
OPEN WEB STEEL JOISTS AND JOIST GIRDERS: 2022 CBC

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PURPOSE

This Interpretation of Regulations (IR) clarifies the process and criteria under which DSA will evaluate, approve, and inspect 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 below.

1. QUALIFIED MANUFACTURERS

The OWSJ manufacturer shall be a current member in good standing with SJI and have a valid certification as an approved fabricator by one of the following organizations:

1.1 International Accreditation Service (IAS), Inc. Approval is based on compliance with IAS AC 172: Accreditation Criteria for Fabricator Inspection Programs for Structural Steel and is listed as “Fabricator Inspection” accreditation on the IAS website.

1.2 American Institute of Steel Construction (AISC). Approval is based on the AISC certification program and is listed as “Building Fabricator” certification on the AISC website.

1.3 American Welding Society (AWS). Approval is based on the AWS facility accreditation program and is listed as “Certified Welding Fabricator” certification on the AWS website.

2. APPROVAL PROCESS

The approval of OWSJ for use on a specific project is typically a four-phase process. The phases outlined in this IR constitute a deferred submittal process in accordance with California Administrative Code (CAC), Section 4-317(g). As an alternate to the deferred submittal process and at the discretion of the project applicant, the information in the joist approval document as described in Section 4 below may be incorporated into the construction documents described in Section 3 below. In this alternate option, the review and approval of construction documents and joist documents will be combined.

There are specific requirements and responsibilities for the joist manufacturer, joist engineer, project design professionals, inspectors, and DSA in each phase as follows:

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2.1 Review and Approval of Construction Documents

The project design professionals work with DSA to submit and obtain approval of the construction documents in accordance with the electronic plan review procedure. Refer to Section 3 below and Procedure (PR) 18-04: Electronic Plan Review for Design Professionals, Sections 1, 2, 3, and 4.

2.2 Review and Approval of Joist Documents

The joist manufacturer, joist engineer, and project design professionals work with DSA to submit and obtain approval of the joist documents in accordance with Section 4 below and PR 18-04 Section 5.

2.3 Manufacture of Joists

After DSA approval of the joist documents, the joist manufacturer may proceed with fabrication of the OWSJ under the oversight of the fabrication special inspector. Any change during manufacturing that is not included in the DSA-approved joist documents as an alternate design substitution requires approval of a Construction Change Document (CCD). The process of submitting a CCD for review and obtaining DSA approval requires contributions from the joist engineer and project design professionals in addition to the joist manufacturer. Refer to Section 5 below.

2.4 Field Installation

After fabrication and delivery, OWSJ erection at the job site is subject to inspection by both the project inspector and the field welding special inspector. Refer to Section 6.5 below.

3. REVIEW AND APPROVAL OF CONSTRUCTION DOCUMENTS

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

3.1 Construction Document Preparation

The project design professionals prepare construction documents 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. See Figure 3.1 below. Any deflection requirements applicable to the defined load cases or combinations shall also be defined.

3.1.6 SJI joist designation for each joist. The designation shall comply with CBC Section 2207A.2.

3.1.7 Specifications requiring the OWSJ manufacturer to comply with Section 1 above. The project design professionals 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 Specifications and form *DSA-103: List of Required Structural Tests and Special Inspections* defining testing and inspection requirements for OWSJ per Section 6 below. Refer to CBC Sections 1704A.2.3 and 1704A.3.

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3.1.9 Note on the construction drawings the same or similar as the following: *“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.”*

