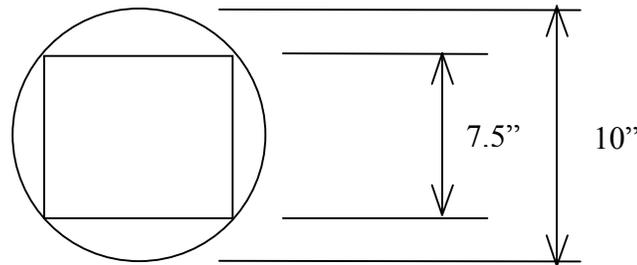


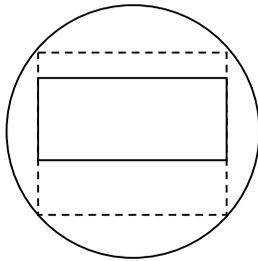
### Round & Square Holes vs. Duct Chase Openings

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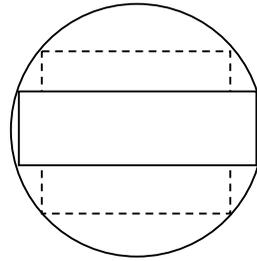
The allowable size of a square or rectangular hole is linked to the allowable size of a round hole. By the APA definition, a Square Hole's maximum allowable size is 75% of the Round Hole. Essentially, that means that an acceptable square hole will just about fit inside of an acceptable round hole. Testing of I-joists during the qualification procedure includes the testing of I-joists with round holes and square holes fitting the descriptions above. Test results show that a round hole and a 75% square hole perform very similarly.



This rule applies to the longest side of a Rectangular Hole as well.

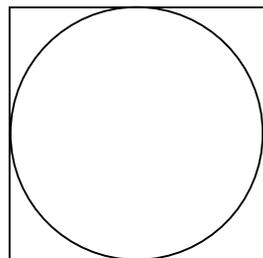


Acceptable rectangular hole.  
It fits inside of square hole.



Unacceptable rectangular hole.  
Fits inside of round hole but does not fit inside of square hole.

If the sides of a Square Hole were the same size as the diameter of a Round Hole, the area of web removed for the square hole would exceed that of the Round Hole by about 27%.



In addition, increased stresses (stress concentrations) occur at the corners of a Square Hole which further reduce the strength of the web and I-joist.

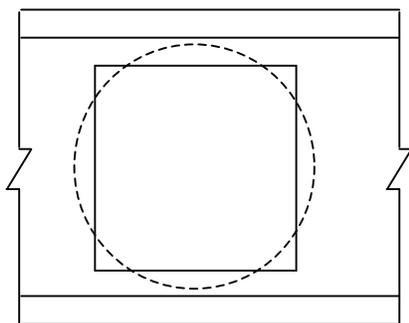
So we keep the Square Hole at 75% of a Round Hole size to maintain the necessary amount of web.

By strictly following the above definitions, we would not be allowed to cut a square or rectangular hole with any side greater than 75% of a maximum size round hole.

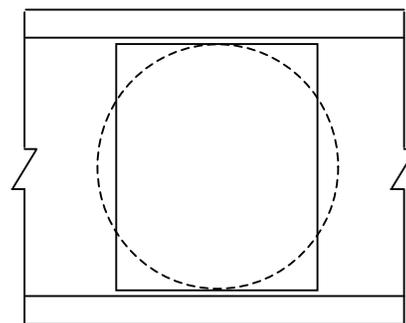
Fortunately, additional testing is also done on a full-depth (less the  $\frac{1}{4}$ " requirement) hole that is called a "Duct Chase". In reality the duct chase is obviously just a big square or rectangular hole, but the test results for a Duct Chase opening differ from test results for a standard Square Hole so different rules (and calculations) apply to cutting a Duct Chase opening as opposed to those of a Square Hole.

Because the calculations are different, the software must distinguish between the two. The width and depth of a square hole must be input into software; whereas, only the width (or length) of a duct chase can be input. This is because when choosing "Duct Chase" in the software, the default depth of the duct chase is the full depth of the web (less the  $\frac{1}{4}$ "). This default cannot be changed. This is also why there are two separate charts in the Design Guide, one for round/square and one for duct chases.

Therefore, even though by definition a "square hole" is 75% of a round hole and a "rectangular hole" must fit inside of a square hole, this "limitation" can possibly be overcome by the use of a duct chase hole. The drawback is that since basically all of the web depth is removed for a duct chase, the resulting allowable shear will be quite a bit lower than a round, square or rectangular hole. A duct chase will only work near mid-span of a uniformly loaded I-joint where the shear is very low. This also means that a square or rectangular hole with a size somewhere between a duct chase and the defined maximum square/rectangular hole cannot be sized in the software. In this case, the user would need to size the hole as a duct chase.



Square hole too big.



Must be conservatively sized as a duct chase.