Shed Framing

NAILING TECHNIQUES

Endnailing   Facenailing   Toenailing
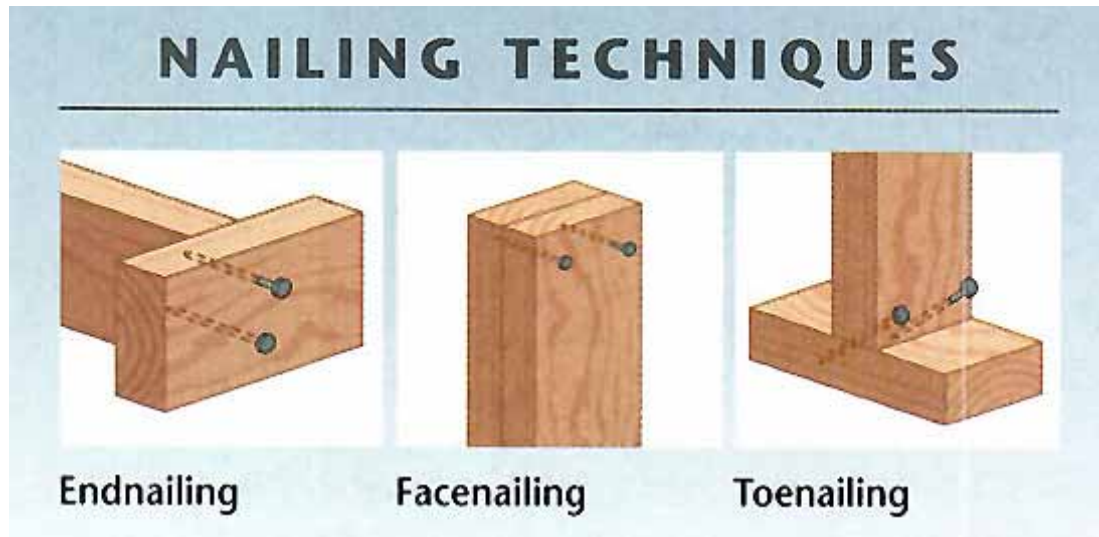
Framing is one of the most satisfying phases of a building project. Using basic tools and materials, you'll the skeleton of the structure, piece-by-piece, and in the process learn the fundamentals of carpentry. The style of framing shown here is standard 2 × 4 framing, also called stick framing.

The tools you'll use for most framing are the circular saw (and power miter saw, if you have one), framing square, level, chalk line, and, of course, a framing hammer. Nails used for most framing are called common nails. These have a larger diameter than box nails, making them stronger, but also more likely to split thinner stock. Box nails are better for siding, trim, and other non-structural materials. The three most commonly used nailing techniques are shown in the illustration. Some framing connections, such as where rafters meet wall plates, require metal anchors for increased strength.

Floor Framing

Floor frames for sheds are simple versions of house floor frames. They have outside, or *rim*, joists that are set on edge and nailed to the ends of the common joists. Gazebos have floor frames similar to

decks, with angled joists that are connected to support beams with joist hangers. On top of floor frames, a layer of tongue-and-groove plywood (or decking boards, for a gazebo) provides the floor surface and adds strength to the frame. To prevent rot, always use pressure-treated lumber and galvanized nails and hardware for floor frames.
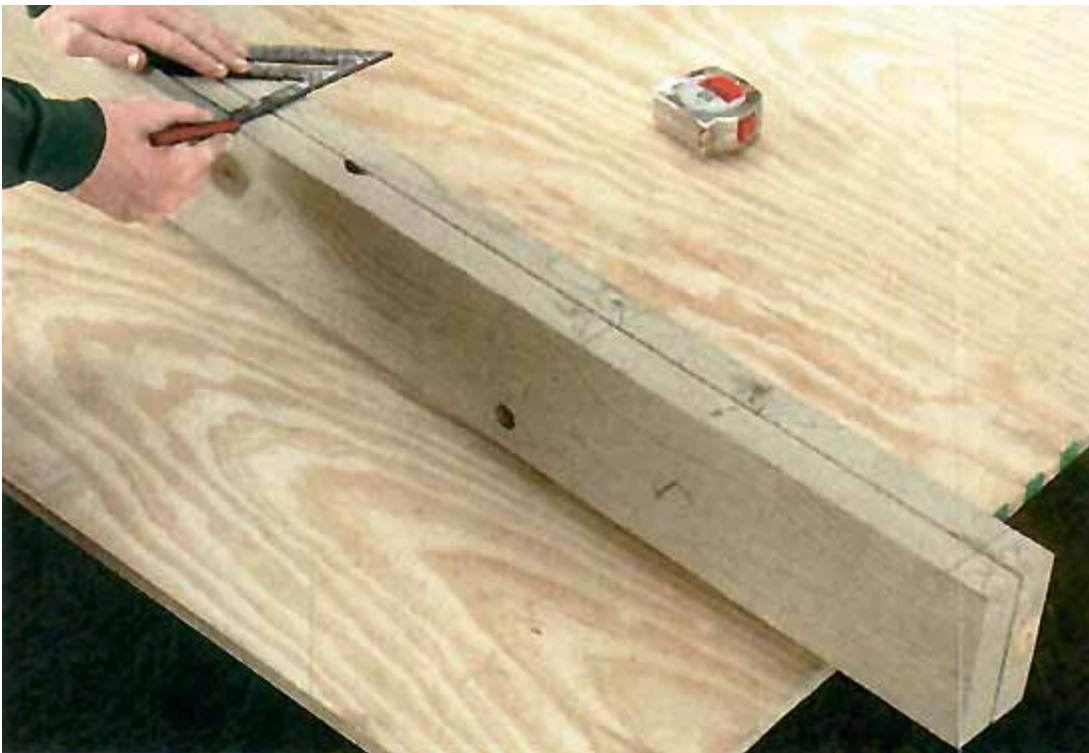
TOOLS & MATERIALS

Circular saw
8d and 16d galv. common nails
square
3/4" tongue-and-groove exterior-grade plywood
pressure-treated 2 × lumber

HOW TO BUILD A SHED FLOOR FRAME

Step A: Cut the Joists & Mark the Layout

1. Cut the two rim joists and the common joists to length, making sure both ends are square. Note that rim joists run the full length of the floor, while common joists are 3" shorter than the floor width.

2. Check the rim joists for crowning—arching along the narrow edges. Pick up one end of the board and hold it flat. With one eye closed, sight down the narrow edges. If the board arches, even slightly, mark the edge on the top (convex) side of the arch. This is the crowned edge and should always be installed facing up. If the board is crowned in both directions, mark the edge with the most significant crowning.

3. Lay one rim joist flat on top of the other so the edges and ends are flush and the crowned edges are on the same side. Tack the joists together with a few 8d nails. Turn the joists on-edge and mark the common joist layout on the top edges: Mark 1 1/2"" and 15 1/4" from the end of one joist. Then, measuring from the 15 1/4" mark, make a mark every 16"—at 32", 48", 64" and so on, to the end of the board (if the plan calls for 24" spacing, make a mark at 1 1/2" and 23 1/4", then every 24" from there). Don't worry if the last space before the opposite end joist isn't as wide as the others. Make a mark 1 1/2" in from the remaining end. After each mark, draw a small × designating to which side of the line the joist goes—this is a handy framers' trick to prevent confusion. This layout ensures that the edges of a 4-ft. or 8-ft. board or sheet will fall, or *break,* on the center of a joist.

