REGULAR SPHERICAL GRIDS OBTAINED WITH THE METHOD OF DEFORMATION OF A SECONDARY NETWORK.

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Geodesic domes, worked out for the first time by B. Fuller, are the form often used to cover wide spanned structures. Geometric parameters of triangular spherical grids approximating the surface of sphere play a significant role in geodesic domes. The grids of this type are determined by means of various methods (T.Tarnai, 1987). Triangular spherical grids should describe as little as possible the curvature of this surface and the lenghts of its individual segments should not be too differentiated while the plane angles included between two adjacent segments should assume the values from the smallest range of their possible but necessary changes. In order that the grid might be determined as a regular spherical grid it should consist of the lowest number of segments of different lenghts. The coefficient η , being the ratio of the longest segment to the shortest segment of a given spherical grid decides about the regularity degree of this grid.

The pictures of the changes of network lenghts brought about by the nodal interstice in metal and interstitial atom (T.Penkala,1977) were the inspiration to work out the method of deformation of a secondary network. The essence of this method consists in the appropriate deformation of a triangular grid in the base plane only to obtain a regular triangular spherical grid after having it re-projected (J.Rebielak,1988). This method employs the properties of the central and orthogonal projections to the plane. Figure 1 presents the scheme of determination of

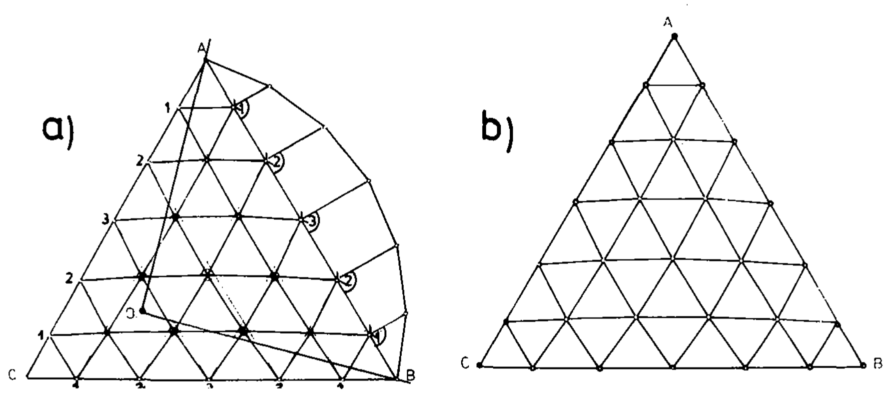

Figure 1.

the deformed secondary network for the principles of orthogonal projection to the plane. The points of division of the great circle to the n-number of equal segments after their orthogonal projection determine a new arrangement of side edges of the triangle ABC. Linking the points of the same ordinal number we determine the inner triangular fields of which the centres of gravity determine the position of nodes of the deformed flat triangular grid. After having orthogonally projected these nodes we get the nodes of regular spherical triangular grids. Figure 2 presents dimention relations of spherical grid formed in the way mentioned above for the division of side edges to $n=6$ equal segments. Through "a" was defined a length of edge of equilateral triangle ABC. The dimention relations of the spherical grid were determined for the same outer conditions, that is the same distance of the sphere centre from the base plane $Z=0,75a$, sphere radius $R=1,0a$ and the same dence division of side edges ($n=6$) using the principles of central projection in the method of deformation of secondary network ; these relations have been shown on the figure 3.

Different values of the coefficient η for the both presented grids can be noticed apart from the different arrangement of the segments of the extreme lengths but at the same density of a given spherical grid (n). Figure 4 presents the course of the changes of the coefficient η values according to the division degree of the spherical triangle sides (n) for two versions of the method of deformation of a secondary network. The curve 1 shows the course of the changes of the coefficient η values for the spherical grids determined by means of orthogonal projection to the plane. The curve 2 shows the increase of the coefficient η values for the grids determined by using the principles of the central projection.

The analysis of the graph on the figure 4 reveals that very dence grids determined by central projection are slightly more regular than spherical grids generated by the orthogonal projection to the plane. The triangular spherical grids generated by the orthogonal projection to the plane are characterized with a favourable degree of regularity for less dence divisions of side edges.

