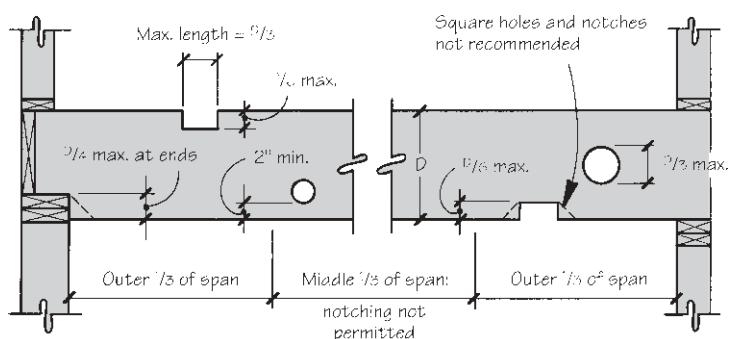


# FRAMING GUIDELINES

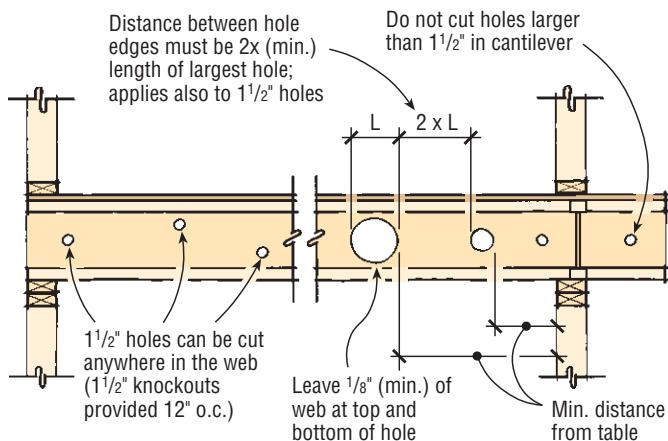
## Cutting, Notching, and Boring Lumber Joists

Joist Size	Maximum Hole	Maximum Notch Depth	Maximum End Notch
2x4	None	None	None
2x6	1 1/2	7/8	1 3/8
2x8	2 3/8	1 1/4	1 7/8
2x10	3	1 1/2	2 3/8
2x12	3 3/4	1 7/8	2 7/8



In joists, never cut holes closer than 2 inches to joist edges, nor make them larger than  $\frac{1}{3}$  the depth of the joist. Also, don't make notches in the middle third of a span, where the bending forces are greatest. They should also not be deeper than  $\frac{1}{6}$  the depth of the joist, or  $\frac{1}{4}$  the depth if the notch is at the end of the joist. Limit the length of notches to  $\frac{1}{3}$  of the joist's depth. Use actual, not nominal, dimensions. ("Field Guide to Common Framing Errors," 10/91)

## Hole-Cutting Rules for Wood I-Joists



With wood I-joists and other types of engineered lumber, it's best to consult the manufacturer's literature. The example provided here is courtesy of Trus Joist MacMillan. ("Repiping With PEX," 10/99)

## Min. Distance from Inside Face of Support to Near Edge of Hole

Depth	TJI/Pro	2"	3"	4"	5"	6"
9 1/2"	150	1'-0"	1'-6"	3'-0"	5'-0"	6'-6"
	250	1'-0"	2'-6"	4'-0"	5'-6"	7'-6"
11 7/8"	150	1'-0"	1'-0"	1'-0"	2'-0"	3'-0"
	250	1'-0"	1'-0"	2'-0"	3'-0"	4'-6"
	350	1'-0"	2'-0"	3'-0"	4'-6"	5'-6"
	550	1'-0"	1'-6"	3'-0"	4'-6"	6'-0"
14"	250	1'-0"	1'-0"	1'-0"	1'-0"	1'-6"
	350	1'-0"	1'-0"	1'-0"	1'-6"	3'-0"
	550	1'-0"	1'-0"	1'-0"	2'-6"	4'-0"
16"	250	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	350	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	550	1'-0"	1'-0"	1'-0"	1'-0"	2'-0"

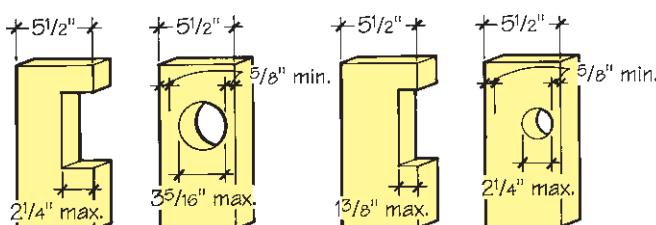
### General Notes:

\*Distances in the charts above are based on uniformly loaded joists using the maximum loads shown [in TJI's] brochure. For other load conditions or hole configurations, contact TJI representative.

\*For simple span (5-foot minimum) uniformly loaded joists, one maximum-size hole may be located at the center of the joist span provided no other holes occur in the joist. DO NOT cut into joist flanges when cutting out web.

