# Chapter 5. Build Walls

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**Tools needed by volunteers:**

Hammer
Nail apron
Tape measure
Square
Utility knife
Pencil

**Tools and equipment needed:**
Generator
Extension cords
Circular saw
Chop saw
Saws-all
Paslode nailers
50’ Steel tape
6’ level
4’ level
Framing square
Chalk line
Pry bar
String line
Sledgehammer
Stepladders

**Materials needed:**

Pre-marked wall plates
Door, window frames
Corners
2x6, 2x4 Studs
16d Nails
8d Nails
4x8 OSB
1” Foamboard
½” Foamboard
3” Weathermate™ Construction tape
1” and 2” Button nails

**Personal Protection Equipment:**
Safety glasses (required)
Work gloves (recommended)

**Safety First! Review the Safety Checklist before performing tasks in this chapter.**

## 5.1. FRAMING EXTERIOR WALLS

1. Assemble each exterior wall on the deck and then erect it in one complete section. Assemble the two long walls first. Assemble and erect the short walls after the two long walls are up.

2. Before separating the upper and bottom plates of the long walls, check for marks on the inside edge of the bottom plate 5½" from each end of the plate. Before assembling the wall, align these marks close to the chalk lines of the adjoining short walls. Once the wall has been lifted, this will help properly position the wall end-to-end.

3. Remove the temporary nails connecting upper and bottom plates of the wall section and separate on the deck. Be sure the words "Upper" and "Bottom" remain in the same orientation.

4. If not presorted, select studs for framing walls by sighting along the edge of each stud to determine which direction the stud is crowned; mark with an arrow pointing to the high side. Place studs with "crown up" (do not use if they are severely crowned), and window and door components in position between plates per markings on upper and bottom plates. Make certain that the flush side of the window and door headers faces up.

   **NOTE:** Set aside the straightest studs for use in the kitchen walls.

5. Preassemble 2x6 corners ensuring that end and side surfaces are flush, nailing every 10" - 12" along the length with 3¼" Paslode nails. Place the "L" "down" at end of the wall, flush with ends and sides of the upper and bottom plates; nail with three 3¼" Paslode nails into each piece.

6. Make sure the edges of the studs are flush with the edges of the plates and that the end studs or corner assemblies are flush with the ends of the plates. Using a plastic speed square with a corner cut off, make a mark on the inside face of each plate at each layout mark to ensure the stud is square to the plate prior to nailing. Align the stud to this mark on the inside of the plate and nail one 16d (or 3¼" Paslode) nail through the plate into the bottom third of the stud. Then square the stud to the line and nail two more 16d (or 3¼" Paslode) nails, taking care to keep hands and body parts away from the nailer. Use a tool to twist the stud to square, if required.

7. Field cut short studs for each window, measuring for length next to the nearest stud. Transfer locations for these short studs from the bottom plate to the window sills and nail in place with three 3¼" Paslode nails at each end.

8. The non-zero end may have an extra stud near the second-last 24" o.c. stud. If the two studs are in direct contact, screw them together with three 2½" drywall screws. If the two studs are separated, fill the gap with multiples of ½" foamboard and then screw the studs together with three appropriate length drywall screws to create a tight stud/foamboard "sandwich."

## 5.2. SQUARING EXTERIOR LONG WALLS

1. After each long wall is assembled on the deck, align the bottom of the wall's bottom plate so it is flush with the chalk line along the entire length of the wall. Toenail through the bottom face of the bottom plate into the deck with 8d nails approximately every 8'.

2. With a long steel tape, "burn a foot" and use diagonal measurements to square up the wall, moving the top of the wall UNTIL BOTH MEASUREMENTS ARE EXACTLY THE SAME (a difference of no more than 1/16"). **(Use good "corners" and the same edge of the tape at each end when making these measurements.)** Toenail the upper plate to the deck with three or four 16d duplex nails through the top face so it will not go out of square.

## 5.3. SHEATHING EXTERIOR LONG WALLS

1. Cut four 5½" x 92⅝" pieces of 1" foamboard (or two pieces of 2" foamboard) and insert into the L-corner. Tape or tack in place. Do this before attaching the sheet of OSB to the corner. Cut additional 5½"-wide pieces of foamboard to create stud-foamboard-stud "sandwiches" where studs are less than 3" apart for conventional insulation. Tape seams and any broken score lines on foamboard with 3" Weathermate™ Construction tape.

