CERIS Civil Engineering Research and Innovation for Sustainability

Development of eco sustainable reinforced concrete solutions with GFRP rods based on the use of sea raw materials and waste

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Summary

The main objective of this thesis is to develop eco-sustainable reinforced concrete solutions with GFRP rods based on the use of sea raw materials and waste. For this purpose, the characterization of the concrete compositions and the bond of the GFRP rod-concrete system will be carried out in the short- and long-terms. From the experimental campaign to be developed, the following results are expected: (i) the mechanical characterization of the concrete compositions, including creep and shrinkage; (ii) a comparative analysis between tap water concrete and seawater concrete; (iii) the mechanical characterization of the GFRP bars; (iv) the main parameters influencing the bond behaviour between the GFRP rods and concrete; and, (v) essential data to perform the calibration of analytical and numerical models. The long-term analysis will allow the evaluation of the influence of environmental exposure on the mechanical properties of concrete compositions and GFRP bars and the degradation of the bond properties of the GFRP-concrete systems.

In this way, it will be possible to determine the durability and compare the solutions developed (reinforced concrete structures with GFRP using sea raw materials and waste) and conventional concrete structures. Based on the experimental results, analytical and numerical simulations, and on the empirical models, design recommendations will be formulated, making it possible to estimate the service life of the proposed concrete compositions and of the GFRP-concrete systems when seawater is used instead of freshwater.

At the same time, a Life Cycle Assessment (LCA) will be carried out considering the savings in freshwater, natural aggregates, the use of GFRP as reinforcement, the service life of the materials, and the maintenance levels required of each one until the end of their service life.

Keywords

Reinforced concrete, Glass Fibre Reinforced Polymer (GFRP) bars, seawater, seashells, durability and long-term behaviour, bond, Life Cycle Assessment (LCA).

Pullout tests setup.

Aging specimens.