

Profiled steel pipes – innovative reinforcement for floor slabs with concrete core activation

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Summary

In buildings in constrained and urbanised areas concrete core activation is often used to realize an efficient and sustainable cooling and heating system. For concrete core activation usually pipes of polyethylene (PE) are used for water transportation through concrete slabs in order to cool and heat the slab. These pipes reduce the concrete's cross section and affect the structural behaviour of the slab adversely. The new approach, profiled steel pipes are used for water transport as elements of the concrete core activation and as innovative reinforcement elements as well.

This paper presents the concept for using profiled steel pipes as reinforcing elements for structural concrete. For the use in a first application in floor slabs bond tests concerning the bond behaviour between pipes and surrounding concrete have been carried out at the Institute and Structural Laboratory of the University of the German Armed Forces Munich, Germany. Based on the test results a theoretical approach based on the German code for structural concrete (DIN 1045-1) has been developed. This approach allows the addition of the pipe cross-section and the cross-section of the conventional reinforcement in consideration of unequal bond behaviour of the pipes and reinforcement bars.

The paper includes the mentioned bond tests, the theoretical approach to consider the bond behaviour of pipe reinforcement and the first application of the new pipe reinforcement in a large floor slab of 50 by 30 m.

Keywords: concrete core activation, profiled steel pipes, bond model, bond tests sensitivity analyses.

1. Introduction and Idea

Slabs made of reinforced concrete which are used as storage or traffic areas are stressed by bending moments, caused by the traffic loads and by bending moments and normal forces, caused by temperature effects. The internal stresses caused by the combination of these loads often can reach the tensile strength so that cracks occur under service loads. In most cases these cracks are not a problem with regard to the load carrying capacity however the serviceability and especially the durability may be impaired significantly.

The concrete core activation is a possibility to reduce the crack formation concerning the thermal effects especially with regard to non-roofed areas by obtaining more uniform thermal conditions. This method is well known for floors in office buildings where concrete core activation is used for the acclimatisation of the buildings - cooling and heating as well. Usually plastic pipes are used