Università degli Studi di Salerno Dipartimento di Ingegneria Civile

WORKSHOP 12-13 febbraio 2007

Materiali ed Approcci Innovativi per il Progetto in Zona Sismica e la Mitigazione della Vulnerabilità delle Strutture

ANALISI DI PANNELLI MURARI RINFORZATI CON FRP SOGGETTI A SOLLECITAZIONI DI TAGLIO

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Task 8.8

Analisi del comportamento di edifici in muratura rinforzati con materiali compositi, crisi delle pareti e dei pannelli, collegamenti, catene e cuciture, comportamento dei pannelli fuori del piano e nel piano.

Coordinatore Responsabile: **Elio Sacco**

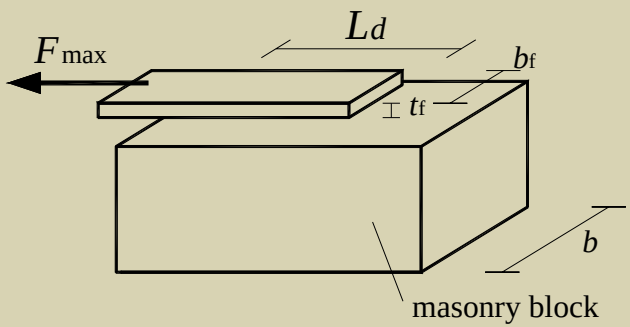
...tra gli obiettivi del primo anno:

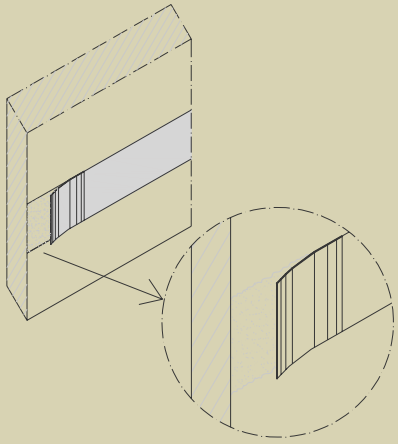
- **Procedure analitiche e numeriche**
  Sviluppo di modelli numerici per l'analisi di pannelli murari non rinforzati e rinforzati con FRP.

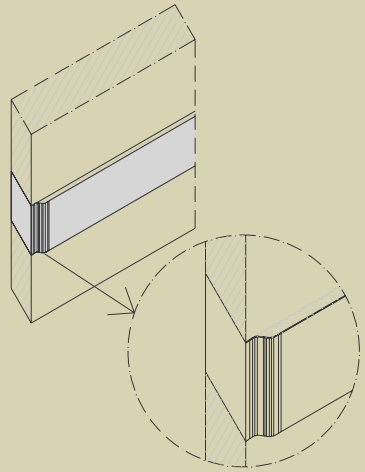
Objectives and Contents

Investigation on modelling approaches for FRP-strengthened masonry panels

- influence of interface/support damage on the bond strength
- effect of FRP anchorage on debonding mechanism



