

## **CHAPTER SIX**

### **STRUCTURAL STEEL**

In steel girder bridges, girders are usually rolled beams, continuous welded plate girders with a constant depth, or continuous welded plate girders with a variable depth. Steel girders are normally used for spans over 145 feet. The superstructure depth (including the deck slab) ranges from 3 feet to 10 feet. Steel bridges tend to be lighter than concrete girder bridges.

In the design of a steel bridge, field bolting is preferred. Field welding should be minimized. If field welding is required, Field Welding Notes should be included on the plans.

#### **6.1 MATERIAL STRENGTHS AND PROPERTIES**

AASHTO M 270 Grade 50 steel is typically used for all main load carrying girder components including the girder web, the top and bottom flanges and splice connection plates. Additionally, Grade 70 steel may be considered for use in these components if it seems advantageous. M 270 Grade 36 is typically used for stiffeners, diaphragms, and cross frame girder connector plates. Sole plates and other minor components of steel or concrete bridges must conform to the requirements of AASHTO M 183.

Weathering steel is a material that should be considered for steel structures in New Mexico. Before shipping, weathering steel should be sand blasted to SSPC SP 6 requirements with all shop markings removed, wet

down, and then dried to provide a clean steel with a protective surface.

Diaphragm bolts, splice connection bolts, cross frame bolts, tension plate bolts, and bolts for all other major components of steel bridges shall be high strength bolts conforming to the requirements of AASHTO M 164 (equivalent to ASTM A 325). Anchor bolts / anchor rods must conform to AASHTO M 183 (ASTM A36) or ASTM F1554 grade 36, 55, or 105. For ASTM F1554 the weldability Supplement S1 is recommended as inexpensive insurance for a more flexible solution should the anchor bolt / anchor rod is placed incorrectly in the field. Shear connector studs must conform to AASHTO M 169.

#### **6.2 DETAILING REQUIREMENTS**

The steel girder detailing requirements are listed in Section 2.3.3. Many of the problems encountered with steel bridges are fatigue related. The most common problem is fatigue related cracking that occurs along the welds of secondary members (stiffeners, diaphragms, and lateral bracing) to the main girder. This is also known as “out of plane” bending. Cracks in the welds begin at corners and propagate along the weld. As a solution, the NMDOT Bridge Section has developed girder attachment details which are intended to improve fatigue performance. In general, the use of longitudinal stiffeners should be avoided. Girder attachment details, developed to improve fatigue performance, are shown in Figures 6.2A and B.

