

# High Tunnel Hoop House Construction for New Mexico

Revised by Del Jimenez<sup>1</sup>

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High tunnel hoop houses are a type of greenhouse structure. They are built on the ground and are large enough to walk into. For heat, they rely on passive solar heating. They are practical and economical to build.

Hoop houses, cold frames, and high tunnels are all types of greenhouses with similar designs. The hoop house gets its name from its shape, although houses can be constructed with straight lines using elbows to get the desired shape for a building. The shape of a hoop house sheds water and snow from its exterior while allowing sunlight in to provide heat.

Houses of this category are made with aluminum or plastic PVC pipes as hoops that are covered with a single layer of polymer plastic covering. A second layer can be added for better insulation.

## REASONS TO BUILD A HIGH TUNNEL HOOP HOUSE

High tunnel hoop houses are self-contained ecosystems, and the environment inside can be manipulated to meet a crop's need. High tunnel hoop houses can extend the growing season since you can plant early, and the collection of heat units (such as growing degree days) with the plant is higher, resulting in earlier harvesting and a longer growing season. Planting in late summer and early fall allows you to produce and harvest throughout the winter months when us-



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ing the correct crops at the correct time. Planting in a protected environment guards the crop from bad weather and low temperatures and allows you to control the crop's quality.

### FACTORS TO CONSIDER BEFORE BUILDING A HIGH TUNNEL HOOP HOUSE

High tunnel hoop houses are relatively inexpensive to construct, costing around \$2.50 per square foot, with low maintenance once constructed. They are easy to build and adapt to small or large land units to meet the needs of gardeners and farmers alike.

Since plants need sunlight to grow, light penetration should be a concern in structure design. Grow lights can be used, but these require an electrical source. In areas where wind and snow are common, consider the load limitations the structure must have to endure stress. The height of the hoop house can be adjusted by lengthening the rib pipes so that you can walk and work inside comfortably; therefore, you should think about height before construction starts.

### SELECTING A SITE FOR A HIGH TUNNEL HOOP HOUSE

Select a site that is moderately level with good drainage and good soil if you plan to plant directly into the soil. A site can be modified by soil fill so that construction is on a pad. Select a site in an open area where trees and other obstacles will not affect sun penetration or create shadows (Figure 1).

Consider the surrounding area so the structure will be protected against high winds and heavy snows to help extend its life. Water will be needed in the high tunnel, and electricity may be an option you may want to consider. Security and protection against vandalism of the high tunnel hoop house and crop may also be a factor to consider when selecting a site.

### ORIENTATION OF THE HIGH TUNNEL HOOP HOUSE

In the Southwest, positioning your high tunnel in a north-south direction is preferable because air currents come from a south or southwest direction and will help ventilate the hot air buildup within the high tunnel hoop house on hot days. The east-west orientation favors sun penetration since the

sun tracks from east to west, going directly over the hoop house for maximum light penetration.

### PAINTING WOODEN MATERIALS

Before beginning construction, paint all wooden building materials with a durable exterior-type paint (Figure 2). This will help protect the wooden materials and extend the life of the hoop house.

### LAYING OUT THE HIGH TUNNEL HOOP HOUSE

Begin by choosing the size of a high tunnel hoop house that meets your needs. Then square off the corners of the high tunnel hoop house using the Pythagorean Theorem:

$$A^2 + B^2 = C^2$$

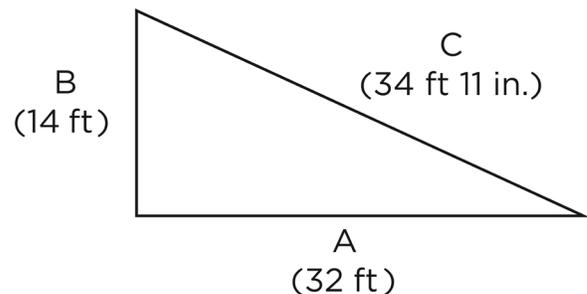
$$(\text{length of building})^2 + (\text{width of building})^2 = (\text{hypotenuse of building})^2$$

$$A (32 \text{ ft})^2 + B (14 \text{ ft})^2 =$$

$$C^2 (1,024 \text{ ft} + 196 \text{ ft}) = 1,220 \text{ ft}$$

$$\sqrt{1,220} = 34.92$$

$$C = 34.92 \text{ ft or } 34 \text{ ft } 11 \text{ in.}$$



Measure out two of the hoop house walls (one long and one short, corresponding to the length and width of the triangle example) and use stakes or similar materials to mark the three corners. Then measure the hypotenuse between the two outside corners. Adjust the corner markers as needed so the hypotenuse measurement is correct. Then mark the fourth and final corner, and measure and adjust the other hypotenuse.

## SETTING STAKES

After squaring the corners of the high tunnel hoop house, set four stakes in the ground using 1/2-in. rebar 24 in. long. Drive these stakes 12 in. into the ground at a 30-degree angle from vertical. The tops of the stakes should point inward toward the hoop house interior. Half of the stake will now be underground and half will be above the soil. Place a string around the four corners to outline the hoop house's foundation.

