Shear strengthening of substandard RC beams with SRG jackets

Georgia E. Thermou
Assistant Professor, AUTh, gthermou@civil.auth.gr

Vassilis Papanikolaou
Assistant Professor, AUTh, billy@civil.auth.gr

Christos Lioupis
Civil Engineer AUTh, xl_larissa@hotmail.com

Extended abstract

The EB-FRP (externally bonded fiber reinforced polymers) applications have gained ground due to the adaptability of the technique to different types of structural members and loading conditions with jacketing being the most popular one. However, the use of organic binders is related to various drawbacks the more significant ones being the poor behaviour to fire conditions, the relatively high cost of epoxy resins and the lack of vapour permeability with adverse effects on reinforced concrete structures. The aforementioned shortcomings and their possible limitation or elimination motivated the research community to examine the use of alternative binding materials that could play the role of the matrix of the composite system. The replacement of organic binders with inorganic ones seems to be an efficient solution since all the advantages of the confinement with FRPs are reserved. Within this concept, a novel jacketing system, the steel-reinforced grout jacket, was developed by Thermou and Pantazopoulou (2007), Thermou et al. (2015, 2016) which proved to be quite efficient in strengthening of RC columns.

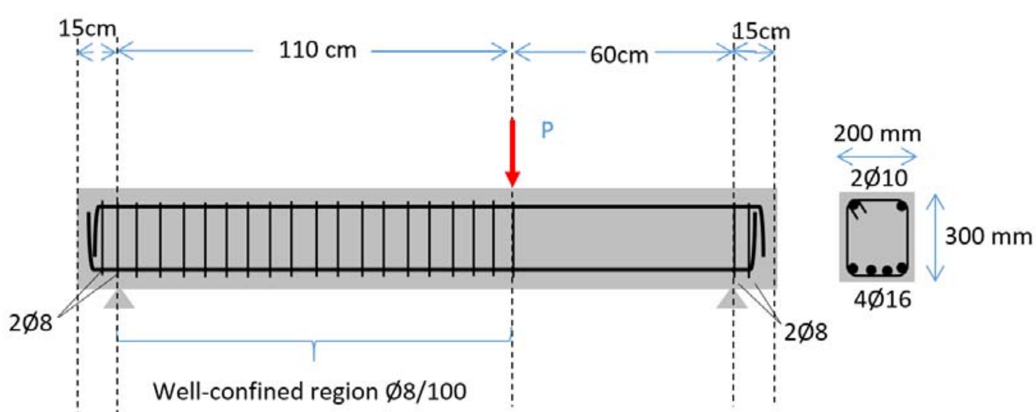


Fig. 1 Beam geometry and reinforcing details.

In the current paper, the potential of SRG jackets as an alternative strengthening system to fiber-reinforced polymer (FRP) jackets for shear strengthening of substandard reinforced concrete beams was investigated experimentally. For this purpose, 6 beams with rectangular cross section 200 mm in width, and 300 mm in height and 2 m length were constructed (Fig. 1). The reinforcement of beams consisted of longitudinal deformed steel bars with 2∅10 bars at the top and 4∅16 bars at the bottom of the cross-section of the beam. Deformed steel 8 mm diameter closed stirrups were distributed at a uniform spacing of 100 mm apart from the critical shorter shear span of 600 mm which did not include any transverse reinforcement (Fig. 1). A three-point bending setup configuration was utilized and the monotonic loading was applied at the end of the well-confined region as shown in Fig. 2. One of the beams was used as a control specimen. In the rest of the beams alternative jacketing systems were applied such as U-wrapped jackets with one and two layers, fully-wrapped jackets with one and two layers and a single layer U-wrapped jacket with mechanical anchorage (Fig. 3). The density of the steel fabric utilized was low (1.57 cords/cm).

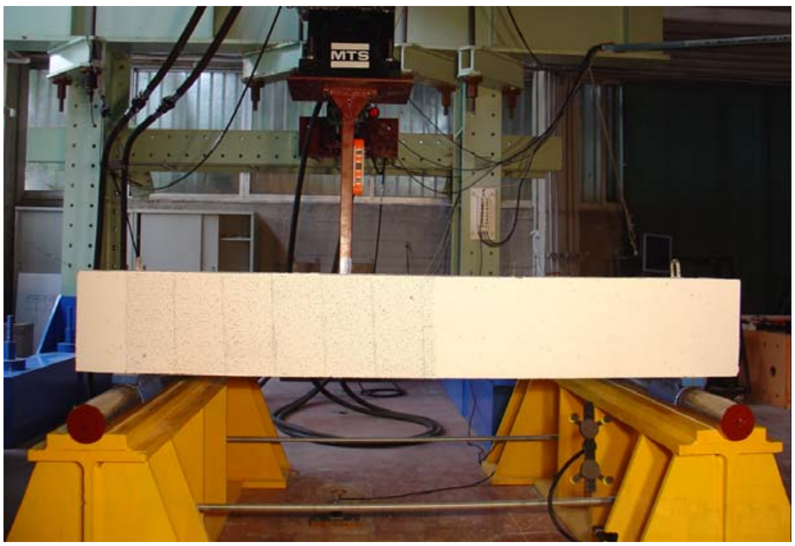
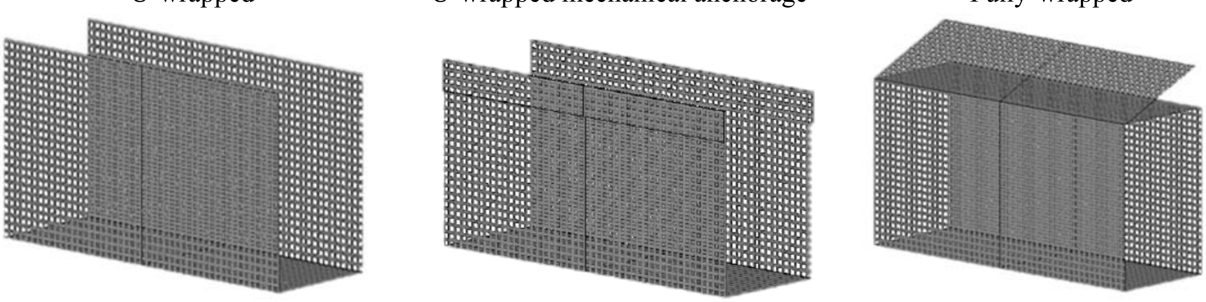


