AISC "Rigid" Speed Connection Contest

Current Situation

In a typical structural steel frame, the floor system is composed of steel beams and girders that transfer gravity forces to the column. As shown in Figure 1, the floor is supported by beams which are attached to girders which in turn connect to columns that support the frame. Designers need to typically consider load on the beam (moment and shear) and deflection. Can beam sizes be reduced while still transferring the required moment and shear and also meet deflection requirements?

It is common to use a "pin" type of connection between the beam and girder. As shown in Figure 2, a pin connection will allow the end of the beam to rotate. An alternative to the "pin" type connection is a "fixed" connection, which prevents rotation at the end of the beam. While a "pin" type connection is simple to design and fabricate, the "fixed" type of connection offers the advantage of helping reduce floor deflections. As shown in Figure 3, the "fixed" connection will reduce the total amount the beam can deflect. Figure 4 shows a potential moment reduction of up to 33% through the use of fixed end connections. The reduction of moment on beams and better deflection performance resulting from the use of fixed end connections can allow designers to select smaller beam depths. Thus, the use of fixed end connections could lead to use of smaller beam sizes and thinner floors.

Problem

While structural steel I-shape beams can resist vertical loads efficiently, the combination of beam depth and floor slab thickness can lead to an overall increase in building height leading to an overall increase in building cost. Finding ways to reduce the beam size will allow one to maintain the same desired floor-to-floor heights while reducing the overall building height and building cost. Use of connections that provide fixity could reduce beam sizes. However, current connection configurations that will provide a "fixed" connection between the beam and girder are expensive to fabricate and time consuming to erect. A commonly used "fixed" connection is shown in Figure 5. This contest looks to find a way to reduce beam depth sizes through the use of a new type of connection that is a quicker and easier way to achieve a "fixity" at a beam to girder connection.

Solution

A solution to this problem will offer a new type of beam to girder connection that can help reduce beam depth sizes. This can be accomplished by designing a connection between the beam and girder that will prevent rotation of the beam end. Utilizing the concrete slab to help reduce beam end rotation could also be considered.

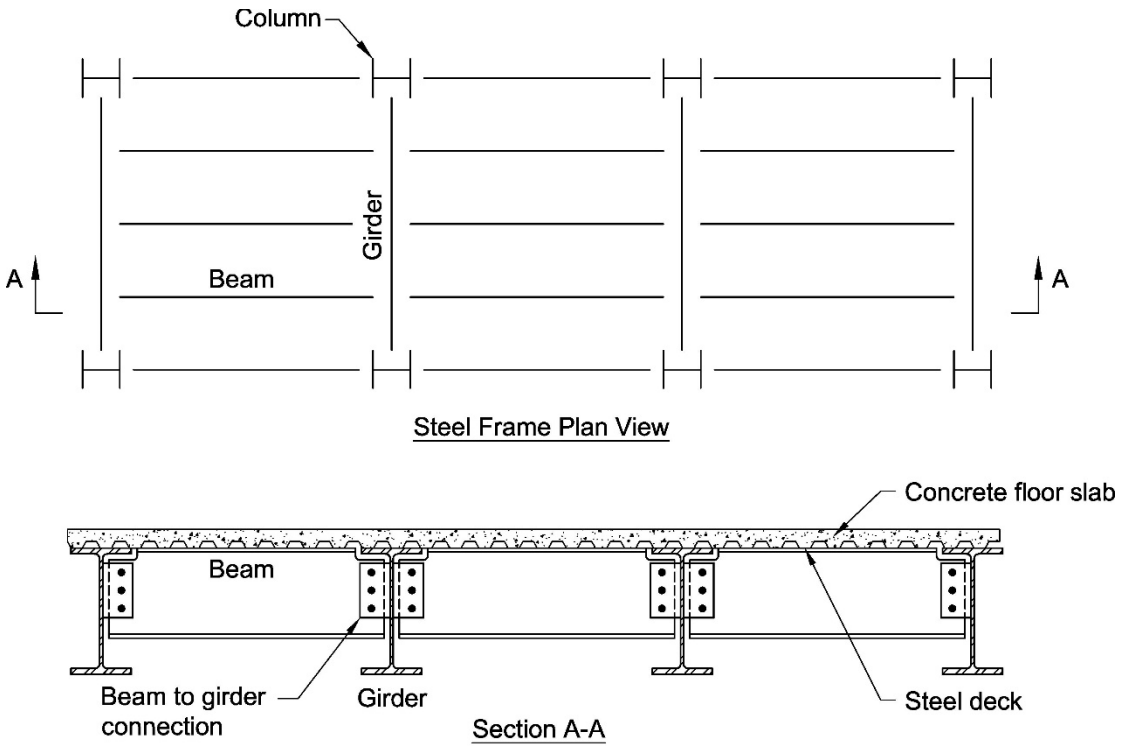

Figure 1. Framing Plan and Beam-to-Girder Connections.

