Potential of the structural application of GFRP bars reinforcement as an alternative for recycled aggregate concrete slabs

Marina Traykova, Roumiana Zaharieva, Irina Kerelezova

University of Architecture, Civil Engineering and Geodesy, Sofia, Bulgaria

Contact:marina521961@gmail.com

Abstract

Two types of reinforcement: GFRP (Glass Fiber Reinforced Polymer) rebars and traditional steel reinforcement, have been used in one way reinforced concrete slabs, made of RAC (Recycled Aggregate Concrete) where 30% of coarse aggregate have been replaced by high quality industrially produced recycled aggregate and NAC (Natural Aggregate Concrete). The results obtained from experimental investigation bring information concerning the crack patterns, evaluation of the crack force, ultimate deflection and bearing capacity. The aim of the present study is to report and discuss the experimental results. Comparisons with a numerical model of the test specimens in ANSYS are made. Some peculiarities of GFRP rebars, RAC and their combination are outlined. The details of the presented investigation provide further information for the engineering practice and contribute to the wider use of alternative reinforcement and RAC in the construction sector.

Keywords: Glass Fiber Reinforced Polymers (GFRP) rebars, Recycled Aggregate Concrete (RAC), slabs, numerical modelling, ANSYS

1 Introduction

The problems of structural safety and high maintenance costs caused by steel bar corrosion have become relevant in the last decades. To avoid reinforcement corrosion in aggressive environments, Fiber Reinforced Polymer (FRP) bars have been proposed. Compared to traditional steel bars, FRP bars have the advantages of being lightweight, high strength and more resistant to some aggressive impacts. The recovery of construction and demolition waste contributes significantly to the sustainable development. In the context of sustainability and circularity in construction, recycled aggregate concrete (RAC) offers many opportunities to improve the resource efficiency. RAC lessens carbon dioxide emission, land required for disposal of construction and demolition waste, and aggregate transportation distance by meeting the desire for environmentally friendly, low-carbon, and sustainable production.

However, due to the porous structure of recycled aggregate, its larger use is hindered by some durability issues, including those related to faster carbonation and bigger permeability and thus menacing the passivation of steel rebars in RAC.

So, the combination of FRP rebars such as Glass Fiber Reinforced Polymer) bars (GFRP) and RAC is one promising combination for the practice, especially in concrete structures subjected to an aggressive environment. According to [1], GFRP has relatively low cost comparing to other kinds of FRPs and makes it one of the most used alternatives to the steel rebars in construction industry.

https://doi.org/10.2749/manchester.2024.1051