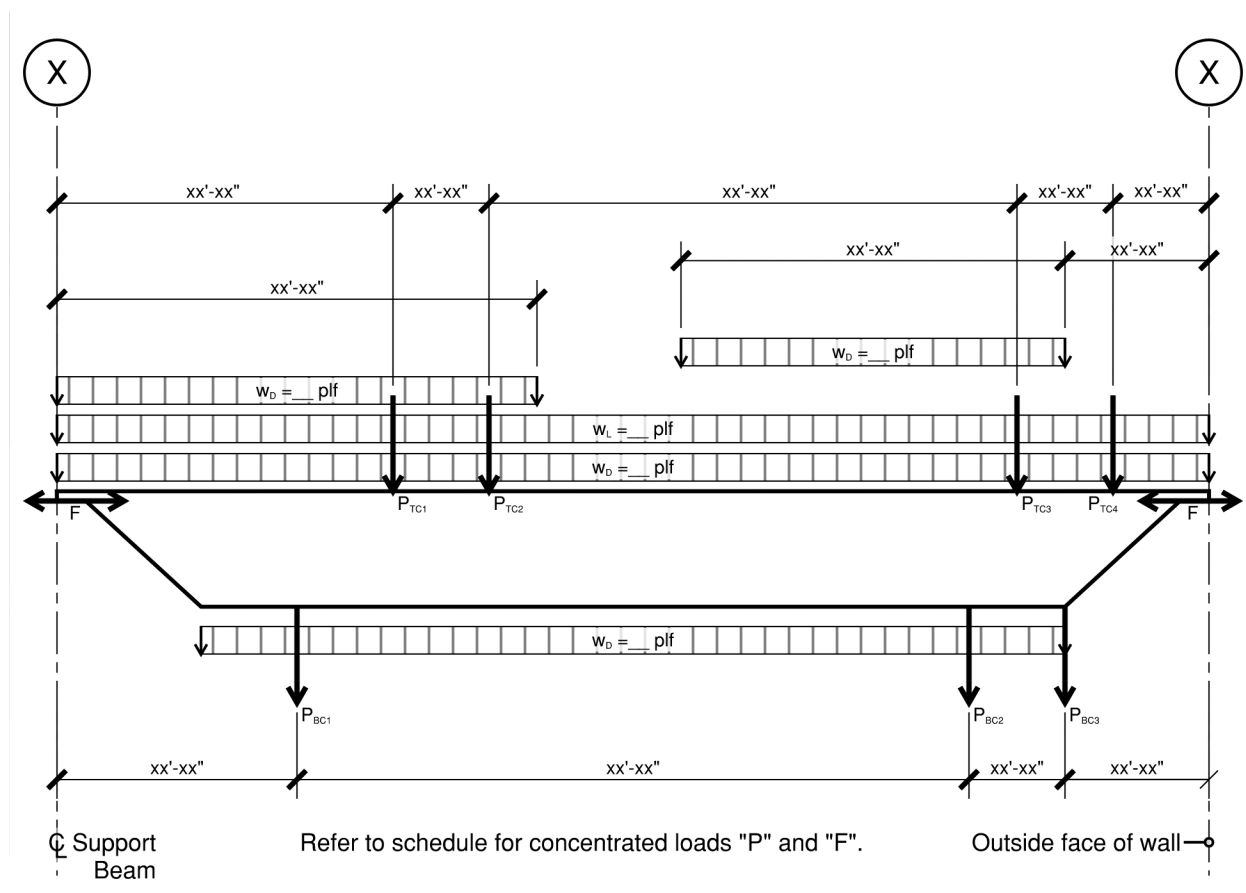


Figure 3.1: Example OWSJ Loading Diagram

3.2 Submission, Review, and Approval

3.2.1 Project design professional submits an application and construction documents to DSA for review and approval. Refer to *PR 17-03: Project Submittal Appointment Process* and PR 18-04 Sections 1 and 2.

3.2.2 After the plan review and back check 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 will commonly occur after the contract has been awarded to a qualified joist 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 Joist Submittal Package Preparation

The joist manufacturer prepares the joist submittal package for DSA review and approval, in accordance with the requirements of the DSA-approved project construction documents and working in a fully coordinated effort with the project design professionals.

4.1.1 If alteration of the DSA-approved construction documents as described in Section 3

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above is required during the preparation of the joist submittal package, the project design professionals shall prepare and submit a CCD to DSA for review and approval 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.

4.1.2 The joist submittal package shall include the documents described in this section. In accordance with PR 18-04 Section 5, the submittal package shall be organized into two separate electronic files: the supporting document file and the approval document file. There are no page or sheet size requirements for either file.

