Web Hole Types in BCI® Joists

A variety of hole shapes may be analyzed and cut in the webs of BCI® Joists. All web holes reduce the shear capacity of a wood I-Joist. To determine this reduction, Section 4.6 of ICC-ES® Evaluation Report ESR-1336 lists provisions for web hole shear capacity. Specifically, Section 4.6.4 provides web hole shear equations based upon hole type. All web hole types may be analyzed in both BC Calc® https://www.bccalc.com/ and BC Framer® software programs. When inputting holes in the software it is important to understand the differences in hole types to ensure that holes are properly analyzed.

Circular

Circular holes are the most common web hole shape used for mechanical lines ranging from electrical wiring to HVAC ducts. Circular holes are to be smoothly cut with a consistent diameter. The equation for circular holes is as follows:

$$V_{hole} = V_{BCI}\left[B_C - M_C\left(\frac{Hole\ Diameter}{Joist\ Depth\ -(2 * Flange\ Depth)}\right)\right]$$

where:

B_C = initial shear reduction coefficient = 0.88 for All BCI® Joists

M_C = hole depth coefficient = 0.69 for All BCI® Joists

Rectangular

Rectangular and square holes allow for various duct and other multiple mechanical lines. Due to the sharp corners, rectangular holes produce the most shear reduction. Thus, rectangular holes may be conservatively used to model holes that do not comply with the other hole types shown. The equation for rectangular holes is:

$$V_{hole} = V_{BCI}\left[B_R - M_D\left(\frac{Hole\ Depth}{Joist\ Depth\ -(2 * Flange\ Depth)}\right) - M_L\left(\frac{Hole\ Length}{18}\right)\right]$$

where:

B_R = initial shear reduction coefficient = 0.60 for All BCI® Joists

M_D = hole depth coefficient = 0.28 for All BCI® Joists

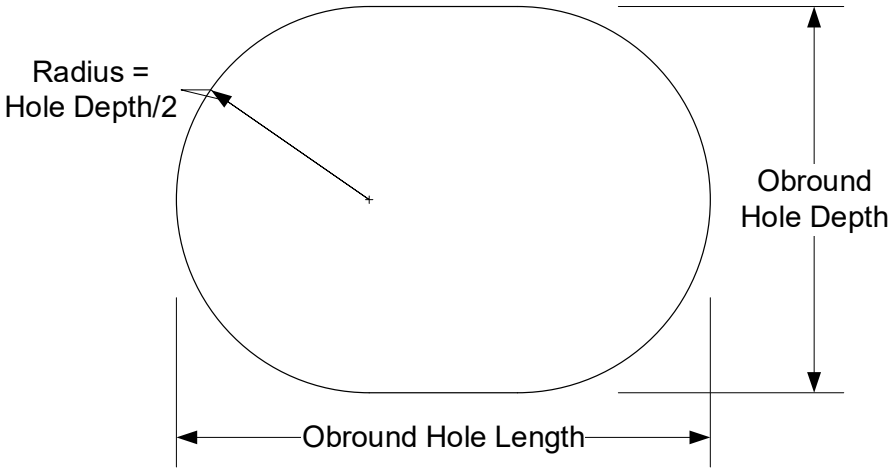
M_L = hole length coefficient

0.25 for BCI® Joists with 1 1/2" deep flanges (BCI® 60, 60s, 90, 90s: a.k.a. "10" Series)

0.29 for BCI® Joists with 1 1/8" deep flanges (all other BCI® series: a.k.a. "1000" Series)

Obround

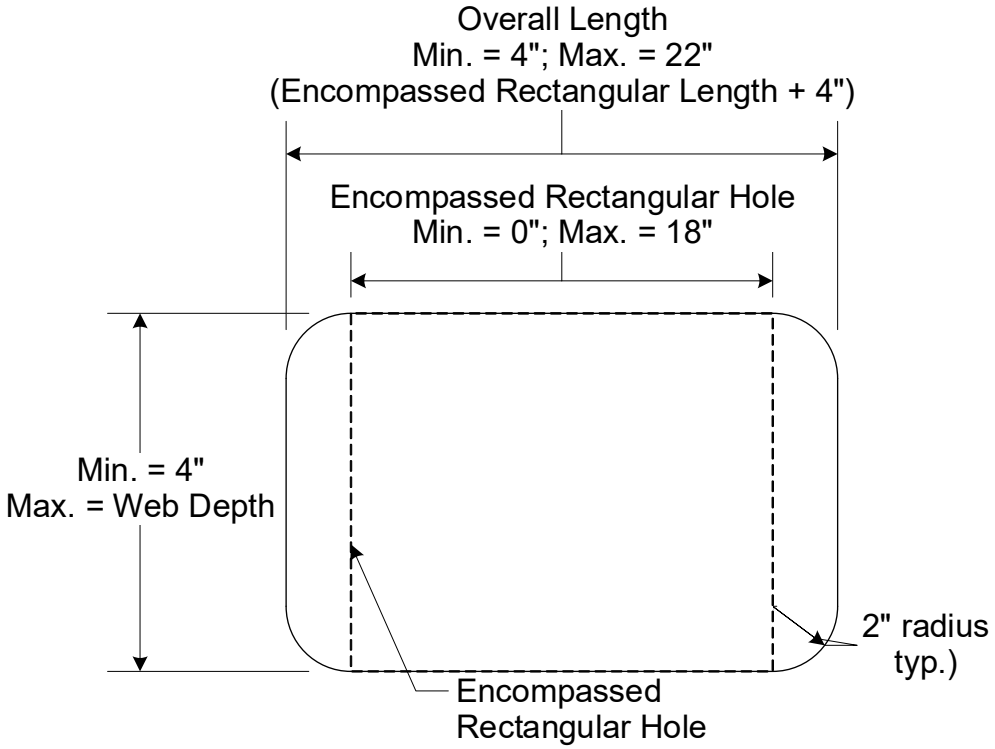
Obround holes are defined as rectangular holes with half circles on each end. Thus, the rectangular hole equation shown above may be used with the following coefficients for all BCI® series:
B_R = 0.60, M_D = 0.28, M_L = 0.25.

