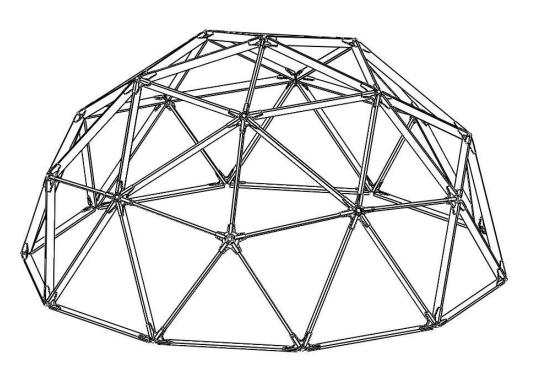
# 2v – 2x4 Dome Kit Assembly Instructions



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# Parts List

All Natural Frequency Hubs, due to their generally identical look, are identified by an alphanumeric numbering system. Located on the underside of every hub you will find impressions that identify the hub as far as identification of which strut is associated to each location in the hub.

PART#	DESCRIPTION		QTY
O2v1	OUTSIDE 5 STRUT HUB		6
O2v2	OUTSIDE 6 STRUT HUB		10
HO2v2A	OUTSIDE BASE ROW HUB A	X	5
HO2v2B	OUTSIDE BASE ROW HUB B	X	5
TH1210	#14 x 1.5" TRUSS HEAD SCREW	6 <b></b>	LOTS

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# **Required Resources**

- Minimum 2 People
- 2x4 Lumber for Struts (See <u>Strut Preparation</u> section below for sizing and quantity)
- 240 Additional Comparable Screws or Bolts (min. 5/16") for side fastening
- Measuring Tape
- Ground Stake
- String (appropriate amount based on size of dome)

- Spray Paint or other ground marking method for base row layout
- Colored Spray Paint or other marking method for Struts
- Power Drill with #3 Phillips Bit
- Scaffolding (appropriate amount based on size of dome, highest point will be ½ the desired diameter plus any riser wall)
- Step Ladder(s)

NOTE: Natural Frequency only provides the hub connectors and accessories for construction. The guides herein related to site preparation, riser walls, sheathing/paneling/covering are for information purposes only related to the interaction and relationship to our hub connectors and are not a substitute for expert advice on construction methods of these subjects.

### **Site Preparation Guide**

- 1. Choose an area where you would like the dome to be constructed. Things to keep in mind for site selection are:
  - a. Sun Exposure/Shade Considerations based on dome use/function
  - b. Water runoff
  - c. Grade angle
  - d. Window Locations
- 2. Clear the area of rocks, foliage, grass or any other item that may interfere with leveling or the functionality of the dome
- 3. Determine Site Preparation and Anchoring method, this could include:

### a. Crushed Stone

A crushed stone base, 4-5" deep, is one of the best ways to prepare your site. Be sure and use "crushed" stone as opposed to "pea" stone. 1/2" is a good diameter and is relatively inexpensive. Place your dome in the center of the pad leaving a minimum of 1' perimeter of stone around the shed. When digging out the area to accept the stone, start at the lowest area and establish the grade by digging down 4-6". You can now excavate the rest of the site keeping in mind the site should be level when finished.

### b. Sono Tubes

Also known as concrete piers are great for a strong anchor

#### c. Wooden Post

Typically 4x4 posts placed in the ground, this method is a great way to provide a strong structure that is easily framed too. It is important to use pressure treated timbers for the posts.

#### d. Cement Slab

A cement slab is one of the more expensive ways to prepare your site, however if done correctly it can also be the best. A slab will keep the dome level and prevent grass and weeds from growing both under and around it. It also offers many options for anchoring the dome.

### e. Ground

You may also decide to simply place your dome directly on the ground. It is important that the shed has pressure treated timbers used where there is contact with the ground

### f. Riser Wall

See next section below.

