Zeitschrift: IABSE structures = Constructions AIPC = IVBH Bauwerke

Band: 12 (1988)

Heft: C-45: Recent structures

Artikel: Ouludome, Oulu (Finland)

Autor: RIL

DOI: https://doi.org/10.5169/seals-20913

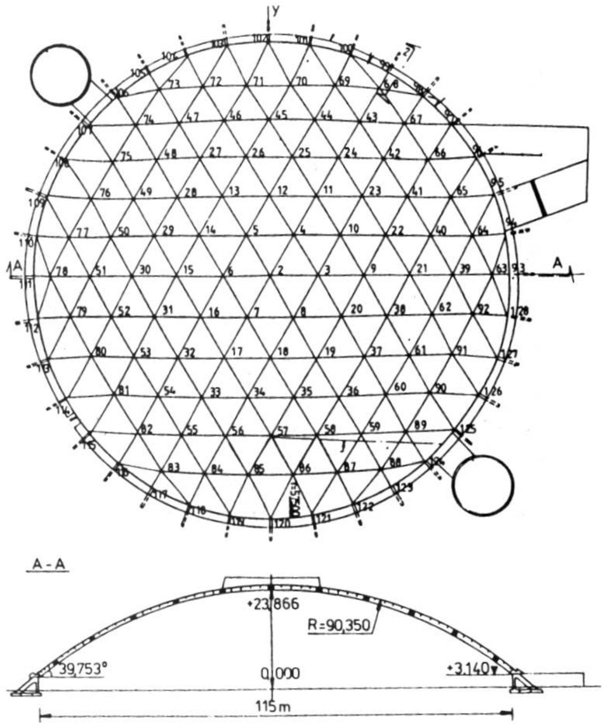
4. Ouludome, Oulu (Finland)

Owner:	*Municipality of Oulu*
Architect:	*Arkkitehtitoimisto Harju & Co., Oulu*
Engineer:	*Insinööritoimisto Pekka Heikkilä Ky, Oulu*
Contractor:	*Oulu Municipality Department of Housing and Docks*
Works' duration:	*15 months*
Service Year:	*1986*

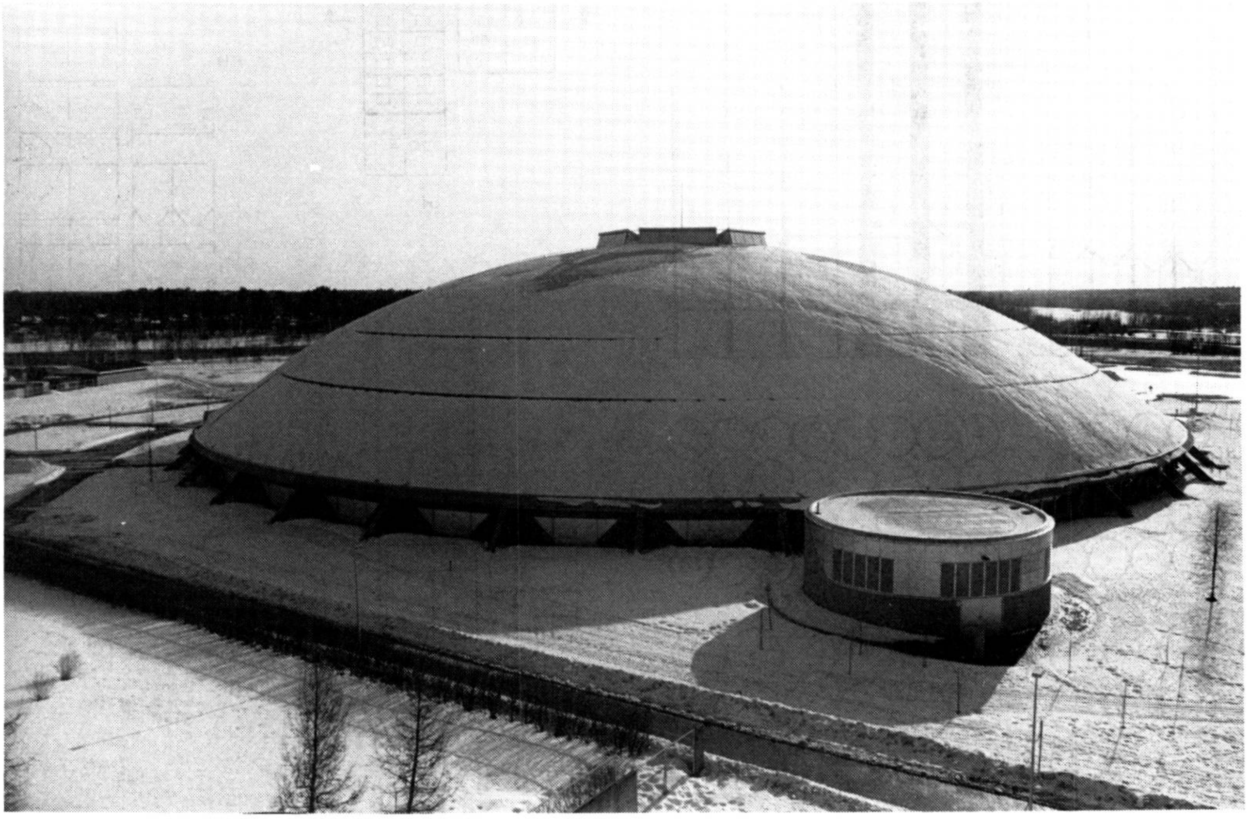
The large sports hall offers the possibility to practice so-called outdoor sports around the year in Oulu, independent of the weather. In addition it can be used for congresses and exhibitions.

