Lifelong Learning Programme

NAEP
Národní agentura pro evropské vzdělávací programy

Concrete and timber structures

Case studies

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Assessment of existing structures
Project number: CZ/08/LLP-LdV/TOI/134005

Structural reassessment

Inadequate reliability;

Structural modifications;

Changes in category of use and design working life;

Damage or deterioration (environmental, chemical or biological, attack);

Damages due to accidental loads (earthquake, impact or explosion), settlements or other unintentional events

Preliminary investigations

Acquisition of original information (design and structural conception of the building, reference structural codes, if any);

History of structural modifications (addition or demolition, and/or deep maintenance interventions);

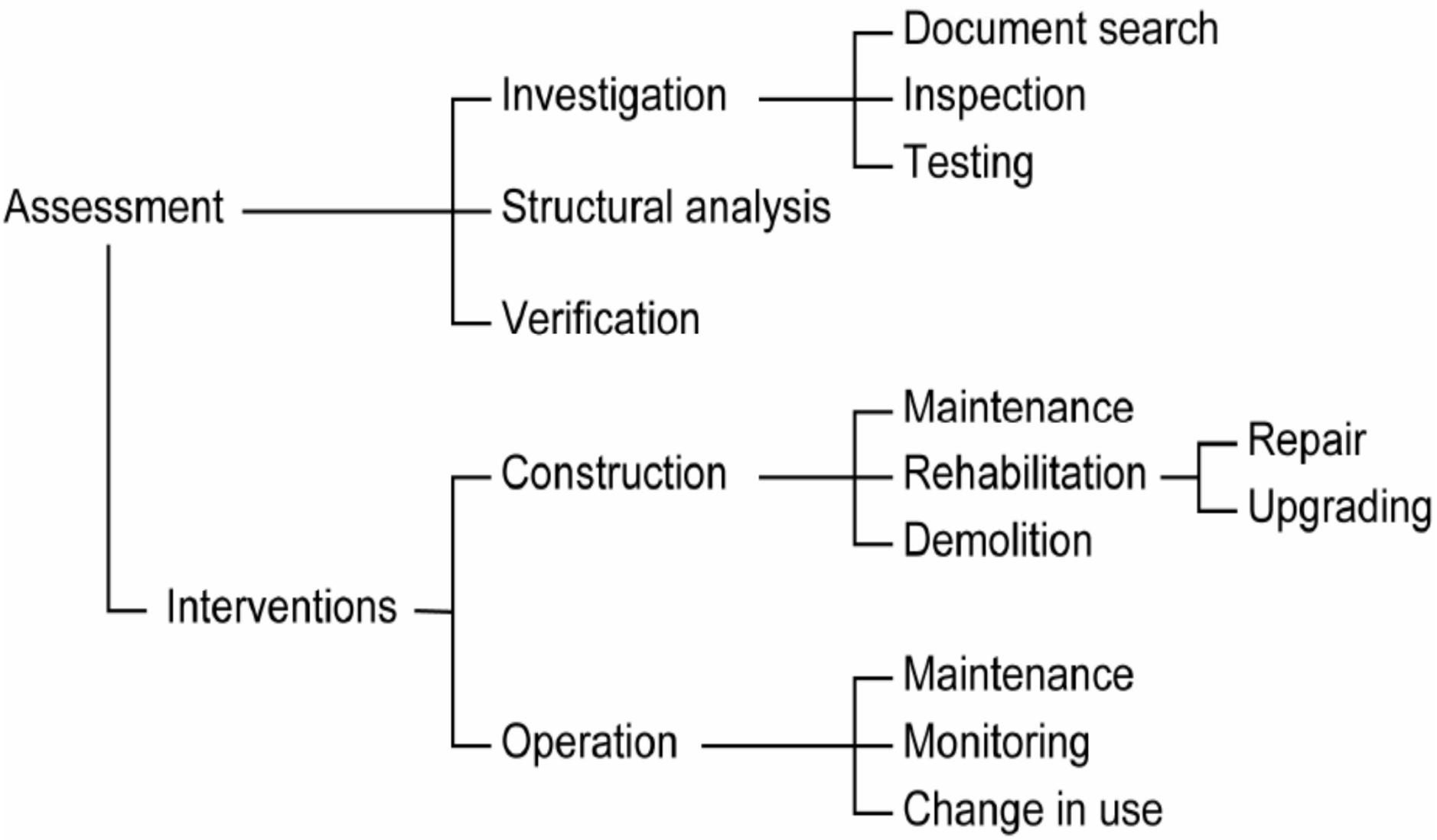
actual damage and/or crack patterns;

actual material properties;

required performance level.

ISO 13822

Hierarchy of terms



CASE STUDY N. 1

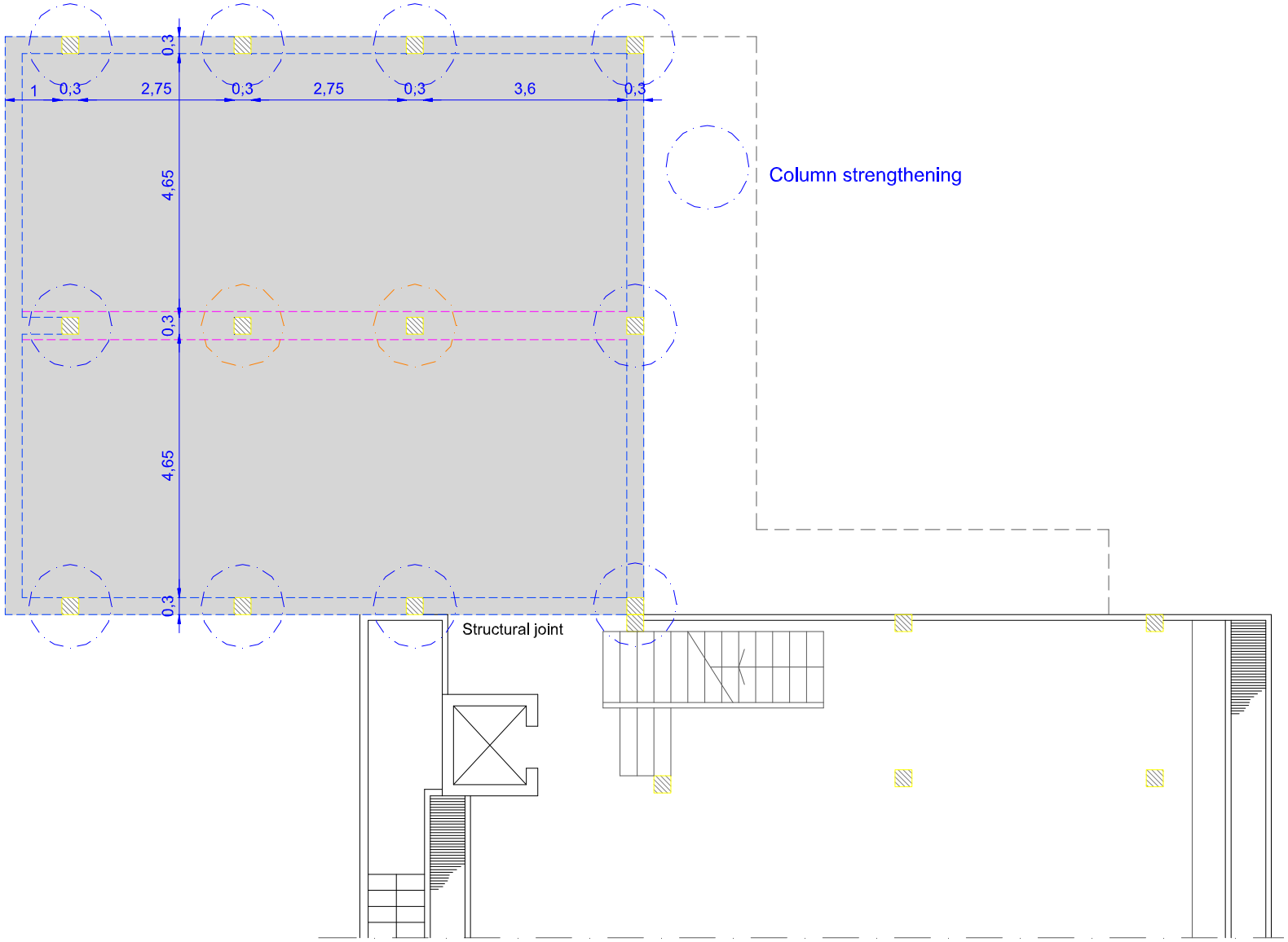
STRENGTHENING OF R.C. COLUMNS

General view of the building

Damaged columns

Corroded rebars

Cracking of concrete cover



Building plan with indication of columns to be strengthened

Rehabilitation of damaged r.c. columns can be done using FRP or steel as reinforcing material.