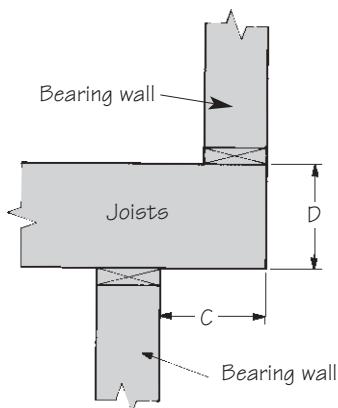
## Notching and Boring Studs

Never notch in the middle third of a joist span, and limit the length of notches to one-third the depth of the member. The rules for notching and boring studs differ for bearing and nonbearing walls. ("Ten Common Framing Flaws," 4/95)



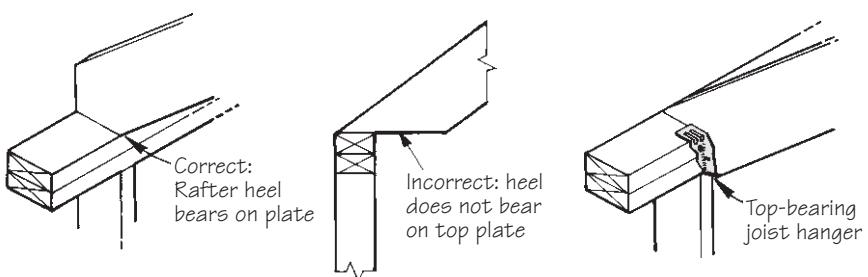
# FRAMING GUIDELINES

## Cantilevers



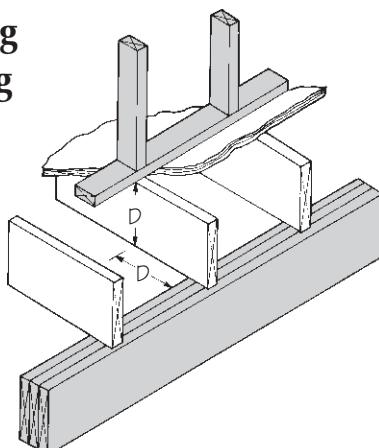
When a cantilever supports a bearing wall, the distance it extends beyond its support (C) should not exceed the depth of the joist (D). ("Field Guide to Common Framing Errors," 10/91)

## Rafter Bearing



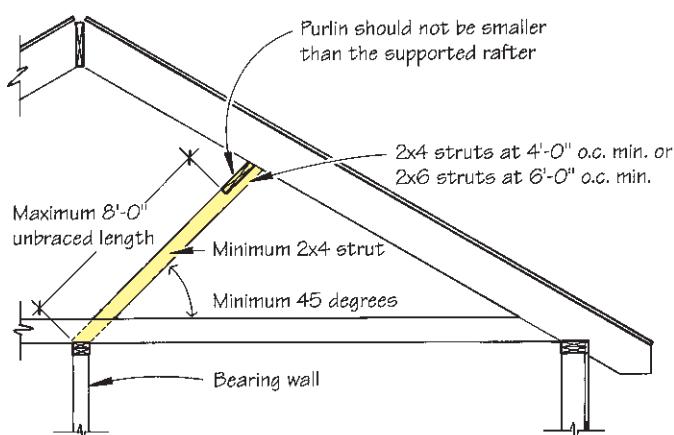
It's best to rest the rafter heel on the plate (left), not on the toe (center). Where this isn't possible, you can sometimes support it with a joist hanger (right). The joist hanger also keeps the rafter from rotating, a job that normally requires ceiling joists or solid blocking. ("Field Guide to Common Framing Errors," 10/91)

## Aligning Bearing Walls



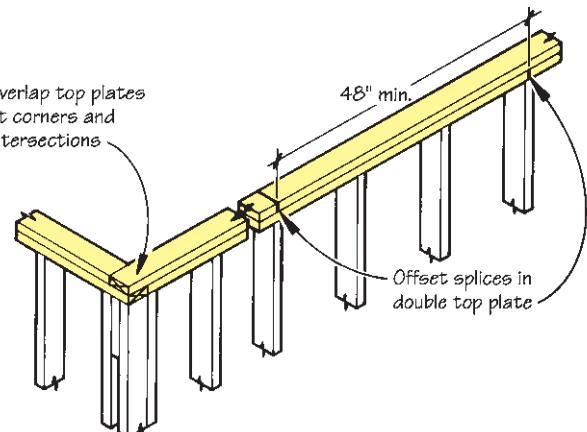
If a bearing wall doesn't line up with the support below, it should lie no farther away than the depth of the joists (D). If the joists are engineered lumber, the walls and support must align exactly. ("Field Guide to Common Framing Errors," 10/91)

## Purlin Design



A properly constructed purlin must be at least the same dimension as the rafters that it supports. Supporting struts should be notched into the purlin and installed at an angle not less than 45 degrees to transfer the load of the roof to a bearing wall. ("Ten Common Framing Flaws," 4/95)

