

HOOP HOUSE  
CONSTRUCTION

12' X 32' HIGH  
TUNNEL

SHERIDAN COLLEGE

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## HOOP HOUSE

A “cold frame” hoop house is also known as a high tunnel or a Quonset house. Basically it is a common design for a polyethylene greenhouse. The frame consists of PVC pipes bent into an arc forming the trusses or ribs of the house. The PVC pipe is placed onto rebar that functions as the footer. These ribs are connected by one or more purlins on each side as well as one on the top. The shape of the Quonset, will allow water and snow to shed from its exterior, while permitting the sun to provide light and heat. The shape allows wind to flow over the top curve making it more stable. It is cooled manually with roll up sides located half way up the structure and doors located on both ends.

## WHY BUILD A HOOP HOUSE

A hoop house can extend a growing season up to 180 days from the normal 65 to 125 day growing season in the Sheridan area. It provides protection from; harsh winds, hail, snow, fluctuating temperatures and wildlife. The inside of the house is its own ecosystem. Pests and diseases can easily be managed. The environment inside can be manually manipulated to adjust to the crops needs. The permanent lower sides allow for early spring planting by keeping harsh cold breezes from blowing over tender young plants. The increase collection of heat units, with the plants, result in earlier harvest. Late summer and fall planting can allow for harvesting well into fall and winter months.

## FACTORS TO CONSIDER BEFORE BUILDING

Relatively inexpensive to construct the hoop house can cost roughly \$1.00 per square foot, with low maintenance once constructed. A hoop house of this size can be constructed for \$1200.00 to \$1400.00, more or less depending on any extras that might be included. Extras might include the use of a small heater, a cooling fan, thermal heating where available, or grow lights. Always consider availability of electricity when including these extras. Other extras may include variations on the irrigation system, such as drip or soaker hoses. Water availability and quality should also be considered for the placement. You should always consider load limits where snow and ice may cause undue stress on the structure. Before construction, consider the height of the structure for walking and working comfortably while inside. Height can be adjusted by changing the width of the structure. A 20 foot PVC arc with the footers (rebar) at the width of 12 feet will be at a height of roughly 6 feet, 6 inches.

## SUITABLE LOCATION

Select a site that is level as possible or leveling can take place easily and has good drainage. The soil type and testing can take place at this time but can be amended after construction. The site should be in an open area free from obstructions like trees and tall buildings that can affect the sun exposure to the house. If possible locate the house at least 100 feet to the south or southeast of a windbreak, hill or tree line. This will help protect it from high damaging winds and provide a natural snow fence prolonging the life of the house and will also decrease heat loss. Other considerations of location (as

stated above) are availability of electricity and water. Security and vandalism might also be a factor in site selection.

## ORIENTATION OF THE HOOP HOUSE

Placement on the site is with both ends with doors facing the north and south. With this orientation, generally the wind currents will be from the north, northwest allowing hot air to flow out for a cooler environment inside. This north south direction also favors full sun exposure rising in the east and setting in the west.

## PAINTING THE WOOD

After purchasing lumber, (see supply list), you will need roughly 540 linear feet of 3/8" lath, that has been "ripped" from six 2"x 4"x 10' wood studs for the entire house. It is advised to paint all wood pieces ahead of time to allow for drying time. Paint all 4 sides of wood and the ends with high quality outdoor/exterior paint. Any touch ups can be done after construction.

## PREDRILLING

Using a 1/8" drill bit, predrill 32' of the painted lath, starting 1" in from each end and every 6" in between for the roll up sides. Set this aside for later when assembling the roll up unit. All of the rest of the lath can be pre drilled 1" from end and 12" in between. Predrilling will allow lath to be screwed into without splitting the wood. At this time the U- channel can be predrilled 1" from end and 9" apart in between.

## LAYING OUT THE HOOP HOUSE

After choosing the size of hoop house that meets your needs, you will need to square off the corners of the house on your chosen site using the Pythagorean Theorem,

$$a^2 + b^2 = c^2, \quad (\text{length})^2 + (\text{width})^2 = (\text{hypotenuse})^2$$

Example 1

A 12'x 32' structure would be:  $(12')^2 + (32')^2 = (C)^2$  or

$144' + 1024' = (1168')^2$ . The square root of 1168' is 34.18'. Your corner to corner measurement diagonally, from the left top to the right bottom corner and the right top to the left bottom corner should both equal 34.18'. Squaring the building is critical and will assure that the rest of the construction of the structure will proceed normally.



