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# A HOUSING DESIGN FOR LARGER TORTOISES



## BACKGROUND

Large tortoises present a unique challenge in identifying and building adequate housing, particularly as they grow beyond the limits of a Dogloo or other pre-made structure adapted for housing. In many cases building or installing a full sized exterior shed is either too costly, too large, or violates local regulations, such as home owners association governances. As my 11-year-old (at the time) Sulcata outgrew his Rubbermaid trappings, I made the decision to construct a structure that would last him for many years to come without breaking the bank or violating property sight lines. The structure was built with some key design features that would ensure the protection and well-being of the tortoise and the longevity of the shelter itself.

These key design features include:

- A solid floor to inhibit digging
- Insulated walls and floor to maintain heat during cooler weather
- Easy to clean interior with hinged roof for easy access
- A height and width large enough to support a number of heating solutions
- An easily modifiable structural design (the dimensions are easily adjusted)

As built, the total project cost approximately \$300 and was completed over a weekend. Your cost and construction time will vary dependent on material sourcing and familiarity with various tools and construction techniques. This is not a complex structure to build, but the process is more involved than a basic dog house.

During the planning stage, I decided to include a board-and-batten siding which influenced the materials selected, namely the use of oriented strand board (OSB) on the interior and exterior surfaces. OSB is acceptable if any exterior siding product (e.g.; hardiboard, vinyl, or shiplap) will be used as it protects the OSB from water damage. Painted plywood could easily be used without siding to replace the exterior OSB, as it is not as susceptible to water damage. Plywood costs slightly more than OSB, but the time to build the structure is reduced significantly, as additional time to add siding is not required and any cost difference will likely be off set. To avoid complicating the build description, I will leave the exterior siding decisions up to you. All dimensions assume a ½" OSB construction. Adjust the dimensions for other materials.

Read all of the instructions prior to beginning and make modifications as necessary. In addition, feel free to use online instructions for steps you may not be familiar with to include vapor barriers, roofing, and exterior sheathing.

## MATERIALS:

- 4 – 2x4x8' boards
- 10 - 2x2x8' boards
- 5 sheets - 4'x8'x½" OSB
- 1 sheet - 4'x8'x¾" Exterior grade plywood
- 10 sheets - 2'x4'x1½" solid foam insulation (commonly used for garage doors)
- 1 roll - Plastic sheeting (painters tarp)
- 1lb - 3in. exterior wood screws
- 1lb - 1 5/8in exterior wood screws
- 1 roll – tar paper
- 1 package – Roofing shingles (You will need about 20 shingles, If color does not matter, ask if the store has loose shingles available and you can get them for free or at a significant discount)
- 3 – 1"x 2"x8' angled flashing (I had trouble finding this, so other sizes are acceptable)
- 1 package – 3/8" or ½" inch heavy duty staples
- 1lb – ¾" roofing nails
- 1 tube – roofing sealant
- 2 pair – Low profile gate hinges
- 1 – Large gate handle
- 1 box – Vinyl "peel and stick" tile
- 1 qt – Vinyl tile primer
- 1 tube – Clear silicone bathroom and kitchen sealer
- 1 tube – PL-3 construction adhesive

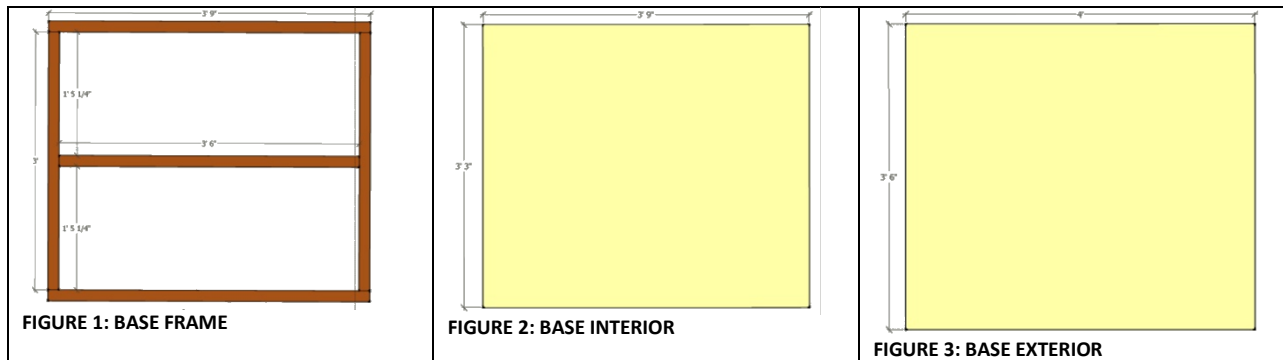
## TOOLS:

