Chapter 23. Garage Construction

Tools needed by volunteers:

Hammer
Nail apron
Tape measure
Square
Pencil

Materials needed:

2x4 studs
4x9 x ½" OSB
16d nails
16d duplex nails
8d nails
3¼" Collated nails
2⅜" Collated nails
4" & 6" Timber screws
Concrete screws
Sill seal

Tools and equipment needed:

Generator
Extension cord
Circular saw
Chop saw
Saws-all
Drill driver
Framing nailer
6' level
4' level
Framing square
Pry bar
Concrete anchor kit
String line
Chalk line
Stepladder

Personal Protection Equipment:

Safety glasses (required)

Reference Materials:

Garage Plan
Plate Layout Drawing

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

23.1. PREPARATION

1. Garages are constructed with two "side" walls, one wall with an overhead door (the "OH door wall"), and one "back" wall, which is opposite the OH door wall.

2. Before the walls are erected, establish the length of the wall studs.

    a. For a detached garage, use standard nominal 9' 2x4 garage studs (104⅝").

    b. For an attached garage, measure from the top of the upper plate of the house wall the top of the garage foundation curb. Do this at both locations where the garage meets the house. If the two measurements are not the same, split the difference. Subtract 4½" (1½" bottom plate, 1½" upper plate and 1½" for the top plate) and that will be the 2x4 stud length. The studs may need to be cut to proper length from 2x4 lumber.

        NOTE: These measurements should be very close to 104⅝". If so, consider using the nominal 9' garage studs instead of cutting other lumber (see Construction Supervisor for directions).

3. In attached garages, measure and record the height of the foundation curb at both the service door and overhead door locations (typically ~4").

4. After establishing the stud lengths, prebuild the window and door components (see Section 23.5 for window and service door component instructions). In all cases, note that garage components are built with 2x4 rather than 2x6 lumber.

    NOTE: Window King and Jack studs will all rest on the garage wall bottom plate. However, in attached garages with a foundation curb, the service door Jack studs must be treated, since they will rest on the garage floor.

5. Confirm that adequate 9' studs and OSB sheathing are on site.

6. Measure the opening in the garage foundation curb or slab for the OH and service doors, and determine a plan to correct if necessary.

23.2. ESTABLISHING CHALK LINES

23.2.1. Detached Garage

1. At each of the four corners, measure in 3¼" from the outside of the foundation and make a mark. Using a square and a sharp pencil (in order to make future small corrections possible), create an initial intersecting corner mark (an "X", 1-2" in length in each direction).

2. **Create a Rectangle.** With a long steel tape (and a helper), compare the lengths of the two side walls, and OH door and back walls by measuring between the initial

corner marks from Step 1 above. If opposite wall lengths differ by ⅛" OR MORE, adjust the corner marks to equalize the lengths by adding one-half the difference at each end of the shorter wall.

3. **Square the Rectangle**. Carefully measure the diagonals between the revised corner marks to check for square. If the diagonals differ by ⅛" OR MORE, adjust the corner marks at EACH end of the SHORT diagonal to lengthen the SIDE wall by one-half the difference. Re-check for square and adjust as needed.

4. Hold a string line between marks on each wall, and check that the concrete foundation is at most 3½" outside of the string. If not, adjust the marks on that wall as required.

5. Once all four corner mark adjustments have been made, carefully re-measure the precise distances between the corner marks on all four walls. Adjust the marks as needed to ensure that opposing wall lengths differ by ⅛" or less. Using these final marks, snap chalk lines for all wall locations. Finally, spray all chalk lines with a clear varnish to protect them from the elements.

23.2.2. Attached Garage

23.2.2.1. Establishing Chalk Lines Before Building House Walls.

1. When the house exterior wall plate layout lines have been squared and snapped, refer to Figure 23-1. At points 2 and 3 on the house deck, measure ½" toward the edge of the deck and make marks. Tack 8d nails at the marks.

