by Robert J. Randall, P.E.

# Framing for Corner Windows

## Cantilevered headers provide hidden support for these wrap-around glass corners

Corner windows have been around for years, but until recently they were expensive novelty items rarely used in residential construction. Although they're still expensive, at least three major wood window manufacturers now offer corner windows in their catalogs of standard products (see manufacturers' list at end of article). It may be only a matter of time before you're asked to install one.

These windows use either bent or mitered insulated glass units in a typical wood frame. The catalogs give no structural details beyond pointing out the need for a cantilevered structural header designed by an engineer to prevent the window from carrying any load. This article provides such a header design suitable for several common framing conditions.

### Design Assumptions

Design loads vary greatly from region to region, so selecting design assumptions turned out to be a challenge. For example, for a typical one-story gable roof in the Sunbelt, with 2x6 rafters of #3 western woods, the roof load carried by the header might be only 230 pounds per linear foot. But up in 100-psf snow country, a roof framed with Doug fir 2x14s could exert a load of 2,510 pounds per linear foot — more than ten times as great. Similarly, the presence or absence of a floor above the header and the span and loading on that floor could result in a wide range of load conditions.

So while I couldn't include every extreme, I chose a set of design loads that would safely cover most conditions in the continental U.S. (see "Design Assumptions," page 37).

Note that in using this design example (or any other), it is very important to review the design assumptions to make sure that they are appropriate to your situation. In this case, either a wider roof