- Measuring tape
- Miter/chop saw or miter box
- Circular saw
- Handsaw or Jigsaw
- Hack saw
- Electric screwdriver and set of bits
- Scissors
- Box cutter
- Caulk gun
- Straight edge (metal ruler or engineering square)
- Various sized clamps and/or an extra set of hands
- Paintbrush
- Staple gun

# CONSTRUCTION

## BUILDING THE BASE

The base of the structure is made from a 2 x 2 frame shown in Figure 1 sandwiched between a single sheet of OSB cut to the dimensions shown in Figures 2 and 3. Use a chop or miter saw to cut the 2 x 2's to length and a circular saw for the interior and exterior OSB.



Assemble the frame using 3in wood screws in each corner and centered through the cross member. Pre-drilling is recommended to avoid splitting the wood. The frame may twist a bit during initial construction, but the sandwich design will flatten it. Once the frame is assembled, lay a piece of plastic sheeting as a vapor barrier over the frame and top it with the smaller, interior OSB piece (Figure 2). Line up the corners and attach the OSB to the frame using 1 5/8in wood screws in each corner and approximately 12in apart along the edges. Pre-drilling is recommended. Cut away any excess plastic sheeting. Flip the piece over and cut 2 pieces of 1½in insulated foam to fill the interior void using the box cutter. Place the foam into the frame with the shiny side facing you. This will be the bottom of the structure.

Next, position the remaining piece of OSB (Figure 3) over the frame and align the edges with 1 ½ inches overlap around all edges. A scrap piece of 2 x 2 will be useful for this. Once the OSB is positioned, use 1 5/8in wood screws to attach it to the frame. The final base will appear as Figure 4 when viewed from above.

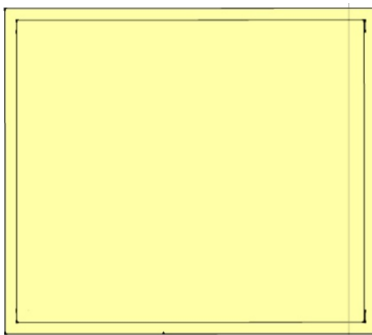
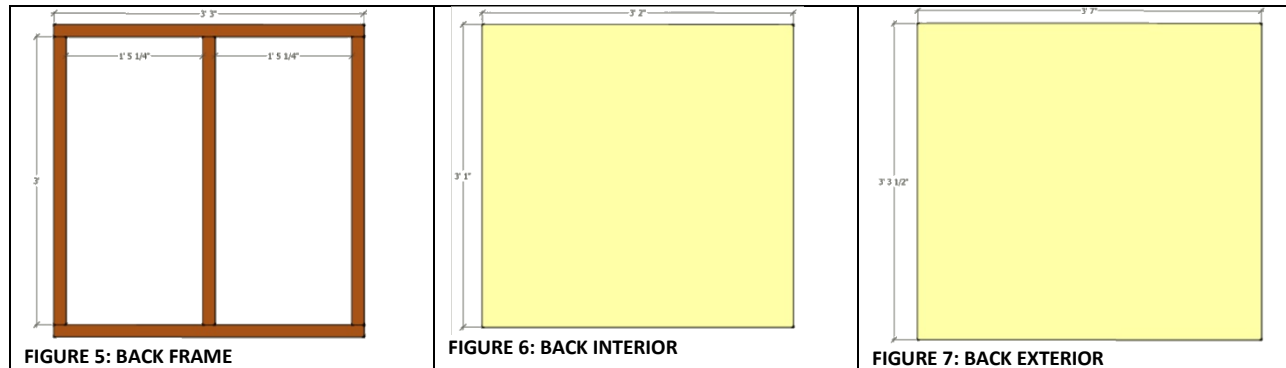


FIGURE 4: COMPLETED BASE

Prime the bottom of the interior of the base with the vinyl tile primer

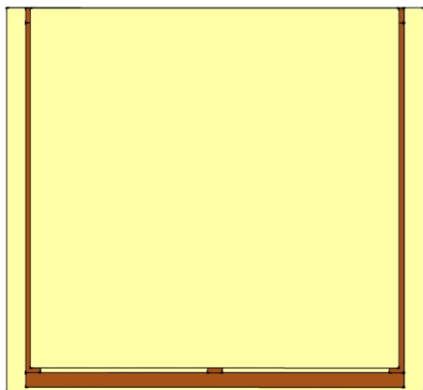
## BUILDING THE BACK

The back of the structure is made from a 2 x 2 frame shown in Figure 5 sandwiched between a single sheet of OSB cut to the dimensions shown in Figures 6 and 7. Use a chop or miter saw to cut the 2 x 2's to length and a circular saw for the interior and exterior OSB. Note that the back and base pieces look similar, but go together differently. If building all the frame structures first, make sure to label each piece carefully.



