

The AISC *Code of Standard Practice* includes an updated approach to reinforcement at beam-to-column connections, which can help you refine your connection design.

codewise REINFORCING THE POINT

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TO ENSURE THE SAFETY and serviceability of a structure and to facilitate efficient bidding and awarding of projects, the structural engineer's intent must be clear and described in sufficient detail to be readily understood.

Relative to the goal of ensuring that project requirements are accurately conveyed, AISC's *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303), available at www.aisc.org/standards, has been remarkably consistent over its nearly 100-year history (it was first published in 1924). It has likewise taken a consistent approach to the bidding process via the following approach: If it is not shown, it will not be included in the bid.

The Preface of the 2016 *Code* states that Section 3.1.2 (formerly Section 3.1.1) "has been improved to address better what is required for bidding when the owner's designated representative for design delegates the determination and design of member reinforcement at connections to the licensed engineer in responsible charge of the connection design." The language that has been added to Section 3.1.2 represents a refinement and an improvement, not a change in intent.

The language, "Permanent bracing, column stiffeners, column web doubler plates, bearing stiffeners in beams and

girders, web reinforcement, openings for other trades and other special details, where required, shall be shown in sufficient detail in the structural design drawings so that the quantity, detailing and fabrication requirements for these items can be readily understood," first appeared in the 2000 *Code*, and

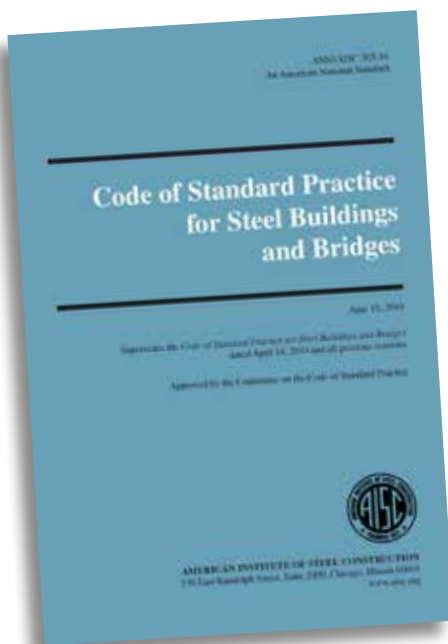
similar wording has appeared in the *Code* since 1976. In fact, the same basic structure has appeared in the *Code* nearly since its inception, with the 1928 version stating: "Wind bracing and special details when required shall be shown in sufficient detail regarding rivets and construction to permit an accurate estimate of cost."

For years, the *Code* addressed plans and specifications for bidding as a separate item from plans and specifications issued for construction. But this changed in 1976, when the term *contract documents* was introduced and defined as: "the documents which define the responsibilities of the parties involved in bidding, purchasing, supplying and erecting structural steel. Such documents normally consist of a contract, plans and specifications." This definition remains essentially unchanged to this day and clarifies that the structural plans and specifications are intended to convey information throughout the bidding and construction process.

Delegated Connection Design

Section 3.1.2 of the 2010 *Code* (now Section 3.1.1 of the 2016 *Code*) listed three options regarding connection design:

- (1) The complete *connection* design shall be shown in the structural *design drawings*.
- (2) In the structural *design drawings* or *specifications*, the *connection* shall be designated to be selected or completed by an experienced *steel detailer*.
- (3) In the structural *design drawings* or *specifications*, the *connection* shall be designated to be designed by a licensed professional engineer working for the *fabricator*.



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The 2010 *Code* was the first version that explicitly addressed the delegation of connection design work. But of course, as with anyone who has been involved with structural steel construction knows, delegated connection design was commonplace long before 2010. Therefore, “Option 3” was added to in 2010 to reflect the best practices that had developed within the industry with regards to delegated connection design work. In the 2016 *Code*, Section 3.1.1 requires the engineer to designate one of three options related to connection design, and Section 3.1.2 provides two subsidiary options for Options 3: 3A and 3B. Either Option 3A or 3B should be designated in the contract document to clearly convey the engineer’s intent.

If the intent is unclear, the fabricator should seek clarification. Fabricators may also want to indicate in the approval documents any connection details assumed to be mandated by the engineer.

The language added to Section 3.1.2 in 2016 can be viewed in a similar light: It represents a codification of best practices that exist within the industry. It does not represent a change to the overall intent of the *Code* and is not intended to cause a significant change to standard practice. The language essentially is a codification of “If it is not shown, it will not be included in the bid.”

Equitable Adjustment

The actual quantity and/or details of reinforcement can differ from the bidding quantity and/or details. The difference can lead to either an increase or a decrease in the actual price and construction time versus the bid price and construction time. The contract price and schedule should be adjusted equitably in accordance with Sections 9.4 and 9.5 of the 2016 *Code*.

