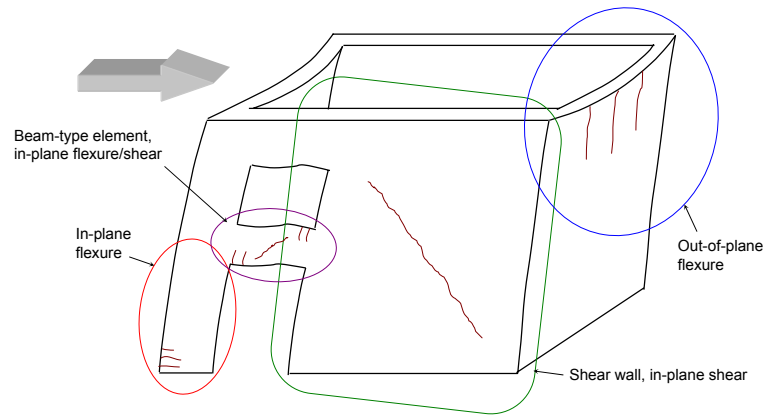


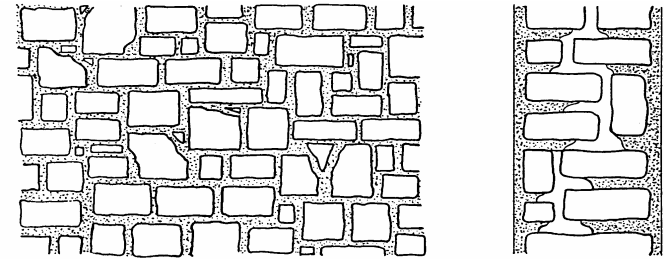
STRENGTHENING OF MASONRY



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IMPROVEMENT OF MORTAR JOINTS

Wall thickness < 0.40 m , light damage



Use of "compatible" mortar, perhaps with the addition of cement (stronger !)

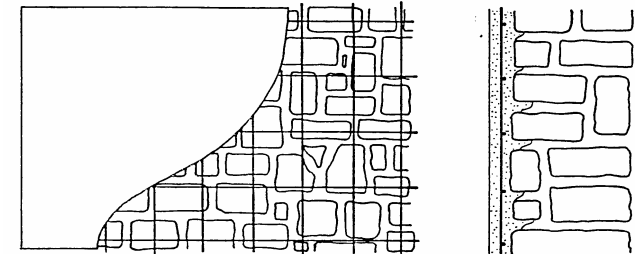
T. TRIANTAFILLOU



T. TRIANTAFILLOU

REINFORCED PLASTERING

Wall thickness < 0.40 m , light damage



Use of light **steel grid** or "**chicken wire**" or **polymer grid**

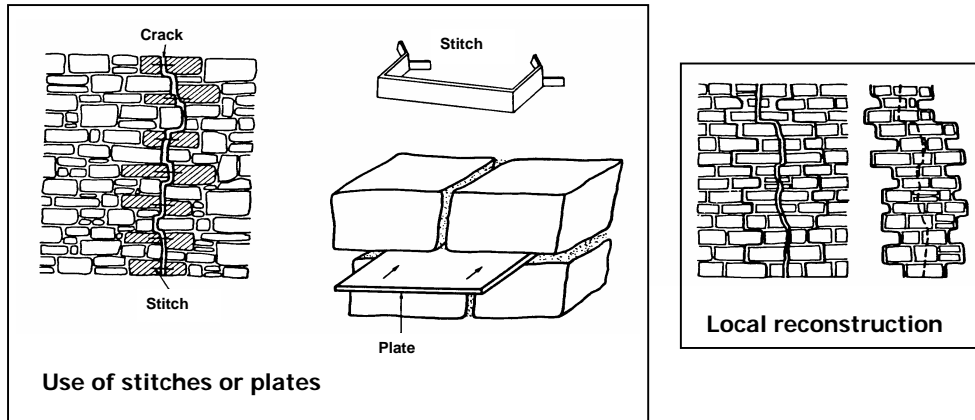
Attachment of reinforcement with nails

Cement-based strong mortar , 30-50 mm thick

Curing is very important !

