conference poster

Application of High Performance Concrete for Reconstruction

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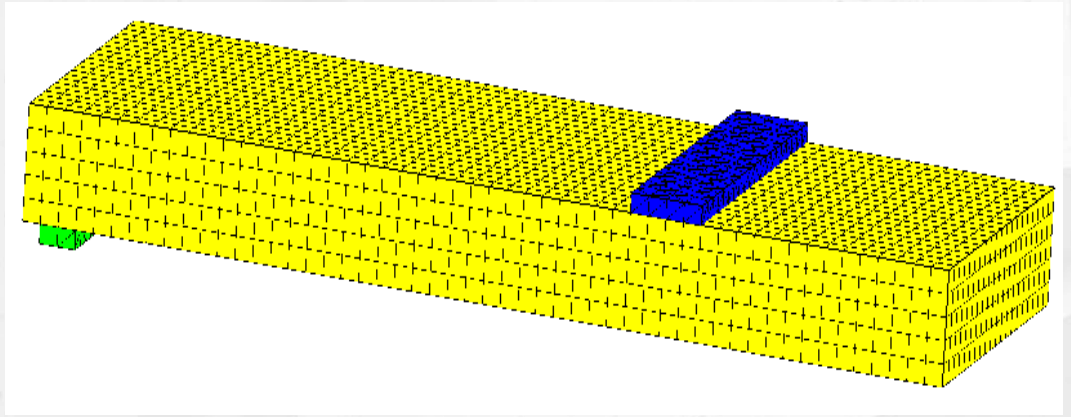
Experimental program

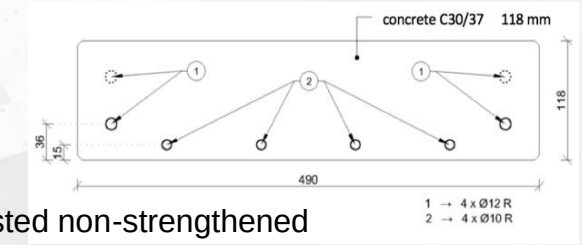
- Prefabricated reinforced concrete (RC) panels
- Material of RC panels: C30/37
- Compressive strength of UHPC: 133 MPa
- Reference panels with no strengthening layer and panels with 30 mm UHPC layer
- Before casting of the UHPC layer the upper surfaces of the panels were treated by hand
- Four-point bending tests (the span of the supporting pins: 2500 mm, the span of the loading pins: 800 mm)
- The loading force and deformation were monitored and recorded during the loading

Numerical modelling of the four-point bending tests

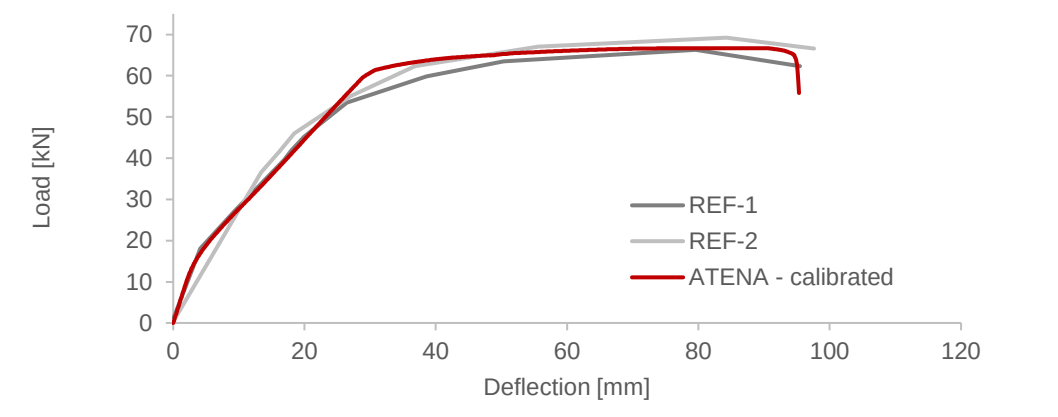
- Finite element analysis software ATENA 5.6.1 Science with GiD interface
- The symmetry of the setup was considered (only halves of the specimens were modelled)
- Analysis of the model with generated default material parameters
- Parametric study and calibration of the models
- UHPC beam subjected to the three-point bending test was modelled using ATENA Science in 2D in order to obtain the force-crack mouth opening displacement curves (CMOD curves)



Non-strengthened panels



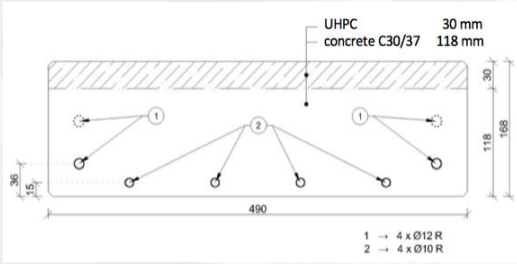
The experimental loading curves of the tested non-strengthened panels compared with the calibrated ATENA simulation:



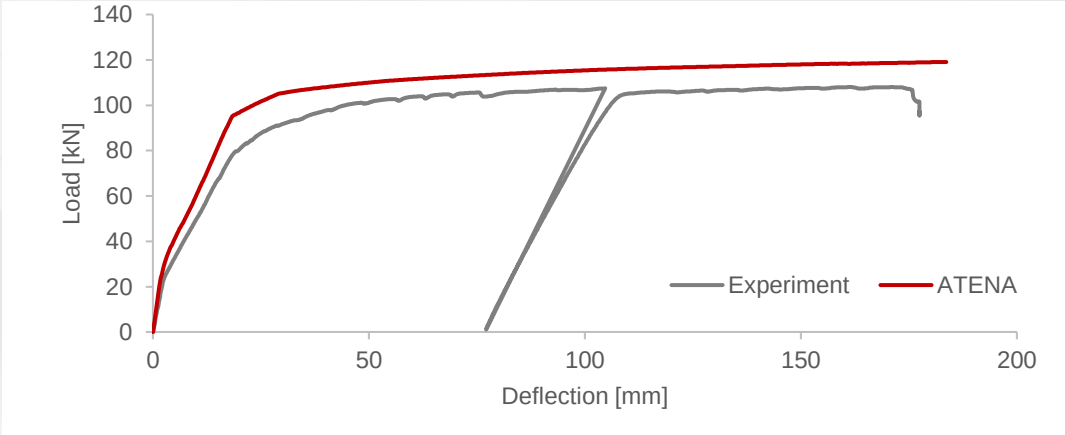
The default parameters of concrete and original reinforcement which have been adjusted by the multiplication factor in the calibration process:

Parameter	Units	Default setting	Multiplication factor
Concrete material model			
Young modulus	MPa	32000	0.56
Tension strength	MPa	2.9	1.00
Compressive strength	MPa	-38	0.79
Fracture energy	MN/m	0.000073	1.14
Tension stiffening	-	no	yes
Critical compressive displacement	m	-0.0005	1.10
Original steel reinforcement model			
Characteristic yield strength	MPa	500	0.84
Class	-	B	C

Strengthened panels



The experimental loading curve of strengthened panels compared with the ATENA simulation with material parameters based on the prior calibration procedures:



Calibrated values of the key material parameters based on the CMOD analysis:

Parameter	Units	Calibrated values
Young modulus	MPa	43000
Tension strength	MPa	6.5
Compressive strength	MPa	-133

Conclusions

- Application of high-performance cementitious composites for reconstruction of concrete structures is a step towards sustainable construction
- The reuse of damaged or no-longer satisfactory structural elements leads to saving both material and waste
- When the non-linear behaviour of the materials is taken into account, it allows the design to be less conservative, thus more economic
- For a sufficient numerical model, the geometry of the recycled structures must be known as precisely as possible
- However, most importantly, it is crucial to ensure inputs for the numerical analysis by conducting a sufficient number of mechanical tests of the materials present in the modelled structure

Acknowledgments
FV20472 Application of high performance cementitious composites at rehabilitation of concrete structures, SGS19/149/OHK1/3T/11 Durability of concrete structure and assessment of its life cycle.

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