Design Chart for Geodesic Parabola Antenna (Ver.5)

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Dimensions of the antenna is calculated for various f/D ratio with normalized diameter. If you want to construct an antenna in different diameter, just multiply the dimensions by scale factor of the normalized diameter and your size.

- As the listed dimensions show spacing between screw holes, note that an overlap allowance (e.g., 5 mm) is required at the ends of flat-bar ribs.
- The screw size should be as thin as possible, at most 1/5 of the width of the flat bar, anything thicker than this will cause the flat bar to buckle.
- To determine the strength of a material, apply a force of 0.5 kg to one end of a 300 mm length, and if it returns to its original shape without undergoing plastic deformation, then the material is usable.
- **The wire mesh should be attached to the back, or convex, side of the dish [1] [2].**
- The feed supporting rods should be connected to the back-supporting structure of the dish **[6]** .
- The original article **[1] [2]** and the other references **[3]**~**[8]** to be referred for details of construction.

Type – I : Diameter < 1 m

Table-1 and **Figure-1** show dimensions and their definitions, respectively.

Design example – 1 :

Diameter	1000 mm						
f/D	**0.3**	**0.35**	**0.4**	**0.45**	**0.5**	**0.55**	**0.6**
A1 (mm)	181	190	196	200	202	204	205
A2 (mm)	372	349	335	325	318	313	309
B1 (mm)	284	286	287	288	288	289	289
B2 (mm)	356	340	328	320	314	310	306
C (mm)	259	259	259	259	259	259	259

Table-1 : Dimensions – Type-1

Target diameter = 800 mm
then Scale factor = 800 / 1000 = 0.8
Target f/D = 0.5

A1 = 0.8 * 202 = 162 mm
A2 = 0.8 * 318 = 254 mm
B1 = 0.8 * 288 = 230 mm
B2 = 0.8 * 314 = 251 mm
C = 0.8 * 259 = 207 mm
The longest required material = 2 * (A1 + A2) + 2 * 5
= 2 * (162 + 254) + 10
= 842 mm

Design example – 2 :
In reality, the length of the material may be more of a constraint than the diameter of the dish. In such cases, ribs can be designed as follows.

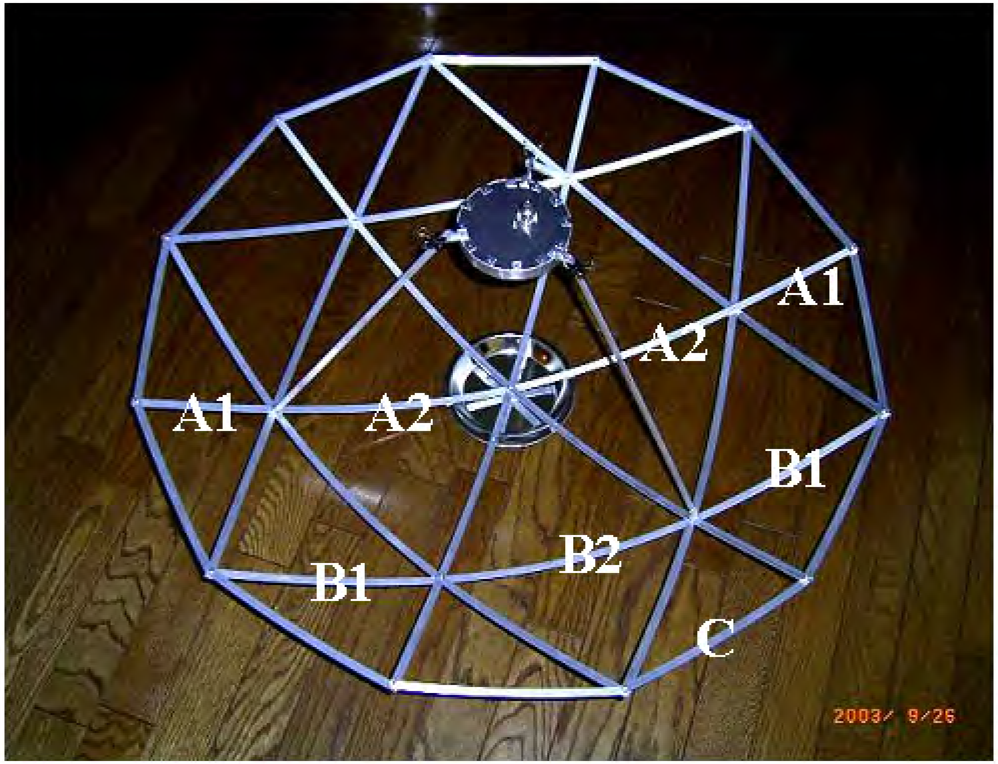

Figure –1 : Definition of dimensions – Type-I

Target f/D = 0.5
Normalized size
The longest rib A = 2 * (A1 + A2) + 2 * 5   Note: 5 mm for holes
= 2 * (202 + 318) + 10
= 1050
(A1 + A2) = 520
Assume an available longest material = 1000 mm
then (A1 + A2) = (1000 – 10) / 2
= 495
Scale factor = 495 / 520
= 0.952

