Defining Responsibilities in Steel Joist Design

2006 IBC Section 2206

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Steel joists and Joist Girders provide a practical and economical framing system for floors and roofs in many types of buildings. The design of these members is governed by the Steel Joist Institute (SJI) *Standard Specifications*, as referenced in Section 2206.1 of the 2006 *International Building Code* (IBC). The SJI *Standard Specifications* and *Code of Standard Practice* provide the project's Engineer of Record (EOR) with load tables, joist designations, and a description of the information that must be supplied on the structural drawings so that the joist manufacturer can complete the joist design. The SJI member company then designs the specific configuration, member sizes, welds, and other details for the manufacture of each individual joist type, under the supervision of the Joist Manufacturer's Registered Design Professional (JMRDP) as required by the project specifications.

It is critical that the division of responsibilities between the EOR and the JMRDP be clearly defined and understood, and that there are no "gaps" between the two parties.

Courtesy of Perry S. Green.

History

In early August 2004, SJI became aware of a pending code change proposal by the National Council of Structural Engineers Associations (NCSEA) through its Code Advisory Committee (CAC) for the upcoming IBC 2004/2005 Code Development Cycle. As this proposal could possibly have serious ramifications for the steel joist industry, SJI immediately started to inquire through members of NCSEA about the impetus behind such desired changes. The primary issue was a concern that critical tasks in the joist engineering process were being performed by technicians or detailers, without supervision of the JMRDP, and that these items then appeared only on the joist placement plans. With a deadline looming and limited time for conversations, SJI submitted an alternate code change proposal for consideration. The key difference between the two proposals was that the NCSEA proposal would require the JMRDP to sign and seal joist placement plans, which are commonly (and incorrectly) referred to as "shop drawings".

NCSEA and SJI felt the necessity to get together to attempt to resolve their concerns and attain consensus language that both could accept prior to the formal hearings in February 2005. In December 2004, SJI invited the proponent for NCSEA, Mr. John Grenier, to meet with SJI personnel at a member company's plant in Buckeye, AZ. This provided SJI with the opportunity to show Mr. Grenier and his associates the actual processes utilized by the typical SJI open web steel joist manufacturer. This meeting, and a subsequent tour of the plant facility, revealed that there was a certain level of unawareness as to what actually transpires in the joist engineering process. All parties left the meeting with a better awareness that a unified direction could be taken, and a general agreement that implementation of language in the code itself was the best approach.

This meeting also led to the suggestion that SJI and the CAC of NCSEA have an open dialog to bring out the specific issues that needed to be addressed to attain a mutually acceptable solution. After a conversation with Mr. Ed Huston and Mr. Jim Delahay (then chair of the CAC) at the NCSEA Annual Conference in New Orleans, LA, SJI was invited to attend the next meeting of the CAC in Las Vegas, NV the following February.

It was at this meeting that personnel from both sides sat across the table from each other, discussed the steel joist detailing and engineering process, and started formulating consensus language. The goal was to attain an alternative proposal (floor modification) that would be introduced at the hearings to replace both previously submitted proposals. The language that is currently in the 2006 IBC is the result of many such meetings, exchanged emails, long discussions, and polling of memberships.

Joist Detailing and Engineering Process

A joist technician or joist detailer prepares joist placement plans in much the same way that a steel detailer prepares steel erection plans.

Based on the project's structural drawings, the detailer lays out the "structural" portion of the building; i.e., grid lines, walls, columns, and beams. Then, using the locations and spacings provided by the EOR on the structural drawings, the detailer creates a layout of the joists and Joist Girders within the building. The detailer develops joist and Joist Girder connection details based on the sections provided by the EOR on the structural drawings, and determines the joist and Joist Girder lengths based on these details and the building dimensions. The joist and Joist Girder designations, specified by the EOR, are noted on the joist layout. Any additional loads not included in the designations and specified by the EOR are shown on the joist placement plans. Having the joist layout, connections,

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sizes, and special loads all known, the detailer places a mark number on each individual joist to identify it in the same way that the steel detailer identifies individual beams and columns. The joist placement plans now have all of the information needed to "define" the joists and Joist Girders for manufacturing.

This information is then tabulated to create the Joist List Sheets or Bills of Material. The List Sheets contain all of the information that is needed to manufacture the joists. This includes, but is not limited to, the joist "base" and overall lengths, top and/or bottom chord extensions, bearing seat depth/height, locations of bolt holes in the bearing seats, and any other "special" detail information that may be required for manufacturing the joist(s). This is the main difference between the detailing of open web steel joists and structural steel. When detailing structural steel, a drawing is made of each beam and column showing the cut length, location of bolt holes, cap plates, and any special skews, notches or attachments that may be required for the structural steel member. Drawings are not made for individual joists. The joist placement plans are then submitted to the EOR for approval.

All of the information used to create the joist placement plans is copied directly from the structural drawings or from other documents prepared by the project's EOR. In fact, the completed joist placement plans now serve as an adjunct of the steel erection plans, and their sole purpose is to facilitate erecting the steel joists and Joist Girders.

When the joist designer completes the joist design from the List Sheets, there may be special details or conditions that require attention beyond the typical computer programs and printouts that the joist manufacturer uses for design of standard joists. It may then be necessary to add certain details to the joist placement plans, so that the erector has the information required in the field. An example of such a condition would be a joist that includes a field-bolted splice detail. Such a detail is not prepared by an unsupervised joist technician, but rather, either directly by the JMRDP, or by a qualified person under the supervision and review of the JMRDP. A detail for field assembly of the bolted splice would be added to the joist placement plans. This same detail, along with appropriate engineering calculations for the bolted splice, will be included in the calculation package from the JMRDP.