## SETTING THE STAKES

After squaring the corners of the hoop house, mark the corners by setting four,  $\frac{1}{2}$ " rebar stakes that have been cut into 2' lengths. Drive these stakes 1' into the ground at a 30 degree angle from vertical. The stakes should be leaning towards the inside of the would-be structure and should be half way in the ground and the other half is above the ground. Place a string around the four corner stakes as if to frame the outline of the structure and pull tight. This will give you a straight line along

both lengths, to follow while driving the rest of the rebar stakes into the ground. Along and on the inside of the string line, drive the stakes, 4' apart and at 30 degree angles like the corner stakes. Make sure all your rebar is even, all at 30 degrees, and all are straight across from the one opposite it. You can use your foot to push the rebar in or out if needed.

## MAKING THE PVC PIPE RIBS

Use new plastic pipe for construction because weathered and used pipe may be brittle and could break when bending into shape. You will need 9- Schedule 40- 20' pipes total, for the ribs and the other 4 pipes will be used for the roll up sides. See supply list, 13-20' pipes total will be needed and may need to be special ordered from a plumbing supply, because the most common size sold in lumber stores is 10' and not recommended for the structure. It is recommended to use 2" pipe because it will hold up well against the stress of high winds and snow loads in the winter.

To set ribs on stakes, start by placing one end of pipe over one of the stakes. To help with the installation of the pipe onto the lateral rebar stake on the opposite side, a rope looped around the top end will help to pull and bend the pipe till it can be placed firmly onto the opposite rebar. Make sure all pipes are solid onto the stakes and the ribs are all uniform and even. Adjustments can be made to make them even and line up by using your foot to push in or out on the rebar.



## PLACING WOOD BASEBOARDS AND PURLINS

Side boards are installed to give the hoop house stability, and support the plastic covering. This is also where the plastic cover is attached. The inside of the base board will be made up of 2-16', 2"x4" studs scabbed together with a short pieces of 1"x4", using 3" screws to make one section. You will need two sections like this for each side of the bottom of the inside of the house. The outside sections will be made up of a 10'-1"x4", scabbed to a 12'-1"x4", scabbed to another 10'-1"x4' using 3" screws. The 12' piece needs to be in the middle with the 10' pieces on the ends. You will need two sections like this for the bottom outside of the house. Holding a level on the PVC rib, attach the inside baseboard (2"x4") to the PVC pipe using 2" screws. Attach the outside boards (1"x4") with 1 1/2" screws. When attaching to boards to the PVC put one screw slightly on the right top and the other slightly on left bottom to avoid hitting the rebar inside the pipe. When the bottom boards are in place anchor them with 6-24" pieces of rebar bent in the shape of a "J". Drive the stakes in, hooked over the inside boards, 3 on each side, spaced evenly. This will help keep the hoop house anchored during high velocity winds.



To make the remaining five support braces or purlins, you will need to scab together 2- 10', 1"x4" pieces and a 12' piece like you made for the bottom of the outside of the house. Measure from the top of the base board, up the rib 32" and make a mark with a line on all four corners. Tie a string (plumb line), at the marks on one side of the house. This is where your side purlin will be located under the string line. Using 1 1/2" screws attach the purlin, don't fasten ends yet and don't over screw, then repeat on other side. Repeat the process of measuring from the base up 6' on the corner ribs and mark. Tie plumb line and repeat process to attach second set of purlins. The 4 side purlins are located on the outside of the structure with the scab pieces facing to the inside. The top support is located on the inside of the structure with the scab pieces facing out. Find the center of the arcs on both ends and attach the centered final support. Do not fasten the ends yet. This support adds stability and will also be used to fasten overhead irrigation system.

