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New Horizons in Open Web Steel Joists and Joist Girders

Longer Spans, Less Bridging and Better End Anchorage

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In preparation for inclusion by reference in the 2012 International Building Code (IBC), the Steel Joist Institute (SJI) has completed the 43rd Edition of the *Open Web Steel Joist and Joist Girder Specifications*, as well as the *Code of Standard Practice*.

This edition includes significant changes and improvements. The 40 balloted revisions encompass previously unpublished design checks and assumptions, better use of "mandatory" code language, and reorganization of certain sections for better clarity. But most important, the changes are all aimed at making SJI products safer, easier to use and more economical. This article highlights significant changes for the Specifying Design Professional.

Longer Spans and Load Table Revisions

A substantial expansion to the deep Longspan DLH-Series Load Tables increases the maximum span length for these SJI joists. The new longest length is 240 feet – almost a 100-foot increase from the previous maximum length of 144 feet. To accommodate the longer spans, the maximum joist depth has been increased from 72 inches to 120 inches.

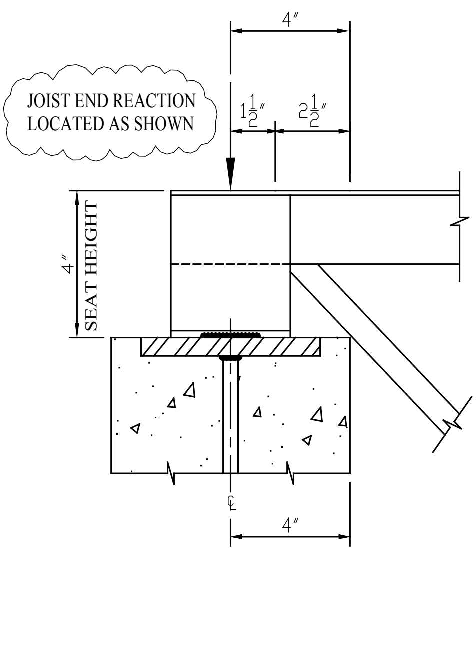
The "chord number," which is the final two digits of an LH/DLH-Series joist designation, is simply a relative indicator and a reference to a particular row in the Load Tables. The increased range of the DLH-Series Load Tables has led to the use of chord numbers up to 25, where the previous limit was 19. Also, because of the tremendous range of the DLH-Series joists, it becomes impractical to list every one foot increment of span in the Load Table. For the larger chord numbers, depths and spans, the increment between Load Table columns increases to 3 feet, and then 5 feet. Linear interpolation can be used for spans between the given columns.

In addition to the expansion of the DLH-Series Load Tables, a number of other less substantial Load Table revisions have been made. For K-Series, the 8K1 designation has been dropped, because typically either a joist substitute can be used or there is sufficient headroom clearance to allow the use of a 10K1. The joist substitute tables have been revised, extending their range from a maximum span of 8 feet to a new maximum span of 10 feet. A few rows have been added to the K-Series Load Table to provide greater clarity as to the load carrying capacity of joists with a span to depth ratio of less than 12.

Span versus Clearspan

In communication between the Specifying Design Professionals and the SJI Member companies, it has become apparent that the current LH and DLH tables can be confusing when determining a uniform load from the load table based on the "clearspan." The K-Series Standard Load Tables are based on "span" and many users have assumed the LH and DLH Standard Load Tables also use span instead of clearspan. The resulting LH and DLH joist selection based on span rather than clearspan would be conservative, but may not lead to the most efficient joist selection. Consequently, all four Longspan Joist Standard Load Tables (LH and DLH Series in both ASD and LRFD) have been made simpler to use and more consistent with the K-Series Standard Load Tables by incorporating *span* instead of the clearspan terminology. Previously for joists with spans within or less than the "Safe Load" range, interpretation of several footnotes was required to establish the uniform load capacity. The revised Standard Load Tables simplify the use of joists in the Safe Load range because the Safe Load can simply be divided by *span*, and for spans less than the minimum Safe Load length, a new column provides the maximum safe uniform load value.

