39th Solid Mechanics Conference
Zakopane, Poland, September 1–5, 2014

P158

EFFECT OF FIBRE CONTENT ON STATIC AND DYNAMIC PROPERTIES OF FIBRE REINFORCED CONCRETE

L. Kruszka[1], **W. Moćko**[2, 3], **E. Cadoni**[4], **L. Fenu**[5]

[1]Military University of Technology, Warsaw, Poland

[2]Institute of Fundamental Technological Research, Warsaw, Poland

[3]Motor Transport Institute, Warsaw, Poland

[4]Scuola Universitaria Professionale della Svizzera Italiana, Lugano, Switzerland

[5]University of Cagliari, Cagliari, Italy

1. Introduction

The static and dynamic behaviour of glass and basalt fibre reinforced concretes (FRC) especially as high performance building materials is still important taking into account applications those materials to protective structures. Fibre reinforced concrete structures are one of solutions, which require suitable quantities of fibres in concrete, taking also into consideration type of fibres [1]. Certain quantity of fibres can be beneficial for enhancing the properties of plain concrete. But it is not necessary that all properties will be improved, the addition of fibres may increase certain properties and at the same time may decrease other ones. Therefore the fibres in appropriate quantity should be selected.

In this work, the effect of 3% and 5% fibres' content on properties of FRC is studied. To evaluate the efficiency of glass and basalt fibres in improving the properties of the concrete the performance of concrete matrix, i.e. plain concrete (PC) is used a reference. Compressive strength, modulus of elasticity, and mod of fracture were determined for all FRC and PC specimens. Static and dynamic properties of the FRC and PC were investigated experimentally using: universal testing machine Instron 8802 equipped (Fig. 1) with Aramis measure system, and split Hopkinson pressure bar (Fig. 2) equipped in Phanton v1210 high speed camera, respectively [2, 3]. Quasi-static tests were carried out at strain rate equal to 0.005/s whereas dynamic tests were performed at strain rate equal to 800/s.

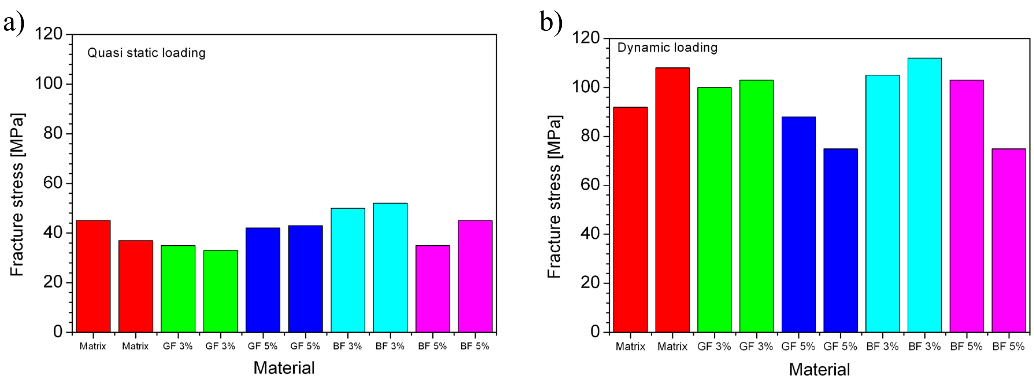

Fig. 1. Fracture stress of tested materials at: a) quasi-static and b) dynamic loading.

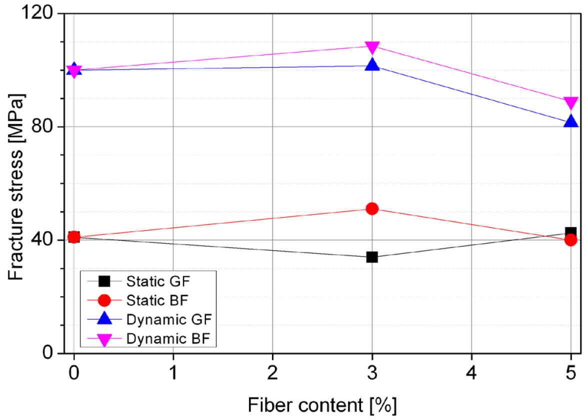

Fig. 2. Influence of glass (GF) and basalt fibers (BF) on the fracture strain at quasi-static and dynamic loading conditions.

2. Influence of the fiber content on the static and dynamic fracture stress

The fracture stress obtained during compression tests of matrix and fiber reinforced material as well is presented in Fig. 1. It may be observed that increase of the applied deformation rate induces clearly observed rise of the fracture stress in all cases. Analysis of the optimal content of fiber reinforcement in the concrete are shown in Fig. 2. Introducing of the 3% or 5% content of the glass fibers into concrete does not influence significantly fracture stress in the dynamic deformation regime. Under dynamic loading conditions 3% of the glass fibers reinforcement does not affect fracture stress, however further increase of the fibers share in the concrete up to 5% results in clearly observed drop of fracture stress, from 100 MPa to 80 MPa, in comparison to plain concrete. Application of 3% content of the basalt fiber induces increase of the fracture stress in both static and dynamic loading conditions. The fracture stress of the FRC concrete is 20 – 30 MPa higher then PC. Higher amount of the basalt fiber, i.e. 5% reduces fracture stress. For the static deformation rates stress of the 5% FRC drops to this same value as for the PC, whereas at the dynamic range the softening effect is even stronger, since the fracture stress drops to 90 MPa in comparison to 100 MPa for the PC.

3. Conclusions

Content of the glass fibers in the concrete does not influence the fracture stress at static loading conditions in a clearly observed way. Moreover at dynamic range 5% content of the fiber results in a significant drop of fracture stress. Analysis of the basalt fibers influence on the fracture stress shows that optimal content of this reinforcement is equal to 3% for both static and dynamic loading conditions. Further increase of the fiber share gives the opposite effect, i.e. drop of the fracture stress.

References

1. P. Baruah, S. Talukdar (2007). A comparative study of compressive, flexural, tensile and shear strength of concrete with fibres of different origins, *Indian Concrete Journal*, **81**, 17–24.
2. W. Mocko, Z.L. Kowalewski (2011). Dynamic Compression Tests – Current Achievements and Future Development, *Engineering Transactions*, **59**, 235–248.
3. L. Kruszka, W.K. Nowacki (1996). New applications of the Hopkinson pressure bar technique to determining dynamic behavior of materials, *Journal of Theoretical and Applied Mechanics*, **34**, 259–280.