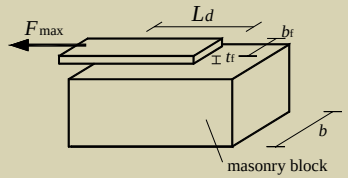




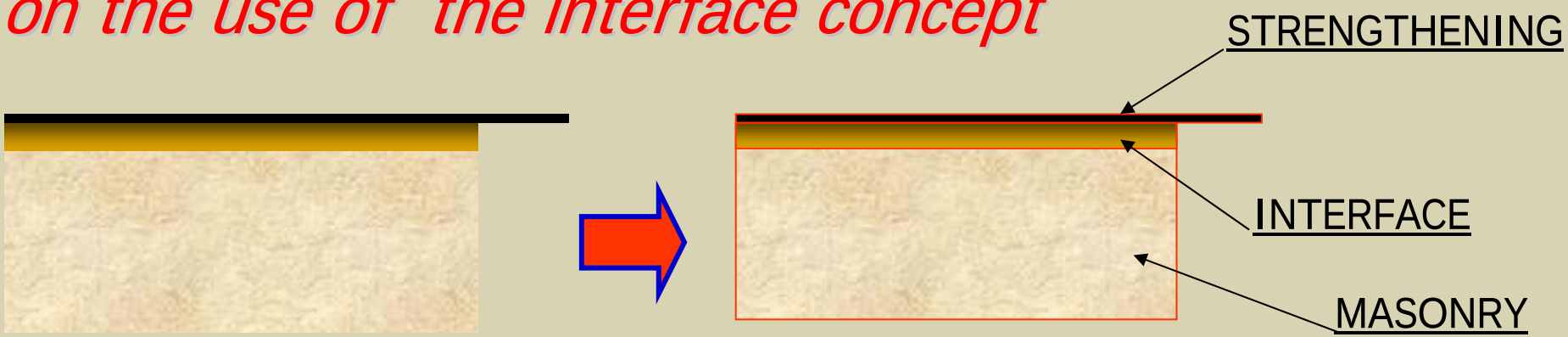
Use of refined and simplified models

- numerical examples
- comparison between experimental and numerical results

Analyses part.1



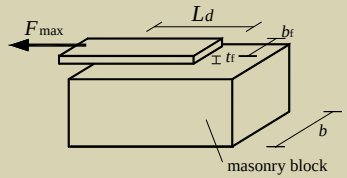
on the use of the interface concept

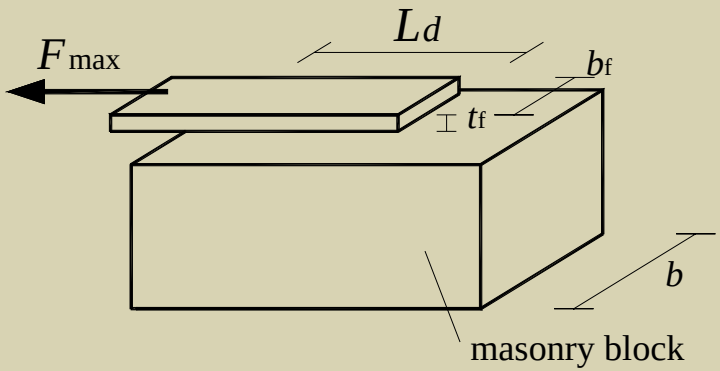


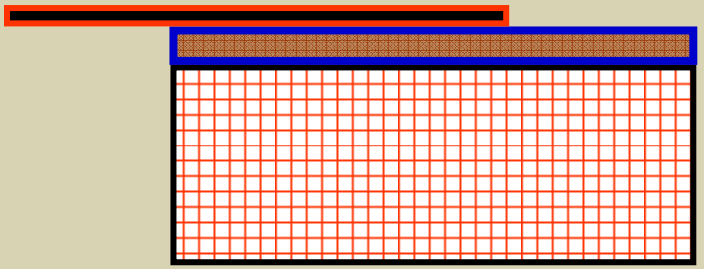
- this model implies the knowledge of parameters defining the behaviour of the FRP/masonry layer
- interface constitutive laws are commonly based on the assumption that damage state of the interface elements does not depend on the damage evolution of the support material

this could lead to unsatisfactory results which are in contrast with experimental observations

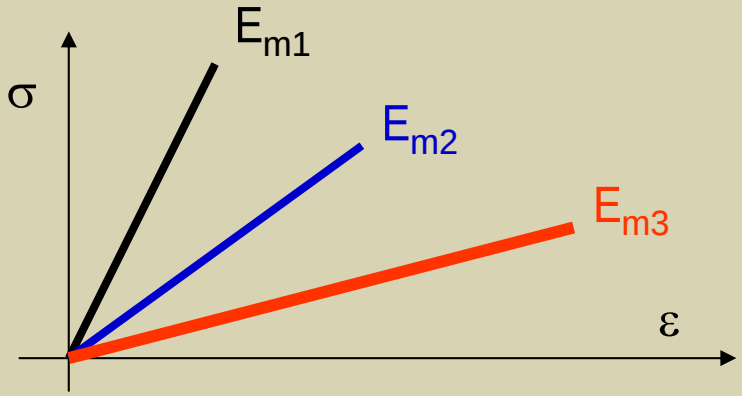
Analyses part.1





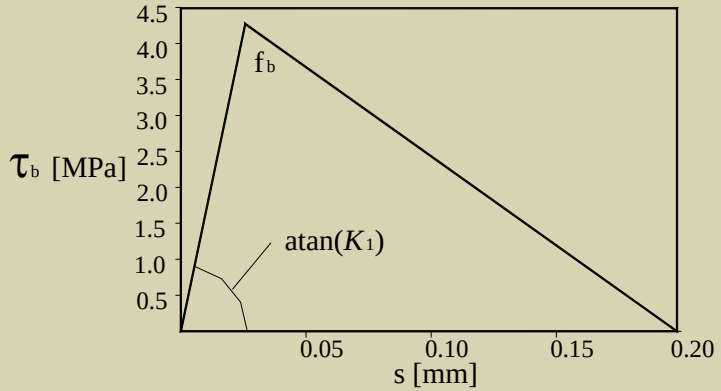


FE model



masonry behaviour – linear-elastic

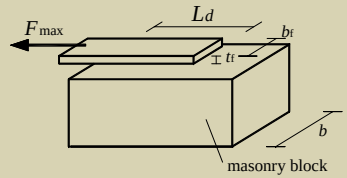
with different values of elastic mod. to simulate the damage of masonry block (smeared crack approach)