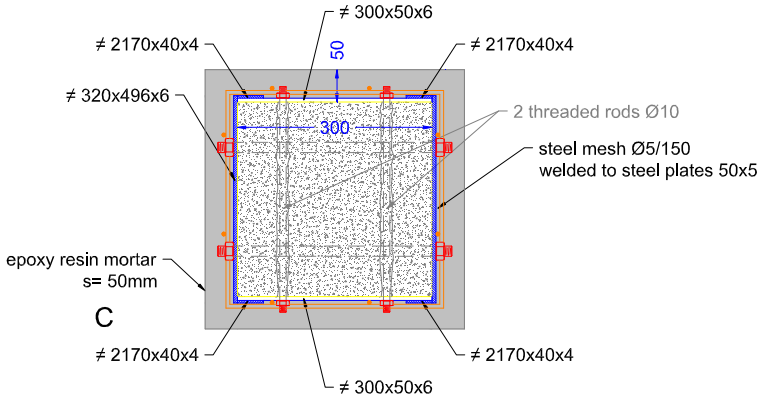
In the choice of repair technique we must consider:

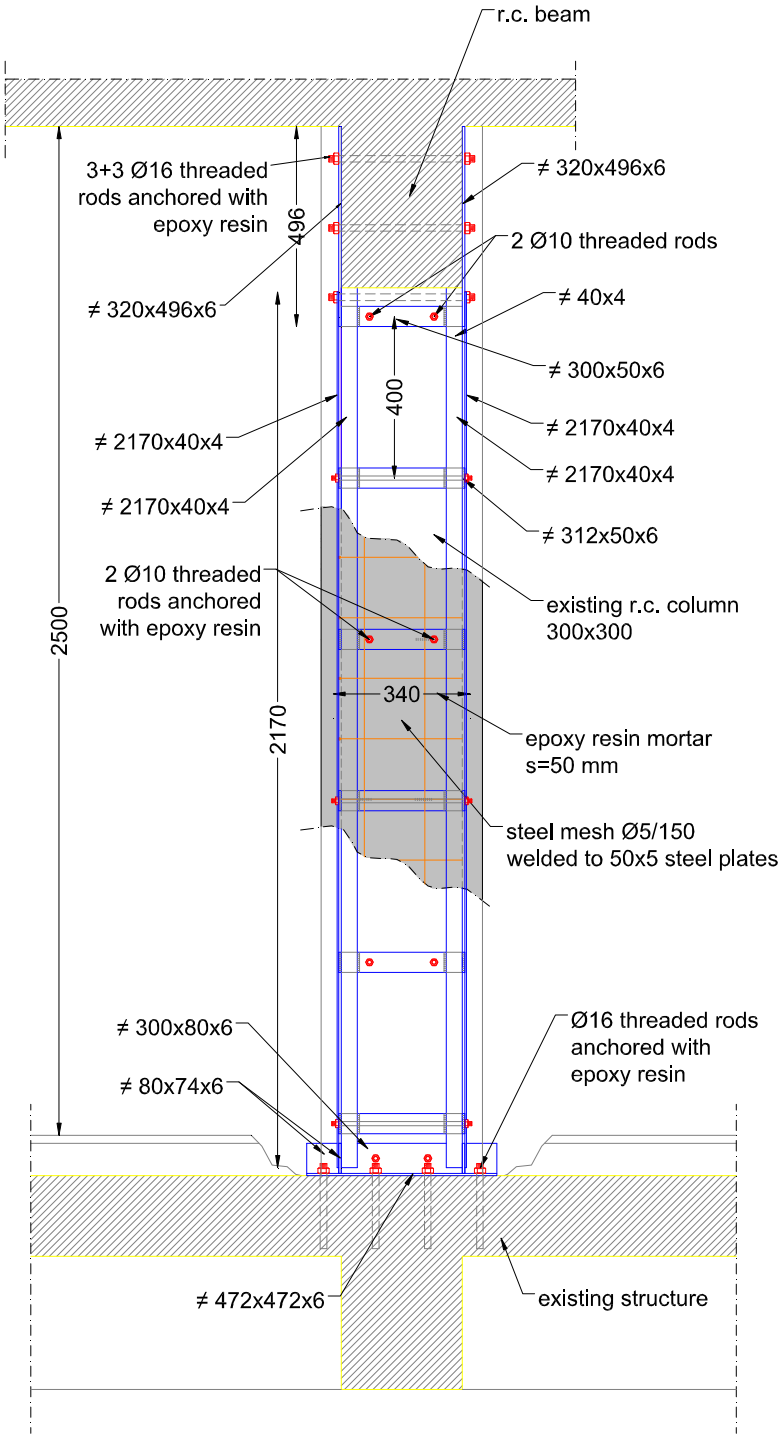
good confinement (it is assured by both techniques);

efficiency of the reinforcement in transferring the stresses from the original column core to the new parts.

Steel is better as it could be mechanically bonded to the existing concrete column using shear connectors, while

FRP reinforcement relies on the surface grip between the adhesive agent and the concrete, which can fail due to peeling or delamination.





Strengthening of the column

concrete cover removal

rust removal and passivation of the reinforcing bars

execution of holes in concrete necessary to allows the passage of connecting devices (threaded rods)

positioning of transverse steel plates and of connecting devices using epoxy resin to anchor the rods and epoxy mortar to regularize the surface

positioning of the longitudinal reinforcement and of the end joints, devoted to connect the reinforcement to the foundation and to beams

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welding of steel mesh to the steel

execution of the additional epoxy mortar layer (s=50 mm)

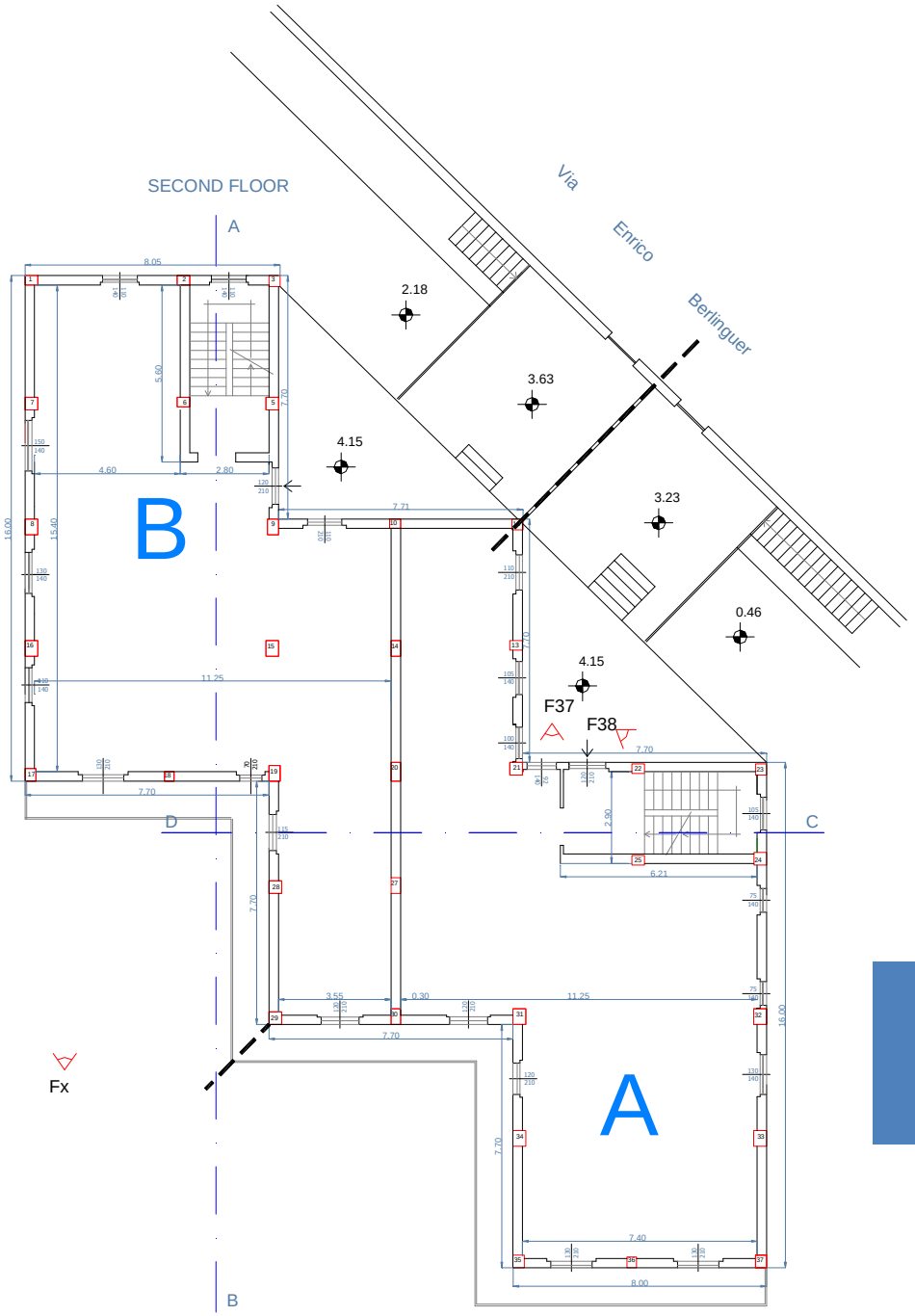
execution of the additional epoxy mortar layer (s=50 mm)

