ERECTION OF CABLE STRUCTURES

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Wire ropes stretch proportionally to load. If there are differences in lengths, considerable stress deviations in the ropes may result. To reach the planned geometry of a cable structure under defined prestressing forces, all possible influences on the rope for the later elongation behaviour of the cable structure must be taken into consideration already during production.

The different wire ropes of a structure can show variable diameters. The rope diameters of a radial cable system for a stadium, for instance, differ considerably. The ring cables are the thickest, followed by the upper radial cables and the lower radial cables. The suspender ropes as connection between the radial cables are the thinnest. The elongation reaction of each rope diameter has to be known exactly before the production, to grant a regularly loaded cable system. Therefore, samples from every rope are tested regarding elongation, creeping, cone settling and lengthening when screwing on clamps. These results as well as the working temperature form the basis of the production of the individual lengths and markings.

The exactness of the later cable structure depends on the tolerance of each individual rope. Adjustment possibilities for corrections are not planned in the cable system. Inexactnesses of the lengths of the ropes would lead to unplanned higher forces in the tension members, which are too short.

There is a constant temperature in the underground 220 m prestressing tunnel with a hydraulic operated prestressing machine which has a capacity rating of up to 6000 kN. With the test results achieved each individual rope will be marked after cycle loading in the prestressing tunnel.

Under prestressing forces also thick ropes change not only their lengths but also reduce their diameter. Therefore screw fixed clamps are best put on under preload in the prestressing tunnel. Very long experience is required to determine the necessary increase of the screw torque moment on clamps at the untensioned rope in a way that they show the required setting value in the finished tensioned construction.

All components of the rope construction are dimensioned for the forces which arise when the construction is put into use. The erection has to be planned in a way that the erection forces in the individual prefabricated parts remain under the operating forces and do not require additional links even under extreme angle changes possibly arising during the erection.

Adjustment possibilities to correct the lengths are only necessary on the connections of the cable structure system to the complete construction building if the required exactness of the geometry of the concrete- or steel construction can not be ensured. The connection of the rope system to steel constructions precisely manufactured and measured in test assemblings during production is carried out by means of direct bolting.

The erection of a radial cable system for a stadium roof structure begins with the laying out of ring cables on the ground within the field but on the outer border to the stands of the stadium. Screwed ring connectors having the same geometry as the fixing points on the complete construction being later the connection to the radial cables.

Temporary tension platforms are installed on these fixing points of the ropes system of the construction. The high tension forces require strand jacks. Several of them are supplied by a central oil pump. The strand jacks can be operated and observed all together or each seperately.

The laying out of the radial cables is carried out via cranes with great length of jib. The lower end is connected with the ring cable and the upper end with the strands of the tension stations. If the geometry of the stands hinders a free sagging of the radial cables, bases able to take a load are used to protect chair rows and ropes.

The ropes received their final corrosion protection already through a Galfan zinc coating of the individual outer wires during wire production. Compared with the zinc coating of the usual hot zinc galvanizing the corrosion protection effect is 3 to 4 times longer through the double dip process in an aluminiferous zinc dip. This corrosion protection is designed for a service life of 50 years without any further coatings. The measures for the corresponding protection during the erection are far less costly than an additional coating. Besides, such a Galfan zinc coating is not as sensitive regarding mechanical damages as a colour coating otherwise required additionally.

After fixing all radial cables the hydraulic presses start with the lifting work symmetrically. In doing so the rope system is being tensioned clearly at first and moved for several meters in the horizontal line before it lifts on the whole from the ground.

The further erection procedure depends on the roof system: if there only is one ring cable level, the lifting of the complete cable structure can be carried out rapidly. Two ring cable levels are jointly connected by supports. To lift a second ring cable level one has to wait until the upper ring cable has been lifted more than one column height up from the ground.

One radial cable level can be moved towards the fixing point with relative low forces. Afterwards the complete tension force of all strand jacks is concentrated on the second radial cable level.

The erection calculation views all individual steps exactly. Regular checks show whether everything behaves according to plan. Even slight deviations regarding geometry and prestressing forces result in new check-calculations to fix corresponding compensation measures.

During the last centimetres towards the fixing points at the construction the tension forces show a steep increase. Gradually the cable system assumes its final shape. Only now it

becomes visible whether all production steps during cutting to lengths and during socketing have been carried out in the necessary accuracy. On the untensioned rope practically no examinations of the lengths can be carried out.

The hydraulic cylinders move rope after rope into the final position. There the bolts can be moved easily through the borings of socket and fastening eye plate. After the prestressing is completed the rope system stands slightly above the target position which will be achieved exactly within the first 24 hours through a slight creeping of the ropes.

The final tension forces of the individual ropes are taken down and compared with the prior statements. They and the overmeasure of the concluding measurement confirm the exactness of the rope system.