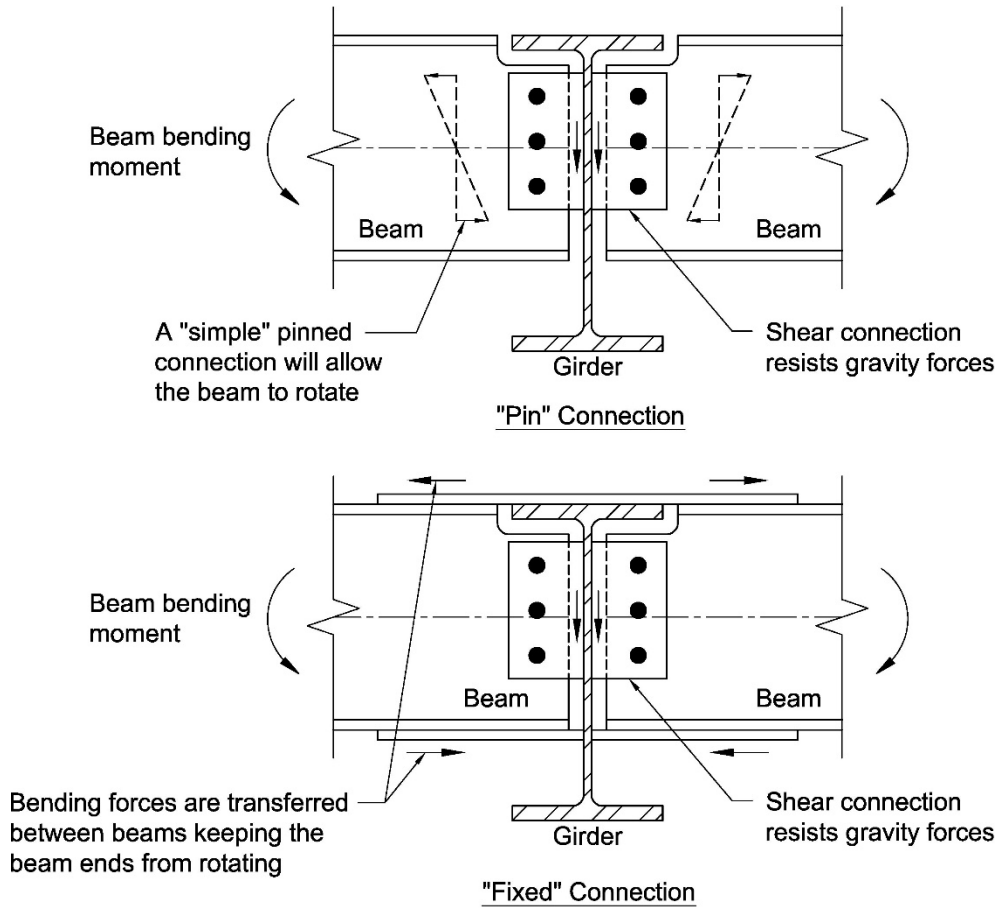

Figure 2. "Pin" and "Fixed" Beam-to-Girder Connections.

