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The Cable-Net Cooling Tower at Schmehausen

La tour de refroidissement avec un réseau de câbles construit à Schmehausen

Der Seilnetzkühlturm in Schmehausen

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The cable-net cooling tower, as described in the preliminary report Ia, pages 33 - 38, is at present nearing its successful completion.

I wish to summarize in short its basic principles and show some slides of the construction on site.

If a cable net with triangular meshes and a surface with negative (anticlastic, hyperbolic) curvature is prestressed, it behaves with respect to outer loads, i.e. here mainly to wind, as an ideal membrane shell. It is not subject to any bending, even under high and local wind gusts, since it has no bending stiffness. It is also not subject to buckling, since it always acts in tension. Horizontal spokes wheels, consisting of rings and radial ropes, are provided as stiffeners (Fig. 1).

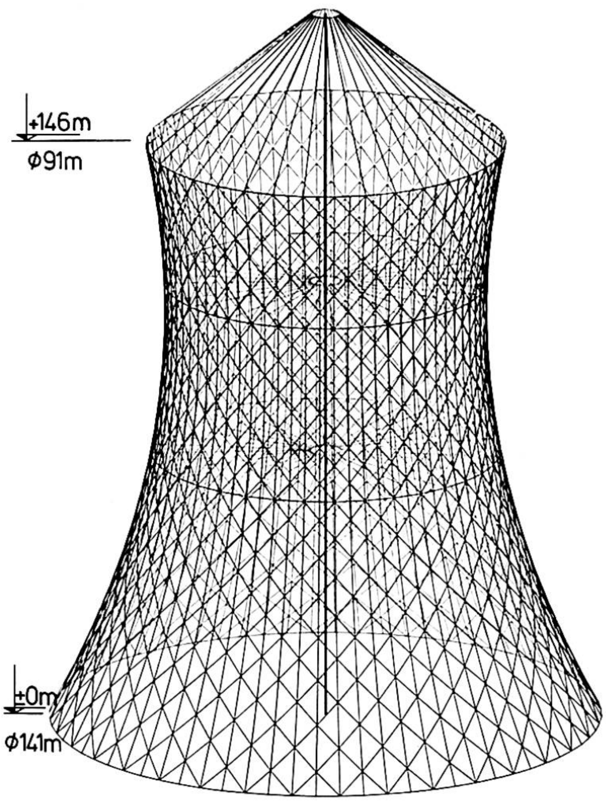

Fig. 1

Such a cable-net readily makes a cooling tower if it is covered with an air-tight cladding, leaving only its bottom part free up to a height as required for the air-inlet. The prestressing forces are introduced by tensioning the net vertically between a foundation ring at the bottom, anchored to the ground with prestressed soil anchors, and a steel ring at the top.

This ring at the top acts in compression, since it is suspended by inclined radial ropes from the top of a mast, which is placed at the center of the tower. Since this mast only is to maintain the prestress, it acts under pure compression and is preferably made from concrete. In Schmehausen the mast is 180 meters high, the diameter of the net being 91 meters on top and 141 meters at the base. The total net surface has an area of 46,000 m^2.

Construction at Schmehausen started with the tubular mast and the foundation ring simultaneously. The cable- and steel structures were designed such that they could be completely prefabricated in the work shops (according to an exact cutting pattern) and be lifted from ground into its final position. After the concrete works, the box steel ring of the future upper spokes wheel was assembled on ground as well as an inner ring surrounding the mast. After the radial ropes were fitted between these two rings, the whole assembly could be lifted (Fig. 2). For this purpose a lifting device was placed on top of the mast and connected by vertical steel rods with the inner steel ring.

