

## NUMERICAL MODELING AND EXPERIMENTAL TESTS FOR THE CHARACTERIZATION OF COMPOSITE MATERIALS

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The research group carried-out several experimental tests concerning FRP-concrete and FRP-masonry bond behaviour and is currently focused on the analysis of FRCM bond on different substrates (mainly concrete and masonry). FRP plates and sheets, FRCM composites with different numbers of layers, of several widths and lengths and with different substrate surface preparations have been studied, together with different test set-ups using traditional instrumentation as well as innovative optical techniques (Digital Image Correlation).

The effectiveness of composite strengthening was analyzed by testing full-scale structural elements such as concrete beams, masonry columns and masonry walls and by investigating their behaviour under different load conditions (e.g. in- and out-of-plane behaviour of reinforced masonry walls).

The research group also developed several numerical models in order to better understand and describe the obtained experimental results.

The effects of aggressive agents and long-term loads have been considered investigating the FRP-concrete interface creep behaviour. The problem of fire resistance has also been addressed, by testing the effectiveness of different methods of protection. Within the ReLUIIS research project, the effect of cyclic loads was studied in order to verify the effectiveness of the strengthening on RC elements subjected to seismic loads. As for the FRCMs, the group has worked on the definition of test standards and on the identification of failure mechanisms (for various types of fibers and matrices). The research group was involved in different national and international Round Robin Tests on bond and components of the group are part of the Committee which drafted the Guidelines CNR DT200/2004 on FRP. Prof. Carloni is member of Technical Committees ACI 440 (FRP), ACI 549 (Thin Reinforced Cementitious Products and Ferrocement), and ASTM D30.10 (Composite Materials).

The group has studied also pultruded elements, addressing problems related to the development of computational models for the descriptions of

the behavior of cellular and thin wall beam sections and has investigated both experimentally and numerically the long-term behavior of pultruded elements. Professor Savoia was part of the Committee which drafted the DT205/2007 “Istruzioni per la Progettazione, l’Esecuzione ed il Controllo di Strutture realizzate con Profili Pultrusi di Materiale Composito Fibrorinforzato (FRP)”, of National Research Council (CNR).

The research group is currently involved in the definition of guidelines for the standardization of qualification procedures for FRPs and FRCMs (with an approach focused also on environmental durability) and took part in the current FRP qualification process for several producers following the current Italian guidelines.

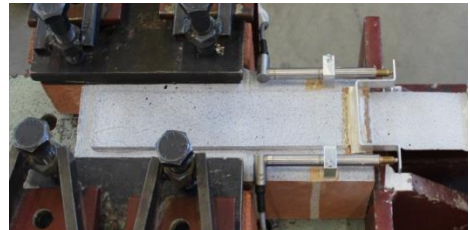


Fig. 1. Experimental set-up for bond tests on FRP and FRCM strengthening systems (Carloni).



Fig. 2. Analysis of the out-of-plane behaviour of reinforced masonry walls (Mazzotti).

## MAIN PUBLICATIONS

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## RESEARCH PROJECTS

RILEM TC 234-DUC Committee "Design procedures for the use of composites in strengthening of reinforced concrete structures": members Proff. Savoia and Mazzotti.

RILEM TC 223-MSD Committee "Masonry Strengthening with Composite materials": member Prof. Mazzotti

Research project with ARDEA and BASF for the study of crisis mechanisms of fiber-reinforced systems.

2010-2013: Research project funded by the Department of Civil Protection - Reluis tasks 1 and 3: "Reinforced Concrete Structures"; "Development and analysis of new materials for seismic retrofit (including new concretes)". Coordinators: Proff. G. Manfredi, L. Ascione

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