NEW APPLICATIONS FOR STEEL FIBRE REINFORCED CONCRETE AND COMBINED REINFORCEMENT

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Abstract

After years of research and development not only recommendations but also codes for the design and construction of steel fibre reinforced concrete are available. These standards allow covering new range of applications as for example foundation slabs of multi-storey buildings, clad rack buildings, structural floors, fluid tight floors and many more. Not solely the application area has been expanded but also progress has been shown for steel fibre products as such. After years of research new types of steel fibres are introduced in the market which lift performance to another level.

Keywords: Steel fibre reinforced concrete (SFRC), new fibre types, strain hardening, strain capacity, combined reinforcement, structural applications

1. Introduction

The question about the “need” of new fibre types for SFRC finds its answer in considering all possibilities of applications which have evolved over years of experiences and which are after years of committee work supported by guidelines, standards and codes. New steel fibres types along with the wide application possibilities allow promising future to SFRC.

2. The new steel fibre generation

A short overview is given in the full paper note to the main properties of typical steel fibres. A logical evolvement of steel fibres was to increase the tensile strength to a high tensile strength wire of 1500 N/mm² and to improve accordingly the type of anchorage in order to utilise the wire strength level best. This development lifts performance to a higher level. Bekaert has clustered these fibres into the Dramix® 4D fibre family.

A totally new development for steel fibres is offered by the Dramix® 5D series. The anchorage is designed as a perfectly shaped hook that is fully restrained into the concrete. Ductility is ensured by a specific material with strain capacity. At fully anchorage of the 5D fibre type, snapping will be avoided due to the strain capacity of its material. 5D fibres achieve strain hardening material behaviour at decent/usual dosage rate.

Specific material behaviour of typical steel fibres in comparison to the 4D and the 5D fibres is further described in the full paper.

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3. Large scale testing

In order to check the performance of the new Dramix® 5D fibre type large scale testing on elastic bedded slabs has been conducted at the University of Kaiserslautern. Comparison has been drawn to typical steel fibres which have also been tested in the same manner. The large scale tests have proven the high performing level of the new 5D fibre types. In addition beam tests with 40 kg/m³ Dramix® 5D 65/60BG according EN 14651 tests were set up outlining the strain hardening behaviour (figure 1).

Fig. 1: Strain capacity of different fibre types

Fig. 2: Load deflection curves

4. Well known application area

The use of SFRC is mainly associated to industrial floors, underground works, precast and to minor residential applications. In the scope of flooring typically non-structural floors (building is erected on foundations and the floor is laid later and does not interfere in the integrity of the building) are core business. Different construction methods like saw cut or jointless floors for various kind of use are established and remain the core application area for SFRC.

5. New application areas for SFRC with focus on SLS and/or ULS

Various applications like structural floors, seismic floors, floors on piles, Clad Rack raft foundations, water and fluid tight elements and raft foundations for multi-storey buildings are possible to be designed with SFRC or combined reinforcement. The performance of the new steel fibre generation supports this development in particular. The full paper introduces some of recently executed raft foundations.

6. Conclusions and perspective

The application area for SFRC and especially for combined reinforcement is multisided than ever. Thanks to widely gained experience, proven economic feasibility and validation in terms of codes and standards the way into new applications is cleared for. With the development of new steel fibre products an essential element has been complemented. All puzzle parts are assembled in order to cover the extended possibilities for steel fibre reinforced concrete in the well-known manner of an economic, durable and time saving construction art.