T. TRIANTAFILLOU

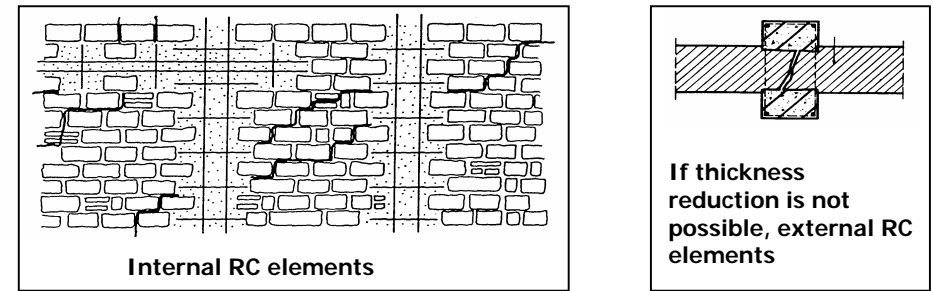
STITCHING OF WIDE CRACKS



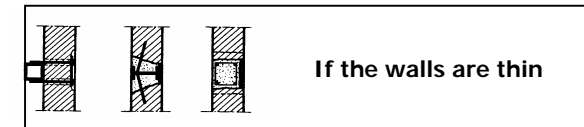
T. TRIANTAFILLOU

STITCHING OF WIDE CRACKS

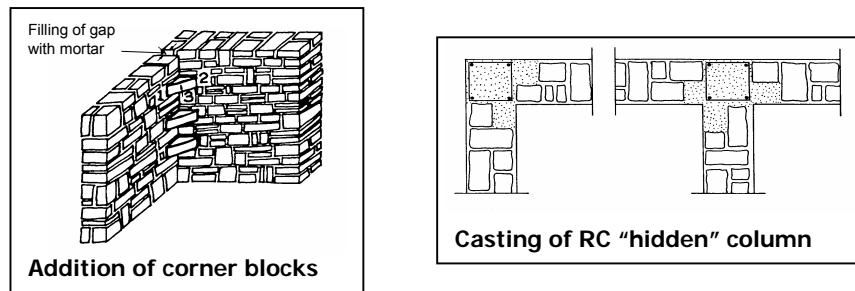
Intersection of inclined cracks with concrete "columns" or "beams"



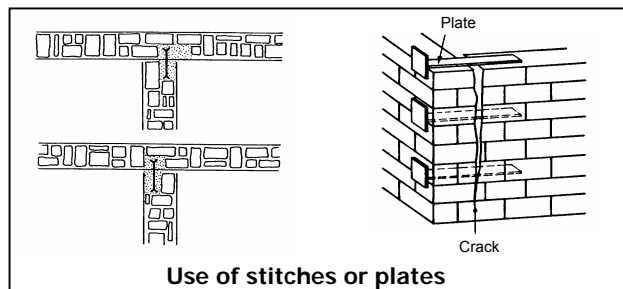
T. TRIANTAFILLOU



STITCHING OF CRACKS AT WALL INTERSECTIONS

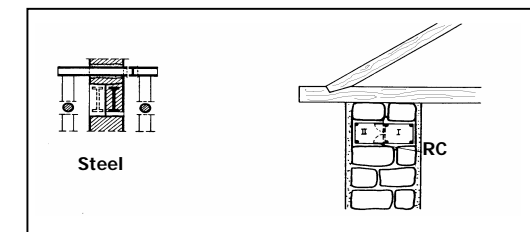


T. TRIANTAFILLOU

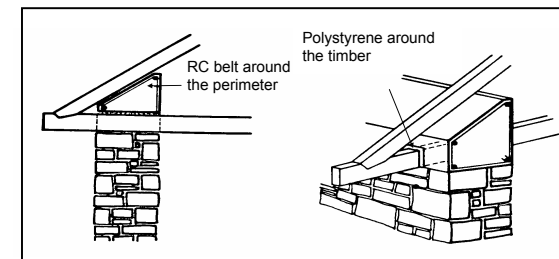


CONSTRUCTION OF RC "BELTS"

(make the building work like a "box")