4. Prepare the site using recommended processes depending on method chosen

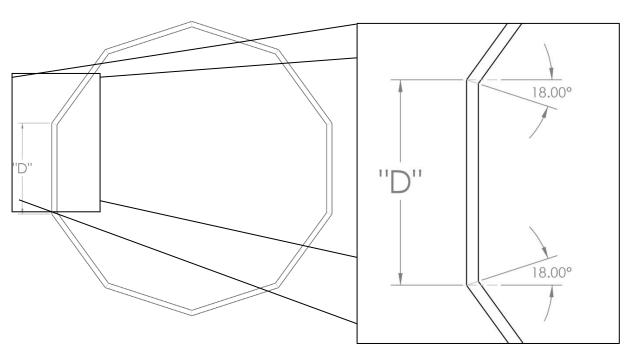
# **Riser Wall Guide**

- In general the use of a riser wall is to gain vertical height. That raised addition helps create vertical walls for doors, cabinets, windows, sinks etc.
- Riser Walls can be constructed from poured concrete, cinder block or wood.
- Sizing for the riser wall can be found below for each individual dome diameter, the "D" dimension is to the outside of the framing members
- The outer points of each board should lay on a scribed circle the diameter of the dome to be constructed
- Each horizontal board cut to the "D" length below must be tapered by 18 degrees inward on each end.

\*For a 26 ft Dome, the riser wall strut dimension is slightly over 8 ft standard lumber length, just be aware that there will be a small gap between boards to maintain the outside dimension of 26 ft if using 8 ft boards.



Riser Wall Strut Length (inches) "D"					
DOME DIAMETER (feet)	8	29.6875			
	9	33.375			
	10	37.0625			
	11	40.8125			
	12	44.5			
	13	48.1875			
	14	51.9375			
	15	55.625			
	16	59.3125			
	17	63.0625			
	18	66.75			
	19	70.4375			
	20	74.1875			
	21	77.875			
	22	81.5625			
	23	85.3125			
	24	89			
	25	92.6875			



### **Strut Preparation**

- Using the table to the right, find the diameter of the dome you are constructing in the first column. Then follow that number to the right to find the length of the "A" and "B" struts. The numbers are rounded to the nearest 1/16<sup>th</sup> of an inch.
- The quantity of each length of board is shown in the second row, 30 of strut A and 35 of strut B.
- Gather your strut material\* and ensure that your saw is set to 90 degrees
- Cut the appropriate quantity listed in the second row of the table for each length, keep them separated into two piles.

\*NOTE: check that the cut and uncut ends are free of staples, protrusions or anything that would prevent it from butting up to the hub connector.

 Label the struts so that they can be easily identified, simply by scribing an "A" and "B" or apply spray paint (Yellow/<u>A</u>mber) for Strut A and <u>B</u>lue for Strut B) to both ends of the boards while they are stacked. These colors will correspond to the markings on the hub connectors.

NOTE: The 26' dome maximizes the material usage from standard home improvement stores assuming 8' lumber and 4' x 8' plywood/sheathing, smaller domes will leave more material cut off and unused. As seen in the table to the left, domes around 14' will also maximize the material by allowing two struts from each 8' board

