INFORMATION ON THE PROGRESS OF NORMATIVE PROCESS FOR FIBRE-REINFORCED CONCRETE IN THE CZECH REPUBLIC

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Abstract

The paper will present activities of sub-committee Fibre Concrete (SC 10) at the National Technical Committee (NTC 36) Concrete Structures during last two years. It will inform the technical community about the personal cast of the committee and about its work on technical standards for fibre-reinforced concrete.

Keywords: fibre concrete, national technical committee, sub-committee

1. Introduction

This article links up to the article from the conference Fibre Concrete 2011 where we informed the professional community about initiation of the new subcommittee 10 for Fibre-Reinforced Concrete – SC 10 by the National Technical Committee – NTC 36.

The subcommittee works from May 2010. Members were delegated from range of producers of fibres, producers of fibre-reinforced concrete, peoples working on sites and from the academic sphere – CTU in Prague, Faculty of Civil Engineering, Department of Concrete and Masonry Structures and Klokner Institute.

The reasons which led to the creation of a subcommittee for fibre-reinforced concrete is to unify a wide range of available technical standards and regulations for testing of fibre-reinforced concrete, particularly in terms of its characteristics required for the design, and then unify the procedures for the design of fibre-reinforced concrete structures.

This article introduce the details from work of SC 10 for Fibre-Reinforced Concrete during last two years.

This year have been created the Task Group 2 (TG 2) for Fibre-Reinforced Concrete by the CEN/TC 250/SC 2, resolution 180. Through National Standards Institute was nominated in TG 2 one expert from each state of European Union. From Czech Republic was nominated

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the member SC 10 Ing. Petr Herka. This TG 2 started its work on standards for fibre-reinforced concrete.

2. Subcommittee Objectives

Objectives of the subcommittee for Fibre Concrete were summarized by the members of subcommittee. Subcommittee will try to produce and to put into effect the technical regulations for fibre concrete that will be **compatible with European standards for concrete structures**, both for plain (unreinforced) fibre concrete as well as for fibre concrete reinforced by standard reinforcing steel and prestressing steel. The whole issue will be divided into the following basic areas:

- **Tests** - standard approach to testing of fibre concrete with a focus on design of fibre concrete bearing members (product standard).
- **Design** - standard practice of structural design (computational methods), taking into account the characteristics of fibre concrete (increased ductility, tensile strength after makrocracks,…).

The subcommittee worked up for the present so called Simplified Technical Conditions (SCT) - code of practise which give instructions how to test fibre-reinforced concrete specimens and how to classify the fibre-reinforced concrete in general (concrete with steel and other fibres) to strength classes.

2.1 Marking of Fibre-Reinforced Concrete

In European Union there are a lot of ways how to classify and mark the fibre-reinforced concrete. It is necessary to unify. The Czech SC 10 communicate with other national groups which are engaged in design of fibre-reinforced concrete structures, especially with the German national group. We consist with the way of testing fibre-reinforced specimens. We both use the four-point flexural test on standard beams 100/100/700mm recommended [1] with span L = 600mm and controlled loading by two loads in thirds span (L/3) and the cross-sectional dimensions of beam b = h = 150mm (see Fig.1). The rate of increase of deflection at the centre of span in the bending test was approved present in the following steps, depending on the deflection:

- To the deflection of 0.75 mm: the speed of deflection increase is 0.1 mm/mm;
- The deflection of 0,75 – 3,5mm: the speed of deflection increase is 0,2 mm/min.

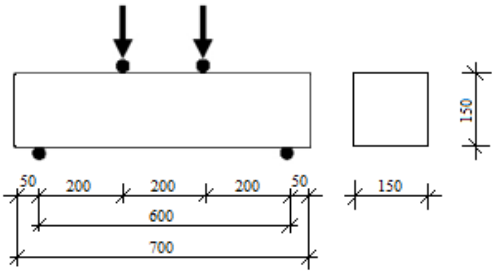


Fig. 1 Recommended arrangement of bend test by SC 10

To document the differences between states we show here an example of the identical fibre-reinforced concrete marking tested on the standard beams in bending according to:

A) German Richtlinie;
B) Simplified Technical Conditions (STC) which were developed in the Czech Republic.

The fibre-reinforced concrete was classified to strength classes with help of resistance diagram ($F_R - \delta_t$) derived from tests of standard beams in bending of fibre-reinforced concrete specimens.

A) Richtlinie: C 55/**67** L 2,4 / 0,9

strength at the deflection 0,5mm (on the decreasing line of resistance diagram)

strength at the deflection 3,5mm

The both characteristic values of stresses in the fibre-reinforced concrete mark are calculated assuming only elastic behaviour of concrete. Despite the fact that both states are after the initiation of macrocrack.