T. TRIANTAFILLOU

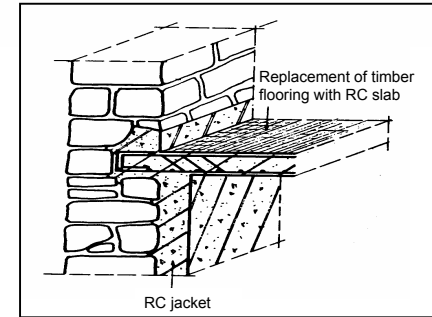
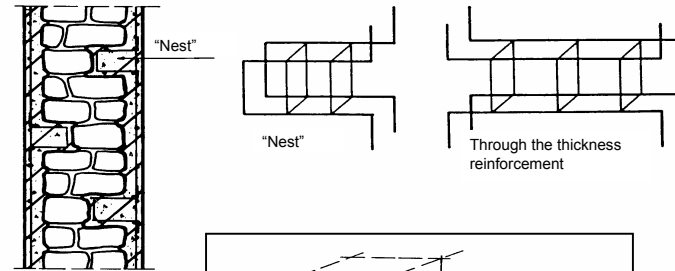




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REINFORCED CONCRETE JACKETS

- Shotcrete for jacket thickness ~ 50-70 mm
- In-situ cast concrete for jacket thickness > 100 mm



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RC jacket foundation

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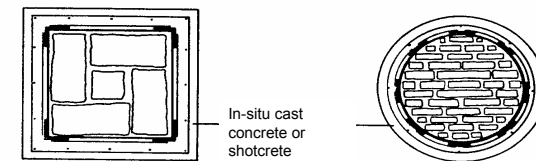
PROBLEMS

- INCREASE OF MASS
 - INCREASE OF STIFFNESS
 - INCREASE OF DIMENSIONS
 - LABOR INTENSIVE
 - OBSTRUCTION OF OCCUPANCY
 - NOT ALWAYS APPLICABLE
- } CHANGE OF DYNAMIC CHARACTERISTICS



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USE OF STEEL ELEMENTS (STEEL JACKETING)

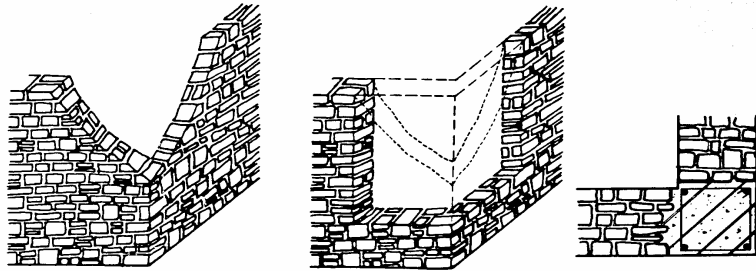


Problem with steel corrosion !

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LOCAL RECONSTRUCTION

Wall thickness < 0.40 m , light damage



Use of "compatible" mortar

Respect the principle of "distinction" for both mortars and bricks

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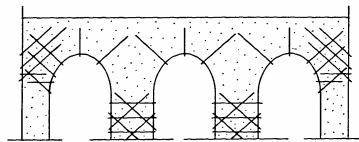
FILLING OF CRACKS WITH MORTAR INJECTION AND MASS HOMOGENIZATION



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Careful, not to apply too much hydrostatic pressure !

REINFORCED GROUTED PERFORATIONS



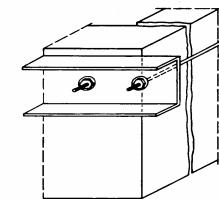
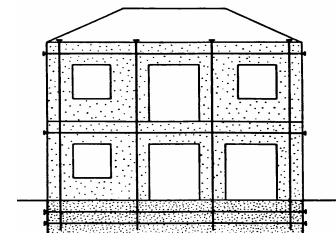
Irreversible intervention