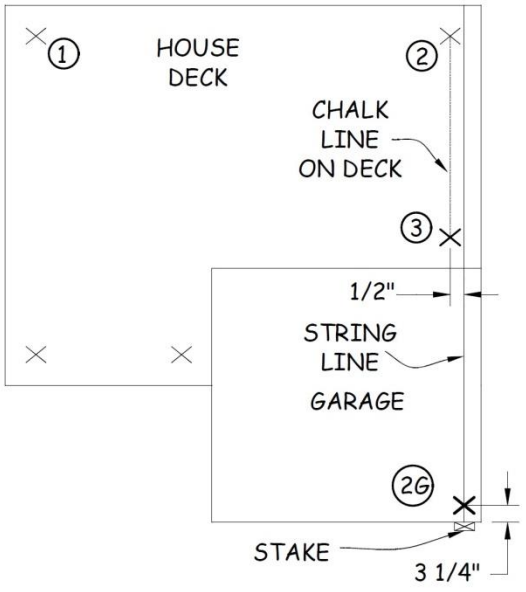

Figure 23-1. Garage Sill Plate Chalk Lines Prior to House Walls.

2. At the garage foundation, near where point 2G will be located, pound a stake into the ground next to the wall, centered about 5¼" from the corner. The top should be just above the elevation of the house deck.

3. Run a string line from Point 2 past Point 3 to the top of the stake, and adjust the stake-end of the string line so that the line just touches the nail at Point 3. Mark the top of the stake at the string line location, and then tack an 8d nail in the stake at the mark. Pull the line tight, and anchor it around the nail.

4. Using a framing square, locate and mark Point 2G on the garage foundation. Stand one leg of the square on the concrete, checking to be sure it's level, then move the square to just touch the line with the vertical leg. Place a mark on the concrete at the corner of the square, 3¼" in from the **front** of the foundation. This is Point 2G.

23.2.2.2. Establishing Chalk Lines After Building House Walls.

1. If the **house** walls are built and erected before the garage wall bottom plate lines have been located and marked, use the following procedure to locate Point 2G.

2. At the wall common with the exterior house wall, determine the location of the outside of the house framing. Measure 5" in toward the garage interior and make a mark on the garage foundation where it touches the house wall (see detail in Figure 23-2). This establishes Point 1G. Measure from Point 1G to the outside of the curb, **X** in Figure 23-2. Establish Point 2G at the other end of the garage wall by measuring **X"** in from the outside of the curb, and 3¼" in from the front of the curb. Establish Points 3G and 4G as shown in Figure 23-2.

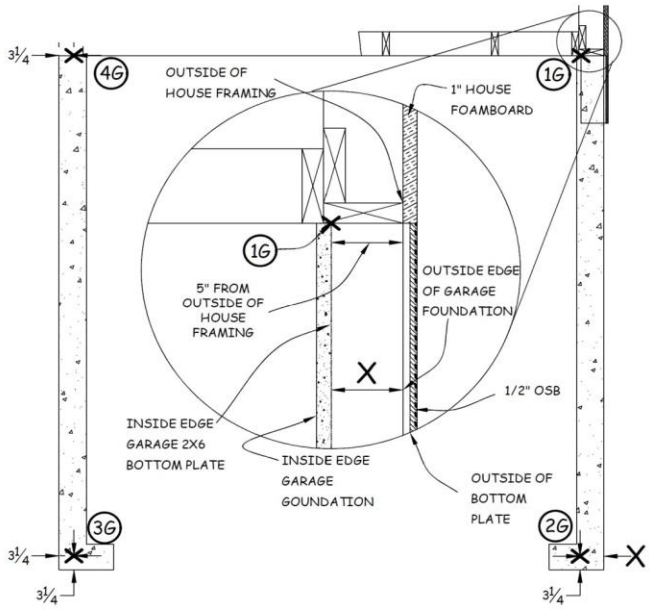

Figure 23-2. Garage Sill Plate Chalk Lines After House Walls.

3. Before squaring the garage wall, use a string line to check that the garage foundation is parallel to the house wall. Space the string line out from the house wall by tacking a 2x block to the house wall at Point 2, at the elevation of the bottom plate. Anchor the string line to the face of the block and stretch it toward Point 2G. With a helper, hold the Point 2G end such that the string is outside of Point 1G. Check that the string is 7½" from Point 2G. If it is not, consult with the Construction Supervisor to correct as required.

