

## Chapter 2. Cap Foundation

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### Tools needed by volunteers:

Hammer  
Nail apron  
Tape measure  
Square  
Utility knife  
Pencil

### Tools and equipment needed:

Generator  
Extension cord  
Circular saw  
Chop saw  
Impact driver  
Framing nailer  
I-joint cutting jig  
Sledgehammer  
Adhesive applicator  
Framing square  
String line  
Chalk line  
Stepladder  
Extension ladder

### Materials needed:

1½”x9½” Rim boards  
Floor I-joists  
¾” Tongue & groove decking OSB  
1” Foamboard  
Tapered shims  
16d nails  
8d nails  
¾” Collated nails  
2¾” Collated nails  
I-Joist hangers  
LVL Joist hangers  
Joist hanger nails  
2” Button nails  
1½” SD screws  
2½” SD screws  
4” Timber screws  
5/16”x4” Lag screws  
5/16” Washers  
House wrap  
Construction adhesive  
Air sealing caulk  
Radon caulk

### Personal Protection Equipment:

Safety glasses (required)  
Hard hat – below deck (required)  
Fall protection harness (required)

### Reference Materials:

House Plan  
Manufacturer’s Layout Plan

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

## 2.1. INSTALLING I-JOISTS AND SILLBOX

### 2.1.1. Installing I-Joists

1. Before proceeding with any installation, check the Manufacturer's Layout Plan and the House Plan for details (consult the Construction Supervisor if there are any differences). Verify that all materials are present in the stated dimensions. Note areas on the plan where specific dimensions will be needed.
2. Measure the width of several I-joist flanges and determine an average width. Divide that number by 2. This result will be used to offset the tape measure in the next steps for laying out the I-joists on the sill plates and lam beam.
3. Starting at the zero end as specified on the House Plan, place the end of a measuring tape on the exterior edge of the short wall sill plate. Make a mark on the long wall sill plate at 19.2".

**NOTE:** The diamond marks on most measuring tapes correspond to multiples of 19.2".

4. Take the number calculated in Step 2 above and add that distance to the 19.2" mark. Draw a line the width of the sill plate at this location. Mark an "X" on the sill plate on the side of the line closer to the zero end.
5. Drive a nail into the center of the sill plate at the line drawn in Step 4 and hook a tape measure to this nail.
6. Proceed the remaining length of the sill plate making marks every 19.2" and marking an "X" for full-length I-joists ("SX" for any joists shorter than full-length - typically around the stair opening) on the sill plate on the side of each line closer to the zero end.
7. Repeat Steps 3-6 for the opposite long wall sill plate and the lam beam.
8. The last I-joist is typically located by measuring back 19.2" from the non-zero end of the wall in order to allow room for mechanicals.
9. Check the width of the rim boards (typically, they are 1 $\frac{1}{8}$ ", but can vary by as much as  $\frac{1}{8}$ "). From the outside edge of the sill plate, measure in the thickness of the rim board on the sill plates at all four corners and snap a chalk line around the perimeter of the sill plate. This line will be used to position the I-joists. Be sure to check the line for straightness (e.g., by using a string line).
10. At both ends of the house and in the middle of the long walls, measure the distance from the chalk line on one long wall to the chalk line on the other long wall. If all three measurements do NOT agree, re-snap one or both of the lines. Recheck lines for squareness.

11. To install an I-joist, first verify that at least one end of the I-joist is square (if neither end is square, square up one end). Set the I-joist on a joist location mark made in Step 2 above so its square end is resting on the zero wall covering half of the chalk line. Mark the other end of the I-joist where it intersects the chalk line on the opposite sill plate. Cut the I-joist to that length using a circular saw and the I-joist cutting jig.

**NOTE:** It is better to cut the I-joist slightly short of the line rather than slightly long of the line. A short joist can always be shimmed out.

12. Position each I-joist on a joist location mark with the end on the zero wall covering half of the chalk line. Check the I-joist for wording on its face, and install so the wording is right-side up. Nail I-joists into the sill plate using six 3¼” collated nails total: at each end, one nail into each side of the flange a minimum of 2” from the end (to avoid splitting the flange); one nail into each side of the flange directly over the joist location mark on the lam beam.