2. Check the House Plan to see where sheets of 4'x8"x½" OSB wind bracing are to be located on each wall section and secure them to the studs. Each OSB sheet at the ends of the wall should be centered on the stud nominally 48" from the end of the wall and flush with the bottom plate but not necessarily flush with the end studs. The "reveal" at the wall end should be consistent from top to bottom—a sign that the wall is square. OSB sheets not at the end of the wall should be centered on studs and flush with the bottom plate.

3. Using a T-square, or measurements, draw a line on the OSB at all studs within the sheet to help ensure that the nails do not miss. Fasten with 8d or 2⅜" Paslode nails into each stud and the upper and bottom plate with a maximum 6" spacing. After all required OSB sheets are fully nailed, pull the nails that are securing the upper plate of the wall to the deck.

4. Measure the width of the house wrap and subtract 14¾" from that width (e.g., if the wrap is 18" wide: 18" - 14¾" = 3¼"). Measure up from the bottom of the wall that amount and snap a chalk line the length of the wall above the bottom plate. Position the wrap so it extends about 12" beyond both ends of the wall and staple the top of the wrap to the chalk line at each stud, leaving a little slack at the edges of any OSB sheets to allow foamboard to be installed tightly to the OSB edges.

   **NOTE:** Once the wall is up and sheathed, the wrap will hang the proper amount below the wall to shed water away from the house, and the bottom of the wrap will fall slightly below the bottom of the foam sheathing. This will then require only one strip of 3" Weathermate™ Construction tape to

seal the bottom foam joint and at the same time attach the bottom of the house wrap to the foundation foam. (See Figure 5.1)

5. Install 1" foamboard sheathing between the OSB wind bracing, flush to the bottom of the bottom plate. Nail with 2" button nails, placing seven in each stud and two between each stud in the upper and bottom plates. Around windows and doors, nail only into the King studs and into the header, 2" away from the opening. Do not nail into the window sill plates.

   **NOTE:** Avoid using full 4x8 sheets of foamboard over windows and doors. Use scrap pieces that cover at least the King/Jack pairs and are centered on short studs below windows. Fill gaps on headers and below windows with smaller pieces, but do NOT create any horizontal seams.

6. Install ½" foamboard over OSB, flush on all sides. Nail with 1" button nails, in three rows top to bottom, with five to six nails in each row. Tape all seams with 3" Weathermate™ Construction tape.

   **CAUTION:** Install ½" foamboard over OSB ONLY if wind bracing inspection IS NOT required (see Construction Supervisor for this decision).

7. After the wall has been sheathed, lift the bottom edge of the house wrap up, taut onto the sheathing, and tape this edge to the sheathing with 3" Weathermate™ Construction tape every 3'–5'.

   **NOTE:** This will keep the house wrap out of the way when erecting the wall in the next section.

## *5.4. ERECTING EXTERIOR LONG WALLS*

1. Apply two generous beads of acrylic latex caulk parallel to each other along the entire length where the wall will stand, except at door openings. Stay at least 2" away from the chalk line and the deck edge. Also, apply a bead of caulk, perpendicular to these two beads, at two additional locations: both ends of the floor deck and at each side of any door opening. This will help to ensure a complete air seal.

2. With one 16d duplex nail, attach a 14' or 16' 2x4 brace to the end stud near the upper plate to serve as a temporary support. Stand the wall section up, keeping the inside of the floor plate flush to the chalk line on the deck. On long walls, be sure to align the 5½" marks on the bottom plates (made in Section 3.1.3.7) with the adjoining chalk lines (as a result, the ends of the wall may not necessarily align with the edge of the deck). Nail the wall to the deck with two 3¼" Paslode nails through the floor plate between each stud and into each I-joist below the OSB deck.

3. To prevent the wall from tipping over, brace it at each end using the long 2x4's attached to the wall in Step 2 above.

    a. Before lifting the wall, attach a 2x4x24" block to the inside end of the long 2x4 with a single 16d or 3¼" Paslode nail, centered in the block. This block will allow clearance for the 1" foamboard on the short walls when they are erected.

    b. After the long wall is lifted, tip it out slightly (about ½"), rotate the 2x4 block horizontal at the end of the brace and nail it to the rim board with two 16d duplex nails. Add a second 16d or 3¼" Paslode through the brace into the 2x4 block. Secure the top end of the 2x4 brace with another 16d duplex nail.