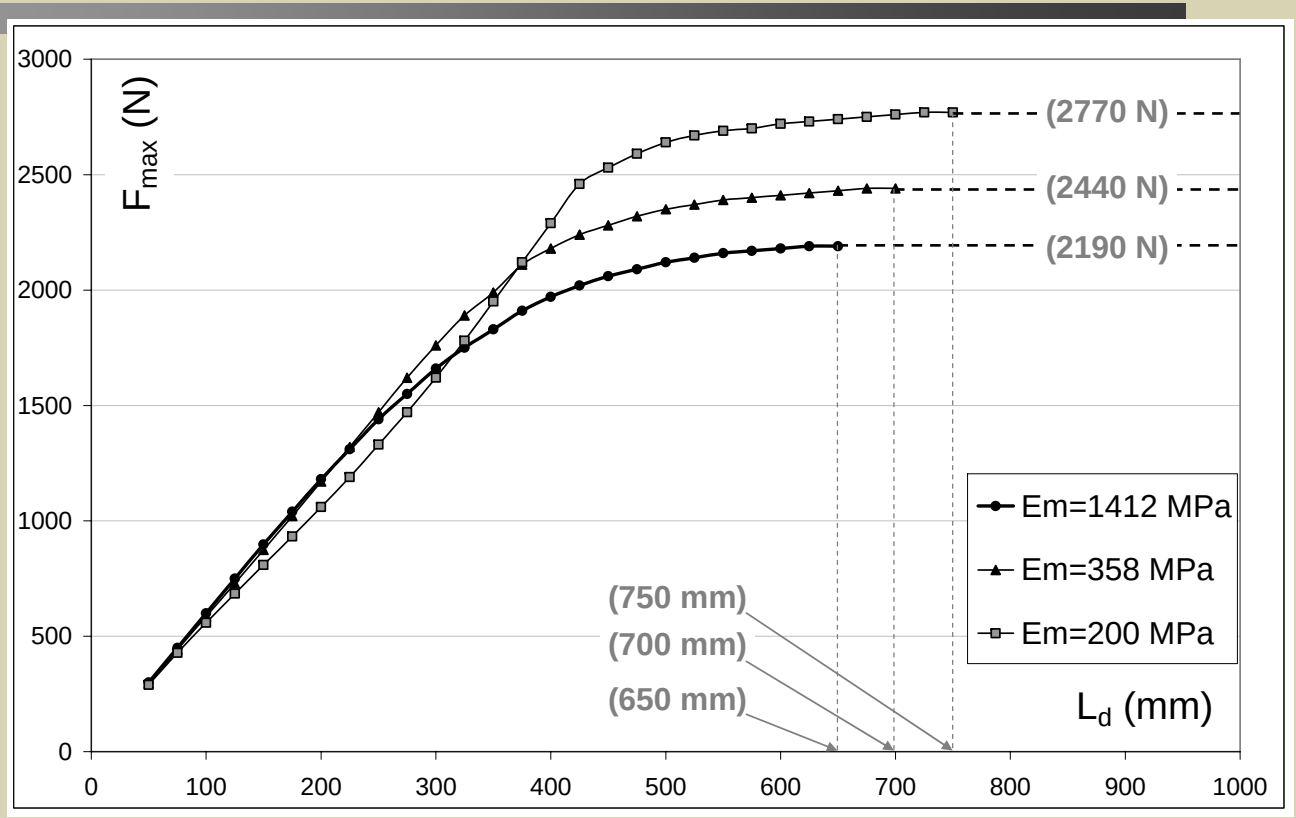


interface behaviour – nonlinear

(according to CNR-DT200/2006)