Figure 6.2A  
Intermediate Stiffener Attachment

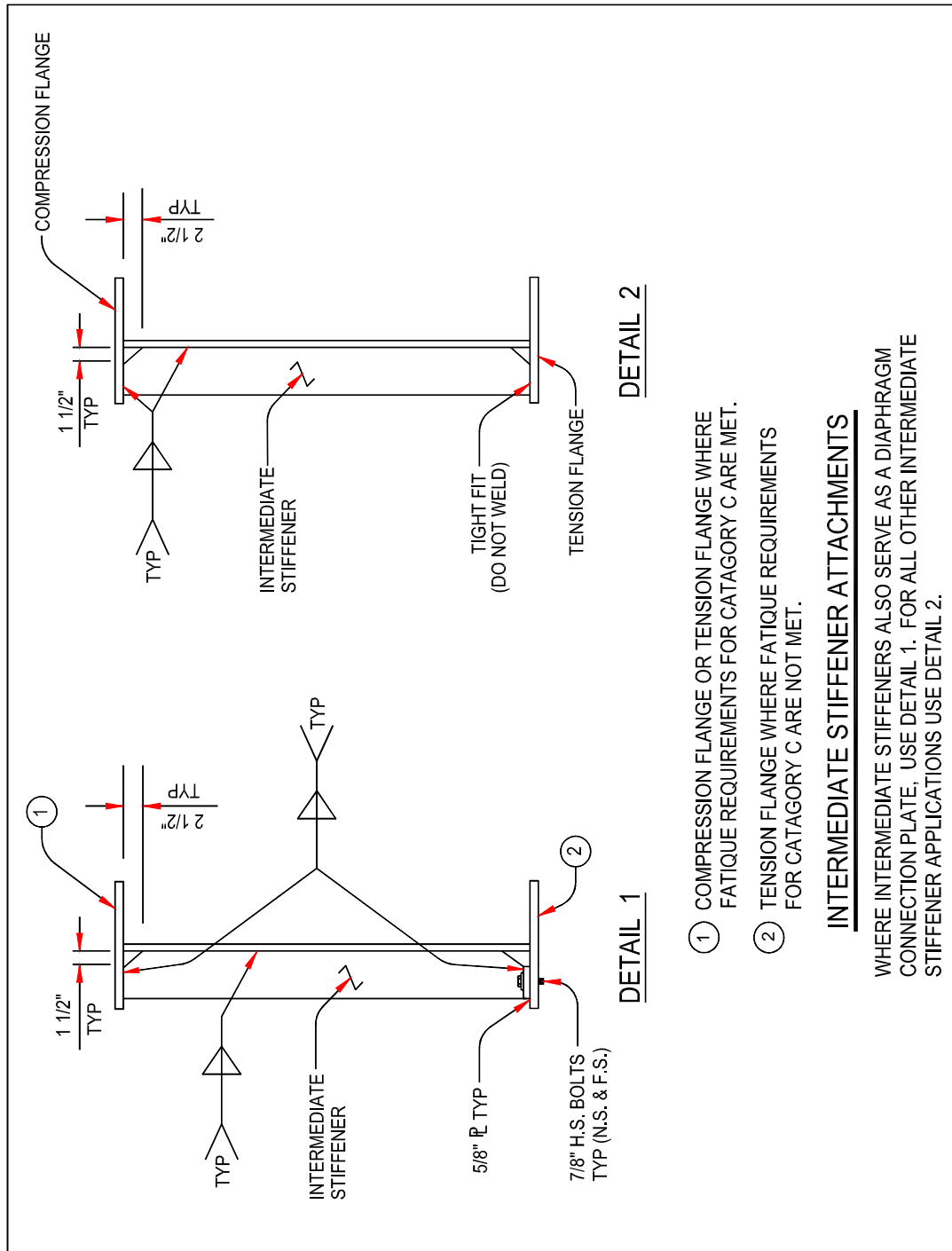
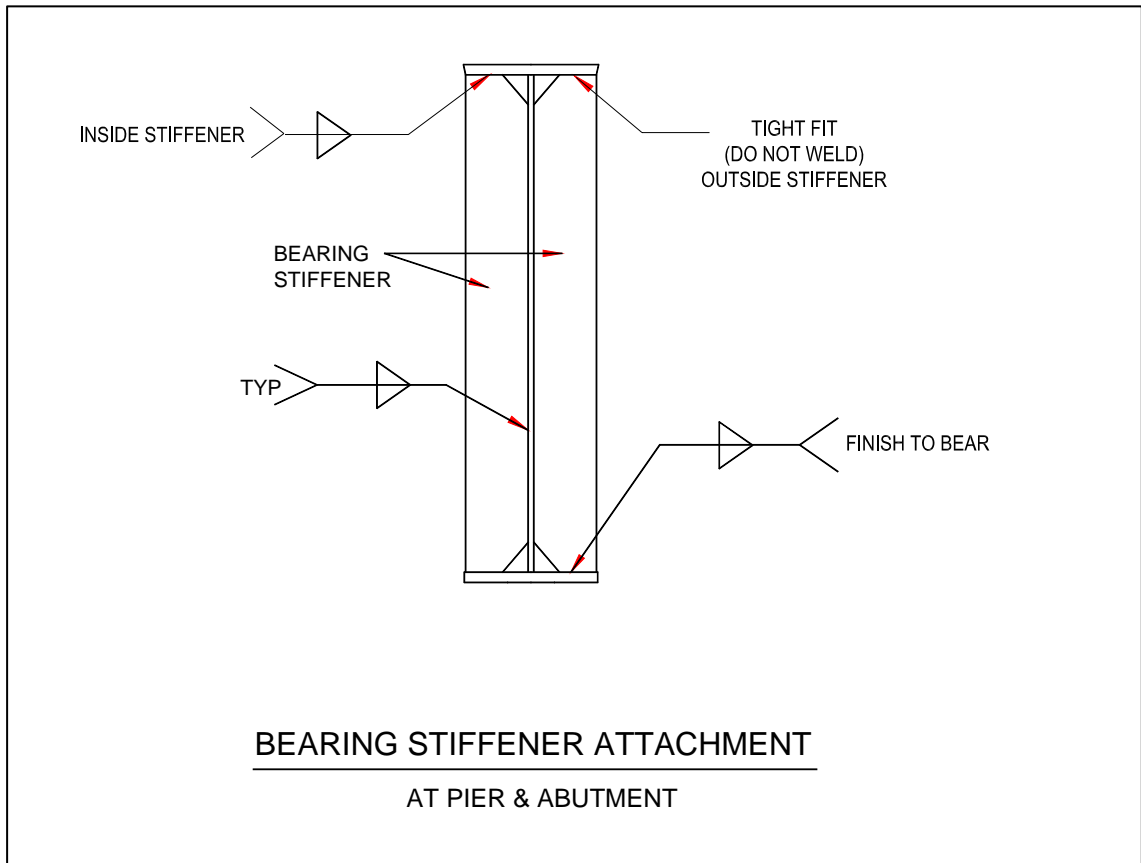