Assemble the frame using 3in wood screws in each corner and centered through the cross member. The frame may twist a bit during initial construction, but the sandwich design will flatten the frame. Once the frame is assembled, lay a piece of plastic sheeting as a vapor barrier over the frame and top it with the smaller, interior OSB piece (Figure 6). Line up the top edge of the frame and OSB and center the OSB  $\frac{1}{2}$ in from each side. Attach the OSB using 1 5/8in wood screws. Cut away any excess plastic sheeting. Flip the piece over and cut 2 pieces of 1 1/2in insulated foam to fill the interior void using the box cutter. Place the foam into the frame with the shiny side facing you. This will be the outside of the structure.

Next, position the remaining piece of OSB (Figure 7) over the frame, align the top edges of the frame and OSB, and center the frame with a 2-inch overlap on each side. There should be a  $\frac{1}{2}$ in extension at the bottom beyond the frame. Once the OSB is positioned, use 1 5/8in wood screws to attach it to the frame. The final back will appear as Figure 8 when viewed from above (interior).

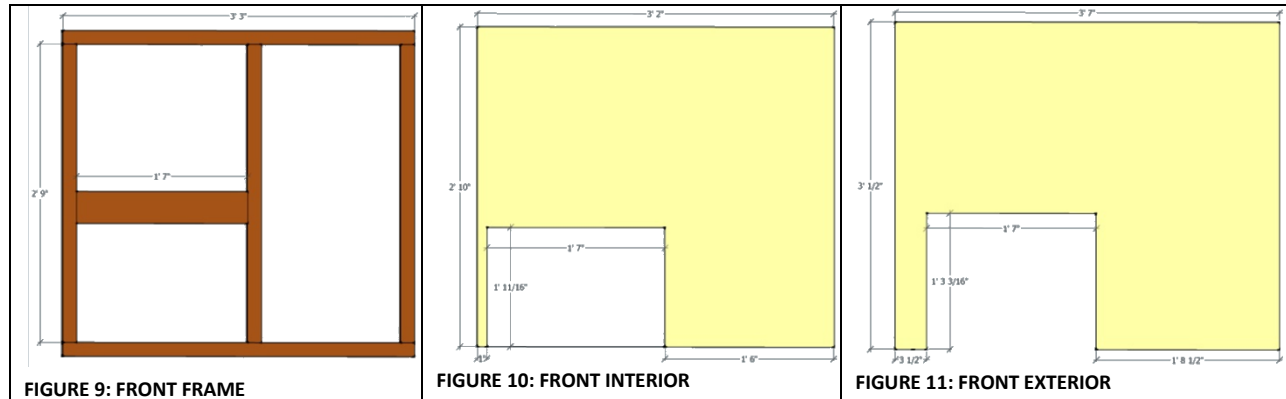


**FIGURE 8: COMPLETED BACK**

Prime the bottom 12 inches of the interior of the back wall with the vinyl tile primer

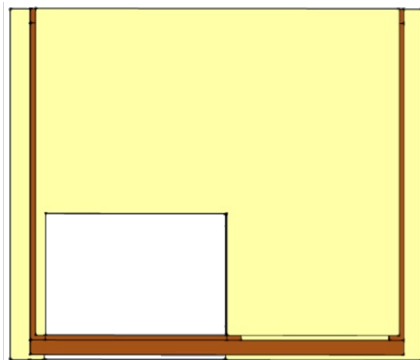
## BUILDING THE FRONT

The front of the structure is made from a 2 x 2 and 2 x 4 frame shown in Figure 9 sandwiched between a single sheet of OSB cut to the dimensions shown in Figures 10 and 11. Adjust the measurements for the 2 x 4 and vertical cross members to fit your tortoise including any future expected growth (within reason). Use a chop or miter saw to cut the 2 x 2's to length and a circular saw for the interior and exterior OSB. The interior cut out can be finished with a jigsaw or hand saw. Be careful not to chip off the 1 inch section on the interior piece (Figure 10).



