MARYLAND DEPARTMENT OF TRANSPORTATION — STATE HIGHWAY ADMINISTRATION	Office of Structures ***Guidelines and Procedures*** ***Memorandum***	DESIGN Number: D-18-52(4) Date: 03-16-2018
	Structural Steel	Approval:

The following guidelines and procedures relate to the design of bridges containing structural steel and shall be used in conjunction with the AASHTO LRFD Bridge Design Specifications.

Steel Selection

Grade 50 Steel shall be used for all new structural steel members.

Grade 70 Steel may be used upon approval by the Director.

Grade 50W (Weathering Steel) may be used when the conditions warrant. Bridges over water or those in wet environments shall not use weathering steel. All weathering steel shall be painted.

Minimum Sizes of Steel Members and Welds in Bridges

All primary fabricated structural steel members, such as stringer flanges and webs, crossframes for curved stringers, floor beams, truss members, cover plates, splice plates, stiffeners, connection plates, etc., in the bridge superstructure shall have a minimum thickness of 1/2". All secondary fabricated structural steel members, such as wind bracing and diaphragms, in the bridge superstructure shall have a minimum thickness of 3/8". The minimum thickness criteria applies to rolled sections as well as built-up members. Particular attention must be given to selecting small rolled sections so as to avoid sections having webs, flanges or legs of less than the minimum thickness. The only exception to the minimum thickness requirement will be for filler plates at splices. The minimum sizes of steel members are set to allow for potential section loss over the life of a structure.

Other minimum size criteria are as follows:

Girder Flange Width: Girder Flange Thickness:	12" 1"	All flange plates shall have a width to thickness ratio of 12 or less.
Weld Size:	5/16" (except for seal welds)	
Stiffener Width:	To nearest 1/2" and about 1/2" $\pm$ less than distance from face of webs to edge of flange, but not over 10 times the stiffener thickness for Grade 50 steel.	

Haunched Girder Bridges

In an attempt to improve the appearance of our bridges, haunched girders should be considered wherever possible. This could require adjusting the grades to accommodate the deeper girder depth. If a structure appears to be a good candidate for haunched girders, such as a two span bridge overpass or the long span main channels of a bridge over navigable waters, allowance should be made early on in the project before grades are set.

At the preliminary stage, estimate the depth of the haunch to be twice the depth of the girder at mid span and the length to be approximately one third the span length. The haunches shall come to a point (width of the bearing) at the pier(s) and the angle at the point of the haunch shall be between 135 and 160 degrees. The dimensions can be adjusted in the final design. Provide the required clearance over the proposed roadway, including shoulders, as well as over any future widening if the roadway underneath allows for widening under the haunched section.

Splices in haunched girders shall be placed outside of the haunched section which may move the splice away from the dead load inflection point (DIP). The design of the splice shall account for additional loading introduced at the splice location.

Cover Plates on Steel Stringers

All MDOT SHA bridges utilizing steel stringers shall be designed without cover plates.

Intermediate Stiffeners for Plate Girders

The webs shall be designed without intermediate stiffeners.

Shear Connectors in Negative Moment Regions

Continuous composite stringers are to be designed as non-composite in the negative moment regions. Beyond the point in negative moment regions where shear connectors cease to be required by AASHTO, shear connectors shall be called for at 24-inch maximum spacing using the same number per row and size of studs as used throughout the bridge.

On rare occasions, because of span configuration, an entire span may develop negative moment. The same criteria indicated above shall prevail through these areas.

Shear connectors on existing steel stringers for bridges being analyzed for a deck replacement shall be evaluated to determine if they need to be modified for use in the new bridge deck.

Camber of Steel Beans and Plate Girders

All steel stringers of less than 50 feet span, which support concrete deck slabs, shall not be cambered to compensate for dead load deflection or to correct for vertical curve ordinates. For these stringers, the following note shall be placed on the contract drawings:

> "No dead load and vertical curve camber is required for Beams (Girder) No. XX of Spans No. XX. If these beams are not rolled exactly true they shall be fabricated and erected with their concave sides down with a camber tolerance of three quarters (3/4) inch over."

All steel stringers of 50 feet span or more, which support deck slabs, shall be cambered to compensate for dead load deflection, and vertical curve ordinates (additional camber for hump vertical curves less for sag vertical curves). For these stringers the following note shall be placed on the contract drawings:

> "Beam (Girders) No. XX of Spans No. XX shall be cambered for dead load deflection (and vertical curve ordinates, if applicable) to the dimensions shown on these plans. The camber tolerance is nothing under to three quarters (3/4) inch over."