execution of the surface finish

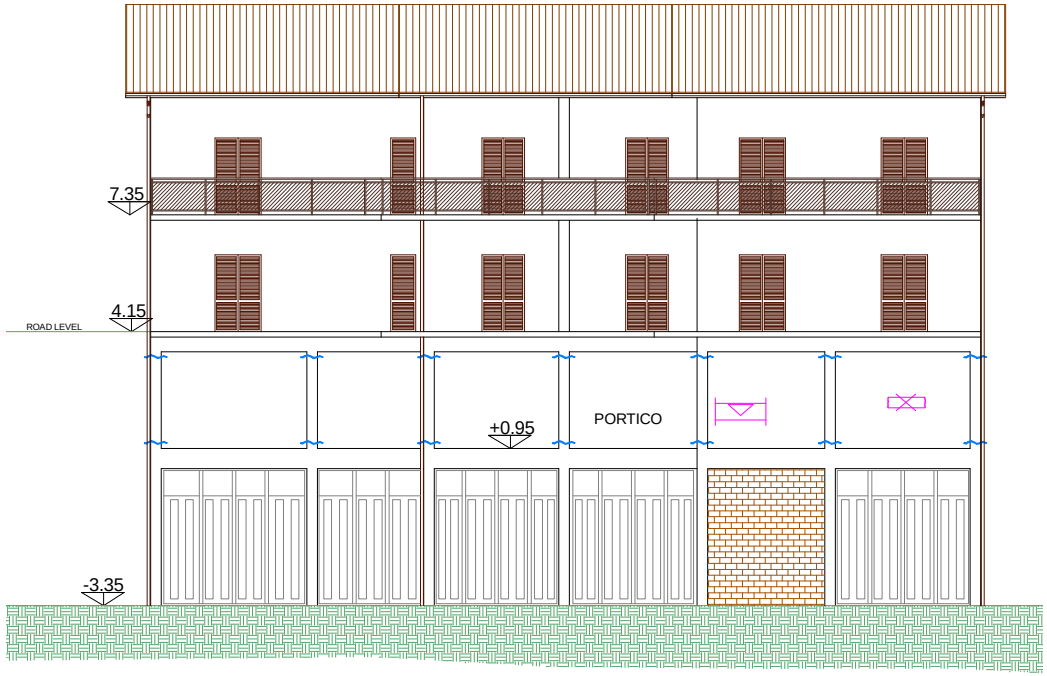
CASE STUDY N. 2

REPAIR AND STRENGTHENING OF AN EARTHQUAKE DAMAGED BUILDING

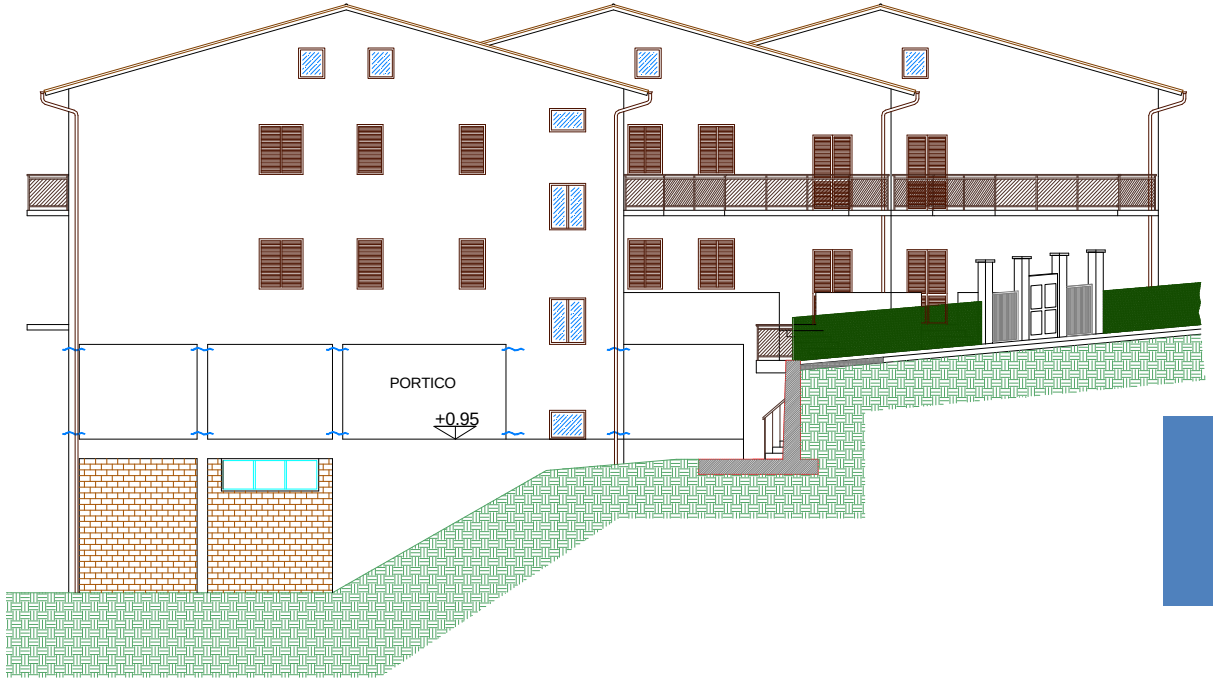
Views of the existing building



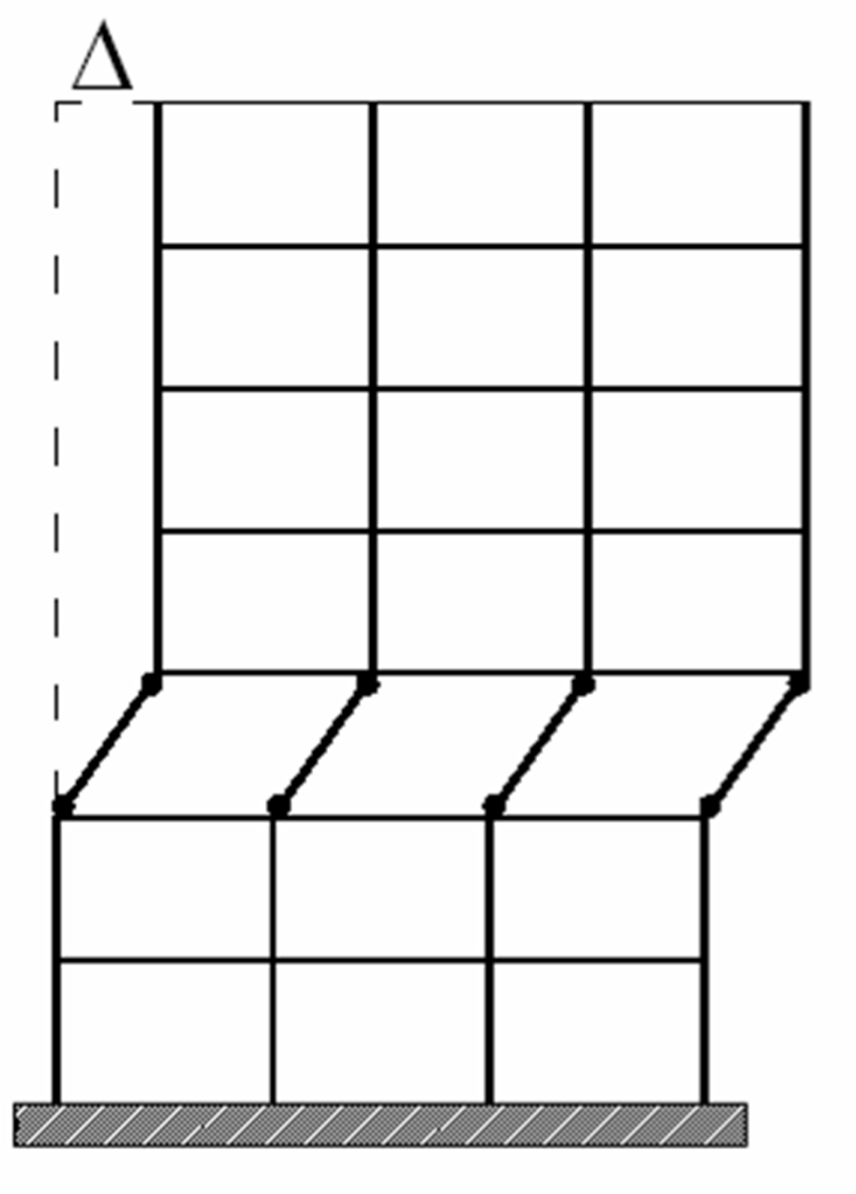
Plan of the 2nd floor



Front view



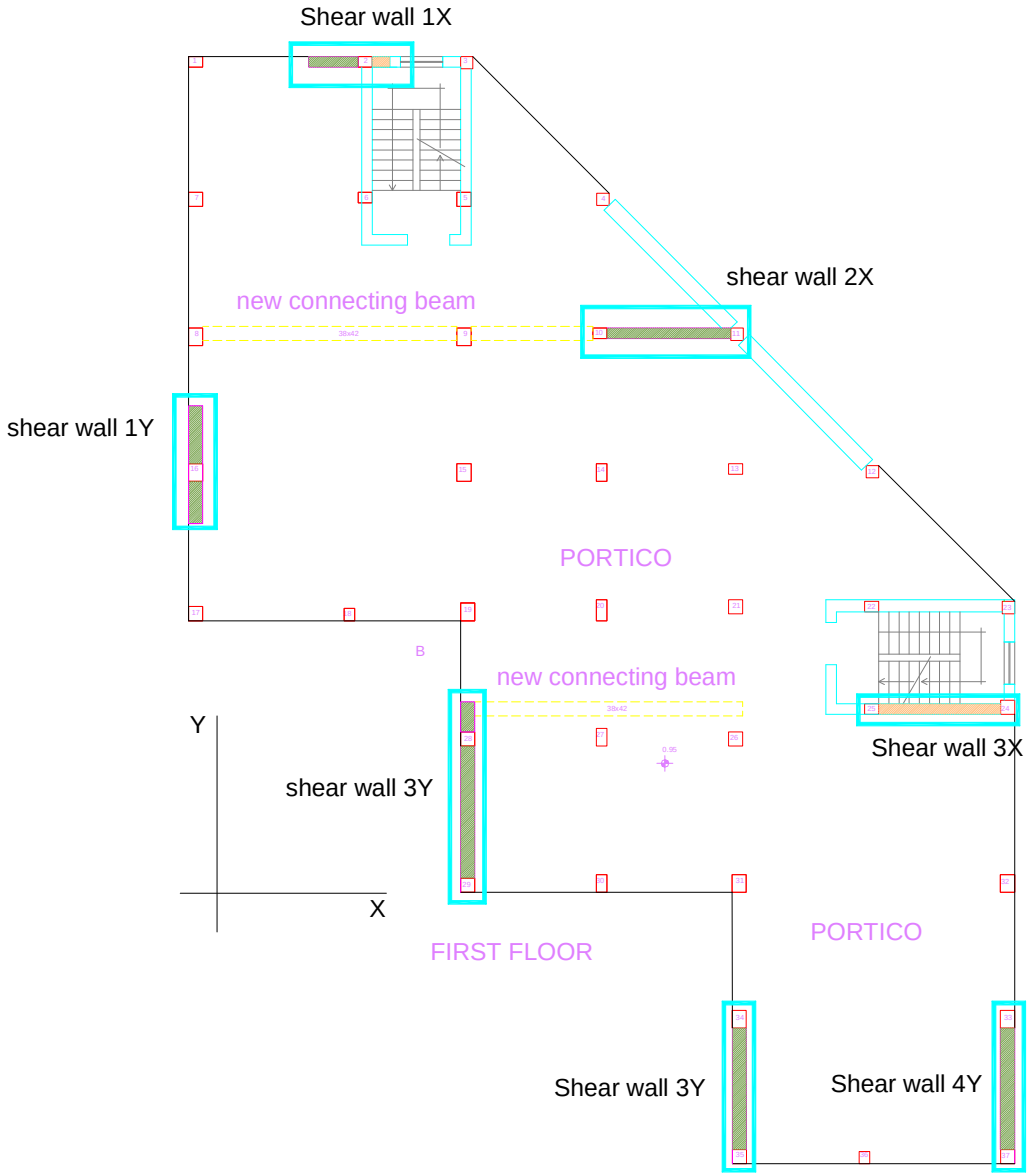