# Cantilevered Headers

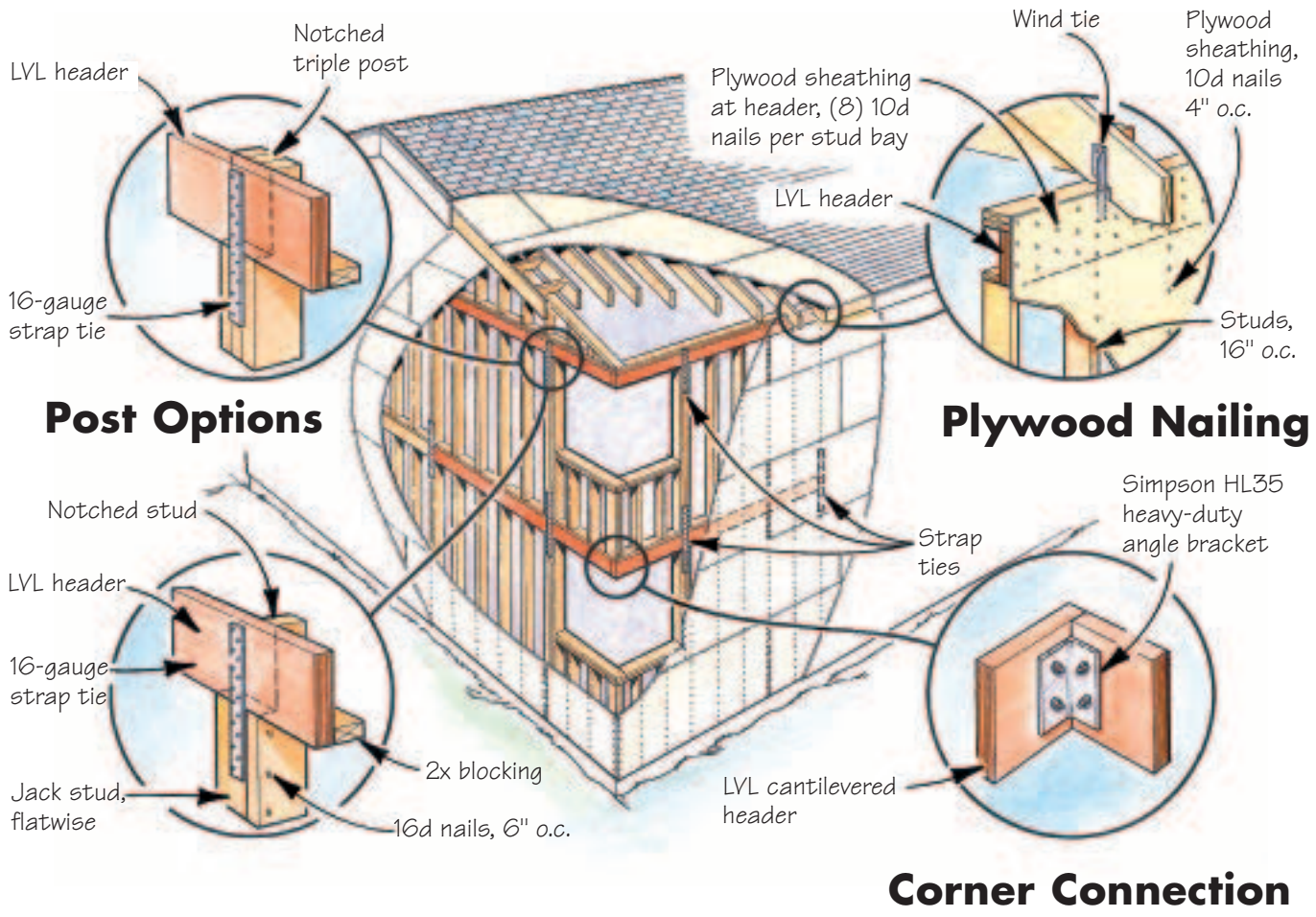


**Figure 1. LVL headers, securely anchored to the wall framing by strap ties and thoroughly nailed sheathing, cantilever above the corner window opening. For a two-story structure, the lower header may be incorporated as the band joist.**

or heavier design loads would mean that this design might be unsuitable. If you are in the north woods or high in the Rockies, you might need to double up the LVL header.

## Simple Framing

My basic design is quite simple (see Figure 1). The wall framing on each side of the corner window incorporates a 10-foot LVL header, with one end cantilevered over the approximately 40-inch rough window opening (the size of the largest corner unit offered by the manufacturers; check the manufacturer's literature for exact R.O. size).

The LVL header sizes for typical gable and hipped roofs are shown in Figure 2. For a two-story structure with corner windows on both floors, the lower header can actually be incorporated as the band joist, and trimmed to match the size of the floor joists if necessary.

At the corner, the headers meet and are bolted together with a heavy-duty angle bracket. This serves to keep them from twisting and also transfers load from one header to the other.

## Header Support Posts

The cantilevered headers are supported by built-up posts at each side of the window opening. The posts must be notched to run past the header and up to the top plates. Because the LVL header bears on a small ($1^1/_2$x$1^3/_4$-inch) cross-section of the individual studs, we have to look carefully at compression perpendicular to the grain to be sure the load on the LVL header won't compress the wood fibers of the header where it rests on the posts. (This would allow the LVL header to drop.) The solution is to spread the load over a large enough area. There are two options: Either use a triple 2-by post, with all three studs notched for the LVL header, or notch a single stud and turn a second stud flatwise against the sheathing underneath the header.

The second method uses wood more efficiently and also somewhat reduces conductive heat loss, since you can insulate behind the flat stud. To assemble this L-shaped post, use 16d nails 6 inches on-center. It's not a bad idea to predrill the nail holes to prevent split-

