



BC Calc software calculates a span to depth ratio when analyzing BCI / AJS floor. The ratio is not compared to any limit; it is simply the length of the longest span in inches divided by the I-joist depth. The span to depth ratio is displayed to help designers limit potential problems due to vibration.

Floor vibration is typically generated by an occupant walking across the floor (impact loading from foot traffic). All floors vibrate to some degree when dynamically loaded. However, it is floor systems with lower frequencies and longer durations that may generate complaints from homeowners. It is important to note that the presence of floor vibration is not an indication of joist failure. However, noticeable floor vibration can be unnerving to a resident. Noticeable vibration is more likely to occur in floors that include structural members with a relatively high strength to weight ratio. Such is the case for metal plate connected wood trusses, open web steel trusses, cold-formed (light gauge) steel, and shallower depth wood I-joists.

The manner in which a floor system reacts to foot traffic is affected by several factors: joist depth and stiffness, floor dead load, room size, and the attachment of a ceiling beneath. Vibration complaints are more likely to occur in a larger room located over a crawl space or unfinished basement. With no gypsum board directly attached to the underside of the joists and no partition walls resting on floor, the weight of the floor system is relatively light. In most cases, an increase in floor weight actually helps floor performance by dampening the vibration.

Attaching drywall directly to the bottom of the joists has another benefit for floor performance. In many cases joists are not installed perfectly plumb. Therefore a vertical load may rotate the joist slightly. If the bottom of the joist is not stabilized laterally, “torsional flutter” may occur in the joist. This slight amount of lateral movement may increase the “perceived” amount of floor vibration. The relatively wider flange widths of BCI / AJS joists are advantageous in resisting torsional flutter compared to other joist products. The increased flange width provides more resistance against lateral movement; this has been documented in research conducted at Idaho State University on BCI joists.

The span to depth ratio is not affected by the joist on-center spacing. When an occupant walks across a floor, impact loads are placed on joists. Even though reducing the on-center spacing decreases the amount of uniform load on a joist, the magnitude of an impact load remains relatively unchanged. When designing a floor system where vibration may occur, increasing the depth of the joist and the on-center spacing may be the best solution - both structurally and economically. For example, 9 1/2” joists at 16” on-center and 11 7/8” joists at 19.2” on-center typically deflect about the same amount under uniform load but the 11 7/8” joist floor will have a better “feel”.

Field experience has shown that vibration problems may occur when the span to depth ratio exceeds 15 for 9 1/2” joists and 16 for 11 7/8” joists. Again, problems are mostly dependent upon the absence of gypsum board attached to the bottom flanges in larger rooms (family room, living room, master bedroom). For floor systems with attached ceilings, experience shows that the span to depth ratio threshold increases to about 18 times the depth. BC Calc does not calculate a span to depth allowable percentage simply because there are no building code limits. Currently floor vibration is not addressed in the U.S. model building codes (IBC, IRC). However, other countries have adopted vibration criteria into their respective building codes. If you have any further questions regarding floor vibration, please feel free to contact Boise Cascade EWP Technical Services at 800.232.0788.