Along both lengths of the high tunnel hoop house and inside the string, drive 24-in. rebar stakes every 4 ft apart, 12 in. deep, at a 30-degree angle, until you reach the desired length of building (Figure 3).

## SETTING THE PLASTIC PVC PIPE HOOPS

The standard length for PVC pipe is 20 ft. With a 12-foot-wide hoop house, the height in the center is approximately 6 1/2 ft. On a 16-foot-wide hoop house, the height is approximately 5 1/2 ft.

Adding an extra 5-ft length of pipe to each rib will increase the height and width of a hoop house. With 25-ft. ribs your high tunnel hoop house will be about 8 1/2 ft high at a 14-ft width.

It is recommended that you add the extra length to the ends of a 20-ft pipe because, when the pipe is bent, the stress is not as severe on the glued joint.

There are various diameters of PVC pipes that can be used for the hoops; 1 in., 1 1/2 in., and 2 in. are the most common.

We recommend using 2-in. PVC because it holds up well to winds blowing 50 mph and the occasional snow 10 in. thick on



*Figure 1. Preparing land for a high tunnel hoop house.*



*Figure 2. Painting all wooden materials for a high tunnel hoop house.*



*Figure 3. Placing the rebar stakes and marking the outline of the hoop house.*



**Figure 4.** Laying out the plastic PVC pipe for the hoops for the high tunnel hoop house.



**Figure 5.** Bending the PVC pipe for the high tunnel hoop house.



**Figure 6.** Using an I-beam level to ensure the side braces are level.

the plastic. Use new plastic pipe for construction because weathered pipe will be brittle and break when bending. Once the pipes for the hoops have been bent and weathered, the pipe will retain its bent shape and can be reused for another hoop house project.

When the rebar stakes are set, it's time to place the PVC pipe (Figure 4). This is accomplished by placing one end of the pipe over one of the rebar stakes, then bending the pipe to place the opposite end of the pipe on the stake on the opposite side (Figure 5). If the rebar stakes are perpendicular to the ground, it is very difficult to place the pipe on the spike. That is why stakes should be placed at a 30-degree angle.

### **INSTALLING THE WOODEN BASEBOARDS**

Baseboards are installed to give the hoop house stability, and are where the plastic covering is attached. The baseboards should be 1 in. x 4 in. boards, butted and fastened together by 12-in. brace pieces to equal 32 ft. On the outside of the hoops along the base of the hoop house, place the baseboard using 2-in. drywall screws fastened to the 2-in. PVC pipes. Make sure the screws and brace pieces are faced toward the inside when installing the baseboard.

When both sides are in place, drive three 24-in. rebar stakes bent in a "J" design along each side. These are hooked over the bottom baseboard to provide stability during high winds. Also place another 1 in. x 4 in. x 32 ft batten board 5 1/2 ft

from the ground along each outside side to improve stability. Use an I-beam level to ensure that the batten boards are level along the length of the hoop house (Figures 6 and 7).

### **INSTALLING 3/4-IN. PVC PIPE INSIDE**

There are three 3/4-in. PVC pipes running the length of the inside of the high tunnel hoop house that will be used for stability, and can be used to install sprinklers or drip irrigation once your house is completed. These PVC pipes will be placed on the 1 in. x 4 in. x 32 ft side batten boards that were installed in the previous step. Use 3/4-in. conduit saddles to hold the pipes to the wood. Use 2-in. screws to attach the wood to the 2-in. PVC rib pipe. The third 3/4-in. pipe and batten board will be put in the center inside of the high tunnel (Figure 8).

### **ADDING END WALLS**

Stretch a string at ground level along the bottom of the first hoop and find the center, which will be used as a guide to construct the entrance. Measure along the string 2 ft in each direction from the center point. Mark these spots and dig a hole 6 in. around and 18 in. deep. Place a 2 in. x 4 in. x 10 ft board into each hole, and angle the top so that the wood fits under the hoop (Figure 9); cut the board to length if needed. Level the 2x4 in both directions, making sure there are 48 in. from the center of the hoop to the wood. Fill in the holes with dirt, and secure the top with a 4-in. drywall screw running through the pipe into the wood.

When the uprights are set, frame the bottom and the middle from the door frame to the 2-in. plastic rib pipe using 2x4s cut to size; refer to Figures



*Figure 7. High tunnel hoop house structure going up, with base and side batten boards.*



*Figure 8. Attaching 3/4-in. water pipe lines to the batten boards.*



*Figure 9. Construction of end wall on high tunnel hoop house.*



**Figure 10.** Framing of end wall on high tunnel hoop house.



**Figure 11.** High tunnel hoop house structure.



**Figure 12.** Making a door frame for the high tunnel hoop house.



**Figure 13.** High tunnel hoop house structure with door frame installed.

10 and 11 for examples. Then construct a door using 2×4s to fit into the door frame and attach with door hinges. This is done at both ends of the high tunnel hoop house frame (Figures 12 and 13).

