Strengthening of a hypar shell with carbon reinforced concrete

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Abstract

For many years, the hypar shell in Magdeburg has been one of the defining examples of shell structures in east Germany. Erected by Ulrich Müther in 1969 [1], the building was one of the largest shell constructions in Germany for several decades and therefore one of the well-known landmarks in Magdeburg. However, considerable defects and damages have occurred over time. Due to this fact, the building was closed in 1997 [2]. In order to prevent a demolition of this unique slim shell construction, years of research for a suitable renovation and repair option for this filigree structure have passed by. At first well known strengthening methods were investigated, e.g. a strengthening with conventional steel reinforced shotcrete was one of the possible methods. But it turned out, that only a retrofitting with carbon reinforced concrete can be considered as a permanent solution to protect the structure from demolition.

The relatively new composite material carbon reinforced concrete consists of two different components, a fine-grained concrete and carbon grids with high tensile strength [3]. Nowadays, many researches were done to investigate the material behavior of carbon reinforced concrete for the strengthening of existent buildings, as well for new structures. Moreover there are already some executed practical examples for the use of carbon reinforced concrete for both field of applications (strengthening and new buildings) in Germany.

In this paper the strengthening of the hypar shell in Magdeburg (Germany) with carbon reinforced concrete will be described in detail. The structure has a shell thickness of 7 cm by a span of 48 m. But, because of many damages, the load capacity of the shell is not sufficient anymore. Due to this, the shell structure will be strengthened with 10 mm thin carbon reinforced concrete layers on the top and bottom of the existent structure. The planning process, the calculation of the strengthening layers will be described. Additionally, a feasibility study with two different types of carbon grids, which was a part of the planning study will be shown.
At the end of the paper an outlook of the practical work at the construction site, which is going to start in summer of 2018, will be performed. With this paper the possibilities of the new strengthening method with carbon reinforced concrete shall be shown.

References

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