



## **Do It Yourself Plans**

**for a 20' 0" diameter dome made with 2 x 4 's**

These instructions are not for a hub-&-strut system, they are for the Good Karma no-hub dome building. If you are not a carpenter who knows how to operate a radial-arm saw, find one. There are several different angles to cut, and the radial-arm saw is the easiest way to cut them. Most importantly read everything thoroughly and try to build this in your mind before you start. Take two or three days and just digest everything. We ask that you take pictures and keep a journal of how things went. Don't be fooled, there is a lot of work involved, we are here for your questions but please try to work it out yourself as I want this to be a good learning experience. Make your models first!!! Good Karma Domes is not to be held responsible for accidents or injuries. You should have the video with the shop help, if you do not, please call.

Only the A struts will have different end cuts - different from each other. All the other struts will match at both ends. In other words: when you get one end sitting right "You can cut the other end by turning the strut over and moving it from left to right against your stop on the right (At the Radial Arm Saw)." See video.

With this size dome you are best to start with EEE triangle as it is easiest and all strut lengths and angles will be the same. Layout plywood centering EEE triangle you will have to piece in the top. Use scrap pieces for BCC triangle. This way you only need 80 sheets of plywood. To sum up cut large triangles out of centered piece of plywood and butt factory edges of scrap or cutt-offs for smaller triangles.

By cutting the E struts first; if you make a mistake, you can recut it for another shorter strut. In other words you can recut any mistakes. End pieces or cut-offs can be used for interior framing. Use E strut cut-offs for A triangles and vice-versa.

Please make notes as we are always trying to improve. Take pictures during building and after erection. We like to place pictures of our customer's creations on our web site. If you have any questions or just want to review before you start or during we are here to help.

On assembly; we now recommend using "Sure-Seal" (found at local lumber yard). It is a polystyrene product and comes in 3-1/2" and 5-1/2" widths. Use this in place of caulking between triangles during erection. It is easily stapled to sides of panels. One piece only between panels. This also helps triangles to slide into place.

We recommend that you cut the B side of last five pent triangles AAB a 1/4" short. Label these five triangles to be saved for the zenith or top of dome. As these are the last to go in and are very tight. They will still be tight but allow you some leeway. After bolts are tightened, windows are in, doors are in, come back and paint loc-tite on nut and bolt threads. Also a good idea is to take a nail gun and nail triangles together (insurance).

## On to the building!

Precision is of the utmost importance for a good fit. Any miscalculations in measuring and cutting will be multiplied around the dome and will cause it to not fit properly or be very difficult to assemble.

See table for the lengths and numbers of each strut needed. Notice there is a inside and outside length for each strut, these are specifically calculated for a 20' 0" dome built with 2 x 4 's only. Any other lumber type will not work with these measurements.

# needed	outside length	Strut	inside length
60 each	30 -3/8"	<b>A</b>	29 -9/16"
60 each	35 -5/16"	<b>B</b>	34 -3/8"
120 each	35 -3/16"	<b>C</b>	34 -1/4"
120 each	37 -7/16"	<b>D</b>	36 -3/8"
60 each	38 -7/8"	<b>E</b>	37 -13/16"
60 each	35 -11/16"	<b>F</b>	34 -3/4"
total	480 struts		

floor area	290.3171 sq. feet	interior volume	1907.190 cu. feet
w/ 1/2 loft	435.4756 sq. feet	surface area	613.1981 sq. feet
w/ 5/8 loft	471.7653 sq. feet		
w/ 3/4 loft	508.0549 sq. feet		