Figure 6.2B  
Bearing Stiffener



### 6.3 DESIGN ECONOMY

Recent experience has shown that, for steel design, economy is achieved not necessarily through conserving material but by designing to limit the fabrication effort that is needed as well. For this reason, plate girder designs that eliminate both longitudinal and intermediate stiffeners and limit the number of welded flange splices to an absolute minimum are preferred.

### 6.4 RECOATING STEEL ELEMENTS ON EXISTING BRIDGES

Prior to 1986 structural steel elements on NMDOT bridges were painted with a system which included a lead based primer. If adequate precautions are not observed, removal of this paint can cause severe health problems for workers. Additionally, the paint residue is harmful to most organisms if introduced into the environment. It must therefore be collected and disposed of in a safe manner. This is both problematic and expensive.

For these reasons, NMDOT recoating specifications (Section 546 of The Standard Specifications For Highway And Bridge Construction) utilizes a procedure where by only non-adherent paint is removed. Adherent paint is left in place and encapsulated by the new coating system. Proper application of this system requires that certain items be included in the plans for bridges that are to be recoated. These items are outlined in the following section.

#### 6.4.1 Plan Requirements for Bridges To Be Recoated

For bridges that are to be recoated the following items need to be included in the plans:

1. In the general Notes, include a note stating that the work of recoating is to be done and identifying the elements that are to be recoated. The areas, if any, which are to be cleaned to SSPC- SP3 and SSPC-SP11 requirements and for which payment is to be included in the lump sum price for "Recoating Bridges" need to be identified in the note.
2. Include the lump sum pay item "Recoating Bridges" in the listing of estimated Quantities
3. Include pay items and quantity estimates for areas to be cleaned to SSPC-SP3 and SSPC-SP11 requirements. These are areas additional to those identified in item 1.
4. Include the lump sum pay item "Safety and Environmental Requirements" in the listing of estimated quantities.
5. If the existing paint system is lead based, include a general note informing the contractor that this is the case.

Automatically include the note discussed In Item 5 above for all bridges built prior to 1986. For bridges built between 1986 and 1990 the designer will have to ascertain whether or not the paint contains lead by researching as-built plans, or if this fails, arranging to have the paint analyzed in a laboratory. Lead based paint was definitely not used on bridges built after 1990.