4. Using a square, draw lines through each of the layout marks, carrying them over to the other rim joist. Draw Xs on the other joist, as well. Separate the joists and remove the nails.
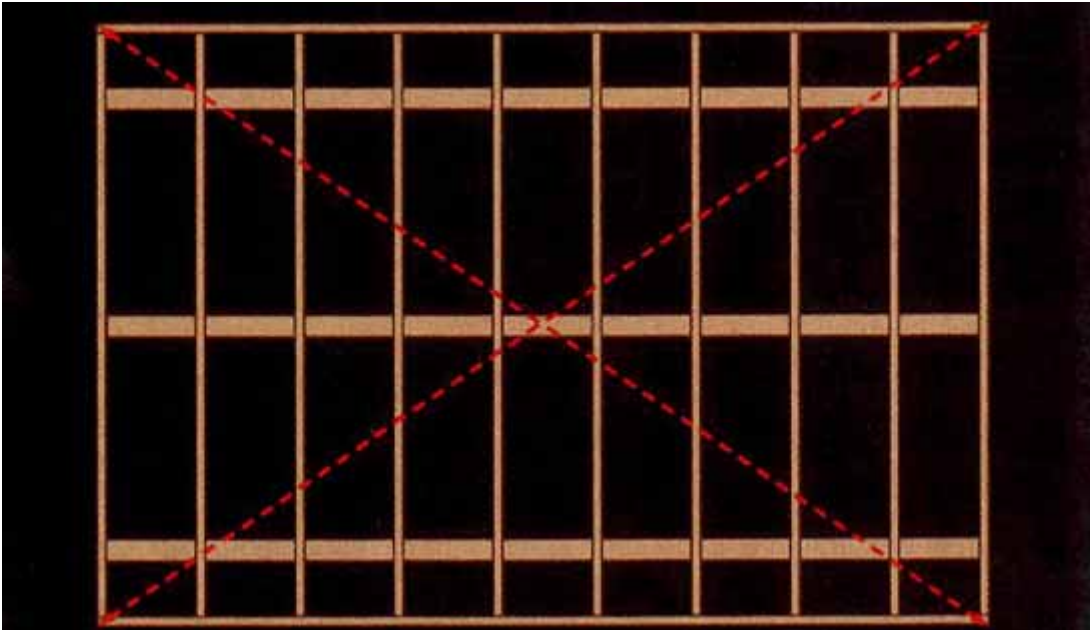
Step B: Assemble & Square the Frame

1. Check the two end joists for crowning, then nail them between the rim joists so their outside faces are flush with the rim joist ends and the top edges are flush. Drive two 16d galvanized common nails through the rim joists and into the ends of the end joists, positioning the nails about 3/4" from the top and bottom edges.

2. Install the remaining joists, making sure the crowned edges are facing up.

3. Check the frame for squareness by measuring diagonally from corner to corner: when the measurements are equal, the frame is square. To adjust the frame, apply inward pressure to the corners with the longer measurement.

4. If you're building the floor over skids, secure each joist to the outside skids with a metal anchor and toenail the joists to the internal skid(s) with 16d galvanized nails.
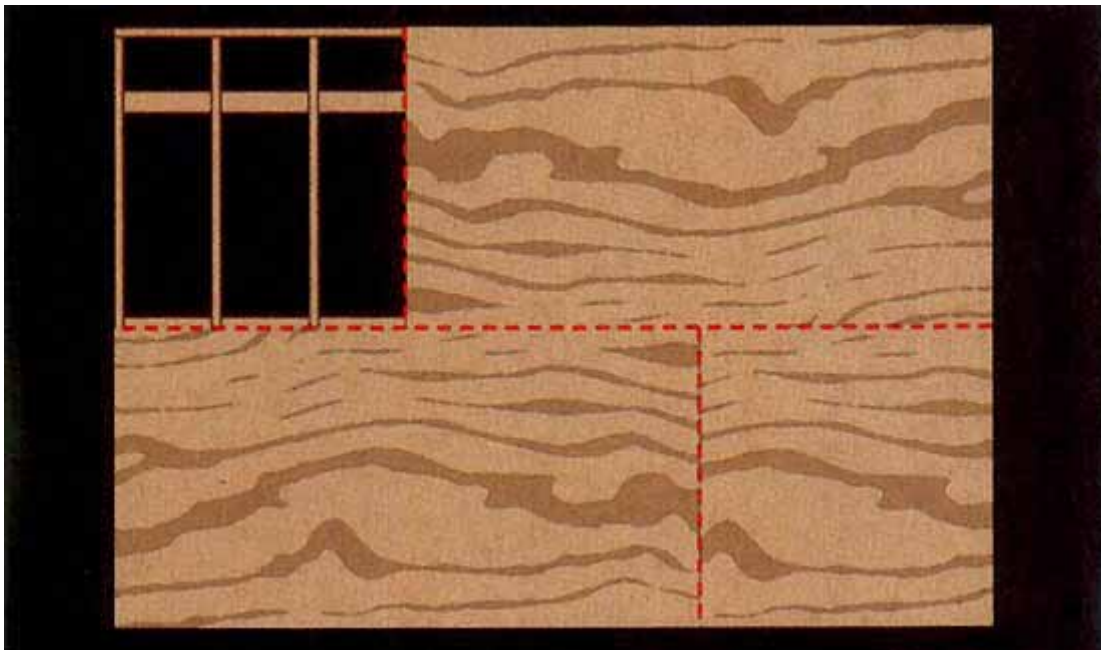
Step C: Install the Plywood Floor

1. Lay a full sheet of 3/4" tongue-and-groove exterior-plywood over the frame so the groove side is flush with a rim joist and one end is flush with an end joist. Fasten the plywood to the joists with 8d galvanized nails driven every 6" along the edges and every 8" in the

field of the sheet. Do not nail along the tongue edge until the next row of plywood is in place.

2. Cut the second piece to fit next to the first, allowing for a 1/8" gap between the sheets. Install the second sheet with its outside edges flush with the frame.

3. Start the next row with a full sheet (ripped to width, if necessary). Install the sheet starting from the corner opposite the first sheet, so the joints between rows are offset. Make sure the tongue-and-groove joint is tight; if necessary, use a wood block and a sledgehammer to close the joint.

4. Cut and install the remaining piece of plywood.

Mark the joist layout onto the header or beam and use a square to draw parallel lines that represent the outer edges of the joist. Position the hanger with one side flush to a joist outline, and fasten it with joist hanger nails (1 1/2") or 10d or 16d galvanized common nails.
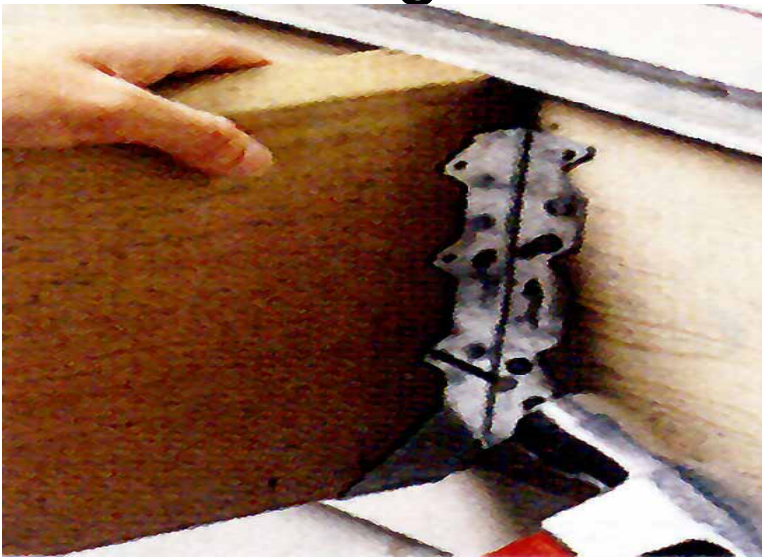

Using a scrap piece of joist as a spacer, close the hanger around the spacer. Check the position of the spacer's top edge, then nail the free side of the hanger in place.