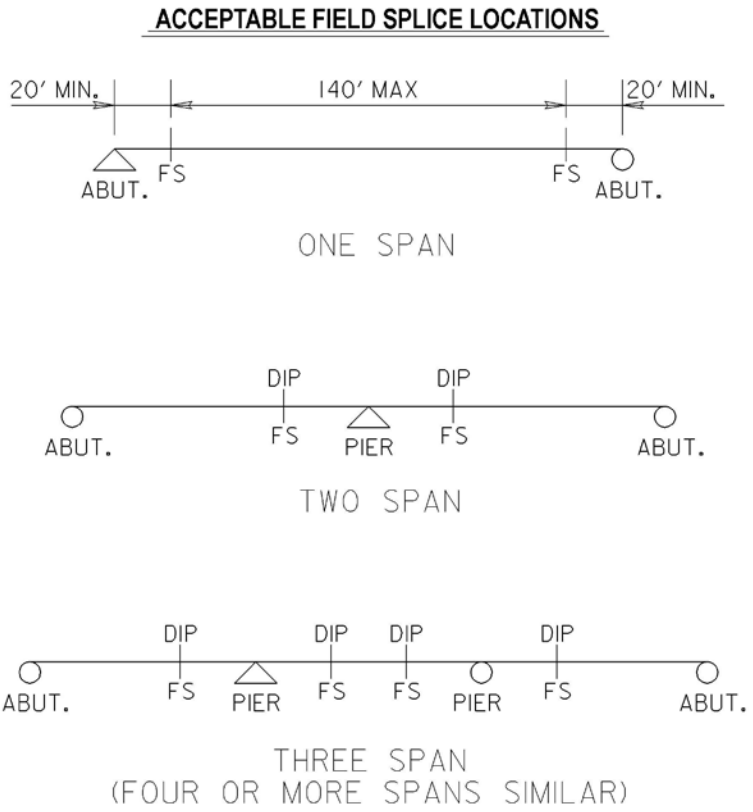
Dead load deflections shall be computed and shown at the points corresponding to the elevations shown on the finished roadway elevation sheets. These deflections shall be shown in a schedule, as separate entries for weight of stringers, concrete slab, and superimposed dead loads. These schedules shall also show the camber required for vertical curve ordinate at the same points. A separate entry showing the total deflection for all dead loads and the correction for vertical curve ordinate shall also be shown.

Field Splices for Steel Beams and Steel Stringers

All field splices shall be bolted.

The minimum number of field splices shall be the number of piers over which the stringer is continuous. Designers may consider a lesser number of field splices on rolled beam bridges with spans less than 60 feet long.

The diagrams below show the acceptable field splice locations (marked FS) for a stringer. Additional splices may be required due to span lengths, fabrication difficulties, etc. and each project shall be evaluated by the designer to ensure adequate splices are supplied. (Designers must verify with a steel fabricator the feasibility of shipping a stringer segment, with a length greater than 140 feet, to the project site prior to detailing it on the Plans.) DIP means dead load inflection point.



The contract plans shall indicate the acceptable field splice locations as well as the minimum number of field splices to be used for each stringer. If the design required more than one type of field splice (4 columns versus 6 columns of bolts in a web splice, and/or different size splice and/or fill plates, and/or different bolt spacing, etc.) then a separate detail will be drawn for each type of splice. The use of tables listing different plate sizes for various types of bolted field splices is unacceptable. Designers should make an effort to limit the number of types of bolted field splices in a design. If the largest field splice will work geometrically at the other field splice locations, then the designer should consider the difference in cost between the types of splices. If the difference in cost is less than 25% of the largest field splice's cost, then the largest field splice should be used at both locations.

Specifying Fit Up Condition

For straight bridges where one or more support lines are skewed more than 20 degrees from normal and horizontally curved girders meeting the requirements of AASHTO Article 6.7.2, the following fit up conditions for the cross-frames or diaphragms shall be specified on the contract plans.

- Steel Dead Load Fit (SDLF) for straight steel girder bridges.
- Steel Dead Load Fit (SDLF) for curved steel girder bridges.

For unusual situations where SDLF may introduce significant forces in the girders due to the application of the bridge deck and parapets and railings, a request may be submitted to the Director of the Office of Structures to use an alternative fit up condition such as Total Dead Load Fit (TDLF). Any submitted request must clearly document the advantages / disadvantages of one method over another from a stress and cost perspective.