Side view



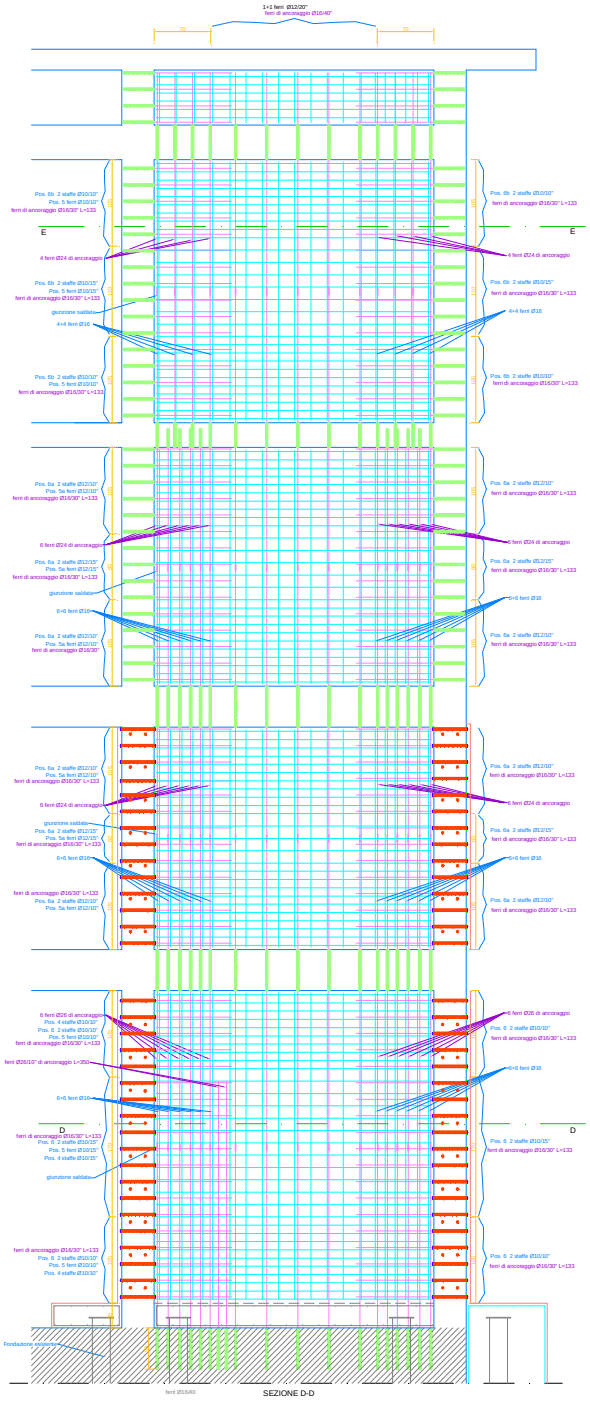
Shear type collapse mechanism

Damages induced by the earthquake

Damages at the ends of the columns



Shear walls system



Vertical section of a shear wall

Execution of the shear walls

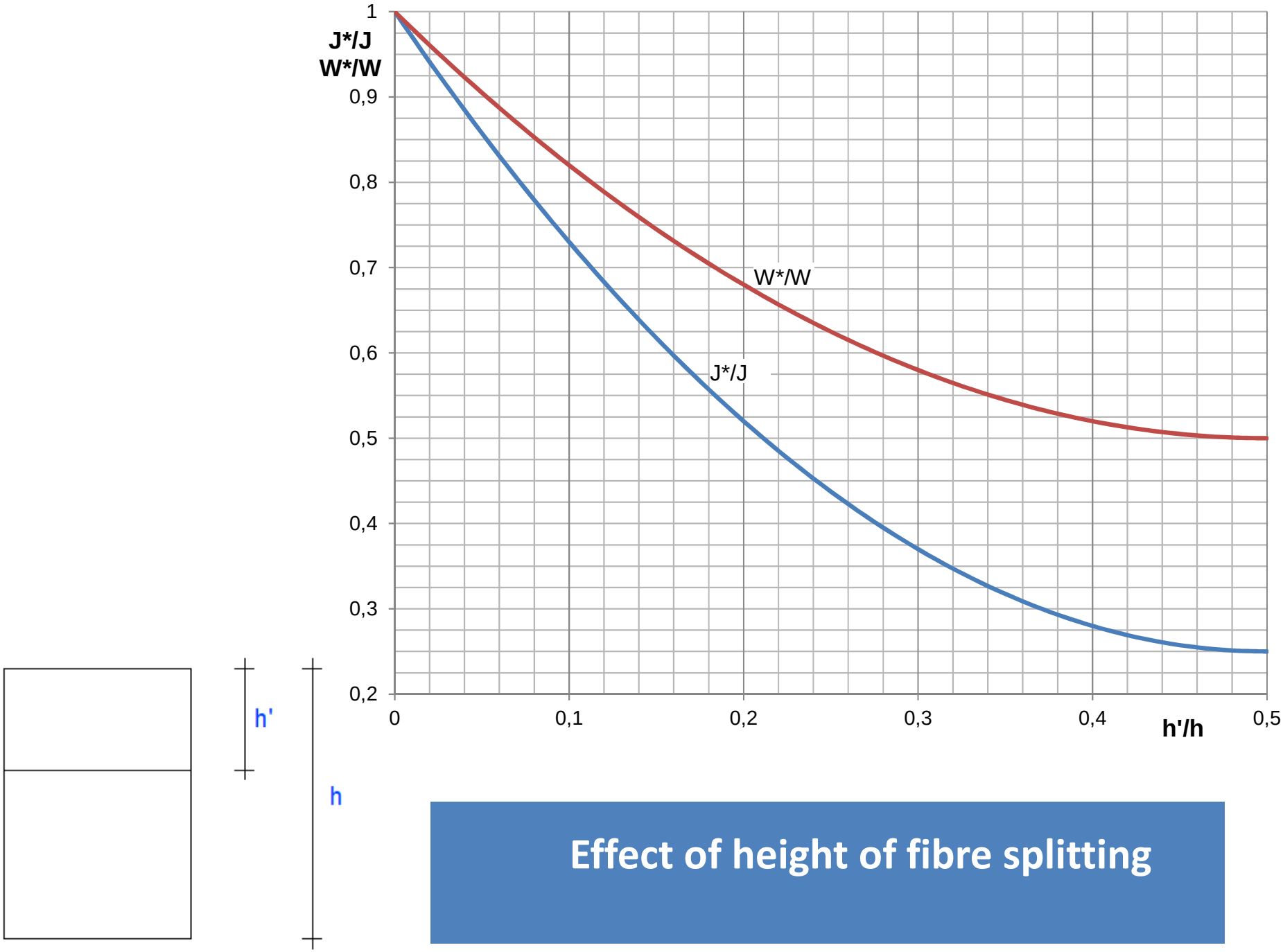
Execution of the beam and column repairs