Assemble the frame using 3in wood screws in each corner and centered through the cross member. Use two 3 inch screws on each side of the 2 x 4 to attach it squarely to the frame. The frame may twist a bit during initial construction, but the sandwich design will flatten the frame. Once the frame is assembled, lay a piece of plastic sheeting as a vapor barrier over the frame and top it with the smaller, interior OSB piece (Figure 10). Line up the top edge of the frame and OSB and center the OSB 1/2in from each side. Attach the OSB using 1 5/8in wood screws. Cut away any excess plastic sheeting. Flip the piece over and cut 2 pieces of 1 1/2in insulated foam to fill the interior void using the box cutter. Do not fill the cut out for the door. Place the foam into the frame with the shiny side facing you. This will be the outside of the structure.

Next, position the remaining piece of OSB (Figure 11) over the frame, align the top edges of the frame and OSB, and center the frame with a 2in overlap on each side. There should be a 1/2in extension at the bottom beyond the frame. Once the OSB is positioned, use 1 5/8in wood screws to attach it to the frame. The final front will appear as Figure 12 when viewed from above (interior).

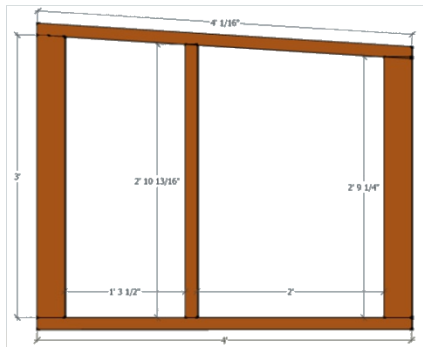


**FIGURE 12: COMPLETED FRONT**

Prime the bottom 12 inches of the interior of the front wall with the vinyl tile primer

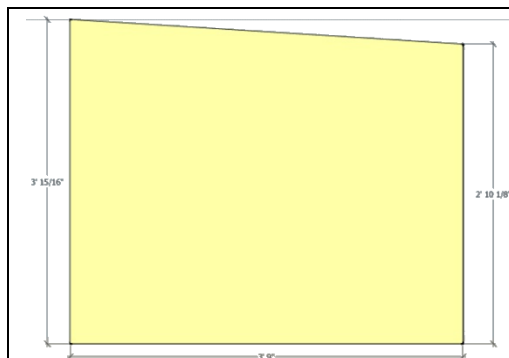
## BUILDING THE SIDES

The sides of the structure are made from two, mirrored 2 x 2 and 2 x 4 frames shown in Figure 13 sandwiched between a two sheets of OSB cut to the dimensions shown in Figures 14 and 15. Use a chop or miter saw to cut the 2 x 2's and 2 x 4's to length. The angle is 3.6 degrees, but 5 degrees is a fine approximation. The longest dimension of each 2 x 4 is shown.

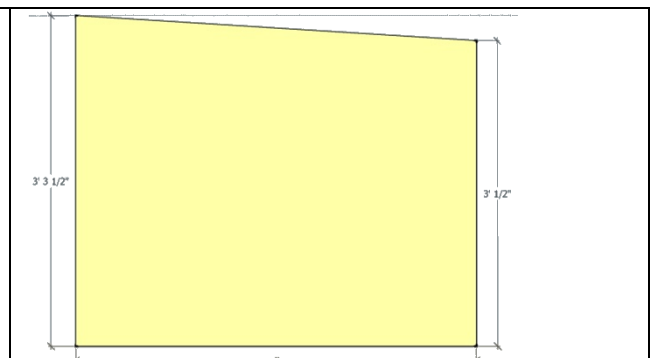


**FIGURE 13: SIDE FRAME**

To minimize the number of cuts when making the angle on the OSB use the cutoff from the exterior of one piece to make the interior of the other piece. Remember the “rough” side of OSB goes in, away from the weather. The angle is approximately 3.6 degrees, but marking a line between the shown measurements will provide an accurate guide. Use a circular saw to cut the interior and exterior OSB pieces.