To install the joist, set it completely into the hanger and fasten it through the hanger holes with joist nails.

Wall Framing

Standard framed walls have vertical 2 × 4 *studs* nailed between horizontal top and bottom *plates*. The top plates are doubled to provide additional support for the roof frame and to strengthen the wall connections. Door and window frames are made up of *king* studs; a *header*, which supports *cripple* studs above the opening;

and *jack* studs, which support the header. A window frame also has a *rough sill* and cripple studs below the opening. The opening defined by the frame is called the *rough opening*. Wall frames gain rigidity from plywood sheathing or siding.

Building walls involves three major phases: laying out and framing the walls; raising the walls; and tying the walls together and adding the double top plates. Note: If your building has a concrete slab floor, use pressure-treated lumber for the bottom plates and anchor the plates to the J-bolts set in the slab.

TOOLS & MATERIALS

Broom
2 × lumber
Circular saw or power miter saw
8d, 10d, and 16d common nails
Square
1/2" plywood
4-ft. level
Construction adhesive
Handsaw

HOW TO FRAME WALLS

Step A: Mark the Bottom-plate Layout Lines

1. Sweep off the floor and make sure it's dry. Cut a short (about 4" to 6") piece of plate material to use as a spacer. Position the spacer at one corner of the floor, with its outside edge flush with the outside of the floor frame. Mark a pencil line along the inside edge of the spacer.

2. Use the spacer to mark the wall ends at each corner of the floor (eight marks total). Snap chalk lines through the marks. These lines represent the inside edges of the bottom plates.
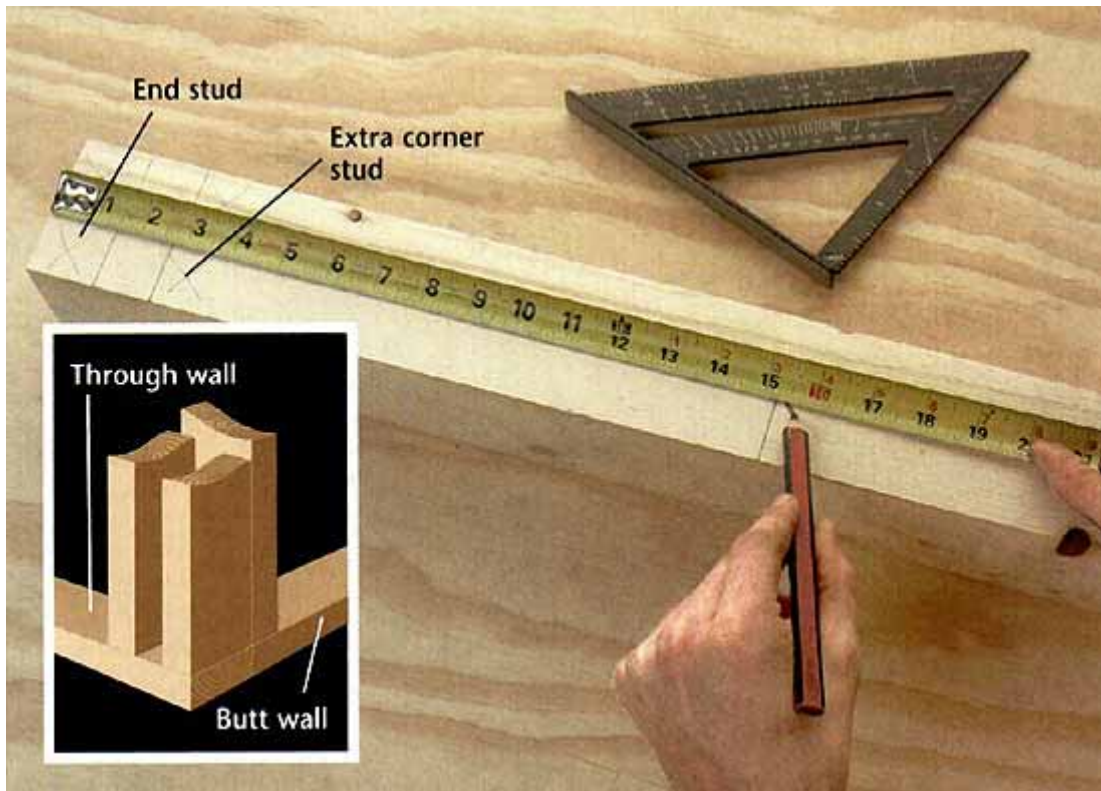
Step B: Lay Out the Plates

1. Measure along the plate layout lines to find the lengths of the plates. Note: Follow your project plans to determine which walls ran to the edges of the building (called *through* walls) and which butt into the other walls (called *butt* walls).

2. Select straight lumber for the plates. Cut a top and bottom plate for the first wall, making sure their dimensions are the same. Use a circular saw or a power miter saw, but make sure both ends are square. Lay the bottom plate flat on the floor and set the top plate on top of it. Make sure their edges and ends are flush, then tack the plates together with a few 8d nails.

3. Turn the plates on-edge and mark the stud layout onto the front edges. If the wall is a through wall, make a mark at 1 1/2" and 2 3/4" to mark the end stud and extra corner stud. Then, mark at 15 1/4" (for 16" on-center spacing) or 23 1/4" (for 24" on-center spacing)—measuring from this mark, make a mark every 16" (or 24") to the end of the plates. Make a mark 1 1/2" in from the opposite end. Following your plan, draw an × next to each mark, designating to which side of the line the stud goes.

Mark the king and jack studs with a K and J respectively, and mark the cripple studs with a C.

If the wall is a butt wall, mark the plate at 1 1/2", then move the tape so the 3 1/2" tape mark is aligned with the end of the plate. Keeping the tape at that position, mark at 15 1/4" (for 16" spacing) or 23 1/4" (for 24" spacing) then mark every 16" (or 24") from there. The 3 1/2" that are "buried" account for the width of the through wall.

4. Using a square, draw lines through each of the layout marks, carrying them over to the other plate. Draw Xs on the other plate, as well.

Step C: Cut the Studs Build the Headers

1. Cut the studs to length, following the framing plan; make sure both ends are square. (Before cutting, give each stud a quick inspection to check for excessive bowing or crowning; reserve any bad studs for scrap or blocking.)

2. Select straight lumber for the door-frame studs. Cut the jack studs to equal the height of the rough opening minus 1 1/2" (this accounts for the thickness of the bottom plate); cut the jack studs for the window frame to equal the height of the top of the rough opening minus 1 1/2'. Cut the king studs the same length as the common studs.

3. To build the headers, cut two pieces of 2 × lumber (using the size prescribed by the plans) to equal the width of the rough opening plus 3". Check the boards for crowning, and mark the top edges. Cut a piece of 1/2" plywood to the same dimensions as the lumber pieces.

4. Apply two wavy beads of construction adhesive to each side of the plywood and sandwich the lumber pieces around the plywood, keeping all edges flush. Nail the header together with pairs of 16d common nails spaced about 12" apart. Drive the nails at a slight angle so they won't protrude from the other side. Nail from both sides of the header.