## Splicing Top Plates in Bearing Walls

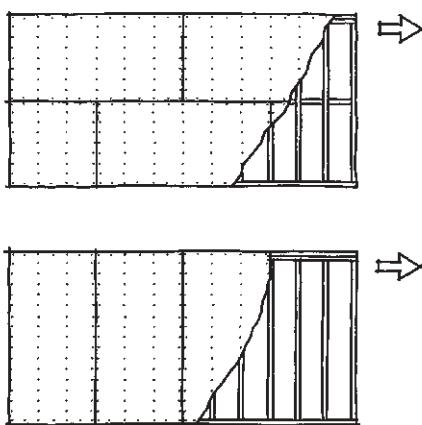


Double top plates must be lapped at corners and intersections, and splices must be staggered by at least 48 inches. ("Ten Common Framing Flaws," 4/95)

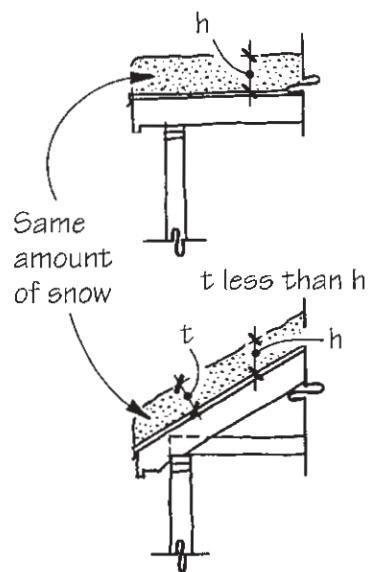
# FRAMING GUIDELINES

## Installing Plywood Sheathing

When all the panel edges are supported by solid framing, 1/2-inch plywood sheathing is stronger against racking forces when installed horizontally (top sketch). If there's no blocking at the 4-foot mark, the sheathing is stronger installed vertically, as long as all edges are supported (bottom sketch). ("Frequently Asked Framing Questions," 4/98)

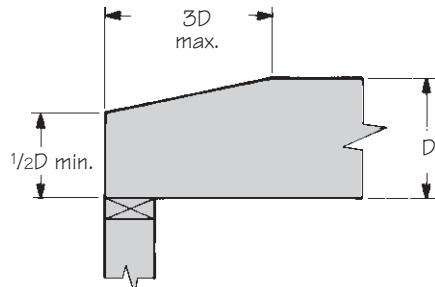


## Calculating Snow Loads



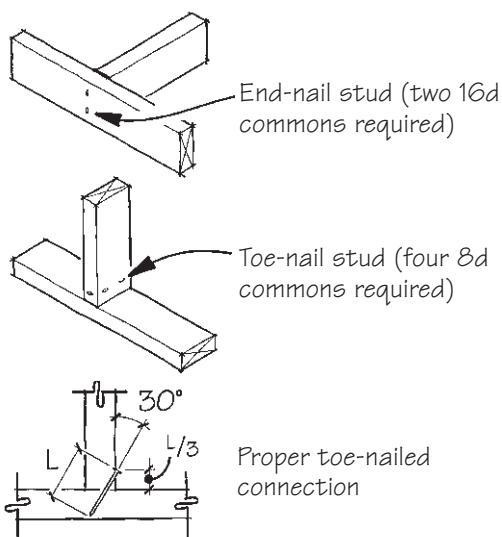
## Tapered Joist Ends

Overtapering joists to fit beneath roofs creates inadequate joist depth at the plate. A proper cut leaves at least half the depth of the joist. ("Field Guide to Common Framing Errors," 10/91)



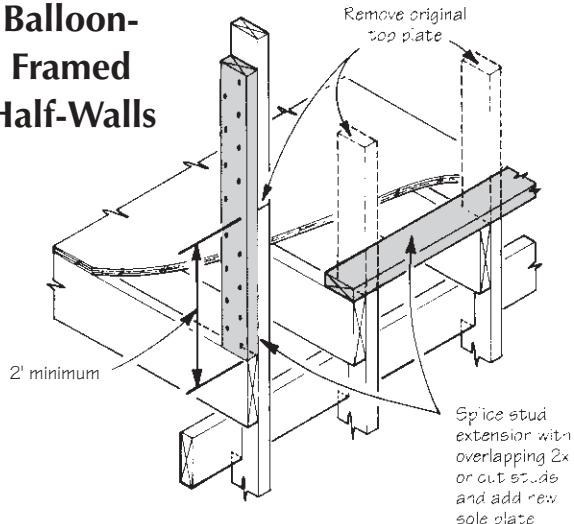
When adding up the weight of snow of a sloping roof, use the horizontal run of the roof, since the same amount of snow would accumulate on a perfectly flat roof. The code also allows you to apply a slope reduction factor, to account for snow blowing or sliding off a sloping surface. ("Frequently Asked Framing Questions," 4/98)

## Toe-Nails Are Stronger



When nailing a stud to a plate, a toe-nailed connection is typically stronger against lateral forces than an end-nailed connection. ("Frequently Asked Framing Questions," 4/98)