4.1.3 The supporting document file shall comply with PR 18-04 Section 5.2.3 and contain the following components specific to OWSJ:

4.1.3.1 Calculations per CBC Section 2207A.3, stamped and signed by the joist engineer per CBC Section 2207A.4.1.

4.1.3.2 Any product data, test data, reports, or other documentation not identified in Section 4.1.4 below that the manufacturer submits in support of the OWSJ design.

4.1.4 The approval document file shall comply with PR 18-04 Section 5.2.2 and contain the following components specific to OWSJ:

4.1.4.1 Joist profiles with member sizes and joist member connection details, stamped and signed by the joist engineer per CBC Section 2207A.4.1.

4.1.4.2 Details of construction for joist chord bridging and the bridging connections to the joist chords per CBC Section 2207A.4, stamped and signed by the joist engineer.

4.1.4.3 Details of construction for joist chord bracing as required by the design or per CBC Section 2207A.6, stamped and signed by the joist engineer.

4.1.4.4 Composite joists shear stud installation plans with sizes, quantity, and locations of all shear connectors on the composite steel joists, stamped and signed by the joist engineer.

4.1.4.5 Details of construction for joist chord splices, stamped and signed by the joist engineer.

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

4.1.4.6.1 Joist placement plans shall show the joist layout as a direct overlay of the framing plans shown on the DSA-approved construction documents. Joist placement plans need not be signed and stamped by the joist engineer. When not stamped and signed, the joist placement plan sheet shall not include details or other information that would otherwise require the stamp and signature.

4.1.4.6.2 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 engineer, are located on the DSA-approved framing plans.

4.1.4.7 When alternate design substitutions (refer to the Glossary below) are anticipated during the manufacturing process, the manufacturer may specify alternate member thicknesses or weld sizes that may be substituted during manufacturing. The requirements of Section 5.5 below do not apply to the implementation of alternate design substitutions approved by DSA in the joist submittal approval document.

4.2 Review and Acceptance by Project Design Professionals

The manufacturer submits the joist submittal package to the project design professionals for review and approval. This process may take multiple exchanges between the project design professionals and the OWSJ manufacturer to finalize the joist submittal package for submission to DSA.

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4.2.1 The project design professionals and the OWSJ manufacturer, working together, shall coordinate the documents with respect to the following:

4.2.1.1 Mechanical, electrical, and plumbing systems that include locations and sizes of roof mounted, floor mounted, and suspended equipment and distributions systems (e.g., ducts, pipes, conduits, etc.).

4.2.1.2 Roof pitch or slopes.

4.2.1.3 Top elevations of support elements to ensure proper seating of OWSJ (e.g., top of steel girders, concrete walls, masonry walls and pilasters, etc.).

4.2.2 When the project design professionals approve 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).

4.3 DSA Review and Approval

The DSA review and approval process may require cycles of plan review comments and corrections to the joist submittal package if DSA determines the initial version to be incomplete or not code compliant. Each revised version of the package is subject to the actions required by Section 4.2 above prior to being resubmitted to DSA.

4.3.1 DSA review of the joist calculations typically includes verification of input and output. Each of the following conditions must be met:

4.3.1.1 The manufacturer is a member of SJI, which (in accordance with SJI 100 Section 4.7.1) includes SJI verification of the joist design calculations (e.g., software) used by the manufacturer to design joists.

4.3.1.2 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.

4.3.1.3 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.

4.3.1.4 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.

4.3.2 The project design professionals shall coordinate with the manufacturer to resolve DSA plan review comments in accordance with PR 18-04 Section 5.4.

4.3.3 When DSA determines the joist submittal package is complete and code compliant, DSA will affix its approval stamp to the approval document as defined in Section 4.1.4 above. Provided the content of the joist placement plan meets the requirements of Section 4.1.4.6 above, DSA will approve the joist placement plan despite the fact it is not stamped and signed by the joist engineer.