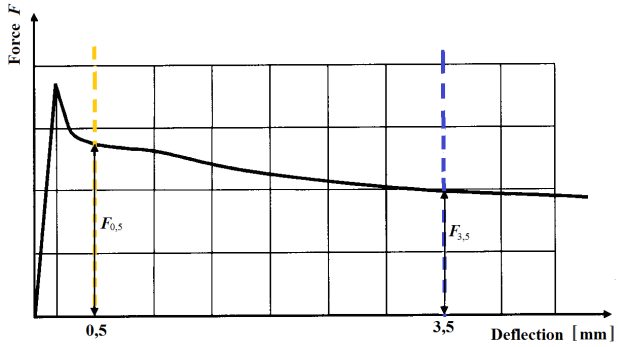


Fig. 1: Resistance diagram of fibre-reinforced concrete with makred deflections according the Richtlinie

B) STC: FC 60/**67** 3,2 / 0,3

strength at the macrocrack initiation

strength at the deflection of 3,5mm

The STC propose to calculate the characteristic values of stress in the axial tensile stress in the makrocrack initiation with assuming elastic behaviour of fibre-reinforced concrete and stress at the limit deflection δ = 3,5mm calculated with assumption the plastic behaviour of fibre-reinforced concrete.

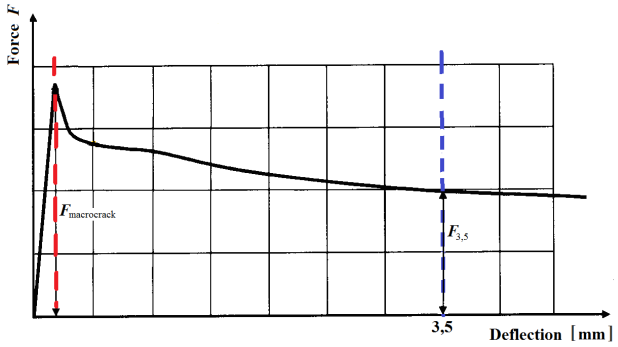


Fig. 2: Resistance diagram of fibre-reinforced concrete with marked deflections according the Simplified Technical Conditions

2.2 Recommendation of SC 10

The Czech subcommittee SC 10 recommends this compromise marking of fibre-reinforced concrete as follows. We can evaluate the three significant values - the creation of th e macrocrack, the deflection 0,5mm and 3,5mm. In our opinion the creation of macrocrack should be evaluated because it is directly connected with application of fibre-reinforced concrete and the reliability of fibre-reinforced concrete structures. The force value at the deflection of 0,5mm is from our point of view moot question because the form of the resistance diagram fully depends on aggregate type and especially on the type and amount of used fibres.

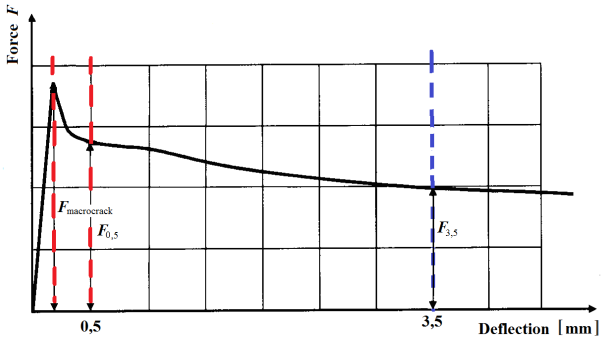


Fig. 3: Resistance diagram of fibre-reinforced concrete with marked deflections recommended by SC 10

The Czech subcommittee for fibre-reinforced concrete recommends marking of strength classes for fibre-reinforced concrete:

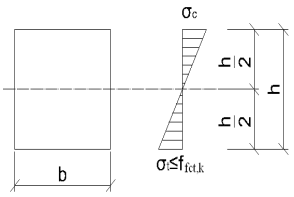
C $f_{fc,k,\,cyl}$ / $f_{fc,k,cube}$ FRC $f_{fc,tk}$ / $f_{fc,eq,0.5}$ / $f_{fc,eq,3.5}$

or

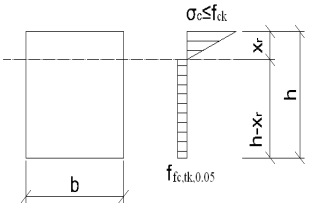
FRC $f_{fc,k,\,cyl}$ / $f_{fc,k,cube}$ - $f_{fc,tk}$ / $f_{fc,eq,0.5}$ / $f_{fc,eq,3.5}$

where is

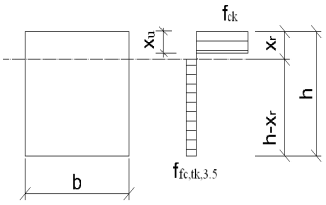
$f_{fc,tk}$ characteristic strength fibre-reinforced concrete in centric tension re-counted at the macrocrack initiation, determined assuming elastic behaviour of cross section



$f_{fc,eq,0.5}$ characteristic equivalent strength of fibre-reinforced concrete in centric tension, determined at the given deflection 0,5mm with regard to plastic behaviour of fibre-reinforced concrete in tension zone of cross section



$f_{fc,eq,3.5}$ characteristic equivalent strength of fibre-reinforced concrete in centric tension, determined at the given deflection 3,5mm with regard to plastic behaviour of fibre-reinforced concrete in tension and compression zone of cross section



Note.: In a simplified procedure can be considered only $f_{fc,tk}$ a $f_{fc,eq,3.5}$

3. Conclusions

Fibre-reinforced concrete is a structural material of the future. The testing methods of fibre-reinforced concrete and design methods of fibre-reinforced concrete structures are not yet fully processed. This article shows process of standardization in the use of fibre-reinforced concrete structures in engineering practice. In the future, it is necessary to harmonize test methods and marking of fibre-reinforced concrete. subsequently with the design procedures of fibre-reinforced concrete structures.

Acknowledgements

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