Execution of the connecting beams

Execution of the connecting beams

PRELIMINARY REMARKS ON

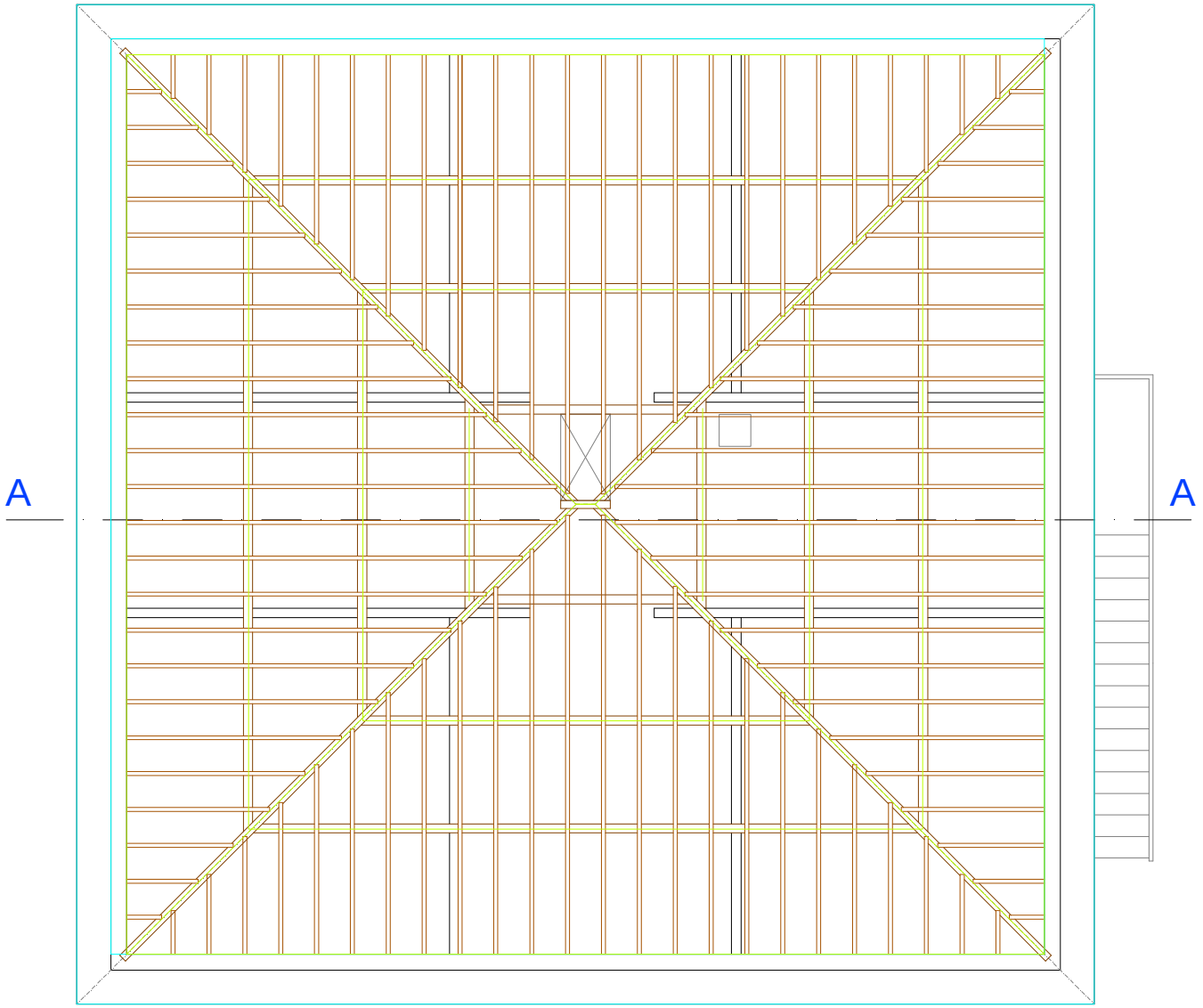
CRACKING OFTIMBER BEAMS



Effect of height of fibre splitting

CASE STUDY N. 3

STRENGTHENING OF A TIMBER ROOF


A
A

Cracked beam

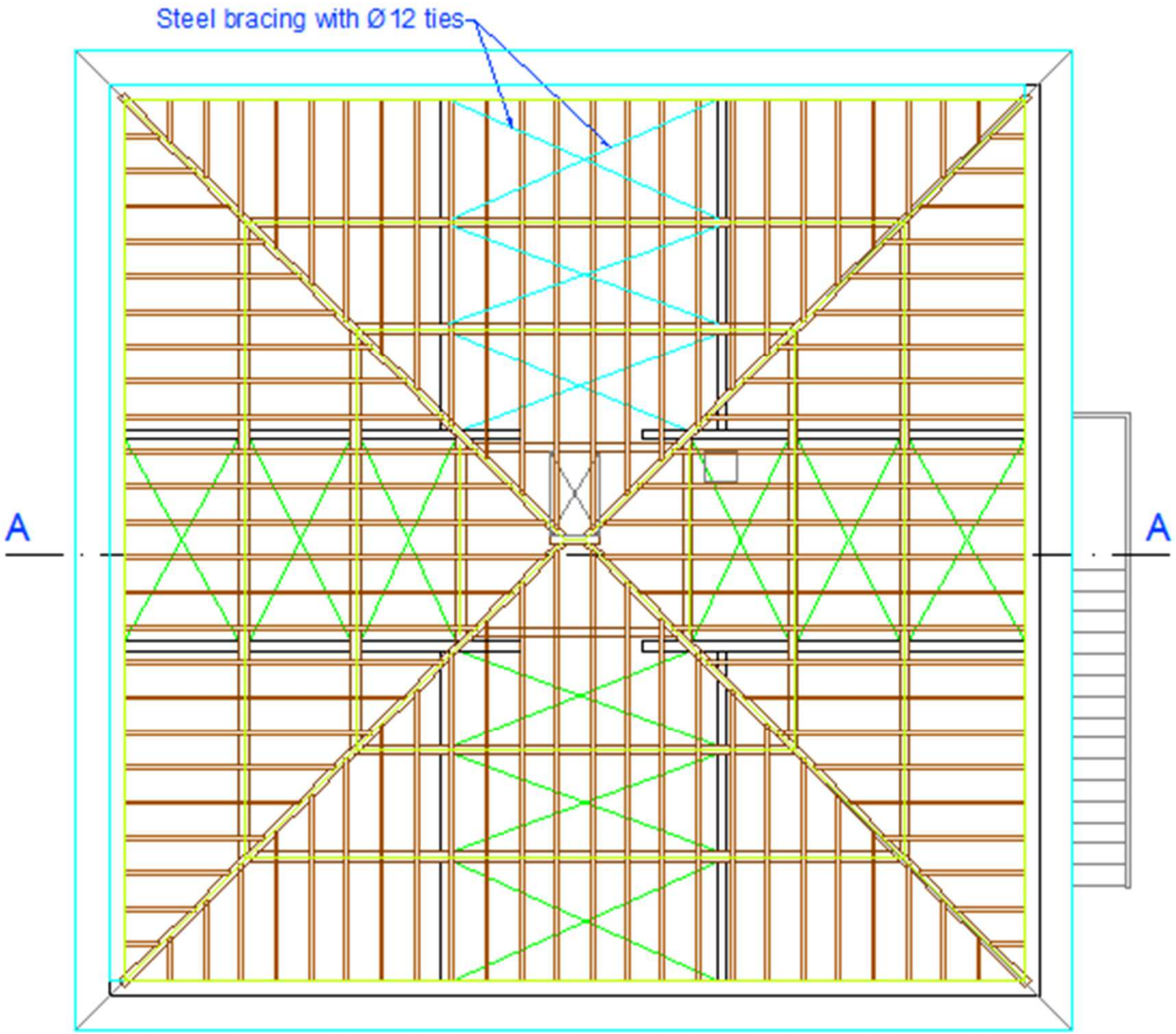
Connection between ridge beam and hip beams