A1 = 0.952 * 202 = 192 mm
A2 = 0.952 * 318 = 303 mm
B1 = 0.952 * 288 = 274 mm

Diameter	1000 mm						
f/D	**0.3**	**0.35**	**0.4**	**0.45**	**0.5**	**0.55**	**0.6**
A1 (mm)	181.2	190.4	196.1	199.8	202.3	204.1	205.4
A2 (mm)	168.9	164.2	160.2	157.2	155.0	153.2	151.8
A3 (mm)	202.8	185.2	174.6	167.6	162.8	159.4	156.9
B1 (mm)	-	-	-	-	-	-	-
B2 (mm)	-	-	-	-	-	-	-
B3 (mm)	182.1	172.6	166.1	161.6	158.3	155.8	154.0
B4 (mm)	200.1	183.6	173.5	166.9	162.3	159.0	156.5
C1 (mm)	284.1	286.2	287.3	288.0	288.3	288.6	288.7
C2 (mm)	-	-	-	-	-	-	-
C3 (mm)	178.2	169.8	164.0	159.9	157.0	154.8	153.1
D (mm)	258.8	258.8	258.8	258.8	258.8	258.8	258.8
E (mm)	-	-	-	-	-	-	-

Table-2 : Dimensions – Type-Ⅱ

B2 = 0.952 * 314 = 299 mm
C = 0.952 * 259 = 247 mm
Diameter = 0.952 * 1000 = 952 mm

Type – Ⅱ (Not recommended) : 1 m < Diameter < 2 m

Type-Ⅱ of convolutional structure was devised to strengthen the inner ribs and to make the segmentation more smaller than the Type-1 in a case of larger diameter antenna **[4]**. However, the springback of the mating point of two inner ribs was found to bend the middle point of the outer rib, thus deteriorating surface accuracy. The Type-Ⅱ is not recommended anymore because of this reason. **Table-2** and **Figure-2** are shown as a reference to the improved Type-Ⅲ.

This design is not recommended, so examples are omitted. However, similarities of the Type-Ⅰ examples are applicable to the Type-Ⅱ.

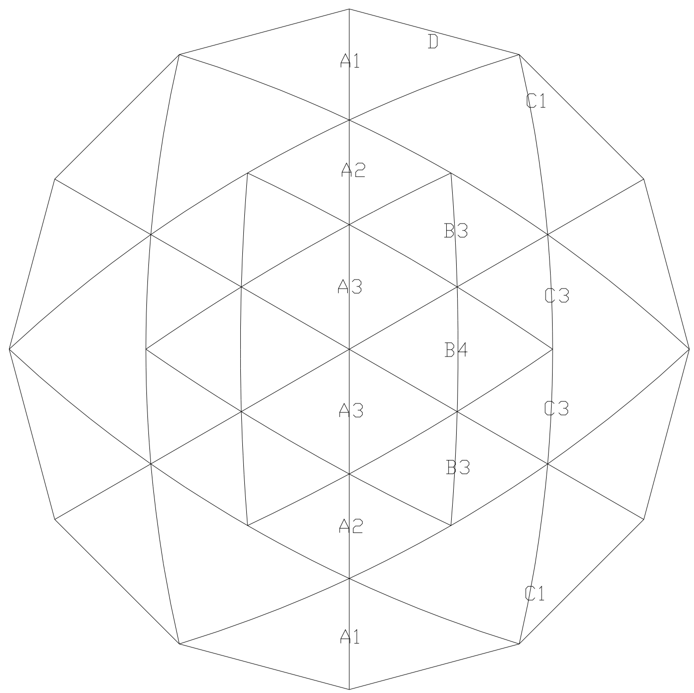

Figure –2 : Definition of dimensions – Type-II

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Type-Ⅲ : 1 m < Diameter < 2 m

In order to improve the problem of the Type-Ⅱ and to make the outer segments smaller, i.e. better surface accuracy, the inner ribs are extended to outer rims. This modification results in better stiffness and surface accuracy. In addition, larger center-hub and another back supporting must be considered **[3] [5]**.

Table-3 and **Figure-3** show dimensions and their definitions, respectively.

