ADDING ON
Above the Garage

A steel moment frame and engineered lumber joists and beams solved the structural problems

by Mike McCabe

Our company recently completed a large remodel in Huntington Beach, Calif. One part of the plans called for the addition of a second-story master bedroom suite, complete with a whirlpool tub and steam shower. Ordinarily, this might be a straightforward add-on, with a strengthened floor system and new walls built above the bearing walls below. But in this case, the addition was to be built over an existing single-story garage, which required major structural modifications to carry the new loads.

Beefing Up the Structure

Garages — especially single-story ones — are not well-suited for supporting habitable space above. For one thing, the large door openings mean that one whole side of the building has very little lateral strength, since there is no room for plywood shear panels. This is a very important consideration out here in earthquake country.

Also, garage ceilings usually have clear spans of 20 feet or more, making it difficult to add live loads above and meet the codes.

Finally, many garages are built right on a slab. Even if the footings are thickened, this often isn't an adequate foundation for the additional living space.

Starting at the Bottom

This garage was no exception. The plans called for "undermining" the existing footings by at least 16 inches to pour new L-shaped concrete pads at critical bearing points (see illustration, next page). We pinned the new concrete to the existing with #4 rebar pins grouted in place with epoxy.

The next matter of business was to provide shear strength to the front wall of the garage. The engineer decided on a steel

moment frame around the smaller of the two garage doors. Steel provides a lot of strength at a reasonable cost. We set the steel just inside the wall so we wouldn't have to disturb the exterior elevation (see photo, below). The moment frame in this case was made of 4x10-inch steel tube, with mitered, welded corners at the top and steel base plates at the bottom of the two legs. The base plates were anchored with two 5/8-inch-diameter expansion bolts 12 inches long. The whole frame was prefabricated off site at a steel shop, then brought to the site and set in place as a unit. We enclosed the steel frame with drywall so that it's completely hidden.

Glulam Header

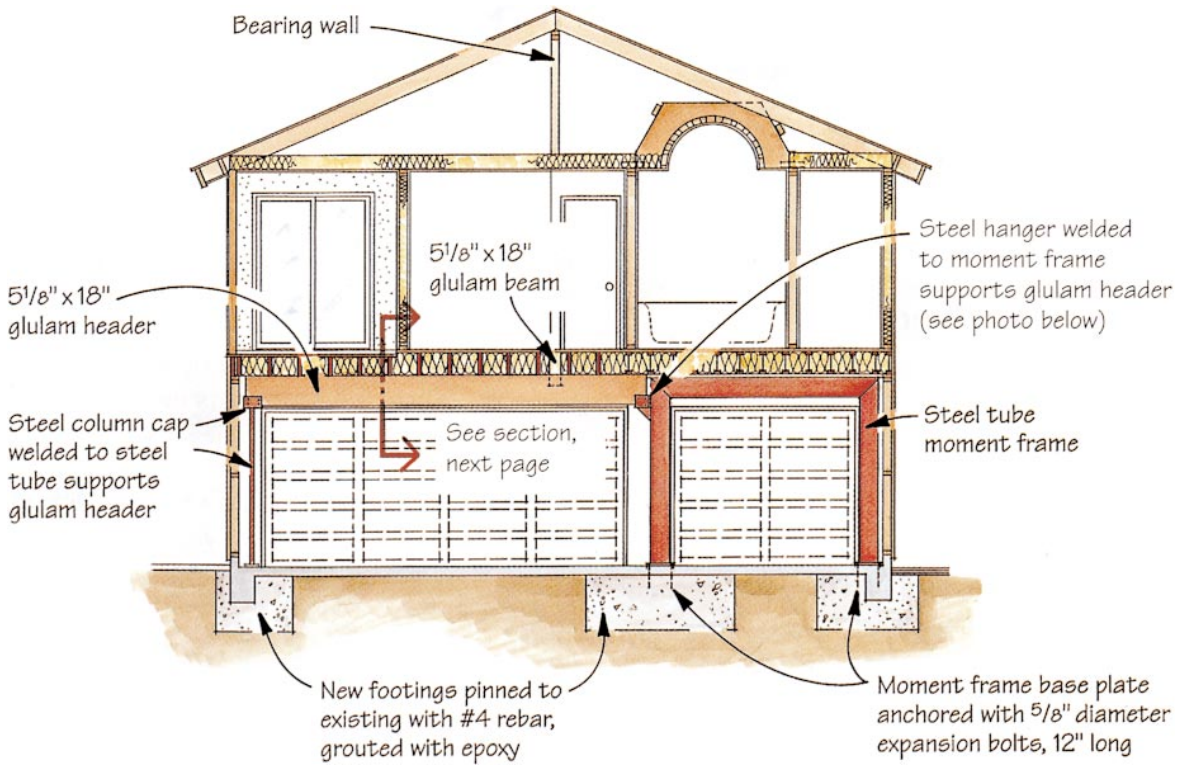
The top of the steel moment frame acts as the header for the smaller garage door. For the larger garage door, we installed a 5 1/8x18-inch glulam header in addition to the existing 4x14-inch Doug fir header. We set the new header inside the existing one, in line with the steel frame. The glulam header is supported by a tube-steel post at one end and the moment frame at the other end.

Hybrid Floor Framing

The original plans called for No. 2 Doug fir 2x12 joists on 12-inch centers. We felt this was a poor choice of material for this application for a couple of reasons. For one thing, it's just about impossible to find straight lumber 22 feet long. Second, the drilling and notching required for the bathroom plumbing would be a potential problem. So we went back to the architect to request a change to wood I-joists, which provide a strong, flat floor and have factory knockouts for plumbers and electricians to use.