Analyses part.1

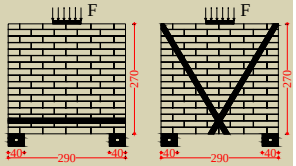




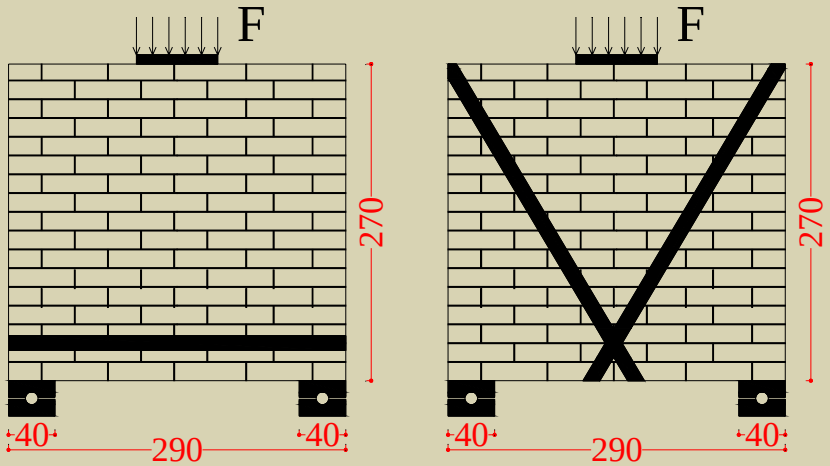
- the increase of damage of block leads to an increase both in terms of bond length and maximum force of strip

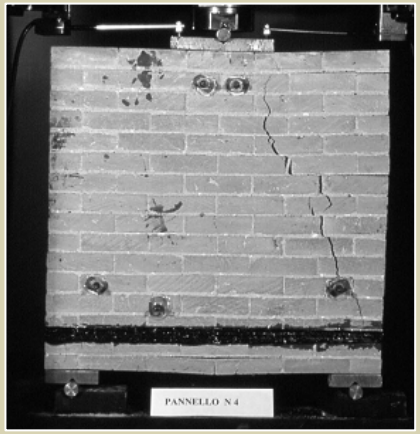
the reinforcement applied on a support characterized by an advanced level of damage is able to sustain a force greater than the force sustained by a not damaged support!

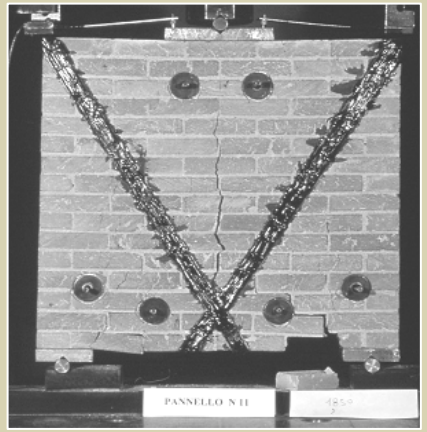
Analyses part.2

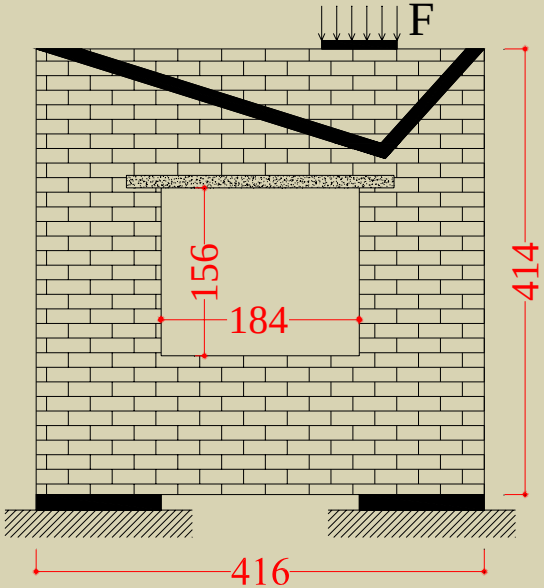


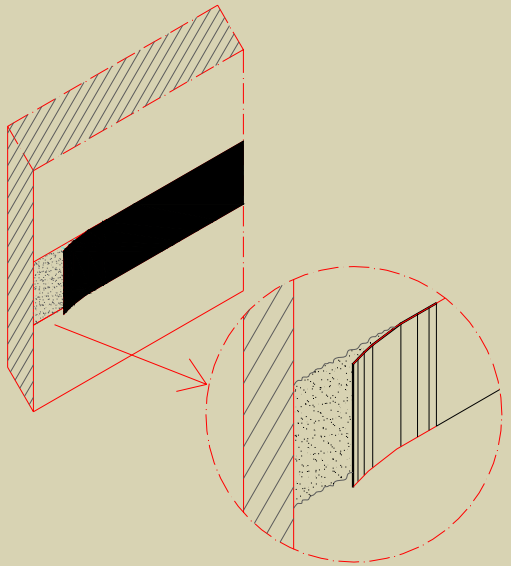
examined masonry panels: *Milani et al., 2006*



