SHAPE MEMORY STEEL FOR STRUCTURAL REINFORCEMENT

Problem – Challenge

Ancient civil works such as bridges, tunnels or buildings often suffer from material aging, cracks and deformations or other damages, and therefore require reinforcement to guarantee structural safety for their future use. Modernizing residential or industrial buildings may come along with removal of walls, to enlarge available spaces, or to create a more generous appearance of the interiors. Current solutions are known to be bulky or expensive, or both, such as a support beam inserted under the ceiling, creating an obstacle to industrial overhead installations, and an insult to the architect's eye. The desirable alternative are integrated, flat, and yet robust structural elements to retrofit the constructions.

Solution

Iron-based shape memory alloys (SMA) are a material class that can solve this problem. In more than 15 years of research work, experts from Empa and the start-up re-fer AG have readied a precise method for series production: SMA steel, which strives to contract during heating and thus permanently pre-stresses the concrete structure. Since 2018, the new building material is available on the market under the name "memory steel". To strengthen an old building, for instance, a strip of this special steel ("re-plate") is fastened under the ceiling using dowels and then heated with electricity, an infrared radiator, or gas. Alternatively, the reinforcement can also be set in the concrete: a groove is milled into the concrete slab, then a ribbed reinforcement bar ("re-bar") is inserted and anchored to the substrate with a levelling mortar. Finally, the memory steel bar is heated with the aid of direct current or gas and thus pre-stressed. Another variant is a full-surface application using re-bar in combination with self-levelling or sprayed mortar. re-bar is particularly interesting and efficient in infrastructure constructions such as bridges and tunnels. With memory steel, bulky beams and wretched retrofit are just a stale memory!

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