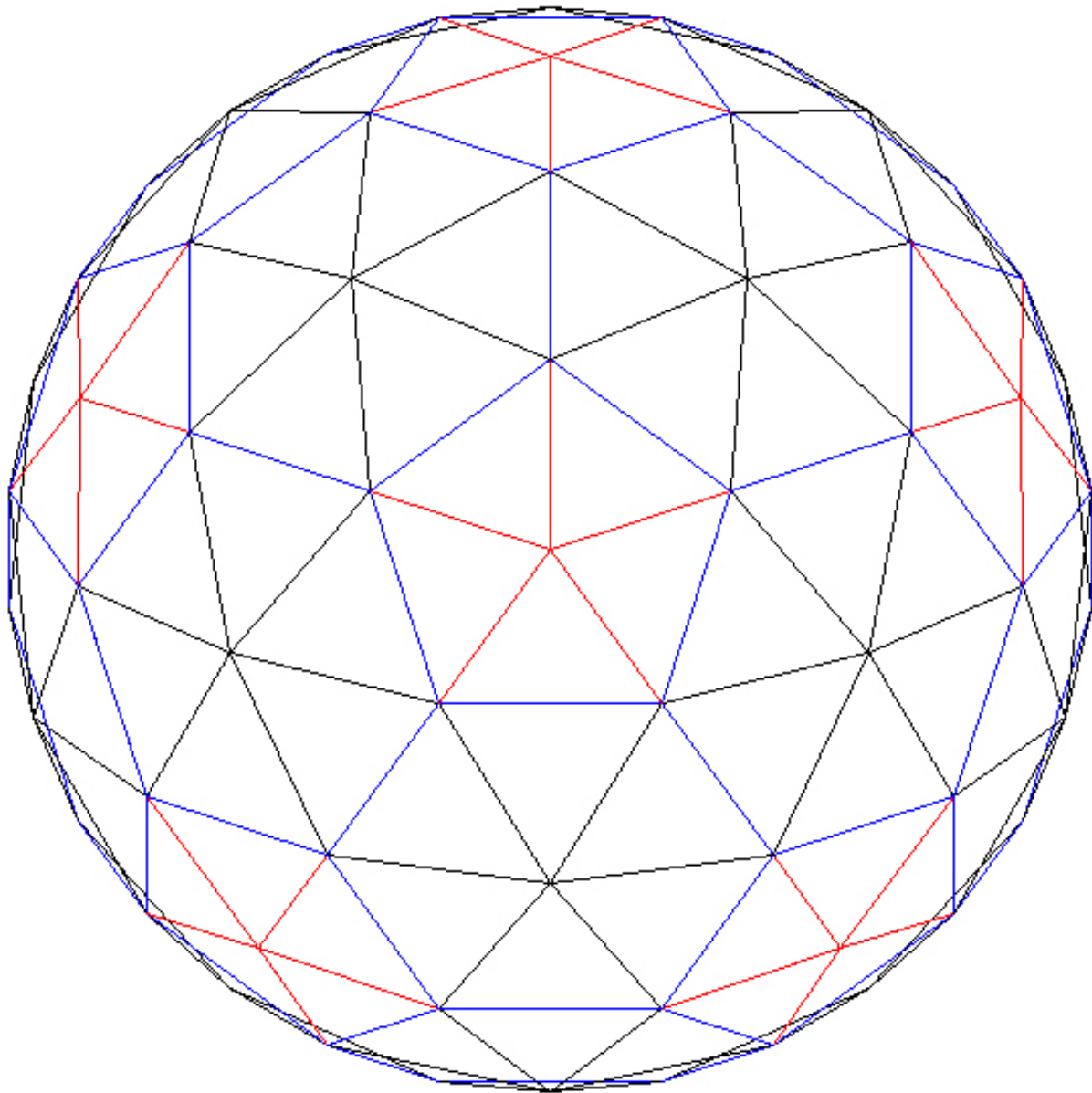
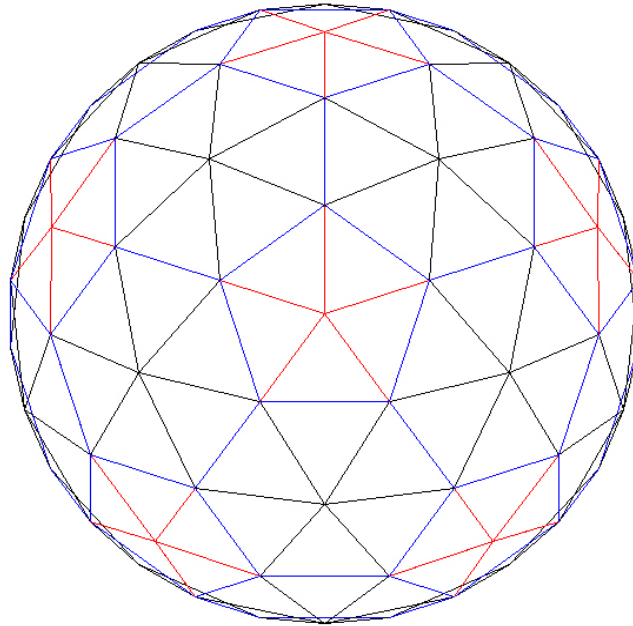


