product expert series

OPEN-WEB STEEL JOISTS

BY JAMES M. FISHER, P.E., PH.D.

What's new with steel joists? *MSC* talked to the nation's leading technical consultant on joists to get the inside scoop.

WITH RESPECT TO SPECIFYING of open-web steel joists (OWSJ) there are several new items of significance that impact both designers and fabricators in the Steel Joist Institute's 43rd Edition *Catalog*.

These include minor changes to the standard load tables for K-Series, KCS Joist Substitutes and Top Chord Extensions. In addition, the 8K1 joist has been removed from the load tables, primarily because Joist Substitutes can support the same load for a lower price.

In recent years specifying professionals have been using wider joist spacing in floor and roof systems, thus creating a demand for higher load carrying joists. Several joist manufacturers had been producing "Super Longspan" joists with spans up to 240 ft at the request of specifying professionals. SJI has standardized these joists into the DLH *Specification*, developing new load tables for LH/DLH-Series joists for the expanded range of spans, which for DLH-Series joists has gone from a maximum of 144 ft to a new upper limit of 240 ft.

Camber requirements have also been changed for longer joists. The standard load tables for LH/DLH-Series are now based on the span rather than clear span to be consistent with the K-Series load tables.

There is also a new method of designating LH-Series joists called the Load/Load method. To use this method, the specifier indicates the total load/live load for a given span, then finds the appropriate joist properties from the new weight tables. As explained in the 43rd *Catalog*, "These weight tables are intended to be a tool to assist in the preliminary design and estimate for joists used in floors and roofs with high capacity loading requirements." The tables are applicable only to joists with parallel chords and cover joists from 14-in. deep to 60-in. deep with loads up to 2,400 lb per ft.

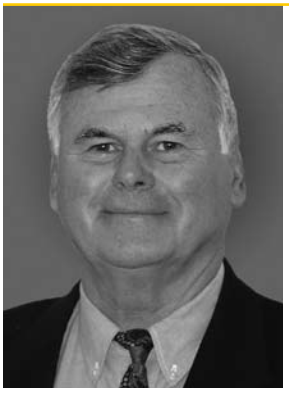
New bridging requirements have been incorporated into the 2010 *Specification* for consistency in requirements between K-Series and LH/DLH-Series bridging requirements. These changes now recognize that construction loads are not proportional to span length, that top chord construction stress varies with joist depth, and that construction loads are independent of joist series.

Steel Joist Institute

▲ DLH joists being installed on a hangar project.

▼ Placing a DLH joist.

Steel Joist Institute



James M. Fisher, P.E., Ph.D., is vice president emeritus of Computerized Structural Design, Milwaukee, and the consulting engineer of the Steel Joist Institute.

Crimped angles and crimped angle local web buckling.

Several specific changes relative to the design of OWSJ are contained in the new *Specification*. Many of these changes do not directly affect the specifier; however, the changes provide greater reliability in the design of the joist. Of significance is a new design procedure for the first primary compression web of the joist when crimped angles are used. The procedure better reflects the strength of the first compression web for crimped angles as compared to the previous *Specification*. This procedure incorporates a new *Q*-factor in the buckling equation. The equation is based upon several years of research conducted by the SJI (see photos). Also, in previous years manufacturers of joists and joist girders seeking to become SJI-approved manufacturers were required to check combined shear and axial loads at node points in joists and joist girders. These requirements are now in the *Specification*. Similarly, a check for top chord transverse bending of joist girders is now included in the joist girder *Specification*.

More information can be found concerning the SJI, and its member companies, on the SJI website, www.steeljoist.org.

One item of special significance to the EOR and to specifiers of OWSJ is that for the first time the SJI *Code of Standard Practice (COSP)* now indicates that a concentrated load of up to 100 lb can be placed between panel points on joists without reinforcement, i.e., the addition of a strut, provided that the 100-lb loads are accounted for by the specifier in the collateral loads. This is meaningful because now small hanging loads, such as those for ceiling grids or lighting, can be hung concentrically from any location on either the top or bottom chord without violating SJI requirements. The *COSP* illustrates how the specifier can obtain joists with even larger concentrated loads between panel points.