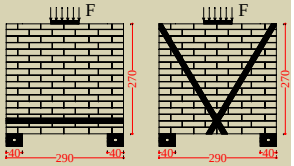


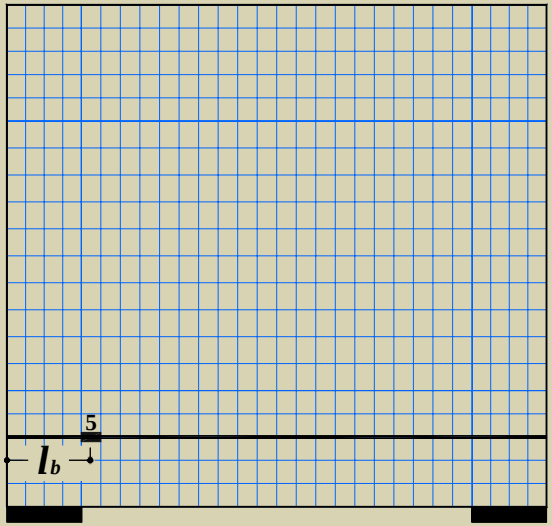




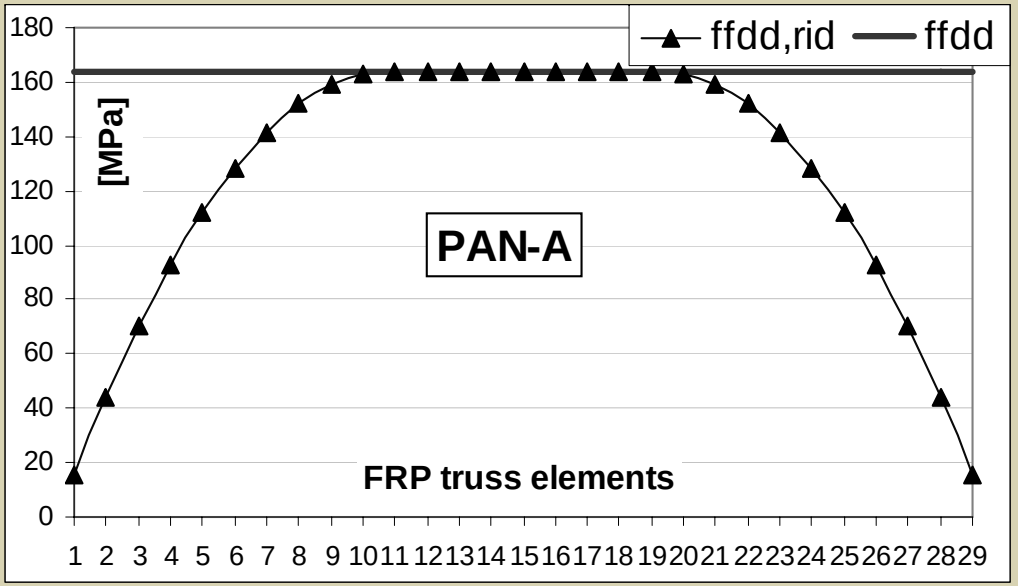


Analyses part.2





FE model

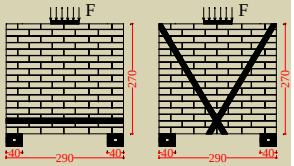


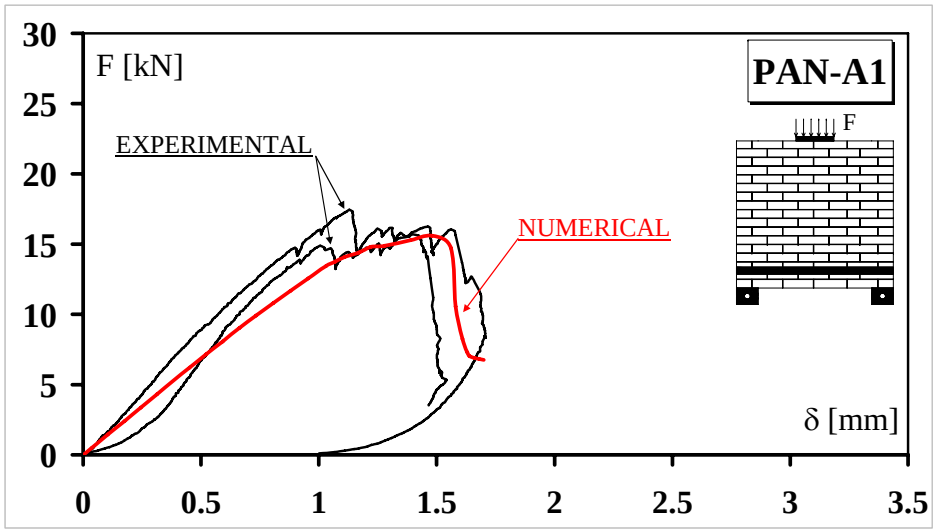
Values of FRP tensile strength (CNR-DT200)

