion stage. The list of reviewers varies by project type and location. All comments generated by the Department Review pertaining to the structure plans must be addressed by the structure designer and check designer. Review comments not incorporated into the plans must be brought to the attention of the Bridge Maintenance Engineer or Bridge Design Engineer, as appropriate. A record of the review comments and subsequent resolution must be kept with the department review plans. In addition, a letter is required to the Project Coordinator describing comment resolution. For structure plans prepared in-house this letter shall be prepared under the direction of the assigned squad leader and for consultant prepared structure plans this letter shall be prepared by the consultant.

General

Inherent in the preparation of quality structure plans and specifications is well qualified engineering and drafting personnel. The structure designer and check designer, as well as the

drafter, should have a level of experience commensurate with the complexity of the structure being designed. Less experienced personnel should be under the direct supervision of experienced bridge engineers. While it is preferable to have one designer and one check designer for each structure, there may be times when this is not possible. In these cases, care shall be taken to ensure that all portions of the structure are adequately checked. For consultant designed structures, all rules and regulations as set forth by the SD State Commission of Engineering, Architectural and Land Surveying Examiners shall be followed.

Design and check design calculations should include the design criteria, design assumptions, loads, structural analysis and individual member design calculations, and computer program input and output. Calculations may be longhand calculations or computer generated design calculations; both are acceptable. All calculations, whether longhand or computer generated shall be marked with the project number, structure number if applicable, and dated. In addition, the designer and check designer must initial their calculations. For new bridge structures and major rehabilitation of existing bridge structures, calculations are generally broken into superstructure and substructure designs. For all structures, it is important that the above information be arranged in a logical order and be neat and orderly. Project correspondence (for example, hydraulic data sheets, roadway design correspondence, etc.) should not be copied and made part of the design calculations. A copy of consultant design and check design calculations shall be included with the final deliverables.

Check prints serve as a check of the drafting and also as a check of the design as assembled into construction plans. As such, every item on the check prints must be checked to ensure that the plans are correct and depict the engineer's intent. Office of Bridge Design practice is to have the designer and check designer highlight in yellow everything on the check prints that is correct and mark in red any revisions or corrections needed. The designer and check designer must initial and date check prints upon completion of drafting review. This procedure may be varied by consultants; however, a thorough check of drafted plans must still be made by the designer and check designer.

Construction plans must include the initials of the designer, check designer and drafter and also must identify the firm or SDDOT office that produced the plans. In addition, plans prepared in the SDDOT Office of Bridge Design shall include the signature of the current Chief Bridge Engineer. Individuals performing the design and check design shall verify that proper initials are shown in the "DESIGNED BY" or "CHECK DESIGN BY" box on each sheet as appropriate and the individual performing the drafting shall verify that the proper initials are shown on each sheet in the "DRAFTED BY" box. The standard SDDOT Office of Bridge Design portion of the title block used to identify the designer, check designer, drafter and Chief Bridge Engineer as well as office of plans preparation is shown below. Consultant plans may use this block, or others as desired, however, the format used must contain the same information. The firm or SDDOT office that prepared the structure plans need only be identified on the first sheet of the structure plans.

PLANS BY:
OFFICE OF BRIDGE DESIGN, SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION

DESIGNED BY XX	CK. DES. BY XX	DRAFTED BY XX	BRIDGE ENGINEER
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Reviewed by:  Date: 4/26/12

Approved by: , Chief Bridge Engineer, Date: 4-27-2012

cc: File