## Balloon-Framed Half-Walls

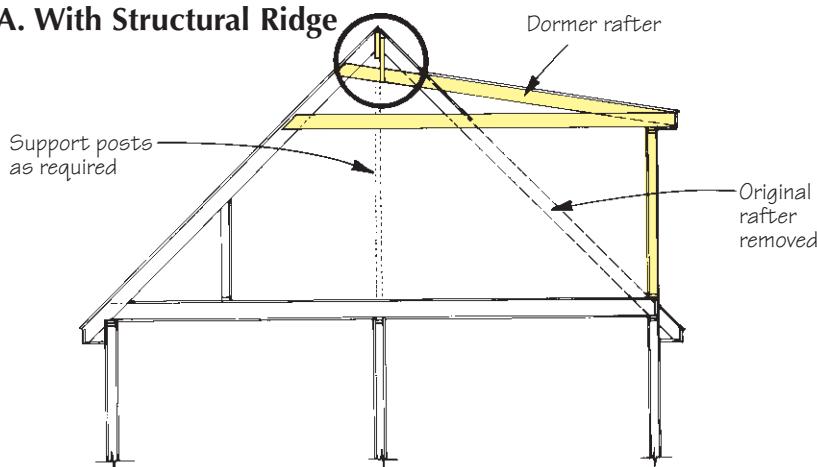


When adding a shed dormer above balloon-framed half-walls, don't build the wall extension directly on top of the balloon wall top plate. Instead, either remove the top plate and carefully splice on stud extensions or cut the balloon studs flush and build a new full-height stud wall. ("Taking the Sag out of Shed Dormers," 9/93)

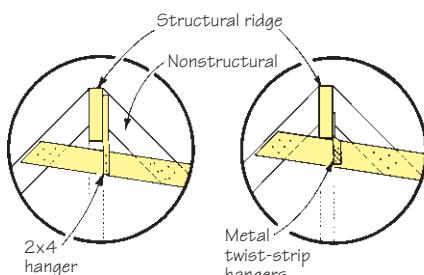
# ROOF FRAMING GUIDELINES

## Drop-Ridge Dormers

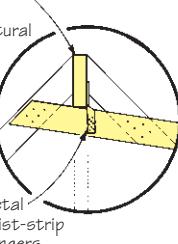
### A. With Structural Ridge



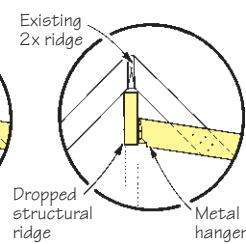
Shed dormer designs sometimes drop the shed ridge below the main ridge of the house. With a center bearing wall or structural ridge (A), this presents no problem; just tie in the dormer rafters and add short non-structural rafters above. The drawing shows three options for tying the dormer rafters to the structural ridge. However, in situations without a structural ridge (B), special attention must be given to connecting the dormer rafters. The author recommends 1/2-inch carriage bolts at all connections. ("Taking the Sag out of Shed Dormers," 9/93)



**Option 1**

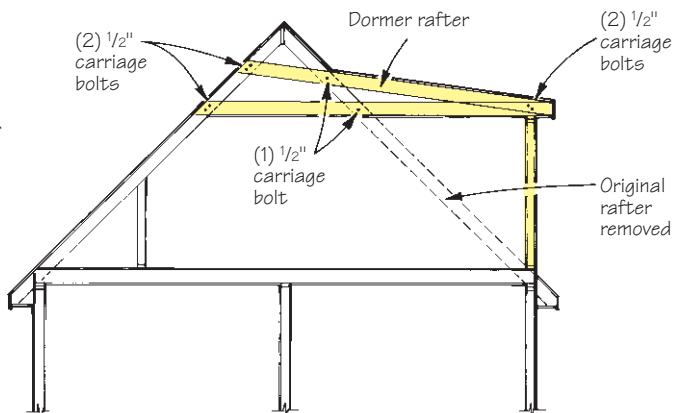


**Option 2**

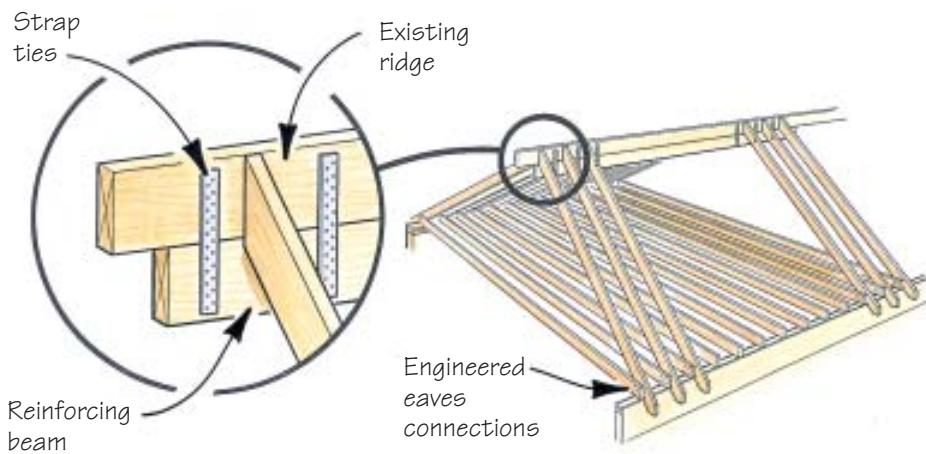


**Option 3**

### B. Without Structural Ridge



## Ridge Retrofit



In cases where an existing ridge board is inadequate for carrying vertical roof loads, as in a shed dormer retrofit, you can use strap ties to suspend a reinforcing beam below the original ridge. (*Practical Engineering*, 5/97)

