DEVELOPMENT OF SHEAR STRESS EQUATION CONTRIBUTING FROM STEEL FIBRE IN REINFORCED CONCRETE

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ABSTRACT

The raised of extensive research and development on the application of steel fibre inside concrete is a tremendouse topic in a last few decades. The discreet steel fibre have an ability to restrained early cracking formation and next delay the cracking propagation at later stage, when inside concrete. The most obvious benefits of adding steel fibre inside concrete can be seen for the improvement of the mechanical properties of steel fibre reinforced concrete (SFRC). The improvement on the mechanical properties can be seen easily on the higher value of strengths for SFRC compared to plain concrete. However, a question arise on to what extend the steel fibre supplied an additional stress to increased the strength. Currently, this additional stress is called as a shear supplement. In this study, shear supplement model developed by RILEM is quantified with some statistical modification to predicts the additional shear supplied by steel fibre when inside concrete. The modified equation was then used to predicts the value of the shear supplement. Results shows that, the modified model predicts the shear supplement by steel fibres well, shown by higher coefficient of correlation.

Keywords: Shear supplement · Shear stress · Steel fibre · Steel fibre reinforced concrete ·

INTRODUCTION

Concrete is a composite material, where the matrix is made up from the combination of fine aggregate, coarse aggregate, cement and water (Hibbeler, 2011), (Sarbini, 2014). However, the combination of those materials in the concrete matrix is not enough to sustain such as tensile load. This is due to the strength of the concrete matrix which good against the compressive load. Therefore, other materials are added in the concrete matrix to sustain the tensile load. This includes using steel reinforcement, which is a common material in building construction. Even so, nowadays people are looking for something that is more cost benefit. Hence, it opposes the idea of using fibre instead of steel. The randomly distributed discreet fibres to reinforce plain concrete provide three dimensional resistances against the applied load as compared to the conventional one (Paine, 1997), (Altun et al, 2007), (Holschemacher et al., 2010) and (Ibrahim et al., 2011).

The extensive use of steel fibre reinforced concrete (SFRC) is due to its performance in restraining shear stresses induced in concrete element. Therefore, randomly discreet distributed steel fibres are added into plain concrete in a hope that the shear stresses are effectively transferred within the developed cracks. There are a lot of works concentrated on the tensile and flexural resistance of SFRC such as Gao et al. (1997), Pierre et al. (1999), Song and Hwang (2004), Teng et al. (2004), Altun et al. (2007), Thomas and Ramaswamy (2007), Yazici et al. (2007), Xu and Shi (2009), Ramli and Dawood (2010), Pawade et al. (2011) and Soulioti et al. (2011). They reported on the excellent performance of tensile and flexural resistances of the composite. Unfortunately, their works are mostly reported on the strength values and the specimen behaviour. To the concern on study the shear stresses restraining by steel fibres inside concrete element, it is a great step to focused on this additional stress contributed by steel fibres. This special attention on shear supplement by steel fibres is somehow a study that rarely focused by any researcher, while other reporting on the tensile and flexural performances.

It is well known that the failure of SFRC due to the applied flexural load is associated with de-bonding process of steel fibres from the surrounding concrete. During the early stage of de-bonding process, the cracks initiation is slow due to the ability of bridging fibres. At some stage of where the element is no longer capable to sustain the flexural load, the de-bonding process occurred rapidly. Due to the unstable cracks propagation at the point of when the steel fibres are pulled out from the specimen, failure will occur. This is also associated with the exceeding maximum limit of ultimate bond strength between the steel fibres and surrounding concrete (Gao et al., 1997). This shows on why the prediction on the additional shear stress contributed by steel fibres are important, as to determined the capacity of such fibres when restrained a concrete.

RESEARCH METHODOLOGY

Experimental works

One plain concrete and 16 SFRC's with different type of fibres and fibre volume fractions are cast. The