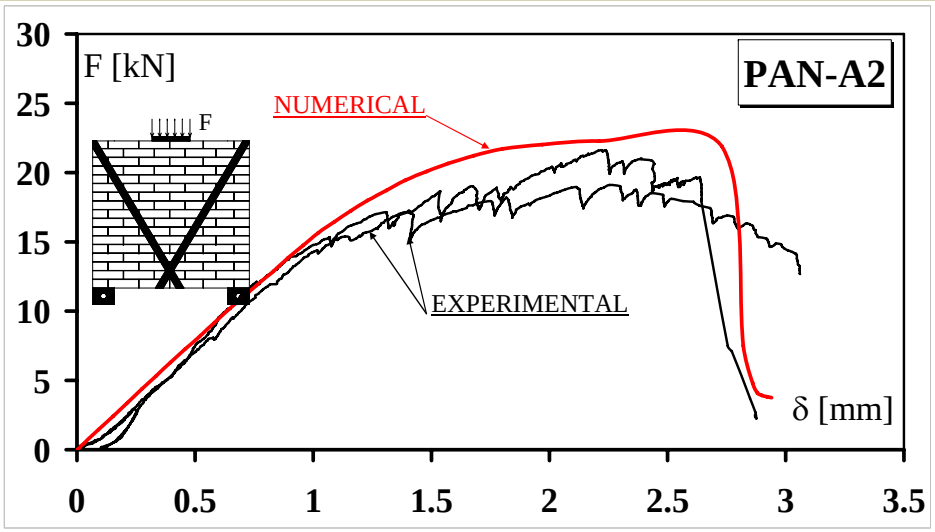
Proposed model for FRP-strengthening

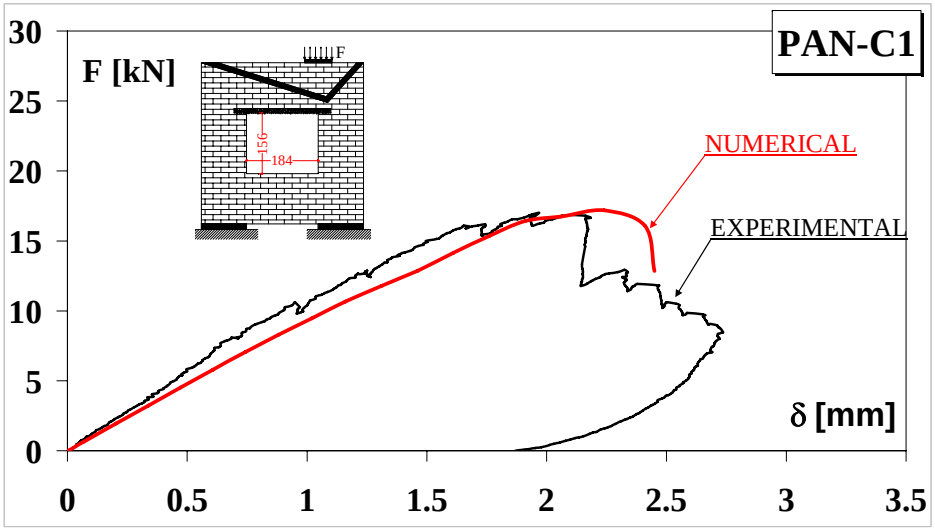
- strips are modeled through truss elements with no compressive strength and limited tensile strength
- trusses are directly joined to the nodes of the mesh of the panel
- brittle behaviour is assumed for the constitutive law of the trusses