4. In a similar manner to that described in Section 23.2.1 for a detached garage, square the foundation. Using a long steel tape, measure between the marks of opposite walls and adjust to equalize. Then, measure the diagonals between the corners and adjust wall lengths to achieve a square foundation.

5. From those final marks on each corner snap chalk lines. Spray chalk lines with clear varnish to weatherproof.

23.3. MEASURING AND CUTTING WALL PLATES

1. Use treated 2x4s for garage bottom plates, except for the house/garage extended wall, where treated 2x6s are used. The two side walls will be the long walls - i.e., they will extend past the back and OH door walls. Cut bottom plate lengths as required to have at least two anchors in each plate. The side wall plates will extend past the OH door and back wall plates by 3½" at each end.

2. Use 2x4s for upper plates. Cut plates to required lengths so they end in the middle of a stud.

   NOTE: In selecting pieces, use standard lengths of 8' to 16' wherever possible.

3. Position the bottom plate on top of the foundation and against the exterior sides of the anchor bolts. Ideally, the bottom plate should be oriented so that any crown is up and any edge with wane (an edge with insufficient wood) is either positioned up and to the inside of the foundation or down and to the outside of the foundation.

4. Using a speed square, mark the location of foundation bolt clearance holes by drawing two parallel lines on the sill plate representing the outside edges of a bolt (see Figure 1-3). Determine the distance from the chalk line to the center of the bolt. Measure that distance from the interior edge of the sill plate and draw a line between the two parallel lines.

5. Use a ¾" or ⅞" bit to drill clearance holes in the middle of the short line created in the previous step.

   NOTE: The diameter of the clearance hole is larger than the bolt diameter in order to facilitate the correct positioning of the plates on the foundation.

6. After cutting the upper and bottom plates according to the Garage Plan, tack the plates together with 16d duplex nails and set them in location on the garage floor.

23.4. MARKING STUD LOCATIONS ON GARAGE WALL PLATES

23.4.1. Detached Garage

1. If the garage is attached, go to Section 23.4.2.

2. Lay out studs on the side walls first. Before marking the stud locations, check opposite walls to be sure they are the same length (within ⅛"). If not, trim to equalize. Both sets of side wall plates may be marked at the same time.

3. Starting at the front of the garage (where the OH door wall meets the side wall), lay out the side walls first. Stand the plates with their outside edges facing up and make layout marks on these edges. Hook a tape on the end of the plates at the front of the garage and mark the location of all wall studs on 24" centers.

4. Determine the approximate location of any window, or service door and mark one of the existing stud location marks as a King for one side of the window or door. Mark a Jack stud next to it, then mark a King/Jack pair the appropriate distance (the window width or door RO width) and write the window or door size on the bottom plate (e.g., 3030 Window, 3068 Service Door).

5. When laying out the back walls, start at one end but this time extend the tape measure 3½" beyond the end of the plate. This offset takes into account the 3½" width of the intersecting side wall plate. Place "X's" and "SX's" as appropriate.

6. The separation between the Jack studs (the "rough opening") for all windows equals the width of the window being located. The rough opening for the service door is 2½" wider than the door size. The first two digits in the window or service door code are the width in feet and inches, not inches.

   EXAMPLE: A 3030 window is 3'-0" wide (not 30") wide; in this example, the rough opening between the Jack studs is 3'-0" or 36". For a 3068 service door, the rough opening is 3'-0" + 2½" = 36" + 2½" = 38½".

7. Label the King and Jack stud locations with "K" or "J" to specify the location of the pre-built window and door components during wall assembly.

8. Wherever 24" centers fall within a window or door, mark an "SX" to represent a short stud on the top and bottom plate above and below the window and on the top plate only for door openings.

9. Label the upper plate "Header Up" to specify that the window or service door header will lie above the deck while the wall is built. It will place the header flush with the outside of the wall when erected.

10. At each end of the side walls, lay out an L-corner with two 2x4 studs made up of the normal 2x4 end stud plus an extra 2x4 stud perpendicular to the end stud on the exterior side of the wall (see Figure 23-3). Mark the "L" as "Corner Up" to specify

that the corner assembly will lay face up on the deck as the wall is being built. This will place the existing 2x4 stud facing the end of the adjoining short wall forming an outside corner.