### Useful Math

$$\Pi = 3.14159265$$

r = radius

d = diameter

h = height

$$\text{Circumference of circle} = 2*\Pi*r \text{ or } \Pi*d$$

$$\text{Area of circle (use this formula for square footage)} = \Pi r^2$$

$$\text{Area of sphere (skin: use this formula for roofing)} = 4\Pi r^2$$

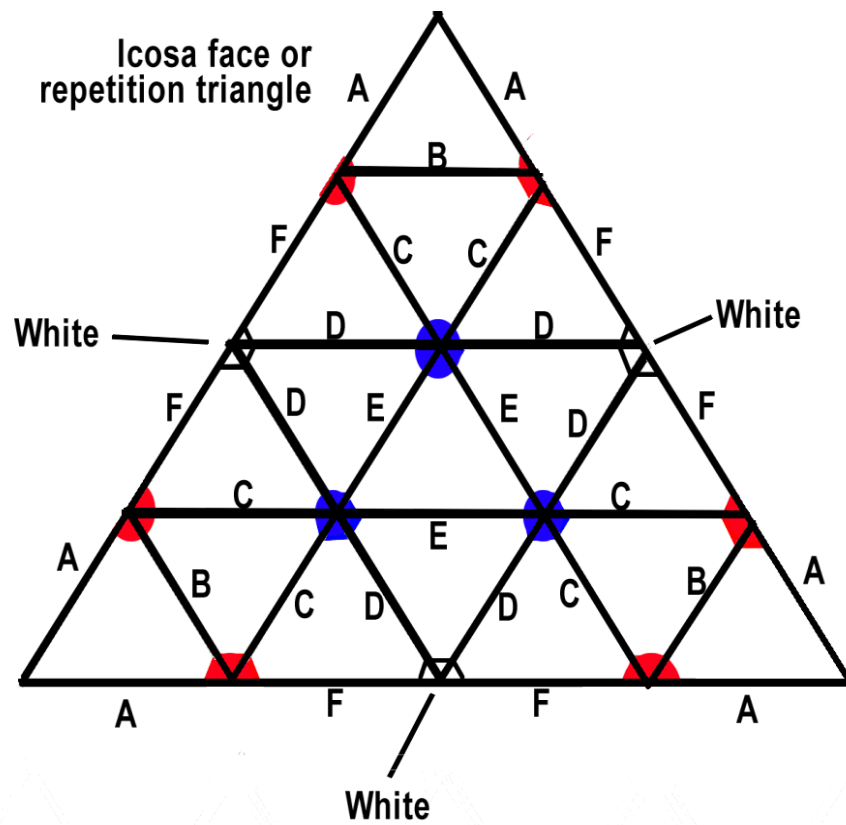
$$\text{Volume of sphere ( use this formula for HVAC)} = 4/3\Pi r^3 \text{ (note: this for a full sphere)}$$

$$\text{( Hemisphere is } 2/3\Pi r^3 \text{)}$$

$$\text{Area of triangle} = 1/2 bh$$

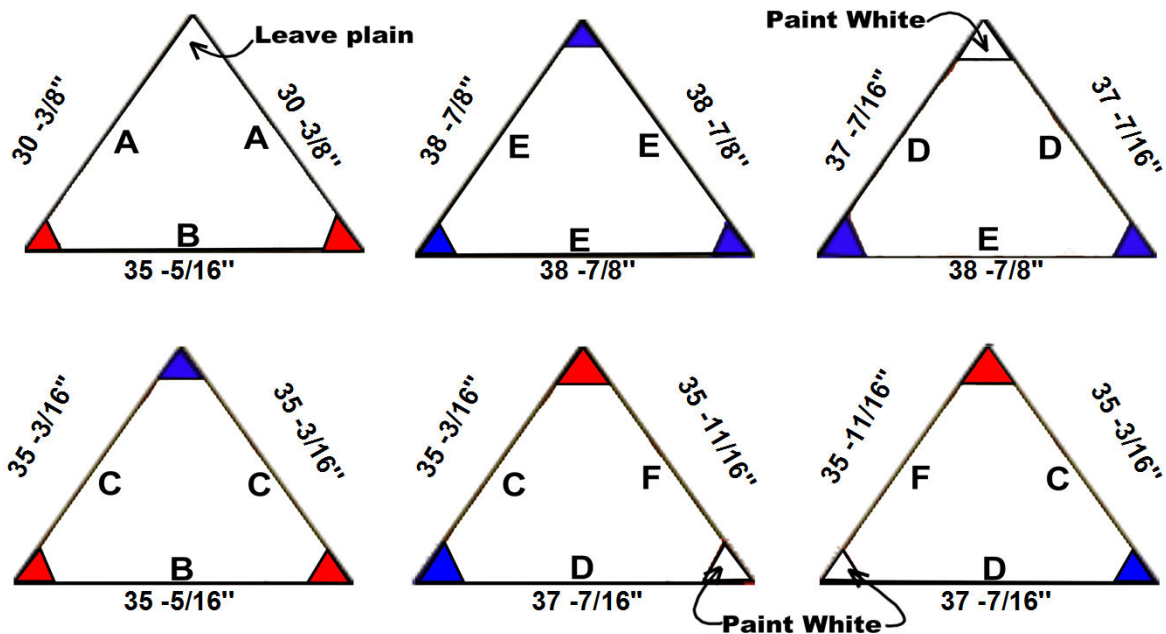
Note: by doubling the diameter of a sphere, the surface area is increased by a factor of 4; the volume is increased by a factor of 8.