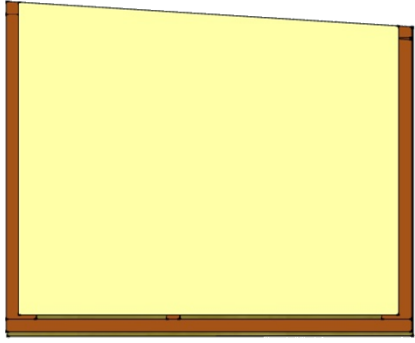
**FIGURE 14: SIDE INTERIOR**



**FIGURE 15: SIDE EXTERIOR**

Assemble the frame using 3in wood screws in each corner and centered through the cross member. Once the frame is assembled, lay a piece of plastic sheeting as a vapor barrier over the frame and top it with the smaller, interior OSB piece (Figure 14). Line up the top edge of the frame and OSB and center the OSB 1/2in from each side. Attach the OSB using 1 5/8in wood screws. Pre-drilling is recommended. Cut away any excess plastic sheeting. Flip the piece over and cut 2 pieces of 1 1/2in insulated foam to fill the interior void using the box cutter. Place the foam into the frame with the shiny side facing you. This will be the outside of the structure.

Next, position the remaining piece of OSB (Figure 15) over the frame, align the top edges of the frame and OSB, and center the frame squarely on each side. There should be a 1/2 inch extension at the bottom beyond the frame. Once the OSB is positioned, use 1 5/8 in wood screws to attach it to the frame. Repeat this process for the other side remembering that it is a mirror image of the first. Do not forget that the rough side will face the frame. The final sides will appear as Figure 16 when viewed from above (right interior shown).



