STEEL-FIBRE-REINFORCED PRESTRESSED PRECAST GIRDERS

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Abstract
The author has developed a prestressed steel-fibre-reinforced girder made of self-compacting concrete (SCC) without conventional steel reinforcement. The fibre salary, dimension and strength as well as the composition of the concrete and the pretensioning were varied so long, until wide range girders could be produced in a precast plant. The loadbearing capacity of this innovative and cost-efficient construction method has been verified by calculations, in large-scale tests and practical applications.

Keywords: prestressed steel-fibre-reinforced girders, without conventional steel reinforcement, self-compacting concrete, four experimental beams, large scale tests, continuous load test, successful practical use

Brief description
Building up on an approval (NO. 73.51-1770) for an SSC without steelfibres obtained from the DIBt, there was added a specific amount of steelfibres per m3 to create a self-compacting steelfibre concrete. In order to substitute the shear reinforcement for precast concrete beams with steelfibres, four experimental girders were manufactured with various types of steelfibres. The composition of the steelfibres used and their properties are listed in a table, see the full paper. For experimental girder No. 4, a fibremix of two types of fibres was used.

A conventionally reinforced beam that ones had already used in a previous construction project was used for the experiment. In the experimental beams the fibres were used to substitute both the shear stirrups and the stirrups in the area where the prestressing forces are introduced. The elimination of the complex reinforcing works results in a noticeable cost advantage for this construction system. A total of four beams were manufactured to study their behaviour in service as well as their structural behaviour. The single-span prestressed concrete beams investigated had an I-shaped cross-section and are more than 24 meters long. To investigate the beams' behaviour in service, two of the four experimental girders were subjected to a continuous load test for several years. The other two girders were subjected to a continuous load test to investigate the beams' behaviour in service.

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Main Conclusions

Based on the preliminary tests and the calculations performed by the author in advance it could be shown that the described prestressed steel-fibre-reinforced beams made of SCC could be manufactured without the benefit of conventional reinforcement, both for shear resistance and for resisting transverse tensile stresses in the area where the prestressing forces are introduced. The load tests performed on two experimental beams showed that the experimental SCC beams reinforced with steel-fibres up to attainment of 2.2 times the service load exhibited a nearly linearly elastic load-bearing behaviour. After that, the load-deformation diagram showed that a marked plateau level had been reached so that the specimens under constant stress and increasing strain exhibited a ductile behaviour until failure occurred at 3.3 times the service load.

By this time, no crack formation has occurred on the experimental beams subjected to the continuous load test, which is still underway to establish the behaviour in service. These beams show moreover no corrosion of the fibres although, despite the fact that always one half the beams is exposed to weathering. After handle the development stage successful the roof structure of the construction scheme of a paper-mill in Leuna/Germany had been realized with steel-fibre reinforced beams for the first time in Germany. The new special building method consisted 100 roof trusses and 850 purlins, all without conventional steel reinforcement.

References

[10] Steel-fibre-reinforced prestressed , precast beams made of self-compacting concrete; Strobach, C.P.; Kurth, Prof. Dr. H., Grunert, J.P.; Petrik, Dr. V.; CONCRETE Engineering International Vol. 10 Number 3 Autumn 2006