Analyses part.2

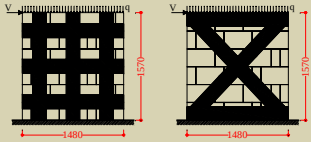




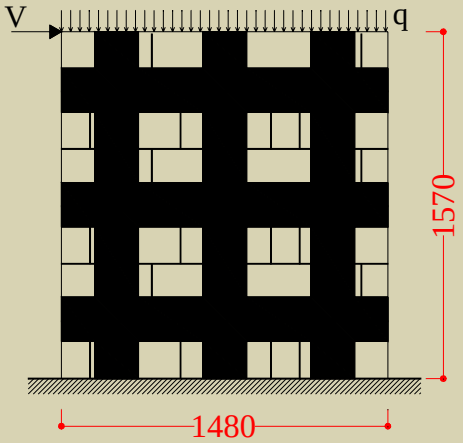


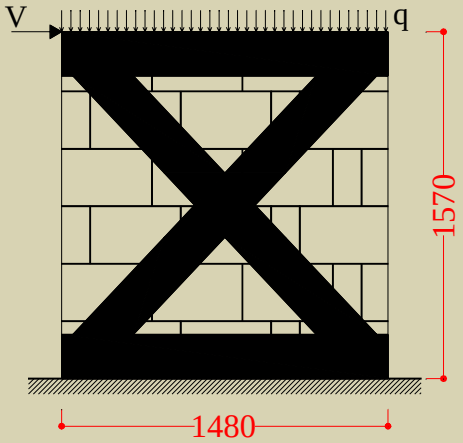


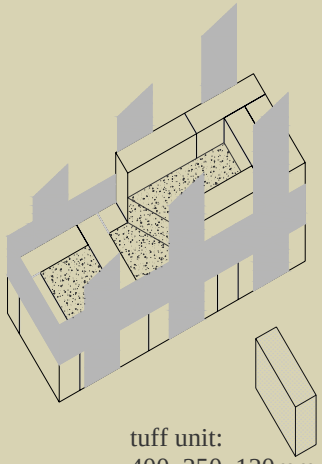
Analyses part.2

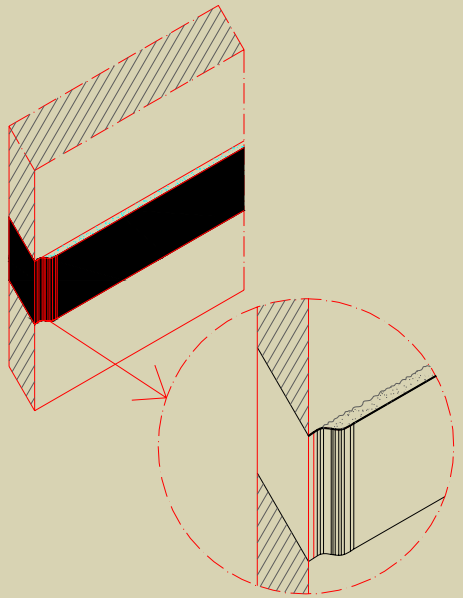


examined masonry panels: *Marcari et al., 2005*





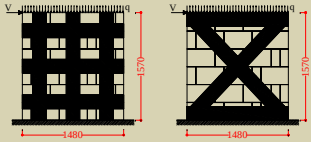


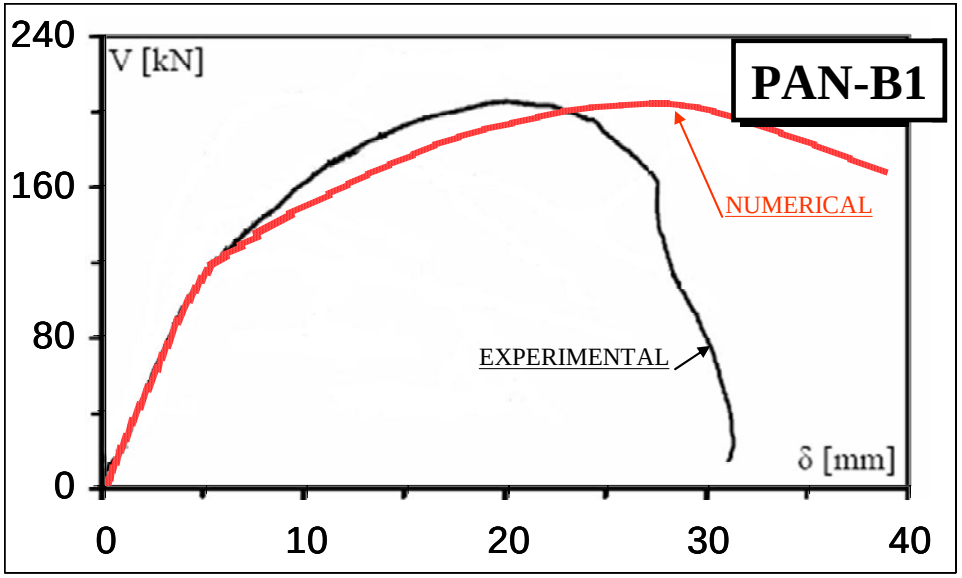


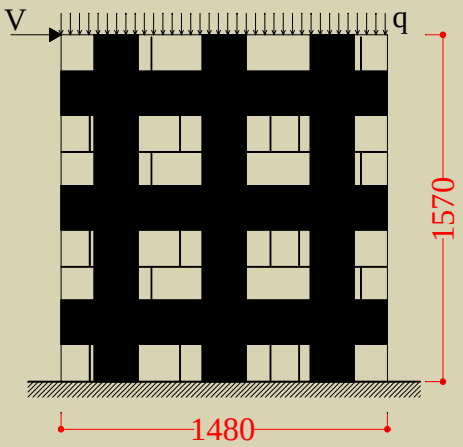
Proposed model for FRP-strengthening

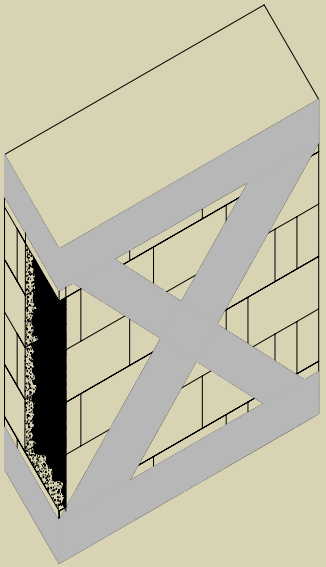
- Strips are still modelled through truss elements with no compressive strength and limited tensile strength
- Trusses are connected to the node of the mesh through interface elements
- Brittle behaviour is considered both for the truss and interface elements