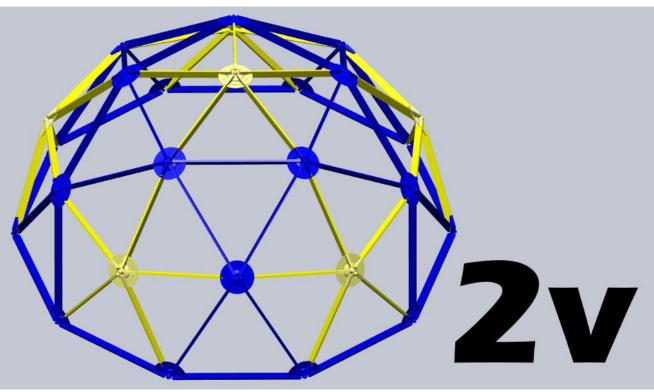


2v		Strut A (inches)	Strut B (inches)
Quantity		30	35
	8	19 - 1/4	22 - 11/16
	9	22 - 1/2	26 - 3/8
	10	25- 13/16	30 - 1/16
•	11	29 - 1/16	33 - 13/16
(feet)	12	32 - 3/8	37 - 1/2
fe	13	35 - 5/8	41 - 3/16
	14	38 - 15/16	44 - 15/16
Ш	15	42 - 3/16	48 - 5/8
⊢ III	16	45 - 7/16	52 - 5/16
ME	17	48 - 3/4	56 - 1/16
IAI	18	52	59 - 3/4
D	19	55 - 5/16	63 - 7/16
DOME DIAMETER	20	58 - 9/16	67 - 3/16
N	21	61 - 7/8	70 - 7/8
ğ	22	65 - 1/8	74 - 9/16
	23	68 - 7/16	78 - 5/16
	24	71 - 11/16	82
	25	75	85 - 11/16
	26	78 1/4	89 - 7/16

# **Hub & Strut Location Identification**

- The primary method for identifying the strut locations and assembly order is that each strut location has a sticker located on it that identifies the type of strut to be used in that location. Locations where "A" struts go will have a yellow (Amber) sticker; the locations where "B" struts go will be labeled with a blue sticker.
- Lastly, in the case that a sticker is missing, the type of strut that is to be used in each strut location on the connector is also embossed in the part near the center and aligned with each strut location.

### **Dome Frame Construction**



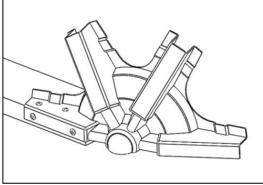
### **ILLUSTRATED LAYOUT PLAN**

Special Considerations:

• When mating a strut to a hub, always make sure that the end of the strut "bottoms out" in the hub strut slot, this ensures the correct dimensions are held throughout construction and will help with consistent panel sizing.

#### Instructions:

- 1. Once the site is prepared and level, locate the middle of the site and drive a stake in until about 2" is visible above the ground. Place a screw in the middle of the stake leaving about 1/4" of the screw above the top of the stake.
- 2. Map out the radius of the dome you are building by hooking a tape measure/string to the screw in the stake and stretch it out to the determined radius. Using some method (i.e. spray paint, scribe, etc) mark the site as you walk around keeping the tape measure/string taught. Complete marking all the way around creating a circle with the full diameter of the desired dome outside dimension.
- 3. Check that the scribed circle is correct by re-measuring several locations.
- 4. Choose a Base Row outside hub connector to begin with. Place the hub so that the outside of the hub lines up with the scribed line. \**ALL hubs and struts should be in the INSIDE of the circle.*\*
- 5. Starting with either side of the hub, insert the first strut, matching the color (Base row is all B struts) on the hub to the matching colored strut, until it butts up. Fasten with 2 screws in the top of the hub.

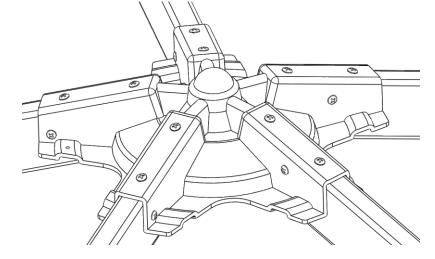


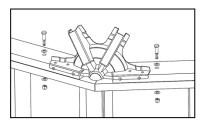
NOTE: Due to different preferences, screws have only been provided for the basic assembly of the dome through the top of the hub connector. Additional comparable screws must be added to the sides of the hubs and for more permanent structures, drill through and use two bolts per each strut end. (min. 5/16" bolts with washers)

- 6. Then using the ILLUSTRATED LAYOUT PLAN above, choose the next hub (Note: the base row hubs alternate between the HO2v2A and HO2v2B), making sure the color markings match the strut, and that the orientation of the A (yellow mark) strut is correct, and assemble and fasten it to the end of the strut.
- 7. Following the ILLUSTRATED LAYOUT PLAN and marked colors, continue adding hub connectors and struts, fastening as you go. Try to keep all hubs oriented in the same direction as the other similar hubs on that row. Continue around the circle, until you reach the hub you started with, completing the 1<sup>st</sup> horizontal or base row.