Better to use stainless steel or FRP reinforcement

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STEEL TIES

- Horizontal or vertical
- Prestressed or non-prestressed



- Easy to apply
- Reversible method

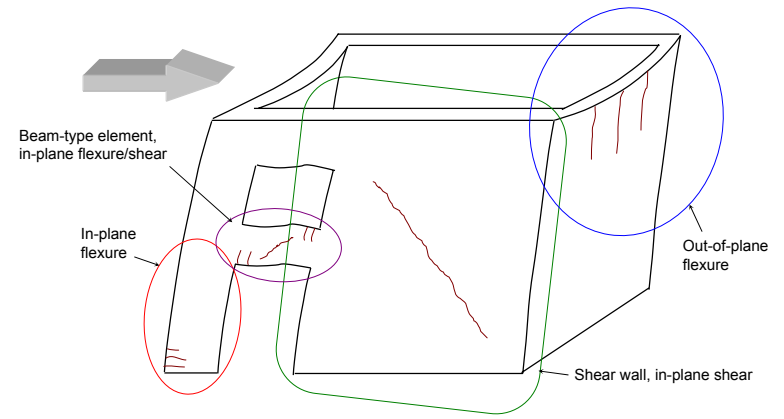
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MODIFICATION OF THE STRUCTURAL SYSTEM

- Close some openings
- Add new elements (e.g. walls)
- Make new construction joints
- Add retaining walls
- Add stiff floors

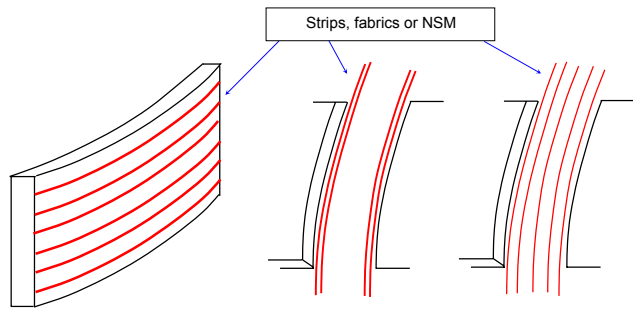
T. TRIANTAFILLOU

STRENGTHENING OF MASONRY



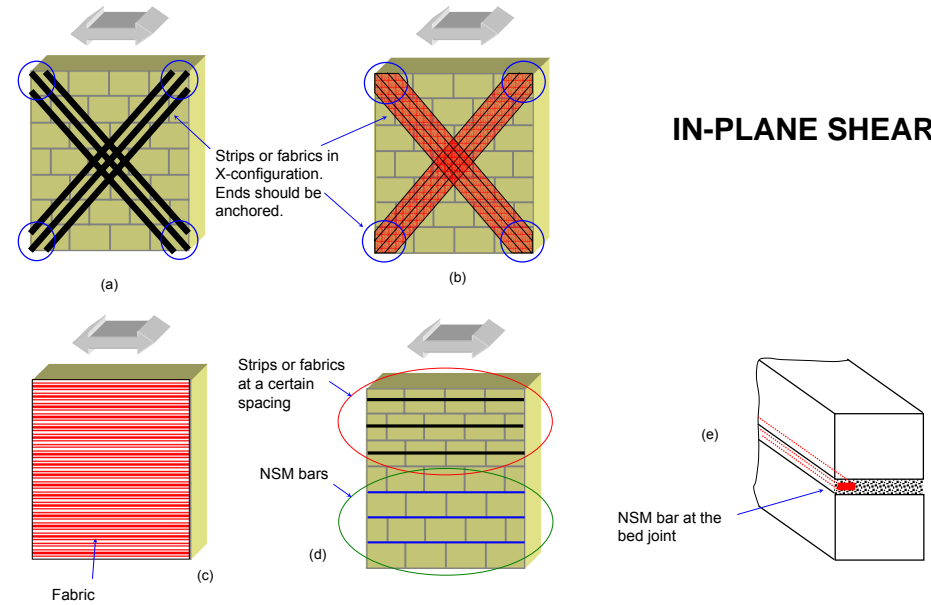
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FLEXURE (OUT-OF-PLANE, IN-PLANE)



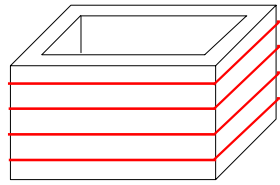
T. TRIANTAFILLOU

IN-PLANE SHEAR

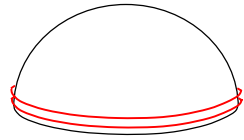


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CONFINEMENT



(a)

