INTERNATIONAL CAE CONFERENCE

AT THE EPICENTRE OF THE **DIGITAL TRASFORMATION** OF INDUSTRY

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36th INTERNATIONAL CAE CONFERENCE AND EXHIBITION

A NOVEL SEISMIC COAT FOR SUPERBONUS 110% TAX DETRACTION ON EXISTING MASONRY BUILDINGS

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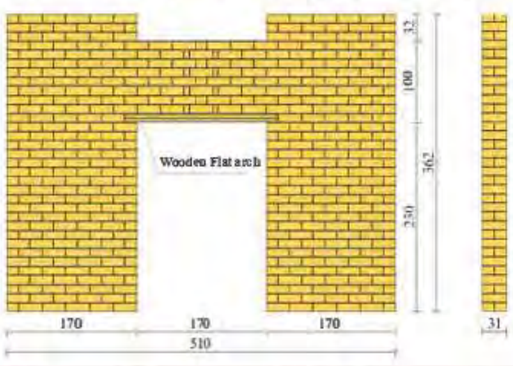
The initiative promoted by the Italian government in order to recover the building heritage mainly used for residential purposes is the 110% Superbonus law. This is a facilitation provided for by ***Relaunch Decree*** (law of 19 May 2020, n. 34), which raises the expenses deduction rate incurred from 1 July 2020 to 31 December 2021 to 110%, for specific interventions in the field of energy efficiency and anti-seismic interventions, in addition to the installation of photovoltaic systems and infrastructure for charging electric vehicles.

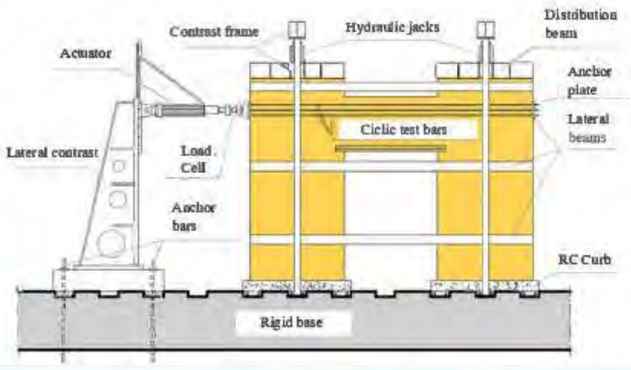
The aim of this research is to find a solution to combine the increase in term of seismic safety and energy efficiency with a light, flexible and economical system. For this reason, the use of a novel seismic coat is proposed to be applied to the external facades of buildings. In this way it is not necessary for users to leave their homes during the installation phase of the seismic coat.

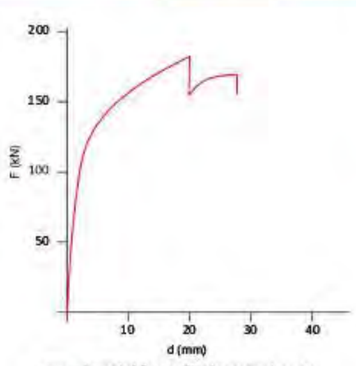
The increase in performance from both seismic and energetic points of view is demonstrated starting from the numerical simulation of an experimental test using ABAQUS software. Then, the system potentiality is checked through its application to a case study masonry building using the SAP2000 software.

FEM CALIBRATION OF EXPERIMENTAL TEST

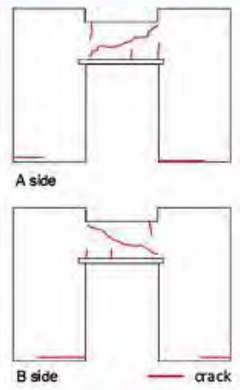
Quasi-static test on masonry wall with an opening (Augenti et al. 2011)