Joint detail

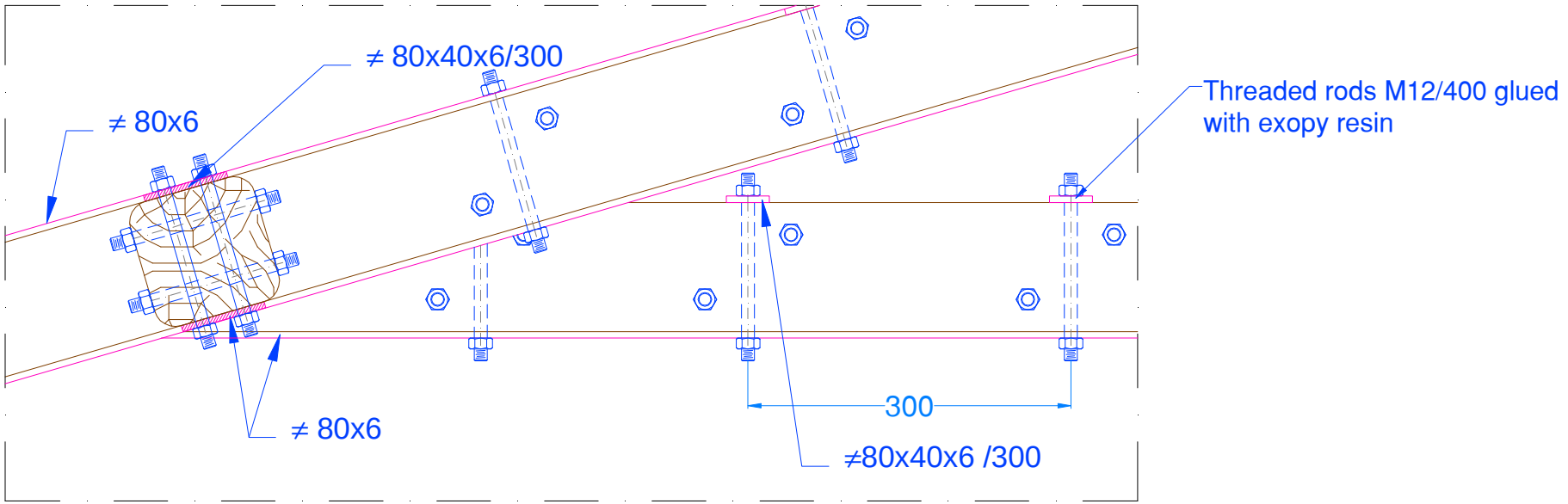
Joint detail

Crack pattern in a beam

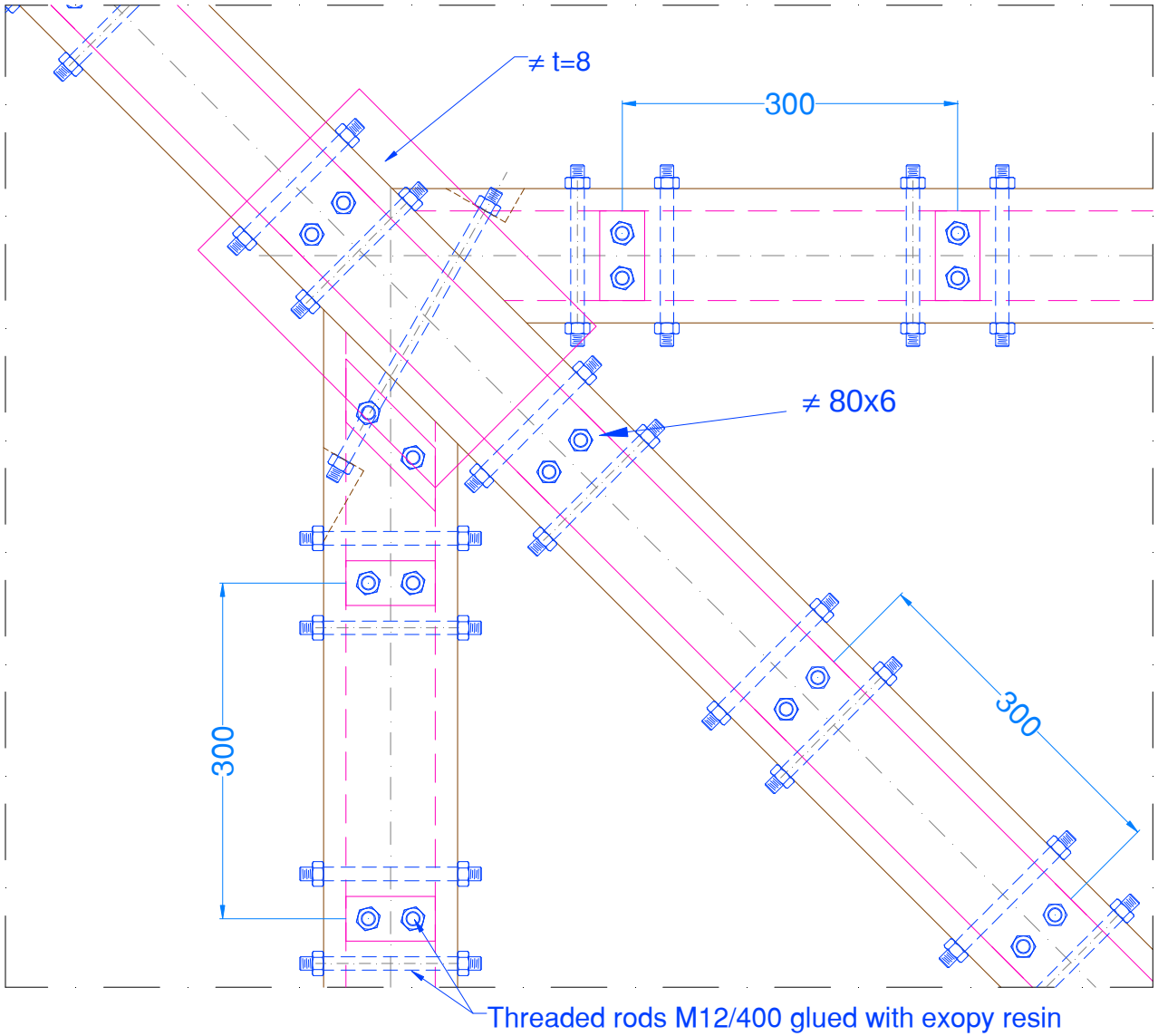
Cracked beams



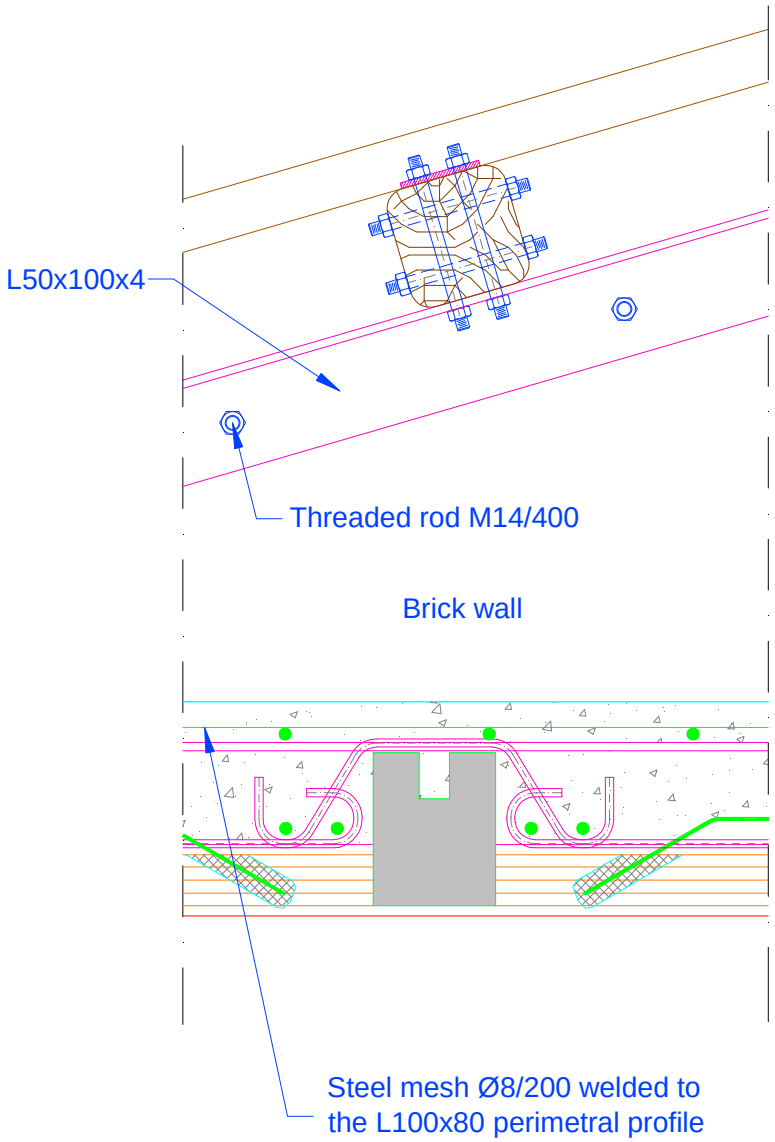
Roof plan