# LVL Sizes for Corner Headers

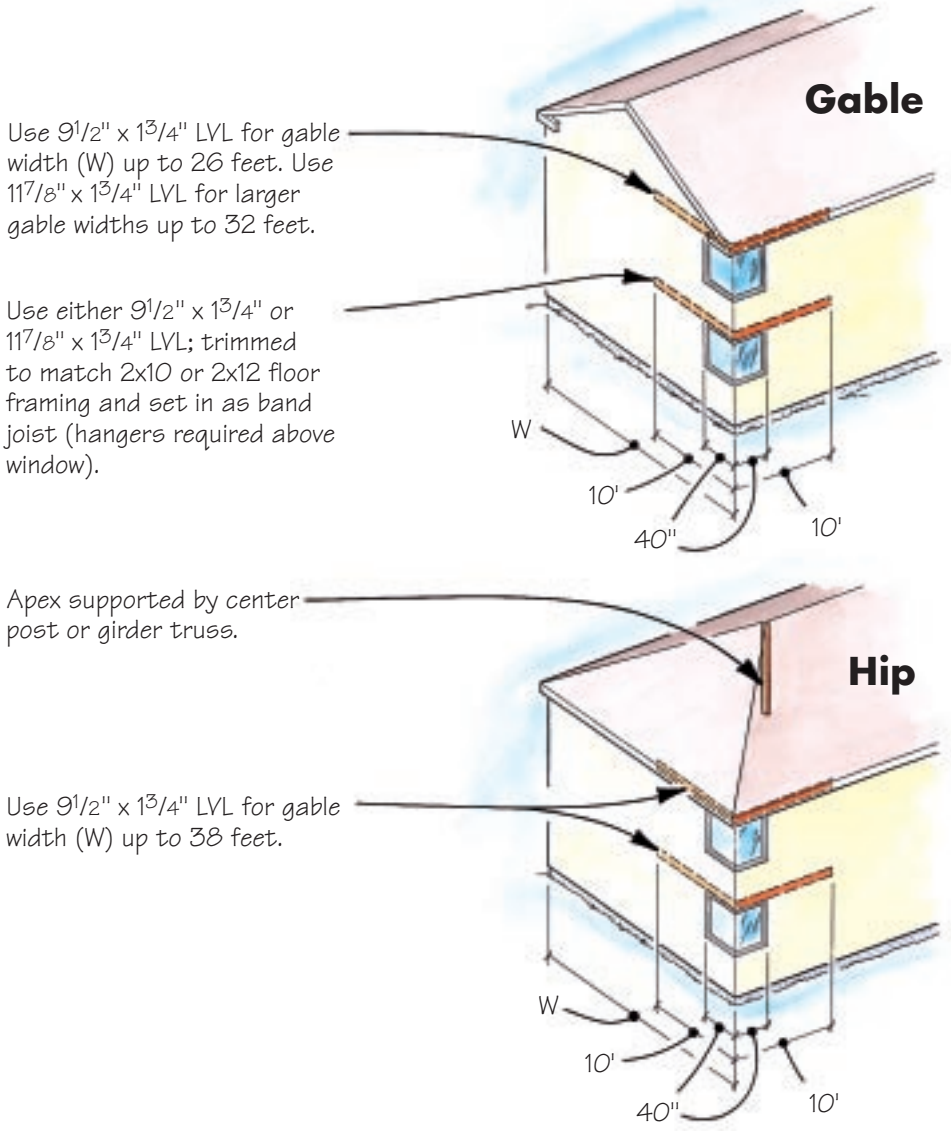


**Figure 2.** **Note that for the hipped roof, the acceptable span is greater while the headers are smaller. This is because the apex, or top end, of the hip rafter is assumed to be fully supported down to the foundation — either by a post or a rafter truss that carries the load to the exterior walls. The supported apex carries two-thirds of the roof loads, which would otherwise rest on the corner window headers. In the case of an unsupported apex (as you might have in a cathedral ceiling design), this design does not apply. For more on hip rafter support, see "Straight Talk About Hip and Valley Rafters"**

ting, but don't drill a hole larger than 75% of the nail's diameter. For 16d common nail's, which are .135 inch in diameter, limit your hole to .1, or 3/32 inch.

However you build the posts, you must also notch the studs beyond the post to accommodate the header and provide nailing for drywall on the interior. Make sure you cut the notches on the post with care, because you want to avoid excessive sagging of the header assembly.

## Allowing for Deflection

Make no mistake, though: The headers will sag under load. Under the full design load, calculated header deflection at the outside corner is slightly over 1/8 inch. But remember, too, that all wood is subject to a progressive sagging called creep, which means that in the long term, the total sag could be almost twice the calculated deflection.

The last thing you want is for the top of your $2,000 corner window to feel any load, resulting in fogged glazing or even cracked glass. The window head detail in Figure 3 (next page) is designed to prevent just that. The LVL header is placed 3/8 to 1/2 inch above the top of the window frame. The metal installation straps, available on special request from the window manufacturers, make for a secure but somewhat flexible connection. Note the use of foam backer rod, which makes an ideal compressible air infiltration gasket at the window head. Don't use spray foam in this area; it's too rigid.

## Design Assumptions

*The LVL header sizes given above are based upon the following design assumptions:*

| | |
|---|---|
| Snow load on roof | 40 psf |
| Roof dead load | 10 psf |
| Attic live load | 20 psf |
| Attic dead load | 10 psf |
| Second-floor live load | 40 psf |
| Second-floor dead load | 10 psf |
| Roof overhang | 1 ft. |
| LVL shear strength | 285 psi |