# ROOF FRAMING GUIDELINES

## Sizing Structural Ridge Retrofits

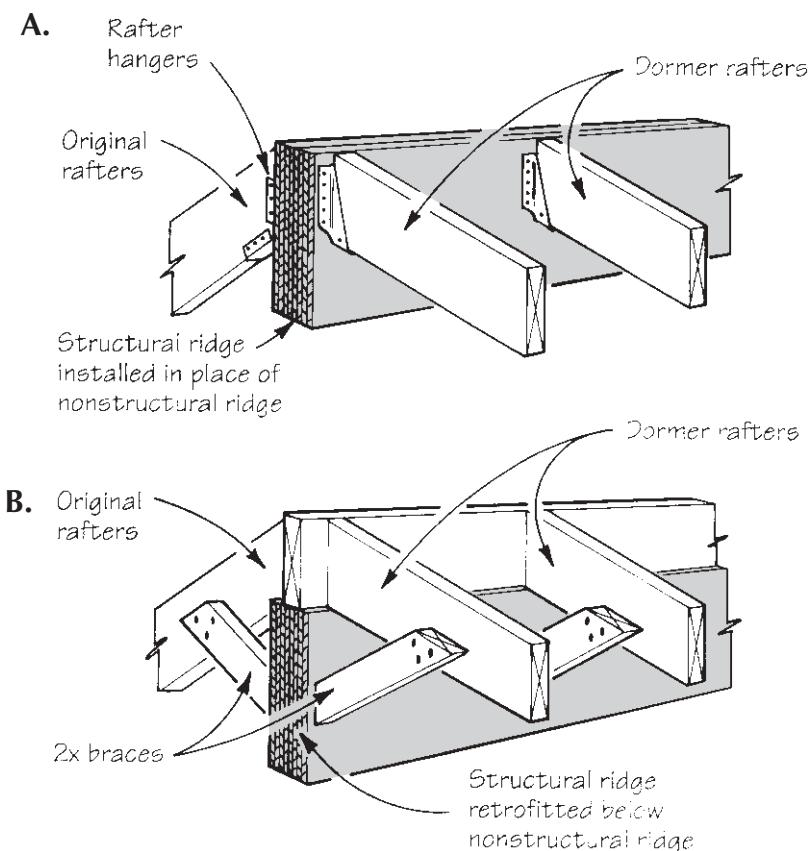
Ridge length	LVL beam	2x beam*
8'	LVL 1 <sup>3</sup> / <sub>4</sub> x 9 <sup>1</sup> / <sub>2</sub>	(2) 2x10
9'	"	
10'	LVL 1 <sup>3</sup> / <sub>4</sub> x 11 <sup>7</sup> / <sub>8</sub>	(3) 2x10, (2) 2x12
11'	"	(2) 2x12
12'	"	(3) 2x12
13'	LVL 1 <sup>3</sup> / <sub>4</sub> x 14	Not recommended
14'	"	"
15'	(2) LVL 1 <sup>3</sup> / <sub>4</sub> x 14	"
16'	"	"

Note: This table is based on a sample house 24 feet wide (eaves to eaves), with design snow loads of 30 psf.

\* Fb = 760 psi min. (new grading tables), or 1,000 psi with the old tables

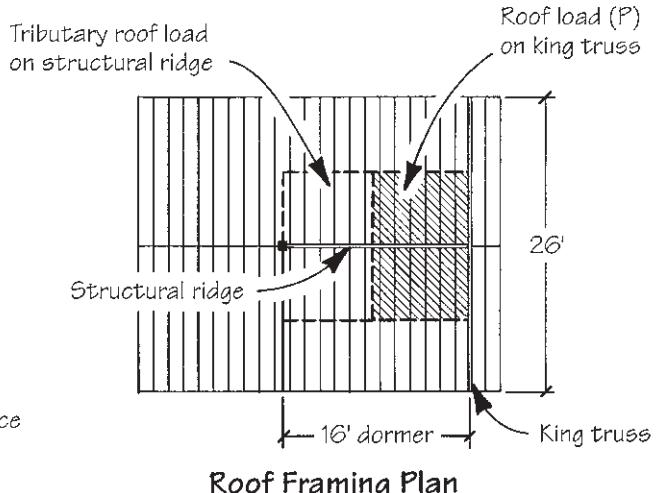
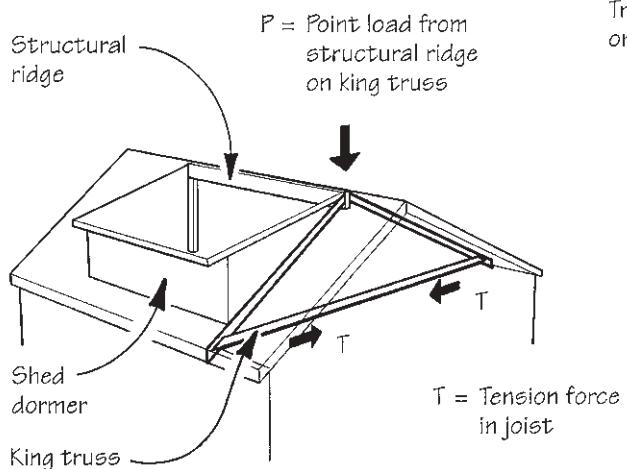
## Structural Ridge Connections