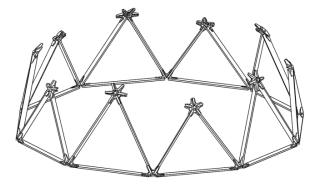


- 8. Using a tape measure, check that the hubs are all equal distance from the center stake, pushing or pulling the hubs into position as you go around.
- 9. At this time, the structure can be anchored to the sub-structure. Utilize the best method based on the type of substructure. Some options are listed below. An anchor point should be positioned just outside the edges of each connector on both sides as well as the center of the strut between the two hub connectors.
  - a. Concrete Minimum  $\frac{1}{2}$ " Concrete Anchors with Nuts and Fender Washers
  - Bolt through using minimum 7/16" Hex Bolts, Nuts and Washers (See Image), Hurricane Straps
  - c. Ground –ground anchors, spikes, U-shaped rebar
- 10. Following the colors on the connectors, insert the correct vertical struts from two base row hubs and join them with the correct hub. Fasten as shown below (Or with bolts through the sides). The holes for the side screws are not drilled due to some customers preferring to use bolts.

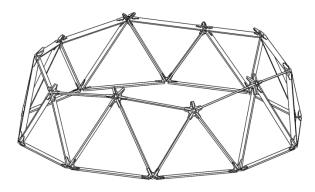




11. Continue around until all vertical struts are installed, joined with a hub and fastened as shown on the right

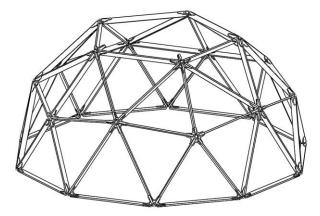


12. Insert the correct horizontal struts between the newly installed hubs and fasten to form the 2<sup>nd</sup> horizontal row.

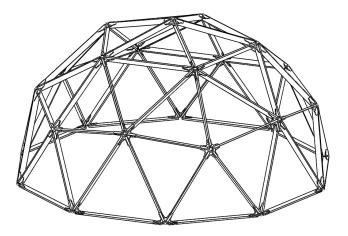


13. Now is a good time to test fit the sheathing panels if utilizing any. **Refer to the Panel Guide below.** To ensure a correct fit, the panels should create an expansion/contraction gap and be sized so that the edge of each panel is kept approximately 1/16<sup>th</sup> of an inch from the center of the strut. If they do not fit correctly, check that the strut lengths are correct and that the panel dimensions match the table. It is recommended that all panels be measured to fit each section prior to cutting.

14. Continue to install the hubs and struts per the colors, fastening along the way. When necessary, support any hanging struts until both ends are supported so undue forces are not put on the connectors which may bend or break them. The true strength of a geodesic dome comes from the completed structure and care must be taken until all pieces are in place.



15. Once you've started to add the final 5 struts, fasten the "keystone" hub to the first board and add each additional strut fastening along the way until the dome frame is completed.



- 16. Check that all fasteners are tight.
- 17. Once all fasteners are installed, the dome is completed and can now be finished with covers, doors, etc to suit your application.

# **Sheathing Guide**

There are many ways to cover a geodesic dome, a few of the more common are listed below with notes specific to their application on a Natural Frequency dome. This section acts as a guide to different methods and does not attempt to outline a "how to" process. There are a lot of great resources on this matter, it is suggested that once you have chosen a method, that you take the time to educate yourself on the process