## DOOR FRAMES/END WALLS

At both ends of the hoop house, door frames will be added to hold the doors. The doors will be used to access the structure and to open for air circulation, and to release the heat from inside. The frames will also add stability to the house. Measure between the baseboards and find the center of the end wall and mark on the ground with a thin spray paint line. Measure out 2' both ways from the center and mark for post holes. Post holes should then be dug 2' deep for stability. When in place the door opening will be 48" wide, which complies with the ADA requirement for wheel chairs and will make it easier to access with a wheelbarrow or a rototiller. Measure and cut 2-48", 2"x4' boards. These will be the headers for the top of the door and will double for the spacers on the bottom for both ends. Mark them as header so that they will not be used in haste somewhere else. Also mark the center of the header/spacer. After holes are dug and are wide enough place a 10', 2"x4" in each hole. This is a good time to place your 48" header as a spacer marked in the middle on the ground between the uprights. Line it up with the center spot you marked in the soil to make sure both uprights are centered. Using a level hold upright against the rib and trace angle where the board, after cut, will fit under the rib making sure bottom of upright is snug against spacer. Cut the board on the angled line and return to hole and fit under the pipe. Make sure upright is level, drill holes through PVC on top. Secure the board with 2-3" screws that are put in off sides and at an angle. After secured and keeping board level, fill in hole and tamp in the soil firmly. Quick Crete can also be used to hold the uprights firmly. With your spacer still in place repeat process of tracing the angle, cutting and securing with the other upright and fill and tamp in. Repeat the process on other end of house. Measure on both uprights from the ground up to the height you wish your door to be and mark. Level and attach header between uprights using 3" screws. Measure from the bottom of the door frame to the base board, and use a 2"x4" piece, the outside end will be marked and cut at an angle to fit snug between the two, repeat on other side. Attach with 3" screws at an angle at top of end into the base board. Finishing pieces for the end walls between the door frame and the ribs, at the height even with both sets of purlins, can be cut out of scrap pieces of 2"x4"s. Hold 2"x4"s up at the level even with the purlins with end against door frame and "eyeball" the angle and mark with a pencil. Cut and attach with 3" screws.



## DOORS

It is best to assemble door on a flat area or on a large piece of plywood to assure that it will be flat and square, using 3" screws. You will need seven - 8', 2"x4"s for the door. Measure length and width of inside of door frame. You will need to leave a ½" gap between door and frame. Example: If your door frame measures 72"x48", measure and cut two- pieces 71 ½" and three pieces 47 ½". Out of shorter scraps cut four- 1' 2"x4" with 45 degree angles on the ends, for corner braces of door. Place hinges on side of door 16" down from top and 16" up from bottom, door should swing out. Drill hole through bottom of door to allow for a piece of rebar to go through and be driven into the ground to anchor door open during hot weather. This will keep door from swinging and slamming shut in high winds. Hold door in place and attach with 1 ½" screws. Finish door frame on inside with 3- 1"x4"s measured to the same length and width as door frame. This gives a finished look and serves as an air gap door seal that covers the ½" door gap.

## ATTACHING THE POLYETHYLENE PLASTIC COVERING

The green house plastic acts as the skin to the structure, letting light rays in and keeping the weather out. It is recommended to use 6-mil polyethylene that has been treated with a UV inhibitor. Unprotected poly plastic of a lower grade can break down over a growing season. The expected life of a good grade poly is 6 years minimum but can last up to 10 years depending on proper installation and weather conditions. Poly can be ordered in rolls of 100' lengths and varying widths, depending on need, from a greenhouse supply company, see list. Start with the piece of poly, measuring 5'x100'. This will be your permanent side that wraps around the bottom of the structure. It extends from the south door frame to the north door frame on both sides of the house. Be sure to leave an excess of at least 1' on the bottom all the way around. After construction, trench plastic in and fill with dirt to secure. Start on front side of



the door frame. Secure poly with lath that has been cut to length. Attach with 1" screws. Pull material to the outside of the house holding as tight as possible with no wrinkles. Attach with lath on top then pull tight towards bottom, still pulling towards outside, and attach lath to bottom. Still holding poly tight, attach lath to rib on the outside of corner. Cut poly 2 "past the lath along the rib, one half of the end is now done. Now place the poly along the side with the top of poly even with the top of the first purlin and hold tightly across. Secure end of poly to the corner with lath on the "end" side of house. Attach Aluminum U-

channel along the center of the first purlin, over the top of poly to hold poly in place. Poly will need to remain stretched tight across side while fastening with 2" screws. Now secure bottom of plastic to base boards with lath, pulling down as tight as possible. You can use your weight by stepping on the excess material while having someone else screw on the lath. Lath should be even with the top of base board.



Now fasten end of poly, to other corner with lath on the “end” side of building. Now repeat procedure on ends and other side.

To successfully complete the next step of applying the top piece of poly it is helpful to have extra labor available, and no wind. Work with the poly, in the heat of the day, so the plastic can heat up and stretch. Lay out the 18’x50’ piece of poly out on a large clean area alongside the hoop house, to warm up. Grab ends of poly and gently drag the material over the top of the ribs.