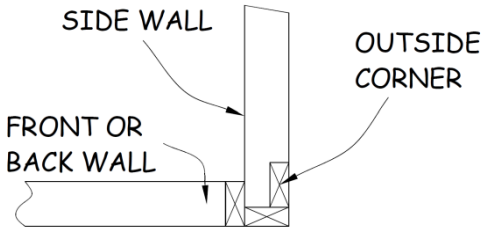

Figure 23-3. Outside L-Corner.

23.4.2. Attached Garage

1. In order to use whole sheets for exterior sheathing and to ensure that trusses land above a stud, the garage part of the extended house/garage wall must continue the house wall stud layout.

2. Locate a house wall stud that is 24" O.C. with the rest of the wall – not a Jack or King. Hook a tape on that stud, and with the garage bottom plate in place on the foundation, measure an integer multiple of 24" to the garage wall bottom plate and mark the location of the side of the first garage wall stud. Mark the rest of the studs 24" O.C. from this mark.

3. Line up the OH door end of the opposite wall plate(s) with the extended house/garage wall plate, and transfer the stud marks from one set of plates to the other.

4. Determine the approximate location of any window or service door and designate one of the existing stud location marks as a King for one side of the window or door. Mark a Jack stud next to it, then mark a King/Jack pair the appropriate distance (the window width or door RO width) away, and write the window or door size on the bottom plate, (e.g., 3030 Window, 3068 Service Door).

23.5. ERECTING GARAGE WALLS

23.5.1. Construct Service Door Component

1. Cut two King studs to the length determined in Section 23.1.1.

2. For **detached** garages, cut two 82" Jack studs from pine 2x4s. For **attached** garages, cut two 82" Jack studs from treated 2x4s (these will extend past the bottom plate to rest on the concrete floor).

3. Nail each Jack stud to a King stud, with the bottoms and edges flush and the crowns opposite, using pairs of 3¼" collated nails no more than 12" apart.

4. Cut two 2x10 header pieces and one 2x4 header piece 3" longer than the rough opening of the door (e.g., 41½" for a 3068 door).

5. Nail the 2x10s together with two rows of 3¼" collated nails. Tack the 2x4 to one long edge of the 2x10 pair, taking care to keep three edges flush.

6. Working on a flat surface, place the header between the King studs, flat surface up, and the 2x4 resting on the top of the Jack studs.

7. Square the 2x4 to the King stud, tight to the top of the Jack studs, and nail through the King into the 2x4 with two 3¼" collated nails.

   NOTE: It is critical that the header be tight against the top of the Jack stud to properly transfer roof load to the foundation.

8. Keeping the exterior surfaces of the header and King studs flush, nail the King studs to the header with three 3¼" collated nails into the ends of each 2x10. Finish nailing the 2x4 header piece into the underside of the 2x10's with 3¼" collated nails.

9. Cut a piece of ½" OSB the size of the header and nail it to the side that the 2x4 projects from. Label the opposite side of the header "Inside".

10. Cut a 1x4 "filler" piece to fit between the Jack studs and nail it to the underside of the header. This helps to limit the gap between the header and the top of the door jamb. (See Figure 4-1.)

23.5.2. Construct Window Components

1. The bottom of the window header is at the same elevation as the bottom of the service door header.

2. For **detached** garages, determine the length of the window Jack studs by subtracting the thickness of the bottom plate (1½") and the height of the foundation curb at the window location from 82". In an **attached** garage, window Jack studs are 82" - the same length as the service door Jack studs.

3. Cut a 2x4 sill piece the width of each window (e.g., 36" for a 36"-wide 30XX window).

4. Construct double 2x10, 2x4 headers similar to that for the door, but 3" wider than the width of the window (e.g., 39" wide for a 36"-wide 30XX window).

5. On each Jack stud, measure down from the top and mark the stud with the height of the window (e.g., 24" for a 3020 window).