**NOTE:** Do NOT hand nail the I-joists with 16d nails as this may split the flange.

13. Not all I-joists can be installed on the first day because the concrete crew needs access to pour the basement floor. Ideally, I-joists are installed at both ends of the foundation and near each support post. If time allows, other I-joists can be cut and stacked next to nearby I-joists that were permanently installed.

**NOTE:** Installing I-joists near the support posts helps to stabilize the posts and the lam beam when the concrete floor is being poured.

### 2.1.2. Installing End Blocking

1. Use I-joist material for end blocking. Beginning at the zero end, mark end blocking locations on the short wall sill plate every 32” o.c. from the outside edge of the long wall sill plate.

**REQUIREMENT:** When measured center-to-center, the spacing of the end blocks CANNOT be greater than 32”.

2. The 32” spacing needs to be adjusted when either of the following two conditions is encountered:
  - a. If the blocking location falls on a foundation bolt, move the marks for the location several inches closer to the previous set of blocking marks in order to position the blocking so it does not fall on the bolt. Then, continue marking blocking locations every 32” o.c. from this adjusted mark.
  - b. If the spacing results in the center of the last end block being positioned less than 32” from the outside edge of the opposite long wall sill plate, install the

last end block half way between the second to last end block and the outside edge of the opposite long wall sill plate.

**NOTE:** Adjusting the position of the last end block ensures there is sufficient room for access from the basement into this area.

3. Repeat this process along the other short wall sill plate.
4. Measure the distance from the chalk line to the end I-joist at several locations along the line. Determine a common measurement that can be used for all the blocking along that wall. Cut enough scrap I-joist material to that length to create end blocks for the entire wall.
5. Set an end block on a blocking location mark made in Step 1 above. Position the flange of the blocking so the outside edge covers half the chalk line on the sill plate. Nail the blocking – with one 3¼” collated nail on each side of the flange – a minimum of 2” from the end of the flange.

**NOTE:** It is better to cut the end block slightly short of the line rather than slightly long of the line. A short block can always be shimmed out.

6. After the rim board has been installed (see Section 2.1.3 below), square the blocking and nail from the rim board into the flanges of the blocking using 2⅜” collated nails - one on the top and one on the bottom.
7. Flush the top of the blocking with the top of the end I-joist and make sure the blocking is square to the I-joist. Then, toenail through the I-joist into the flanges of the blocking using 8d nails - one on the top and one on the bottom.

**NOTE:** It sometimes helps to clamp the pieces in place before toenailing.

### 2.1.3. Installing Rim Boards

1. Because the rim boards bear the weight of the outside walls, the width of the rim boards should be identical to, or slightly (no more than ⅛”) greater than the height of the I-joists. If this difference is greater than ⅛”, rip the rim boards on the table saw so they are the same as, or slightly wider than, the height of the I-joists.

**NOTE:** Each rim board may be different (i.e., some need to be trimmed others don't), so test each rim board separately.

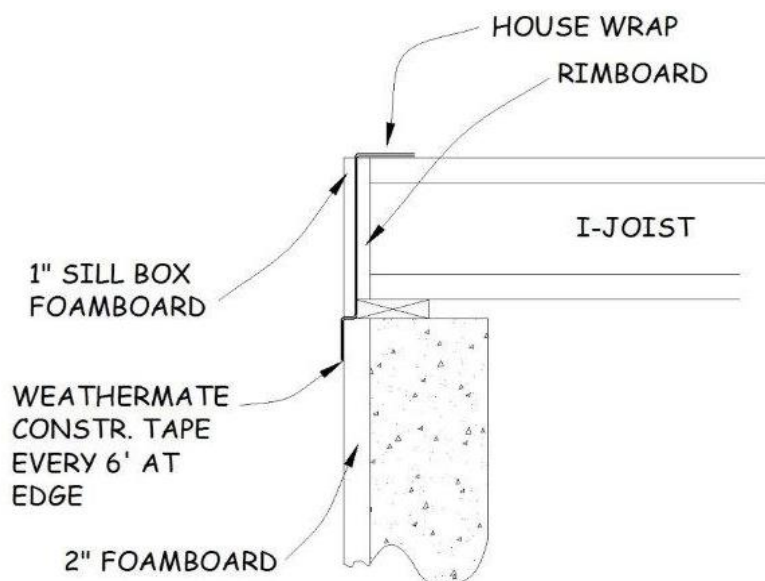
2. Dry fit the rim board in its intended location. Check the rim board for a crown; if it has a crown, install crown up. If the rim board sticks up above the I-joists by more than ⅛”, repeat Step 1.
3. Apply a thick bead of air sealing caulk on the sill plate where the rim board will sit. Install the rim board rough side out. Caulk the seams where rim boards abut.

