Hybrid concrete beams with lightweight concrete and fibre-reinforcement

Linn Grepstad and Jan Arve Øverli
Department of Structural Engineering, Norwegian University of Science and Technology, Trondheim, Norway

ABSTRACT

Hybrid concrete beams consisting of a top layer of lightweight concrete and a bottom layer of fibre-reinforced concrete, were exposed to a four-point bending test. The experimental program covers six small beams and four larger beams, where half of them contain steel fibre reinforcement and the rest are reinforced with synthetic fibres in the bottom layer. The purpose of this study is to investigate the flexural behaviour of such hybrid concrete beams. The response for the small beams was dominated by one cracked zone and moment failures, while a distributed crack pattern was observed for the large beams where the ultimate capacity were governed by moment and shear failures.

The beams were analysed numerically using the finite element code DIANA by employing a smeared crack approach and assuming perfect bond between the two concrete layers. From the analyses of the small beams, material parameters and stress-strain relationships were obtained and used in the analyses of the large beams. The aim of this study is also to investigate the influence different material parameters have on the simulations compared to results from the four-point bending test. The numerical analyses show that the global behaviour of the beams is governed mainly by the stress-strain relationships for the fibre reinforced layer. The crack patterns from the analyses are in accordance with the results from the experimental program.

This work must be considered as a first step on investigating the behaviour of hybrid concrete beams. In further work also the bonding and the different shrinkage properties of the two concrete layers must be considered.