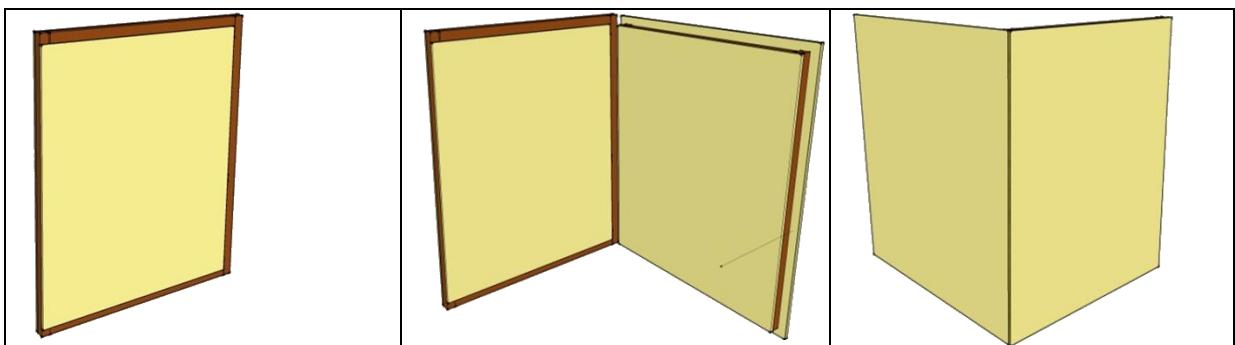
**FIGURE 16: COMPLETED (RIGHT) SIDE**

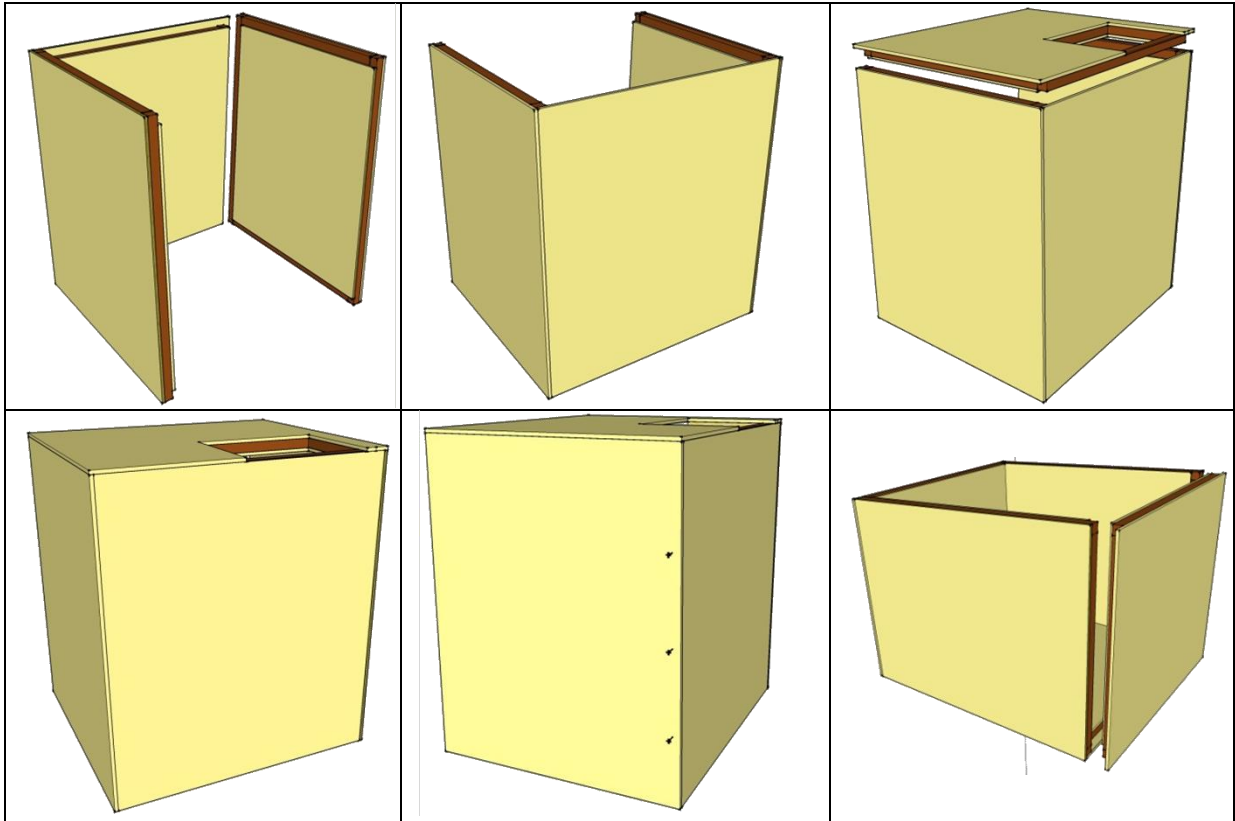
Prime the bottom 12 inches of the interior of each side with the vinyl tile primer

## ASSEMBLING THE STRUCTURE

At least two people are recommended for the portion of the build.

1. Position one side wall upright along the back side (longer vertical) edge
2. Position the base so that it fits inside the bottom lip of the side piece (This is along the 4ft measurement)
3. Square up the two pieces and attach using a 3in screw in each corner through the side wall into the base
4. Position the other side wall upright along the back edge and align with the base
5. Ensure the base fits inside the bottom lip of the side wall and secure using a 3in screw in each corner through the sidewall into the base
6. Place the front piece on top of the structure ensuring the bottom lip overlaps the base and the exterior “wings” fully overlap the side walls evenly. If any adjustments are required to the sides, stop now to make these adjustments.
7. Secure the front piece to the base and sides using 3in screws at each corner and in the center
8. Secure the sides to the base using six additional screws placed at approximately 1 ft intervals
9. Turn the structure upright and position the back wall into position ensuring the bottom lip covers the base and that the exterior squarely covers the side walls. Secure the back wall to the sides and base using 3 in screws in the corners and approximately 1 foot in from the top and bottom.
10. Take a breather.





## FINISHING THE INTERIOR

Grab your peel-and-stick tiles, straight edge, box cutter, PL-3 adhesive, silicone and a caulk gun and climb inside the structure. Fit the tiles to the floor following the instructions on the box. Use the box cutter to cut any pieces to size in the corners or at the ends of the rows. Keep track of which way the arrows face to make a tight fit.

The peel and stick tiles will not stay stuck to the walls when the weather heats up. I discovered this when all the tiles began to fall off. To remedy this proactively, when attaching the tiles to the walls use a bead of PL-3 adhesive about  $\frac{3}{4}$  inch from all edges and a squiggle across the middle when putting the tiles up. The tacky adhesive will keep the tiles in place when the weather is cooler, but can be held in place with a scrap piece of wood and a couple of bricks until the PL-3 sets when it is warmer. Run a single row of tile on the walls (unless you want to go higher then you will need to add more primer), cutting as needed with the box cutter and keeping the arrows facing the same direction. Once all the tiles are in place, run a thin bead of silicone along the edges where the walls meet the floor and in the corner of each wall. This will allow you to wash out the interior without concerns of water intrusion into the wood. This will also keep your tortoise's wet tendencies out of the wood as well.

