Optimum design of double-layer space girds

Autor(en): **Agerskov, Henning**

Objekttyp: **Article**

Zeitschrift: **IABSE congress report = Rapport du congrès AIPC = IVBH Kongressbericht**

Band (Jahr): **12 (1984)**

PDF erstellt am: **15.09.2024**

Persistenter Link: https://doi.org/10.5169/seals-12290

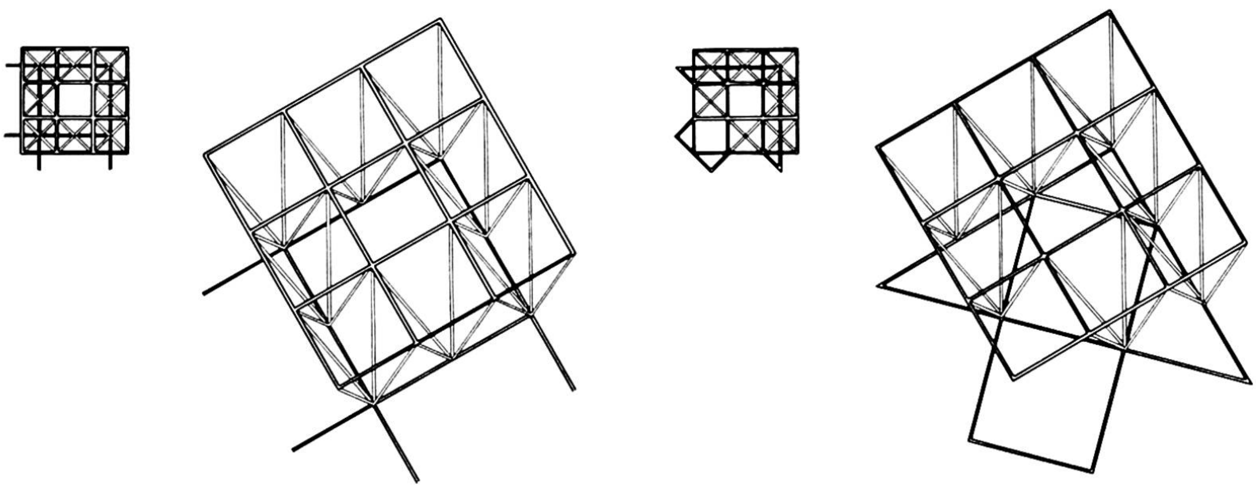
Optimum Design of Double-Layer Space Grids

Henning AGERSKOV
Assoc. Prof. of Struct. Eng.
Technical University of Denmark
Lyngby, Denmark

In recent years extensive and increasing use has been made of space trusses, especially in the form of double-layer space grids. These types of structures have in many cases been able to compete with more traditional constructions. The main areas of application have been sports halls, swimming pools, exhibition buildings, churches, shopping centres, hangars, factory buildings, etc., where the space grid is used as roof construction.

In the design, almost unlimited possibilities exist in practice for the choice of geometry of space trusses. This forms the background for a research project, in which the optimum design of double-layer space trusses has been investigated. As a first part of the investigation, a study covering what has, until recently, been obtained as regards optimization of double-layer space grids was carried out. With the results of this investigation as a starting point, various geometrical designs were studied in detail to determine the optimum design. Both square and rectangular grids have been investigated, under the assumption of either simple supports along the entire edge or column supports at the corners.

In determination of the optimum design, an ordinary mathematical optimization based on a minimum of material consumption, was found to be of little practical interest. The present investigation is based on assumptions concerning nodes, members, supports, loading, etc., which make the results realistic to a practical design. To determine the optimum de-



a) b)

Fig. 1. Space grid systems, which will in general result in good overall economy.

sign, both the material consumption, the number of nodes, and the number of members in the structure have to be considered, while an optimum design based only on a minimum of material will rarely, if ever, be an economical optimum for a double-layer space grid.

On the basis of the results obtained in the investigation, guidelines for the structural engineer to obtain an optimum design, have been worked out. Guidelines are given for choice of overall geometry of simply supported and corner-supported square and rectangular space grids.

RECOMMENDATIONS

The following general recommendations concerning optimum design of double-layer space grids can be made:

1. The member density must be small. In addition to giving a small material consumption, this leads to a grid with relatively few nodal points and thus least possible production costs for nodes, erection expenses, etc.

2. The system should be chosen so that the space grid is built of relatively long tension members and relatively short compression members.

3. For rectangular, relatively long space grids, optimum design is obtained with systems where the load is mainly carried across the short span. Systems where the members in both top and bottom layer grids are parallel to the edges will generally result in the least material consumption.

4. If both the material consumption and the number of nodes and number of members are considered, the space grid systems shown in Fig. 1 a and b will, generally speaking, result in good overall economy. This could be concluded from investigations on both square and rectangular double-layer space grids, simply supported along the entire edge or column-supported at the corners.

REFERENCES

1. Agerskov, H., and Gudjonsson, H., "Optimal udformning af rumgitterkonstruktioner", Proceedings of the Scandinavian Conference on Steel Research, Copenhagen, Denmark, Aug., 1979, pp. VI. 5.1-13.

2. Agerskov, H., "Optimum Design of Double-Layer Space Trusses", Report, Dept. of Civil-Structural Engineering, Portland State University, Portland, Or., U.S.A., 1981.

3. Agerskov, H., and Bjørnbak-Hansen, J., "Optimum Design of Corner-Supported Double-Layer Space Trusses", Report No. R 177, Dept. of Structural Engineering, Technical University of Denmark, Lyngby, Denmark, 1983.

4. Agerskov, H., "Optimum Design of Double-Layer Space Grids", Dept. of Structural Engineering, Technical University of Denmark, Lyngby, Denmark, Sept., 1984, 21 pp.