A Modular Method of Assembling a Geodesic Dome Frame

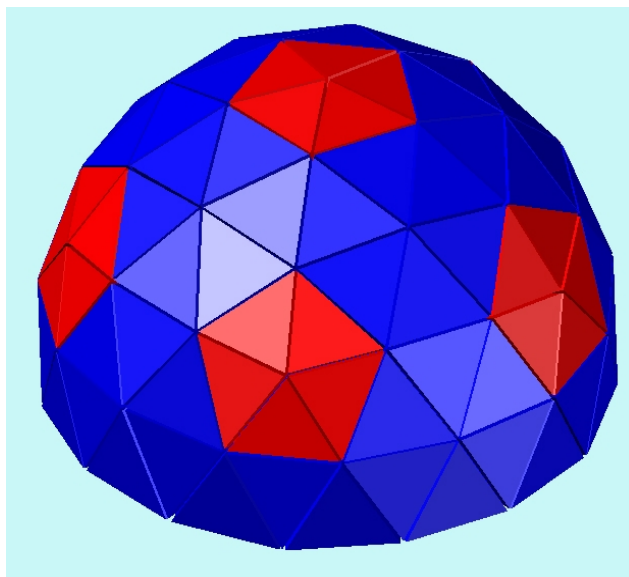
John E. Hall



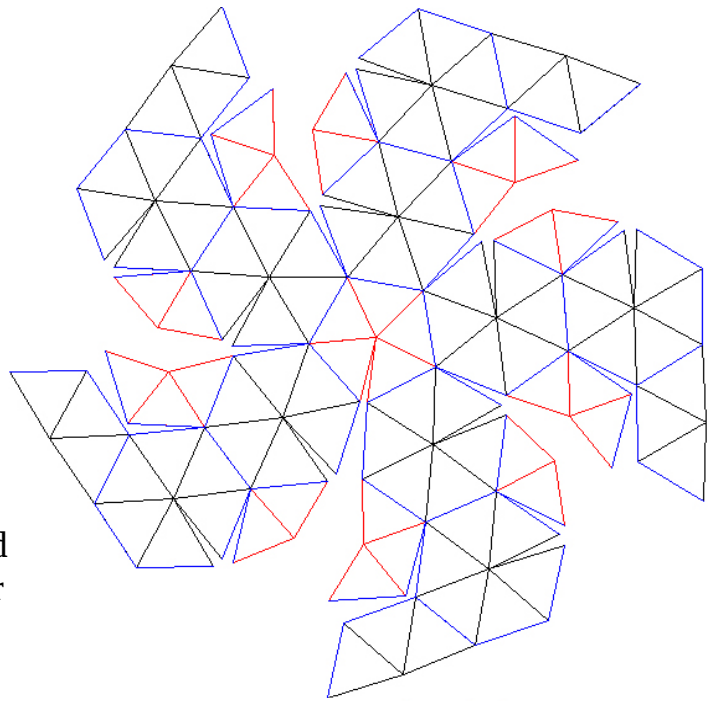
While a 3v dome appears to be complicated when you look at all the individual elements, it is actually very simple. In the above picture you can see red struts, blue struts, and black struts. There are only three lengths of struts in a 3v dome. We call the red, or shortest struts, “A”. The blue, middle sized struts are “B”, and the black longest struts are “C”.



