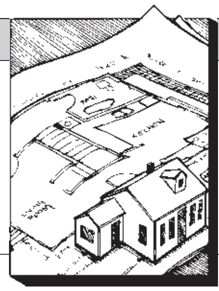

Cathedral Ceilings, Part II

by Gordon Tully

Last month, we looked at detailing cathedral ceilings that are supported by structures running lengthwise. This month, we will consider the other case, where the main structure spans the width of the space.

Exposed Trusses

When the span is longer than it is wide, trusses are in order. (In some cases, trusses are also attractive in short, wide spaces.) First, let's consider trusses that are entirely visible within the room. In this case, these trusses carry purlins that run lengthwise in the room and support the roof. Such purlins have two problems.

First, when you set the purlins on the trusses, do you set them vertically – at an angle to the roof plane – or do you set them perpendicular to the roof plane? If you set them vertically, how do they rest on the trusses and the endwalls? If you set them perpendicular to the roof plane – which makes construction easier – the purlins cannot carry the same load the vertical purlins can (see Figure 1). This may not be a problem if the purlins are oversized to allow room for more insulation. Have an engineer check this out for you; the calculations are a bit complicated.

The second problem is that the tops of the purlins block the free flow of ventilation from eave to ridge. The easiest way to deal with this is to add a layer of flat 2x4s on the top of the purlins, running up and down the roof. Between the 2x4s, add vent spacers to prevent the insulation from fluffing up and blocking the free flow of air. This added cost might cause you to think about going with the foam-insulated plank roof that I described last month.

Truss Types

Trusses can be made in almost any configuration. Their appearance depends upon the proportions of their chords and webs and the care with which the joints are detailed. Ordinary roof trusses are unlikely to produce a finished enough appearance for most homes, but in some commercial wood and tubing trusses look okay for informal spaces. Several manufacturers make an astonishing variety of truss connectors, so don't reinvent the wheel if you can buy what you want from your local lumberyard. When designing them, be sure to consult an engineer, unless you have the necessary training.

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Buried-Truss Roofs

By "buried truss" I mean one that has its top chord integral with the rafters. The simplest buried truss is an opposing pair of rafters with a tie across the bottom. (Yes, this is technically a truss, even though it does not have any vertical member in the middle.) You probably know from experience that tying the bottom ends of each pair of rafters requires only a few nails to make an adequate joint. But if you move the ties up to where they become "collar ties," this greatly increases the tensile stress on the joint.

If you move these ties high up on the rafters, ordinary nails won't do the job of making an adequate joint. Similarly, if you just tie every other rafter,

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you double the tensile stress on the ones you've left untied (see Figure 2). Tying every fourth one quadruples the stress, and so on. This is an important point, because in a finished space, it is usually desirable not to have a continuous sea of ties running across the space from eave to eave; higher, less-frequent ties usually look much better.

We recently detailed ties at eave level, spaced at 8-feet on-center across a 36-foot-wide space. The steel gusset required at each end of the rafter is remarkably complex for what might seem an easy connection (see Figure 3). Be careful about highly stressed joints in wood. Unless they are carefully designed, they are likely to move over time. I recommend a conservative attitude about such things.

General Problems

Wherever a truss or purlin supports members above, there will be a break in the interior air/vapor barrier. The only way around this is to install pieces of sturdy vapor retarder over the trusses and tape the adjacent sheets after the roof structure is complete and insulated. Few builders, however, find it practical to do this sort of thing.

