FIBRE CONCRETE WITH FIBREX FIBRES MADE FROM SCRAP STEEL STRIPS

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Abstract

This contribution contains several examples of fibre-concrete structures which use fibre-concrete with atypical FIBREX A1 steel fibres, which are made of scrap steel strips of the strength of 350 ~ 450 MPa. The steel fibres with rectangular cross-section are 25 mm long. More effective anchoring in the cement matrix is provided by flattening of the fibre ends. The production of the mentioned steel fibres is backed by the characteristics of the produced fibre-concrete. Some of them are presented in this contribution.

Keywords: steel fibres, concrete, metal strips, strength, ductility, homogeneity

Introduction

The idea of producing steel fibres out of scrap steel strips occurred about 10 years ago in Adler company seated in Žďár nad Sázavou and was supported by the researchers of Department of Concrete and Masonry Structures, Faculty of Civil Engineering, CTU in Prague, who have been dealing with composites of cement matrix reinforced with dispersed fibres. The support for this type of fibres comes with the following reasons:

- strength of steel fibres is more than 10 times higher that the strength of commonly produced concrete and therefore it is logical that their uniform dispersion in the cement matrix must lead to an increase of mechanical properties as compared with concrete without fibres,
- production of fibres from scrap steel strips and their possible application in novel fibre-concrete structures is in accordance with the current trend to improve the environment, development of fibre-concrete and sustainability of construction.

Several experiments including mix design of fibre-concrete, production of fibre-concrete and testing of hardened fibre-concrete were conducted in the Experimental Centre of Faculty of Civil Engineering, CTU in Prague. Based on the results of all conducted test, the test were conducted according to:

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- ČSN EN 14845-1 „Testing methods for fibres for concrete“- Part 1: Reference concrete, Part 2: Influence of concrete,
- ČSN EN 14651 „Testing method for concrete with metal fibres“- Measurement of flexural tensile strength (proportionality limit, residual strength),

which proved that fibres made from scrap metal strips can be classified as fibres suitable for production of fibre-concrete.

The analysis of the test results also showed several differences in the positive and negative effects on characteristics of fibre-concrete when compared with characteristics of steel fibre-concrete produced with today's steel fibres, e.g. Dramix or Harex. The following differences can be listed:

positive effects:

- Fibrex fibres tend to segregate from each other during production of fibre-concrete even when high mass concentration are dosed,
- the effect of air-retaining in the aggregate mixture is less than when longer fibres are used, which allows higher dosage of coarse aggregate for production of fibre-concrete,
- Fibrex fibres stiffen the structure of cement matrix for common fibre-concrete (max. aggregate particle size of 16 mm or 22 mm), which leads to higher compressive strength characteristics of fibre-concrete than the strength, which are attained when longer fibres are used at the same mass dosages,
- fibres with rectangular cross-section are more suitable for shotcrete that the circular cross-section fibres,
- lower price of the weight unit of Fibrex fibres than the price of the commonly available steel fibres,

negative effects:

- low ductility of hardened fibre-concrete after crack initiation,
- hardened fibre-concrete tends to crack suddenly in brittle manner.

Both these negative effects of fibre-concrete with Fibrex steel fibres can be reduced by higher weight dosages of the fibres per unit volume. Relatively good knowledge of the characteristic properties of fibre-concrete with Fibrex fibres and its behaviour in the structure gives an opportunity to identify practically applicable structures which will utilized the characteristics of these steel fibres effectively. All the up-to-date applications of fibre-concrete when the fibres made of scrap metal strip offered by Adler company are described in detail in the proceedings of FC2011 conference. Very valuable are the detailed comments on these fibre-concrete structures which deal, besides the technological aspects, also with the behaviour, functionality and possible also their durability. The locations of these applications were selected with respect to the size of the concrete areas and the volume of the fresh fibre-concrete.

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