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DAMAGE AND FAILURE MECHANISMS ASSOCIATED WITH STRESS TRANSFER OF TEXTILE OVERLAP JOINTS IN TEXTILE REINFORCED CONCRETE

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SUMMARY

The present work aims at identifying the main factors influencing the stress redistribution in overlapped textile joints of Textile Reinforced Concrete (TRC) elements, focusing on damage mechanisms and their relationship with geometrical characteristics. The experimental campaign consists of twelve plates subjected to uniaxial traction, combining carbon textile layers with Ultra High Performance Concrete (UHPC) and presenting both symmetrical and non-symmetrical overlapped joints with two different overlapping lengths. All the specimens have been designed to exhibit pull-out failure. The experimental tests were carried out using a Digital Image Correlation (DIC) system on both sides to monitor deformations. Results highlighted a strong dependence of both maximum force and crack opening at maximum force on textile configuration, with an increase of over 25% in the case of symmetrical layout. Two main concrete splitting mechanisms (delamination of textile and localized spalling of concrete cover) were observed and described.

Keywords: *Textile Reinforcement, Overlapped Joint, TRC, Concrete Splitting, DIC.*

1. INTRODUCTION

Textile Reinforced concrete (TRC) is an innovative material consisting of a fine graded concrete reinforced with high strength fabrics made of long fibres of different materials such as carbon, glass, basalt, high strength polymers, etc. The replacement of steel rebars, used in traditional reinforced concrete elements and structures, with textile layers enables such material to exhibit good performance, a reduced thickness of the elements and, furthermore, preventing the corrosion phenomena.

Thanks to its characteristics, TRC is currently being used in different applications such as the creation of sandwich panels for facades [1] or roof elements [2] and thin shell structures [3]. Another very promising application field for TRC is strengthening and repairing of existing elements such as columns [4], slabs [5] and beams, both in bending [6] and shear [7].

Similar to steel reinforced concrete, in TRC elements the concrete carries compressive stresses while the textile fabric carries tensile stresses. Thus, in order to activate the whole resistance of the high strength material, a correct design of the element preventing roving pull-out is needed. Such phenomenon has been studied by several authors analysing the influence of different parameters on the pull-out strength or on the bond-slip behaviour of TRC [8]–[11]. Such studies showed how different parameters could affect the ultimate pull-out load, highlighting some interesting and non-trivial phenomena. Among them, one of particular interest is the telescopic pull-out, consisting of the slip of only the inner core of the roving. This is due to a non-complete embedment of the fibres in the cementitious matrix, causing a premature slip of the inner filaments.

To avoid such behaviour the fabric can be preliminary embedded with epoxy resin. This procedure strongly increases the ultimate pull-out load since the resin, penetrating almost completely among the fibres, enables the rovings to behave as a solid continuous material. On the other hand however, pre-impregnating textile

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