AAB 30ea.  
 EEE 10ea.  
 DED 30ea.  
 CDF 30 left & 30 right (these are identical except for reversed)  
 BCC 30ea.



## STEP A -Patterns

Cut 6 triangles out of plywood (we will use two for CDF, one for left & one for right this will help avoid confusion and mistakes). These will be our patterns AAB, EEE, DED, BCC, CDF left, & CDF right. Use outside strut measurements to determine lengths of sides (see enclosed picture "triangle patterns"). Paint corners as follows. Note: color code goes on inside (not on plywood side) as we erect it from the inside (so as to see it). Paint sides of triangles a little so you can readily identify them when stacked so-- ie. A little color code on the inside and a little on the sides. If you paint using a different color code, I will not have the foggiest idea of what is going on when you call with a problem. The model you did before you started this project has the same color code. All my four freq. have the same color code. It's like having everyone speak the same language.



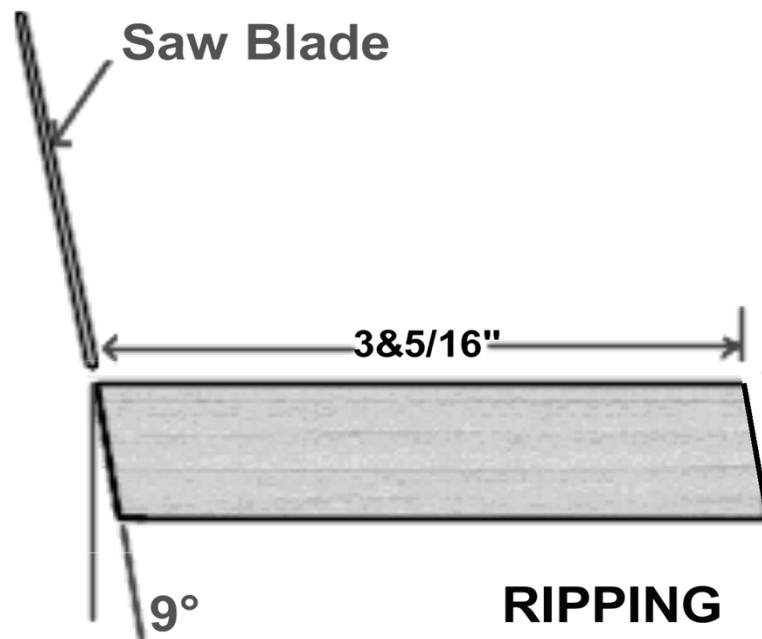
Where A & A come together leave plain  
 Where A & B come together paint red  
 Where B & C come together paint red  
 Where C & C come together paint blue  
 Where D & E come together paint blue  
 Where C & F come together paint red  
 Where C & D come together paint blue  
 Where D & F come together paint white  
 Where D & D come together paint white  
 Where E & E come together paint blue

## STEP B - Cutting Struts

SEE VIDEO: laying out strut on plywood pattern and scribing. Follow video instructions on cutting strut lengths. Cut an extra couple of each strut for mistakes & rejects. The scrap or cutoff will be used for interior framing. Organize the scrap for best utilization (use the larger cutoffs for the larger triangles)

