Characterisation of the toughness of fibre reinforced concrete – Revisited in the Indian context

Dear Sir,

Kindly refer to the paper titled 'Characterisation of the toughness of fibre reinforced concrete – Revisited in the Indian context' authored by Sunitha K. Nayar, Ravindra Gettu and Sree Krishnan C. (The Indian Concrete Journal, February 2014, Vol. 88, No. 2, pp. 8-23). The authors have carried out laborious testing work and review of standards of various countries and they deserve to be congratulated for their efforts. However, following issues remain uncovered in the study.

1. Toughness of the material is defined as energy absorbed by the material per unit volume. This basic aspect has neither been tested nor discussed in the paper.

2. In the study various types of fibres in different dosages have been tested in M-35 grade of concrete under flexure. It is not brought out that how the results can be co-related with toughness.

3. As rightly brought out in the paper, there is nominal increase in flexural strength with use of fibres. The results show that plastic stage reached almost at same load for different dosages of fibres and even in concrete without fibres. The role of fibres in concrete therefore in elastic stage in zero, as far as behaviour in flexure is concerned. Does it mean that toughness of material is same with or without fibres during the elastic stage of the concrete?

4. The more appropriate test methods to find toughness of fibre reinforced concrete need to be explored or developed in order to incorporate in Indian Standard whenever it is formed.

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THE AUTHORS REPLY

Our replies to the reader's queries are as follows.

Query 1 - Toughness of the material is defined as energy absorbed by the material per unit volume. This basic aspect has neither been tested nor discussed in the paper.
Reply: Toughness is indeed related to the energy absorbed by the material during failure, which is in general related to the area under the load- deflection curve. The toughness calculated as the energy absorbed per unit volume is only one way of representing toughness; however, many other parameters have been defined in international standards for representing toughness. There is a discussion on these toughness parameters and the corresponding standards in the first and third paragraph of the *"Introduction"* section and a detailed discussion in the fourth paragraph of the section *"On flexural toughness testing"* of the paper. Also, Reference 3, the paper by Gopalaratnam and Gettu, gives a detailed discussion on the toughness parameter classification. The authors have chosen the toughness parameters that are most suitable for application in design equations and conforming to international committees.

Query 2 - In the study various types of fibres in different dosages have been tested in M-35 grade of concrete under flexure. It is not brought out that how the results can be co-related with toughness.
Reply: The parameters evaluated in the test program, namely Equivalent flexural strength, Equivalent flexural strength ratio and Residual flexural strengths are treated in the context of fibre reinforced concrete as toughness parameters.

Query 3 - As rightly brought out in the paper, there is nominal increase in flexural strength with use of fibres. The results show that plastic stage reached almost at same load for different dosages of fibres and even in concrete without fibres. The role of fibres in concrete therefore in elastic stage in zero, as far as behavior in flexure is concerned. Does it mean that toughness of material is

same with or without fibres during the elastic stage of the concrete?

Reply: It is now accepted that concrete is not plastic but strain softening. That is, it undergoes a progressive loss in stress-carrying capacity and secant stiffness as the strain increases, primarily due to the development and coalescence of micro-cracks. The authors wish to stress the fact that the effect of fibre is mobilised only after cracking and so it is not expected to affect any mechanical parameter in the elastic stage significantly.

Query 4 - The more appropriate test methods to find toughness of fibre reinforced concrete need to be explored or developed in order to incorporate in Indian Standard whenever it is formed.

Reply: A detailed discussion of the available and recommended methods of testing configuration for toughness characterization is available in the *"Introduction"* section. The reason for adopting and recommending the configuration suggested in this paper is elaborately explored and justified in the section *"On flexural toughness testing"*. The authors would also like to draw attention to the fact that these testing methods are the most widely accepted in the international scientific community. It should also be reiterated that a toughness test should be able to capture the post cracking regime or else it will not represent the contribution of the fibres.

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Geopolymer concrete for environmental production

Dear Sir,

This has reference to the paper titled 'Geopolymer concrete for environmental production' authored by B. Vijaya Rangan (The Indian Concrete Journal, April 2014, Vol. 88, No. 4, pp. 41-59).

I appreciate the authors work related to this field. This paper is very useful for our project too. Now, I have the following queries

1. Is there some other alkaline solution instead of sodium or potassium combination?

2. Why did the author use low calcium fly ash (Class F) instead of high calcium fly ash (Class C). If we use high calcium fly ash, what is the effect in geopolymer concrete?

3. Why was the alkaline liquid prepared at least 24 hours prior to use?

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THE AUTHOR REPLIES

My reply to the reader's queries are as follows:

Query 1: Is there some other alkaline solution instead of sodium or potassium combination?

Reply: Only sodium or potassium based alkaline liquids are used to make geopolymers, and the experience with other liquids is generally not available.

Query 2: Why did the author use low calcium fly ash (Class F) instead of high calcium fly ash (Class C). If we use high calcium fly ash, what is the effect in geopolymer concrete?

Reply: Excessive calcium in high calcium fly ash may interfere with the geopolymer formation, and adversely affect the properties of geopolymers.

Query 3: Why was the alkaline liquid prepared at least 24 hours prior to use?

Reply: It is recommended that both the alkaline solutions are mixed earlier to provide a stable alkaline liquid to produce good geopolymers.

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