
OPEN-WEB STEEL JOISTS AND JOIST GIRDERS: 2019 CBC

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PURPOSE

This Interpretation of Regulations (IR) clarifies the process and criteria under which DSA will evaluate, accept for use, and inspect the use of open web steel joists (OWSJ) on construction projects under DSA jurisdiction.

SCOPE

This IR is applicable to the design, fabrication, and installation of OWSJ. DSA requirements for the design, submittal, review, approval, testing, and inspection of OWSJ are covered. OWSJ addressed by this IR include both steel joist and joist girders, defined generally by the Steel Joist Institute (SJI) as “open web, in-plane load carrying steel members utilizing hot-rolled or cold-formed steel.”

BACKGROUND

California Building Code (CBC), Section 2207A defines requirements pertaining to the design, manufacture, and use of OWSJ and adopts SJI 100 and SJI 200. Frequently used terms in this IR are defined in the glossary, Section 9 below.

1. QUALIFIED MANUFACTURERS

The OWSJ manufacturer must be a current member in good standing with SJI and currently certified as an approved fabricator by one of the following organizations:

- International Accreditation Service, Inc.
- City of Los Angeles

2. APPROVAL PROCESS

The approval of OWSJ for use on a specific project is a four-phase process. The process outlined in this IR is a deferred submittal process in compliance with California Administrative Code (CAC), Section 4-317(g). As an alternate option, the OWSJ submittal package described in Section 4 below may be included with the construction documents in the first phase described in Section 3 below. In this case, the review and approval of construction documents and truss submittal package will be combined.

There are specific requirements and responsibilities for the joist manufacturers and architect or structural engineer in general responsible charge (project design professional) in each phase. The four phases and the key players involved are as follows:

2.1 Review and Approval of Construction Documents: Project Design Professional and DSA.

2.2 Review and Approval of Joist Documents: Project Design Professional, Manufacturer and DSA.

2.3 Manufacturing of Joists: Manufacturer and Fabrication Special Inspector.

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2.4 Field Installation: Project Inspector and Field Welding Special Inspector.

3. REVIEW AND APPROVAL OF CONSTRUCTION DOCUMENTS

This phase occurs before a project construction contract is awarded to a qualified joist manufacturer. The steps and requirements for this phase are as follows:

3.1 Project design professional prepares construction documents (plans and specifications) for the project. In addition to the requirements in CBC Section 2207A.2, the portion of the construction documents pertaining to OWSJ shall also include the following:

3.1.1 Structural framing plan including layout of OWSJ and all supporting elements.

3.1.2 Details of construction for the joist-to-building structure connections.

3.1.3 Details of construction for joist bridging-to-building structure connections.

3.1.4 Details of construction for joist-to-joist girder connections.

3.1.5 Loading diagrams for all OWSJ in accordance with CBC Section 2207A.2, Item 1 and any deflection requirements applicable to the defined load cases or combinations.

3.1.6 Specify the SJJ joist designation for each joist. The designation shall comply with CBC Section 2207A.2.

3.1.7 Project specifications shall require the OWSJ manufacturer(s) to comply with Section 1 above. The project design professional should closely coordinate OWSJ design including all connections, non-standard products and details with a qualified OWSJ manufacturer prior to the submittal of construction documents to DSA for review.

3.1.8 Project specifications and form *DSA-103: List of Required Structural Tests and Special Inspections* (CBC Sections 1704A.2.3 and 1704A.3) shall include testing and inspection requirements for OWSJ per Section 7 below.

3.1.9 The following note shall be shown on the plans: *“Mechanical, electrical, and plumbing units and systems shall be coordinated with the manufacturer’s joist document prior to field installation. Field modification of OWSJ is prohibited without the prior approval of DSA.”*

3.1.10 As an option, joist documents as described in Section 4 below may be included with the construction documents. Otherwise, they are submitted as a deferred submittal per Section 4 below and CAC Section 4-317(g).

3.2 Project design professional submits an application and construction documents to DSA for review. Refer to *PR 17-03: Project Submittal Appointment Process* and *PR 18-04: Electronic Plan Review for Design Professionals of Record*, Sections 1 and 2.

3.3 After the plan review process is completed (refer to PR 18-04 Sections 3 and 4), the approved construction documents will bear the DSA identification stamp.

