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strengthening solutions

Shear tests with memory-steel

re-bar

«In Sika MonoTop-422 PCC sprayed mortar»

Empa experiments show that the entire prestressing force of an embedded memory-steel stirrup can be introduced as shear resistance in the structure. This leads to an increased service load and additional load-bearing capacity.

Empa
Materials Science and Technology

System tested with memory-steel

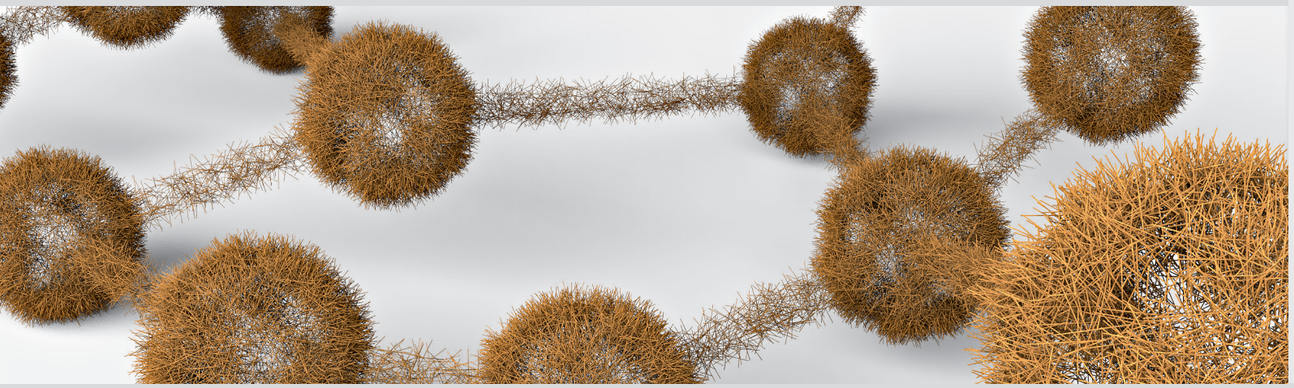
Sika
BUILDING TRUST

Mortar in combination with re-bar:

- Sika MonoTop-452 N «Reprofiling mortar horizontal»
- SikaGrout-311 «Grouting in the slot»
- Sika MonoTop-422 PCC «Sprayed mortar vertical/overhead»

Fire protection in combination with re-plate:

- SikaCem Pyrocoat «Fire Protection sprayed mortar»
- SikaCrete-213F «Fire protection sprayed mortar»



memory-steel

Easy and efficient prestressing.

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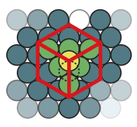
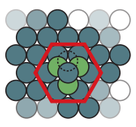
Atomic structure in the memory-steel



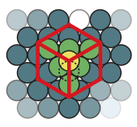
Initial alloy in the steel plant

Prestressing by re-fer



Delivery and installation at the construction site

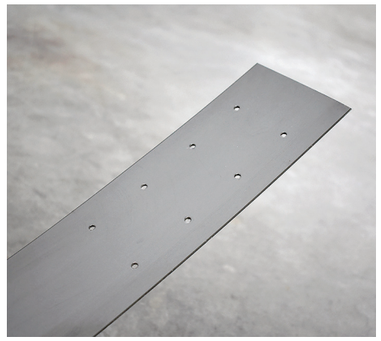
Activating «heating»



Reversion in the construction: **prestress**

memory-steel products

re-plate



Steel strips 120 mm x 1.5 mm

re-plate:

Dimensions	Cross-section	Prestressing force $F_{p,0}$	Prestress $\sigma_{p,0}$ *	Relaxation
120/1.5 mm	180 mm²	68 kN	380 N/mm²	15% after t_∞

Maximal stress $f_{s,ud}$ **	Anchorage resistance $F_{s,ud}$ **
610MPa	109.8 kN

* In case corrosion protection is required max. activating temperature is 165 °C, this results in prestress 300N/mm² (54 kN/re-plate)

** Design value at anchorage failure

re-bar

Ribbed steel bar Ø12 mm

re-bar:

