Moment Connections To Column Webs

By M. Thomas Ferrell

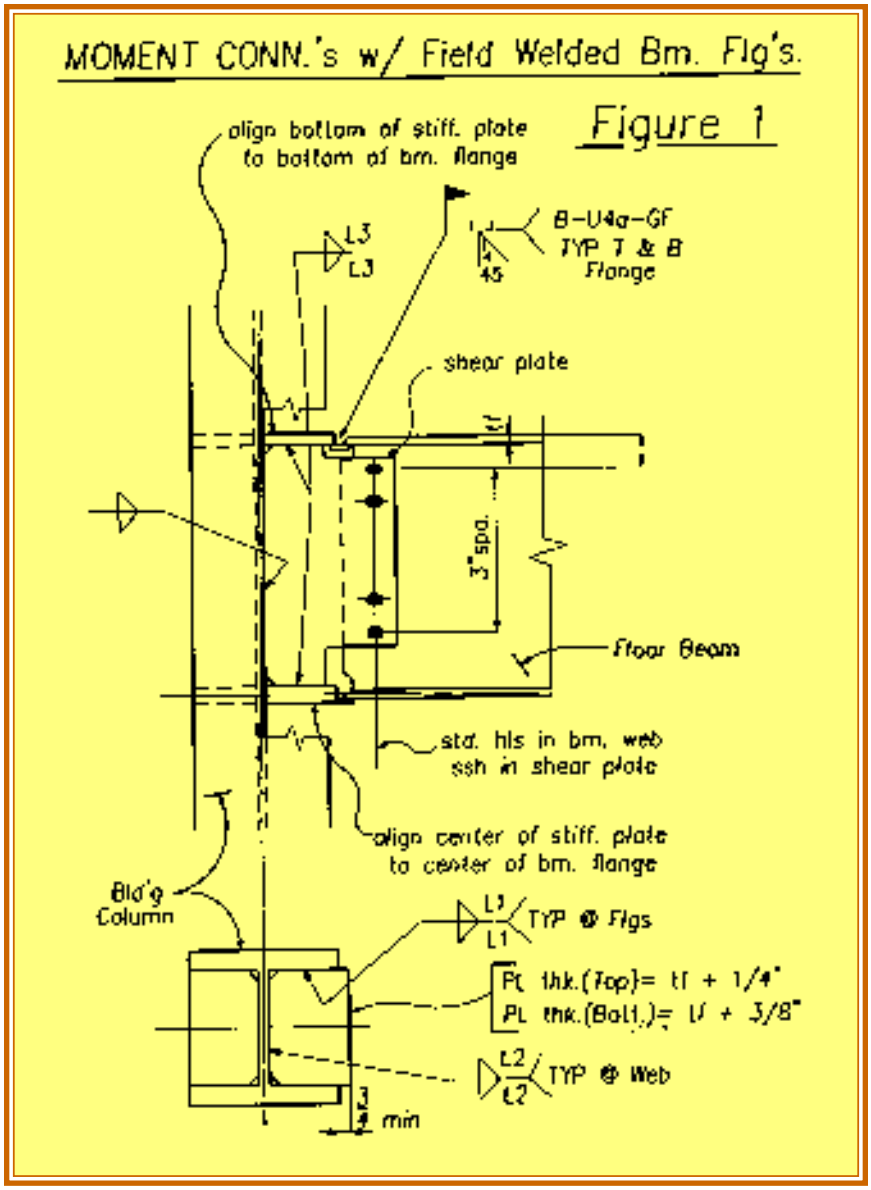
This article will present details that will accommodate mill and shop tolerances of structural members, as well as providing for material ductility. It will also present limit state strength considerations for both moment connections with field welded beam flanges and field bolted flange plates.

Moment Connection with Field Welded Beam Flanges (Figure 1)

