Wood Frame Garage Floor Design Guidelines

In applications where a residential garage floor is elevated, it may be possible to utilize wood framing as the structural support. The following technical note provides information to the both the design professional of record and component designer regarding the use of Boise Cascade products in these types of applications.

Code Minimum Design Loads

Both the International Building Code (IBC) and International Residential Code (IRC) have provisions for design loads for residential garage floor. Though not applied simultaneously, both a uniform live load and a concentrated live load is required in the analysis. The concentrated load is intended to represent a vehicle wheel load and is applied on a 4.5" x 4.5" footprint. Code prescribed design loads are shown in Table 1:

Table 1: Building Code Minimum Design Loads

Building Code	Uniform Load	Concentrated Load
IBC	40 psf	3000 lb
IRC	50 psf	2000 lb
Oregon State Residential Code	50 psf	(2) 2000 lb loads per joist (see code for details)

The uniform and concentrated live loads are applied separately with the dead load. The concentrated load is applied at intervals along the joist span to create worst-case stresses. Garage floor dead load must include the concrete topping and framing members. Below is an example of a typical garage floor topping system:

Table 2: Example Garage Floor Topping Dead Load

Material	Weight [psf]
3.5" Concrete	44
¾" Sheathing	2.5
VERSA-LAM® Joists @ 16" o.c.	4.0
Miscellaneous	2.5
Total	***53***

Decking & Topping

APA – The Engineered Wood Association publishes recommendations for garage floor sheathing. From Technical Topic TT-071A, published by the APA-The Engineered Wood Association:

For 16" on center (two options):

- 2-Layers of 23/32" thick, Exposure 1, 48/24 Rated CDX or Structural CDX sheathing. Joints should be staggered between layers, with both layers applied with face grain perpendicular to joists.
  OR
- Single layer of 23/32" thick, Exposure 1, 48/24 Rated CDX or Structural CDX sheathing with face grain perpendicular to joists, plus a topping layer of 3" concrete reinforced with 6" x 6" 10/10 wire mesh.

For 12" on center:

- One layer of Single Floor Panels (Underlayment, C-C Plugged) 1-1/8" thick 48 oc rating with face grain perpendicular to joists, and tongue-and-groove edges glued with AFG-01 construction adhesive.

The following are additional code provisions pertaining to garage floors:

- Garage floor surfaces must be an approved noncombustible surface per section 309.1 in the IRC; 406.3.3 in the IBC.
- Garage floors must be sloped to a drain or sloped to the main vehicle entry doorway to facilitate the movement of liquids.
- The wood subfloor and support members must be protected from exposure to moisture and direct contact with concrete or mortar.

BC CALC® Analysis

Boise Cascade's BC CALC® sizing software allows users to analyze residential garage floors by selecting Garage Loading in the Settings tab (see Figure 1). The program analyzes the joist application with all required load combinations and concentrated load locations. BC CALC® applies the IBC prescribed concentrated 3000 lb live load. The entire concentrated load is applied to one joist; no load sharing to adjacent joists is assumed.