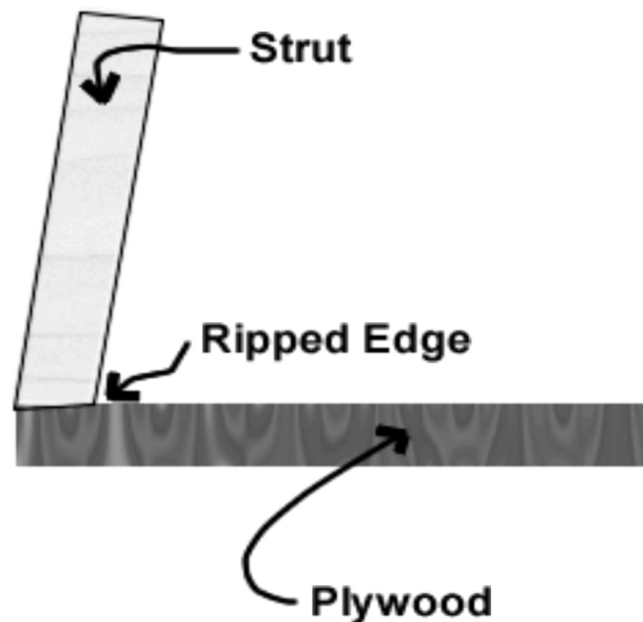
## STEP C - Ripping the lumber

Set the radial-arm saw to rip the outside edge of the 2 x 4, the arm is perpendicular to the table, and the blade is set parallel with the fence at a  $9^\circ$  angle (see picture "ripping"). If your not familiar with how to rip go to your manual or find someone with experience. Remember safety first be sure to use short sleeves, safety glasses, and hearing protection. Rip all of the struts and then on to step-D. After ripping both sides, finish width should be  $3\text{-}5/16"$  or  $5\text{-}5/16"$ . Latest breakthrough in domecutting technology. Buy a 4" or 6" jointer if you don't already have one. and incorporate  $9^\circ$  bevel with it (much, much easier). Tell wife I said you need this tool.



### STEP D- Final cuts

This is the hardest part -mitering the corners. Place a strut on plywood pattern with the ripped side against the pattern see picture “strut on pattern”. Scribe each end of strut where it meets the edge of the pattern (as in video previous section).