4. Nail the rim board to the I-joists using  $2\frac{3}{8}$ " collated nails. To avoid splitting the joist flanges, use only one nail in each top flange and only one nail in each bottom flange. For the same reason, do NOT seam rim boards on I-joists.
5. Toenail the rim board to the sill plate every 6" using  $2\frac{3}{8}$ " collated nails.
6. Mark the locations of all end blocking on the outside face of the rim board with a black marker.

**NOTE:** This helps to ensure the decking is nailed to the end blocking when the foundation is capped. It also helps locate the blocking so, when erecting exterior walls, the bottom wall plates can be secured to the blocking and not to the rim board.

7. On the first construction day, any rim board above porch areas must be covered with foamboard and house wrap (see Figure 2-1).
  - a. Cut a length of house wrap that is 1-2' longer than the length of the porch. Center it on the porch and attach it to the I-joists or end blocking so it hangs over the rim board and extends down about 1" below the top of the 2" foundation foamboard.
  - b. Rip 1" foamboard to  $10\frac{7}{8}$ " wide. Place the foamboard over the house wrap and fasten it to the rim board with 2" button nails so it is flush with the top of the rim board and seams are staggered with those of the rim board. Attach sufficient lengths of foamboard in these areas so it extends about 6-12" beyond the edges of the porch.

**NOTE:** This step must be completed before concrete can be poured in the porch areas.



**Figure 2-1. Sill Box Section.**

## 2.2. FRAMING STAIR OPENING

1. Typical framing for the stair opening uses a combination of Laminated Veneer Lumber (LVL), and rim board material.

**NOTE:** Some of the following steps may need to be modified for atypical stairway configurations. Use the House Plan to guide the installation.

2. Per the House Plan, lay out joist and LVL spacing for the stairway on the sill plates and lam beam, labelling the locations for short I-joists with “SX” and the LVL positions with “LVL”.
3. Stairs can run either perpendicular or parallel to the lam beam. In either case, two LVL beams extend from the lam beam to the sill plate on one long wall. A third LVL beam extends parallel to the lam beam and is attached to the two perpendicular LVL beams with LVL joist hangers.
4. On one of the locations marked “LVL” in Step 2 above, measure from the rim board line on the sill plate to the far edge of the lam beam and add 3”-5”. Cut two pieces of LVL material to that length.

**NOTE:** Building Code requires the two LVL beams to extend no less than 2” and no more than 6” beyond the lam beam.

5. Per the dimensions on the House Plan, cut a third piece of LVL material to run parallel to the lam beam between the other two pieces of LVL. Also cut a piece of rim board material to that length.
6. Place the parallel LVL beam cut in Step 5 above on the foundation next to the sill plate and between the LVL marks on the sill plate. Transfer the location(s) of the short I-joist(s) found on the sill plate (designated with “SX”) to one face of the parallel LVL beam. Attach I-joist hanger(s) to these locations, using a scrap piece of I-joist to position the hanger so the top of the scrap piece is flush and square with the top of the LVL beam. Secure the joist hanger(s) to the LVL beam using 1½” SD screws (if screws not available, use joist hanger nails), one in each hole of the hanger.
7. On each of the two LVL beams that run perpendicular to the lam beam, lay out the locations, per the House Plan, where the parallel LVL beam will be attached.
8. Place the two perpendicular LVL beams on the marks established in Step 2 above and covering half the chalk line on the sill plate. Toenail the ends to the sill plate with 8d or 2¾” collated nails.
9. Cut two pieces of 24”-36” long 2x material. Place one piece along the top edge of the parallel LVL and extending out about 12” past the vertical edge of the beam. Securely clamp the 2x material to the beam. Repeat with the other piece of 2x material on the opposite end of the parallel LVL beam.