4. Install turnbuckle pipe braces in the middle sections of the wall for extra support. Install them using three 2" screws into the upper plate and through the floor into an I-joist. Or, screw the brace into 2x blocking secured to two I-joists with 16d duplex nails. Place the braces 10' to 12' apart.

    **NOTE:** Do not place a turnbuckle where an interior wall will intersect an exterior wall.

## *5.5. SHEATHING & ERECTING SHORT WALLS*

1. Before erecting the wall, locate the blocking between the rim board and the first/last I-joist to which the bottom plate will be nailed. If not marked on the deck or rim board, go to the basement, locate one of the blocking pieces, make appropriate measurements and transfer to the rim board. The blocking should be on a maximum of 32" centers.

2. After the wall is assembled on the deck (see Section 5.1), align the bottom plate so it is flush with the chalk line along the entire length of the wall. Toenail through the bottom face of the bottom plate into the deck approximately every 6-8' with 8d nails. This will ensure that the bottom plate will be straight before installing sheathing

3. If the House Plan calls for wind-bracing in the center of the wall, place a 4x8 sheet of ½" OSB centered on studs and flush with the bottom plate. Nail to the bottom plate with three 8d nails. Go up about 4 ft. and tack with three more 8d nails, one each into the two end studs and one into the center stud. This will be sufficient to hold the sheet in place while raising the wall but still allow movement if necessary for squaring.

4. Attach house wrap to the short walls in the same fashion as that done in Section 5.3.4.

5. Install 1" foamboard as done on the long walls, while ensuring corner OSB sheets can be installed properly after the wall is raised. Tape seams and any broken score lines on the foamboard with 3" Weathermate™ Construction tape.

6. Secure the house wrap to the sheathing on the short walls in the same fashion as that done in Section 5.3.7.

7. Following the procedure in Section 5.4.1, apply two generous beads of caulk on the deck. Lift the wall and lean it against the long wall braces until it can be joined at the corners. Align the bottom plate with the chalk line. Nail the wall to the deck with two 3¼" Paslode nails through the floor plate into the blocking located in Step 1 above.

   **NOTE:** Be sure to plumb the ends of the short walls before final bracing and before corner OSB is installed. Even though foamboard has been installed, these walls should move enough to be plumbed.

8. At each corner, remove the temporary brace on the long wall to allow the walls to come together. Before nailing the corners together, check that the upper plates are flush with each other at each corner. Fasten wall panels to each other by flushing the corners and nailing the adjoining end studs every 12" from bottom to upper plate with 3¼" Paslode nails.

   **NOTE:** Be sure both walls are supported before removing the long wall brace on the outside of the short wall

9. When all exterior walls have been erected, plumb and brace all corners with 2x4 bracing on the INSIDE of the house (both long and short walls). Brace with 12'–16' 2x4s from the upper plate at the corner to the bottom plate. Nail at least once into both the upper and bottom plates with 16d duplex nails for each brace. Keep the top of the brace less than 1" above the upper plate and avoid crossing interior walls with the brace. Add a few extra nails (duplex) where the brace crosses King, Jack, or regular wall studs.

10. If center OSB was installed (see Section 5.3.3), finish nailing it with 8d or 2⅜" Paslode nails every 6".

11. Nail ½" OSB to the short walls between the 1" foamboard and the corner of the wall, tight to the edge of the foamboard and attach with 8d or 2⅜" Paslode nails every 6". Cover the OSB with ½" foamboard and nail with 1" button nails. If necessary, add short strips of 1" foamboard to fill the gap from the full sheet to the corner of the house.

## *5.6. COMPLETING EXTERIOR WALLS*

1. At each wall panel, measure and cut 1" foamboard to fit tightly between the bottom of foamboard on the house wall and the foundation foam. Do the same below the OSB/½" foamboard wind bracing. When inserting the sill box foamboard, be sure the house wrap is behind the foamboard, leaving 3"-4" of wrap protruding from the gap above the foundation foam (see Figure 5-1). Nail with 2" button nails about 8" apart and 2" away from the top and bottom edges of the sill box foamboard.