When building walls over a concrete slab, drill holes in the bottom plates for the anchor bolts before marking the stud layouts. Position each plate on its layout line with the ends flush with the edges of the slab. Use a square to mark the edges of the bolt onto the plate.
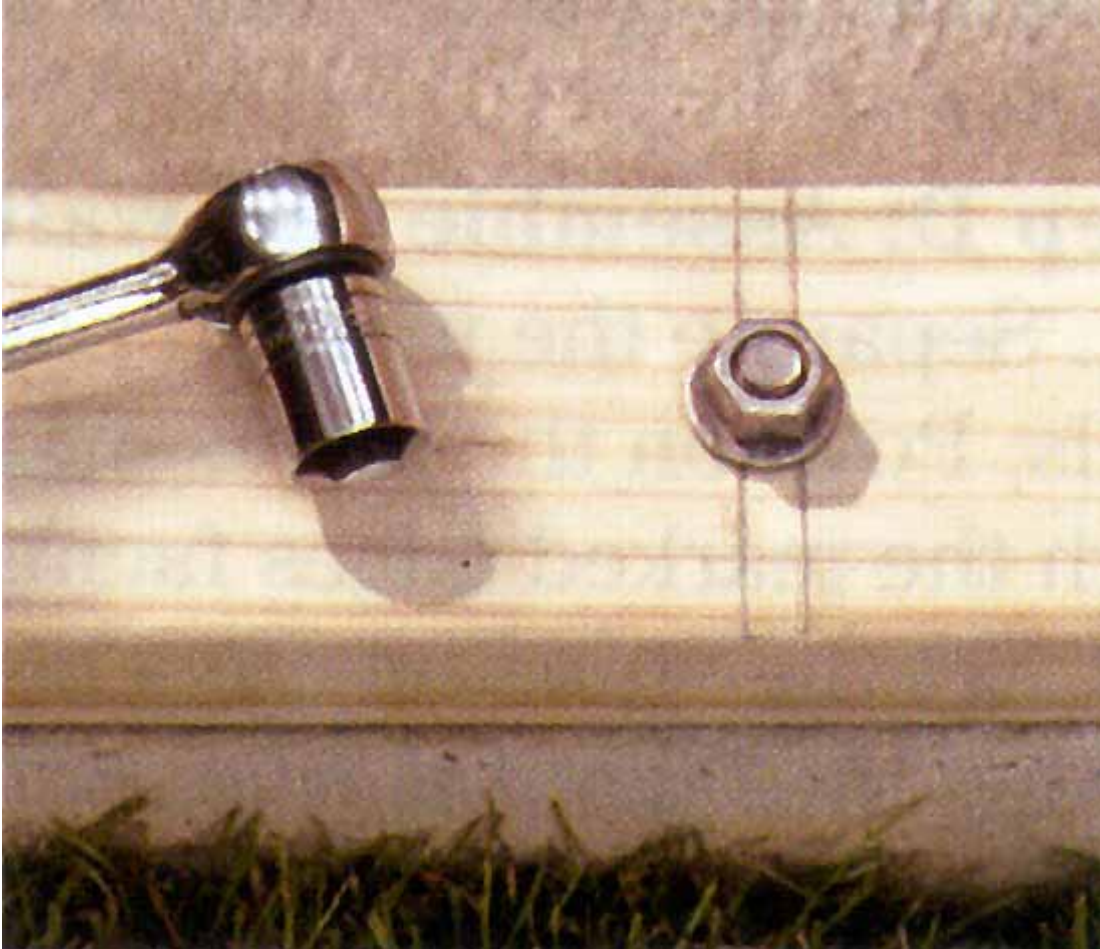
Measure from the layout line to the bolt center and transfer that dimension to the plate. Drill holes through the plates slightly larger in diameter than the bolts. After raising the walls, anchor the plates to the bolts with washers and nuts.

Step D: Assemble the Wall

1. Separate the marked plates and remove the nails. Position the plates on-edge, about 8 ft. apart, with the marked edges facing up.

2. Set the studs on-edge between the plates, following the layout marks. Before setting the door- or window-frame studs, facenail the jack studs to the inside faces of the king studs with 10d common nails staggered and spaced every 12"; make sure the bottom ends and side edges are flush.

3. Nail all of the studs to the bottom plate, then to the top plate. Position each stud on its layout mark so its front edge is flush with

the plate edge, and nail through the plate and into the stud end with two 16d common nails (use galvanized nails on the bottom plate if your floor is concrete). Drive the nails about 3/4" in from the plate edges.

4. Set the header in place above the jack studs and nail through the king studs and into the header ends with 16d nails—use four nails on each end for a 2 × 6 header, and six for a 2 × 8 header.

For a window frame, measure up from the bottom of the bottom plate and mark the top of the sill on the inside faces of the jack studs—this defines the bottom of the rough opening. Cut two sill pieces to fit between the jack studs and nail them together with 10d nails. Toenail the sill to the jack studs with 16d nails.

5. Cut the cripple studs to fit between the header and the top plate (and the sill and bottom plate, for window frames). Toenail the cripple studs to the plates and headers (and sill) with two 8d nails on one side and one more through the center on the other side.
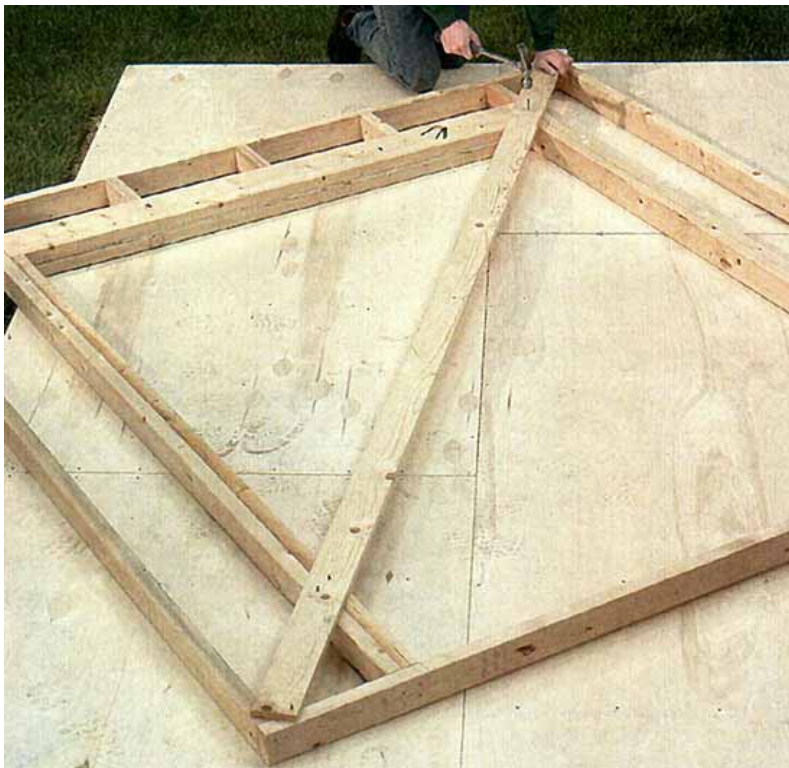
Step E: Square the Wall Frame

1. Check the wall frame for squareness by measuring diagonally

from corner to corner: when the measurements are equal, the frame is square. To adjust the frame, apply inward pressure to the corners with the longer measurement.

2. When the frame is perfectly square, install a temporary 1 × 4 or 2 × 4 brace diagonally across the studs and plates. Nail the brace to the frame with 8d nails. Use two nails on the plates and on every other stud. To stabilize the structure, leave the wall braces in place until the walls are sheathed or sided.