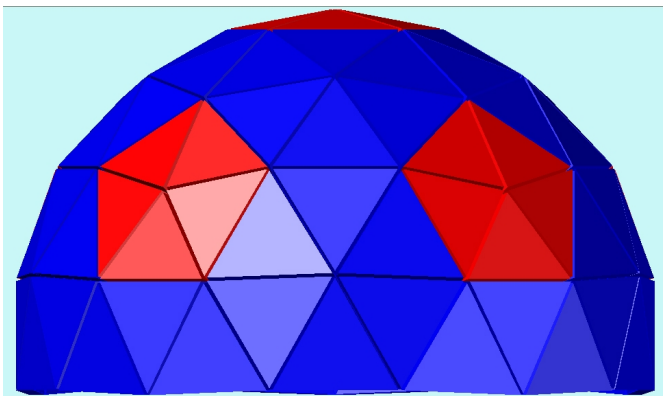
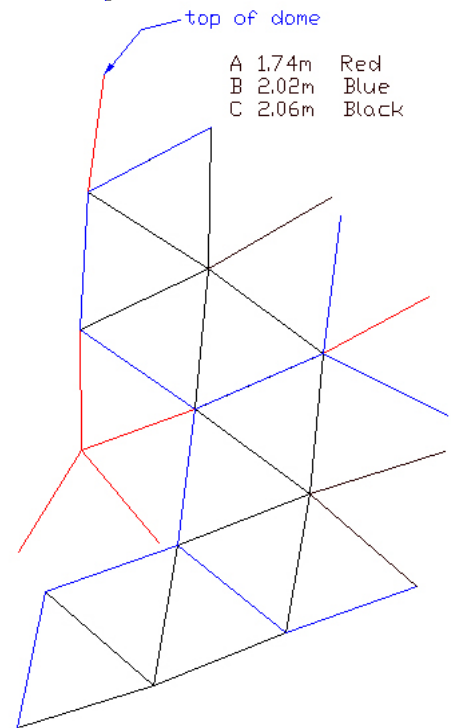
Those three strut sizes are used to make two types of triangles, ABA and CBC triangles. Both are isosceles triangles, meaning that two sides are equal in length and two angles are equal. These two triangle types are assembled into pentagons and hexagons, each with a raised center. The ABA triangles form pentagons (red surrounded by blue) and the CBC triangles form hexagons (black surrounded by blue). For a 5/9 truncation dome there are six pentagons and ten hexagons, and five half hexagons.



This diagram shows how a 5/9 truncation dome would look if it were flattened by removing some of the bolts. For clarity some struts are shown twice to complete triangles. This is useful for seeing the pattern of pentagons and hexagons. The center of the diagram shows the top pentagon, formed by five A struts (red) surrounded by five B struts (blue) which are shared with hexagons. Below the top pentagon is a hexagon formed by six C (black) struts surrounded by six B struts, which are shared with other hexagons and pentagons. Below that hexagon is another hexagon. Between the two hexagons are pentagons. Below the lower pentagon is half of a hexagon. This pattern is radially symmetrical around the center of the top pentagon.



The pattern to the right is 1/5 of the complete dome without the struts added as in the above diagram. The strut lengths are for a ten meter dome.



Above pentagons shown in red and hexagons shown in blue. Each pentagon shares each of its B sides with a hexagon. Each hexagon shares three B sides with pentagons and three B sides with other hexagons. In a 5/9 truncation dome five of the hexagons are cut in half at the base of the dome.

This pattern simplifies assembling the frame using a modular approach.

Before assembly check all the struts for shipping damage. The most common damage is bending of the ends of the struts. The struts should have a 12 degree offset on each end, and should be adjusted for ease of assembly if they have been altered during shipping.

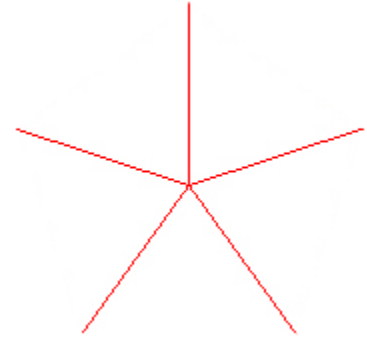
During assembly avoid excessive flexing of the strut ends by supporting any loose ends. Flexing will cause metal fatigue which can lead to failure of the strut end.

The dome frame is not designed to support weight on the span of the strut. Weight should be applied only at hubs to avoid bending the struts. If a strut inadvertently becomes bent during or after assembly it should be straightened immediately to prevent “dimpling” and possible collapse of the frame.

Your frame should give you many years of service with minimal maintenance. Though the struts are galvanized their lifetime can be extended with a coat of paint.

We hope assembling your dome is a pleasant experience for you, and that you enjoy its use.

