The Waldstadion Frankfurt - Germany

Lifting and tensioning
of the cable roof structure for the new sports stadium.

▲ *Partial view during the first pulling stage with the centre of Frankfurt in the background*

During June and July 2004, one of the most spectacular roof structures in the world was lifted into place over the newly renovated ‘’Waldstadion’’ in Frankfurt. A tremendous time pressure was on the installation works, as only the break in the football season was available to get the roof anchored in its final position.

The first activity was to remove the grass from the pitch and to replace with gravel. All the components for the roof structure were then laid out and assembled on this working surface and over the stands.

The roof consists of a double layered cable net structure, which will later be covered by a membrane. 44 radial cables are anchored on the compression ring running over a length of 709 m around the top of the stands. 35 m above the centre of the field all 44 cables are anchored in a massive central node.
Hanging from it will be a video cube with 10 m long sides.

The 9,000 m2 central part of the roof can be retracted and folded inside the cube within 20 minutes. Because of this feature the stadium has been dubbed the biggest ‘‘convertible‘‘ in the world.

The lifting operation was executed in 2 stages. In a first step, the upper radial cables were pulled with 44 strand lifting units over a distance of about 30 m.
Halfway through this operation a stop was necessary to install the flying masts between the upper and the lower level of the tension ring.

The latter has an almost rectangular shape, a bit larger than the pitch itself. It is named the ‘’ring of fire’’ because all the flood lights are suspended there. After 8 days all 44 cables were anchored at the compression ring.

Scope of works performed

- Heavy lifting
- Post tensioning

▲ *Shortly before setting the pin*

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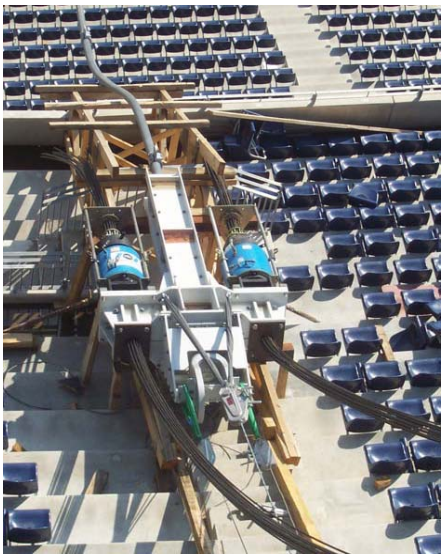
This very slender ring with its optimised design weighs only 1440 t. During the whole operation, the compression ring was stabilized with temporary struts.

Even so the cable forces and movements had to be monitored within very tight tolerances. This information was continuously fed to the consultant to compare with the calculated values.

The equipment was then reset for the pulling and tensioning of the lower radial cables. For this second step of another 25 m, 2 strand lifting units were installed for each radial cable. The total pulling capacity of the 88 units exceeded now 21,000 t.



▲ *Pulling units for the second stage are ready on the stands*

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STRAND JACKING OPERATIONS
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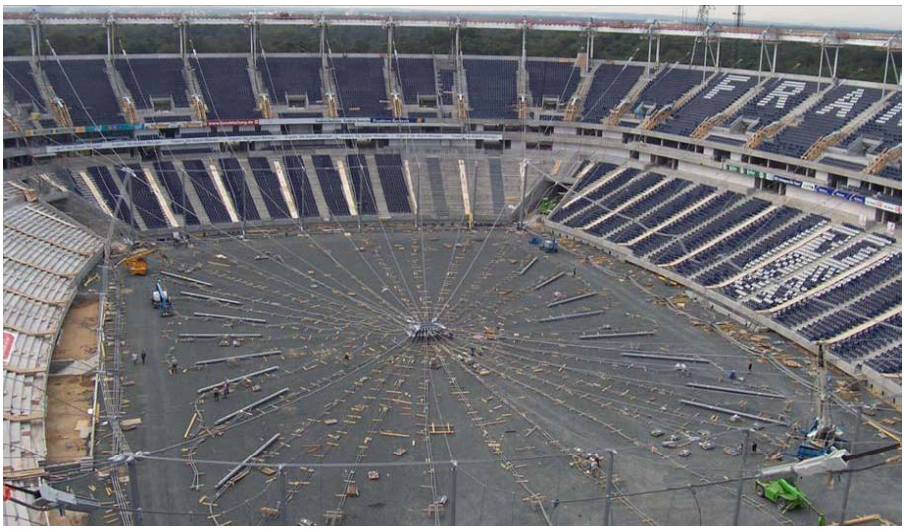
▼ *At the beginning of the first stage, flying masts still on the ground*



▼ *The cable net at the end of the first stage with the flying masts installed*

The temporary struts at the compression ring were removed when there was about 1 m left to pull. In this final stage, all the 44 cables had to be pulled simultaneously within millimetres so as not to locally overstress the compression ring.

On July 16, 2004 at 4.13 pm the last pin was set. The roof cable net was now in its final place. In the words of the project manager: ‘’Even though it’s a structure of 3,000 t, it had to be treated like a raw egg’’.

This elegant structure will certainly be a worthy venue for some of the games of the 2006 World Cup.

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