3. At each end of the wall, attach a board to brace the wall upright after it is raised; nail it to the end stud with one 16d nail. Note: Install only one end brace for the second and third walls; no end brace is needed for the final wall.
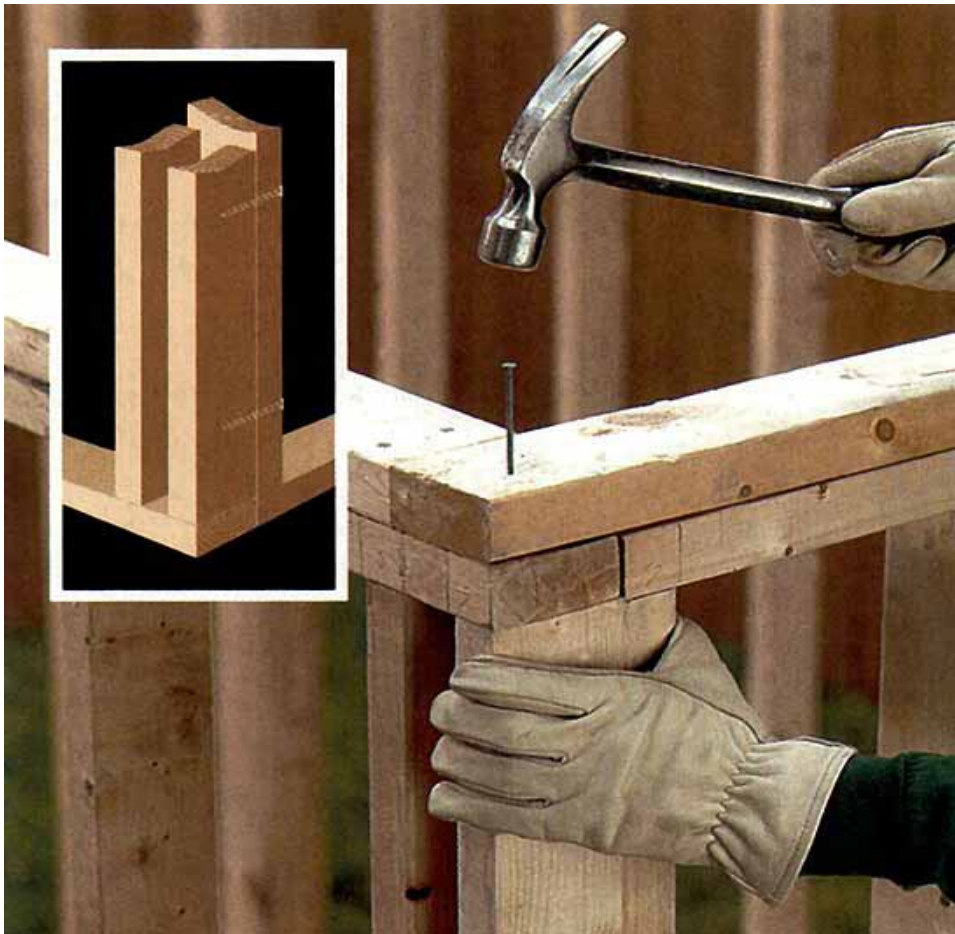

Step F: Raise the Wall

1. With a helper, lift the top end of the wall and set the bottom

plate on the layout lines you snapped in Step A. Swing out the free ends of the end braces and tack them to the floor frame to keep the wall upright. If you have a slab floor, nail the braces to stakes in the ground.

2. Fine-tune the wall position so the bottom plate is flush with the chalk line, then nail the plate to the floor with 16d nails. Drive a nail every 16" and stagger them so that half go into the rim joist and half go into the common joists. Do not nail the plate inside the door opening.

3. Pull the nails at the bottom ends of the end braces, and adjust the wall until it is perfectly plumb, using a 4-ft. level; set the level against a few different studs to get an accurate reading. Reattach the end braces with 16d nails.


Step G: Complete the Wall Frames Install the Double Top

Plates

1. Build and raise the remaining walls, following the same procedure used for the first wall. After each wall is plumbed and braced in position, nail together the end studs of the adjacent walls with 16d nails, driven every 12". Make sure the wall ends are flush.

2. Cut the double top plates from 2 × 4 lumber. The double top plates must overlap the top plate joints, so that on through walls, the double plate is 3 1/2" shorter on each end than the top plate; on butt walls, the double plate is 3 1/2" longer on each end. Nail the double top plates to the top plates with 10d nails. Drive two nails at the ends of the plates that overlap intersecting walls, and one nail every 16" in between.

3. Use a handsaw or reciprocating saw to cut out the bottom plate in the door opening.

Roof Framing

Ridge board — Roof sheathing
Collar tie   Rafters
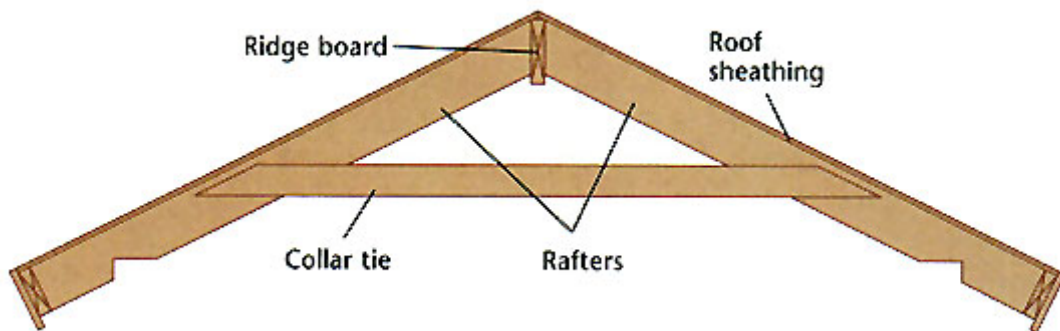
A roof frame is an important structure not only because it supports the roofing and helps keep the building dry, but because its style and shape have a great impact on the character of the building, the feel of the interior space, and the amount of storage space available.

There are four common roof types shown in this book. A *gable* roof is the classic, triangular design, with two sloped sides meeting at

the peak, and flat ends (called *gable ends*). *Gambrel* roofs are like gable roofs with an extra joint on each side, resulting in two different slopes. A *hip* roof is structurally similar to a gable, but has no gable ends. *Shed* roofs are the simplest style, with only one sloped plane. They can be built with frames or, for small structures, a sheet of plywood.

All of these roof styles have a designated slope, which is the degree of angle of each side. The slope is expressed in a ratio that states the number of inches of vertical rise per 12" of horizontal run. For example, a roof that rises 6" for every 12" of run is said to have a slope of 6-in-12. Roof slope is indicated in plan drawings by a triangular symbol known as the *roof-slope indicator*. You'll use the roof slope to lay out rafters and fascia.

In standard roof framing, rafters are the principal structural members, rising from the walls to theridge board (or *hub*, in gazebos) at the peak of the roof. Rafters in outbuildings typically are made from 2 × 4s or 2 × 6s, are spaced 16" or 24" on center, and are installed perpendicular to the length of the building. To keep the roof planes from spreading apart, *rafter ties*, or *collar ties*, are nailed between opposing rafters to form a structural triangle. With shed-style roofs, the rafters span from wall-to-wall and no ridge board or ties are needed.

The key to successful roof sheathing framing is making accurate cuts on the rafters. Take your time to cut the first two rafters, making any necessary adjustments, then use one as a pattern for marking the rest. The following project shows you how to cut and install rafters in a gable roof frame, but the basic procedures are the same for gambrel and hip roofs.

As an alternative to rafter framing, you can take your plans to a truss manufacturer and have custom trusses built for your project. However, this will cost you more and probably will limit your storage space: the internal supports in truss frames leave little room for storage.