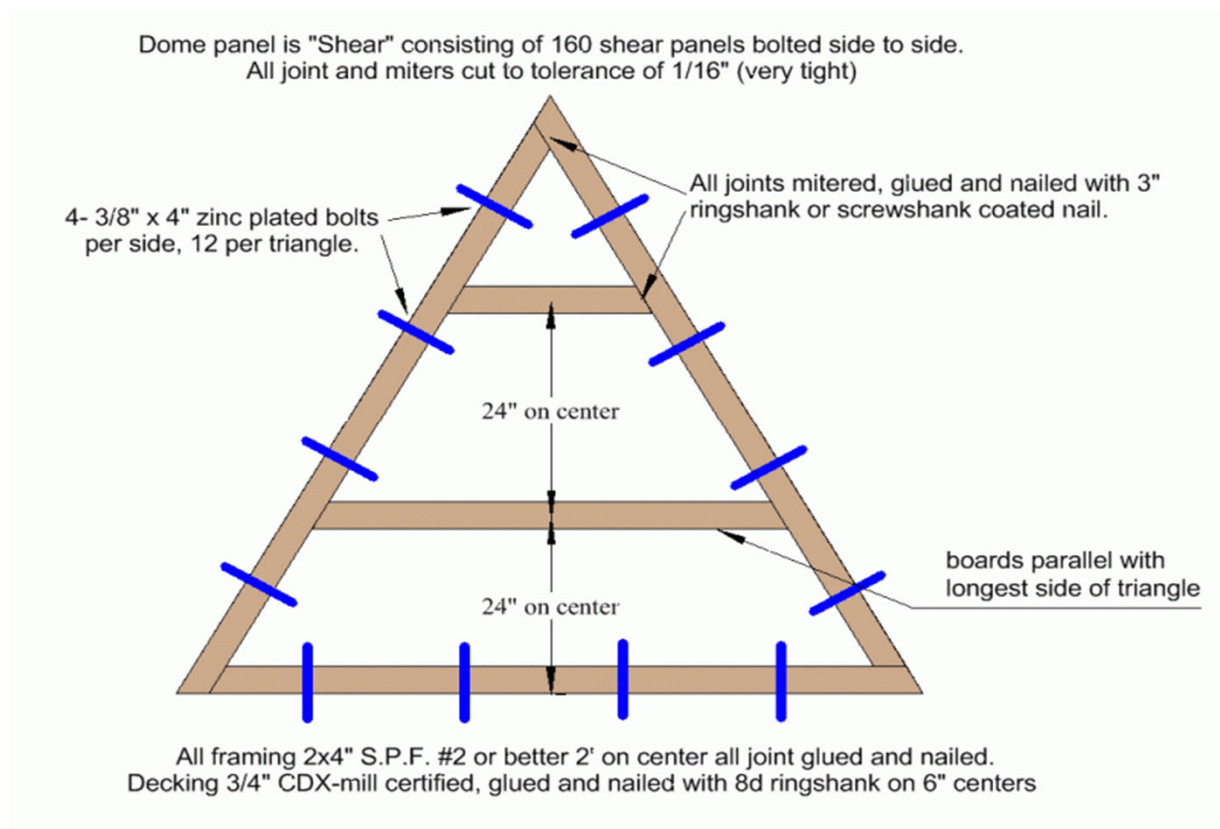


### strut on pattern

Cut one of each (left-strut, right-strut) and see how they fit. Scribe and cut a strut for the bottom side (this one is kind of tricky to mark, take your time, it's usually easiest to lay both left-strut and right-strut on the pattern and transfer the measurement between these to your bottom strut). When done all 3 struts should fit on our plywood pattern almost perfectly. If they fit well on the plywood, measure the inside of the struts to see if they match our figures. Just keep adjusting till everything fits (see video). These will be your pattern struts. Cut the rest of the struts to match the pattern & color code ends of struts after cutting to match system on plywood. And then repeat step-D for all other patterns. Remember that the different triangles have different angles and the angle on the end of each strut is different, so keep the struts from one triangle pattern separate from the others a quick shot of spray paint (red, white, or blue) to match pattern should keep everything organized.

## STEP-E Fastening corners of triangles

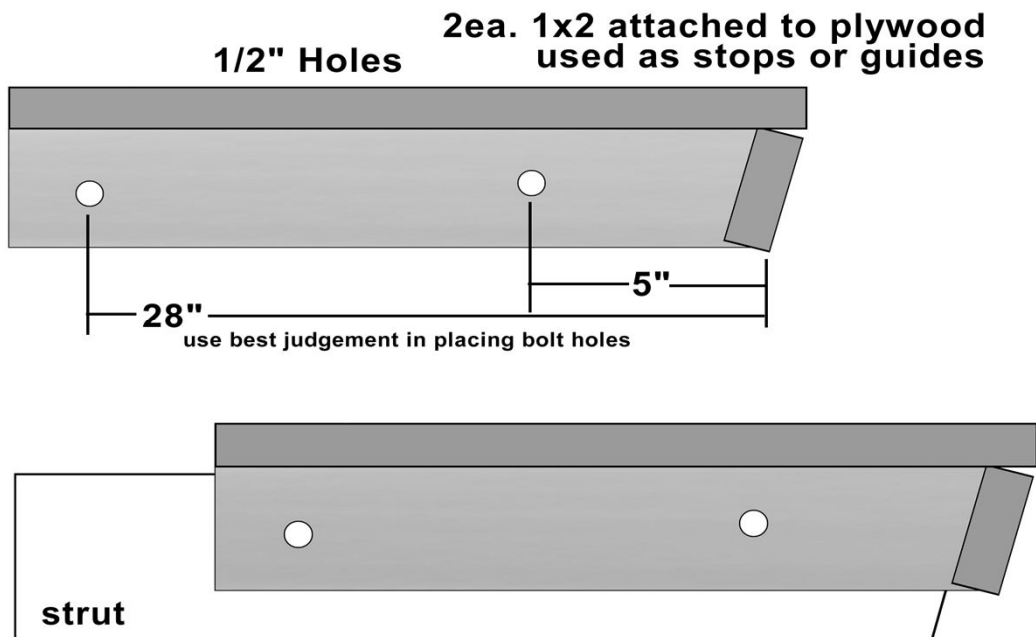
Fasten 2 x 4 struts with 3" ringshank or screwshank nails (3 per end) making sure the measurements are tolerable and the color codes match. Then insert 2 x 4 blocks made for interior framing, and attach with nails. It is best to use some type of wood adhesive on all joints for extra strength (see picture "completed triangle"). More detailed instructions on video.