4. REVIEW AND APPROVAL OF JOIST DOCUMENTS

This phase may occur after the project has been bid and the contract for the fabrication of the OWSJ has been awarded to a qualified manufacturer as defined in Section 1 above. As such, this phase constitutes a deferred submittal in accordance with CAC Section 4-317(g). Refer to PR 18-04 Section 5. The steps and requirements for this phase are as follows:

4.1 Submittal Preparation

Manufacturer prepares joist submittal package for DSA approval, in accordance with the

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requirements of the DSA-approved project construction documents and working in a fully coordinated effort with the project design professional.

4.1.1 If alteration of the DSA-approved construction documents (see Section 3 above) is required by the manufacturer during the preparation of the joist submittal package, the project design professional shall prepare and submit a Construction Change Document (CCD) to DSA for review in accordance with *IR A-6: Construction Change Document Submittal and Approval Process*. These changes may include, but are not limited to, joist designation, joist depths, layout, framing plans, loads, joist anchorage, etc.

4.2 Submittal Package

As applicable, the joist manufacturer's submittal shall include the following. In accordance with PR 18-04 Section 5, the submittal package shall be organized into two separate electronic files.

4.2.1 Supporting Document File

4.2.1.1 Calculations per CBC Section 2207A.3, signed and stamped by the manufacturer's California registered professional engineer per CBC Section 2207A.4.1.

4.2.1.2 Any other product data, test data, reports, or other documentation not identified in Section 4.2.2 below that the manufacturer chooses to submit in support of the OWSJ design.

4.2.2 Approval Document File

4.2.2.1 Joist profiles with member sizes and joist member connection details, signed and stamped by the manufacturer's California registered professional engineer per CBC Section 2207A.4.1.

4.2.2.2 Details of construction for joist chord bridging and the bridging connections to the joist chords per CBC Section 2207A.4, signed and stamped by the manufacturer's California registered professional engineer.

4.2.2.3 Details of construction for joist chord bracing as required by the design or per CBC Section 2207A.6, signed and stamped by the manufacturer's California registered professional engineer.

4.2.2.4 Composite joists shear stud installation plans with sizes, quantity and locations of all shear connectors on the composite steel joists. Composite joist plans shall be stamped and signed by the joist manufacturer's California registered design professional.

4.2.2.5 Details of construction for joist chord splices, signed and stamped by the manufacturer's California registered professional engineer.

4.2.2.6 Joist placement plan(s) per CBC Section 2207A.4.

4.2.2.6.1 Joist placement plan(s) shall show the joist layout as a direct overlay of the framing plan(s) shown on the DSA-approved construction documents. Joist placement plan(s) shall not include details or other information that would otherwise require the signature and stamp of a design professional, so these plans are not required to be signed and stamped by the joist manufacturer's California registered design professional.

4.2.2.6.2 The joist placement plan is only intended to be a vehicle used by the joist manufacturer to communicate (for field installation) where specific joists, designed by the joist manufacturer's registered design professional, are located on the DSA-approved framing plans.

4.2.2.7 When alternate design substitutions (ADS) are anticipated during the manufacturing

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process, the manufacturer may specify alternate member thickness or weld sizes that may be substituted during manufacturing. If the joist documents with ADS are approved by DSA, the manufacturer will not be subject to the provisions of Section 8 below if ADS were used during the manufacturing.

4.3 Design Professional Review of Submittal Package

The manufacturer submits the joist submittal package to the project design professional for review and approval. This step may take multiple exchanges between the project design professional and the OWSJ manufacturer to finalize the submittal package for submittal to DSA. The project design professional and the OWSJ manufacturer, working together, shall coordinate the documents with respect to the following:

4.3.1 Mechanical, electrical and plumbing plans that include locations and sizes of roof top or floor units, ducts, pipes, conduits, etc.

4.3.2 Roof pitch or slopes.

4.3.3 Top elevations of support elements to ensure proper seating of OWSJ (i.e., top of steel girders, concrete or CMU pilasters or walls).

4.4 Submittal to DSA

When the project design professional(s) approves the joist submittal package, they shall prepare and affix a signed Statement of General Conformance and Signature Block per *IR A-18: Use of Construction Documents Prepared by Other Professionals*. The design professional shall submit the package to DSA for review and approval in accordance with CAC Section 4-317(g).