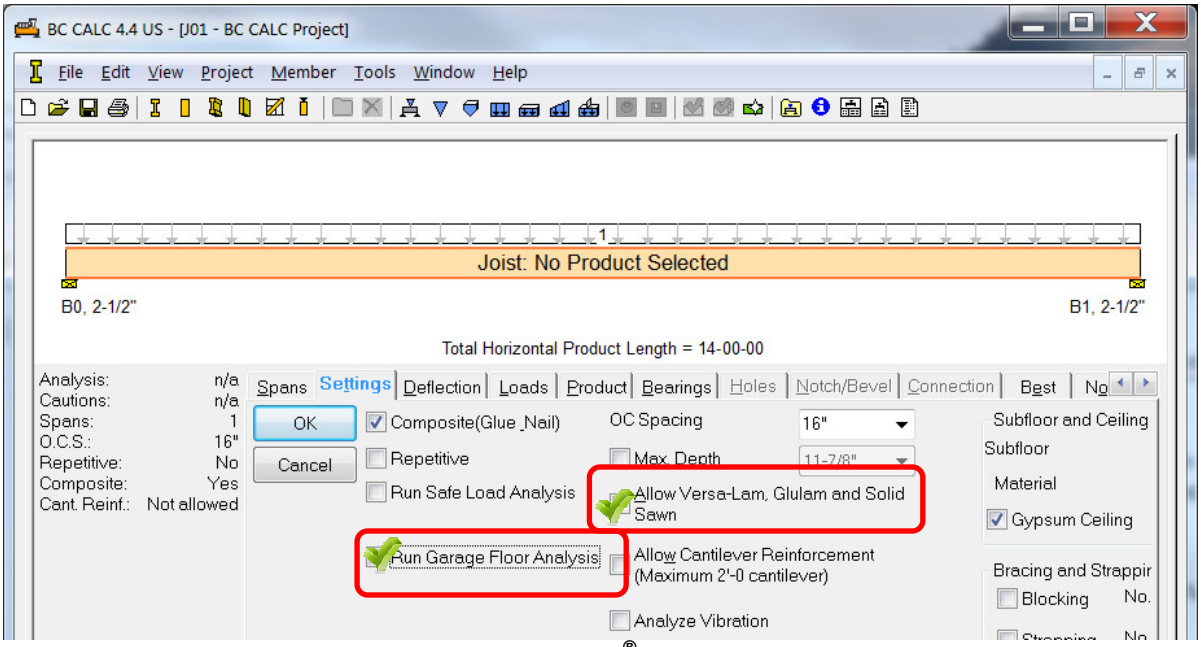

Figure 1: BC CALC® Settings Tab

Deflection

Considering the presence of concrete topping and high magnitude of live load, deflection limits are a critical portion of the design:

- L/600 Total Load deflection recommended by Boise Cascade EWP for members supporting concrete topping, unless slab is designed by the engineer of record with proper reinforcement.
- Creep deflection should be considered in the design due to the long-term loads involved; deflection under long-term loading will be 1.5 times the initial deflection (Section 3.5.2, *2012 National Design Specification® for Wood Construction*). The amount of long-term loading should include the dead load and possibly the concentrated wheel load.
- Building designer of record should review and verify project-required deflection limits.

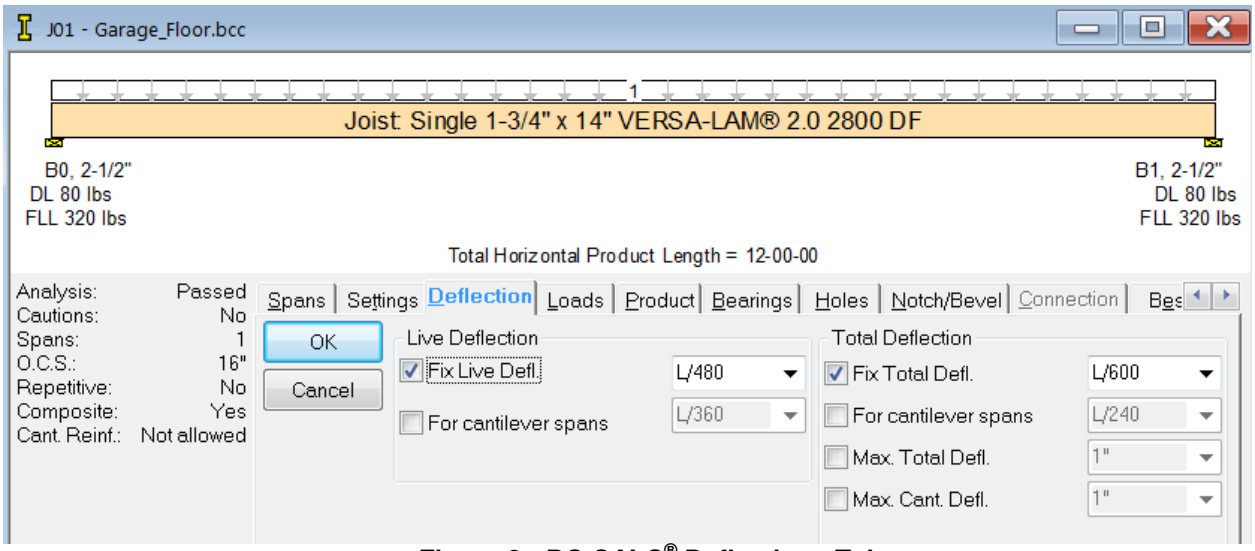

Figure 2: BC CALC® Deflections Tab

BC CALC® allows the user to set tighter deflection limits as shown in Figure 2.

Summary

Due to the significant concentrated live load requirement for garage floor and the relative low shear capacity, wood I-joists are typically not used in these applications. Boise Cascade produces VERSA-LAM® laminated veneer lumber in typical floor joists dimensions: 1 ½" and 1 ¾" widths, depths of 9 ½", 11 ¼", 11 7/8", 14" and 16". Considering the attributes of LVL, VERSA-LAM® joists are best solution for wood-framed garage floors.

Residential garage floors are areas where the actual load will approach the full design load during the lifetime of the structure. Thus, extra attention should be applied when designing such a floor. This is especially true with large multiple-vehicle garages like those used by

car collectors. These garages can be designed using Boise Cascade engineered wood products using similar techniques as shown above. However, these facilities *shall* have a design professional of record who designs and specifies the structural components. For further information, please contact Boise Cascade EWP Engineering.