## APPLY THE SIDING (OPTIONAL, EXCEPT OSB)

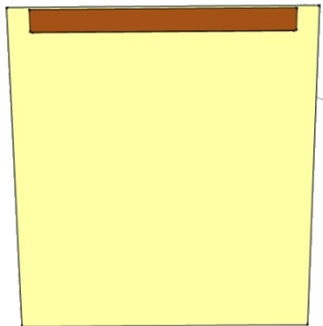
Due to the wide range of siding available, I am not going to add any directions to this section other than siding is required with OSB installations. Siding needs to be added before putting the roof on the structure to accommodate differences in width between different siding options.



## CONSTRUCT THE ROOF

The roof is made from a single piece of  $\frac{3}{4}$ in exterior grade plywood. This will support the weight of standard composite shingles, which are recommended for this build. A painted roof is not recommended, but is possible assuming it will be replaced every 2-4 years. The roof is 4ft wide and variable in length dependent on the siding selected and personal preference. At a minimum, the back of the structure will need to accommodate at least 4 inches to clear the 2 x 4 support for the a low profile gate hinge. The front of the house is variable, but 4 inches is also recommended as a minimum. The gate handle will be placed in this area to lift the roof for cleaning.

Once the length is decided, cut away the excess plywood with a circular saw. Attach a 2 x 4 as a hinge support measuring the width of the total structure (including siding) centered across the width of the plywood and  $\frac{1}{2}$  inch in from the short edge. Use 1 5/8in wood screws to attach the hinge support through the plywood.

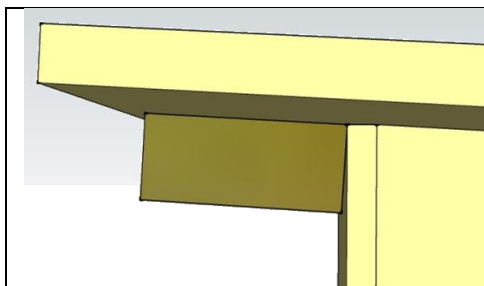


**FIGURE 17: ROOF WITH HINGE SUPPORT**

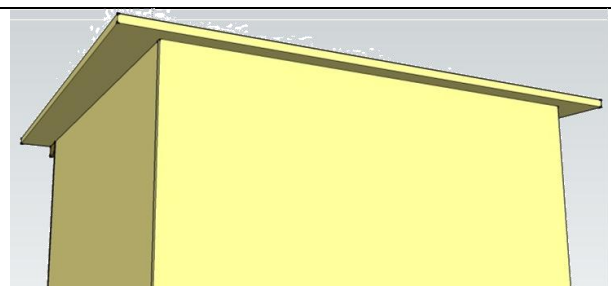
If a roof vent will be used (see Other Considerations below), cut the hole required for this installation prior to installing the roof. If overhead radiant heat panels will be attached to the roof, now is the best time to install any required support. Follow the directions provided by the manufacturer for mounting the installation. Do not install the actual panel at this time and do not attempt to mount the panel directly to the roof without some form of support.

## ATTACHING THE ROOF

Place the roof on the structure allowing the hinge support to lay snugly against the back wall. Center the roof over the structure in alignment with the 2 x 4 hinge support and attach the low profile hinges using the included hardware 28 - 32 inches apart. Pre-drill as per the instructions provided with the hinges. Ensure at least two screws of each hinge penetrate the 2 x 2 structure of the back wall. Longer screws may be required depending on the siding selected and the screws provided with the hinges. Test the swing of the roof before continuing and make any adjustments as required.



**FIGURE 18: CORRECT ROOF MOUNTING POSITION**



**FIGURE 19: ROOF VIEWED FROM FRONT**

## FINISHING THE ROOF (IF SHINGLES ARE USED)

Cover the roof with tar paper from side to side, bottom to top, overlapping layers. Cut away any excess and secure the paper with staples. Cut four pieces of 1 x 2 (or as purchased) flashing, two the length of sides and two the length of the top and bottom. Avoid bending the flashing as much as possible. Place a bead of roofing sealant bottom edge of the roof and install the flashing on the lower edge, securing with roofing nails in the center. (Pre-drilling the flashing may be required). Next, run a bead of roofing sealant down each side of the roof and overlap the bottom flashing with the side pieces. Secure the flashing every 12-16in, making sure to go through the ends of the side and bottom pieces where they overlap. Save the top piece of flashing until after the shingles are laid.