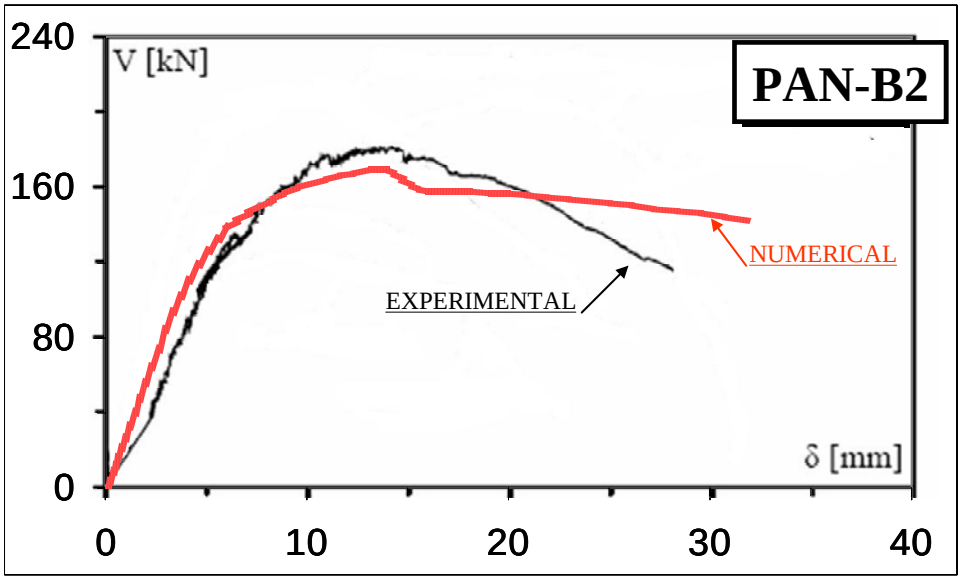
Analyses part.2

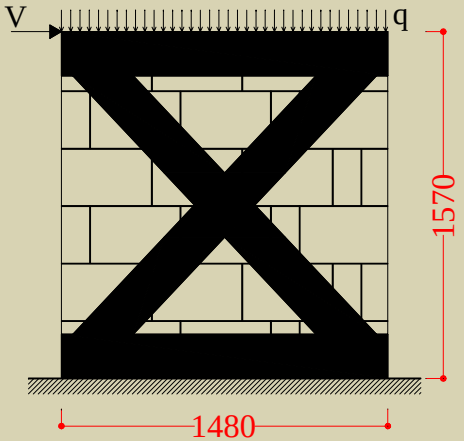


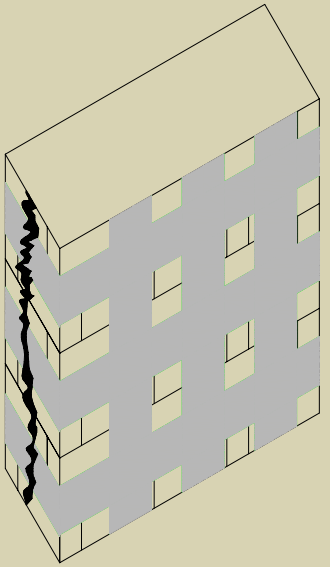












Conclusive Remarks

Different modelling strategies have been proposed and the response of some FRP-strengthened panels have been examined.

- In the modelling process particular regard has been addressed to the delamination phenomenon and different models have been proposed.
- The performed analyses have shown that the use of interface concept is not reliable if the interaction between masonry and interface damage propagation is not considered.
- The results obtained adopting the proposed models agree the experimental behaviour both for pre and post-peak range.

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Thanks for your attention