A similar problem occurs where col-

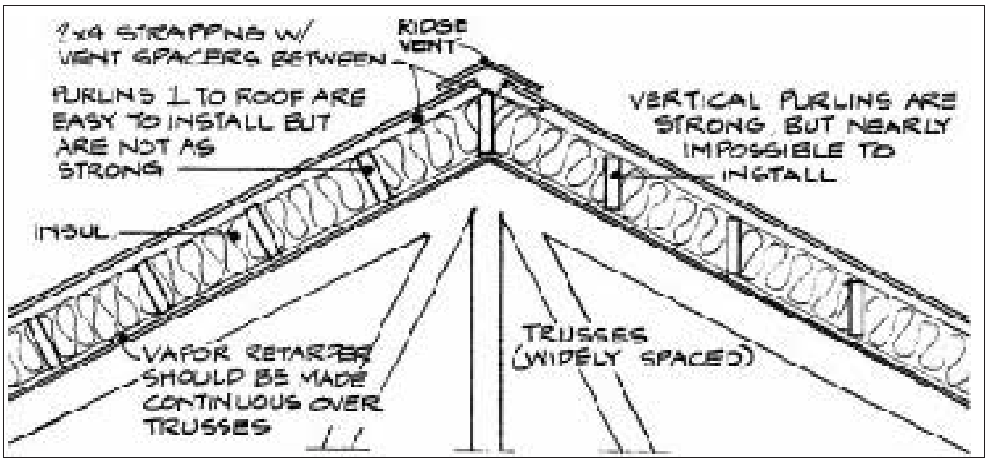

Figure 1. *Setting purlins perpendicular to the roof plane makes for easy construction, but they are not as strong as purlins set vertically.*

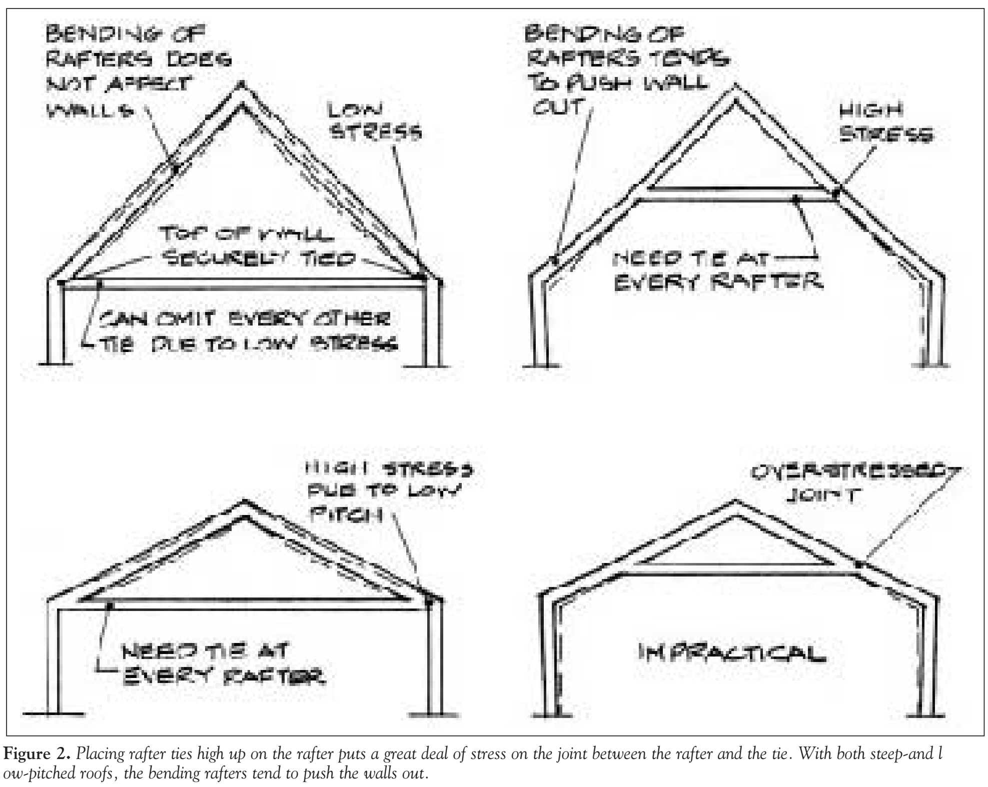

Figure 2. *Placing rafter ties high up on the rafter puts a great deal of stress on the joint between the rafter and the tie. With both steep-and l ow-pitched roofs, the bending rafters tend to push the walls out.*

lar ties on rafters enter an insulated roof. Inevitably there is a hole in the vapor retarder, one that cannot be easily closed up. The vapor retarder must be carefully taped and caulked around the holes, and I suspect that such joints open up over time. If the roof is well ventilated, and there are many open joints in the vapor retarder, the effective R-factor could be quite low and condensation problems abundant.