.**Design example – 3 :**

Target diameter = 1800 mm
then Scale factor = 1800 / 1000 = 1.8
Target f/D = 0.5

A1 = 1.8 * 202.3 = 364.1 mm

Diameter	**1000 mm**						
f/D	**0.3**	**0.35**	**0.4**	**0.45**	**0.5**	**0.55**	**0.6**
A1 (mm)	181.2	190.4	196.1	199.8	202.3	204.1	205.4
A2 (mm)	168.9	164.2	160.2	157.2	155.0	153.2	151.8
A3 (mm)	202.8	185.2	174.6	167.6	162.8	159.4	156.9
B1 (mm)	104.3	106.5	110.3	113.1	115.1	116.5	117.6
B2 (mm)	147.8	148.6	148.5	148.2	147.7	147.3	147.0
B3 (mm)	182.1	172.6	166.1	161.6	158.3	155.8	154.0
B4 (mm)	200.1	183.6	173.5	166.9	162.3	159.0	156.5
C1 (mm)	129.2	132.6	135.1	137.0	138.4	139.5	140.3
C2 (mm)	154.9	153.6	152.2	151.0	149.9	149.1	148.4
C3 (mm)	178.2	169.8	164.0	159.9	157.0	154.8	153.1
D (mm)	122.4	124.3	125.1	125.4	125.7	125.8	125.8
E (mm)	138.6	136.8	136.0	135.6	135.4	135.3	135.2

Table-3 : Dimensions – Type-Ⅲ

A2 = 1.8 * 155.0 = 279.0 mm
A3 = 1.8 * 162.8 = 293.0 mm
B1 = 1.8 * 115.1 = 207.2 mm
B2 = 1.8 * 147.7 = 265.9 mm
B3 = 1.8 * 158.3 = 284.9 mm
B4 = 1.8 * 162.3 = 292.1 mm
C1 = 1.8 * 138.4 = 249.1 mm
C2 = 1.8 * 149.9 = 269.8 mm
C3 = 1.8 * 157.0 = 282.6 mm
D = 1.8 * 125.7 = 226.3 mm
E = 1.8 * 135.4 = 243.7 mm

The longest required material = 2 * (A1 + A2 + A3) + 2 * 5
= 2 * (364.1 + 279.0 + 293.0) + 10
= 1846.2 mm

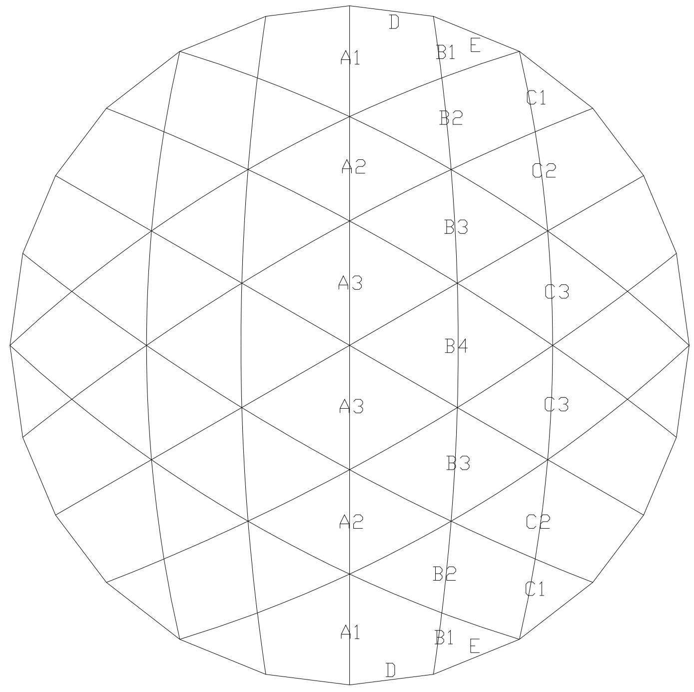

Figure –3 : Definition of dimensions – Type-Ⅲ

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Design example – 4 :

Target f/D = 0.5

Normalized size

The longest rib A = 2 * (A1 + A2 + A3) + 2 * 5
= 2 * (202.3 + 155.0 + 162.8) + 10
= 1050.2 mm

(A1 + A2 + A3) = 520.1 mm

Assume an available longest material = 2000 mm

then (A1 + A2 + A3) = (2000 – 10) / 2
= 995

Scale factor = 995 / 520.1
= 1.913

A1 = 1.913 * 202.3 = 387.0 mm
A2 = 1.913 * 155.0 = 296.5 mm
A3 = 1.913 * 162.8 = 311.4 mm
B1 = 1.913 * 115.1 = 220.2 mm
B2 = 1.913 * 147.7 = 282.6 mm
B3 = 1.913 * 158.3 = 302.8 mm
B4 = 1.913 * 162.3 = 310.5 mm
C1 = 1.913 * 138.4 = 264.8 mm
C2 = 1.913 * 149.9 = 286.8 mm
C3 = 1.913 * 157.0 = 300.3 mm
D = 1.913 * 125.7 = 240.5 mm
E = 1.913 * 135.4 = 259.0 mm
Diameter = 1.913 * 1000 = 1913 mm

Type-Ⅳ : 1.5 m < Diameter < 3 m

The Type-Ⅲ design left some room for improvement in terms of stiffness and surface accuracy when scaling up due to the rectangular segments remaining around the perimeter of the parabolic reflector. To address these issues, the Type-Ⅳ design adds additional geodesic line ribs to achieve a more homogeneous segmentation.