2. As needed, measure, cut, and nail 1" foamboard around porch corners and under the door.

3. Fill in any gaps at the corners.

   **NOTE:** These pieces may be too narrow to nail. If so, simply tape in place using Weathermate Straight Flashing Tape.

4. After the foamboard has been installed:

   a. Tape the seam between the wall foamboard and the top of the rim foamboard with Weathermate™ Construction tape, taking care to completely cover the nails above the seam. In the process, ensure that the tape is tight to the foamboard above the nails. Do not use an additional row of tape to cover the nails below the seam. Covering these nails is not critical.

   b. Continue taping other seams with Weathermate™ Construction tape **except for** the seam between the rim board foamboard and the foundation foamboard. **Do not tape the seam where the house wrap emerges from below the sill box foamboard.** Instead, tape the bottom of the house wrap to the foundation foamboard every 6' with a 6" piece of Weathermate™ Construction tape as shown in Figure 5-1.

   c. At other seams, tape shingle-style, starting from the bottom, beginning with horizontal seams, and overlapping with any vertical seam above. Again, when taping horizontal seams, be sure to completely cover the button nails above the seams as in Step 4a above. Only tape over button nails at the seams (not in the field).

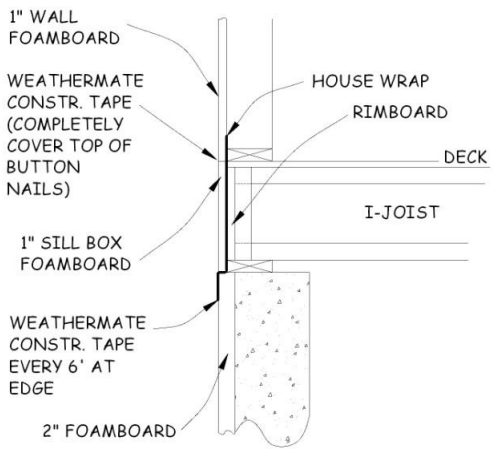


**Figure 5-1. Taping Foamboard Seams.**

5. If not already done, cut out foamboard around windows and doors. Take time to make square cuts.

6. Fill the inside of every window and door header with 2" of foamboard. Caulk the perimeter and any joints.

**NOTE:** Use pieces of foamboard that are 1" or 2" thick. This is a good spot to use scraps, as long as the pieces fit together tightly, and the joints of the multiple layers are not aligned with each other.

7. Do not throw **ANY** foamboard scraps in the dumpster. Set aside in the basement or in black plastic bags.

## *5.7. STRAIGHTENING EXTERIOR WALLS*

### 5.7.1. Attach String Line

1. To straighten exterior walls, a VERY taut string line is stretched from one inside corner to another adjacent inside corner and the wall is adjusted to the string line every 8 – 10 feet and braced to hold in place.

2. For each exterior wall corner, cut a scrap 2x4 10-12" long.

3. In approximately the center of this 2x4, drive a 16d nail straight in leaving the nail about ½" above the 2x4 (this is left to wrap the string around), and approx. 1" sticking out the bottom. Be sure the nail is straight, since the nail above the 2x4 represents the inside of the corner.

4. At the exterior wall "inside" corner place the 2x4 on top of the 2x6 upper plates at roughly a 45º angle so that the point end of the 16d nail rests tight against the "inside" upper plates of both walls (nail resting tightly against the inside of the corner). See Figure 5-2.

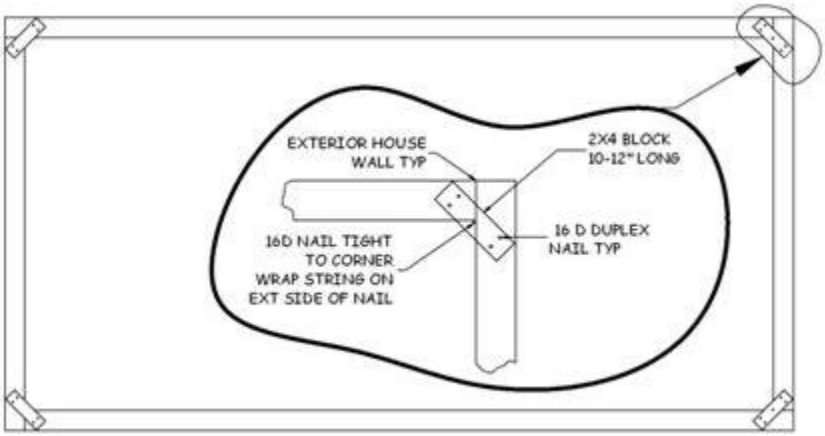


**Figure 5-2. Attaching String Line.**

5. Nail the 2x4 to the upper plate with two 16d or duplex nails on each end of the 2x4. Nail securely as there will be a lot of string tension on these.