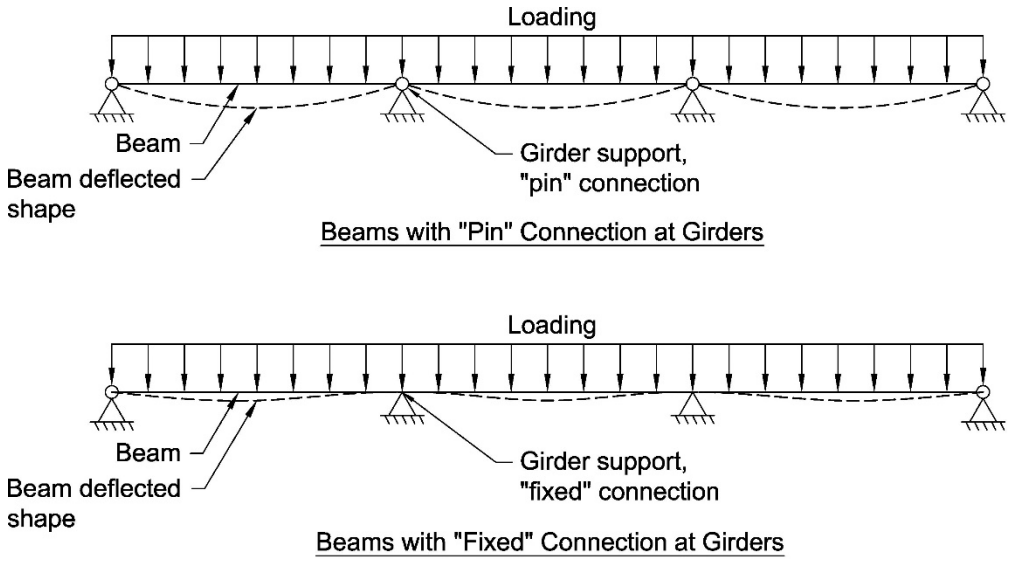

Fig. 3. Beam Loading and Deflected Shape.

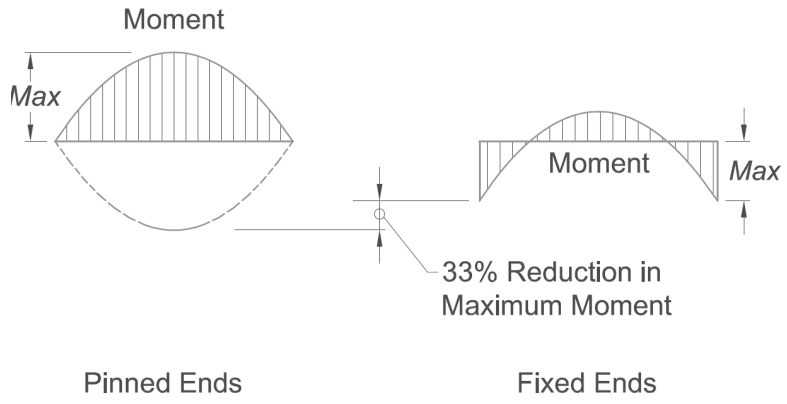

Fig. 4. Reduced Moment Using Fixed End Connections.

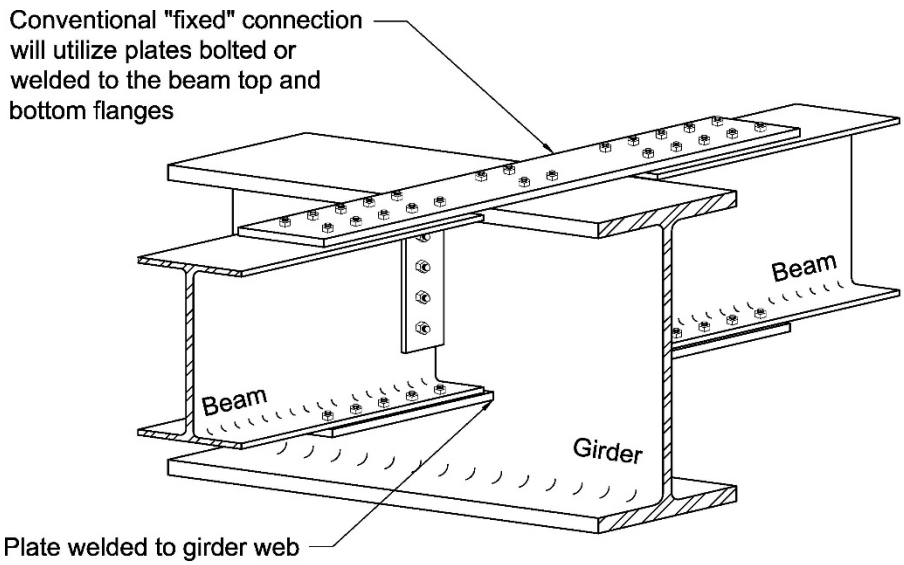

Figure 5. Conventional "Fixed" Beam-to-Girder Connection.