reluis Progetto DPC-ReLUIS 2022-2024 - WP 14

PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

Application of FRCM composites to strength masonry structural elements

M.A. Aiello[1], A. Cascardi[2] ,F. Ceroni[3], L. La Mendola[4], G.P. Lignola[5], M. C. Oddo[4], A. Prota[5]

(1) University of Salento
(2) University of Calabria
(3) University of Naples – Parthenope
(4) University of Palermo
(5) University of Naples – Federico II

FRCM: ADVANTAGES and OPPORTUNITIES

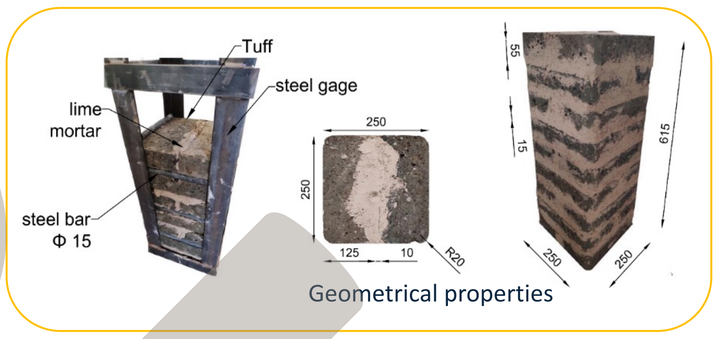
- ✓ Sustainability
- ✓ Compatibility with the substrate
- ✓ Reversibility of interventions
- ✓ Resistance to relatively high temperatures
- ✓ No toxic exposures

Generally, a single ply of external reinforcement produced a negligible increase of bearing capacity, while the same strengthening systems applied with multi-ply strengthening schemes produced a significant increase in terms of strength and ultimate axial deformation.

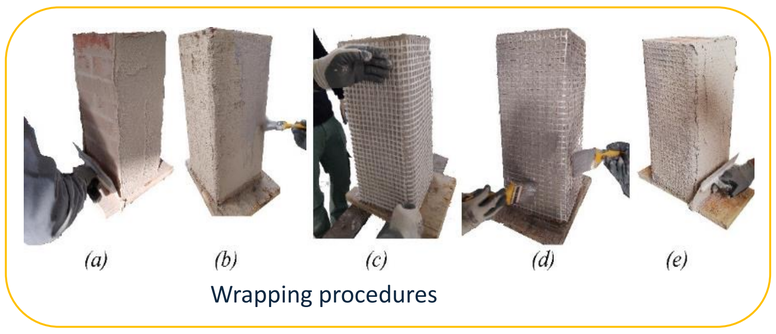
Confinement of masonry columns with FRCM

The use of FRCM composites is a highly effective technique for enhancing the strength and shortening capacity of masonry columns subjected to axial load. Results from experimental tests on small scale confined masonry columns provide valuable insights into the benefits of FRCM systems.

