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DEVELOPMENT OF A CONSTITUTIVE MODEL FOR THE MASONRY-FRP INTERFACE BEHAVIOUR

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ABSTRACT

Masonry structures are often encountered in the historical architectural heritage being always used from the past until modern times. Due to material degradation, imposed displacements, structural alterations or increased service loads, some members need repair and/or strengthening. To re-establish the performance of these structures and preventing their brittle collapse when subjected to ultimate limits state, fiber-reinforced polymer (FRP) composites in the form of bonded laminates applied to the external surface with the wet lay-up technique are an effective solution [1]. In particular, the bond mechanism between masonry and FRP was investigated by few researchers in the last years although it is a key issue when dealing with the strengthening of masonry constructions [2]. At the same time, several analytical and numerical models for the simulation of the de-bonding process of FRP sheets from concrete substrates have been proposed and their performance has been appraised [3-4]. However, according to the knowledge of the authors of the present work, a model able to predict the interface behaviour of FRP-masonry joints is still not available. Based on a previous experimental campaign (Fig.1), a constitutive model for FRP-masonry interfaces was developed and implemented into the TNO Diana finite element code.

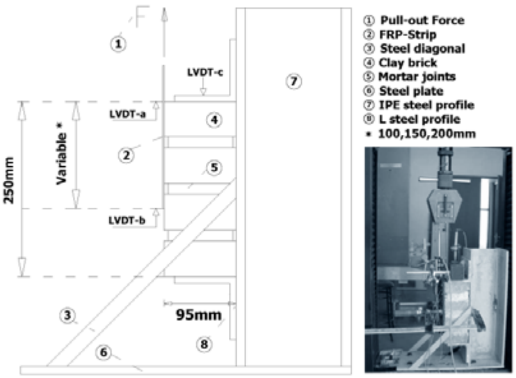

Fig.1 Pull test setup: schematic view and test to be started

Its theoretical framework is fully based on the plasticity theory and the aim is to simulate the observed strengthening effect of FRP sheets bounded to masonry. Starting from an existing monotonic model [5], two new multi-linear hardening laws for tension and shear are introduced in order to describe the motion of the yielding functions in a more accurate fashion and to simulate the plastic phase characterizing the evolution of the de-bonding process when the effective bond length is exceeded. It is shown that the model is able to describe the bond phenomenon at local level up to the ultimate load (Fig.2) and that numerical results can reproduce available experimental bond tests in an accurate way as well as the effects of the FRP sheets in the strengthening of masonry arches.

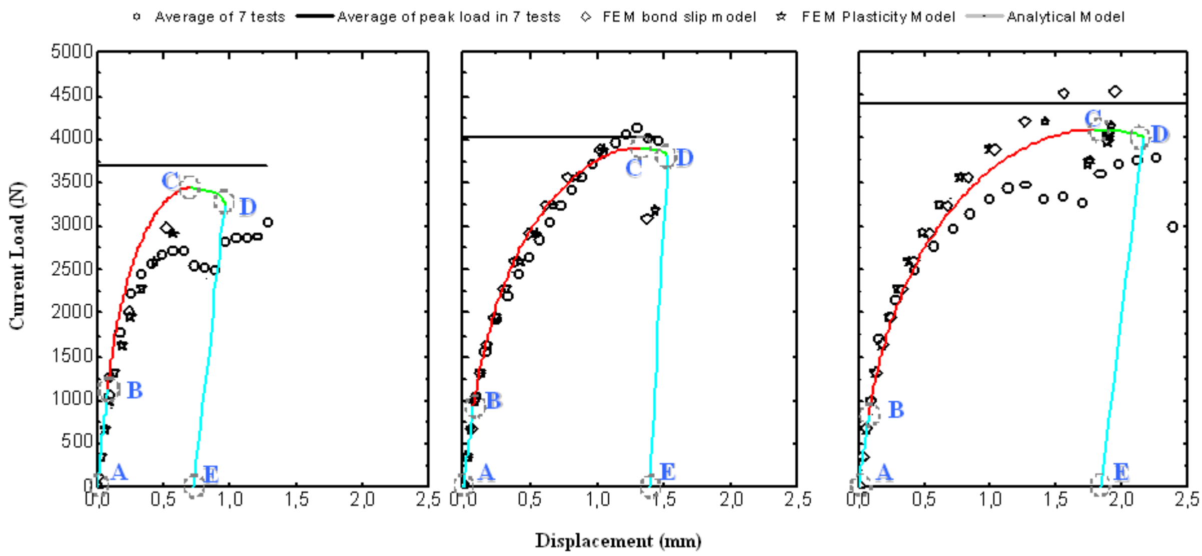

Fig.2 Load displacement diagram : (a) L=100mm; (b) L=150mm (c) L=200mm

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