

# PROFESSIONAL ISSUES

issues affecting the structural engineering profession

## Connection Design Responsibility

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Connection Design Responsibility is a commonly used term to describe the relationship between the Structural Engineer of Record and an engineer retained by the Structural Steel Fabricator on projects where the work of connection design is shared between these two entities. This article presents the current state of practice on this topic, as reflected in the current edition of the AISC *Code of Standard Practice for Steel Buildings and Bridges*.

For as long as there has been structural steel, there have been structural steel connections. As long as more than one entity or individual has been involved in determining the attributes of connections in a structural steel frame, there has been the possibility for ambiguity in the responsibility for connection design. The provisions of the recently published *Code of Standard Practice for Steel Buildings and Bridges* are the latest clarification of this topic. Commonly referred to as the AISC *Code*, this document is published by the American Institute of Steel Construction, and the current edition is dated April 14, 2010.

Without going back too far in time, the current concerns about connection design responsibility date back to the 1976 version of the AISC *Code*, which contained the following two sentences in paragraph 4.2.1:

*Approval by the owner of shop drawings prepared by the fabricator indicates that the fabricator has correctly interpreted the contract requirements. This approval constitutes the owner's acceptance of all design responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings.*

In the 1986 edition, the second sentence was modified to read as follows:

*This approval constitutes the owner's acceptance of all design responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as a part of his preparation of these shop drawings.*

It is this sentence, along with its predecessor, that launched a thousand panel discussions, technical articles and modifying text in project specifications. In some cases, the AISC *Code* was written out of project specifications in its entirety.

In recognition of this, in 1998, AISC reconstituted the roster of its Committee on the Code of Standard Practice. The new Committee was charged with reviewing the entire AISC *Code* to ensure that it reflected current standard

practice, and in particular to address concerns about Section 4.2.1 and the issue of connection design responsibility. The roster of the committee that created the 2000 version of the AISC *Code* had broad and balanced representation from both the design community and the steel construction industry. In addition to steel fabricators, detailers, and erectors, the Code Committee had several design engineers, as well as an architect, a specification expert, and a general contractor.

In the 2000 edition, the Code Committee removed the controversial sentence and replaced it with two methods for conveying connection information in structural design drawings in Section 3.1.2. Section 4.2 was modified and the text regarding approvals was shifted to Section 4.4, which read in part as follows in Section 4.4.1:

*Approval of the Shop and Erection Drawings, approval subject to corrections noted and similar approvals shall constitute the following:*

- 1) *Confirmation that the Fabricator has correctly interpreted the Contract Documents in the preparation of those submittals;*
- 2) *Confirmation that the Owner's Designated Representative for Design has reviewed and approved the Connection details shown on the Shop and Erection Drawings and submitted in accordance with Section 3.1.2, if applicable; and,*
- 3) *Release by the Owner's Designated Representatives for Design and Construction for the Fabricator to begin fabrication using the approved submittals.*

The two methods for conveying connection information in the AISC *Code* were described in this sentence from Section 3.1.2:

*The Owner's Designated Representative for Design shall either show the complete design of the Connections in the structural Design Drawings or allow the Fabricator to select or complete the Connection details while preparing the Shop and Erection Drawings.*

In its deliberations leading to the 2000 version of the AISC *Code*, the Committee was aware of other methodologies relating to connection design, but elected to only describe the two methodologies cited above – primarily because there was no consensus among the members of the Committee that there was a standard practice for other methodologies. The Committee did this, acknowledging the general principle stated in the Preface to the Code that:

2000

Unless specific provisions to the contrary are contained in the contract documents, the existing trade practices that are contained herein are considered to be the standard custom and usage of the industry and are thereby into the relationships between the parties to a contract.

Thus, on a specific project, the contract terms (i.e., provisions in the drawings and specifications) can provide requirements for the delegation of the connection design work in ways that differed from the provisions of Section 3.1.2.

The 2005 version of the AISC Code retained these provisions from the 2000 version.

In the 2010 version, the provisions of Section 3.1.2 were modified to include a third method of conveying connection information in the structural design drawings. The addition of this third method was prompted by a request from and subsequent collaboration with the Guidelines Committee of the Council of American Structural Engineers (CASE). Glenn Bishop of LBYP, in Birmingham, Alabama served as an ongoing representative of that group, participating actively in the development of the new provisions. The three methods are described in Section 3.1.2 as follows:

The owner's designated representative for design shall indicate one of the following options for each connection:

- 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; or,
- 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.

The essential feature of Option (3) is the acknowledgement that some connection design work will be performed by a licensed engineer working for the Fabricator. Section 3.1.2 contains detailed provisions on the relationship between the Structural Engineer of Record and the engineer working for the Fabricator. These provisions apply in the absence of specific contract provisions to the contrary, and as allowed by State laws and regulations. Code Section 4.4 Approval was also modified to be consistent with the new provisions of Section 3.1.2.

2005

When Option (2) is used, the Code provides as follows:

When option (2) above is specified, the experienced steel detailer shall utilize tables or schematic information provided in the structural design drawings in the selection or completion of the connections. When such information is not provided, tables in the AISC Steel Construction Manual, or other reference information as approved by the owner's designated representative for design, shall be used.

It further provides for both Options (2) and (3):

When option (2) or (3) above is specified, the owner's designated representative for design shall provide the following information in the structural design drawings and specifications:

- a) Any restrictions on the types of connections that are permitted;
- b) Data concerning the loads, including shears, moments, axial forces and transfer forces, that are to be resisted by the individual members and their connections, sufficient to allow the selection, completion, or design of the connection details while preparing the shop and erection drawings;
- c) Whether the data required in (b) is given at the service-load level or the factored-load level;
- d) Whether LFRD or ASD is to be used in the selection, completion, or design of connection details; and,
- e) What substantiating connection information, if any, is to be provided with the shop and erection drawings to the owner's designated representative for design.