### STEP-F make jig for bolt holes

Cut a piece of 1/2" plywood 5" for 2x4 framing, 7" wide for 2x6" framing by 32" long. Screw or nail a 1" x 2" on both sides so that you can set it on the outside/longside of assembled triangles. Put a 1" x 2" on the end, this will catch the end of the triangles. Drill a 1/2" hole 1/3 of the way down from the bottom of the 1" x 2" and approximately 5" from the end board, drill a second 1/2" hole 2/3 way down from the bottom of the 1" x 2" and approximately 26" from the end board. **This will set all holes equidistant from the ends of the triangles and from the outer edges. Precision of the holes is extremely important.** If one hole is an 1/8" high and another is 1/8" low then your triangles will be a 1/4" off. If you do not drill holes perpendicular to strut sides you will have difficulty sticking bolt through both pieces (think about this). Good holes in position are very important take your time and do a clean job. \*\*\*\* I'm only going to say this once "Don't think that you can put the triangles up and then drill holes in place - WRONG WRONG WRONG". If your jig gets worn out make another that is identical. Drill 4 holes on each side of every triangle (12 holes per triangle).

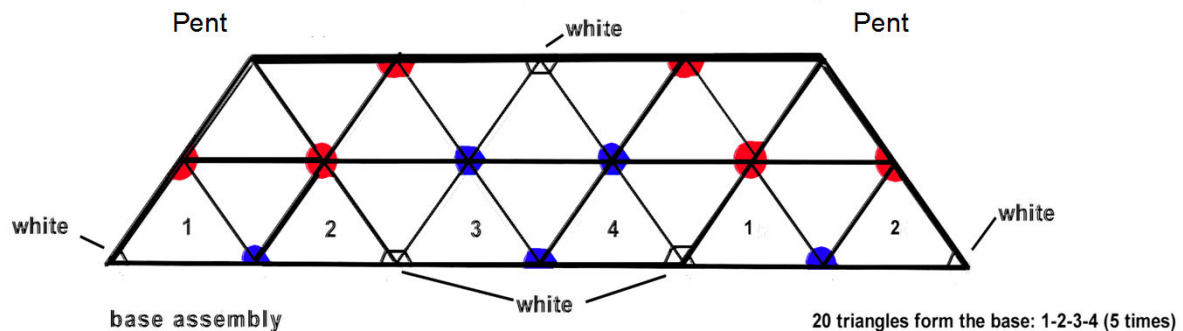


### STEP-G DECKING

Cut plywood for decking to fit each size triangle (same as each pattern). Use glue and nails or screws to attach decking to triangles. Make sure that decking fits well, overhang will cause gaps between struts and shortage will leave a gap between decking.

## STEP-H Assembly of dome

We suggest painting the decking on all triangles with primer before the assembly to protect it in climatic weather until the roofing material can be applied. It will take 20 's for the base (see enclosed picture "assembly", copying the following pattern around 5 times for the base.) and then just follow the color code to the top. Tighten the bolts just snug until the whole dome is assembled and then go back and adjust the panels in or out and tighten the bolts. At about the third course you may want to use 1/4" or 3/8" shims between triangles, as you set the next triangles into place remove previous shims and reinstall. The idea is to keep the dome opened or wide enough to accept incoming triangles. After assembly and tightening of all the bolts, go back and apply caulking in the groove where the decking comes together.



Have you made your models yet? Good! Note: color code goes on inside (not on plywood side) as we erect it from the inside (so as to see it). Paint sides of triangles a little so you can readily identify them when stacked so-- ie. A little color code on the inside and a little on the sides.

## Riser Wall

Top and bottom plate are same dimensions as "D" strut. Cut your studs to length ie. 24", 48" etc., conventional framing 20 sections will form circle. End cuts of plates are 9°. Drill holes using same jig.