The layout of the Ouludome is circular with a basal diameter of 115 meters. The racetrack (304 m) and football pitch (53×90 m^2) are covered by the low external wall and domed roof. There is fixed space for just under 1000 spectators. The foundations and the external walls are of concrete. The domed roof is of wooden construction. The joints of the wooden main beams are of reinforced concrete. Ouludome is the largest wooden domed hall in Europe with a volume of 145000 m^3.

The frame of the dome is formed of curved microlam main beams with a cross-section of 150 – 204 × 700 mm^2. There are 342 beams and their average length



Geometry of the dome

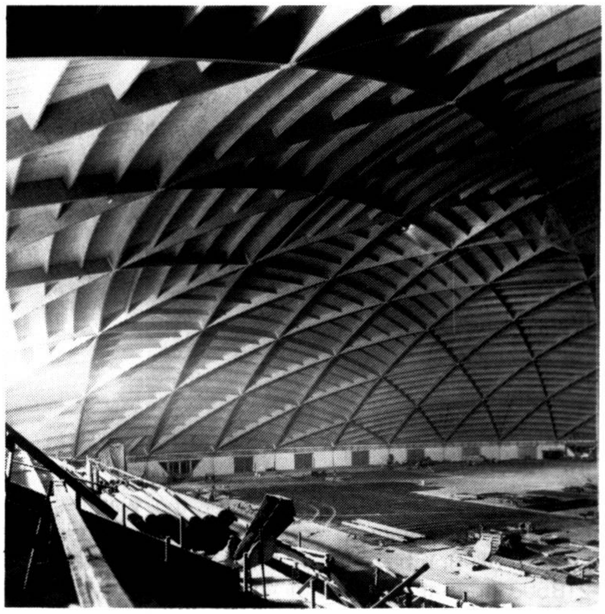


Ouludome in winter

is about 11 meters. The bearing structure resembles a 3-dimensioned grid. The beam grid structure curves into a sphere with a radius of 90 m. A secondary curved microlam beam system and uniform deck structure is supported by the beam grid structure.

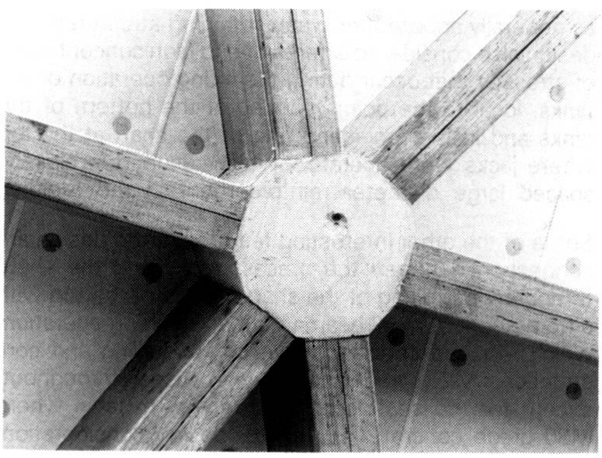
The net of the dome's main beams is formed of three arched groups which intersect each other at an angle of 60 degrees. At the apex of the dome the three main arches intersect and divide the roof into six symmetrical areas. The frame forms a reticulum consisting of 216 triangles.

The main beams of the dome are connected to each other at six rod intersection points. The junction hubs are 390 mm in diameter and are of cast white concrete. The slight tension forces which might occur in the joints are taken up by steel components. They are fixed to the wooden beams with the aid of double nailplates which are fitted between the laminations of the beams. There is a total of 127 joints and they are an important part of the dome structure. They play a crucial role in the erection, functioning, price and external appearance of the dome.



Inside view of the dome after erection

Erection of the dome



Concrete joint of wooden beams

The edge of the dome is supported on a three-meter high sub-structure. The sub-structure is formed by 36 edge support points situated at intervals of 10 degrees (about 10 meters) and the connecting polygonal ring beam. Vertical forces are led into reinforced concrete piles and horizontal forces to the tension ring beam via angled support structures and the external wall. The ring beam is a post-stressed concrete structure. It is situated beneath the surface of the ground and insulated to maintain constant temperature. It also acts as the foundation of the external wall. In the visible parts of the sub-structure the structure's function is brought out by architectural means.

The dome grid was analysed as a space frame formed by the main beam net, using a computer programme based on the element method. The sub-structure was also incorporated simultaneously into the calculations as the rigidity of the sub-structure and the stability of the dome are interdependent. A central part of the design was the control of the structural geometry. In the same way, the wind and the snow loading assumptions were crucial. The strength and rigidity of the concrete joint type used for the wooden arches was investigated at Oulu University on a 1:1 scale. The rigidity of the joint was essential from the point of view of the function of the dome.

The erection of the pre-fabricated microlam frame demanded extreme dimensional accuracy. Sufficient installation tolerances were achieved by the concrete technology and the friction bolt connectors used. Erection work progressed in the sixth sector by circling the ring and rising from arch to arch. Vertical supports were needed under the unconcreted joints at the edge of the structure. Erection time for the frame of the dome was 8 weeks.

(RIL)