10. Place the parallel LVL beam between the two perpendicular LVL beams, aligned with the marks made in Step 7 above, and hanging from the 2x material installed in Step 9 above. Make sure the I-joint hangers on the parallel LVL beam are outside the stairway opening (i.e., facing the sill plate on the long wall).
11. Verify the parallel LVL beam is aligned with the marks made in Step 7 above and the tops of the parallel LVL beam are flush with the perpendicular LVL beams. Secure the assembly by driving two 4" timber screws through each perpendicular LVL beam, about 2" below the top and above the bottom, into the ends of the parallel LVL beam. Remove the scrap 2x material.
12. Install an LVL joist hanger at each end of the parallel LVL beam. Secure the LVL beam inside the joist hanger using 1½" SD screws (if screws not available, use joist hanger nails) into the straight holes of the joist hanger and 2½" SD screws (if screws not available, use 16d nails) into the angled holes of the joist hanger, one in each hole
13. Position the length of rim board cut in Step 5 above on top of the lam beam between the two LVL beams and flush with the face of the lam beam on the stairway side of the beam. Nail five 3¼" collated nails through each LVL beam into the ends of the rim board.
14. Measure the distance along the long wall from the rim board line on the sill plate on the nearest short wall to the closest LVL beam. Repeat this measurement along the lam beam. If the measurements are not identical, adjust the location of the LVL beam on the lam beam. Mark the new location and toenail the two LVL beams to the lam beam with 8d or 2⅜" collated nails.
15. Measure the length of the two I-joists located at the ends of the parallel LVL beam and cut all short I-joint(s) extending from the sill plate to the parallel LVL beam to that length. Position the I-joint(s) in the joist hangers, securely. At the other end, attach the I-joint(s) to the sill plate with 3¼" collated nails, one into each side of the flange.
16. Check perpendicular LVL beams for bow. If necessary, straighten and brace with angled 14' or 16' long pieces of 2x4 attached under the I-joists. These will be removed after the deck is installed.
17. Install the temporary stair cover by first attaching the temporary cover support ledgers (lengths of 2x6 with joist hangers attached) to the inside faces of the long LVL beams using 5/16"x4" lag screws and 5/16" washers. Then, insert pre-cut 2x6 temporary joists into the joist hangers. Finally, secure the pre-cut OSB temporary covers to the ledger boards with 8d nails.

**NOTE:** Use hardware found in the trailer in a bin labeled "Temporary Stair Cover Hardware".

## **2.3. INSTALLING FOAMBOARD IN SILLBOX**

### **2.3.1. Preparation**

1. Install 1” of foamboard in the sillbox. This may be done before or after the rim board has been installed. Installation is easier if done before rim board installation, and it helps to square up the I-joists for nailing to the rim board.
2. Determine how many pieces are needed and of what length for the entire sillbox. There are two standard sizes: 9-7/16” x 18<sup>7</sup>/<sub>8</sub>” for between the I-joists and 9-7/16” x 31<sup>5</sup>/<sub>8</sub>” for between the end blocking. Pieces longer or shorter than normal are also needed, typically near the stairwell opening and near the corners of the foundation.
3. On the table saw that has been designated to only cut foamboard, raise the blade to ½” above the foamboard and rip the foamboard to 9-7/16” x 8’ strips. Make sure all the safety guards are in place.