The "Clearspan" terminology is inconsistent with other top chord length criteria used in the specifications, such as camber and erection stability bridging. So the use of a common term *span* will greatly simplify the specification.



Anchorage

The Steel Joist Institute Specification includes an introduction to each joist series. For the K-Series, the statement is made that standard K-Series joists have a 2½ inch end bearing depth. This implies that other depths may not be available or that, if the seat is deeper, the entire joist would no longer be "standard," which is not the case. Likewise, the introduction for the LH and DLH Series states that the bearing seat depth has been established at 5 inches or 7½ inches depending on the chord number of the joist. Although the Accessories and Details section of the catalog shows seat depths for sloped joists that are greater than the established standards, there are other conditions where the use of deeper seats may be more appropriate and necessary.

In some cases, the "standard" bearing depths can be problematic and a deeper seat is the best solution. For example, on perimeter beams or supporting members with unbalanced tributary loading, the Specifying Design Professional may wish to move the reaction point, for a K-Series joist, to the center of the support to minimize eccentric loading. When Insulating Form Concrete walls are used, the outside of the form may need to be notched to allow for joist end web clearance, or the inside face of the form to be tapered to allow the steel embed plate to fall no farther than ½ inch from the face of the wall. Perhaps for K-series joists bearing on the top of masonry walls, the Specifying Design Professional may wish to move the reaction point of the joist closer to the center of the wall to minimize the opportunity for spalling of the concrete at the edge of the embed plate.

The new specification clarifies that seat depths greater than 2½ inches, for K-Series joists, are readily available. An exception is created in the K-Series, LH and DLH Series specifications allowing the Specifying Design Professional to locate the bearing plate more than ½-inch from the face of the wall, provided that the condition is clearly noted on the contract drawings and the bearing seat depth is sufficient. Specifically, the Specifying Design Professional needs to note the required location of the joist end reaction over the wall. To deliver the end reaction to the desired location, the joist manufacturer needs to provide sufficient bearing seat depth. The specifications state if the joist reaction is to occur more than 2½ inches from the face of the wall, the minimum seat depth shall be 2½ inches plus a dimension equal to the distance the joist reaction is to occur beyond 2½ inches.

Bridging

Joist bridging plays a key role in the stability and load carrying capacity of the joists. During the construction and erection phase of a project, the bridging stabilizes the joist for construction loads prior to the top chord having full lateral support from the steel deck. After construction and during the life of the structure, bridging stabilizes unsupported joist components for the design loads. Consequently, bridging is not directly designed for the external loads applied to the joists. Joists are designed to be strong "in plane" or the direction perpendicular to the applied loads. In the "out of plane" direction, joists are weaker and need bridging to keep them properly stabilized and aligned so that they can resist the in plane loads. Factors that determine the type and number of rows of bridging not only include construction loads but also span, depth and member component sizes. Bridging consists of horizontal and diagonal angle members connecting to the joist top and bottom chords. Common types of bridging are Horizontal Bridging, Welded Cross Bridging, Bolted Cross Bridging, Bolted Erection Stability Cross Bridging (EX) and Uplift Bridging.