6. Nail the Jack studs to the King studs with pairs of 3¼" collated nails, no more than 12" apart.

7. Place the header tight to the top of the Jack studs, flush the appropriate surfaces, and nail through the King stud into the ends of the header pieces with 3¼" collated nails.

8. Place the sill piece between the Jack studs at the mark made in Step 4 above and square to the frame surface. Drive one 6" timber screw through the King/Jack pair into each end of the sill.

9. As with the door header in Step 6 above, cut and attach a piece of OSB to one side of the header. Label the opposite side "Inside".

23.5.3. Assemble and Erect the Side and Back Walls

1. Remove the temporary nails connecting the 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.

2. Select studs for framing walls by sighting along the edge of each stud to determine in which direction the stud is crowned; mark with an arrow pointing to the high side. Place studs with "crown up".

3. Assemble each wall on the garage floor and then erect in one entire section. Assemble the two side walls first. Assemble and erect the back wall after the two side walls are up.

4. Place the separate window and service door components in place between the upper and bottom plates with the "Header Up" orientation (this places the "smooth" surface of the header on the outside of the wall).

5. Nail all wall sections together with 3¼" collated nails using two nails through the plates into the ends of each stud. Always make sure that the edges of the studs are flush with the exterior edges of the plates.

6. Place foam sill seal on the foundation wall slightly back from the chalk line. Stand the wall section up, making sure the bolts emerge through each pre-drilled hole. Align the wall so it is flush with the chalk line, then add the washer and nut to each bolt and tighten.

7. For a **detached** garage, temporarily brace each end of the side walls using two 12-14' 2x4s nailed near the top of the end studs, with the bottom end resting on the ground in an "A" shape.

8. For an **attached** garage, one end of the front and and/or side walls will connect to the house wall and can be plumbed and secured to the house. The other end of each wall should be braced as described in Step 7 above.

9. For both attached and detached garages, make sure the side walls lean out slightly when they are braced so they will not interfere with the installation of the back and OH door walls.

10. The back wall is constructed, erected and braced in the same manner as the side walls. Fasten walls to each other by flushing the corners and nailing with 3¼" collated nails the adjoining end studs every 12" from bottom to upper plate.

11. At the inside of each wall corner, nail a long 2x4 brace into the upper plate and run it diagonally down to the bottom plate. Plumb the wall corner. Nail the brace into the bottom plate and into two of the wall studs with one 16d duplex nail at each point. After the side and back walls are up and braced, build and erect the OH door wall.

23.5.4. Assemble and Erect the Overhead (OH) Wall

1. Erect the side and back walls, and stabilize them before laying out the OH door wall. Refer to Figure 23-4 for the following steps.

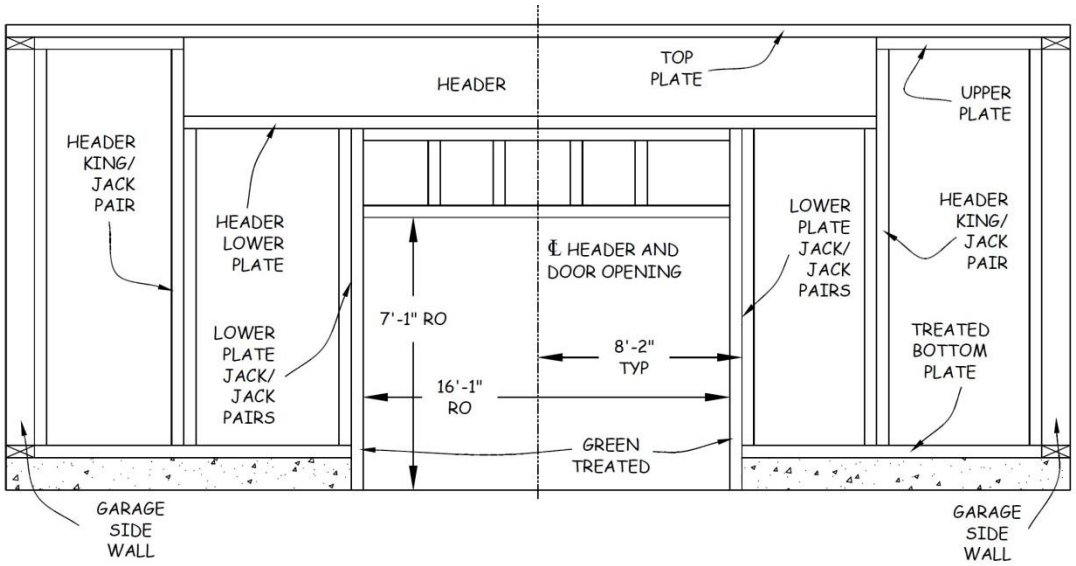

Figure 23.4. Overhead (OH) Wall Assembly.