**NOTE:** Do NOT use the DeWalt table saw for this operation

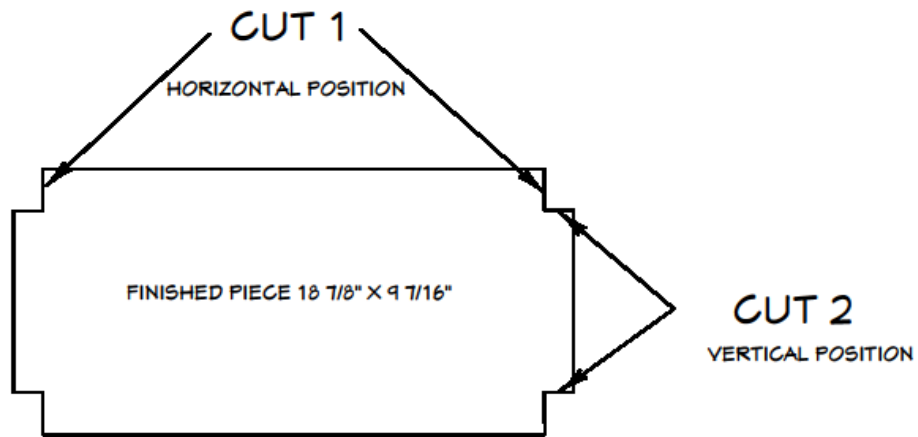
### **2.3.2. Cutting Foamboard to Length**

1. Five 18<sup>7</sup>/<sub>8</sub>” long pieces can be obtained from an 8’ strip. For pieces that are either shorter or longer than 18<sup>7</sup>/<sub>8</sub>”, determine what combination of pieces to cut from an 8’ strip to minimize waste.
2. Remove the table saw’s fence and put it into the attachment compartment below the saw.
3. To cut pieces that are 18<sup>7</sup>/<sub>8</sub>”, use the “cross cut sled” riding in the left track. Make sure the sled slides back and forth freely. Position the piece of foam so that it abuts the sled stop and slide the sled past the saw blade.
4. Cut other length pieces to length with a handsaw or the chop saw.)

### **2.3.3. Notching Foamboard Pieces**

1. Unplug the saw.
2. Remove the blade guard (loosen the two thumb screws) and put the guard in the storage area below the saw.
3. Place the “Notch Cutting Jig” on the left side of the saw table so that the blade comes through the jig slot and the jig fits securely in the left side track. Make sure the blade turns freely (no contact with the jig).
4. Adjust the saw blade height so that it is 1½” above the surface of the jig.





**Figure 2-2. Foamboard notches.**

5. Set the “adjustable notch guide” in the #1 (HORIZONTAL) notching position (lift and rotate the guide).
6. Plug the saw in and turn it on.
7. Hold the foamboard HORIZONTALLY in the jig against the stop (on the right) and push the foamboard downward into the blade until it hits the surface of the jig. Repeat for the remaining three HORIZONTAL corner cuts.
8. When all pieces have been cut HORIZONTALLY, set the “adjustable notch guide” in the #2 (VERTICAL) notching position (lift and rotate the guide as needed).
9. Hold the foamboard VERTICALLY in the jig against the stop (on the right) and push the foamboard downward into the blade until it hits the surface of the jig to complete the notching cut. Repeat for the remaining three VERTICAL corner cuts.

#### **2.3.4. Installing Foamboard**

1. Install the foamboard in the sillbox, carefully cutting around any interfering anchor bolts.
2. Apply air sealing caulk on the inside, where the foamboard meets the sill plate and the I-joists.
3. Fill any notches around the anchor bolts with air sealing caulk.
4. Apply air sealing caulk to any seams in the foamboard.

**NOTE:** This process for installing the foamboard is very important because a tight air seal is needed here.

## 2.4. INSTALLING SUMP PUMP HOSE

1. After the sill box has been completely installed, the sump pump hose must be repositioned so it exits through a hole in the rim board.
2. Locate the I-joist bay through which the hose will exit. Choose the I-joist bay closest to the sump pump (but NOT out the front of the house) which provides the shortest and straightest run for the hose from the sump pump. If a storm sewer pipe exists, center the sump pump outlet 5-6" to the side of the pipe that is away from the corner of the house. The outlet also must be at least 12" away from the gas meter, electrical box, egress well, porch, deck, or any other exterior obstacles.
3. Using a 2½" hole saw, drill a hole centered vertically and horizontally in the sill box through the rim board (and foam board if already installed).
4. Reposition the sump pump hose so it exits through this hole to the exterior of the house.