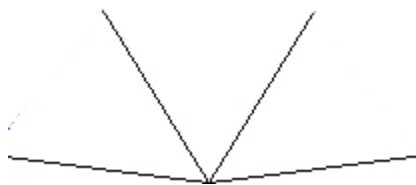
1. Connect five A struts with one bolt (two washers and a nut) to make a star pattern like the red struts in the picture to the right. Tighten the nut enough so that the struts can be adjusted by hand but do not move from gravity. Repeat this with all the A struts and to make six of the star patterns, which are the pentagon modules.



This is a three dimensional pattern that is raised in the center so be careful to prevent bending the strut ends unnecessarily, as this will cause metal fatigue.

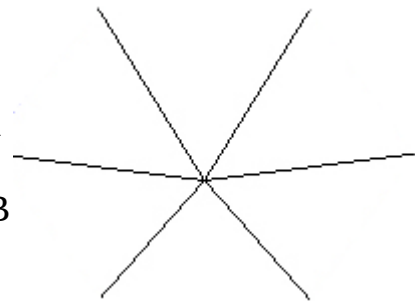
Eventually these pentagons will be surrounded by B struts. Those B struts are shared by hexagons. Set the pentagon modules aside.

2.



Using twenty C struts, make five sets of four C struts on one bolt. Tighten this bolt so they can be adjusted by hand. Again avoid unnecessary bending. These are the five half hexagon modules which will be surrounded by B struts in step 4.

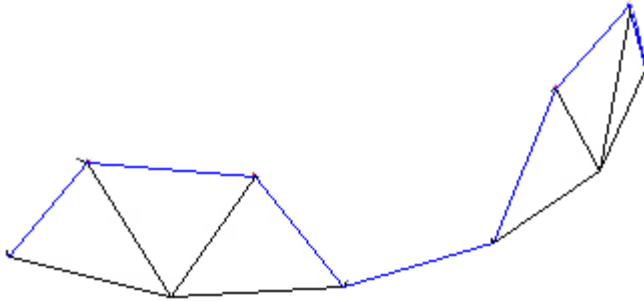
3. With the remaining sixty C struts make ten sets of six on one bolt. Tighten this bolt so you can adjust by hand. These are the hexagon modules and will be surrounded by shared B struts during assembly of the frame.



During assembly of the frame be sure to support any parts of the dome that are not yet secured. Before all the parts of a dome are in place it has only a fraction of the strength that it will have when complete. Excessive bending of strut ends will cause metal fatigue and could cause the dome to fail.

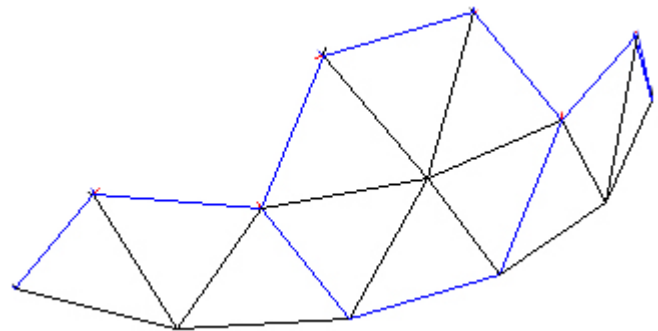
As each assembly step is completed, all the bolts in completed hubs (with six struts, or five in the pentagon modules) should be tightened to their final torque.

4. Add three B struts to each half hexagon module, between the free ends of the C struts. Place the five half hexagon modules around the circumference of a circle that is the same diameter as the dome. Join the half hexagons with a B strut.



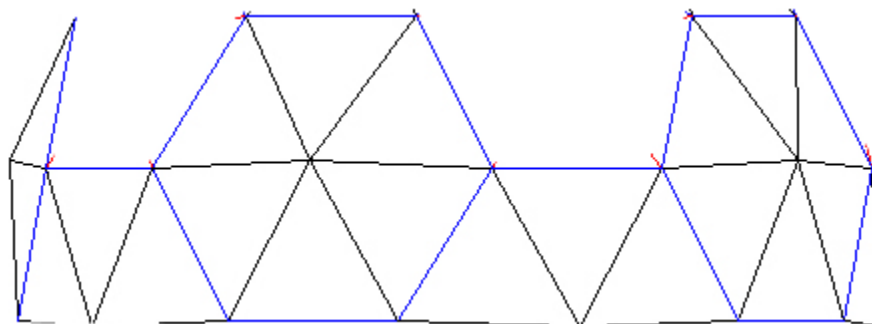
This diagram shows two of the half hexagon modules separated by a B strut. This is done for all five half hexagons. The centers of the half hexagons can be tightened to their final torque.

