bonded to the desired depth. High strengths are achieved in a similar way as SCL by selecting high-quality material and dispersing defects throughout the members. Additional strength is achieved by placing the highest-quality laminations in specific zones within the members. Glulams can be manufactured as unbalanced bending members with designated compression and tension zones to achieve higher efficiency. The members are also manufactured with a designated top and bottom for simple span beam applications. Glulams are most often selected for their visual appeal where the structural wood framing will remain exposed.

Prefabricated wood I-Joists are efficiently shaped members — similar to W shapes in structural steel. They are formed by gluing either sawn lumber or LVL flanges to a plywood or oriented strandboard web. The composite nature takes advantage of the high strength of quality sawn lumber or LVLs in conjunction with the high shear strength of plywood. The “I” shape also results in a lightweight member for ease in constructability. Most wood I-beams are made with “knockouts” or precut hole locations to simplify the installation of mechanical and electrical system pipe/conduit. These members are useful for beam and girder applications where the higher strength of SCL is not needed, but sawn lumber is not efficient. Since wood I-beams are slender, more care has to be taken during erection to maintain stability.

When designing with SCL it is important to consider environmental conditions that may be encountered both during construction and in service. When SCL gets wet during construction and then dries under load, the long-term dead load deflection can be more than anticipated from standard calculations. We have encountered several instances where SCL members, even when continuously dry, have more than twice the calculated long-term dead load deflection. In addition, wood I-joint floor systems can experience undesirable vibration characteristics — even when designed for code-stipulated deflection limits. Some manufacturers recommend increased stiffness and deflection limits to reduce floor vibrations.

Comparison

Natural and engineered wood products are available in a variety of grades, sizes, and geometries that offer the designer many options for framing. Figure 1 summarizes strength and size limitations of wood products, as well as uses for each type of product.

Figure 2 includes a comparison of engineered wood systems in typical floor framing applications. The design assumes a spacing of 16-inches on-center, repetitive members, floor dead loads of 15 pounds per square foot (psf), floor live loads of 40 psf, and deflection criteria of L/360 for total load and L/480 for live load. Relative costs (based in the Northeastern United States) are for comparison. It is clear that for shorter spans, dimension lumber will be the most efficient system. Wood I-joists may be a viable option if issues with dimension lumber submittals, as previously mentioned, are an anticipated problem or if greater consistency between members is desired. For moderate spans, wood I-beams are both cost effective and comparable in depth to the dimension lumber systems. At long spans, wood-I-joists are still cost effective, but other SCL options become reasonable.

Due to the uniqueness of natural building materials, the architect and engineer need to be aware of the benefits and limitations of each option. Consideration must be made not only to the final constructed building, but also to the methods of construction that may affect both the strength and stiffness of various wood products.

Matthew Johnson, P.E., is an associate principal, and Ariane Fund is a staff II engineer. Both are with Simpson Gumpertz & Heger Inc. (www.sgh.com), in Waltham, Mass., and can be reached at mhjohnson@sgh.com and aifund@sgh.com, respectively.