Bearing behaviour of biaxial hollow core slabs

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Summary

Two way hollow core slabs with void formers between the upper and lower static reinforcement are getting more and more popular in Germany. The reduction of the dead load of the slab resulting from the cavities allows larger spans compared to solid slabs with the same depth. Since the void formers are spherical or ellipsoid shaped the slab maintains its biaxial strength. However some open questions regarding the bearing behaviour of two way hollow core slabs still prevent a wider spread of these innovative structural elements. The goal of this research project was to answer these open questions.

While the bending strength of a two way hollow core slab is almost the same like for a solid slab its shear strength is significantly smaller. Therefore in this research project the shear strength of two way hollow core slabs was investigated. 13 large scale tests and corresponding nonlinear finite element calculations were conducted to prove that the shear strength of a two way hollow core slab is at least 50% of the shear strength of an equivalent solid slab.

Another open question was the stiffness of the slab in arbitrary directions which leads to the question whether the internal forces of a two way hollow core slab should be determined like they are determined for a solid slab or rather like they are determined for a ribbed slab. The test and the nonlinear finite element calculations of this research project have shown that it is correct to calculate the internal forces of a two way hollow core slab in the same way like they are calculated for a solid slab.

Keywords: slabs; hollow core; shear strength; nonlinear finite element calculations.

1. Introduction

Reinforced concrete slabs fulfill many requirements in structures like e.g. bearing capacity, sound insulation and fire protection. They can be produced economically and are therefore very common in structural engineering. One of their disadvantages is the high dead load. This is particularly true for large spans and for multi-storey buildings with difficult soil conditions. In these cases reinforced concrete slabs can be optimized by eliminating the concrete in those parts of the cross section where it does not significantly contribute to the bearing capacity of the slab. Recently spherical plastic void formers have been suggested and applied for use in reinforced concrete slabs (fig. 1). The reduced dead load leads to smaller deflections and a smaller amount of reinforcement in the slab but also to smaller loads for the columns and the foundation which allows smaller dimensions of these structural members. Last but not least there is a positive ecological impact since smaller amounts of reinforcement and cement are needed.

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