CHARACTERISTICS OF SFRC WITH FIBRES DRAMIX 4D AND 5D PRODUCED BY BEKAERT

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Abstract

The paper presents load-deflection diagrams measured in flexural tests of prisms performed to compare standard fibres 3D and fibres 4D and 5D.

Fibre Dramix 4D and 5D differ from the standard fibres 3D by hooked ends that should provide better anchoring of fibres in the fibre concrete structure. Enhanced fibre concrete characteristics are exhibited by the BEKAERT firm in case of use of 4D and 5D fibres.

The beneficial behaviour of SFRC with 4D and 5D fibres was evaluated with help of four-point flexural tests according to Czech Prestandard ČSN P 73

2452 „Zkoušení ztvrdlého drátkobetonu“ (Testing of hardened Steel Fibre Reinforced Concrete). Four-point tests of prism specimens 150/150/700 mm are strongly recommended as they provide information on SFRC properties with respect to homogeneity of the material, uniform distribution of fibres and appropriate scatter of results. For each mentioned type of fibres a set of three test specimens was prepared with volume content 1% of fibres.

Keywords: SFRC, steel fibres, 3D, 4D, 5D, 4-point bending test

1. Introduction

The use of dispersed fibres to the reinforcement of the structure of common concrete leads to the so called fibre reinforced concrete (FRC), which is characterized by higher characteristic strengths, ductility and ability to transmit the tensile stress even after the formation of macro-cracks. This fact s more or less affected by the type of used fibres.

At present, fibres of various origin are available for the manufacturing of FRC. The most used fibres are metallic – especially steel and synthetic fibres.

It is possible to increase the effect of synthetic fibres to listed characteristics by changing their length in relation to the maximum aggregate grain applied, or by changing their weight dose. For steel fibres, the same applies, i.e. the influence of the length of fibre as compared to the maximum aggregate size, weight dose plus finishing region of used fibres.

Bekaert company offers for the production of steel fibre reinforced concrete (SFRC) steel fibres under the designation 4D and 5D, which differs from standard 3D fibres in addition of one or two bends in the end region of fibres. For standard fibres, fibres length of

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60mm.are considered. The promise of higher tensile strength properties of SFRC when using fibres 4D and 5D compare with fibres 3D can be regarded at least for economic benefits for SFRC application.

The paper presents the results of bending test (4-point test arrangement), which have to be considered as indicative due to the number of test samples. From the results obtained, which should support or should not support the manufacturer´s intention work to increase the anchoring of fibres, is processed a discussion.

In any event, the discussion of tests included production technology of SFRC, should also include issue of fresh SFRC. More bends in the end region of the individual fibres affect clumping of fibres (especially at higher weight concentration) and hence to inhomogeneity of produced SFRC.

2. Records from the bending tests – diagrams of resistance

The diagrams of resistence resulting from tests on the standard normalized beams with dimensions of 150/150/700mm by the four-point test arrangement (bending test) are sufficient for evaluating impact of end region – anchorage area of the new types of fibres made by Bekaert.

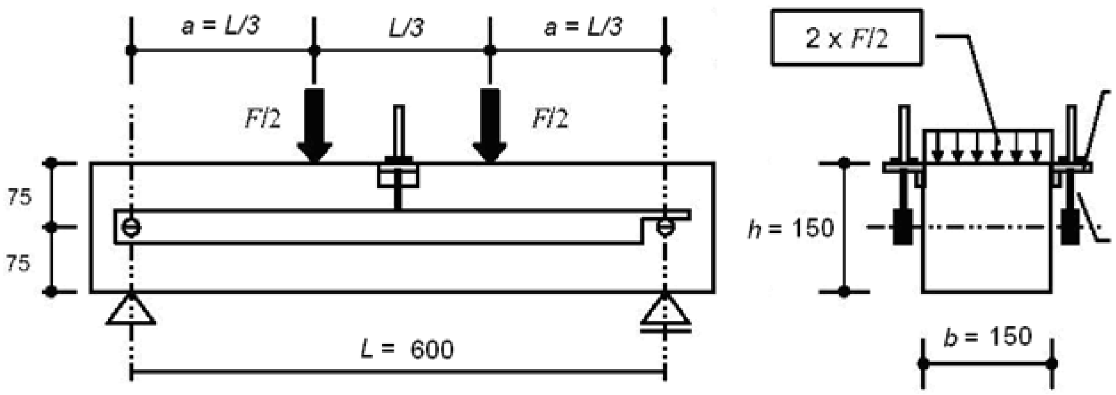

Fig. 1: 4 point test arrangement according to ČSN P 73 2452

For the proof of the influence of anchorage area of fibres 4D and 5D recipe of SFRC with 1% weight concentration of fibres 3D was used. It does not reflect the impact of the weight concentration of fibres 4D and 5D. By this weight concentration, we can see the impact of the number of fibres per unit, and possible impact on the homogeneity of SFRC.