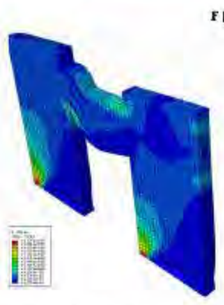


experimental force-displacement curve

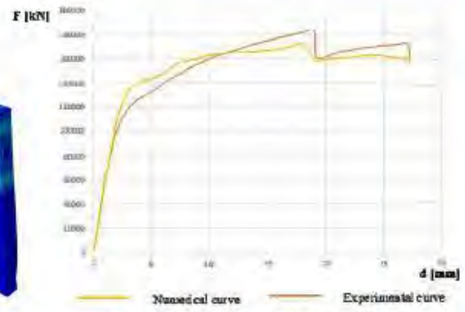


NUMERICAL SIMULATION USING ABAQUS SOFTWARE

FE Model



Distribution of Plastic Strains



Comparison between experimental and numerical curves

concrete damage plasticity				
dilatation angle	eccentricity	fb0/fc0	k	viscosity
18	0.1	1.3	1	0.0001

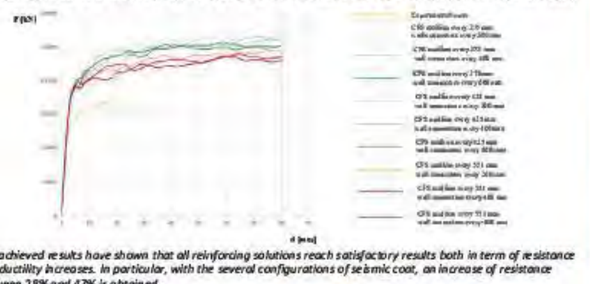
tensile behavior	
yield stress	fracture energy
0.1	0.72

compressive behavior	
yield stress	inelastic strain
3.96	0
3.96	0,04

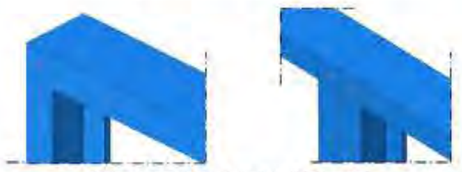
PARAMETRIC FEM ANALYSES ON SEISMIC COAT

After numerical calibration of experimental test, a parametric analysis with variable mullions distance using ABAQUS software has been done aiming at understanding the advantages in terms of strength and ductility provided by the used seismic coat. In particular, mullions distance of 275,425 and 551 mm and wall-to-CFS connectors every 200, 400 and 600 mm have been taken into account.

CFS frame arrangements: mullions distance of 275,425 and 551 mm

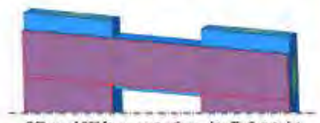


The achieved results have shown that all reinforcing solutions reach satisfactory results both in term of resistance and ductility increases. In particular, with the several configurations of seismic coat, an increase of resistance between 28% and 47% is obtained.



Mullions-transoms connection using Tie constraint

CFS frame-masonry wall connections using Tie Constraint



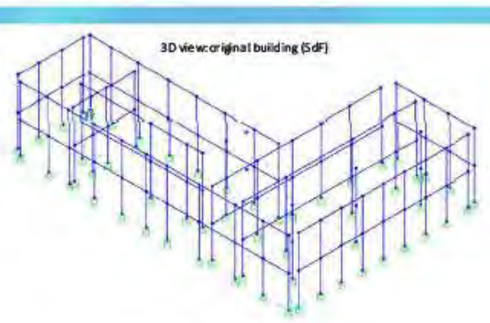
OSB panel-CFS frame connections using Tie Constraint

APPLICATION OF SEISMIC COAT TO A CASE STUDY

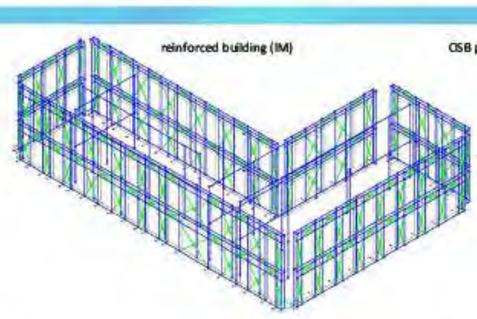
Case study: Leccisotti Istitute, Serracapriola (FG)

Numerical analisys are developped by a equivalent frame model and are conducted trough SAP2000 software.