Fig. 2 Test setup.

U-wrapped | U-wrapped mechanical anchorage | Fully-wrapped



BU1L (U-wrapped 1 layer of fabric)
BU2L (U-wrapped 2 layers of fabric)

BUM (U-wrapped mechanical anchorage 1 layer of fabric)

BFW1L (Fully-wrapped 1 layer of fabric)
BFW2L (Fully-wrapped 2 layers of fabric)

Fig. 3 SRG jacket configurations

The results of the tested beams in the form of load versus vertical displacement curves are depicted in Fig. 4. Experimental evidence has shown that all the alternative SRG jacketing systems managed to increase strength whereas the fully-wrapped SRG jackets (BFW1L, BFW2L in Fig. 4) managed to increase substantially the deformation capacity of the beams. The knowledge gained from this experimental study renders SRG jacketing a remarkably promising retrofit solution for shear strengthening of old-type detailing RC beams.

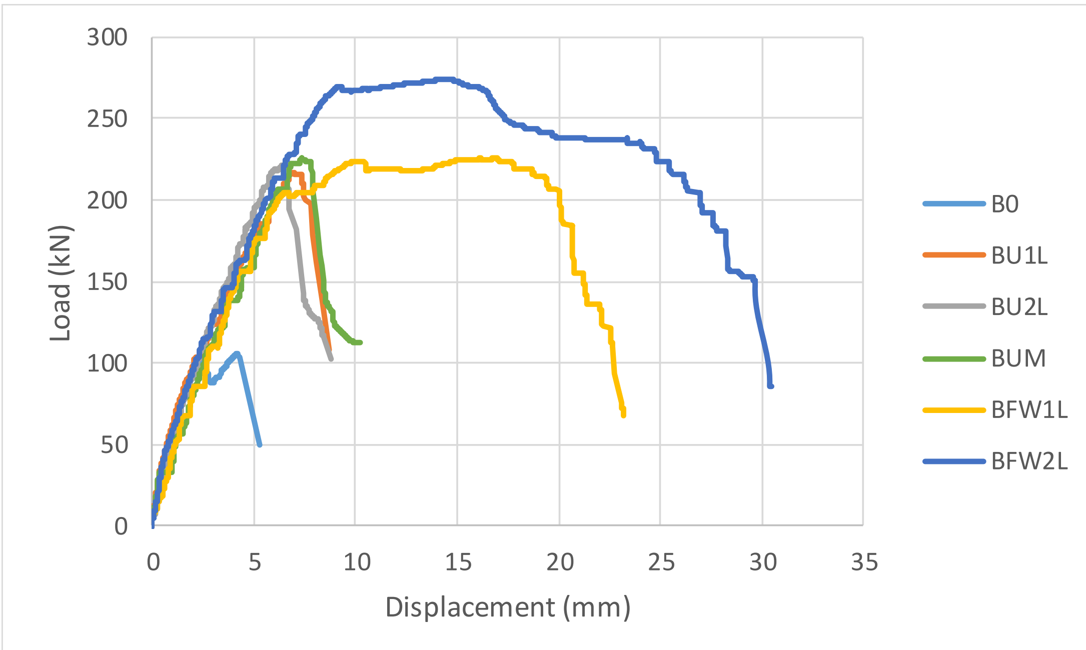


Fig. 4 Load versus vertical displacement curves for all tested specimens.

Aknowledgements

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References

Thermou, G.E., Katakalos, K. and Manos, G. (2016) "Influence of the cross section shape on the behaviour of SRG-confined prismatic concrete specimens." Materials and Structures, 49(3), 869-887.

Thermou, G.E., Katakalos, K. and Manos, G. (2015). "Concrete Confinement with Steel-Reinforced Grout Jackets." Materials and Structures, 48(5), 1355-1376.

Thermou, G.E., and Pantazopoulou, S.J. (2007) "Metallic fabric jackets: an innovative method for seismic retrofitting of substandard RC prismatic members." Structural Concrete, Journal of the fib, 8(1), 35-46.