Following reffered records of diagrams of resistance do not only show the resulting characteristics of the tested SFRC during the formation of macro-crack and after cracking, but also variance observed on 3 specimens.

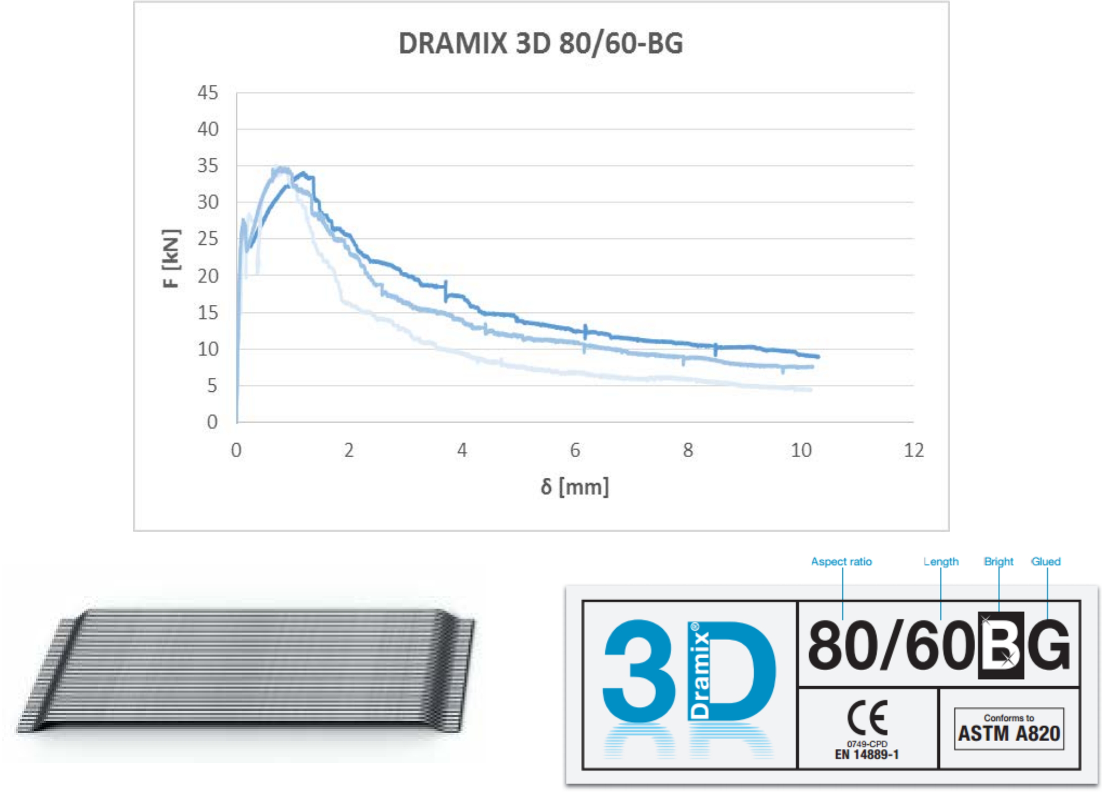

Fig. 2: Dramix 3D 80/60-BG

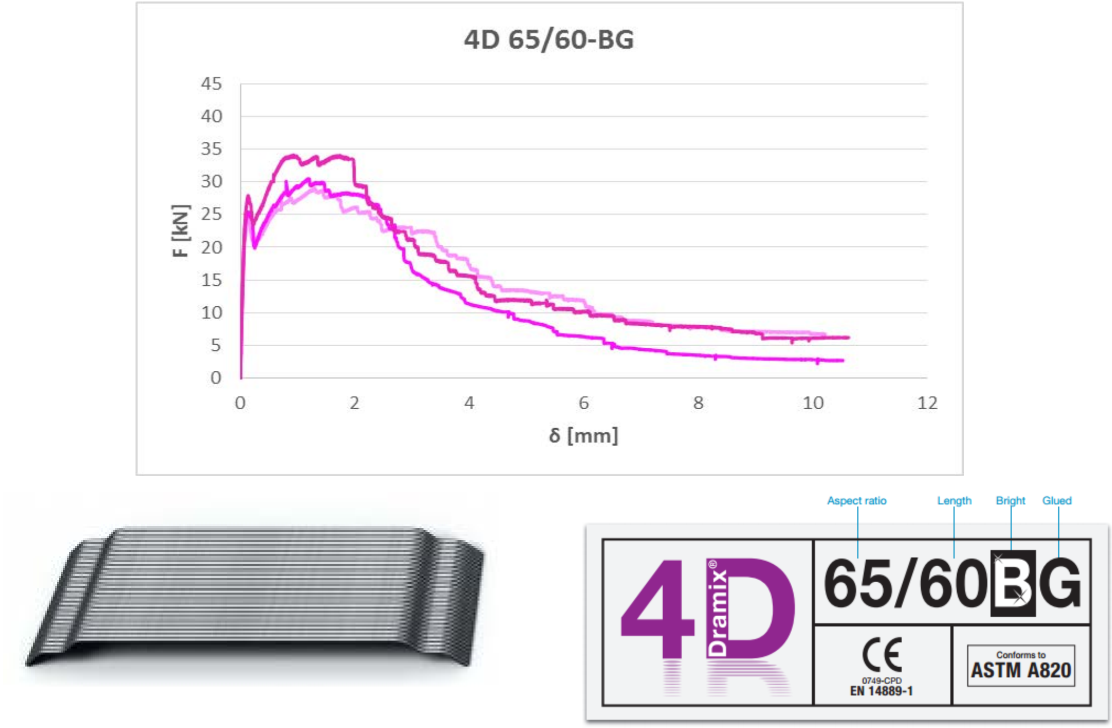

Fig. 3: Dramix 4D 65/60-BG

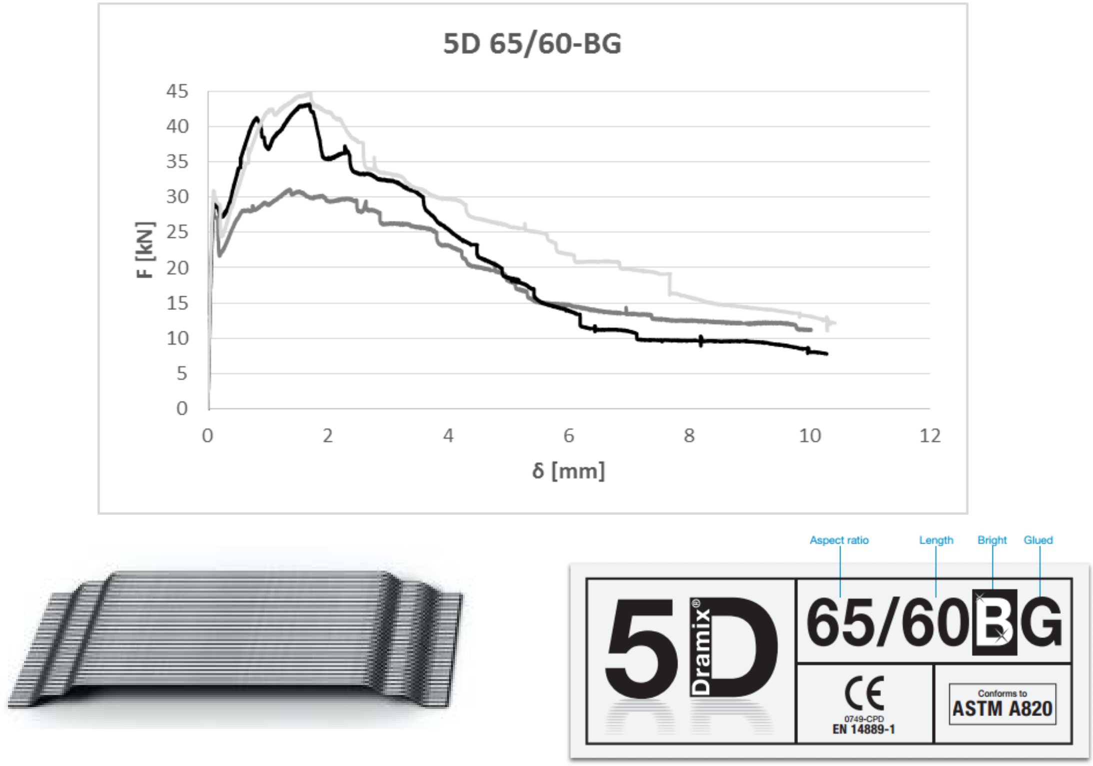

Fig. 4: Dramix 5D 65/60-BG

3. Discussion to the test results

Discussion of these tests can be controlled according to the attached graph (Fig. 5) for summary referred bending test. From the above summary diagram of resistence for the tested SFRC samples, it can be stated:

- end region – anchorage area of fibres affects the ductility which is reflected in comparing of strength with optionally selected deflections,
- measured forces at ultimate formation of macro-crack are for all types of used fibres approximately equal in range 25kN to 30kN,
- forces after the formation of macro-crack reach up to 35kN in samples with 3D fibres, with 4D and 5D fibres up to 45kN,
- in any case, these forces are obtained at different deflections, which precisely shows the ductility of tested SFRC.

