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EXPERIMENTAL VERIFICATION OF THE NEW MODELS APPLIED TO GLASS FIBRE REINFORCED CONCRETE (GFRC) CONFINED WITH GLASS FIBRE REINFORCED POLYMER (GFRP) COMPOSITES

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External confinement by the GFRP composites offers an actual process for retrofitting glass fibre reinforced concrete columns (GFRC) subject to static or seismic loads. This paper presents an experimental investigation and analytical modelling of the axial compression of confined circular concrete columns of different strengths (8.5, 16, and 25 MPa). Furthermore, the columns contain different percentages of glass fibres (0.3 to 1.2 %), and their confinement is given by GFRP composites of various thicknesses (0.8 to 2.4 mm). The uniaxial compression test on these specimens reveals that the glass fibre percentage and the thickness of the GFRP play a vital role in improving the load-deformation behaviour and crack propagation. Whatever the concrete strength, the ultimate axial strain and stress predicted using the suggested confinement model almost agrees with the available experimental results.

INTRODUCTION

Nowadays, concrete is the main building material in the world. There is a slight concern that concrete will remain a construction material due to its benefits, such as its high strength, sturdy deformation resistance, and low cost. However, concrete has a particular fragility, poor performance in terms of ductility, and reduced crack resistance. More importantly, it easily cracks due to its low tensile strength, which causes a faster failure after the first indications of fracture [1–3]. Hence, the need to develop new processes offers the opportunity to overcome these limitations.

Researchers have reported that randomly distributed concrete fibres mainly reduce the crack propagation and improve the aforementioned imperfections [4-6]. The traction forces acting on the cracks are carried by the fibres, strengthening the concrete matrices and supporting the traction load, preventing further crack development. As a result, when compared to conventional concrete, fibre-reinforced concrete has improved properties, bending resistance, shock strength, elongation, and ductility. It also has properties that prevent shrinkage, breaking, freezing, and corrosion. Steel fibres [7-9], carbon fibres [10-11], polypropylene fibres [12-13], basalt fibres [14-15], glass fibres, [16-17] and vegetal fibres [18-19] are just some examples of the fibres that can be utilised. According to these research studies, the fibre type should be carefully chosen depending on the job's specifications.

As the fibre volume increases, the tensile and compressive strengths firstly increase, then decrease. Furthermore, shorter fibres have proven to be more beneficial to longer fibres. As a result, different fibres have various impacts on the mechanical and physical properties. For example, tiny flexible fibres have also proven to be more effective at limiting the initiation of microcracks. On the other hand, large, stiff fibres are better at controlling the growth of cracks [20]. Though, the mechanical resistance does not always increase with the percentage and mechanical properties of the incorporated fibre, implying that there are ideal fibre parameters to achieve maximum the mechanical strength [21]. The type of fibre determines the optimum glass fibre percentage. In general, shorter fibres with higher length diameter metrics are more effective at regulating the formation of small cracks. Despite this, longer fibres with a reduced length diameter percentage are more efficient at monitoring the evolution of microcracks. As a result, incorporating multiple fibres could create a notable impact. For illustration, the mixture of polyvinyl alcohol (PVA) and steel fibres aids in achieving the optimal tensile behaviour. Also, it was demonstrated that incorporating adequate quantities of basalt fibres limited the porous structure of the concrete and, thus, enhanced its longevity [22-23].

Nevertheless, combining different types of fibres does not significantly improve the tensile strength of reinforced concrete. Therefore, the glass fibre reinforced