We were able to use 11 7/8-inch-deep wood I-joists 12 inches on-center for about 40% of the floor, including the section under the bathroom (see illustrations, next page). The rest of

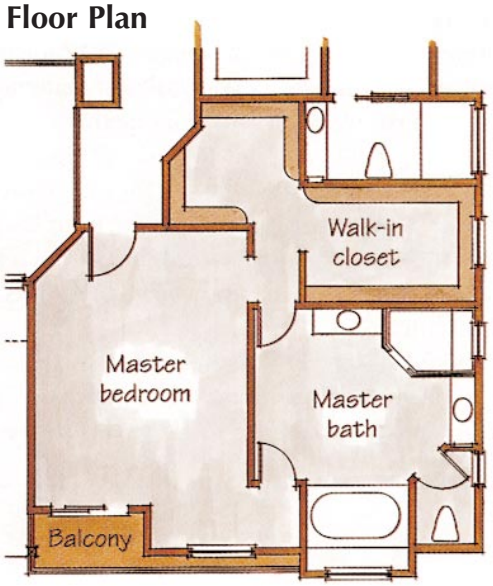
Reinforcing the Structure



To avoid a "soft story" below the master bedroom addition, the engineer designed a steel moment frame around the smaller garage door to resist lateral earthquake forces. New concrete footings anchor the frame, helping to resist overturning. The photo at left, taken from inside the garage, shows the connection between the moment frame and the new glulam header above the larger opening.

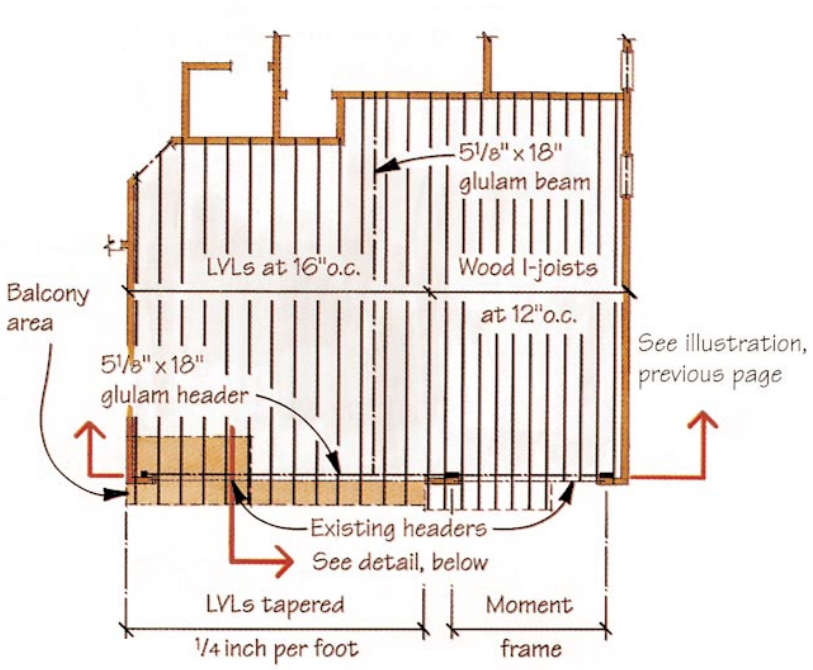
Master Suite Details

Floor Plan

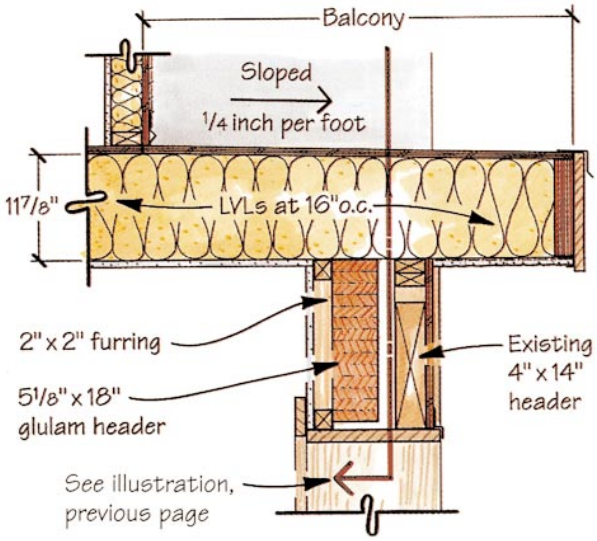


The author used I-joists 12 inches on-center to support the master bath area. He switched to LVL joists below the bedroom so he could taper the ends to provide a sloped surface for the balcony.

Framing Plan



Balcony Section



Field-tapered LVL joists provided a slope for the balcony surface, which was later finished with a waterproofing membrane. Note the relationship of the new header to the existing one.

the floor has a protected exterior balcony. Wood I-joists wouldn't work here, because we needed to provide a drainage slope for the deck (the original plans called for notching the 2x12s). For this section, we switched over to Microllam LVLs, which exactly matched the depth of the 11 7/8-inch TJI I-joists. We cantilevered the LVLs over the outside bearing wall, and tapered the ends 1/4 inch per foot to provide drainage for the balcony surface. The deck was later finished with a trowel-on deck coating made by Pacific Polymers (12271 Monarch St., Garden Grove, CA 92641; 714/898-0025).

The plans also called for a second glulam beam running in the direction of the joists at the center of the floor. This supports the second-story bearing wall that catches the roof peak.

This project is a good example of how builders can — and should — influence the design process. Regardless of what the engineer and architect provide, it's the builder's reputation that's at stake if the project has problems. If we had gone with solid-sawn 2x12s for the floor, as the plans indicated, we would have faced callbacks as the lumber shrank and the floor began to squeak, not to mention the extra problems involved in trying to run plumbing through dimension lumber. As it is, we are confident we will have no callbacks, and the clients are pleased with an addition that looks like it was part of the original home.

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