2. Unless otherwise specified, the overhead door rough opening is 16'-1" wide and 7'-1" high. The height must be measured from the flat concrete slab.

3. Check that the ends of the header pieces are square and that they are the same length; trim as necessary.

4. Measure the length of the header pieces, then measure and mark the centerline location.

5. Cut 2x4s to create a header lower plate that end-to-end will match the length of the header.

6. Determine the length of the four untreated Jack studs by subtracting the width of the header 2x12s (typically 11¼") from the length of the King studs. Measure the width of the 2x12s in several locations, and use the average.

   EXAMPLE: Garage studs are typically 104⅝" long. 104⅝" – 11¼" = 93⅜".

7. Cut four Jack studs to the length determined above, typically 93⅜".

8. Nail together two King/Jack pairs using 3¼" or 16d nails with crowns opposite, keeping one end and the edges flush.

9. Measure the distance between the ends of the garage foundation wall at the OH door opening. Measure and mark on the garage slab the centerline of the OH door opening. From the OH door opening centerline, measure 8'-2" toward each side and make a mark on the garage foundation. The 8'-2" measurement is half of the 16'-1" RO (8'-½") plus 1½" for the treated Jack stud.

10. Measure from the 8'-2" marks to the inside of the side wall bottom plate, and cut treated bottom plates to those lengths. Label with their locations.

11. Locate and drill anchor bolt holes in the bottom plate(s) as described in Section 23.3 above.

12. Lay one of the header pieces in the OH door opening with its centerline mark aligned with the OH door opening centerline mark on the slab.

13. Measure from each end of the header to the side walls and cut upper plates that length. Label with their location and orientation, and tack, using 16d duplex nails, to their respective bottom plates, flushing the side-wall ends.

14. Lay the bottom and upper plates on the garage foundation with the ends snug to the side walls. Mark each end of the header on the respective bottom plate; this is the location of the center of the header King/Jack pairs. The OH-door end of the upper plate should align with this mark.

15. The OH door wall plates are typically about 2' long, so there should be no need to mark studs 24" O.C. Mark the plates to locate a stud at the side-wall ends of each plate pair.

16. The length of the two green treated Jack studs will be as follows. Add the height of the foundation curb (3½" from the example above) and 1½" (bottom plate thickness) to the length of the non-treated Jack stud determined in the previous example (Step 6 above).

    EXAMPLE cont'd: Jack studs determined above are 93⅜". Foundation curb height measured at 3½"; bottom plate = 1 ½". 93⅜" + 3½" + 1½" = 98⅜" length of treated Jack studs.

17. Cut the bottom of two treated 2x4s to the same angle as the inclined portion of the OH door opening (usually about 10º). Measure and mark the length determined above from the short side of the angle cut, and square cut the top of the 2x4s to that length.

18. Determine the height of the ladder-like wall below the header by subtracting the RO height, 7-1" (85"), from the length of the treated Jack stud.

    EXAMPLE cont'd: 98⅜" length of treated Jack studs minus 85" (7-1") =13⅜". Stud length: 13⅜ - 3" (top and bottom plates) = 10⅜".

19. Construct a ladder-like wall the height determined above, 16'-1" long.

    NOTE: 16' 2x4s are typically ½-1" longer than the nominal length. Use 16-1" 2x4s if available, otherwise cut them to 15'-10½" long and use a 2x4 3" longer than the stud length determined above as a spacer at one end.

20. Cut short studs to the length determined above and assemble a 16'-1" long wall in the usual fashion with studs 24" OC. If 16' 2x4s are not available, arrange the upper and lower plates so that any joints are staggered and land in the middle of a stud.