EXPERIMENTAL CAMPAIGN ON TUFF MASONRY COLUMNS CONFINED WITH GLASS-FRCM

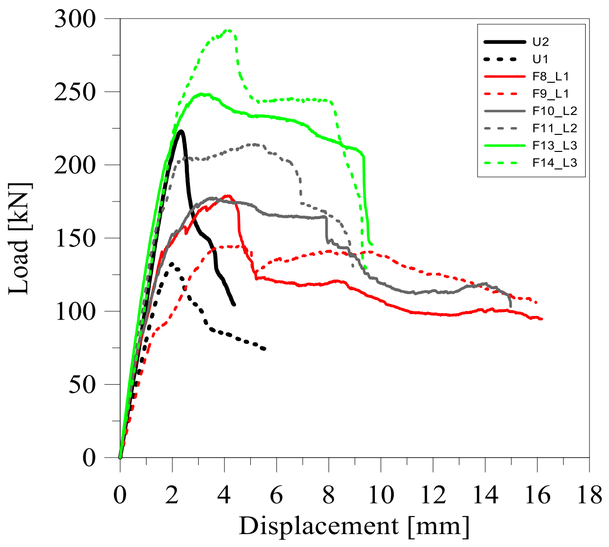


Geometrical properties

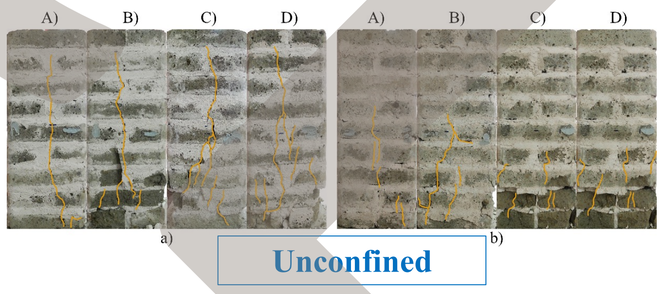


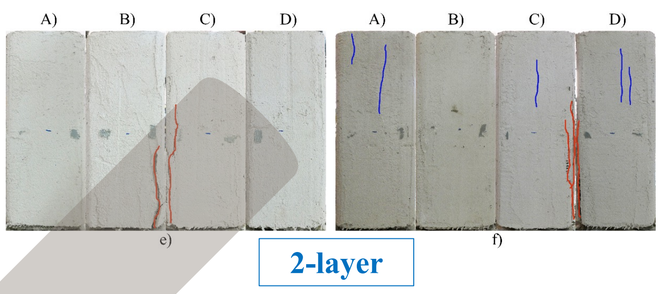
Wrapping procedures

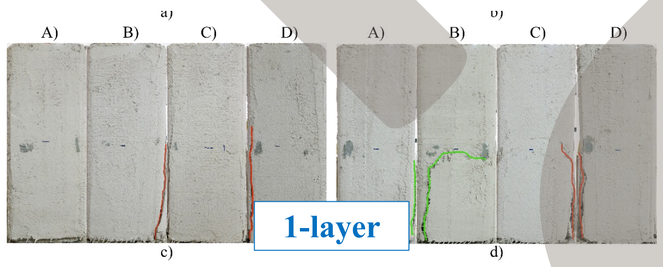
LOAD-DISPLACEMENT CURVE

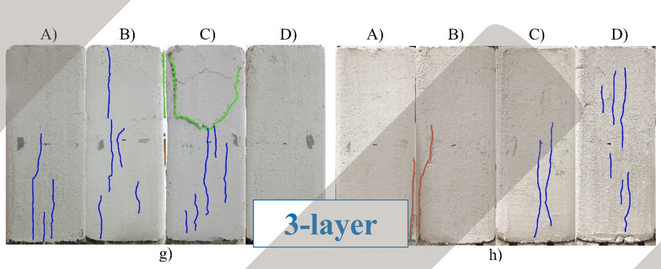


FAILURE MODES









Crushing (C): longitudinal cracking of the masonry

Knife-effect (KE): fiber rupture at the corner of the cross section

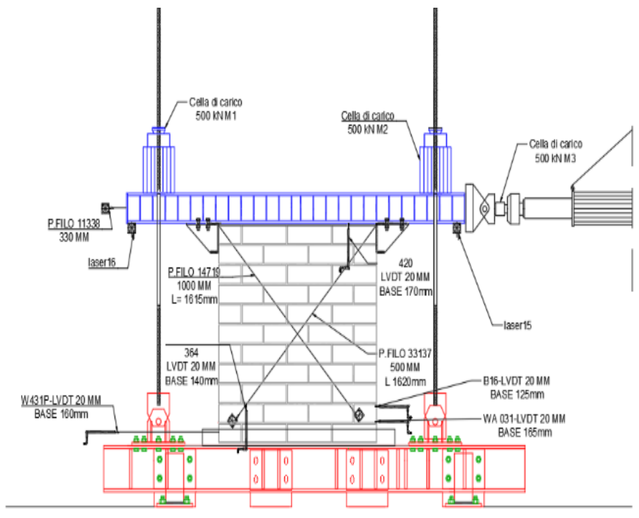
Matrix Cracking (MC): longitudinal cracking of the FRCM lime-based mortar

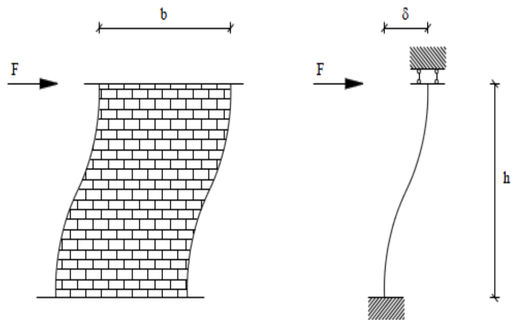
Detachment (D): separation of the external layer of the FRCM-matrix

Shear compression tests

Shear compression tests performed on masonry tuff panels with dimension 1.3×1.3×0.25 m strengthened with a basalt FRCM bidirectional grid and hydraulic lime (mortar thickness about 10 mm). Same materials (tuff stones, mortar, FRCM) used in bond tests.

EXPERIMENTAL SET-UP FOR SHEAR COMPRESSION TESTS





Reproduction of a pier panel (wall) with a rigid spandrel on top (**no rotation on top**).

Vertical load of 200 kN, compression stress ≅0.60MPa (v=0.23).

RESULTS

Unstrengthened panels (URM)

Average F_{max} = 116,7 kN

Shear Failure in tuff blocks

1-side Reinforced panels (SRM)

Average F_{max} = 162,1 kN

Shear Failure in tuff blocks

✓Shear resistance of masonry panels: effectiveness of reinforcement

- Single-side reinforced panels (SRM)
  $F_{max,average}$ = 162,1 kN
  + **39%** with respect to URM
  - Comparable stiffness
  - Relevant influence of FRCM on strength
- Double-side reinforced panel (DRM)
  F_{max} = 184,0 kN (flexural failure of the wall)
  + **58%** with respect to URM
  + **14%** with respect to SR