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# Experimental and Theoretical Analysis Using FEA of Fiber-Reinforced Concrete Beam Flexural Performance

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An experimental and theoretical program was conducted to enhance comprehension with regard to how variations in fibre ratio affect the structural performance of concrete beams. In this research a concrete mix with Three fibre volume fractions of 0.5%, 1.0%, and 1.5%were tested to evaluate the fibre effect on concrete strength. The results showed that the fibre increased the tensile strength by a maximum of 86% (1.05MPa Vs 1.95MPa) and the compressive strength by 8%. The research also included testing four beams under four-point loading tests to evaluate the flexural strength. The tests showed that adding fibre increased the flexural strength of the beam by 17%, the initial stiffness by 77%, and flexural toughness by 20%. A three-dimensional finite element model was created using ABAQUS to simulate the beam behaviour, the model was calibrated using the experimental data and good agreement was obtained from the model. It was concluded that increasing the fibre content generally enhanced the material up to the point where the concrete workability of the concrete was adversely affected by increasing fibre content.

**Keywords:** polyolefin fibre; Flexural Performance; FEA; ABAQUS

## I. INTRODUCTION

The tensile capacity of the concrete in a reinforced concrete beam (RC Beam) is usually neglected by engineers for flexure design, that is because the contribution of the concrete in the tensile zone is mostly addressed as a stress transferee media to the reinforcement in the tensile zone of the section (ACI Committee 318, 2014).

However, the contribution of that part of concrete to the stiffness of the beam is partially neglected as per the cracked section analysis that shall consider that all concrete under the neutral axis of the section have a stress level of zero due to cracking(McCormac & Brown, 2015). This type of analysis, although conservative to a point, yet it is true for only the area with maximum moment, this area in a commonly loaded beams is usually less than 10% of the beam span.

In a normal low high building that might not be of a significant importance, however, for high rise building or buildings with large spans weight saving is of great important to accommodate the soil capacity or to reduce the required height of a beam required for a certain span (Coull & Smith 1991).

There currently several methods used to work around this issue, the obvious one is increasing the depth of the beam thus providing more stiffness in the cracked section stage, increasing the compressive strength of the concrete and as the tensile strength is related to compression strength value the increment shall provide more stiffness by lowering the neutral axis and permeating the addition of more tensile steel, these solution despite being adequate to solve the lack of stiffens of the beam adds more weight to the structure or make the concrete more expensive (El Bakzawy *et al.*, 2024).

In this research, a polyolefin fibre is utilised to increase the tensile strength of the concrete by adding several percentages of it to already tested mix and comparing the concrete tensile and compressive strength and the overall beam behaviour.

The addition of fibre to concrete enhances its ability to resist cracking by increasing the tensile strength of concrete, furthermore the fibre bridges the cracks thus improving the

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