The purpose of the proposals was to clarify the responsibilities of the EOR and the JMRDP. The International Building Code now accomplishes this task with greater definition. To understand these additions better, let us address them one by one.

2206.2 Design. The registered design professional shall indicate on the construction documents the steel joist and/or steel joist girder designations from the specifications listed in Section 2206.1 and shall indicate the requirements for joist and joist girder design, layout, end supports, anchorage, non-SJI standard bridging, bridging termination connections and bearing connection design to resist uplift and lateral loads. These documents shall indicate special requirements as follows:

1) Special loads including:
   - 1.1. Concentrated loads;
   - 1.2. Nonuniform loads;
   - 1.3. Net uplift loads;
   - 1.4. Axial loads;
   - 1.5. End moments; and
   - 1.6. Connection forces.
2) Special considerations including:
   - 2.1. Profiles for nonstandard joist and joist girder configurations (standard joist and joist girder configurations are as indicated in the SJI catalog);
   - 2.2. Oversized or other nonstandard web openings; and
   - 2.3. Extended ends.
3) Deflection criteria for live and total loads for non-SJI standard joists.

The language in **2206.2 Design** identifies the requirements for steel joist and Joist Girder design that need to be shown on the structural drawings by the EOR.

Section **2206.3 Calculations** states that the JMRDP shall incorporate the information denoted in Section 2206.2. The calculation package is the JMRDP's interpretation of such information and is subject to signing and sealing by the JMRDP, if requested. This is generally accomplished by signing and sealing a "cover letter", rather than each calculation page that may be involved. The special details noted in this section, by inclusion in the calculation package, are covered by the signed and sealed cover letter. Therefore, use of these details, such as on the joist placement plans, is permitted without the need for further sealing.

2206.4 Steel joist drawings. Steel joist placement plans shall be provided to show the steel joist products as specified on the construction documents and are to be utilized for field installation in accordance with specific project requirements as stated in Section 2206.2. Steel placement plans shall include, at a minimum, the following:

1) Listing of all applicable loads as stated in Section 2206.2 and used in the design of the steel joists and joist girders as specified in the construction documents.
2) Profiles for nonstandard joist and joist girder configurations (standard joist and joist girder configurations are as indicated in the SJI catalog).
3) Connection requirements for:
   - 3.1. Joist supports;
   - 3.2. Joist girder supports;
   - 3.3. Field splices; and
   - 3.4. Bridging attachments.
4) Deflection criteria for live and total loads for non-SJI standard joists.
5) Size, location and connections for all bridging.
6) Joist headers.

Steel joist placement plans do not require the seal and signature of the joist manufacturer's registered design professional.

2206.3 Calculations. The steel joist and joist girder manufacturer shall design the steel joists and/or steel joist girders in accordance with the current SJI specifications and load tables to support the load requirements of Section 2206.2. The registered design professional may require submission of the steel joist and joist girder calculations as prepared by a registered design professional responsible for the product design. If requested by the registered design professional, the steel joist manufacturer shall submit design calculations with a cover letter bearing the seal and signature of the joist manufacturer's registered design professional. In addition to standard calculations under this seal and signature, submittal of the following shall be included:

1) Non-SJI standard bridging details (e.g. for cantilevered conditions, net uplift, etc.).
2) Connection details for:
   - 2.1. Non-SJI standard connections (e.g. flush-framed or framed connections);
   - 2.2. Field splices; and
   - 2.3. Joist headers.

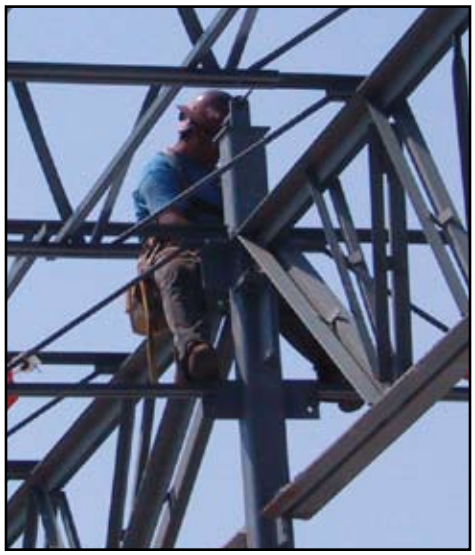
The joist manufacturer does not create "shop drawings" for the manufacture of steel joists and Joist Girders. This is accomplished through computer-generated "cut sheets" and CNC input, as much of the manufacturing is done through automation. What is created, however, are steel joist placement plans for field installation. These joist placement plans are not required to carry the seal or signature of the JMRDP, as it would be inappropriate for one engineer to adopt another engineer's design work as his own (Section 2206.4).

2206.5 Certification. At completion of fabrication, the steel joist manufacturer shall submit a certificate of compliance in accordance with Section 1704.2.2 stating that work was performed in accordance with approved construction documents and with SJI standard specifications.

As assurances for other parties, the steel joist manufacturer may be asked to submit a certificate of compliance (Section 2206.5).

Conclusion

The engineering process for steel joists and Joist Girders has been compared to structural steel or wood trusses, but in fact, the process is unique. The key to avoiding any responsibility "gap" between the EOR and the JMRDP is to define clearly the responsibilities of each party, and the new 2006 IBC language and Sections 2206.2 thru 2206.5 have accomplished that task. The steel joist manufacturer must make sure that the calculation package is complete, including the calculations and details for items such as special bridging, framed connections, field-bolted splices, and joist headers. While the joist placement plans may also contain these same special details for field use, the placement plans are not to be sealed by the JMRDP.▪



Courtesy of Perry S. Green.

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