6. In the first corner start the string line on any nail other than the centered nail (feel free to add additional "tie off" nails as needed).

7. Wrap the string on the exterior of the centered nail, aligned with the inside edge of the upper plates on each wall.

8. Go to next corner and repeat Steps 4 thru 6 until you are back to the starting corner. Make sure string is not obstructed between corners and is VERY taut.

**NOTE:** At each corner, verify that the string attached to the 2x4 scraps installed in Step 3 above is aligned with the "inside" of the upper plates. Adjust the nail as needed. (See Section 5.7.2.2.)

### 5.7.2. Straighten the Walls

1. Start 5'-7' from the corner.

2. Place one end of a 6' level against the upper plate and the other against a nearby stud - not the stud immediately below. (This "two-point contact avoids problems with a bowed or twisted stud.)

3. Slide the level up the wall until it reaches the string. If the top of the level touches the string, use the turnbuckle pipe bracing to move the wall in until the inner edge of the level lines up with the string. If the level misses the string, move the wall outward until the inside edge lines up with the string. The wall is now straight in that section. Then brace appropriately.

4. Move approximately 5'-7' or to a pipe brace and repeat Steps 2 and 3. Install additional pipe braces as required to get the wall straight.

5. After completing adjustment using the string line, verify that the wall is plumb at each brace and at each intersecting wall location. Compare these readings to those obtained at each corner. If these readings differ by more than ⅛", consult with the Construction Supervisor or the Site Leader.

6. After all bracing is completed, recheck alignment at the center of the wall (using the string and a 6' level). Once all walls have been straightened, remove the string and the blocks.

## *5.8. FRAMING INTERIOR WALLS*

1. Start by building the longer walls that will intersect the exterior walls. Remove the temporary nails connecting the upper and bottom plates and separate on the deck. Be sure the words "Upper" and "Bottom" remain in the same orientation.

2. If not presorted, select studs for framing walls by sighting along the edge of each stud to determine which direction the stud is crowned; mark with an arrow pointing to the high side. Place studs with "crown up" (do not use if they are severely crowned) and door components in position between plates per markings on upper and bottom plates.

3. Make sure the studs are flush with the edges of the plates and that the end studs are flush with the ends of the plates. Nail with two 16d or 3¼" Paslode nails through the plates into the studs.

## *5.9. ERECTING INTERIOR WALLS*

1. Start by erecting the longer walls that intersect the exterior walls. Before erecting these walls, install 2x4 blocking between the two exterior wall studs where the interior wall will be located. Place this 2x4 with the wide side flush with the interior surface of the studs and the top edge 50" off the floor. HAND NAIL with two 16d nails through the studs into the ends of the 2x4.

2. Similarly, where a flush sliding door intersects an exterior wall, install a similar 2x4 block but with the top edge 83½" above the floor. This provides support for the door header at the end opposite that of the single Jack stud.

   **CAUTION:** For safety reasons, do NOT use a Paslode nailer for these first two steps.

3. For walls that do NOT include a flush sliding door, stand up each wall section and position the bottom plate in line with the chalk line. Make sure the bottom plate is tight to the bottom plate of the exterior wall and then secure it to the floor using 3¼" Paslode nails if they will hit an I-joist; otherwise, use 3" drywall screws driven at an angle. After checking that the end stud is plumb and tight to the exterior wall, nail at an angle THROUGH THE EXTERIOR WALL TOP PLATE into the interior wall top plate with 16d nails. Nail the end stud into the blocking installed between the exterior wall studs in Step 1. Check to be sure the joints at the upper and bottom plates are tight.