5. Add three B struts to each of five hexagon modules and place these modules on the B struts between the half hexagons. Three of the surrounding B struts are already in place.



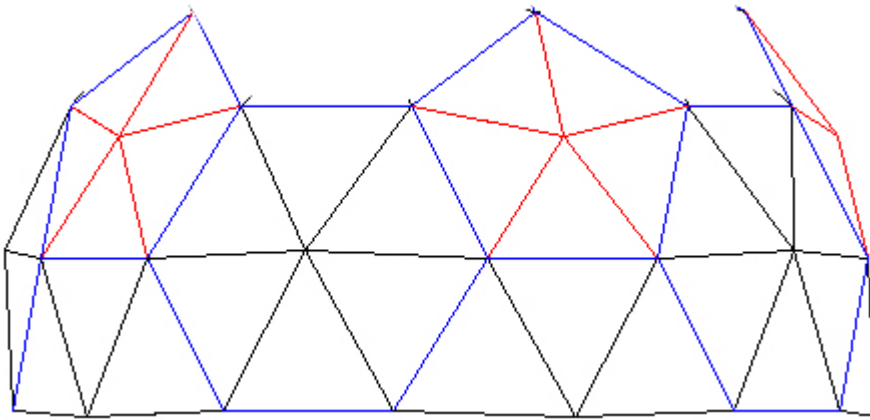
This diagram shows one of the five hexagon modules that are added in this step.

After this step the frame should look like the below diagram when viewed from one side.

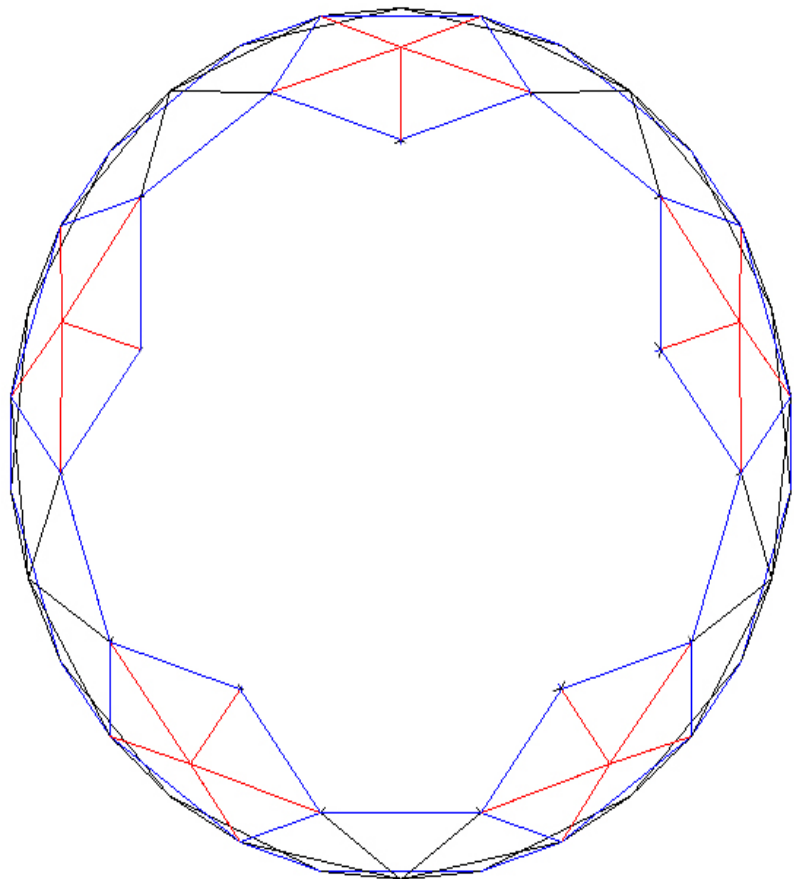


The hubs at the bottom and the centers of the hexagons are complete and can now be tightened to their final torque.