- Plywood/Shingles
  - a. Using the Panel Guide included in this manual, cut a panel to test fit in the location to ensure a good fit. The same panel can be used in several locations to ensure that repeating the dimensions will provide a good fit.
  - b. Once you have confirmed that the panel is sized correctly, cut the allotted number of panels needed.
  - c. Using 16D Nails, hammer a nail in the center of the strut at each end near the hub, leaving the head of the nail higher than the thickness of the paneling. These nails will act to establish the expansion gap between the panels.
  - d. Snap chalk lines along the center of each strut to act as a guideline when placing the panel.
  - e. Install Natural Frequency sheathing spacers or other .25" thick shim along the strut to support the panel between hubs
  - f. Position the panel and fasten it to the struts and hubs.
  - g. Repeat for the remaining panels
  - h. Once completed, shingle using a conventional process
- Shrink Wrap
  - Shrink Wrap is applied by draping the sheet over the dome structure and applying heat with a hand-held propane powered heat gun.
    Zipper doors, vents, fans and more can all be applied to the heat shrink plastic for a quick covering method.
- Tarp, Canvas, Screen
- Plexiglas/Polycarbonate Panels

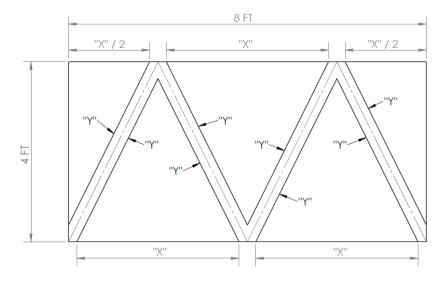
**Caution:** When using a flexible cover like a tarp, canvas or film, ensure that it is pulled tight and cannot come loose. A loose cover can allow water to accumulate which could result in excessive weight on the dome in a manner unintended. If too much water is allowed to pool, the dome structure risks damage or collapse. Natural Frequency will not warranty any connectors which are damaged in this way.

Visit our website for some covering accessories www.geodesicdomekits.net

# **Paneling Guide**

\*\*As stated, this is meant to be a guide and all measurements should be checked on the actual structure prior to cutting material, variances in struts including twisting, bending and length as well as base row layout may cause the need for slight changes to the guide dimensions below or between individual panels.

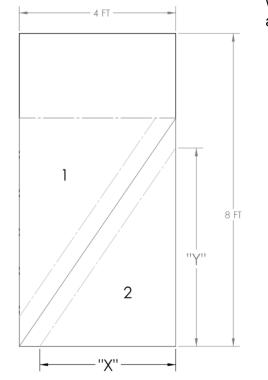
This guide outlines the general procedure of cutting the panel triangles used for a 3v Dome. Always account for overlap on the struts and an expansion gap between panels. Additionally, since the hubs go on the outside of the struts, they sit higher than the strut. So if you plan to panel them, it is recommended that you fill that gap with 3/16"-1/4" thick material over the top of the strut wherever you plan to fasten the panel to the strut. Natural Frequency offers our SHEATHING SPACER Kit which contains lengths of "U" shaped material which accomplishes this.



As a general rule, the panel side dimension should be 7" longer than the strut that it would be covering. Always check prior to cutting.

Using the methods depicted, a 4'x8' sheet of panel material (i.e. tongue & groove plywood, etc) you can yield from 1 to 3 Other methods and layouts are possible and may work better for in different applications.

# The size of the dome will dictate assemble panels from two halves



whether you can use full panels as shown on the left, or will have to as shown on the right.

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18. NO ASSIGNMENT. You agree that you may not to assign or transfer any of your rights arising out of or related to these terms and conditions or your purchase of Product.

19. ATTORNEYS FEES. You agree that if you fail to timely pay to Natural Frequency any sums due hereunder and Natural Frequency sues to collect such sums, you will be liable for reasonable attorney's fees so incurred by Natural Frequency

I hereby agree to order the Product at the stated costs and have read and agree to the TERMS AND CONDITIONS, incorporated herein under this reference. I understand that Natural Frequency reserves the right to change, discontinue or substitute materials. I understand that the Product delivered will consist of all hub connector parts and pieces, as well as fasteners, but does not include any foundational work, struts, covers, doors, windows, lighting, electrical, steps, etc. from Natural Frequency or its delivery personnel, unless otherwise stated.