# Window Installation Details

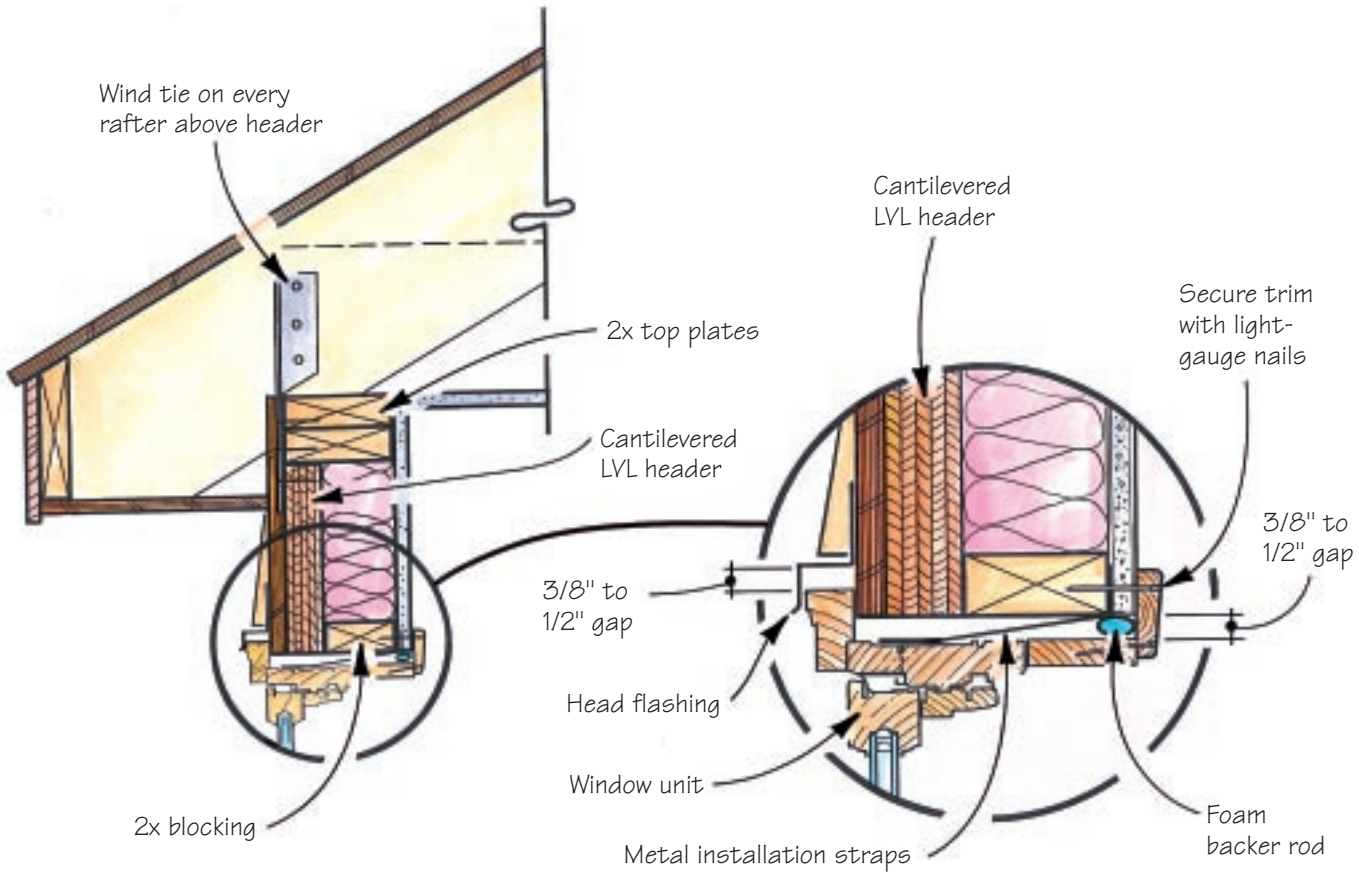


**Figure 3.** **To ensure that the header load never transfers to the top of the corner window frame, use foam backer rod as an infiltration gasket, and avoid nailing directly through the window frame into the header. Metal installation clips are available upon request from window makers.**

## Anchoring the Header

Recent articles have discussed the different roles that wall sheathing plays in the structural design of a house (see *Practical Engineering*, 7/96, 11/96). In this case, the sheathing anchors the butt of the cantilever header where it is embedded in the wall framing.

Attach the sheathing to each stud with at least eight 10d nails (nail 4 inches on-center for horizontal sheathing), and continue this nailing pattern all the way down to the band joist at the foundation below. Also fasten the plywood to the header with at least eight 10d nails per stud (in other words, eight nails for every 16 inches running). Yes, that's a lot of nails, but it's cheaper than having to replace a fogged corner glass unit.

## Preventing Wind Lift

The projecting corner of a roof overhang is subject to severe wind loading, far greater than other parts of the structure. And because a corner window breaks the structural continuity at the building corner, there is a redirection of the load path that concentrates a lot of force at the header posts. Strap ties are the simplest and most economical solution. Note that in the window head detail, hurricane ties are shown at each rafter over the window. In addition, I suggest installing 16-gauge galvanized steel strap ties such as Simpson ST6224s, which are $2^{1}/_{16}$ inches wide and 23 inches long. Use these at the locations shown in Figure 1. ■

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## Makers of Corner Windows

***Marvin Windows & Doors***
P.O. Box 100
Warroad, MN 56763
800/346-5128

***Pella Corporation***
102 Main St.
Pella, IA 50219
800/847-3552

***Weather Shield***
1 Weather Shield Plaza
Medford, WI 54451
800/222-2995