TOOLS & MATERIALS

Circular saw
2 × lumber
framing square
8d, 10d, and 16d common nails
4-ft. level
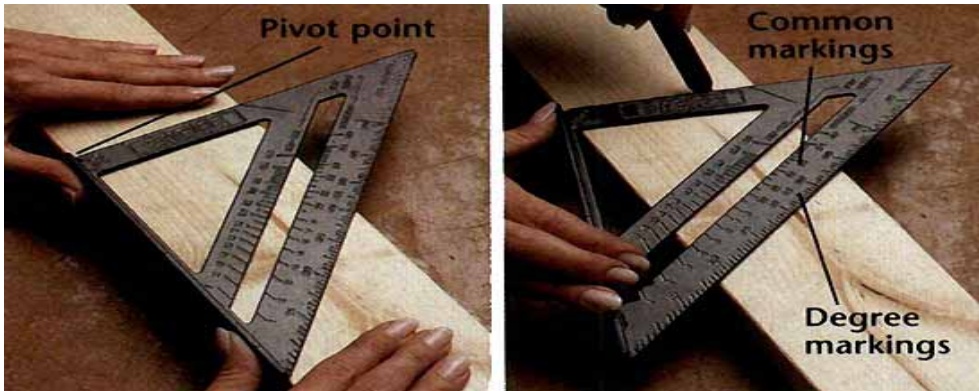
A speed square is a handy tool for marking angled cuts—using the degree of the cut or the roof slope. Set the square flange against the board edge and align the PIVOT point with the top of the cut. Pivot the square until the board edge is aligned with the desired DEGREE marking or the rise of the roof slope, indicated in the row of COMMON numbers. Mark along the right-angle edge of the square.
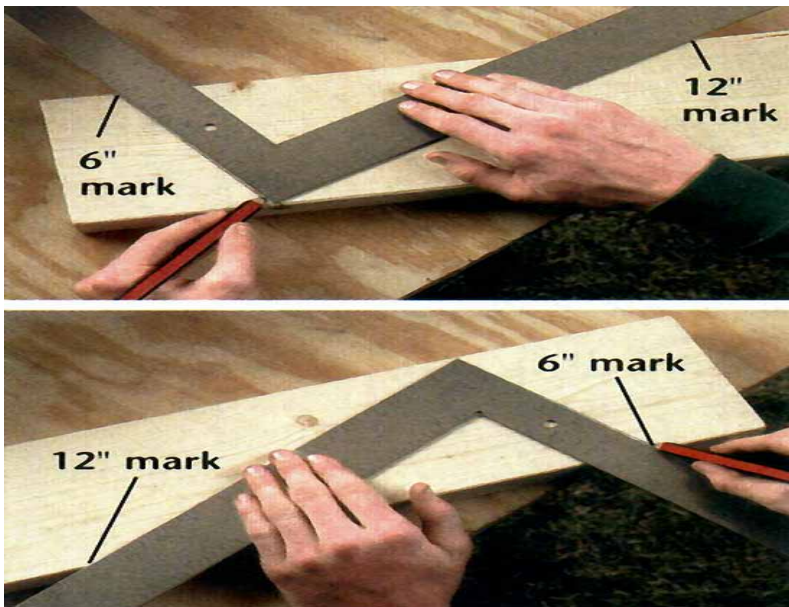
HOW TO BUILD A ROOF FRAME

Note: The following instructions are based on the sample rafter template shown here, which is designed for a 6-in-12 roof slope.

Step A: Mark the Plumb Cuts

1. Select a straight board to use for the pattern rafter. Mark the top plumb cut near one end of the board: Position a framing square with the 6" mark of the tongue (short part) and the 12" mark of the blade (wide part) on the top edge of the board. Draw a pencil line along the outside edge of the tongue.

2. Starting from the top of the plumb-cut mark, measure along the top edge of the board and mark the overall length of the rafter, then use the square to transfer this mark to the bottom edge of the board. Position the square so the tongue points down, and align the 6" mark of the tongue and the 12" mark of the blade with the bottom board edge, while aligning the tongue with the overall length mark. Draw a line along the tongue. If the bottom end cut of the rafter is square (perpendicular to the edges) rather than parallel to the top end, mark a square cut at the overall length mark.
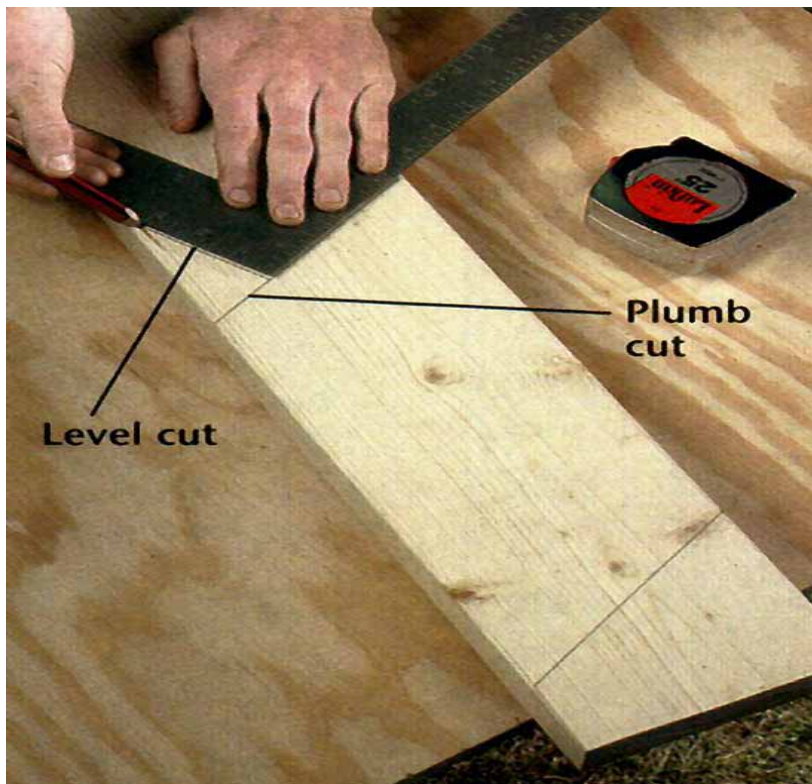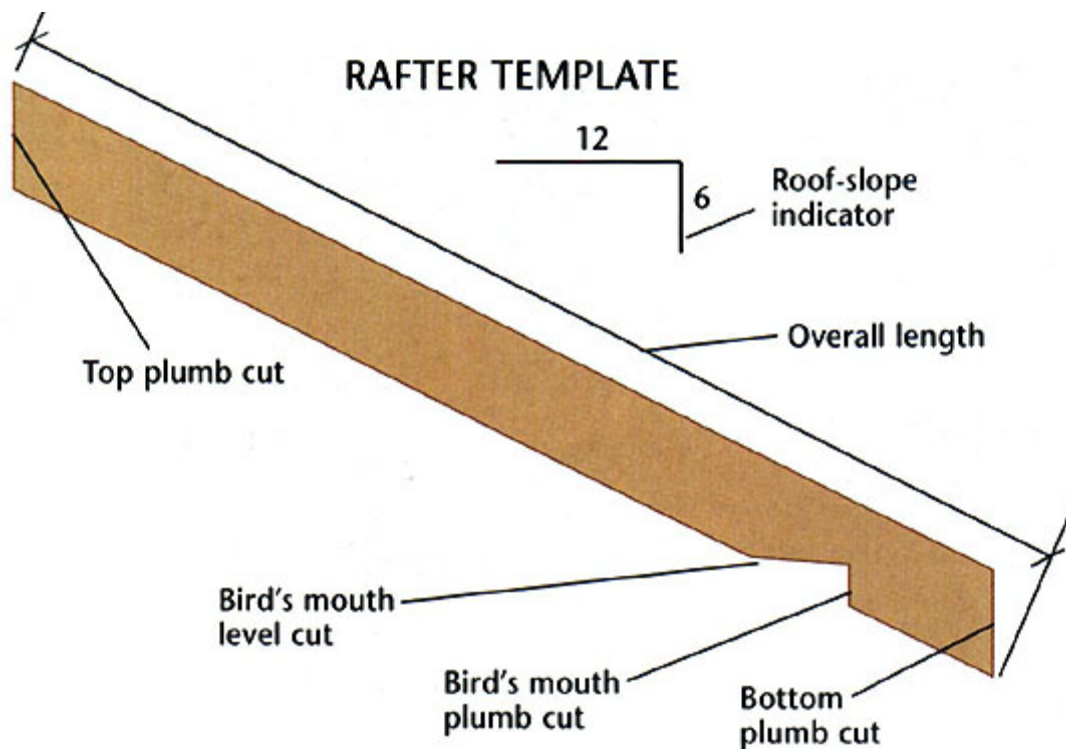
Step B: Mark the Bird's Mouth Cuts

1. Measure from the bottom of the lower plumb cut and mark the plumb cut of the bird's mouth. Position the square as you did for the lower plumb cut and draw a line across the board face at the new mark.