### **ATTACHING POLYETHYLENE PLASTIC COVERING TO END WALLS**

Greenhouse polyethylene plastic film is a durable and inexpensive way to cover your greenhouse. It offers UV protection, and can last for up to 12 years if cared for correctly. It will also retain a lot of heat and humidity for year-round growing. The film comes in rolls 100 ft long and 12–54 ft wide. For the hoop house, use 6 mil plastic film 24 ft × 100 ft.

Cut the plastic to the appropriate size (Figure 14); the pieces should be cut several inches larger than the end walls so you have plastic to pull on while stretching it over the ends.

Starting in the middle of your end walls, attach the greenhouse plastic to the frame, always keeping the plastic stretched taut (Figures 15 and 16). Sandwich the plastic covering between a 1/4 in. × 2 in. × 10 ft long furring strip and the frame of the building. The furring strip will be placed on the outside of the end wall's frame pipe (Figure 17). Once the plastic is in place between the furring strip and the pipe rib, proceed to attach the plastic cover onto the 2-in. plastic pipe ribs using screws 10 in. apart. You may want to pre-drill a 1/4-in. hole in the furring strip every 10 in. before attaching the wood strips to the plastic pipe.

Now that the plastic is attached to the end walls, proceed to cut out the door in the door frame.

### **ATTACHING POLYETHYLENE PLASTIC COVERING OVER HIGH TUNNEL HOOP HOUSE FRAME**

Cut a piece of plastic that is around two feet longer than the total length of the hoop house; this will give you extra plastic to pull on while stretching the plastic over the frame. Pull your greenhouse plastic over your high tunnel hoop house frame. Be very careful that the plastic does not hook onto anything when pulling it over.

Start from the middle and work your way outward, pulling the plastic tight while attaching your plastic cover to the outside batten board (Figure 18). Once attached, go to the opposite side and attach your plastic cover to your other outside batten board.

Now that your plastic cover is attached, pull your plastic down and out and attach it to the baseboard (Figure 19). Proceed to the opposite side and repeat.

On the end rib pipes, pull the plastic cover out and sandwich the plastic between a 1/4 in. × 2 in. × 10 ft long furring strip and the rib pipe. Trim excess plastic off your building.

## CONCLUSION

A high tunnel hoop house is a practical tool that is affordable to construct and practical to use, and can extend the growing season and possibly improve income for an operation. By choosing selective low-profile fruits and vegetables that withstand cold temperatures, it is possible to grow most of the year without using heating equipment and electricity. These structures, with special plastic covers, can keep inside temperatures 4–6°F warmer than outside temperatures, and with a row cover made from specially improved webbings over the crop, another 4–6°F increase can be obtained. With these structures, you can make the farming of food crops affordable, profitable, and fun all year long.

Photos of the hoop house construction were taken at a Taos Pueblo workshop.

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Figure 14. Laying out the UV protectant plastic cover that will cover the high tunnel hoop house.



Figure 15. Attaching UV protectant plastic to the end wall on the high tunnel hoop house.



Figure 16. Attaching UV protectant plastic to the end wall on the high tunnel hoop house.



Figure 17. Use a furring strip to attach the UV protectant plastic to end wall on the high tunnel hoop house.

<b>Hoop House Construction Material List and Estimated Costs (as of 3/2019)</b>			
<b>Item</b>	<b>Cost per (\$)</b>	<b>Quantity</b>	<b>Total cost (\$)</b>
Plastic PVC pipes, 2 in. x 20 ft	22.00	10	220.00
Plastic PVC pipes, 3/4 in. x 20 ft	8.00	5	40.00
Two-hole conduit straps	0.25	28	7.00
Rebar, 1/2 in. x 24 in.	2.75	18 standard 8 J-hooks	71.50
Glue and primer set	25.00	1	25.00
Drywall screws			
1 in. (box of 150)	7.50	2	15.00
2 in. (box of 150)	7.50	2	15.00
3 in. (box of 150)	7.50	2	15.00
4 in. (box of 150)	8.50	1	8.50
Wooden boards			
1 in. x 4 in. x 10 ft	8.50	21	178.50
1 in. x 4 in. x 12 ft	9.00	7	63.00
Plastic film cover (6-mil), 24 ft x 100 ft	330.00	1	330.00
Wooden studs, 2 in. x 4 in. x 10 ft	4.50	25	112.50
Hinges	2.50	4	10.00
Latches	3.50	2	7.00
Paint	25.00	2	50.00
Roller brush	10.00	1	10.00
<b>Total Cost</b>			<b>1,178.00</b>



*Figure 18. Attaching UV protectant plastic over the high tunnel hoop house.*



*Figure 19. Attaching UV protectant plastic to the high tunnel hoop house baseboards.*

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