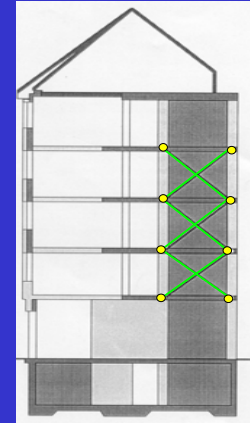


(b)



(v)

T. TRIANTAFILLOU



T. TRIANTAFILLOU



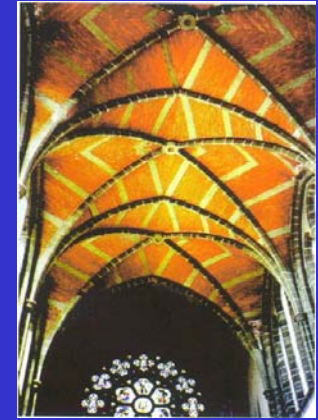
T. TRIANTAFILLOU



T. TRIANTAFILLOU

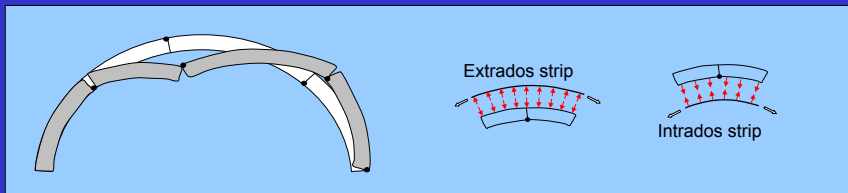
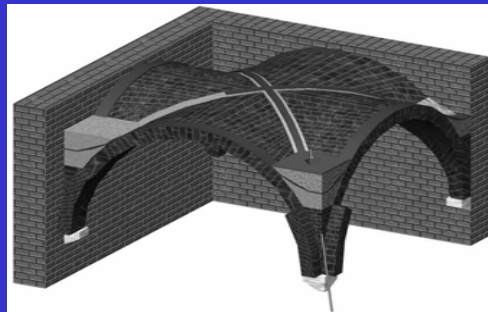


TRANSPARENT FABRICS



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VAULTS - ARCHES

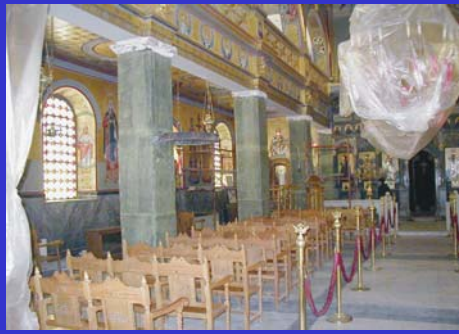


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CFRP tapes

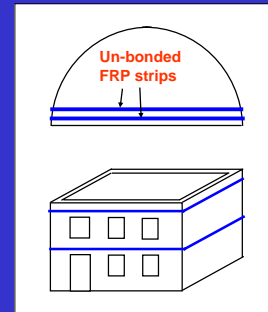


T. TRIANTAFILLOU



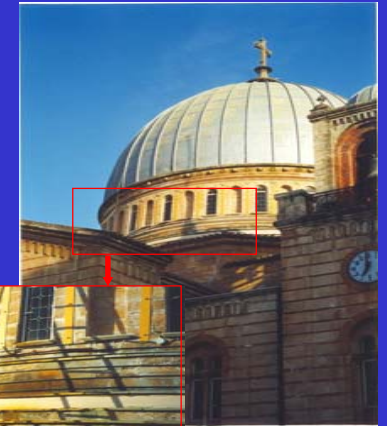
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REVERSIBLE INTERVENTION , UNBONDED TENDONS