Note that items (a) through (d) were carried over from the 2000 and 2005 versions of the AISC Code.

"Substantiating connection information" is defined in the glossary as "Information submitted by the fabricator, if requested by the owner's designated representative for design in the contract documents, when option (2) or option (3) is designated for connections per Section 3.1.2." This information is commonly known as calculations, but may also take the form of tables and spread sheets. The requirements for substantiating connection information are left to the specifier on a project-by-project basis. The requirements may vary due to such factors as

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project complexity, the policies and practices of an individual firm or practitioner, and State rules and regulations. Whether or not the submittals are sealed by the preparer, and the form of the presentation, are also project specific requirements.

The Code further requires with regard to the use of Option (3):

*When option (3) above is specified:*

- a) *The fabricator shall submit in a timely manner representative samples of the required substantiating connection information to the owner's designated representatives for design and construction. The owner's designated representative for design shall confirm in writing in a timely manner that these representative samples are consistent with the requirements in the contract documents, or shall advise what modifications are required to bring the representative samples into compliance with the requirements in the contract documents. This initial submittal and review is in addition to the requirements in Section 4.4.*
- b) *The licensed professional engineer in responsible charge of the connection design shall review and confirm in writing as part of the substantiating connection information, that the shop and erection drawings properly incorporate the connection designs. However, this review by the licensed professional engineer in responsible charge of the connection design does not replace the approval process of the shop and erection drawings by the owner's designated representative for design in Section 4.4.*
- c) *The fabricator shall provide a means by which the substantiating connection information is referenced to the related connections on the shop and erection drawings for the purpose of review.*

Note that, this process begins with the requirements of the contract documents and ends with the approval of shop and erection drawings and fabrication. Through the process, there are exchanges between the Owner's Designated Representative for Design (the engineer of record, EOR) and the engineer in responsible charge of the connection design (connection engineer).

The first step in this exchange is the preparation and submittal of representative samples

of the required substantiating connection information. The purpose of this submittal is to ensure that the EOR and the connection engineer are in accord with the connection design principles and procedures that will be used on the project. Notwithstanding AISC's extensive efforts to research and document connection design procedures over the years, connection design retains an element of engineering judgment, and two engineers may differ on an aspect of a connection design. This early submittal is intended to allow any differences to be identified and resolved before the connection design work is done. Accordingly, the AISC Code requires that the EOR review and comment on these early submittals. Once this early stage submittal process is complete and differences, if any, have been resolved, the connection engineer can proceed with the connection designs with the assurance of not being challenged on the design concepts illustrated in the representative samples.

As the connection engineer's designs are completed, they are provided to the detailer for incorporation into the shop drawings. Per item (b) in the above list, the connection engineer must review the shop drawings to ensure that the designs have been successfully incorporated. When this has been established, the connection designer is required to provide a statement to this effect to the EOR. Usually this can be accomplished in the form of a letter.

Lastly, the AISC Code requires that a system of cross references between the substantiating connection information and the shop drawings be established for a project, and that the cross references be provided. This system will vary by detailer and fabricator, and may also vary by project complexity and other such factors. The essential principle is that the system must permit the EOR to readily cross reference between two groups of numerous, but interrelated documents.

As noted above, the AISC Code provisions for approval (Section 4) have been adapted to the changes in Section 3 on connections. A key new provision is cited below.

*Final substantiating connection information, if any, shall also be submitted with the shop and erection drawings. The owner's designated representative for design is the final authority in the event of a disagreement between parties regarding connection design.*

This provision balances the fact that Section 4.4.1(b) states that, in approving the shop drawings, the owner's designated

representative for design has *reviewed and approved* the connection details shown on the shop and erection drawings.

The practice of engineering includes the exercise of professional judgment, and engineers may have different judgments on the same topic. Even though earlier in the process there may have been a submittal and approval of representative samples, at the time of final submittal of shop drawings the EOR may believe that the connection design engineer has not properly interpreted a contract requirement. In such a case, two basic principles of engineering practice can come into conflict:

*No third party can direct a licensed person to seal work contrary to his or her professional judgment, and one licensed individual cannot be required to categorically accept the work of another simply by virtue of the fact that the work has been sealed.*

The EOR's final authority to resolve disagreements is consistent with the AISC Code requirement that the EOR must review and approve the connection details shown in the shop drawings, and the EOR's overall responsibility for the completed structural frame, including connections. However, this does not grant the EOR unilateral authority to modify provisions of the contract. For example, during shop drawing review the EOR may indicate that a connection must have a feature, such as the thickness of a plate in the connection, which differs from that indicated in the connection calculations and shop drawings. New connection design requirements or statements of design intent not provided in the original contract carry the corresponding responsibility for the EOR to acknowledge to the owner that compensation may be due for such modifications, where appropriate. In extreme circumstances, an unresolved difference of opinion between the EOR and the connection designer could lead to a formal dispute under the appropriate provisions of the contract documents.

In contrast to the objectionable language in the 1986 version of the AISC Code, the 2010 AISC Code provides a process that involves both the EOR and connection engineer, and considers the interests of both. The provisions of the 2010 AISC Code provide a reasonable basis for delegating connection design work in the typical project.

It should be noted that there is a detailed presentation related to the subjects discussed in this article in Part 2 of the AISC *Steel Construction Manual*, 14<sup>th</sup> Edition, in a section entitled, *Establishing Criteria for Connections*. ■