3D view: original building (SdF)

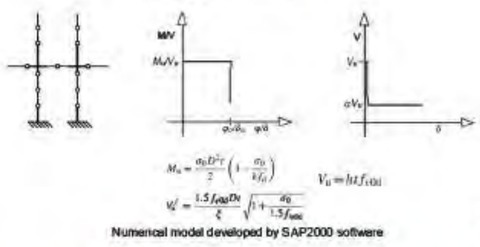


reinforced building (IM)



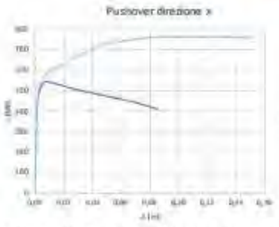
OSB panel, dimensions: 2,40x8,00m

Plastic hinge: piers and spandrel



Numerical model developed by SAP2000 software

Pushover direzione x



Pushover direzione y

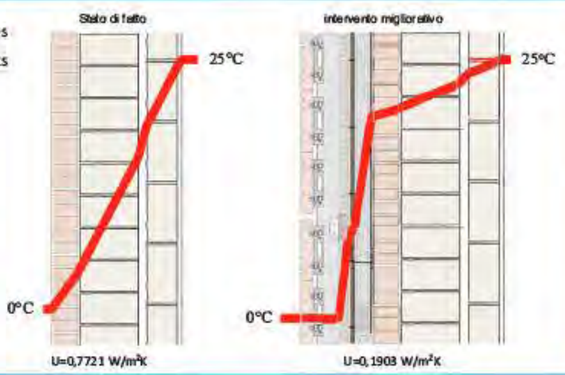
The obtained curves have shown that the used seismic coat improves significantly resistance and ductility of the existing building. In x direction, an increase of 31% and 45% in term of strength and ductility, respectively, is obtained. Instead, in y direction an increase of 18% and 47% in term of strength and ductility is recorded, respectively.

SEISMIC UPGRADING

PAM is a parameter that allows to evaluate the building seismic risk class and takes into account economic losses associated to the damaged elements in terms of a percentage of the reconstruction cost. For the examined case study, the used seismic coat allows to overcome one risk class, so to attain the building upgrading.

ENERGY RETROFIT

The energy improvement interventions consist of the seismic coat installation, fixtures replacement and the substitution of the neo lamps with LED ones. These improvements allow to overcome 4 energy classes, from D to A2.



CONCLUSION

In the current research work the use of an innovative low-cost sustainable and reversible seismic coat as energetic and seismic improvement system of existing masonry buildings has been investigated. The system potentiality has been demonstrates through FEM simulations carried out in the ABAQUS non-linear software environment. Parametric analyses on different configurations of CFS frame (variable mullions and connectors pitches) has been done aiming at understanding the advantages in terms of strength and ductility provided by the proposed system. Finally, to confirm the performance obtained from refined FEM analyses, the seismic coat has been applied to a case study represented by a school building. The improvement of performances has been very large: 1 seismic risk class and 4 energy classes are exceeded thanks to the seismic coat installation. This means that the proposed system can effectively replace the traditional thermal coat thanks to both the higher energy performance and an additional seismic resistance, which is not provided by the traditional envelope systems.

REFERENCE

N.Augenti, F. Parisi, A.Prota, G. Manfredi, *Qquasi-static tests on a full-scale perforated masonry wall with and without inorganic matrix composite materials* (in Italian), 14th Italian National Conference on Earthquake Engineering, Bari (Italy), 2011.