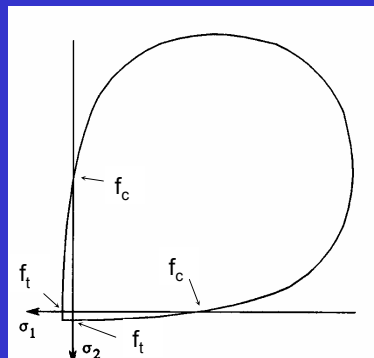
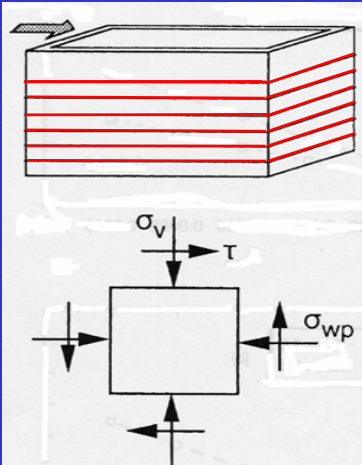


Church of Panaghia Faneromeni, Egion, Greece (1995)

FRP strip

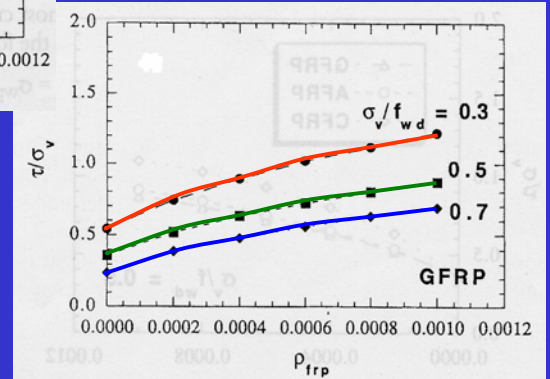
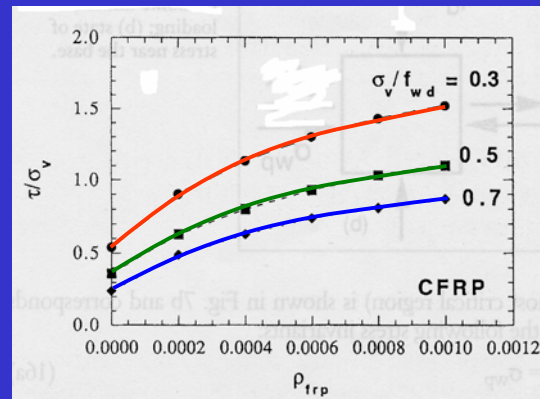


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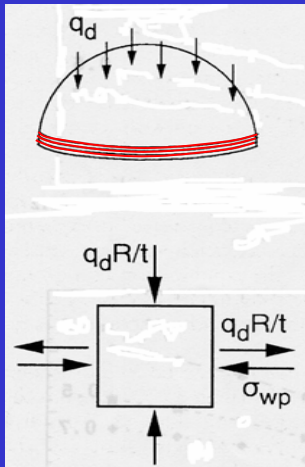


$$\sigma_{wp} = \frac{\alpha_s}{\gamma_p} \frac{f_{frp,k}}{\gamma_{frp}} \rho_{frp}$$

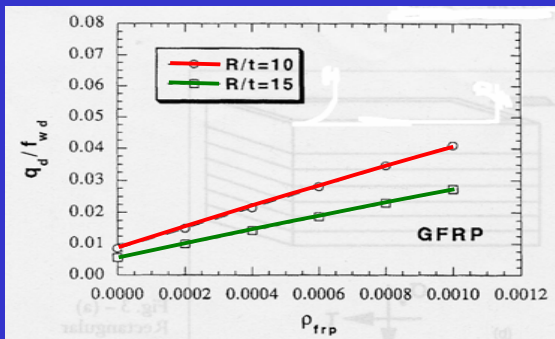
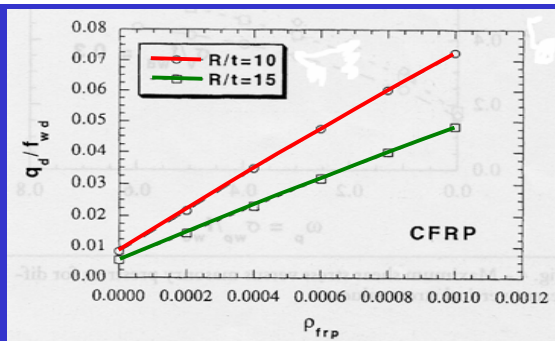
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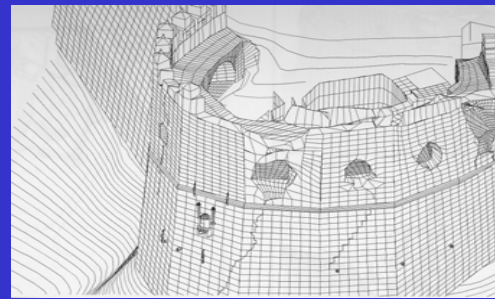
T. TRIANTAFILLOU