When reinforcing is shown to provide conceptual configurations and quantities for bidding, it may be possible that when the connections are designed, the reinforcement will not be necessary. In this case, the fabricator can request a change to omit the reinforcement in accordance with Section 4.2.3, which states: “When the fabricator submits a request to change connection details that are described in the contract documents, the fabricator shall notify the owner’s designated representatives for design and construction in writing in advance of the submission of the approval documents.” This change in the contract will also be subject to an equitable adjustment per Sections 9.4 and 9.5, which could include a reduction in the contract price.

Rubber Meeting the Road

So what does this all mean in practice? How should bids be prepared and evaluated? Let’s look at some examples where connection design work has been delegated:

Case 1

The Contract Documents: The contract documents provide no indication that reinforcement is required.
 The Bid: No reinforcement will be included in the bid.

The Outcome: **Option 3A:** The absence of reinforcement in the contract documents indicates that the members have been sized such that reinforcement is not required. There will be no need to adjust the contract price or schedule.

Option 3B: If reinforcement is required to support the design loads provided by the engineer, then the contract price and schedule will be adjusted per Sections 9.4 and 9.5.

Case 2

The Contract Documents: The contract documents provide conceptual configurations with explicit information related to reinforcement dimensions and welding.

The Bid: The information provided in the contract documents will be included in the bids.

The Outcome: **Option 3A:** The reinforcement shown in the contract documents will be provided. There will be no need to adjust the contract price or schedule.

Option 3B: The design of the reinforcing has been delegated. If the final quantity and/or configuration of details of the reinforcing vary from those shown in the bidding documents, then the contract price and schedule will be adjusted per Sections 9.4 and 9.5.

Case 3

The Contract Documents: The contract documents provide only conceptual configurations of reinforcement, marked “AS REQUIRED” without any quantifying information.

The Bid: No reinforcement will be included in the bid.

The intent of the *Code*, as described in the Commentary, is to ensure that “all bidders use the same assumptions in preparing their bids.” This is not possible unless the contract documents provide a quantity that can be readily understood by the bidders. In the absence of such bidding quantities, member reinforcement at connections will not be included in the bid. This is consistent with Section 3.1.2, which states: “If no quantities or conceptual configurations are shown, member reinforcement at connections will not be included in the bid.”

The Outcome: The term “AS REQUIRED” indicates that Option 3B has been used. If reinforcement is required to support the design loads provided by the engineer, then the contract price and schedule will be adjusted per Sections 9.4 and 9.5.

Case 4

- The Contract Documents: The contract documents provide conceptual configurations of reinforcement accompanied by notes such as “½” STIFF. MIN.” and “¾” DOUBLER MIN.”
- The Bid: The bid should include the cost associated with providing the minimum reinforcement indicated.
- The Outcome: The term “MIN.” indicates that Option 3B has been used. If the final quantity and/or configuration of details of the reinforcing vary from those shown in the bidding documents, then the contract price and schedule will be adjusted per Sections 9.4 and 9.5 either upward or downward as required.

Reach Out

Using project-specific details and bidding quantities in the *Code* ensures that the bids you receive will be equitable. Every bid received for a project will include the same quantity of reinforcing. This should help reduce the need for change orders to pay for additional reinforcing at beam-to-column connections.

In addition, the “Advice for Owners” sidebar contains column reinforcement information directed toward owners and general contractors, and we encourage you to share this information with any owners and general contractors you work with. ■

Advice for Owners

Owners can reduce both costs and risks associated with their capital investments by ensuring that neither they nor the general contractors that they hire judge engineers based on the weight of the steel structures they design. The fallacy that the cost and weight of steel structures are correlated distorts the proper functioning of the marketplace by introducing incentives that increase both cost and exposure to risk. In effect, a premium is placed on the weight of a structure, when in reality least cost should be the goal.

Lighter columns often require reinforcement. The cost associated with this reinforcement is often much greater than the cost of providing a heavier column that will eliminate the need for reinforcement. Engineers know that providing the heavier column will reduce the cost of the project. However, engineers also recognize that owners and general contractors tend to use the weight of the structure as a metric by which to judge their performance. Engineers often respond to the market by expressing a preference for least weight in favor of least cost.

But Wait, There’s More!

The strength of columns subjected to a concentrated load at beam-to-column moment connections is also addressed in Section J10 of the *AISC Specification for Structural Steel Buildings* (ANSI/AISC 360), available at www.aisc.org/standards. Two other publications, *AISC Design Guide 13: Wide-Flange Column Stiffening at Moment Connections* (www.aisc.org/dg) and the *AISC Steel Construction Manual* design examples (www.aisc.org/manual), provide further guidance.

In addition, AISC’s Clean Column app, available for free at www.steeltools.org, provides guidance on column sizing, with an emphasis on the fact that properly sizing columns such that reinforcement is not necessary will generally minimize costs, disputes and exposure to risk.