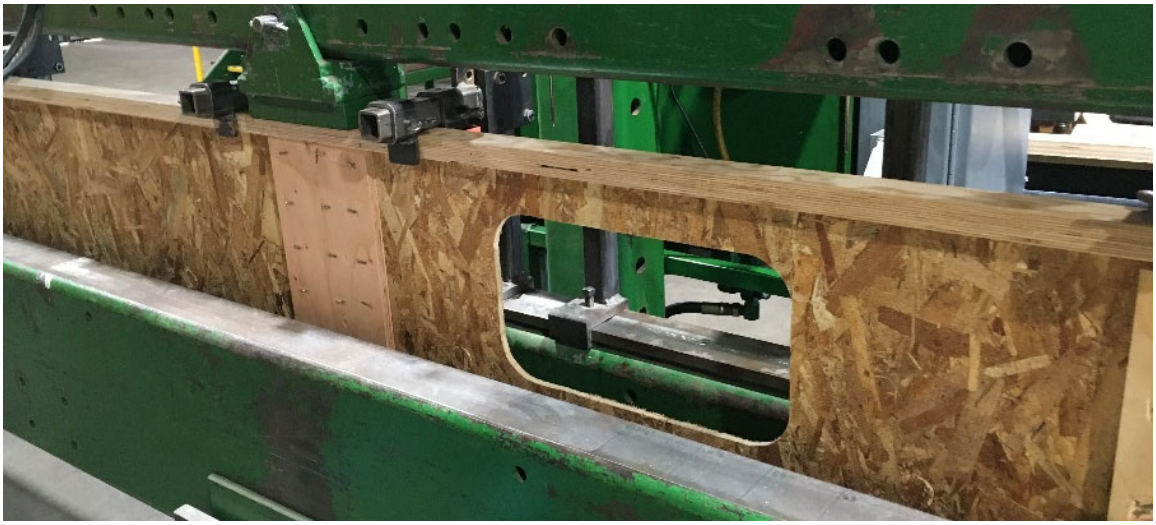


Each end of an obround hole shall be smoothly cut with a constant radius. The maximum length of an obround hole is 18".

Rounded Rectangular

As shown in the detail and photograph below, a rounded rectangular hole has a 2" radius at all corners. The rounded corners allow for an increase in hole shear capacity, compared to a standard rectangular hole with 90° corners. This increase allows for a longer encompassing web hole. Rounded rectangular holes may be cut either by an automated saw system or in the field.





BCI Rounded Rectangular Hole Test Sample

Each corner of a rounded rectangular hole shall be smoothly cut. If a corner is cut with a smaller radius or is mis-aligned, the resulting hole shall be analyzed as an encompassing rectangular hole.

The hole shear capacity (V_{hole}) for rounded rectangular holes may be calculated with the following equation:

$$V_{hole} = V_{BCI}\left[B_R - M_D\left(\frac{Hole\ Depth}{Joist\ Depth\ -(2*Flange\ Depth)}\right) - M_L\ \left(\frac{Overall\ Hole\ Length - 4}{18}\right)\right]$$

where:
V_{BCI} = allowable BCI® Joist shear
B_R = initial shear reduction coefficient = 0.60
M_D = hole depth coefficient = 0.28
M_L = hole length coefficient = 0.25
Hole Depth: Minimum = 4”, Maximum = Web Depth
Overall Hole Length: Minimum = 4”, Maximum = 22”

See the follow Boise Cascade technical notes for further information on web holes cut in BCI® Joists:

- IJ-20: *Web Holes Cut with SawTek® Router*
- IJ-24: *Analyzing Multiple Web Holes as a Single Encompassing Hole*
- IJ-27: *BCI / AJS Knockout and Field cut Web Hole Location Provisions* (for additional information on web hole provisions including knockouts and prescriptive holes).
- GE-27: *Electrical Wiring Installation in Horizontal Holes*

.