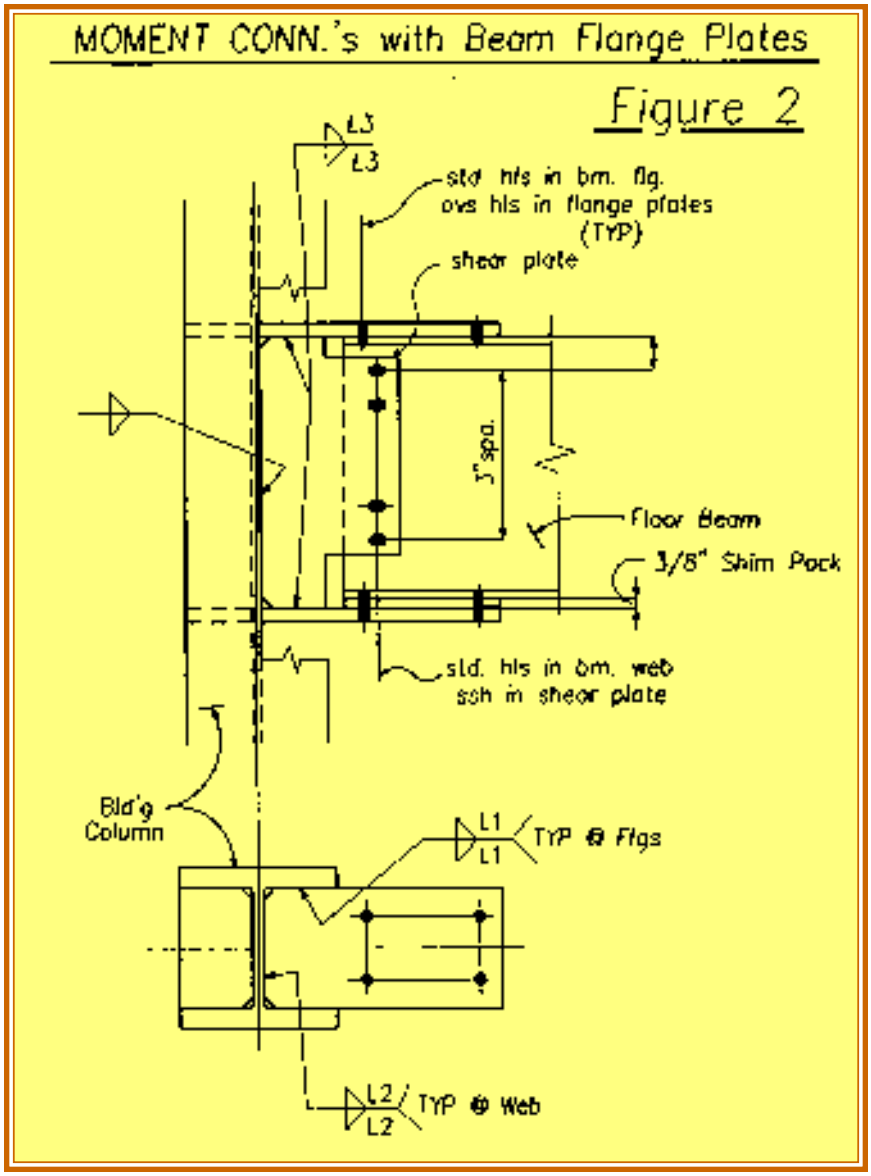
1. The connection plates must be the same grade of material as the weak axis moment beam.

2. The connection plate has been extended ¾" minimum beyond the column flange to provide better toughness and ductility. AISC's Manual of Steel Construction (LRFD) Volume II—Connections, pages 10-60 through 10-65, has summarized results of nine simulated weak axis FR moment connection tests performed by Driscoll, et. al., to aid in selection of details to ensure ductility.

3. The top connection plate thickness is equal to tf plus ¼". This additional thickness is necessary to accommodate tolerances for fabrication and beam flange tilt. Note that the bottom of this connection plate is aligned with the bottom of the beam top flange.



4. The bottom connection plate thickness is equal to tf plus ⅜". This is necessary to accommodate tolerances for fabrication and beam flange tilt plus possible overrun/under-run in the beam depth. Note that the centerline of this connection plate is aligned with the centerline of the bottom flange of the beam.



5. The welds for connection plates to the column flanges must be designed for shear forces. These welds may also be subjected to tensile/compression and shear forces when these plates serve as stiffener plates for a strong axis moment beam. Use fillet welds where possible. It is good practice to deduct twice the weld size from the length of plate available for welding so that the welds do not terminate at the edges of the plate or column flange. If calculated stresses are transferred through the welds at the column web, then back-up stiffener plates must be provided.

6. Bolts for the shear plate to beam web are normally located outside of the column flanges. This practice simplifies beam erection and allows access to tighten the bolts with use of an impact wrench. Short slots should be used in the plate and standard holes in the beam web. Flange welds should be completed before the bolts are tightened. The short slots will "hold" top of beam elevation and allow for weld shrinkage to occur at the flange welds. The bolts are designed for shear forces only (no eccentricity). The welds for the shear plate-to-column web are designed for shear only. The welds for the shear plate-to-connection plates must be designed for shear stresses due to the eccentricity from the neutral axis of the bolt group to the edge of the column flange. If a column web doubler is required due to a strong axis moment beam, then the additional stresses from the shear plate must be considered in determining the thickness of the web doubler plate.