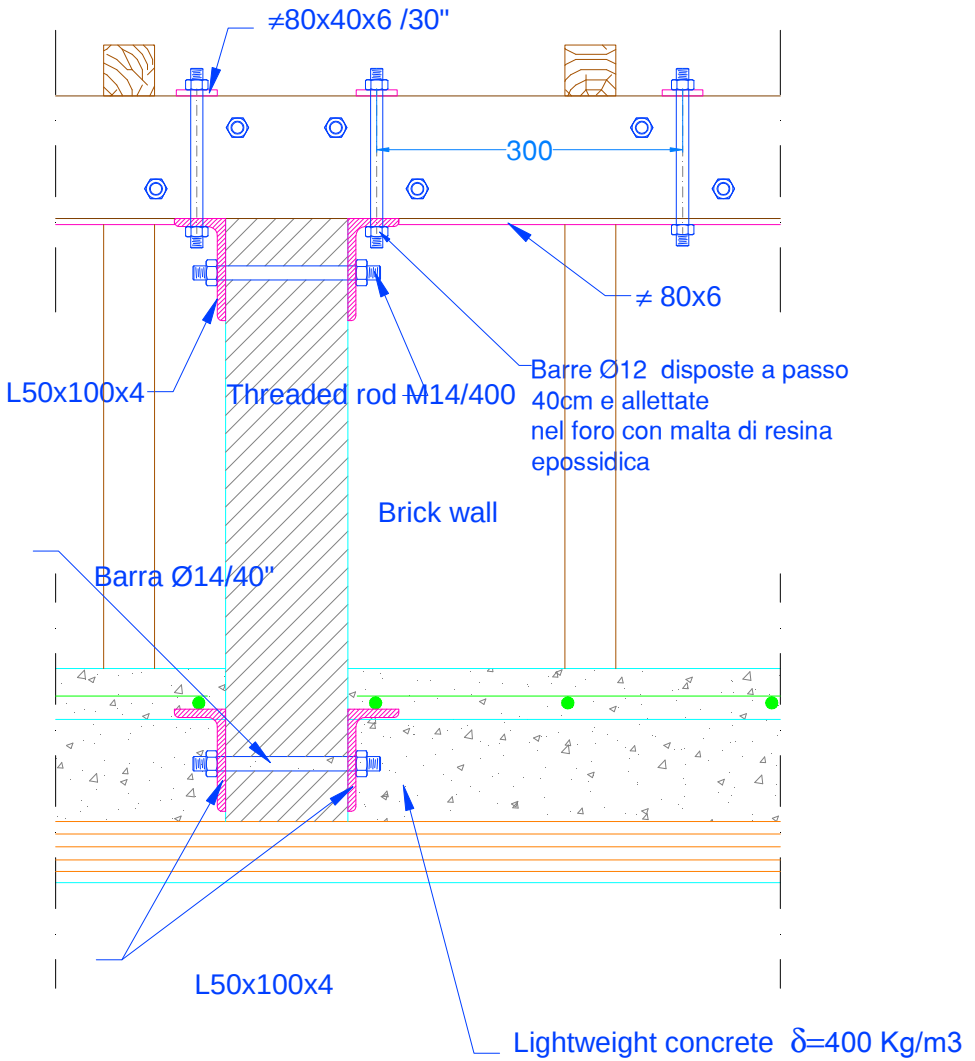


Strengthening of the beams

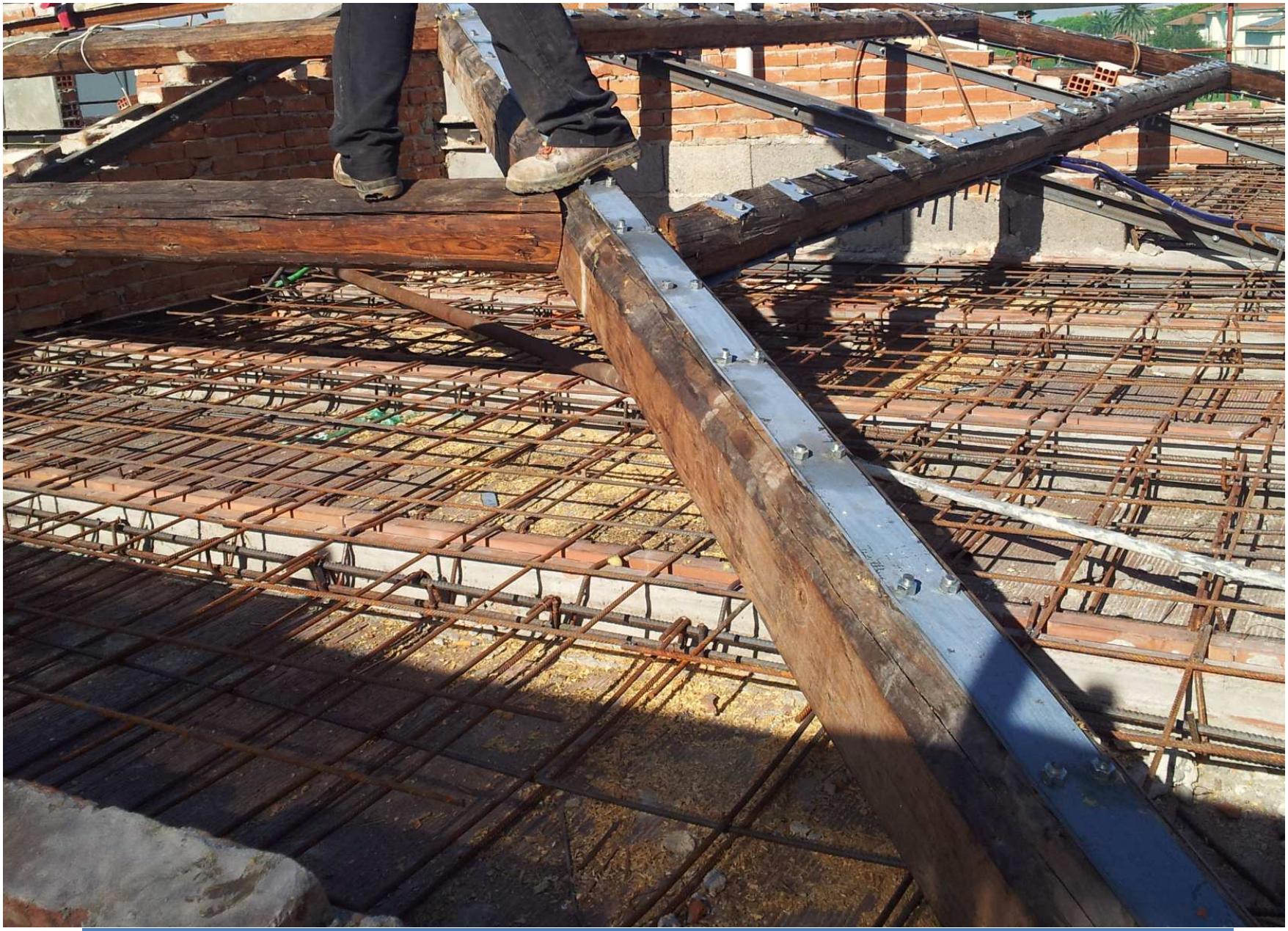


Strengthening of the connection





Connection with the upper part of the shear walls



Strengthening of hip beams (main beams)

