INFORMATION OF NORMATIVE PROCESS FOR FIBRE-REINFORCED CONCRETE STANDARDS 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 acceptance process of three technical standards for fibre-reinforced concrete to be used in Czech Republic.

Keywords: fibre-reinforced concrete, technical standard, material characteristic, strength

1. Introduction

This article links up to the articles from the conference Fibre Concrete 2011 and 2013 where we informed the professional community about activities of the subcommittee 10 (SC10) for Fibre-Reinforced Concrete working under 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; Technical University Ostrava – Faculty of Civil Engineering, Forensic Institute and Klokner Institute). This article inform about standardisation process in Czech Republic.

In 2013 have been created the Task Group 2 (TG 2) for Fibre-Reinforced Concrete by the CEN/TC 250/SC 2, resolution 180. This TG 2 started its work on standards for steel fibre-reinforced concrete only.

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 is in contact with other national groups which are engaged in design of fibre-reinforced concrete structures, especially with the German national group.

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The reasons which led to the creation of a subcommittee for fibre-reinforced concrete are to unify a wide range of available technical standards and regulations for testing of fresh and hardened fibre-reinforced concrete, to define its material characteristics required for the design, to classify fibre-reinforced concrete and then to unify the procedures for the design of fibre-reinforced concrete structures in Czech Republic. We decided not wait for European standards for fibre-reinforced concrete.

2. Standardization process

Subcommittee produced three technical preliminary standards for fibre concrete which are valid from June 2015 for testing in practice. Namely:

- ČSN P 73 2450 Fibre-reinforced concrete – Specification, performance, production and conformity;
- ČSN P 73 2451 Fibre-reinforced concrete – Testing of fresh fibre-reinforced concrete;
- ČSN P 73 2452 Fibre-reinforced concrete – Testing of hardened fibre-reinforced concrete.

All three standards are **compatible with European standards for concrete** – EN 206, EN 12350-1 up to EN 12350-12 Testing fresh concrete, EN 12390-1 up to EN 12390-13 Testing hardened concrete and EN 1992-1-1 Design of concrete structures. The standards can be used for plain (unreinforced) fibre concrete as well as for fibre concrete reinforced by standard reinforcing steel and/or prestressing steel bars.

2.1 Fresh fibre-reinforced concrete

The standard ČSN P 73 2451 Fibre-reinforced concrete – Testing of fresh fibre-reinforced concrete complements valid rules of EN 12350 for testing of concrete for testing fresh fibre-reinforced concrete according to specification of production and control of fresh fibre-reinforced concrete.

2.2 Hardened fibre-reinforced concrete

The standard ČSN P 73 2452 Fibre-reinforced concrete – Testing of hardened fibre-reinforced concrete complements valid rules of EN 12390 for testing of concrete for testing hardened fibre-reinforced concrete according to specification of production and control of hardened fibre-reinforced concrete.

The standard specifies the way of testing fibre-reinforced specimens. We 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 0,75mm – 3,5mm: the speed of deflection increase is 0,2 mm/min.

The standard request min 6 test specimens for statistic evaluation.

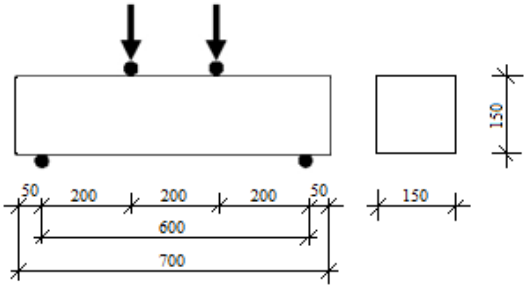


Fig. 1 Recommended arrangement of bend test by SC 10

From tests we obtain 6 resistance diagrams – it means the relation between the acting load and deflection on testing specimen.
There is necessary to obtain the mean and characteristic load at the macrocrack initiation $F_{Rm,cr}$ and $F_{rk,cr}$; the load at the deflection of 0,5mm $F_{Rm,0.5}$ and $F_{rk,0.5}$ and the load at the deflection 3,5mm $F_{Rm,res,1}$ and $F_{rk,res,1}$ (see Fig.2) and afterwards to calculate three characteristics strength values using assuming distribution of stress in cross section.
Using this we can classify the fibre-reinforced concrete and to specify mark of FRC. This can be used for design of fibre-reinforced structural members.

We evaluate the three significant values - the creation of the 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 can define properties of fibre-reinforced concrete – because the resistance diagram fully depends on aggregate type and especially on the type and amount of used fibres.

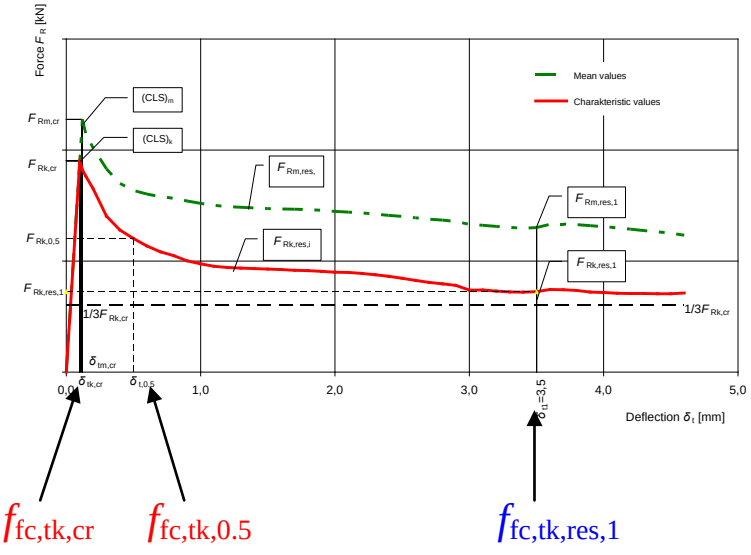
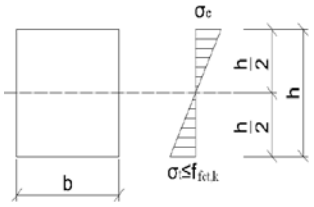
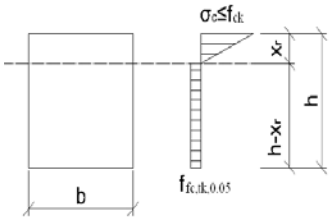


Fig. 2: Resistance diagram of fibre-reinforced concrete with marked deflections according to ČSN P 73 2452

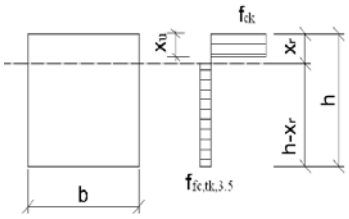
$f_{fc,tk,cr}$ characteristic strength fibre-reinforced concrete in centric tension re-counted at the macrocrack initiation, determined assuming elastic behaviour of cross section



$f_{fc,tk,0.5}$ 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



$f_{fc,tk,res,1}$ 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



2.3 Marking of Fibre-Reinforced Concrete

According to the Czech standard ČSN P 73 2450 Fibre-reinforced concrete – Specification, performance, production and conformity the marking of fibre-reinforced concrete is as follows.

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

C $f_{fc,k}$ / $f_{fc,k,cube}$ FRC $f_{fc,tk}$ / $f_{fc,tk,0.5}$ / $f_{fc,res,1}$ + and other specification parameters

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 Czech republic for 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 standards for design procedures of fibre-reinforced concrete structures.

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References

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