Table-4 and **Figure-4** show dimensions and their definitions, respectively.

Note that in the Type-Ⅳ, the added rib-F can no longer be connected at a single point on the circumference. This is due to the constraints of the geodesic lines on the parabolic surface.

Diameter	**1000 mm**						
f/D	**0.3**	**0.35**	**0.4**	**0.45**	**0.5**	**0.55**	**0.6**
A1 (mm)	49.2	53.5	56.6	58.7	60.4	61.5	62.4
A2 (mm)	132.0	136.8	139.5	141.1	141.9	142.6	143.0
A3 (mm)	168.9	164.2	160.2	157.2	155.0	153.2	151.8
A4 (mm)	202.8	185.2	174.6	167.6	162.8	159.4	156.9
B1 (mm)	101.2	106.5	110.3	113.1	115.1	116.5	117.6
B2 (mm)	147.8	148.6	148.5	148.2	147.7	147.3	147.0
B3 (mm)	182.1	172.6	166.1	161.6	158.3	155.8	154.0
B4 (mm)	200.1	183.6	173.5	166.9	162.3	159.0	156.5
C1 (mm)	129.2	132.6	135.1	137.0	138.4	139.5	140.3
C2 (mm)	154.9	153.6	152.2	151.0	149.9	149.1	148.4
C3 (mm)	178.2	169.8	164.0	159.9	157.0	154.8	153.1
D1 (mm)	88.2	90.7	92.3	93.3	94.0	94.5	94.7
D2 (mm)	34.2	33.6	32.8	32.1	31.7	31.3	31.1
E (mm)	138.6	136.8	136.0	135.6	135.4	135.3	135.2
F1 (mm)	96.1	99.8	102.4	104.2	105.5	106.3	107.0
F2 (mm)	152.5	151.3	150.2	149.2	148.4	147.8	147.3
F3 (mm)	164.2	159.1	155.7	153.4	151.7	150.5	149.5

Table-4 : Dimensions – Type-Ⅳ

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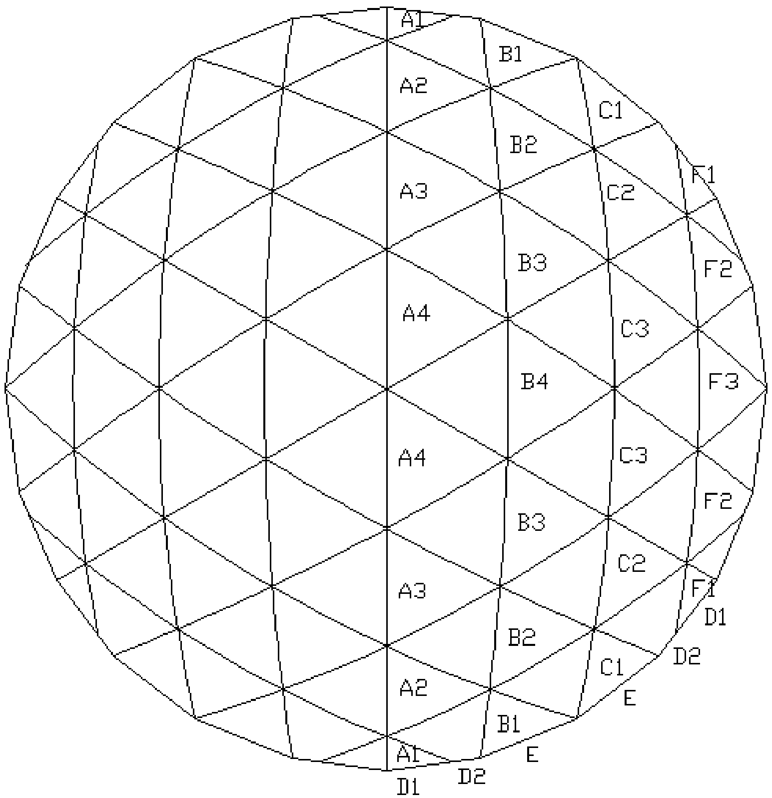

Figure –4 : Definition of dimensions – Type-IV
Note : D1 and D2 are a single flat bar.

References

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