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## **Chapter Twenty-Four**

# **CONSTRUCTION OPERATIONS**

### **24.1 GENERAL**

The Bridge Design Section of the Bridge Bureau continues to be involved during construction to ensure the designer's intent is followed. Frequently, issues arise because of construction errors or materials problems that could compromise the performance or longevity of the finished product. Additionally, because the contractor often wishes to place construction equipment on bridges that MDT wishes to remain in service, the Section reviews engineering submittals from the contractor for the use of large equipment on bridges. Design intent is ensured by approval of materials, fabrication, etc., of structural components of bridges.

The Bridge Design Section is also contacted for advice on out-of-specification materials and construction errors. Because the Section is frequently expected to respond very quickly to construction problems, these problems frequently become the highest priority.

## **24.2 SHOP DRAWINGS**

The contractor must submit drawings that show how, and of what materials, structural components will be fabricated. These drawings are widely used throughout the Department, and explicit procedures for submittal, review and approval have been developed.

### **24.2.1 General**

The Bridge Bureau has the responsibility for reviewing and approving fabricator's shop drawings for structural steel, prestressed beams and structural timber.

### **24.2.2 Responsibility**

A position in the Bridge Management Section is used full time to provide this function.

### **24.2.3 Procedures**

The Shop Drawing Reviewer has written procedures to ensure accountability, consistency and a timely review of submitted material.

#### **24.2.3.1 Shop Drawing and Material Submittal**

The requirements for shop drawings submittals are contained in the **Montana Standard Specifications for Road and Bridge Construction**.

#### **24.2.3.2 Copy Distribution**

The distribution of approved shop drawings is as stated in the written shop drawings procedures.

#### **24.2.3.3 Approval Level**

The individual tasked with reviewing shop drawings is delegated approval authority for the shop drawings.

#### **24.2.3.4 Bridge Bureau Review**

The Shop Drawings for prestressed girders are submitted with calculations from the fabricator to validate that the proposed girder strand configuration and concrete strength is adequate for the purposes of the project. The Shop Drawing Reviewer gives these calculations to the appropriate Bridge Area Engineer for review and approval. Calculations currently take the form of computer output from one of several approved prestressed beam design programs. Currently, these programs are Con-Span and BT Beam. See Chapter Twenty-five. The designer must review data input for the computer runs and verify that the output indicates correct beam stresses and adequate ultimate moment capacity. The Shop Drawing Reviewer has approval authority for the drawings, and no additional review of shop drawings occurs within the Bridge Bureau.

#### **24.2.3.5 Checklists**

The individual that reviews shop drawings has developed a series of shop drawing approval checklists that are specific to the material and type of component being fabricated.

### 24.3 FIELD ISSUES

Bridge Bureau structural engineers are on-call to Construction Bureau and District construction staff for consultation on materials that do not comply with specification materials, variations in construction tolerances that are beyond normal and accepted practice, and construction mistakes. If problems arise during construction, Bridge Design Section staff must frequently travel to the project site to observe, gather information and discuss options with District construction staff. Bridge Bureau personnel work through the District construction staff and do not interface directly with the contractor's staff.

#### 24.3.1 Construction Realities

From a practical standpoint, it is not realistic to expect that the contractor can construct the project precisely to the dimensions set forth in the construction plans. Reasons include:

1. The allowable deviation from dimensions in the plans should be determined based on the impact of the deviation on the structural integrity or the appearance of the structure. For example, a deviation of 10 mm might be of no consequence in a foundation, but this deviation might seriously weaken a thin slab.
2. Deviations from the specified dimensions may be greater on a structural component not exposed to view.
3. Preferably, any deviation should be too thick rather than too thin.

A contractor builds from the bottom up. Not so obvious is the fact that, because of flowing water or other difficult site conditions, when piers or bents are initially laid out by the surveyors, they might not be very precise. The construction process that gives the least risk to the contractor is to wait until one bent or pier is constructed to establish a firm centerline bearing at centerline bridge, and then build the rest of the bridge to fit. In this way, one is assured that the

superstructure will fit the substructure. Tolerances will become progressively tighter as the bridge is constructed and, finally, tolerances of 3 mm on deck flatness in any 3000-mm radius are achieved.

The District construction field personnel will have the final decision-making authority on whether or not the contractor is constructing an acceptable product. If requested, the Bridge Bureau will provide input and advice on a case-by-case basis.

#### 24.3.2 Technical Assistance

The Bridge Design Section provides assistance as requested for the construction of structural items.

##### 24.3.2.1 Effects of Construction Activity

By its very nature, much construction machinery tends to be compact and very robustly constructed. Often, a piece of construction machinery has a weight that seems out of proportion to its size. A piece of equipment may be tasked to hoist loads, which adds to the effective weight of a piece of machinery. The contractor may wish to place heavy construction machinery on a partially completed structure, or may wish to place heavy construction machinery on a bridge that MDT will own and use at the conclusion of the work.

Under these circumstances, the contractor must retain an outside engineering firm to conduct an appropriate structural analysis and submit a summary report of the construction machinery's effect on the bridge. These engineering calculations obviously need to use an appropriate machine weight, such as data presented in the manufacturer's literature or, better yet, certified scale tickets. The report that the engineering firm prepares must specifically define an operational "envelope" of loads and conditions within which the machinery must operate.

**24.3.2.2 Contractor Submittals to Correct Fabrication/Construction Errors**

determine if the product meets the designer's intent and the contract documents.

Not infrequently, the Bridge Design Section is contacted to review the technical merits of a technical submittal from a contractor attempting to salvage an undesirable situation or attempting to salvage whatever is salvageable out of a misfabricated component or perhaps a bent or pier that was constructed in the wrong location.

Determine relevant facts and develop solutions to problems encountered during construction when it appears to the District construction staff that the designer's intent is physically unconstructable.

**24.3.2.3 Change Orders**

The Bridge Design Section receives and comments on all bridge-related construction change orders and works with the Construction Bureau and the District construction staff to resolve issues.

**24.3.2.4 Value Engineering**

Evaluate Value Engineering proposals for structural items. Although Bridge Plans represent one solution to the structural problem, the solution presented may not be the most economical for a particular contractor because each contractor has unique equipment and staff expertise. A contractor may wish to submit a proposal to value engineer alternative methods or materials. The Bridge Design Section will be asked to review any value engineering submittal that concerns bridge issues. Any proposed product must be at least equal in functionality and longevity as that shown in the contract documents.

**24.3.2.5 Evaluate Product Submittals**

The designer may on occasion specify a type of product that the District construction staff is unfamiliar with. The Bridge Design Section may be requested to evaluate a product to

#### **24.4 STANDARD AND SUPPLEMENTAL SPECIFICATIONS**

The Bridge Design Section works closely with the Specifications Section of the Construction Bureau for the development and modification of the **Montana Standard Specifications for Road and Bridge Construction**. The Bridge Design Section's core areas of interest are in Division 550 – Structures and Division 700 – Materials.