Structural ridge beams are a good solution for the loads introduced by a shed dormer addition. The author prefers to install them in place of the nonstructural ridge (A), but they can also be retrofitted below the existing ridge (B). The table above gives the author's sizing recommendations for LVL and laminated 2x ridge beams. ("Taking the Sag out of Shed Dormers," 9/93)



# ROOF FRAMING GUIDELINES

## Calculating Load on a King Truss



Assuming a total (dead + live) roof design load of 40 psf:

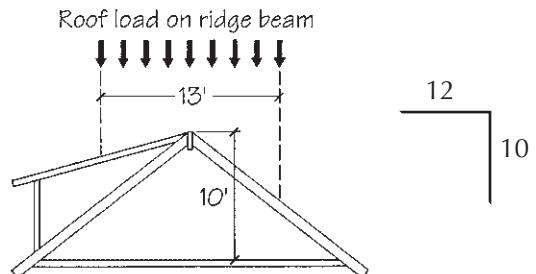
$$P = \frac{26'}{2} \times \frac{16'}{2} \times 40 \text{ psf} = 13' \times 8' \times 40 \text{ psf} = 4160 \text{ lb.}$$

$$T = \frac{1}{2}P \times \frac{\text{Run}}{\text{Rise}} = \frac{4160}{2} \times \frac{12}{10} = 2496 \text{ lb.}$$

Divide T by bolt capacity to calculate number of bolts (N) required for joist-rafter connection:

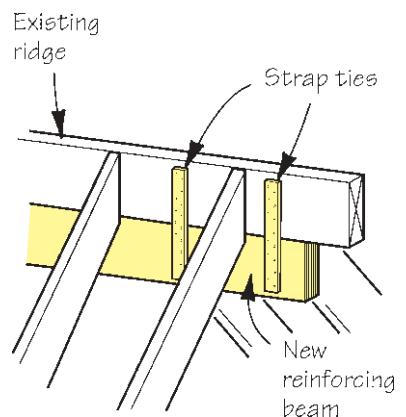
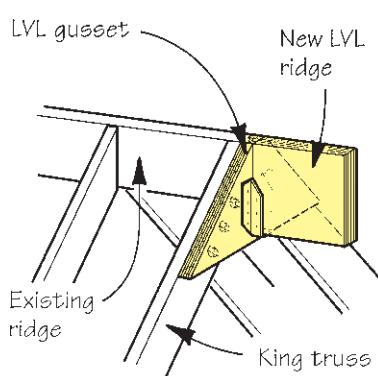
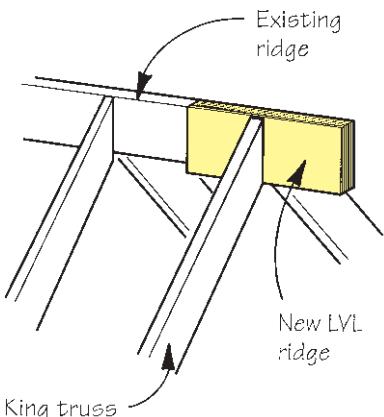
$$N = \frac{T}{\text{bolt capacity}}$$

To design a rafter-joist king truss to support the end of a structural ridge, the engineer must calculate the tension force, T, that will be induced in the joist. First, the tributary roof load flowing to the end of the ridge beam is calculated, then this point load, P, is used to calculate the tension force in the joist. The designer then specifies the bolts needed to carry this tension force at the rafter-joist connections. (*Practical Engineering*, 9/97)



**Section**

## Structural Ridge Installation Details

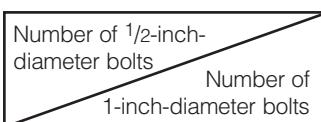


When supporting a structural ridge with a rafter truss, the beam can be sandwiched in place just like a nonstructural ridge (left), supported by a hanger attached to a gusset plate (middle), or even hung by straps from an existing ridge board (right). (*Practical Engineering*, 9/97)

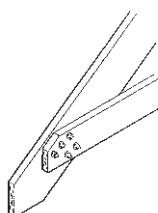
## Number of Bolts Required for King Truss Joist-Rafter Connections

To use this chart, calculate the point load,  $P$ , at the top of the king truss (always round up), then find the number of bolts required for the roof pitch. Note that where seven or more 1/2-inch bolts are not recommended, fewer 1-inch bolts may work. The number of required bolts assumes a single-shear connection. Reduce bolts by half for double-shear connections. The chart is based on use of S-P-F 2-by lumber (specific gravity = 0.42). In some, but not all, cases, fewer bolts would be required if a stronger grade of lumber were used. Use of lower grades, such as redwood, eastern softwoods, S-P-F (south), western cedars, western woods, or northern species, would in some cases require more bolts. When in doubt, the designer should refer to the NDS tabulated bolt design values, which were used as the basis for this chart.