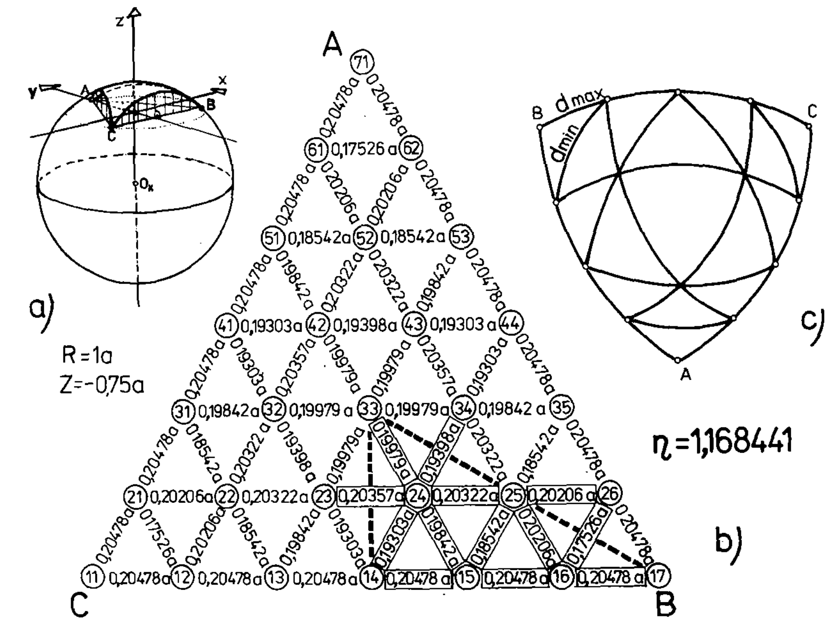

Figure 2.

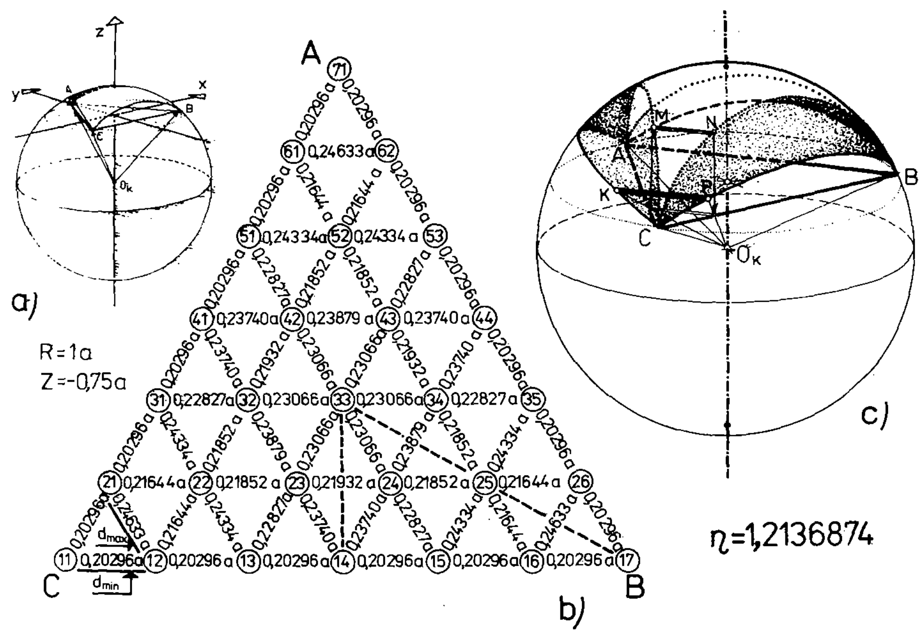

Figure 3.

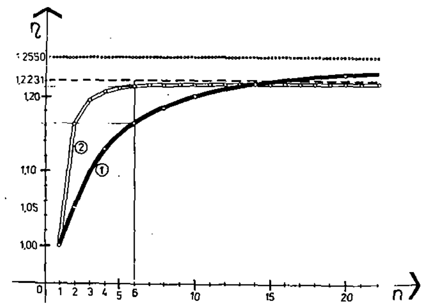

Figure 4.

References :

1 . T.Tarnai , Geodesic domes with skew networks, p.127-159, Spherical Grig Structures , Hungarian Institute for Buildings Science , Budapest 1987

2. T. Penkala, Zarys Krystalografii, p.335, PWN, Warszawa 1977

3. J.Rębielak, Modularne struktury powierzchniowe, Prace Instytutu Architektury i Urbanistyki Politechniki Wrocławskiej, Seria Monografie Nr 14, Wydawnictwo Politechniki Wrocławskiej, Wrocław 1988