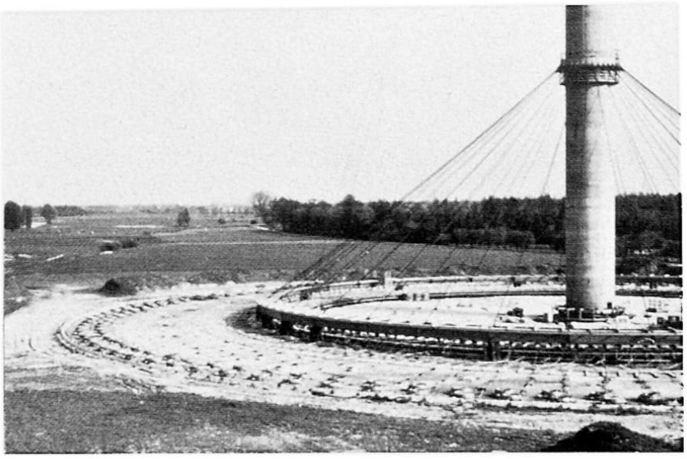

Fig. 2

After the outer ring just raised from ground, the cables of the net were fixed to it and unspooled whilst further lifting the ring. The net cables consist of two parallel strands each, with aluminum clamps press-fitted in the shop such that there is only one bolt required to connect the three layers of cables at each knot.

These bolts additionally serve for fixing aluminum ring beams, which are later to carry the cladding and which were also attached to the net on ground during the lifting process (Fig. 3).

Fig. 3

The continuous lifting process, which could cover 4 meters a day minimum, had to be interrupted shortly only twice, when the net-cables had to be fixed to the outer spokes-wheels, which were also assembled on ground and lifted with the net.

These rings carry trolleys, running around and like funiculars also up and down the cable net, to transport the corrugated aluminum sheets for the cladding into their final position (Fig. 4). (See page 38 of the preliminary report.)

The cladding could however only be fixed, after the net had reached its final height, was attached to the foundation ring and prestressed with the same (but strengthened) device as used for lifting - and finally after the lifting ring was permanently connected with the top of the mast (Fig. 5).

Fig. 4

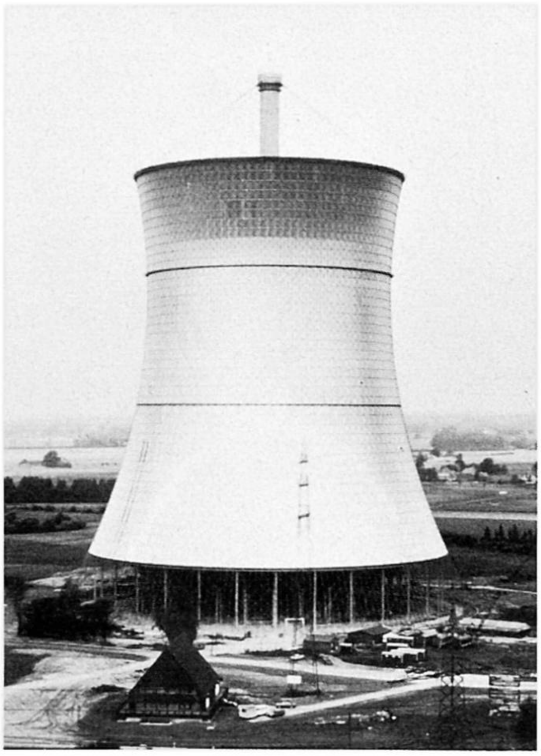

Fig. 5

The new type of a cooling tower with a triangular cable net was perceived by Jörg Schlaich and Günter Mayr, who are in charge of this structure in the consulting firm Leonhardt und Andrä, Stuttgart. Balcke-Dürr/GEA, Bochum, are the general contractors and Krupp Industrie- und Stahlbau, Goddelau, the contractors for the cable-net tower. With this system, cooling towers with even much larger sizes can be built.

SUMMARY

A new type of natural draught cooling tower is presented, which is mainly of advantage, if either one of the following conditions is required: large dimensions (specially large width to height ratio), seismic conditions and soil settlements.

RESUME

Une nouvelle tour de refroidissement est décrite, qui est surtout avantageuse si l'une des exigences suivantes est remplie: grandes dimensions (particulièrement grand diamètre par rapport à la hauteur), construction en zone sismique ou sur des terrains exposés aux tassements.

ZUSAMMENFASSUNG

Ein neuartiger Naturzugkühlturm wird beschrieben, der vor allem dann vorteilhaft ist, wenn eine der folgenden Forderungen gestellt wird: grosse Abmessungen (besonders grosser Durchmesser gegenüber der Höhe), Bau in Erdbebengebieten oder auf setzungsempfindlichen Böden.