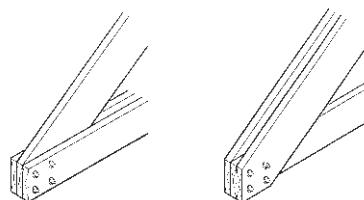
Roof Pitch	Point Load (P) on King Truss				
	1000 lb.	2000 lb.	3000 lb.	4000 lb.	5000 lb.
12/12	2 1	4 2	5 3	7* 4	9* 5
10/12	2 1	4 2	6 3	8* 4	10* 5
8/12	3 2	5 3	7* 4	9* 5	12* 6
6/12	3 2	6 3	9* 5	12* 6	14* 7*
4/12	4 2	8* 4	12* 6	16* 8*	20* 10*
3/12	5 3	11* 6	16* 8*	21* 11*	26* 13*



\*Not recommended



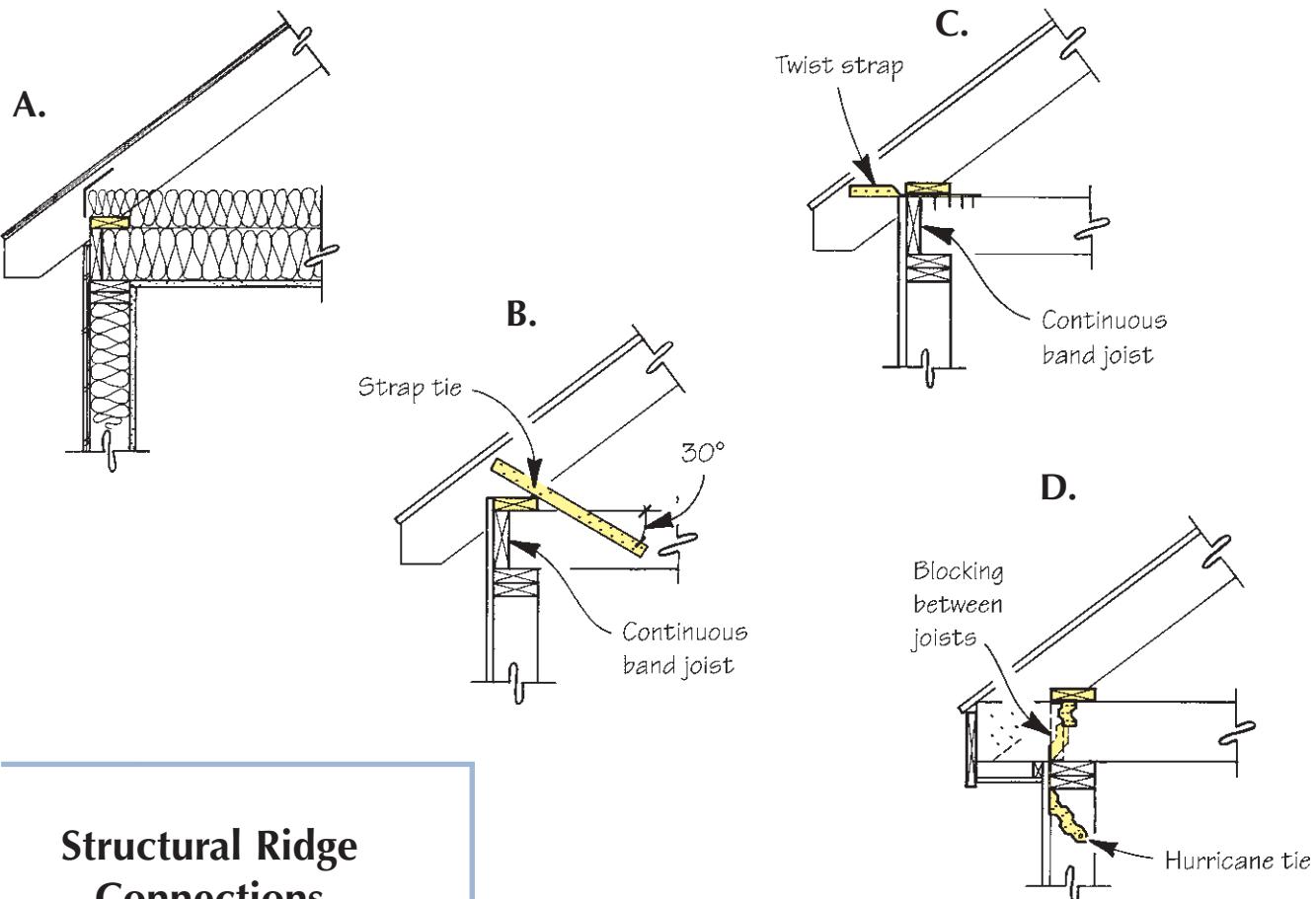
Single-Shear Connection



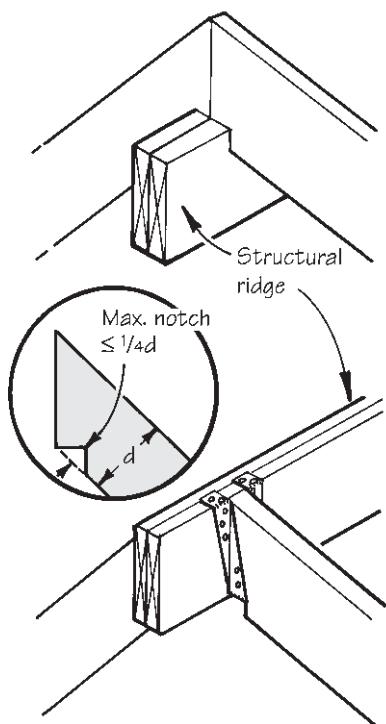
Double-Shear Connections

# ROOF FRAMING GUIDELINES

## Roof Framing With a Raised Rafter Plate



### Structural Ridge Connections

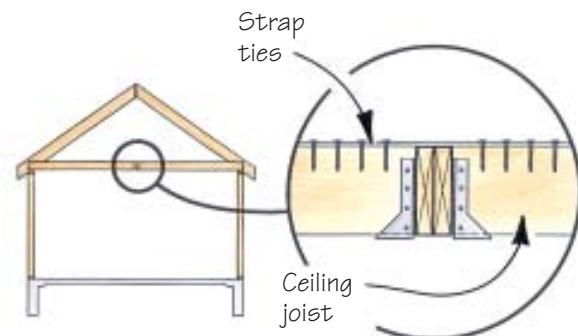


The raised rafter plate (A) allows room for insulation above the wall plate, but the lateral thrust of the roof must be accounted for in the design. When using a raised rafter plate, Simpson strap ties (B) are the easiest way to resist roof thrust, according to the author. When an attic floor is in the way, twist straps will work (C). Extending the attic joists beyond the walls (D) provides a strong rafter-joist connection, but may require additional hurricane ties to resist wind uplift. (*Practical Engineering*, 7/96)

The most effective way to reduce outward roof thrust is to use a structural ridge beam. Either rest the rafters on top of a structural ridge beam (top left) or use joist hangers attached to the ridge beam (left). The notch at the bottom of the plumb cut should be no deeper than one-fourth the rafter width. ("Common Roof-Framing Errors," 8/95)

