'memory steel' for Shear Reinforcement of Concrete Structures

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ABSTRACT: Strengthening of reinforced concrete (RC) structures is generally used to increase either their bending or shear resistance. The latter is usually performed with fiber reinforced polymer (CFRP) by means of the near-surface mounted (NSM) strengthening technique (bars), or by external bonded CFRP fabrics and strips. In case of a prestressed shear strengthening, several advantages can be obtained due to the prestressing force: closing of existing cracks, reducing the force in the internal stirrups, delaying the appearance of new cracks, and increasing the ultimate shear resistance. However, technical implementation is complex.

Empa and re-fer AG developed strengthening products from a new iron based shape memory alloy (Fe-SMA), also denominated as 'memory-steel'. A shape memory alloy (SMA) has the unique property to remember its initially given shape upon heating after having been deformed over elastic extent. This memory steel can be used as a prestressing system for concrete structures.

In the current study, small scale experiments for investigating the overall principle have been carried out. These experiments demonstrated the feasibility of such a Fe-SMA shear reinforcement. Additionally, T-beams with a span of 5 m have been experimentally examined to study the application of memory steel bars for pre-stressed shear strengthening. The ribbed memory steel stirrups have been used in combination with shotcrete mortar. An important finding was the fact that the bending of the stirrups in the corners did not hinder the system to work. The application finally enhanced the structural behavior of the RC members as the shear cracks width can be reduced and new shear cracks occur under higher loads.

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