   **NOTE:** If time and staffing permit, consider installing OSB drywall blocking at the end of these walls before they are attached to the exterior wall (see Section 10.5.5.4 for the number and size of the OSB pieces required). Install one piece above and one piece below the 2x4 blocking installed in Step 1 above. Attach the OSB to the end of the wall with three or four pairs of 2" drywall or square-drive screws, taking care that the OSB does not contact the 2x4 blocking, the bottom exterior plates, or the upper exterior plates.

4. For walls that DO include a flush sliding door:

   a. Measure the length of the upper plate and cut a 2x4 (or 2x6 if a 2x6 wall) 1⅝" longer than that measurement. This will be the top plate for the closet wall.

   b. Nail that piece to the wall upper plate, extending it 2" beyond the end of the wall upper plate and 3⅝" short of the interior end (leaving room for top plate overlap).

   c. Stand the wall up, move it into position as with other walls installed in Step 3 above, tight to the exterior wall and with the door header sitting on top of the blocking installed in Step 1 above. Secure the bottom plate to the floor between the

chalk lines using 3¼" Paslode nails if they will hit an I-joist; otherwise, use 3" drywall screws driven at an angle.

d. Using a long, straight 2x4 (8' or greater) against the closet upper and bottom plates, plumb the wall and nail the end of the top plate into the exterior wall upper plate with two 3¼" Paslode nails. (Once an exterior wall top plate is installed adjacent to this closet wall, it will be notched to accommodate the 2" overhang of the interior top plate.)

e. Again, place the edge of the straight 2x4 against the side of the closet top and bottom plates. Move the door header against the 2x4 and mark the edge on the horizontal blocking between the exterior wall studs. Nail the header to the wall blocking at this mark with 3¼" Paslode nails

5. Continue to build the remainder of the interior walls, standing them up, positioning to the chalk line, and nailing into place between each stud using 3¼" Paslode nails into the I-joist below, or 2" screws where no I-joists are below the wall. Check that each wall is plumb before nailing it to the adjacent wall.

## 5.10. INSTALLING TOP PLATES

1. Walls must be tied together by nailing overlapping top plates to the tops of all walls. Top plates at the intersection of interior and exterior walls are done first.

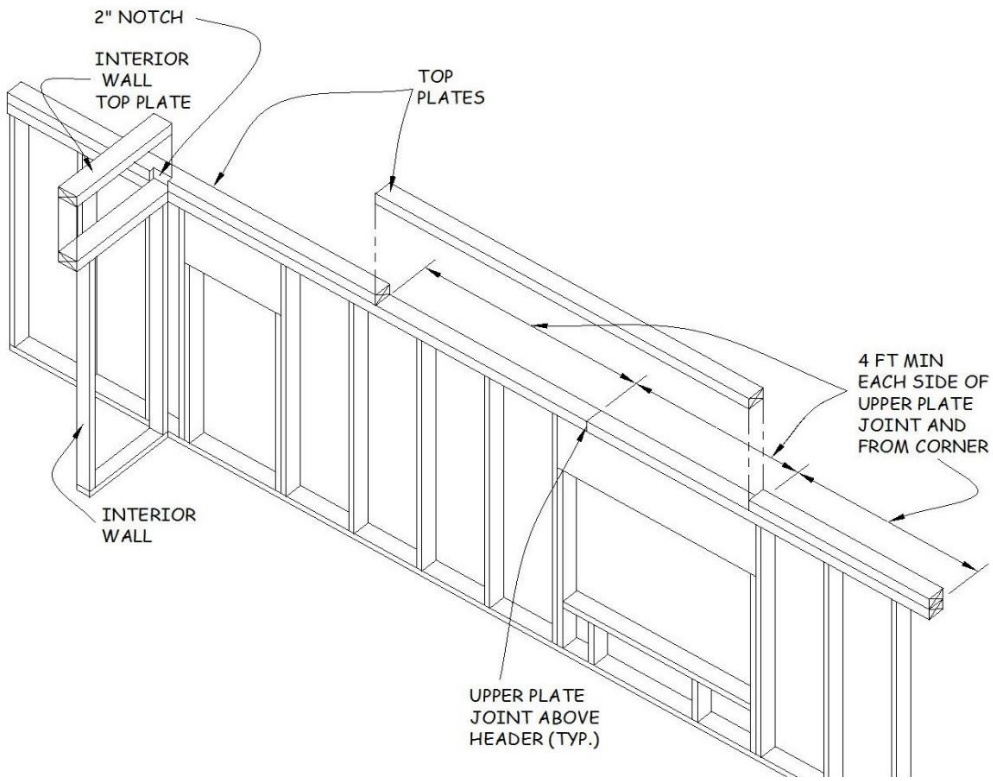


**Figure 5-3. Exterior Wall Top Plate Installation.**

2. The top plate on all bearing walls must extend a minimum of 4’ on each side of the wall plate joint, and at each corner.