Why not forget about ventilating a cathedral ceiling? If I am right that there are no condensation problems with plank roofs, why should there be in cathedral ceilings with rafters? Aside from the problem that no one wants to be the first person on the block to stop using vapor retarders, consider well-known causes of serious condensation problems in cathedral ceilings: skylights and recessed downlights. It is a good rule to avoid using any form of recessed lighting in cathedral ceilings, because the housing will penetrate right through the insulation and invite condensation. (Downlights in bathrooms are an absolute no-no.) Air conditioning and exhaust ductwork should likewise be kept out of cathedral ceilings (and uninsulated attics, unless you like rainfall coming out of your ceiling grilles).

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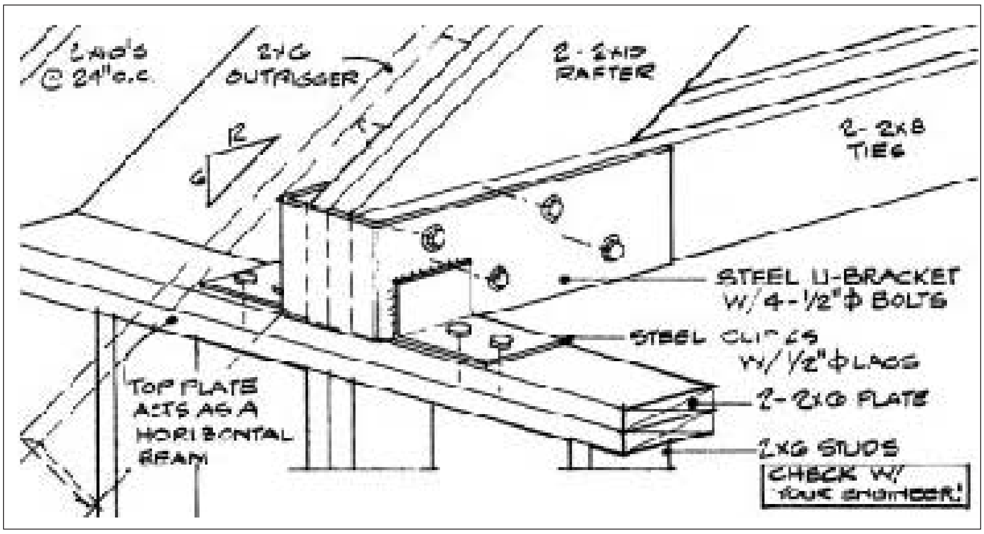

Figure 3. *Sometimes, steel gussets are required where the tie meets the rafter. Gussets can be remarkably complex for even simple connections, like the one used for these ties, placed 8 feet on-center, with a 36-foot span.*

Skylights in cathedral ceilings, especially on a north roof or in a bathroom, demand careful detailing to ensure that roof-ventilation air circulates among them. One good approach involves two steps. First, notch the top of the joists above and below the skylight. Then, miter vent spacers to route the air around the skylight and back into all the joist spaces above the skylight.

If you are using plywood I-joists, however, you can't notch the top chord. Instead, consider running plastic hoses through the knock-out holes in the trusses. This connects the vent spaces over the fiberglass insulation and routes the air around the skylight. I proposed such a scheme to my builder, who countered with the idea of using sections of foam insulation above and below the skylight opening. The foam could be installed so that the air could flow naturally through the knockout holes.

I hope these warnings and recommended precautions do not turn you away from cathedral ceilings, but instead inspire you to "beat the system" and figure out how to do it right. Cathedral ceilings create an enlarged vertical space, and this helps to overcome the claustrophobia of today's small dwellings. ■

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