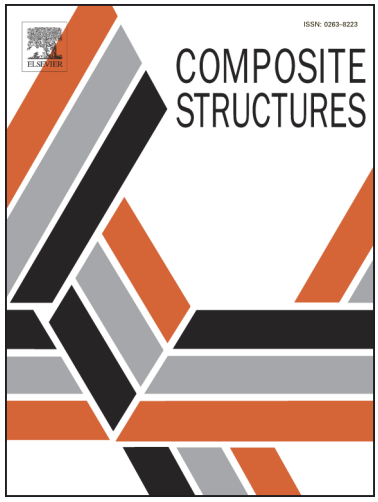

Experimental study on compressive behavior and failure analysis of composite concrete confined by glass/epoxy ±55° filament wound pipes

Lokman Gemi, Mehmet Alpaslan Köroğlu, Ashraf Ashour

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Lokman Gemi[a], Mehmet Alpaslan Köroğlu[b*], Ashraf Ashour[c]

[a] *Meram Vocational School, Necmettin Erbakan University, Dere Aşıklar Mah. Demeç Sok. No:42/A 42140 Meram, Konya, Turkey.*

[b] *Civil Engineering Department, Faculty of Engineering and Architecture, Necmettin Erbakan University, Dere Aşıklar Mah. Demeç Sok. No:42/A 42140 Meram, Konya, Turkey. (*Corresponding Author makoroglu@konya.edu.tr)*

[c] *Faculty of Engineering & Informatics, University of Bradford, Bradford, West Yorkshire, BD7 1DP, UK*

ABSTRACT

This paper investigates the strength and ductility of concrete confined by Glass/Epoxy ±55° Filament Wound Pipes (GFRP) under axial compression. A total of 24 cylinderical specimens were prepared with expansive and Portland cements, properly compacted and un-compacted for different composite fresh concrete matrix. Test results showed that compressive strength and axial deformation at failure of concrete confined with GFRP tubes increased by an average of 2.85 and 5.57 times these of unconfined concrete, respectively. Macro and micro analyses of GFRP pipes after failure were also investigated. Debonding, whitening, matrix/transfer cracking, delamination and splitting mechanisms were detected at failure, respectively. The experimental results were also employed to assess the reliability of design models available in the literature for confined concrete compressive strength.

Keywords: GFRP tubes, Composite column, Uniaxial strength, Filament winding, Damage mechanism, Confined concrete, Fiber orientation, Debonding, Micro structure.

1. Introduction

Corrosion of steel reinforcement due to harsh environment is a major cause of deterioration of performance of reinforced concrete columns. Various strengthening techniques have been developed to restore the column capacity and ductility, for example wrapping reinforced concrete columns by fibre reinforced polymer (FRP) jackets. However, in the last two decades, concrete filled FRP tube columns have been proposed as an alternative technique for protecting the internal steel reinforcement against corrosion. In fact, FRP tubes not only preserve steel reinforcement from corrosion but also act as confining reinforcement in the transverse direction.

For strengthening concrete members, external confinement with FRP jackets has become a common practice in construction industry. A significant number of experimental studies on compressive behaviour of FRP-confined concrete have been carried out over the past two decades [1-33]. However, studies focused on FRP tubes are still