3. Top plates on non-bearing walls that extend into the 2" notch of the exterior top plates must be at least 16" long.

4. Where interior walls intersect exterior walls, create a notch 2” deep in the top plate of the exterior wall so it can receive the intersecting interior wall top plate. Verify that the interior wall is plumb before locating and cutting the notch.

   **NOTE:** Notching 2” deep leaves 3½” of material on exterior 2x6 wall top plates.

5. To locate the notches, lay the exterior wall top plate on the wall in its final position. Mark the location of each intersecting interior wall. Place the top plate on the deck and, using a speed square, mark lines at each location. Using a circular saw with the blade set at 2” depth, cut the marked edge of the top plate at the outside of each line (this should allow enough clearance for the width of the intersecting top plate). Make multiple cross-cuts between these two cuts and knock the pieces out with a hammer.

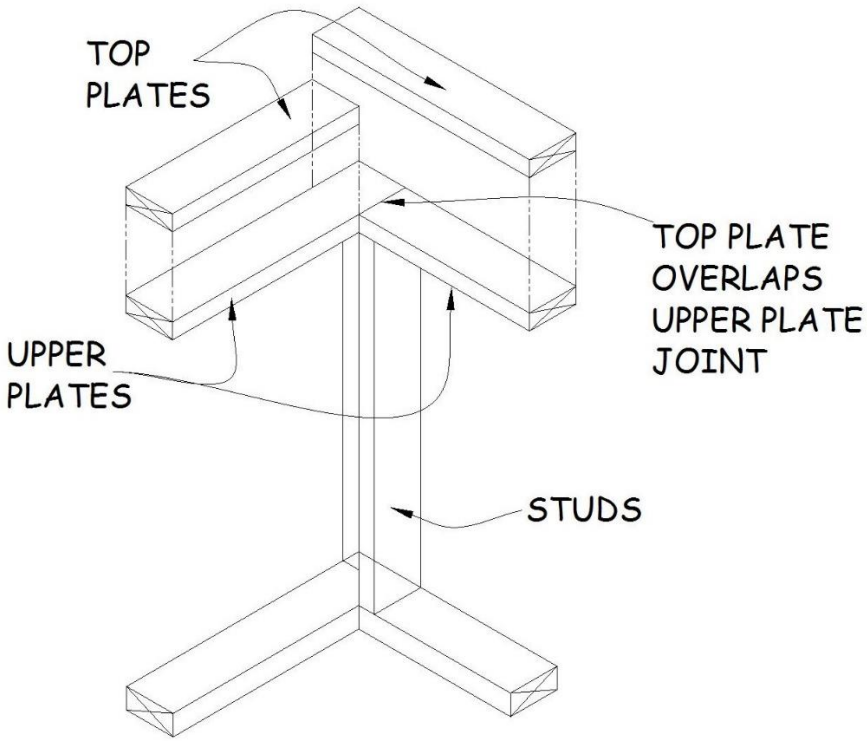


**Figure 5-4. Interior Wall Top Plate Installation.**

6. When nailing top plates, use three 16d (or 3¼” Paslode) nails across 2x6 plates and two 16d (or 3¼” Paslode) nails across 2x4 plates. Nail at each intersection of top plates and

nail at each stud location. Note that the top plates at an intersection overlap the joints of the walls below (see Figure 5.4).

7. Nail two to four pairs of nails across exterior door and window headers. Be sure the interior edges of the top plates are flush with the edges of the plates below and that interior walls are tight to exterior walls before nailing.

**NOTE:** Occasionally the house will include a 2x4 interior wall butting against the end of a 2x6 plumbing wall (in a straight line). In this case, install a 2x4 top plate the full length of the wall, on the flush side. Install a 2" wide "filler" on the 2x6 section of the wall (necessary to provide nailing surface for wall sheetrock).