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Topology and geometry of bar constructions
made from regular 20-hedron

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The centres of 20-polyhedrons edges determine the halfregular
32-polyhedron. Vertices of the 20-polyhedron and 32-polyhedron de-
termine the 80-polyhedron, which topology is presented on fig.1a.
The centres of 32-polyhedron's edges are vertices the 92-polyhe-
dron. Placing on the walls of the 32-polyhedron pyramids, which
vertices are lying on the common spherical surface, we get the
180-polyhedron.

If on the spherical surface circumscribing the vertices of the
regular 20-polyhedron are projected the centres of its walls, we
get the 12-polyhedron. Each edge of the 20-polyhedron fits in one
edge square with one of the 12-polyhedron. The vertices of the 20-, 12-, and 32-polyhedron compose the vertices of the 240-polyhedron
having 360 edges, which topology is shown on fig.1b. The vertices
of the 20-polyhedron and 12-polyhedron compose the vertices of
the 60-polyhedron.

From the given polyhedrons can be formed, in turn, bigger ones
for instance - in the first kind the 180-polyhedron is converted
into the 540-polyhedron, 240-polyhedron into 720-polyhedron, the
320-polyhedron into 960-polyhedron etc., in the second case the
80-polyhedron is converted into 320-one, 180-polyhedron into 720-
one. 240-polyhedron into 960-one, etc. In the third case the 240-
polyhedron is converted into 320-one, 540-polyhedron into the 720 -one. the 720-polyhedron into the 960-one, etc.. These 3 kinds of
conversion enable 3 quite different constructions.

Treating the edges of each polyhedron
as bars and vertices as nodes we get one
layer space truss. Taking the opportuni-
ty of converting of one polyhedron into
the second one, at their concentric set-
ing, we can join together two one layer
structures, forming in this way two-la-
ers bar constructions.

Fig.1c presents the topology of the
two-layers construction consisting from
the bar layer fitting in the 80-polyhe-
dron /thick lines/ the bar layer fitting
in the 240-polyhedron /thin lines/ and
the layer of joining bars /punctate li-
nes/. The calculated angle coordinates
of nodes for 1/20 part are presented in
tabl.
Fig. 2 shows the two-layer bar construction and at the same time reflects the conversion of a polyhedron into a second one. The bars of the internal layer are the edges of the 180-polyhedron. The double line is marking the mother network of this 180-polyhedron, which is the halfregular 32-polyhedron. The external layer bars are the edges of the 92-polyhedron which walls are: 60 isosceles triangles, 20 regular hexagons. Transposing polygons into triangles we get 240-polyhedron. It's the conversion of the 3d kind.

Fig. 3 displays the two-layers bar structure based on the conversion of the internal 60-polyhedron into the external 240-polyhedron changed here into mother network of the second type /60:3/, being 92-polyhedron. The double line is marking the network of
The nodes of two-layers constructions were described by independent concentric spheres and changed the reciprocal relation of their radii calculating geometric characteristics of the constructions.

Fig. 4 presents the two-layer bar construction based on the conversion of the internal 80-polyhedron into the external 240-one changed here into mother network of the first kind /80x3/ closed by 12 pentagons and 30 hexagons. Fig. 5 presents the view of the 240-polyhedron.

Fig. 6 illustrates an example of a change of bars length according to radii ratio $R_{180}/R_{60}$ is the radius of sphere describing construction nodes coming from the 180-polyhedron, $R_{60}$ is the radius of sphere describing the nodes of construction coming from the 60-polyhedron. The lines 1 and 2 illustrate the changes of length for bars of the 60-polyhedron. Completing the polygons with triangles we get the 240-polyhedron.
construction described by sphere with the radius $R_{60}$; the lines 3, 4 and 5 illustrate changes of length bar groups for the construction described by the sphere with the radius $R_{180}$; the lines 6, 7 present the change of groups of bar length joining both layers.

Similarly were marked the lengths of bars for two-layers bar construction based on 80-polyhedron and 240-one, and the results are presented on fig.7.

Fig. 5.

Fig. 6.

Fig. 7.