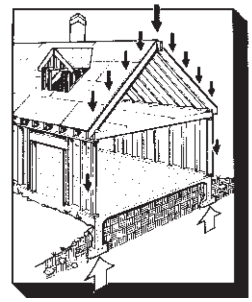

Site-Built Trusses for Large Loads

by Robert Randall, P.E.

Large open spaces sometimes require greater clear spans than you can get with common framing details. In recent years, the use of engineered lumber, wood I-joists, and various types of prefabricated trusses have become standard practice in response to this need.

But occasionally, specific design factors and site conditions rule out prefab engineered products — when, for instance, the bearing walls don't have enough capacity to carry the end loads from trusses or the roof configuration can't accommodate standard trusses.

Also, on some jobs, it may not be practical to use a crane: Scheduling complications, rental cost, or difficult site access may make anything too heavy to be handled by two carpenters seem like a bad idea.

In such cases, I sometimes turn to site-assembled "king trusses" to solve the problem. The two cases discussed here were well received by the owners and contractors. The heaviest pieces the carpenters had to horse into place weighed only 185 pounds, and site assembly required no unusual tools or skills.

A 35-Foot LVL Truss

On this project, the owner wanted a 25x35-foot clear space for a recreation room over the garage. Large windows in front, a big slider with a walk-out balcony at the rear, crossed ridge lines, and a partial cathedral ceiling all made for a challenging design problem.

The solution I chose was a site-built king truss spanning 35 feet (see Figure 1). Framing carpenters assembled the truss on a scaffold platform using precut pieces of 1$^3/_4$x11$^7/_8$ Microllam LVL (laminated veneer lumber) and $^3/_4$-inch-diameter bolts. No piece weighed more than 185 pounds.

The truss was designed for a total load of 10.25 tons. The load a large clear-span structure must carry can be surprising. This is not a situation where guesswork applies; a carefully engineered design is required.

A 25-Foot Steel Truss

Another high-end custom-home design called for a grand entry 25 feet wide by 40 feet deep with a semi-

cathedral ceiling and partial attic above (Figure 2.). The total load, including snow load, dead load, and attic live load, was 22.5 tons. Ganged 18-inch-deep Microllams might have worked, but two trusses made from steel angle provided more stiffness at a lower cost and with lighter members to lift into place
(and therefore less dead load).

I designed two king trusses from 5x3x1/4-inch steel angle stock. The pieces were fabricated by a local shop, then carried to the site where they were assembled in place with 3/4-inch-diameter bolts. The heaviest load the builders had to lift was 165 pounds; the total weight per truss was 600 pounds.

Deflection Considerations

Most people will instinctively understand the idea that the strength of a beam or girder is related to its depth; the deeper the beam, the stronger and *stiffer* it will be. The *stiffness* of a truss (measured by engineers with a term called *moment of inertia*, usually given the symbol I_x) is calculated by a formula in which the truss depth, D, is squared:

$$I_x = \frac{\Sigma A}{4} \, x \, D^2$$

This D^2 term is powerful: It means that if you double the depth of a truss, you get four times the stiffness or one-fourth the deflection as compared with the shallower version. This makes trusses particularly effective in designs where there is plenty of height available and where light weight is desirable. A deep truss will provide an inherently stiff structure with comparatively light weight — which usually translates to lower cost for both materials and installation. ■

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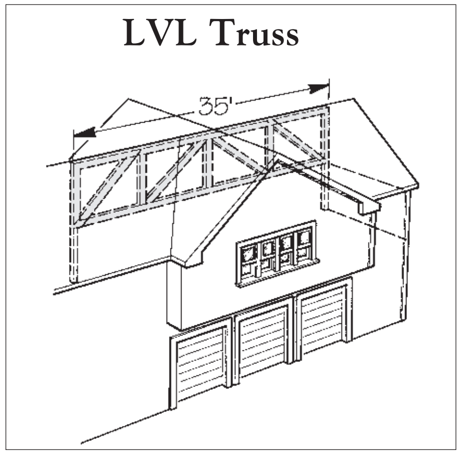

Figure 1. *The author designed this LVL king truss to carry the roof loads above a clear-span rec room. Carpenters assembled the truss in place on staging; the heaviest piece weighed only 185 pounds. The drawing above shows the front view; the photo is from the rear.*

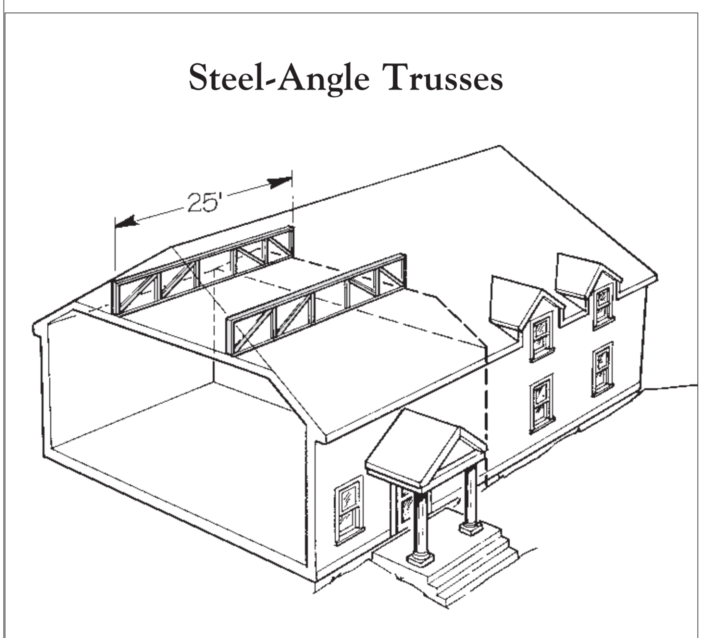

Figure 2. *The author used steel angle in the design of a pair of trusses to carry the roof loads for a large, two-story entry. Steel tubes hidden in the walls carried the loads to the foundation. Steel provides about twice as much stiffness and strength per pound as wood.*