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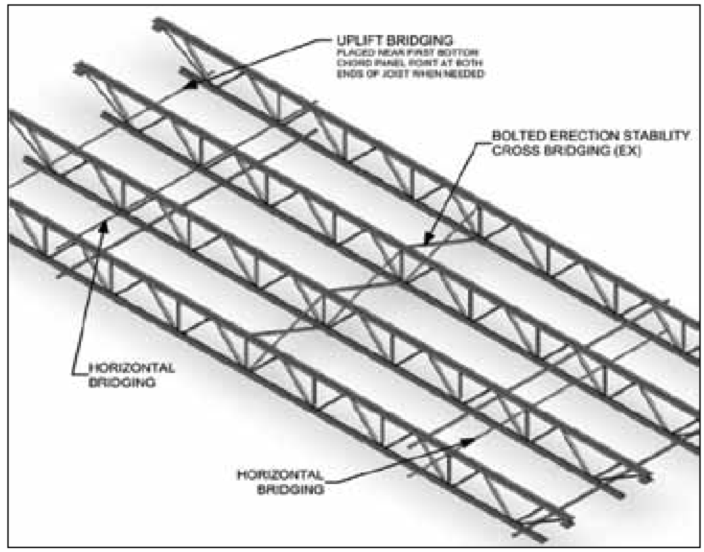
A number of variables were revisited to come up with the modifications to the way the 43rd SJI Specification addresses bridging requirements. In order to make the bridging revisions in the specification, the construction loads were reviewed. Construction loads are not proportional to span and are independent of joist series (K and LH). Also, the stresses in the top chord vary with joist depth. Consequently, some revisions to the specification were made to better match the needs of the joist but not to over design the bridging, which may cause undo expense to the project. Also, the bridging tables in the 43rd SJI Specification have been expanded for longer length joists. These changes resulted in new tables for all joist types.

In the past, the bridging requirement may have seemed quite arbitrary and tabulated values were shown with little or no explanation as to how these values were determined. The 43rd SJI Specification includes some simple information, which explains design criteria and equations (K series specification section 5.4(d)) to determine a force (P_{br}) for which the bridging should be designed. Also, the role of bridging anchorage is included. Rows of bridging must be anchored or terminated at a rigid support to function properly, which is addressed in more detail than before. Additionally, the cumulative effect of the number of joist spaces is included in the equations to determine the bridging force. Consequently, the new bridging tables include this force (P_{br}) for different standard sizes of joists.

As a result of the revisions to bridging provisions in the 43rd SJI Specification, some joists will have fewer rows of bridging. In all cases, the bridging will be more exact in it usage.



Conclusion

The 43rd Edition of the SJI specification contains many revisions. It is the culmination of years of research and a concerted effort to simplify the use of open web steel joist products. This article has highlighted just a few of the changes. In 2011, the SJI will be conducting Webinars to explain the changes in more detail. Visit the SJI website at **www.steeljoist.org** to learn more about new publications and educational opportunities.▪

COSP New Bridging Table 2.7-1c

MAXIMUM BRIDGING FORCE (P_{br}) FOR HORIZONTAL BRIDGING (lbs)							
Joist Spacing (Ft.)	Bridging Angle Size (Equal Leg Angle)						
	1 x 7/64 r = 0.20”	1¼ x 7/64 r = 0.25”	1½ x7/64 r = 0.30”	1¾ x 7/64 r = 0.35”	2 x 1/8 r = 0.40”	2½ x 5/32 r = 0.50”	3 x 3/16 r = 0.60”
2.0	2150	3960	5600				
2.5	1370	2730	4410	5910			
3.0	950	1890	3290	4850			
3.5	700	1390	2420	3840	6180		
4.0	530	1060	1850	2960	5030		
4.5	420	840	1460	2340	4000		
5.0	340	680	1180	1890	3240		
5.5	-	560	980	1560	2670		
6.0	-	470	820	1310	2250	5490	
6.5	-	-	700	1120	1910	4680	
7.0	-	-	600	960	1650	4030	
7.5	-	-	520	840	1440	3510	
8.0	-	-	-	740	1260	3090	
8.5	-	-	-	650	1120	2740	5680
9.0	-	-	-	-	1000	2440	5060
9.5	-	-	-	-	890	2190	4540
10.0	-	-	-	-	810	1970	4100
10.5	-	-	-	-	-	1790	3720
11.0	-	-	-	-	-	1630	3390
11.5	-	-	-	-	-	1490	3100
12.0	-	-	-	-	-	1370	2850