Dome Extension

Expand 220 sq.ft. dome to 299 sq.ft.

The basic 16.88' diameter dome (area=220 sq.ft.)

The drawing shows the layout of the dome struts that is repeated five times around the structure. You can skip all the complicated math and build a successful dome by referencing only this drawing and the table below it.

A "chord factor" of a strut in a dome, is its length divided by the radius of the sphere. The simplest geodesic dome requires two different struts, with chord factors of: 0.54653 and 0.61803

In order to make the maximum use of standard 10' sticks of 3/4" metal conduit, we can cut both strut lengths out of a single piece. We will need 30 short ones and 35 long ones. Unfortunately, we need five more long ones than short ones, so we need to purchase 35 ten-foot pieces of conduit.

If we allow one half inch on each end of each strut piece to center the bolt holes, we have 118 inches of steel tubing remaining. Now we need to divide this between the long and short chord factors.

If we divide 1 by the sum of these two chord factors, we get 0.8586. Naturally, when we multiply our chord factors by this number and add the results together, their sum = 1 (0. 4693, plus 0.5307 = 1).

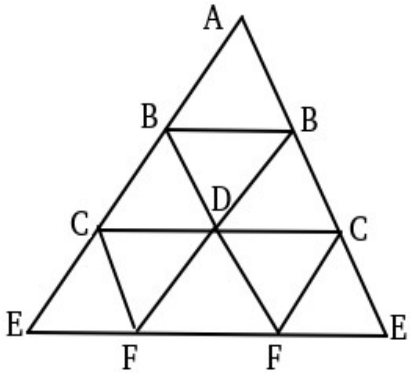
When we multiply these numbers by the length of the material we have available we can see exactly the length between the bolt-hole centers of each strut needed, to exactly use up the available distance.

To perfectly fit our available material length of 118", the center-to-center distance of our short struts will be **55.37** inches and the long ones will be **62.62** inches. When the ½ inch is added to each end of each piece, the actual cut lengths will be **56.37 (56-3/8")** and **63.62 (63-5/8)** inches.

We determine the radius of the structure these struts will build by dividing a strut's center-to-center length by its chord factor – for instance: The shorter strut is 55.37". If we divide it by its chord factor (0.54653), we have a radius of 101.31 inches, or **8.443** (8'5-5/16") feet; and a diameter of **16.885** feet (16'10-5/8").

The dome extension

The objective is to add to the width and height of this spherical dome. An extension will be added to replace everything below points C and D with a parabolic format to extend the **diameter to 19.5 feet** (299 sq.ft.).



On the existing spherical dome, the **C radius** is the sine of 60 degrees times the dome's radius: 0.8660 * 8.443 = **7.312** feet.

The angle of D is the arctan(cos 30^2/sin 30) Atan(0.8660^2/.5) =33.69 degrees. **D radius**=cos(33.69) * 8.443= **7.025**.

With our **target radius of 9.75'**, our C radius of 7.312' gives us a height factor of 7.312/9.75 = .75. This gives us a **C height** of 9.75-(0.75^2*9.75)=**4.265 ft.**

The D radius factor is 7.025/9.75=**.**7205. This gives us a **D height** of 9.75-(.7205^2*9.75)=**4.689 ft.**

Distance from **C to the edge** is 9.75-7.312 **= 2.438**

Distance from **D to the edge** is 9.75-7.025 **= 2.725**

There are fifteen equal pieces around the perimeter labeled EF and FF. Each piece subtends 360°/15=24°

Chord	Factors	Length
AB	.4693	4.620'
BB	.5307	5.214'
BC	.4693	4.620'
BD	.5307	5.214'
CD	.4693	4.620'
Parabolic calculations		
DF	0.587	5.693
CE	0.504	4.913'
CF	0.597	5.824
EF,FF	0.416	4.054'

<u>Chord length calculations</u>

CE=sqrt(4.265^2 + 2.438^2)=**4.913**

CF=sqrt(sin(24)*9.75)^2+4.265^2)=5.824

DF=sqrt(4.689^2 + 2.512^2)=**5.693**

EF and FF are 2*sin(24/2)*9.75=**4.054 feet**.

Now you can enjoy all that math if you want to, but if all you really want to do is build a dome, just cut the pieces of the respective chords (AB, BB, etc.) to the lengths shown in the length column, drill, and assemble per the diagram. Do note that the pattern repeats five times around the structure.
IMPORTANT: The measurements given above are to the centers of the bolt holes, so add 1” (0.1 ft. will do) to these lengths, so you can center the holes one half inch in from each end.