Make sure it is centered with equal lengths on all sides. Let poly rest for 15 minutes to absorb the heat. Keeping the plastic stretched, temporarily attach one side by weaving three of the the stainless steel spring wires or “wiggly wire” into the U-channel along the purlin. Fasten the middle wiggly wire first then the two outside ones. Pleat the plastic as if making hospital corners towards the ends. Now pulling on both ends of poly above the doors, and keeping skin tight, attach lath over the top of the arc of the pipe, continuing down both sides till you reach the top of second set purlins. Do not fasten end of lath



yet. Now stretch center of end piece straight down over the door and hold firmly while both side pleats are now pulled firmly out to the sides, remove any wrinkles. The tighter the plastic is the better. Measure and attach two upright pieces of lath from the



bottom of the door frame up to the PVC on both sides of the doorframe. Measure and attach a piece of lath across top of door frame between the two uprights. Holding the plastic firmly and removing wrinkles, attach the plastic to the door with lath all the way around the door. Now still holding the pleats out firmly, and wrinkle free as possible, fasten plastic down on outside of pipe with a section of u-channel.



This vertical U-channel will be where you will secure the ends of the roll up sides during winter. Now attached to the corner, you will have two layers of plastic from the pleat, cut only the piece of plastic that is closest to the U- channel. Continue pulling tight and attach the upper part of plastic under the lath you did not fasten completely on the pipe above second purlin. Cut plastic on corner as if making sections that will fold over each other. Firmly pulling down on plastic on the sides attach lath along second purlin. Don't fasten ends of lath yet. The cut pieces can then, be tucked under the lath and fasten ends. This will allow for a tighter fit on edge. Now repeat process on other corners and side. Complete ends by the doors by fastening lath on to cross members even with the first purlin. This will further tighten and secure plastic on ends. Now cut plastic around door, between lath on door frame and lath on door. Now door can be opened. Attach eye hook and eye to fasten door shut. A variation on door could include two pieces of plywood covering the door and hinged in the middle to open down like a Dutch door.



## ROLL UP SIDES AND HANDLES

Line up the writing on the sides of two 20'-2" PVC pipes and glue together with a slip coupler. Undo wiggle wire on side of house leaving sides to hang down. Lay out enough laths, end to end, to attach pipe to plastic. With several people holding the pipe, cradle it in the plastic. Make sure that one end of the pipe is at least 2" past end of structure. This will be the end that is capped. The other end will stick out past the structure about 6". This will be the end that the crank made of 90 degree elbows and an end cap will be attached. Make sure it is straight all the way across and just below the first purlin. Use tape measure to make sure pipe remains the same height all the way across. Using the writing on the pipe as a guide to line up where lath will be attached will assure it remains straight. Roll plastic around pipe and screw on lath over the top of writing. Cut excess plastic as needed next to lath. Repeat on other side. To secure the crank when roll up sides are open, fasten bicycle hooks to the bottom end of the house near the crank and attach a nylon rope with a loop in it. This will keep the side from unrolling and slipping down when open.

## SOLARIG BATTEN TAPE

Cut 16 pieces of lath about 1' long. Wrap end of tape around lath by rolling it, about 7 to 8 times. Screw on each side of lath below existing lath on bottom of base board centering tape between each rib. Make sure tape is "pinched" between the two pieces of lath. Unroll enough tape to be able to throw the roll over the top of structure to other side. Make sure tape is not twisted and lying flat. Holding tape down at the bottom cut an extra 15" or more. Wind end of tape around lath and while someone is pulling tape down tight, screw on lath like the other side, below existing lath on base board. Repeat process till there is batten tape between every rib. The batten tape also adds more stability and tightens the poly down on the ribs so it will not flap in the wind which can damage it.



## IRRIGATION

There are several things to consider when adding your irrigation. You can have an overhead system like shown but the sprinklers may or may not reach the sides of the house so some crops will not receive adequate water. Turning these heads, angled towards the outside may solve this problem. You must take into consideration the "ecosystem" you have created; it will stay moister and more humid which can lead to more fungal diseases. This particular system is constructed with  $\frac{3}{4}$ " PVC pipe, PVC "T"s, "90"s and slip ball valves. See supply list. A garden hose can attach to one end of the system on one of the side pipes, and will supply the water that will run throughout the system. The PVC pipe with the hose will connect to the other side and to the top pipe, by attaching an arch of  $\frac{3}{4}$ " pipe on the end of the house. This arc will fasten to the rib on the end. A good suggestion may be to add along the sides, on and off valves and attach drip or soaker hose to the "T"s. that way you can regulate the amount of water to different kinds of crops that may need more or less water. If you can envision it you can probably come up with a system that meets your needs.



## CONCLUSION

A hoop house is a practical tool to extend your growing season and can be made to different sizes simply by adding or subtracting PVC ribs. They can be constructed easily and affordably to meet your needs. With careful planning, and some maintenance they can last for years. Keep in mind, with hoop houses there is always a learning curve involved, this can be anything from what crops do well, to pest management or changing the irrigation. Sometimes we learn better with trial and error and what best suits are needs. Have fun and enjoy.

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