## 2.5. INSTALLING FLOOR SHEATHING (DECKING)

1. Begin decking the floor at the zero corner on the side of the house that does NOT contain the stairwell. Before decking, determine the best layout of the decking. To minimize waste, determine the best I-joist on which to start a full sheet. Also, make sure that if a piece of decking is cut, the drop is useable somewhere else on the floor. Whenever possible, cut to fit at the ends of a row, although a 2"-3" overhang is acceptable. This overhang will be trimmed later after the adhesive dries.

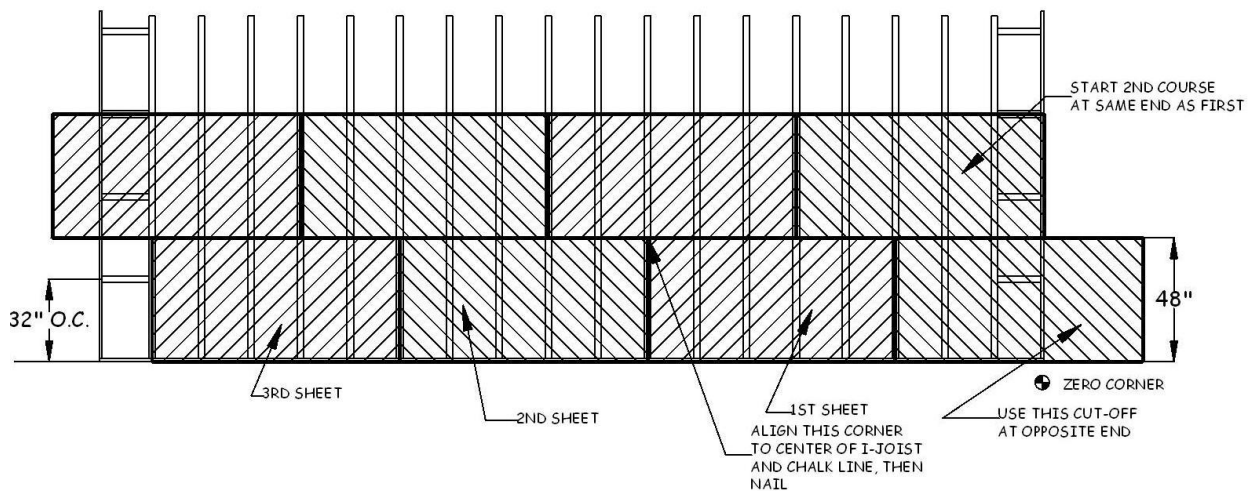


Figure 2-3. Floor Decking Layout.

2. Snap a chalk line across the floor joists at 48" from the outside edge of the rim boards on the long wall. Continue snapping additional chalk lines at intervals 1" less than 4' (e.g., 1" less than 8', 12', 16') across the remaining width of the foundation. The initial line is an alignment aid for the first row of decking; the remaining lines indicate how far to apply adhesive in Step 3 below.

3. Apply a continuous bead of adhesive to the tops of rim boards, I-joists, and end blocking, holding it 2" back from the chalk lines created in Step 2 above. Apply two continuous beads on those I-joists where the decking edges abut. A continuous bead on the rim board creates an air seal between the decking and the rim board. Apply adhesive only when ready to install that piece of decking.

**NOTE:** Avoid applying excess adhesive to prevent adhesive from depositing on tools, decking, porches, and the 2x4 used when securing the decking.

4. Before laying a sheet of decking, note which side is labeled "This Side Down." Start each row with a full sheet. Working from right-to left, lay a ¾"x4x8 OSB (full sheet) tongue and groove floor sheathing down on the adhesive-covered I-joists, with the grooved edge flush to the first chalk line snapped in Step 2 above. Make sure the right edge is centered on the selected I-joist at both the chalk line (upper right) and the rim board (lower right). Secure the lower right corner of the sheathing to the rim board with an 8d nail. Next, make sure the upper right corner of the sheathing is still on the chalk line and centered on its I-joist. Secure it with an 8d nail. Move to the upper left corner of the sheet, center the left edge of the sheet on its I-joist and nail the corner to the I-joist. Finally, measuring from the right edge of the I-joist that is under the right edge of the sheet, make marks on the top edge of the sheet every 19.2". Adjust the corresponding I-joists so their right edges are aligned under these marks and nail the sheet to the I-joists.