Starting at the bottom of the roof, align the bottom row of shingles and nail in place every 6–8in along the top edge of the shingle with roofing nails. Butt a new shingle adjacent to the first and cut off any excess with scissors or a box cutter after securing with roofing nails. Square the cut off as required and use it to start the next row overlapping the row below. This prevents having a single seam down the length of the roof. Continue up the roof overlapping each row as you go. Use the box cutter or scissors to cut away excess and make sure to install any roof fittings (vents) according to their instructions. As you approach the top three or four rows, adjust the spacing to avoid having excessive overlap at the top edge. The top row should be cut lengthwise at the tar strip that will be covered with flashing. When reaching the top row, place a bead of roofing sealant along the edge of the roof and lay the shingles in place. Then run a thin bead of sealant on top of the shingles and place the piece of flashing kept from earlier over the sealant. Secure the flashing and top row of shingles with roofing nails. While not required, a drop of sealant can be placed in the nail hole before driving the nail all the way down for extra water protection.

Finish the roof by installing the gate handle centered across the width a couple of inches in from the lower, front edge. The hardware that came with the handle will probably not work as is. I would recommend either supporting it from beneath with a piece of scrap 2 x 2 or swapping the screws for nuts and bolts with large washers to prevent the handle from ripping out of the plywood. Pre-drill through the shingles and plywood and seal the holes with roofing sealant before making the final attachment.

## BUILDING THE RAMP

The ramp can be made from the scrap plywood leftover from the roof or a solid wood product. As this part of the structure will make direct contact with the ground and see the most tortoise action, I built mine from 5/8in cedar fencing rather than plywood (solid wood is regionally optional). The length of the ramp will be based on the placement of the house (see below). Do not make the ramp too steep for the tortoise to climb. Ideally, the ramp will not exceed 2 inches of rise for every 12 inches of length (run). Place treads measuring approximately ½" by ½" using galvanized, exterior finish nails or an exterior wood glue every 3 to 4 inches along the length of the ramp to prevent the tortoise from slipping when entering or exiting the house.

## ATTACHING THE RAMP

Attach the ramp to the house using the extra set of gate hinges in the doorway as shown in Figure 20. If desired, cover the gap between the ramp and the floor with a scrap piece of plywood 1¼ inches by 19 inches long. Depending on how the hinges were installed will determine if any special consideration must be made to the filler piece. Remember the ramp will need to swing down to the ground based on its final placement.



**FIGURE 20**

## PLACING THE HOUSE

House placement is based on the variables of your enclosure. For my build, I sank four cinder blocks into the ground set approximately 2in in from the bottom edge of the base and topped this with a 2 x 6 “frame.” The frame is probably excessive, but provides additional structural support to the suspended base.



**FIGURE 21: STRUCTURE AND FRAME SUSPENDED ON CINDER BLOCK**

In all circumstances, leave some distance between the bottom of the house and the ground, preferably with something that will not rot. As another consideration, the house should not be so high that the tortoise could fall a significant distance when using the ramp. 1.5 to 4 inches above the ground is a reasonable height for most situations. If rodents are a problem in your area, the base can be dressed with a ½in hardware cloth skirt buried at a depth appropriate for your region.

## OTHER CONSIDERATIONS

### ELECTRICAL

You will need to provide electricity to the house for heating. Short sections of threaded EMT fittings can be purchased at home improvement stores. You will need to know the total thickness of the wall and the diameter of the cord being used. Add approximately ½ inch to the length of the fitting to allow the section to be locked into place with sealing nuts. Washers are available to make a snug fit between the interior and exterior surfaces if needed. Make the penetration near the top of the house, but below the top 2 x 2 to prevent compromising the structure. Place a bead of silicone sealant into the opening to prevent mold growth on the insulation when placing the fitting. Secure any wiring to the interior walls above tortoise height with wire brackets or staples depending on your installation requirements.

## OVERHEAD HEATING

Heating panels that hang above the tortoise will either need to be attached to the roof or suspended from a bracket on the side of the enclosure. Either method will work, but it is best to think about how this will be done before the structure is finished, particularly if suspending the panel directly from the roof as supports will need to be installed on the bottom of the roof before the shingles are installed. A solution suspended from the walls can be installed at any time, but will be easiest before the roof is installed.

## VENTILATION

Ventilation may be needed in some areas to remove excess heat. I purchased a shed vent/skylight from Duraflo (available on Amazon.com) that installs on the roof. Various vent designs are available that install in the walls or large (1 ½ - 2 inches) holes could be made just below the top 2 x 2's on the side of the house and sealed with silicone and EMT fittings as described above. These will be easiest to install before the roof is installed, but can be added later if needed.