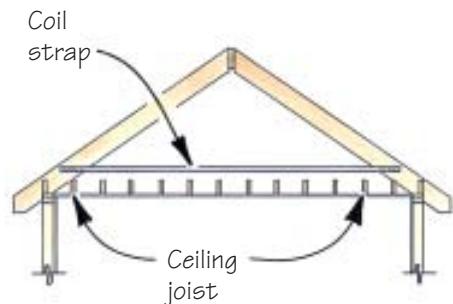
# ROOF FRAMING GUIDELINES

## Tension Tie



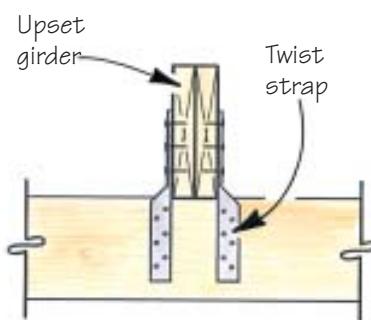
In the absence of a structural ridge or center bearing wall, ceiling joists are critical for preventing rafters from spreading. Where the joists are interrupted by a flush-framed beam, strap ties make an ideal tension connection. (*Practical Engineering*, 5/97)

## Strapping the Roof Together



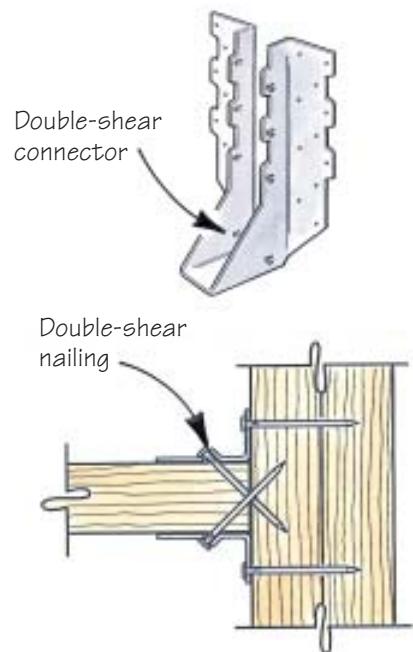
Where ceiling joists run perpendicular to the rafters, coil strap makes an excellent rafter tie. (*Practical Engineering*, 5/97)

## Upset Beam

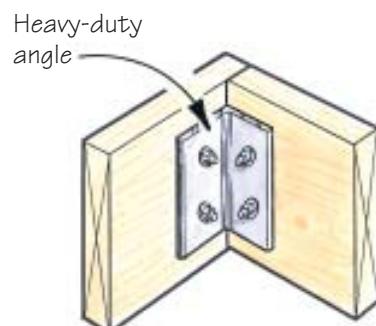


An "upset" girder is often easier to frame than a flush-framed beam. The joists hang by twist straps, installed in pairs. (*Practical Engineering*, 5/97)

## Strongest Joist Hangers



## The Right Angle



Heavy-duty angles like Simpson's HL or USP's KHL are a good solution for attaching that last deck joist to the ledger board. (*Practical Engineering*, 5/97)

Double-shear connectors provide greater strength with fewer nails than ordinary hangers. The angled nail configuration also makes it easier to drive the nails in a joist bay. (*Practical Engineering*, 5/97)