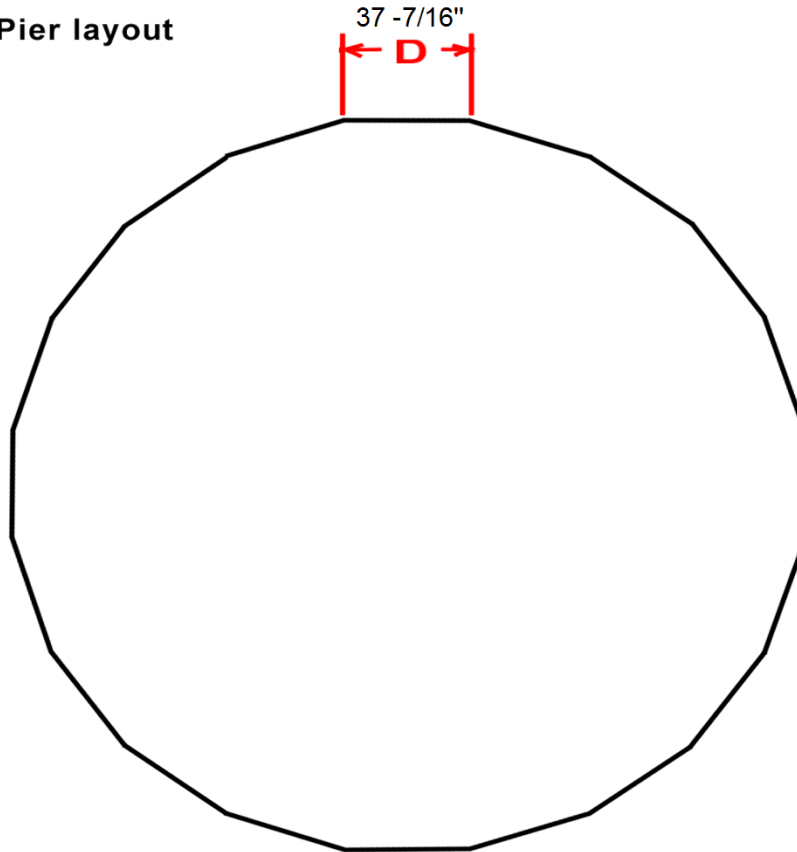
## Attaching dome to slab

Use hammer drill 1/2" hole 6" deep; Drill & clean hole; 2 per triangle or riser wall section. Inject with 2-part epoxy (like red head) with 5000psi test or better. Insert 3/8" x 9" all thread, let set and tighten down with nut and washer.

### Foundation forms

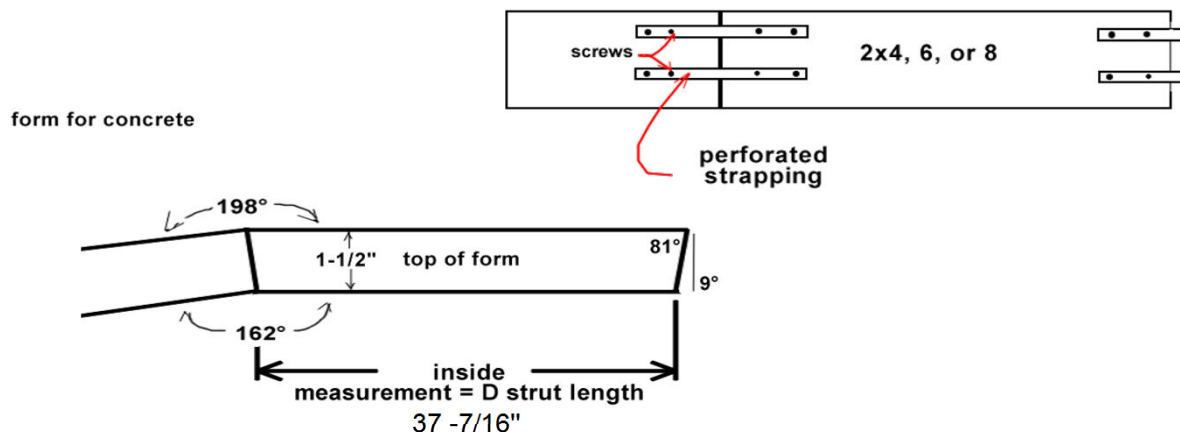
Use 2x4, 2x6, or 2x8 depending on desired depth of concrete make twenty identical. Butt outside edges end to end join together using perforated strapping 2 or 3 pieces 9" to 12" long at each joint. Layout in circle or polygon measure radius to each joint when satisfied that everything is good stake form down.

**Pier layout**



Note: this is an even 20 sided polygon using all "D" strut measurements. (20 vertices x  $18^\circ = 360^\circ$  or 20 vertices x 2ea  $9^\circ$  struts =  $360^\circ$ ) If you will be using the polystyrene between triangles and riser wall sections, and because we want the finished outside edge of the concrete to be flush with outside of plywood, add  $3/8$ " to the "D" length.

**Side view of form**



Please submit pictures and suggestions and comments to Good Karma

NOTES: