Progetto DPC-ReLUIS 2022-2024 - WP 14

PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

Studies on shear bond behavior of FRCM applied to masonry substrates

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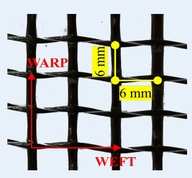
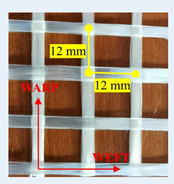
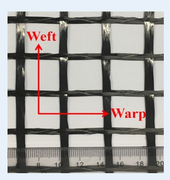
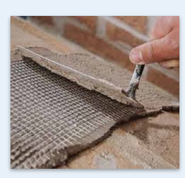
Fabric Reinforced Cementitious Matrix (FRCM)

INORGANIC MATRIX + 

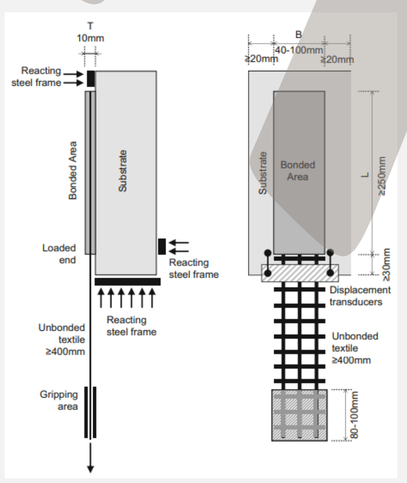
Basalt OR 

Glass OR 

Carbon = 
FRCM SYSTEM

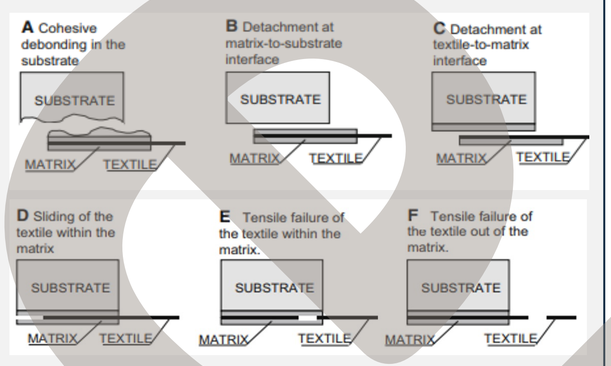
Interface behaviour FRCM-masonry

The **effectiveness of FRCM materials** in strengthening structures depend on the bond between the composite system and the reinforced substrate.

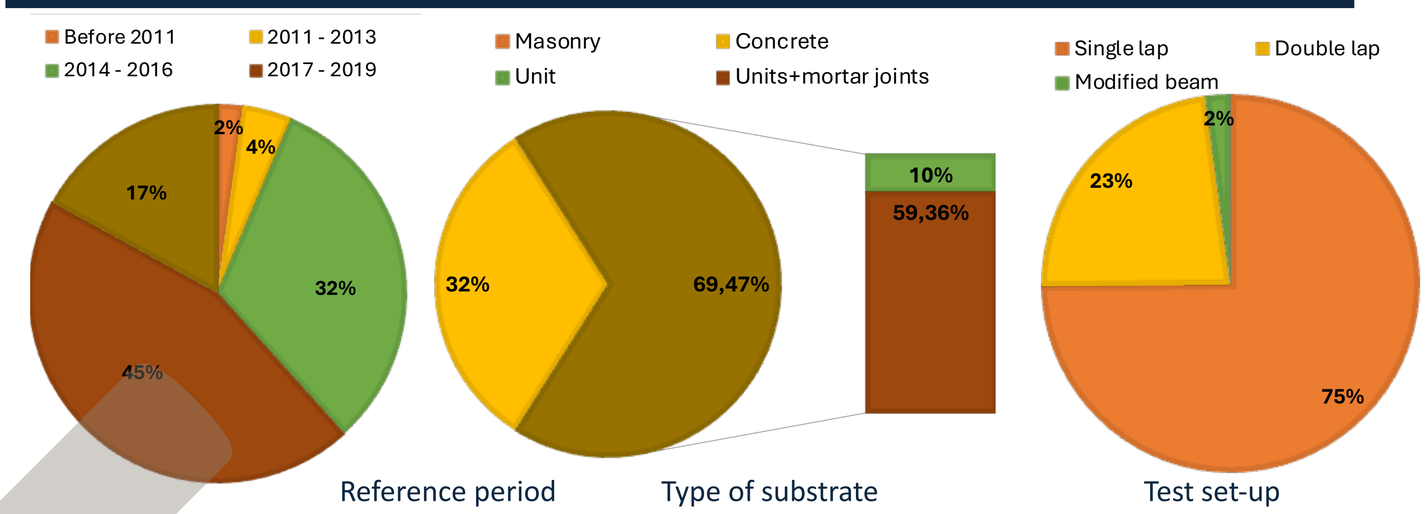


Test set-up: **RILEM TC 250 CSM**

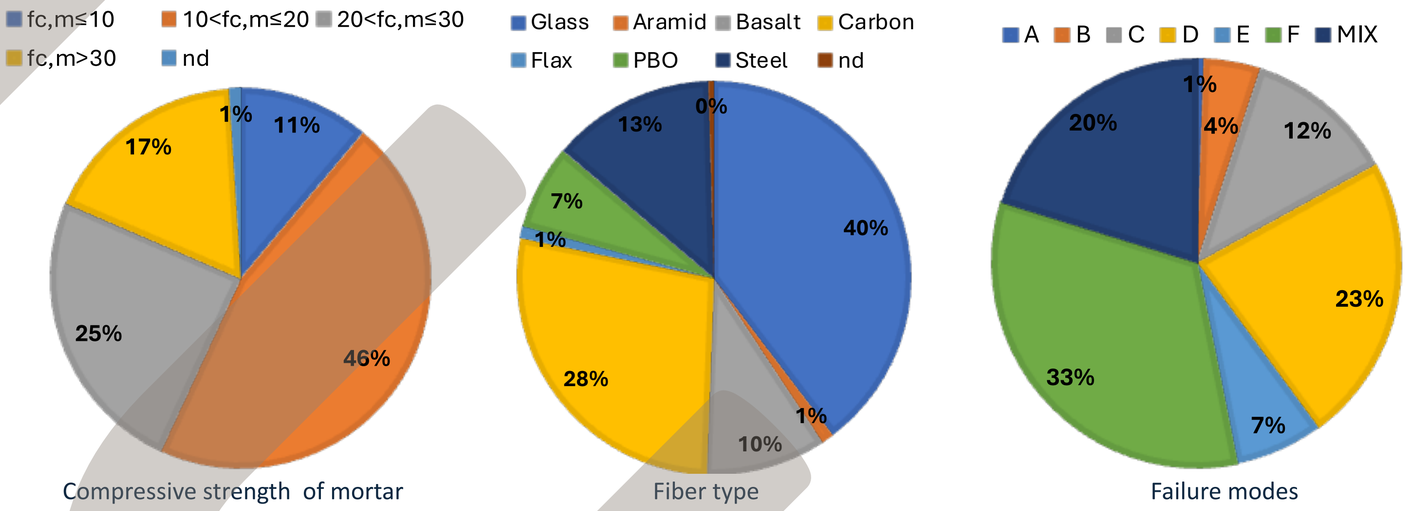
Failure mode classification
according to **CNR-DT 215-2018**



Bond test data-base (2011-2022)



The most commonly used test method is the single lap shear bond test.

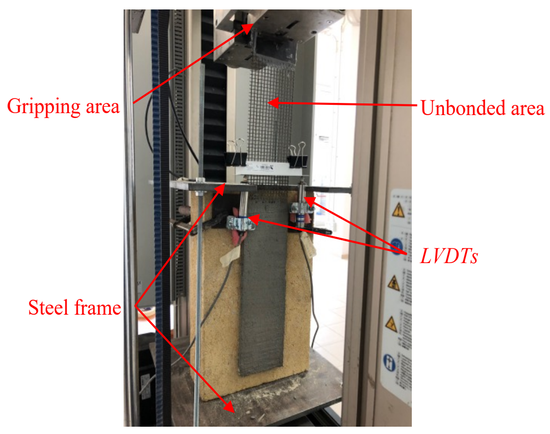


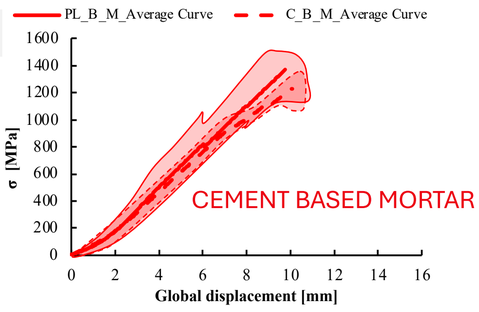
Experimental investigation

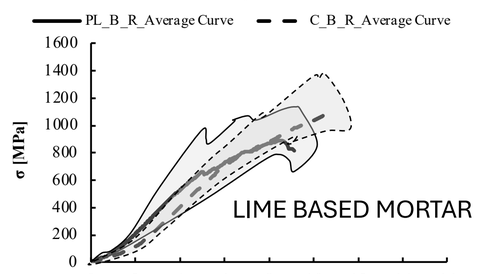
The bond behavior of externally bonded basalt FRCM systems on calcareous stone was experimentally investigated. Two types of calcareous stone and three different mortars were considered as variables.

Calcarenite stone

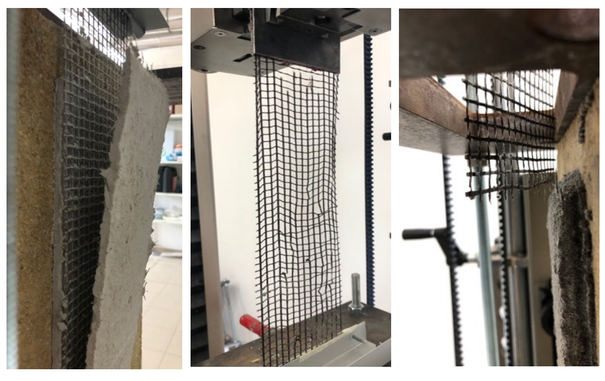
SINGLE LAP SHEAR BOND TEST SET-UP

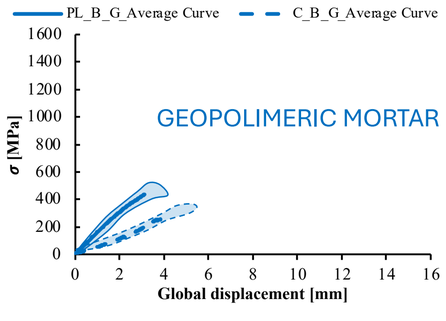






FAILURE MODES





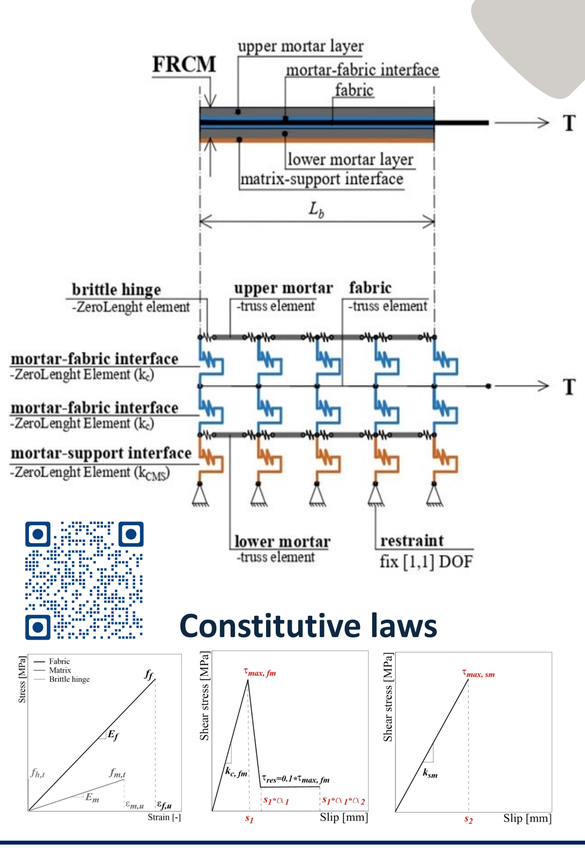
Unit	Substrate	Mortar	$\sigma_{max,av}$ [MPa]	η_{av} [%]	Unit	Substrate	Mortar	$\sigma_{max,av}$ [MPa]	η_{av} [%]
Unina Uniparthenope	Tufo	Lime Based	1123	63%	UniSalento	Pietra Leccese	Cementitious	1373	77%
Unina Uniparthenope	Tufo	Cementitious	941	53%	UniSalento	Calcarenite	Lime Based	842	47%
Unina Uniparthenope	Calcarenite	Lime Based	975	55%	UniSalento	Calcarenite	Cementitious	1208	68%
Unina Uniparthenope	Calcarenite	Cementitious	608	34%	UniPa	Calcarenite	Lime Based	799	45%
UniSalento	Pietra Leccese	Lime Based	840	47%	UniPa	Calcarenite	Cementitious	829	47%