Moment Connections with Beam Flange Plates (figure 2)

1. It is not necessary for the flange plates to be the same grade of material of the weak axis moment beam.

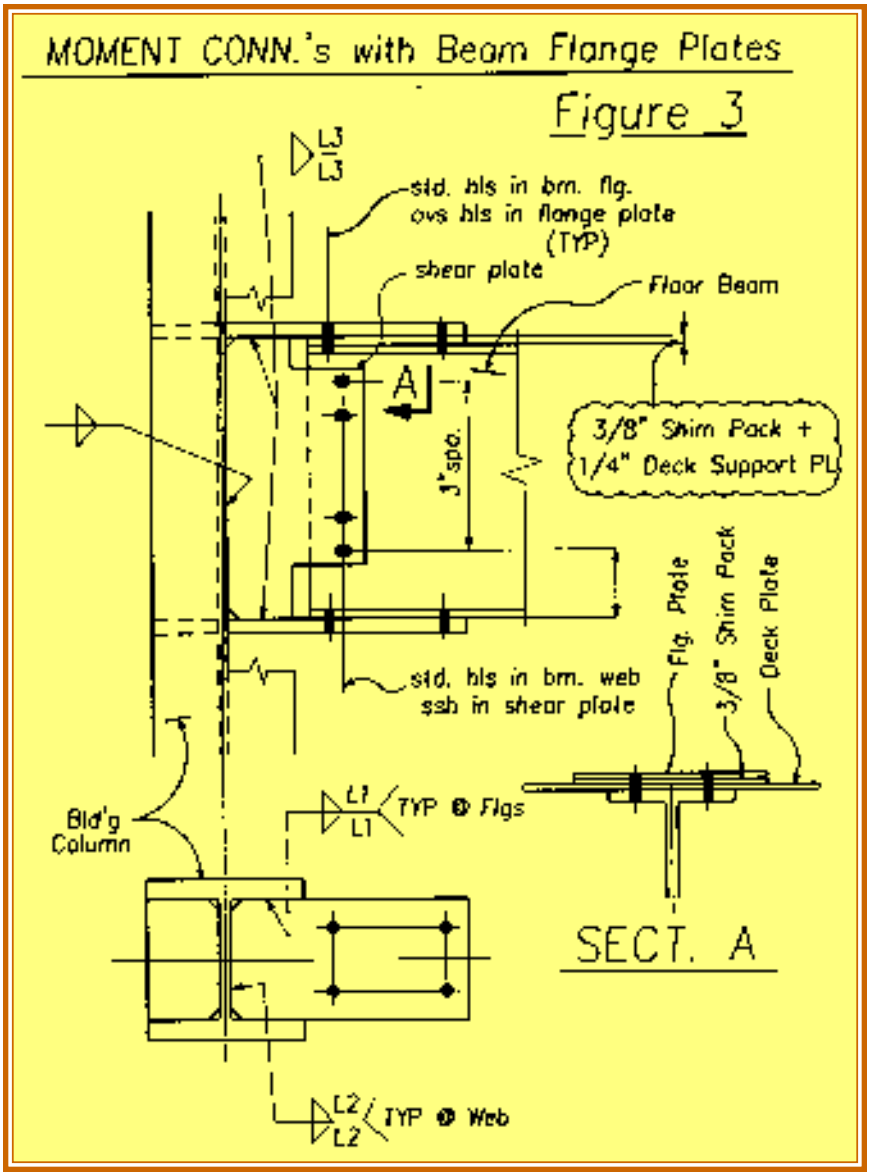
2. Oversized holes should be used in the flange plates to allow for mill tolerances in the column beam. These connections with oversized holes must be designed as slip critical. If tension control bolts are used, if possible use a bolt gage that will allow bolts at the bottom flange to be tightened from inside of the beam flange. In many cases, this is not possible due to beam flange widths and beam depths.

3. Shims must be provided at the top or bottom flanges to accommodate fabrication and mill tolerances for flange tilt plus possible overrun/under-run in beam depths. Fabricators normally prefer the shims to be at the bottom flange due to restrictions on programming of shop equipment. If shims are provided at the top flange, the detail can be provided to serve as a deck support (figure 3).

4. The flange plates must be designed for tension yielding, tension rupture, and compression strength.

5. The flange bolts must be designed for shear strength.

6. The beam design flexural strength with regard to net section must be determined to assure that the net beam section is adequate without reinforcing.



7. The welds for the flange plates to the column flanges/webs are designed using the same criteria used for the connection plates for the field welded flange moment beams in figure 1.

8. The web shear plate design is the same as for the field welded flange moment beams.

This article is adapted from a paper by M. Thomas Ferrell, P.E., for the 1998 National Steel Construction Conference. Ferrell is President of Ferrell Engineering, Inc., a specialty structural engineering firm located in Birmingham, AL.