21. Position the ladder wall between the treated Jack studs, and nail the upper plate of the ladder wall to the header lower plate, keeping the edges flush. Toenail or screw the ladder wall lower plate to the treated Jack studs at each end.

22. With the bottom treated plates on the garage foundation, and the upper plates on the garage slab, assemble the wall as shown on Figure 23-4 with all of the components described above except the header pieces.

23. Raise the wall and secure it to the anchor bolts and side walls after plumbing in two directions.

24. Nail the two header pieces together, keeping the edges and ends flush. Arrange with crowns opposite, and use clamps as necessary to align the edges and pull the pieces tight together. Use three 3¼" collated or 16d nails every 36" on one side, then turn the pair over and repeat on the other side, staggering the nail pattern 18", to end with three nails every 18".

25. Check for residual crown, and install with the crown up. Carefully lift the header into position and secure.

23.6. STRAIGHTENING GARAGE WALLS

23.6.1. Attach String Line

1. To straighten the exterior walls, a stretch a VERY taut string line from one inside corner to an adjacent inside corner. The wall is adjusted to the string line every 8'–10' and braced to hold.

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

3. Drive a 16d nail into the approximate center of this 2x4, 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.

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, attach 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 the exterior of the centered nail, aligned with the inside edge of the upper plates on each wall

8. Continue around the exterior walls, repeating Steps 4 thru 6 at each corner, until back at the starting corner. Make sure the string is not obstructed between corners and is VERY taut.

9. At each corner, verify that the string is aligned with the "inside" of the upper plates and adjust as needed.

23.6.2. Straighten the Walls

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

2. Place one end of a 6' level against the top 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, adjust the 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 to the mid-point of the wall and repeat Steps 2 and 3.

5. Repeat Steps 1 thru 4 for the remaining exterior walls. After bracing for all exterior walls is completed, recheck the alignment (using the string line) and remove string and blocks.

23.7. INSTALLING TOP PLATES AND SHEATHING WALLS

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.

2. The top plate on all walls must be lapped a minimum of 4’ on each side of the upper plate joint, and at each corner.

3. Top plates of the garage walls that intersect the house walls must extend into the house exterior top plates by 2” and must be at least 16" long.

4. When nailing top plates, use two 16d nails across 2x4 plates. Nail at each intersection of top plates and nail at each stud location.

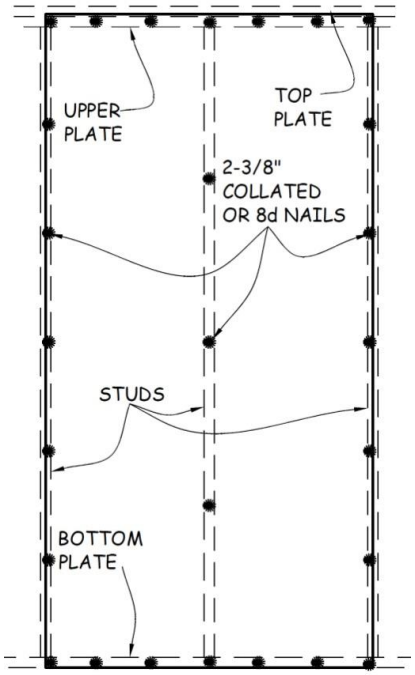

Figure 23-5. Garage OSB Nailing Pattern.

5. Starting at the zero corner, place a sheet of 4’x9’x½” OSB on each end of a wall section, flush with bottom plate and overlapping ¾” onto the stud 4’ from the corner. Secure it to

the studs with 8d or 2⅜" collated nails into each stud and the top and bottom plate using the nailing pattern shown in Figure 23-5.

NOTE: The OSB is secured with seven nails equally spaced in each edge stud, five in the center stud, and two in each plate equally spaced between each stud.

6. Continue sheathing across the wall, holding the OSB even with the bottom of the bottom plate and tight against the previous sheet.

7. On the OH door wall, place a whole sheet from the corner, covering the end of the header. Glue and nail the sheet, then cut the OSB from the opening.