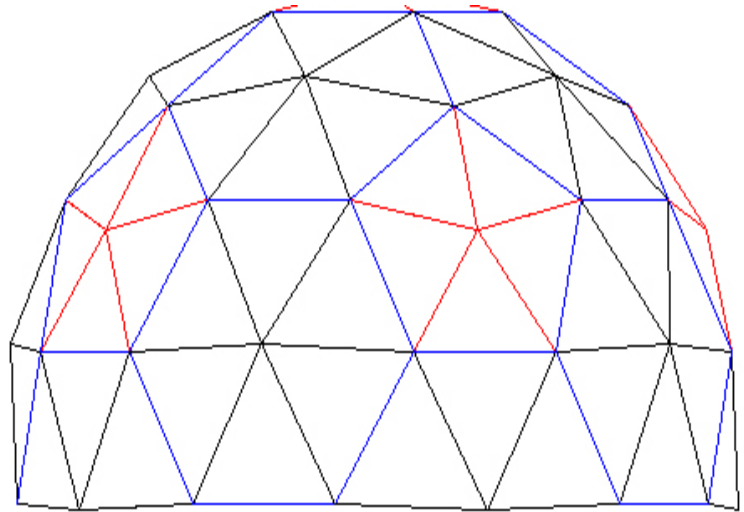
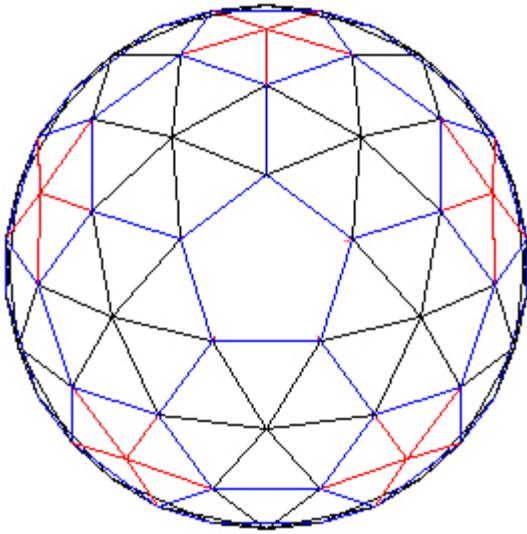
6. Add two B struts to each of five pentagon modules and place the modules between the hexagons from step 5. Tighten the centers of the pentagons and the bottom B strut ends.



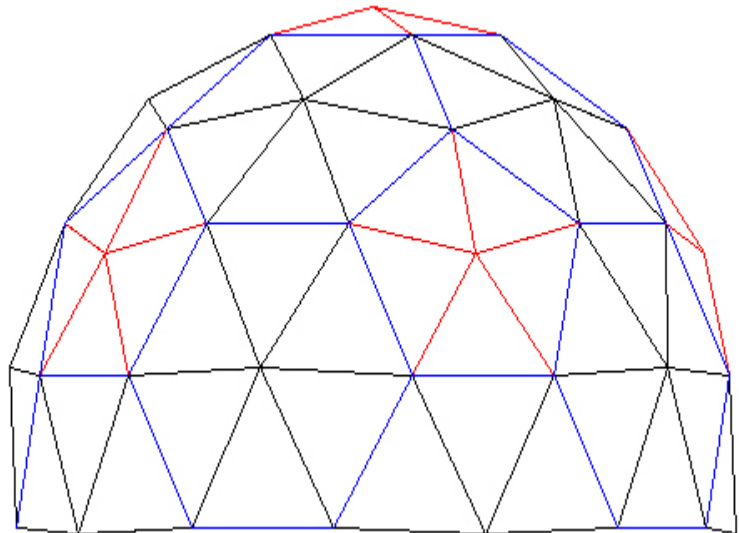
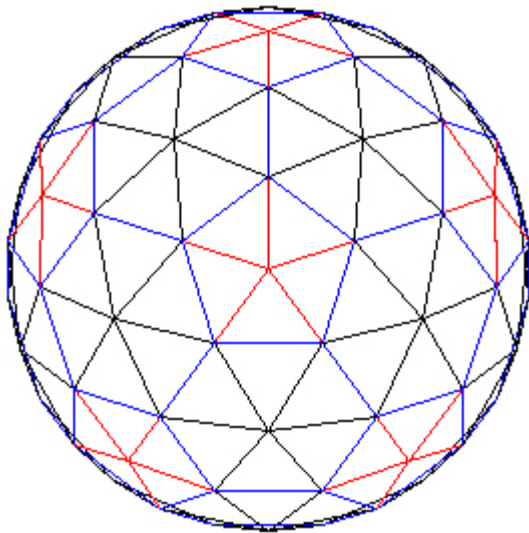
From the top, the frame should look like the diagram below.



7. Add two B struts to each of the five remaining hexagon modules. Place them between the pentagon modules from step 6. Tighten all bolts except the five B struts on top.



8. Install the last pentagon module at the top of the frame and tighten its center and surrounding B struts.



If the completed hubs were tightened at each step, the frame is ready for use.