The above-mentioned results do not include the basic difference in number of fibres in the weight concentration.

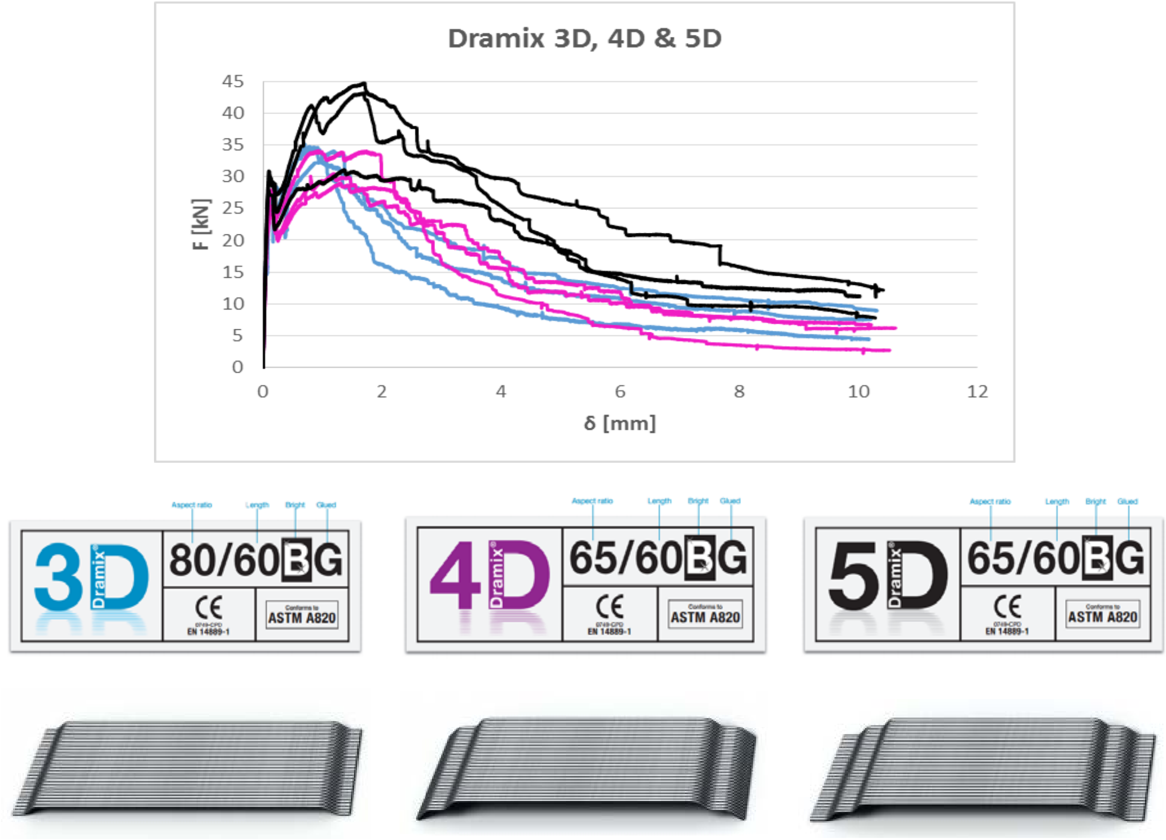

Fig. 5: Dramix 3D, 4D & 5D

4. Conclusions

These test results, showing the influence of end region – anchorage area on the resulting properties can be considered as initial due to the number of test specimens and the selected default mass concentration of fibres 1% of volume. In any case, these results support the efforts made to improve end region of fibres which is mentioned in the discussion.

To prove real benefits of end region (anchorage area), which manufacturer of the DRAMIX fibres performed, we have to continue with performing of substantiating tests focused especially on influence of weight doses of fibres and correct design recipe of SFRC, which must be performed separately for each type of fibres and their concentration.

Acknowledgements

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References

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