$$\sigma_{wp} = \frac{\alpha_s f_{frp,k}}{\gamma_p \gamma_{frp}} \rho_{frp}$$

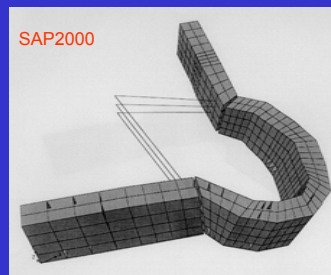
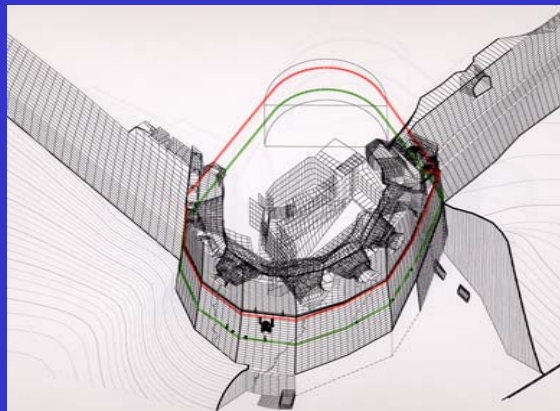


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PATRAS FORTRESS, GREECE

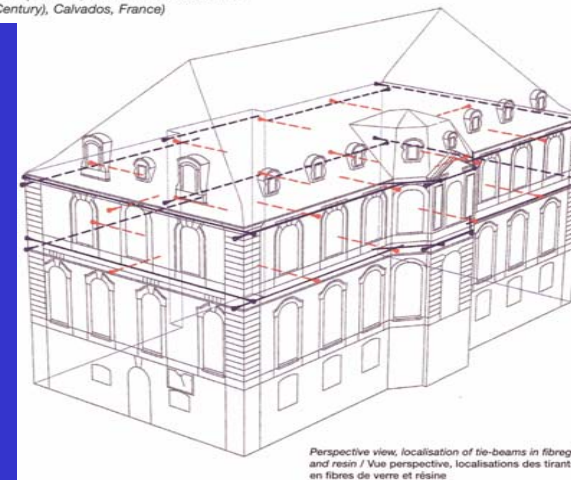


Design completed in 1997
2 CFRP tapes, 100 mm wide

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This is a solution to reinforce masonry, by means of fibreglass rods sealed inside a resin mortar used in frontages or interior supporting walls. The process guarantees a perfect contact between tie-beams and masonry; the creation of two layers of tie-beams (upstairs floors and cornices) maximises the effectiveness of the system; little inside work is required and costs are reduced.
(Renofors process, Château de Vendreuve (18th Century), Calvados, France)

GFRP RODS & RESIN MORTAR



Perspective view, localisation of tie-beams in fibreglass and resin / Vue perspective, localisations des tirants en fibres de verre et résine



Château de Vendreuve, France



Extra-long laser-guided drilling work for the insertion of composite tie-beams / Exécution des forages de grandes longueurs guidés par visée laser pour l'insertion des tirants en composite

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Zurich National Museum

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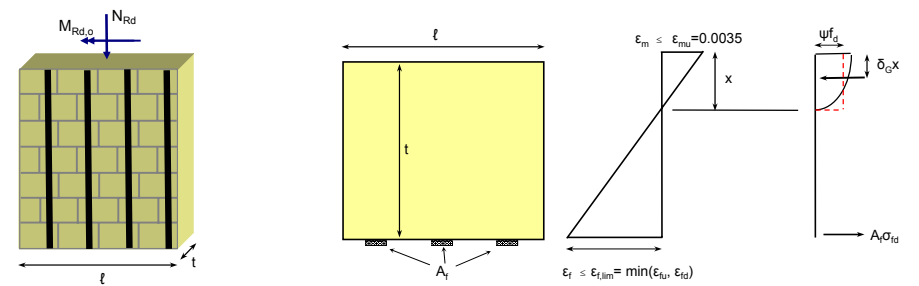
El Aini Domes