Diameter	Cross-section	Prestressing $F_{p,0}$	Breaking force $F_{s,u}$
12 mm	105 mm²	35 kN	68 kN

Tensile strength $f_{s,u}$	Strain at failure $\varepsilon_{s,u}$	Prestress $\sigma_{p,0}$	Relaxation
650 N/mm²	>10%	340 N/mm²	15% after t_∞

* Reduced prestress can be achieved at lower heating temperatures

Structure reinforcement with memory-steel

Strengthening reinforced concrete

- positive / negative bending moment
- Shear reinforcement
- Seismic retrofitting
- Confinements
- Prestressing of compling joints

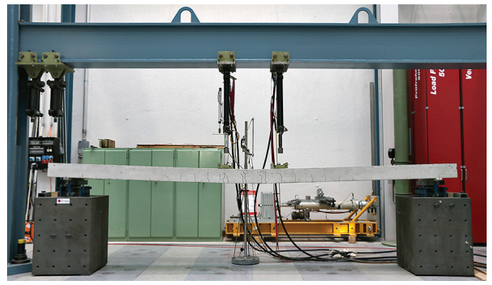
Reinforcement of steel components

- Bridging fatigue cracks

Application in new constructions

- Prestressing in situ casted components
- Prestressing of precast components

Bending tests with memory-steel



- very ductile material (re-plate strain at failure >10%, re-bar >10%)
- 15% relaxation (t = ∞) with stable stress evolution over time
- very good corrosion resistance (CHP 1)
- Service life of over 250 hours in the adapted fib test for stress corrosion cracking

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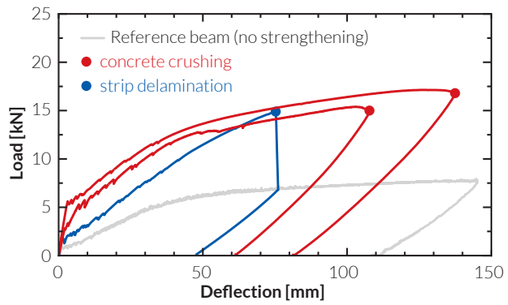


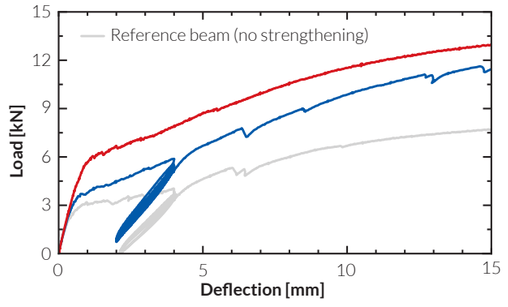
re-plate

«Mechanically anchored with Hilti direct fastening»

(pos. and neg. moment) compared with CFRP strip

	re-plate	CFRP strip
Axial stiffness EA [kN]	~10*10³	~11*10³
Cracking load [kN]	3.4 - 5.4	2.0

- 70 - 170% increase compared to the CFRP lamina



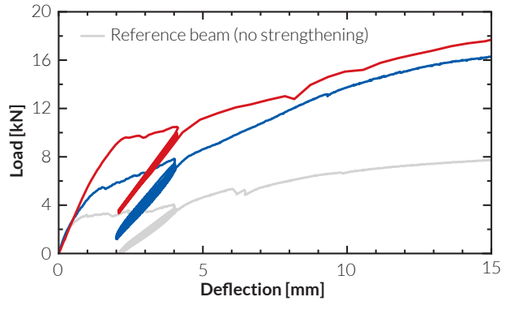
re-bar

«In Sika grouting mortar SikaGrout-311»

(neg. moment) compared with slotted CFRP

	re-bar	slotted CFRP
Axial stiffness EA [kN]	~4.4*10³	~4.0*10³
Cracking load [kN]	6.0	3.0

- 100% increase compared to slotted CFRP



re-bar

«In Sika MonoTop-422 PCC sprayed mortar»

(pos. moment) Comparison activated / not activated

memory-steel:	activated	not activated
Cracking load [kN]	9.0	5.0

- 80% increase compared to strengthening without prestressing

Test reports and publications on request.