4.5 DSA Review

4.5.1 DSA review of the calculations typically includes verification of input and output. This step will involve a back-check review if the documents are not approved on the initial submission. Each of the following conditions must be met:

4.5.1.1 The manufacturer is licensed by SJI to manufacture the joist series (which includes SJI certification of joist design software).

4.5.1.2 The composite joist designation CJ is specified in accordance with SJI 200 containing the Standard Specification, weight tables and bridging tables such that the design loads are not greater than the safe factored uniformly distributed joist loads listed therein.

4.5.1.3 The joist designation K, LH, DLH, or Joist Girder listed in SJI 100 containing the Standard Specification and load tables such that the design loads are not greater than the load tables listed therein.

4.5.1.4 The effect of eccentricity on LH/DLH series joists and joist girders is permitted to be neglected if the eccentricity is within the allowable tolerance specified in SJI 100 Section 4.5.4.

4.5.2 The project design professional shall coordinate with the manufacturer to resolve DSA plan review comments as noted on the mark-up set of joist submittal package and schedule a back-check appointment with DSA if necessary.

4.6 DSA Approval

When DSA determines the joist submittal package is in conformance, DSA will affix its approval stamp to the documents defined in Section 4.2.2 above. Provided the content of the joist placement plan meets the requirements of Section 4.2.6 above, DSA will approve the joist

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placement plan despite the fact it is not stamped and signed by the joist manufacturer's California registered design professional. ←

5. MANUFACTURING OF JOISTS

The steps and requirements for this phase are as follows:

5.1 Manufacturer prepares shop orders or shop drawings from the DSA-approved construction documents and DSA-approved joist documents. Other than approved ADS described in Section 4.2 above, changes to the approved joist documents must be reviewed and approved by DSA prior to manufacturing in accordance with Section 8 below.

5.2 Manufacturer notifies the project design professional, project inspector, and fabrication special inspector of the fabrication schedule. Manufacturing may not start without the presence of the fabrication special inspector.

5.3 A fabrication special inspector must be approved by DSA for each project prior to manufacturing. The fabrication special inspector provides inspection during OWSJ manufacturing in accordance with Section 7 below.

5.4 At the end of fabrication, the manufacturer shall submit a certificate of compliance per CBC Section 2207A.5 to DSA, the owner, and the project design professional.

6. FIELD INSTALLATION

The steps and requirements for this phase are as follows:

6.1 Working from the DSA-approved construction documents and DSA-approved joist documents (including revised joist documents as may be needed per Section 8 below), the project inspector shall verify joist size, fabrication special inspector's ID tag or mark, and placement in the field.

6.2 Working from the DSA-approved documents listed above the field welding special inspector provides continuous inspection for field welding of attachments of the OWSJ.

7. TESTING AND INSPECTION

Testing and inspection shall comply with CBC Section 1705A.2 and shall be performed in accordance with CAC Sections 4-333 and 4-335, and *IR 17-3: Structural Welding Inspection*.

7.1 Unidentified Steel

All steel shall be identified by the fabrication special inspector per CBC Section 1705A.2.3. Unidentified steel shall be tested per CBC Section 2202A.1.

7.2 Composite Joists

Shear studs shall conform to the requirements of the American Institute of Steel Construction (AISC) 360, Section A3.6 and shall be sampled and tested per CBC Section 2213A.2.

7.3 Shop Fabrication

Inspection of shop fabrication shall comply with CBC Section 1705A.2.3.

7.3.1 Marking

The special inspector shall place a distinguishing mark, and/or tag with this distinguishing mark, on each inspected joist or joist girder. This mark or tag shall remain on the joist or joist girder throughout the jobsite receiving and erection process. At a minimum the "distinguishing mark" shall include the special inspector's initials and date.

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Inspection of shop and field welding shall comply with CBC Section 1705A.2.3, *IR 17-2: Nondestructive Testing (NDT) of Structural Welds*, and IR 17-3. Additional requirements for welding inspections are listed below:

7.4.1 The cost of inspection shall be paid by the owner, which is usually the school district.

7.4.2 Fabrication special inspectors and field welding special inspectors shall hold current certification as an American Welding Society (AWS) Certified Welding Inspector (CWI), in accordance with AWS QC1.

