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EFFICIENT AND LOW INVASIVE STRENGTHENING OF EXISTING CONCRETE STRUCTURES IN SHEAR

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SUMMARY

Three different low invasive shear strengthening techniques have been investigated in a number of structural tests with RC members subject to shear loading, namely post-installed reinforcing bars, a specifically designed anchor system and CFRP sheets. The post-installed rebars are inserted into inclined pre-drilled and mortar-injected holes from the bottom side of a concrete member and anchored with metal plates at the accessible bar end. The sleeved undercut anchor, on the other hand, is set vertically into the pre-drilled hole and the load is then introduced via a self-undercutting expansion sleeve. The third tested system consists of CFRP sheets and special end anchorages, introducing the load of the CFRP tension chords to the compression zone of the beam. All three strengthening methods can be installed from the soffit of a structure without significant disturbance of the traffic and without major interventions affecting the existing cross section of the structure. Significant load gains have been reached in the performed structural tests with each strengthening technique.

Keywords: *Shear failure, Strengthening, Retrofitting, CFRP, Post-installed reinforcement, Fatigue testing.*

1. INTRODUCTION

While flexural strengthening of RC structures has become a routine task in the field of civil engineering, retrofitting of shear deficient members is rather challenging due to the more brittle deformation characteristics and the rather complex nature of RC shear design. So far there exist only few well established methods to strengthen RC structures in shear [1]. Local shear strengthening can typically be done by applying externally bonded reinforcement or steel plates, near surface mounted reinforcement or externally anchored or grouted steel bars inserted into holes drilled through the cross section. Nowadays, Fibre Reinforced Polymers (FRP) are increasingly used for externally bonded or near surface mounted reinforcements due to their extraordinary strength to weight ratio and high durability.

However, the mentioned current shear strengthening methods have some major disadvantages such as significant intervention in the existing structure, high installation efforts or restrictions on the unhindered use of the structure during the necessary construction works. The three methods presented in here can overcome these drawbacks and their effectiveness had been verified in two different and time-shifted experimental campaigns: While the tests investigating shear strengthening with post-installed rebars (method 1) had been conducted earlier in the accredited laboratory of the Hilti Corp., the post-installed undercut anchors (method 2) and the Carbon Fiber Reinforced Polymer (CFRP) - technique with a special end anchorage (method 3) were tested more recently in the certified lab of Carinthia University of Applied Sciences (CUAS) in Austria.

2. POST-INSTALLED REINFORCING BARS (METHOD 1)

Post-installed reinforcement is installed into hardened concrete members by drilling holes, injecting them with appropriate adhesive mortars and inserting the reinforcing bars. For strengthening and rehabilitation projects, as well as in specific situations in new construction, post-installed bars are used more and more frequently [2]. In the case of strengthening existing structures, they may serve as an additional subsequently applied

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