**NOTE:** The above instruction assumes a right-to-left installation. Be sure to switch right and left designations if the installation proceeds from left-to-right.

5. Repeat for each subsequent sheet, nailing only the top of the sheet. Align one top corner with the adjacent sheet, leaving a ⅛" gap between sheets. Make sure the other end of the sheet is centered on its floor joist and secure the top corner adjacent to the previously installed sheet using an 8d nail. Center the other edge of the sheet on its floor joist and nail that top corner using an 8d nail. Measuring from a nailed truss that is not at a joint between sheets, make marks on the top edge of the sheet every 19.2". Adjust the corresponding I-joists so their right edges are aligned under these marks and nail the top of the sheet to the I-joists using 8d nails.

**NOTE:** One method to ensure the ⅛" gap between sheets is to tack an 8d nail at two locations along the edge of the previously installed sheet into the I-joist below before driving the next sheet home. After the next sheet has been installed, pull the tacked nails and re-nail them into edges of the sheets.

6. Finish nailing each sheet of decking so that there are five 8d nails in the decking field and seven nails on each of the ends. On the first row, also nail one 8d nail through the decking into the rim board midway between each I-joist. Nail two 8d nails through the decking into each piece of end blocking.

**NOTE:** If using the framing nailer, verify that the nail head is being sunk no more than 1/8" below the surface of the decking. Adjust the nailer as necessary.

7. When installing subsequent rows of decking, make sure to stagger the joints of the decking, preferably by two I-joists (see Figure 2-3).
8. Tightly drive the tongues of the next row of decking into the grooves of the previous row of decking with a sledgehammer and a 6' length of 2x4 scrap so as not to damage the panels. Position and nail the sheets to the I-joists following the procedure generally outlined in Step 4 to Step 6 above.

**NOTE:** A maximum of 1/8" is allowed between decking prior to nailing.

9. For each sheet of decking, verify that all required nails have been installed on the edges and in the field, that the nails are sunk to the proper depth, and that no nails missed the framing below the deck (remove and re-nail any that did miss). Use a red crayon to mark "OK" on each sheet that passes inspection.
10. Using a black or blue crayon, transfer the end blocking marks made in Section 2.1.3.6 to the decking, making sure each mark is at least 8-10" long. Confirm there are two nails through the decking into the blocking where each black mark lands.
11. Cut away decking over the stairwell opening leaving a 1 1/4" overhang where the top of stairs will be attached.
12. Thoroughly clean the Adhesive Applicator, removing as much adhesive as possible, before storing it in the Tool Trailer.

**NOTE:** Sometimes use of a moist towelette (e.g., wet wipes) may facilitate adhesive removal.

## **2.6. BASEMENT PREPARATION**

1. Cut the floor drain flush with the surface of the concrete floor.
2. Remove any debris from the basement floor in preparation for wall layout. Use a broom to remove any remaining dirt from the floor next to all foundation walls.
3. After the basement floor is clean and dry, apply radon caulk to the concrete floor where it meets the wall and any other cracks in the floor. It is much easier to do this now than when basement walls are being framed or have been built.

**NOTE:** Sealing the cracks helps air seal the basement and prevents any harmful soil gases from getting in the basement.

4. Remove any plastic and framing from basement windows.
5. Remove all debris from the egress wells.

6. Locate the drain tile protruding through the stone at the bottom of the egress well. The top of the tile should be 2"-3" below the bottom of the window sill. If it extends higher than this, use a utility knife to cut off the top of the tile to the desired height. Place a 6"x6" piece of 1" foam over the top of the drain tile and cover that with at least 2" of stone to hide the drain tile. Level the remaining stone in the well so it is flush with the bottom of the window sill.