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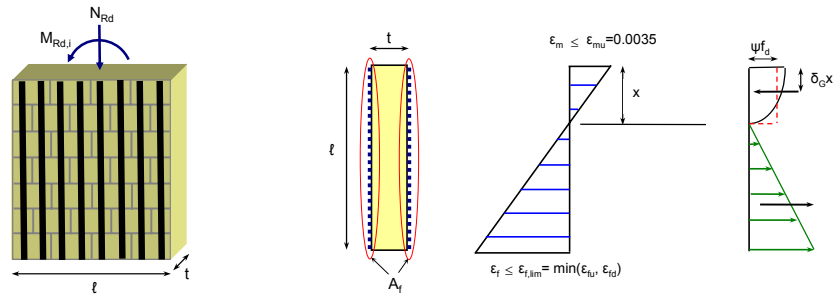
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OUT-OF-PLANE FLEXURE



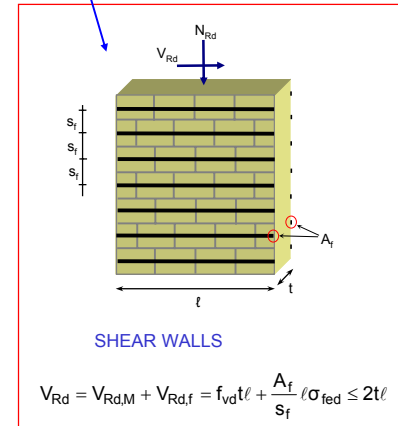
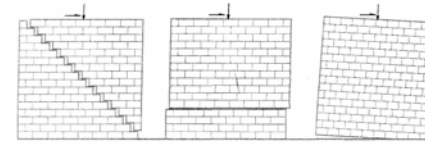
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IN-PLANE FLEXURE

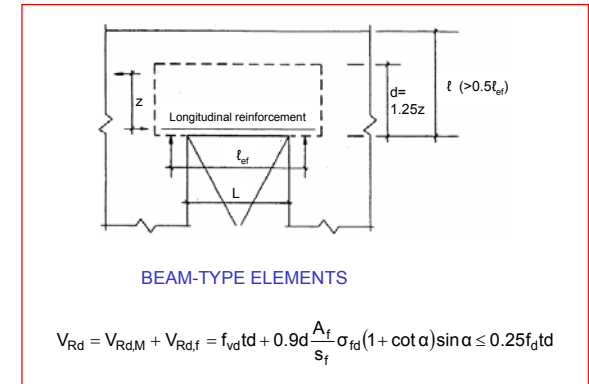


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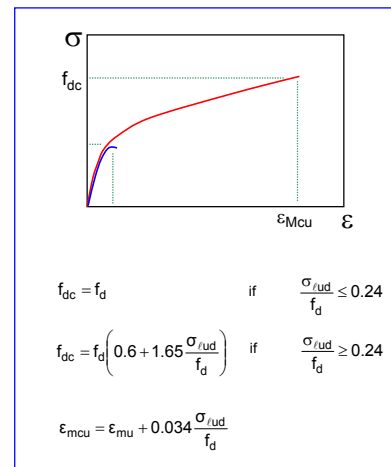
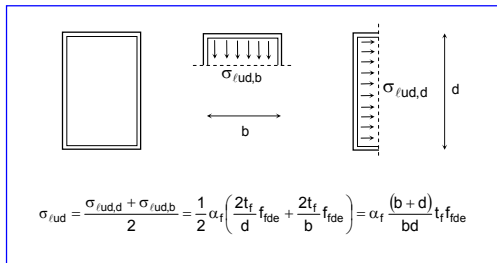
IN-PLANE SHEAR



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CONFINEMENT



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