7.4.3 Welding procedure specification shall be pre-qualified or qualified by test per AWS D1.1/D1.1M Sections 3 and 4 respectively, and SJI 100 or SJI 200 as applicable.

8. REVISIONS DURING MANUFACTURING

This section is not applicable to the approved ADS described in Section 4.2 above. If revisions to the approved joist document are necessary, the manufacturer shall obtain DSA approval of the revisions prior to the manufacturing of the affected joists. The steps and requirements for making revisions are as follows:

8.1 Manufacturer notifies the fabrication special inspector of changes being proposed.

8.2 Manufacturer submits revised joist documents to the project design professional for approval. The revised joist documents shall include all the items listed in Section 4.2 above for the affected joists.

8.3 If acceptable, the project design professional approves the joist manufacturer's revised documents and affixes a signed and stamped statement of general conformance on the documents.

8.4 The project design professional submits the revised documents as a CCD to DSA for review and approval. Refer to IR A-6.

8.5 DSA reviews the CCD and, when the revised joist documents are determined to be in conformance, will affix its approval stamp. This step will require a resubmittal if the initial CCD submittal is not approved.

8.6 The manufacturer starts the manufacturing of the joists in accordance with the DSA-approved CCD following the procedures in Section 5 above.

9. GLOSSARY

For clarity and reference, some frequently used terms in this IR are defined below:

9.1 Alternate Design Substitutions (ADS)

DSA-approved alternate member(s) or components that may be substituted during manufacturing. The ADS are shown in the joist submittal package and are equal or greater in load carrying capacity than the component(s) for which they are substituted. They can be readily verified by the fabrication special inspector.

9.2 Construction Documents

Project documents pertaining to the construction of the project and submitted to DSA for review prior to construction. These documents may include drawings and specifications for site, architectural, structural, mechanical, electrical and energy features.

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An AWS certified welding inspector who provides continuous inspection during the manufacturing of OWSJ. The inspector may be employed by the school district and independently approved for the project by DSA, or the inspector may be employed by the laboratory of record (LOR). Refer to CAC Section 4-335.

9.4 Field Welding Special Inspector

A welding inspector who provides continuous inspection of field welding. The inspector may be employed by the school district and independently approved for the project by DSA, or the inspector may be employed by the LOR. Refer to CAC Section 4-335.

9.5 Joist Documents

The joist placement drawings, calculations, joist profiles with member sizes and connection details prepared by the manufacturer. Refer to CBC Sections 2207A.3 and 2207A.4. The joist documents may be submitted to DSA as a deferred submittal. Refer to CAC Section 4-317(g).

9.6 Joist Manufacturer

An OWSJ manufacturer who manufactures the members and components of OWSJ and uses those members and components to fabricate on a continuing basis joists of the K-Series, LH-Series, DLH-Series, CJ-Series, and/or Joist Girders conforming to SJI 100 or SJI 200 as applicable.

9.7 Joist Submittal Package

The compiled set of joist documents submitted to DSA for review and approval in accordance with Section 4 above.

9.8 Project Design Professional

The architect or structural engineer in "general responsible charge" of a project. Refer to CAC Section 4-316(a).

9.9 Project Inspector (PI)

A DSA certified inspector who is in general responsible charge of inspection for the project. The PI is employed by the school district and approved by DSA for the project. Refer to CAC Section 4-333(b).

9.10 Revised Joist Documents

Joist documents that are revised during the manufacturing/fabrication phase. These design alterations require DSA approval through the CCD process.

9.11 Shop Order/Drawings

Fabrication plans and details develop by manufacturer to facilitate the fabrication of OWSJ.

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REFERENCES:

2019 California Code of Regulations (CCR) Title 24

Part 1: California Administrative Code (CAC), Sections 4-316, 4-317, 4-333 and 4-335

Part 2: California Building Code (CBC), Sections 1705A.2 and 2207A

This IR is intended for use by DSA staff and by design professionals to promote statewide consistency for review and approval of plans and specifications as well as construction oversight of projects within the jurisdiction of DSA, which includes State of California public schools (K–12), community colleges and state-owned or state-leased essential services buildings. This IR indicates an acceptable method for achieving compliance with applicable codes and regulations, although other methods proposed by design professionals may be considered by DSA.

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