2. Measure along the bird's mouth plumb cut and mark the bird's mouth level cut. Use the square to draw the level cut—it must be perpendicular to the bird's mouth plumb cut.

Step C: Make the Cuts

1. Cut the rafter ends at the plumb-cut lines, using a circular saw or power miter saw.

2. Set the base of a circular saw to cut at the maximum depth. Make the bird's mouth cuts, overcutting slightly to complete the cut through the thickness of the board. As an alternative to overcutting (for aesthetic reasons), you can stop the circular saw at the line intersections, then finish the cuts with a handsaw.

3. Select another straight board to use as a second pattern rafter. Use the original pattern rafter to trace the cutting lines onto the duplicate, then make the cuts.

RAFTER TEMPLATE

12

6

Roof-slope indicator

Overall length

Top plumb cut

Bird's mouth level cut

Bird's mouth plumb cut

Bottom plumb cut

Step D: Test-fit the Rafters

1. Cut a 12"-long spacer block from 2 × 6 or 2 × 8 material.

2. With a helper or two, set the two rafters in place on top of the walls, holding the spacer block between the top rafter ends. Make sure the rafters are in line with each other (perpendicular to the walls) and are plumb.

3. Check the cuts for fit: the top-end plumb cuts should meet flush with the spacer block, and the bird's mouths should sit flush against the wall plates. Make sure the top ends are at the same elevation. Recut any angles that don't fit and test-fit the rafters again.

4. Write "PAT" on the pattern rafter, then use it to trace the cutting lines onto the remaining rafters. Before marking, check each rafter for crowning and mark the crowned edge; always install the crowned edge up. If your building has overhangs at the gable ends, mark the end cuts for the overhang rafters but not the bird's mouth cuts-overhang rafters don't have them. Also, if you have the fascia material on-hand, use the pattern rafter to mark the angle for the top ends of the fascia boards.

5. Cut the remaining rafters.

Step E: Lay Out the Wall Plates & Ridge Board

Note: Start the rafter layouts from the ends of the walls where you started the wall stud layouts. This ensures the rafters will fall above the studs. Install rafters aligned with the end studs but not the extra corner studs.

1. Make a mark on the top wall plate 1 1/2" in from the end. Then, mark at 15 1/4" (for 16" on-center spacing) or 23 1/4" (for 24" oncenter
spacing)—measuring from this mark, make a mark every 16"
(or 24") to the end of the wall. Make a mark 1 1/2" in from the remaining end. Following your plan, draw an × next to each mark, designating to which side of the line the rafter goes.

2. Mark the wall on the other side of the building, starting from the same end.

3. Cut the ridge board to length, using the plan dimensions. Check the board for crowning, then lay it on top of the walls next to one of the marked plates, making sure it overhangs the end walls equally at both ends. Use a square to transfer the rafter layout onto both faces of the ridge board.
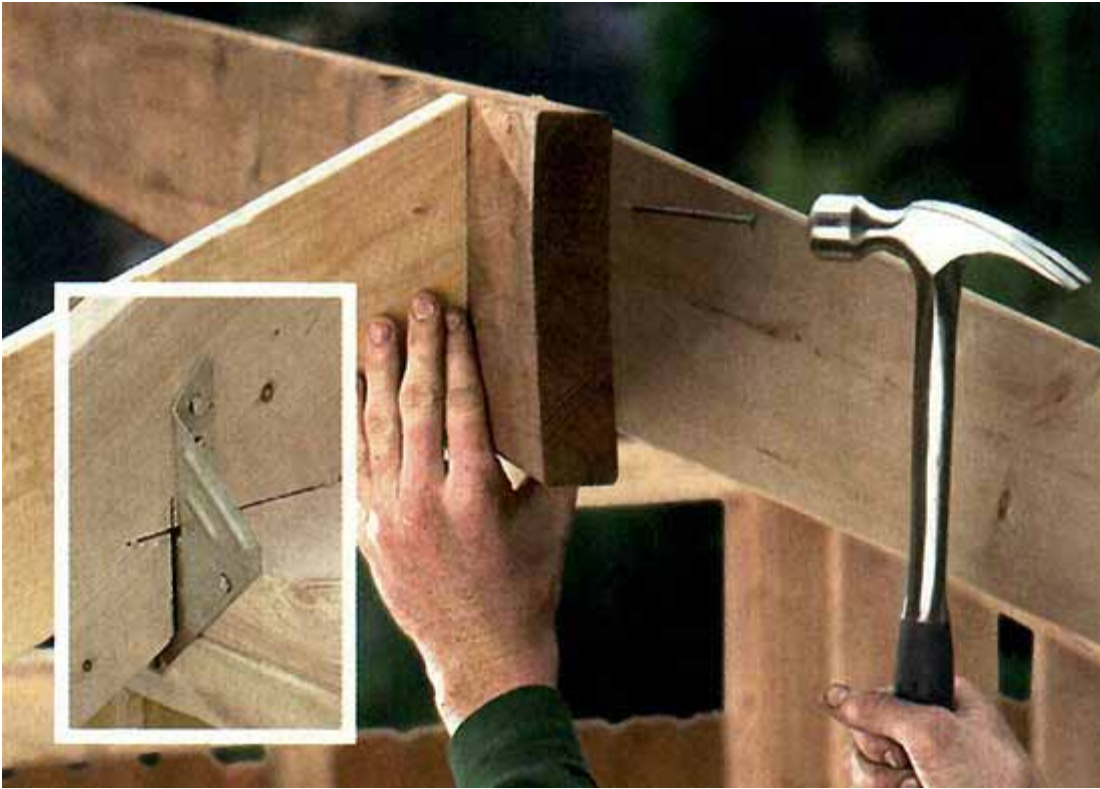
Step F: Install the Rafters

1. You'll need a couple of helpers and a long, straight 2 × 4 to get the rafters started. Lay the first two rafters on top of the wall, then nail the 2 × 4 to the far end of the ridge board to serve as a temporary support. Set up the rafters at the end of the walls and hold the free end of the ridge board in place between them. Have a helper tack the rafters to the wall plates. Hold a level on the ridge board and make sure it's level, then have a helper tack the support to the far wall to keep the ridge level.

2. Slide one rafter a few inches to the side and endnail the other rafter through the ridge board with three 16d common nails (use two nails for 2 × 4 rafters). Slide the other rafter onto its layout mark and toenail it to the ridge with four 16d nails (three for 2 × 4s). Toenail the lower end of each rafter to the wall plate with two 16d nails, then reinforce the joint with a metal anchor, using the nails specified by the manufacturer.