5. MANUFACTURE OF JOISTS

Fabrication of OWSJ shall not start until the deferred joist submittal package has been accepted by the project design professionals (refer to Section 4.2 above) and approved by DSA (refer to Section 4.3 above). The steps and requirements for this phase are as follows:

5.1 Fabrication and Inspection

5.1.1 Manufacturer prepares shop orders or shop drawings from the DSA-approved construction documents and DSA-approved joist documents. Excluding approved alternate

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design substitutions described in Section 4.1.4.7 above, changes to the approved joist documents shall be reviewed and approved by DSA prior to manufacturing in accordance with Section 5.2 below.

5.1.2 Manufacturer shall notify 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.

5.1.3 A fabrication special inspector shall be identified who either is employed by the laboratory of record (LOR) or is contracted directly with the school district (and approved by DSA on a project-by-project basis) prior to manufacturing. Refer to the definition of fabrication special inspector in the Glossary below. The fabrication special inspector provides inspection during OWSJ manufacturing in accordance with Section 6 below.

5.1.4 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.

5.2 Revisions

If revisions to the approved joist documents are necessary, the manufacturer shall obtain DSA approval of the revisions prior to manufacturing the affected joists as follows:

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

5.2.2 Manufacturer submits revised joist documents to the project design professionals for review and approval. The revised joist documents shall include all the items listed in Section 4.1 above for the affected joists.

5.2.3 If acceptable, the project design professionals approve the revised joist documents and affix a signed statement of general conformance on the documents.

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

5.2.5 DSA reviews the CCD and, when the revised joist documents are determined to be complete and code compliant, affixes the DSA approval stamp. This step will require a resubmittal if the initial CCD submittal is not approved.

5.2.6 The manufacturer proceeds with manufacturing the subject joists in accordance with the DSA-approved CCD.

6. 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*.

6.1 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.

6.2 Composite Joists

Shear studs shall conform to the requirements of the AISC 360 Section A3.6 and shall be sampled and tested per CBC Section 2213A.2.

6.3 Shop Fabrication

Inspection of shop fabrication shall comply with CBC Section 1705A.2.3. The special inspector shall place a distinguishing mark or tag with the 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:

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

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

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

6.5 Inspection of Field Erection

6.5.1 Working from the DSA-approved construction documents and DSA-approved joist documents (including revised joist documents as may be needed and approved by DSA per Section 5.5 above), the project inspector shall verify joist size, fabrication special inspector's identification tag or mark, and placement in the field.

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

OPEN WEB STEEL JOISTS AND JOIST GIRDERS: 2022 CBC**GLOSSARY****Alternate Design Substitutions**

DSA-approved alternate members, components, or welds that may be substituted during manufacturing. Alternate design substitutions are shown in the joist submittal package and are equal or greater in load carrying capacity than the components for which they are substituted. They can be readily verified by the fabrication special inspector.

Construction Documents

Drawings and specifications prepared by the project design professionals for the construction of the project and submitted to DSA for review and approval prior to construction. These documents may include drawings and specifications for site, architectural, structural, mechanical, electrical, plumbing, and energy features.

Fabrication Special Inspector

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

Field Welding Special Inspector

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

Joist Documents

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

Joist Engineer

A California registered professional engineer retained by the joist manufacturer who is responsible for the design of the OWSJ and stamps and signs the joist documents.

Joist Manufacturer

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

Joist Submittal Package

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

Project Design Professional

The architect or structural engineer in general responsible charge of a project in accordance CAC Section 4-316(a) and the structural engineer with delegated responsibility in accordance with CAC Section 4-316(b). These individuals are sometimes referred to as the architect of record and structural engineer of record, and both are intended when this term is used in the plural form in this IR.

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Project Inspector

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

Shop Order/Drawings

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

REFERENCES:

2022 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 1704A.2, 1704A.3, 1705A.2, 2202A.1, 2207A, 2207A.2, 2207A.3, 2207A.4, 2207A.5, 2207A.6, and 2213A.2.

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.

This IR is subject to revision at any time. Please check DSA's website for currently effective IRs. Only IRs listed on the webpage at www.dgs.ca.gov/dsa/publications at the time of project application submittal to DSA are considered applicable.