Current Projects and Initiatives

Several projects are under way under the auspices of the SJI. These include:

1. A revision and update of SJI *Technical Digest No. 6*, *Structural Design of Steel Joist Roofs to Resist Uplift Loads*. The update will include several design examples for specifying OWSJ in accordance with ASCE 7-10.
2. A complete update of SJI *Technical Digest No. 5*, *Vibration of Steel Joist-Concrete Slab Floors*. This will be accompanied by an updated computer program for the determination of joist floor vibration characteristics.
3. Research is being conducted to better understand bridging requirements for OWSJ for construction loads, as well as for wind uplift.

The Historical Context of Today's Joists

The first open-web steel joist (OWSJ) was developed in 1923. It was a Warren truss type, with top and bottom chords of round bars and a web formed from a single continuous bar. Modifications and improvements over the years have resulted in six primary types of OWSJ listed here. Except as noted, their capacities vary with span.

1. K-Series joists, which range from 10 in. to 30 in. in depth and span from 10 ft to 60 ft.
2. KCS-Series joists, which also range from 10 in. to 30 in. in depth and span from 10 ft to 60 ft. These differ from the K-Series in that they have a constant moment and shear capacity along their entire length.
3. LH-Series joists range from 18 in. to 48 in. in depth and span from 21 ft to 96 ft.
4. DLH-Series joists, which range from 52 in. to 120 in. in depth, span from 62 ft to 240 ft.
5. Composite Joists have depths that range from 10 in. to 96 in. and span from 20 ft to 120 ft. Capacities vary with span, depth, concrete thickness and properties.
6. Joist Girders, with depths ranging from 20 in. through 120 in., span from 20 ft to 120 ft.

All of the above joists and joist girders are covered by ANSI-accredited specifications.

The Origins of Standardization

In 1928 manufacturers of OWSJ formed the Steel Joist Institute (SJI). The first SJI *Catalog* and the first *Standard Specifications* were published in 1932, and through 2009 a total of 42 editions of these documents were published.

The *Catalog* contains the specifications, load tables and weight tables for OWSJ and joist girders, the SJI *Code of Standard Practice* and other helpful information. Also, the first *Composite Steel Joist Catalog* was published in 2007.

The K-Series, LH- and DLH-Series and Joist Girder standard specifications are ANSI accredited and are part of the 2009 *International Building Code (IBC)* Section 2206. The *CJ-Series Standard Specification* is ANSI accredited and also included in the 2009 *IBC*. All are also in the 2012 *IBC*.

The 43rd *Catalog* was published in late 2011 and contains information relative to the design and specification of OWSJ and joist girders. It includes the following revised and updated documents:

- ANSI/SJI-K-2010, *Standard Specification for Open Web Steel Joists, K-Series and Load Tables.*
- ANSI/SJI-LH/DLH-2010, *Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series and Load Tables.*
- ANSI/SJI-JG-2010, *Standard Specification for Joist Girders.*
- SJI-COSP-2010, *Code of Standard Practice for Steel Joists and Joist Girders.*

4. Pseudo Joist Girder Tables are nearing completion so that designers can incorporate joist girders into various commercial computer programs. This will aid designers in the selection of joist girders for gravity and lateral load design.
5. Work is beginning to consolidate the specifications covering K-, LH- and DLH-Series joists into a single specification.
6. Several webinars are being offered relative to the specification and use of OWSJ.

Also of note, the SJI has a new general manager, Ken Charles, and a new office location: 234 W. Cheves Street, Florence, S.C. 29501. Phone: 434.525.7377

More information can be found concerning the SJI, and its member companies, on the SJI website, **www.steeljoist.org**. MSC