Efficiency respect to the fibres tensile strength: 34-77%

For masonry specimens, the substrate typically has a compressive strength of 10-20 MPa (66%) and 20-30 MPa (13%), corresponding to the predominant use of clay bricks. The reinforcing mortar generally has lower compressive strengths, ranging from 10 to 20 MPa. A wider variety of the dry fibers are adopted as reinforcement. The most frequent failure modes are the tensile rupture of the fibers (type "F", 36.3%) and a mixed failure mode involving both slippage and debonding phenomena (20%)

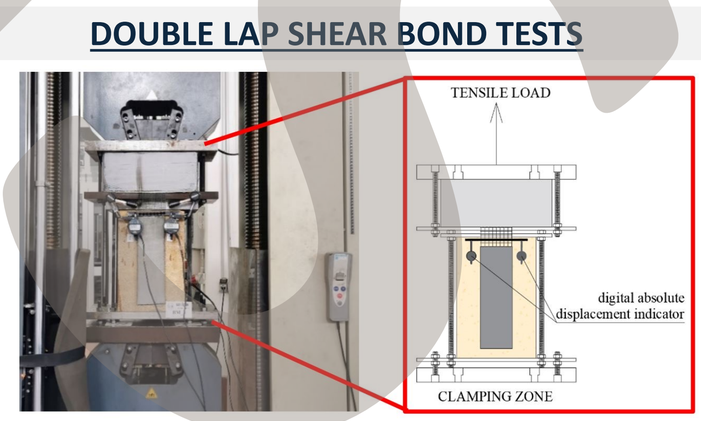
Numerical model

A numerical approach able to predict the bond behavior of FRCM to-masonry systems is proposed. The model is based on truss elements and nonlinear springs to simulate the fabric-to-matrix and composite-to-substrate interactions.

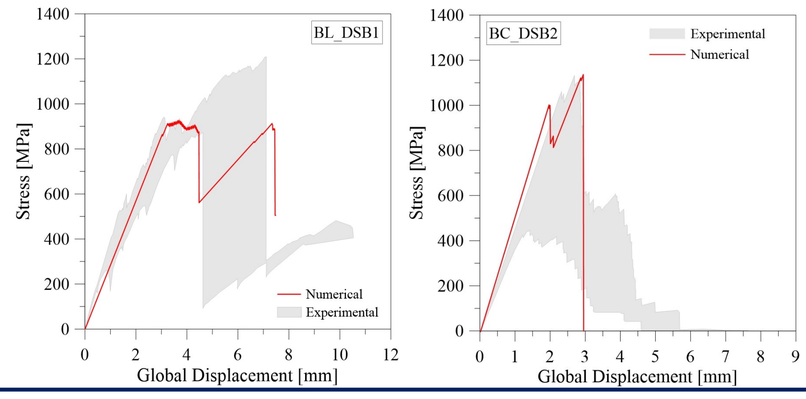


Constitutive laws

DOUBLE LAP SHEAR BOND TESTS



Numerical-experimental comparisons



Convegno ReLUIS - Napoli, 17-18 ottobre 2024