3. Make sure the rafters are plumb and the ridge is level. Install the remaining rafters, checking for plumb and level periodically as you work.
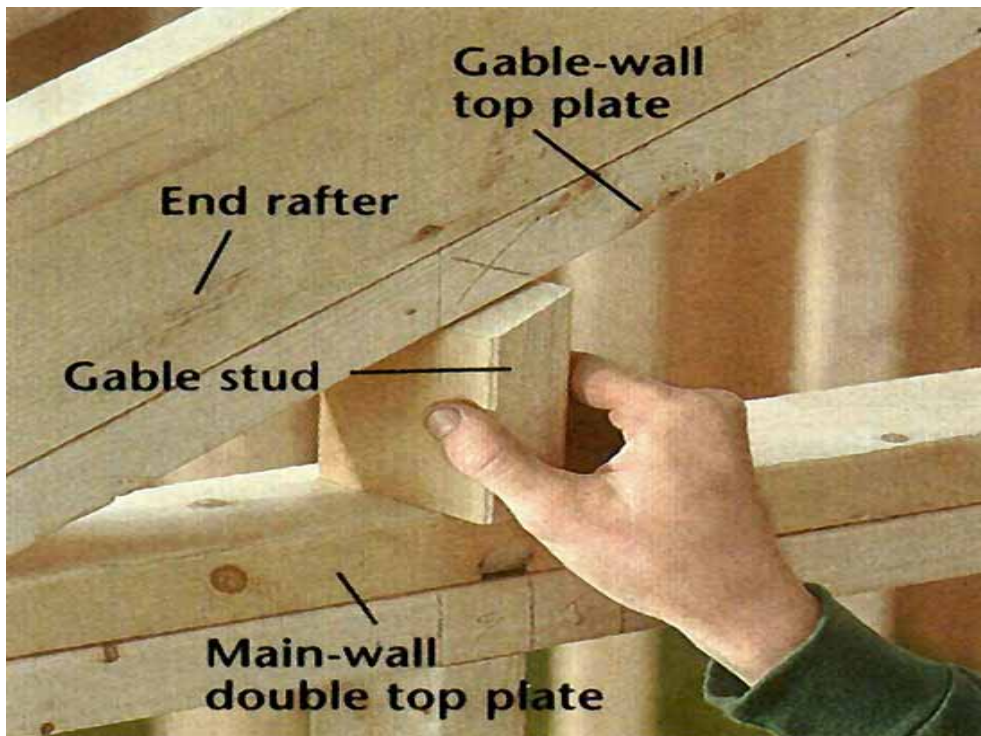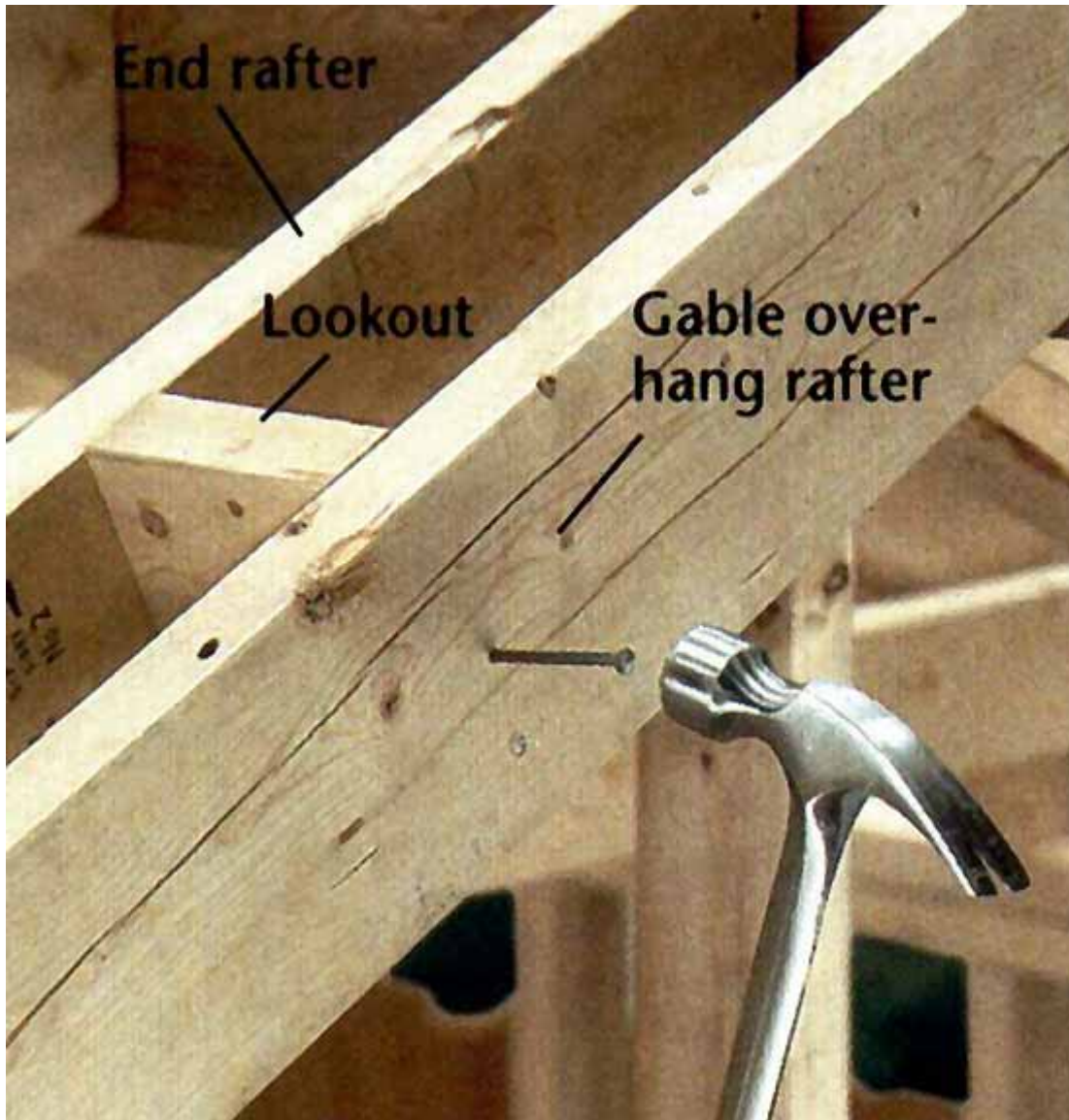
Step

G:

Install the Collar Ties

1. Cut the collar ties (or rafter ties) to span between opposing rafters at the prescribed elevation, angle-cutting the ends to match the roof slope.

2. Position the collar tie ends against the rafter faces so the ends are about 1/2" from the rafters edges. Make sure the ties are level, then facenail them to the rafters with three 10d common nails at each end.

Step H: Frame the Gable Wall

Note: Gable walls consist of top plates that attach to the undersides of the end rafters, and short studs set on top of the wall plates. They appear only on gable and gambrel roofs.

1. Cut the top plates to extend from the side of the ridge board to the wall plates. Angle-cut the ends so they meet flush with the ridge and wall plate. The top-end angle matches the rafter plumb cut; the bottom angle matches the level cut of the bird's mouth.

2. Fasten the plates to the rafters so the front plate edges are flush with the outside faces of the rafters; use 16d nails.

3. Mark the gable stud layout onto the wall plate, then use a level to transfer the layout to the gable plates. Cut the gable studs to fit, angle-cutting the ends to match the roof slope. Install the gable studs with 8d toenails. Also install a square-cut stud directly under the ridge board.

Step I: Build the Gable Overhang (Gable Gambrel Roofs)

Note: Gable overhangs are built with additional rafters installed at the gable ends. They are supported by the ridge board and blocks called *lookouts*—attached to the end rafters.

1. Mark the layouts for the lookouts onto the end rafters, following the project plan. Cut the lookouts and toenail them to the rafters with 8d nails (or endnail them with 16d nails) so that the top edges of the blocks are flush with, and parallel to, the tops of the rafters.

2. Install the overhang rafters over the ends of the lookouts with 16d endnails.