Strengthening of secondary beams

Strengthening of the roof during the works

Strengthening of the roof during the works

Strengthening of the joints

Beams and joint after the strengthening

Strengthening of the beams - Detail

Details of the connections with intermediate brick walls

View of the roof during the work

Strengthening of brick wall

CASE STUDY N. 4

ANALYSIS AND REPAIR OF TIMBER BEAMS

Insufficient cross section – Uncorrect wood fibre pattern

Insufficient cross section – Uncorrect wood fibre pattern

Insufficient cross section – Uncorrect wood fibre pattern

Beam supported with a pack prop

Beams supported with pack props

Support and crack

Crack pattern in a beam

Beam covered with wood plates

General view of the floor

Detail of the cover

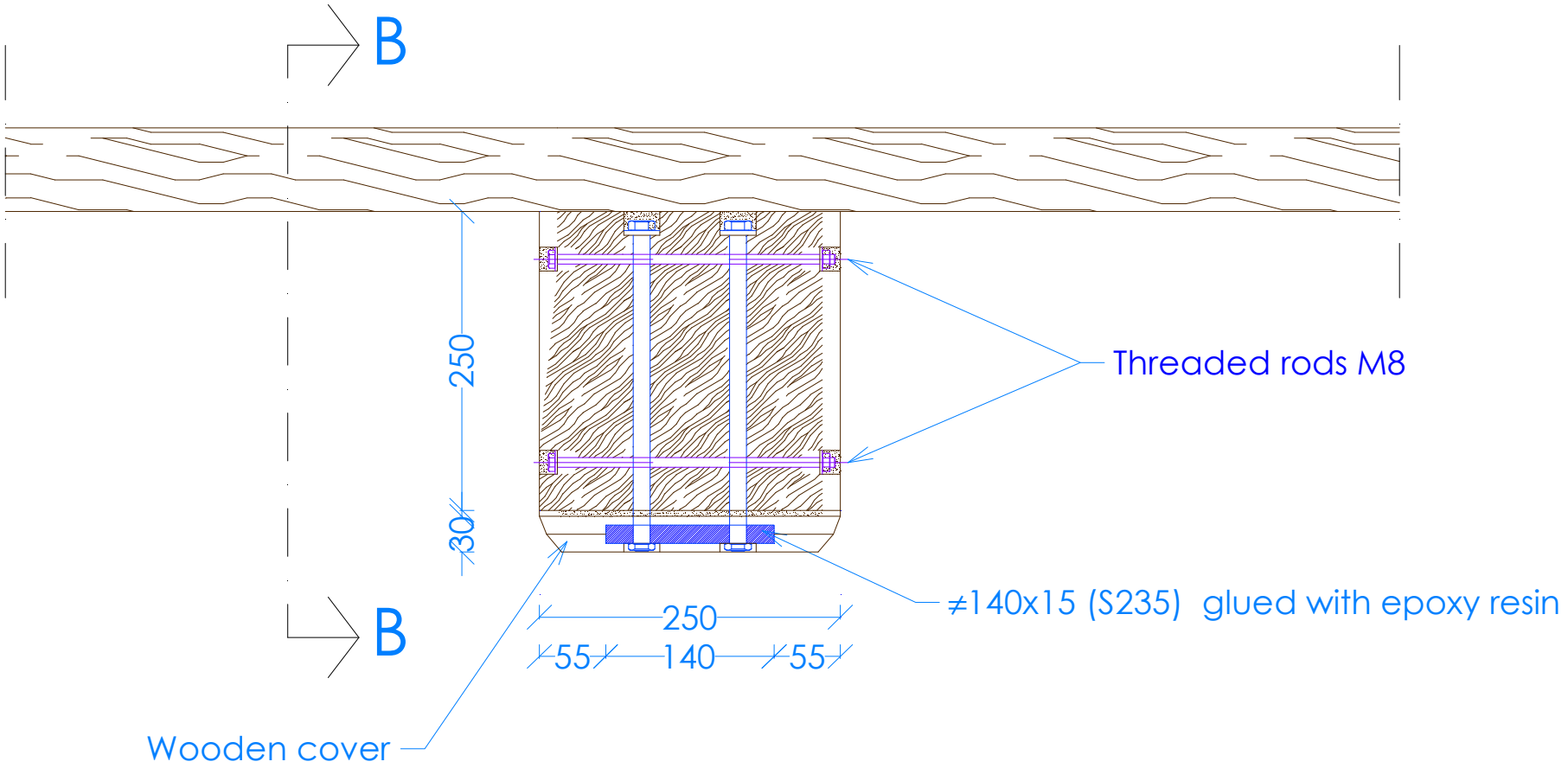
A surprising arrangement of the cover

Detail of the supports

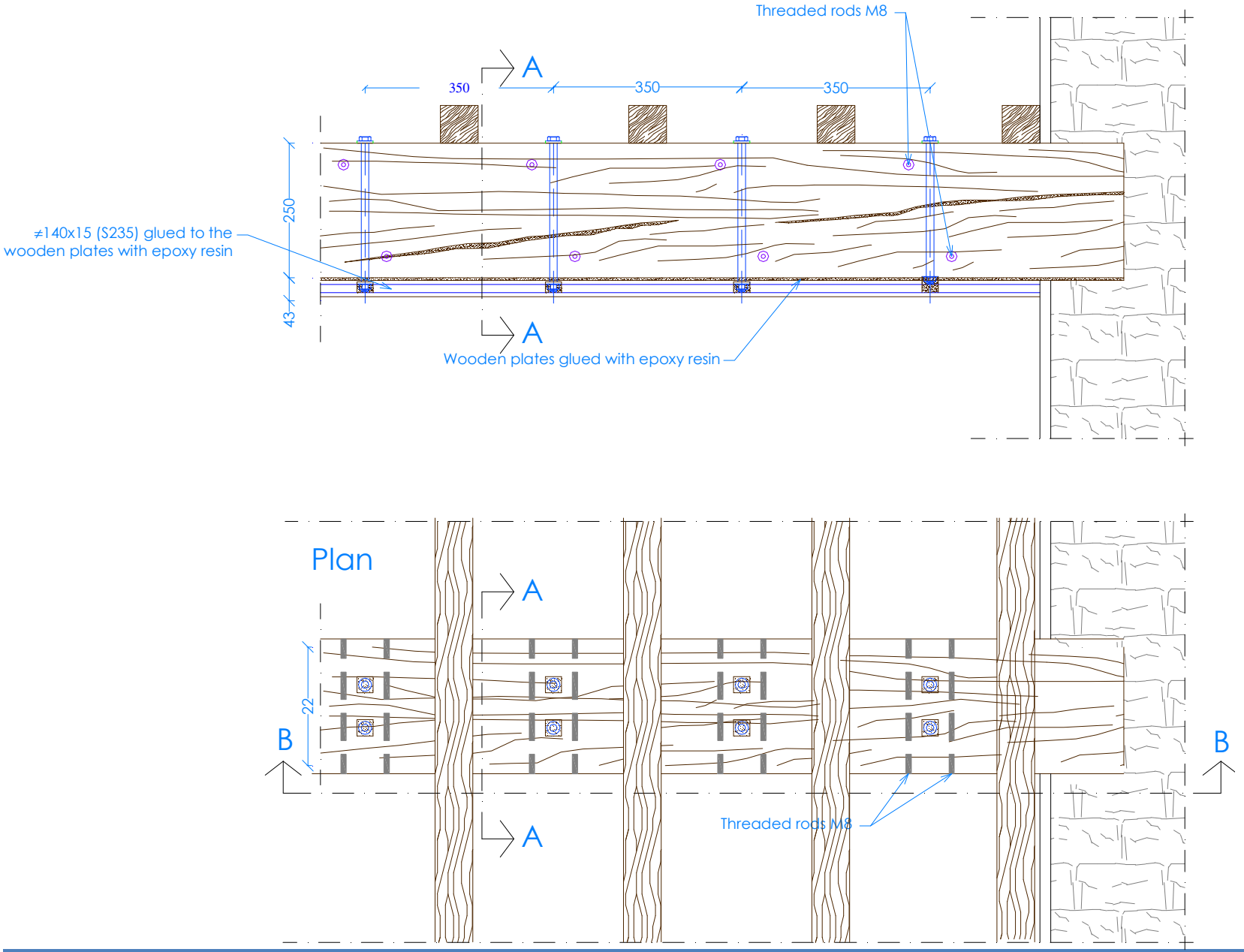
Typical crack pattern

Covered beams

Painted vault



Strengthening of timber beam preserving the exterior aspect



Strengthening of timber beam preserving the exterior aspect

CASE STUDY N. 5

SUBSTITUTION OF TIMBER BEAMS

CASE STUDY N. 5

A- SUBSTITUTION OF TIMBER BEAM

Substitution of the floor

CASE STUDY N. 5

B- SUBSTITUTION OF TIMBER BEAMS FROM BELOW

Removal of the beam supporting the floor

Insertion of the new beam

Preparation of the support

Beam substitutions completed

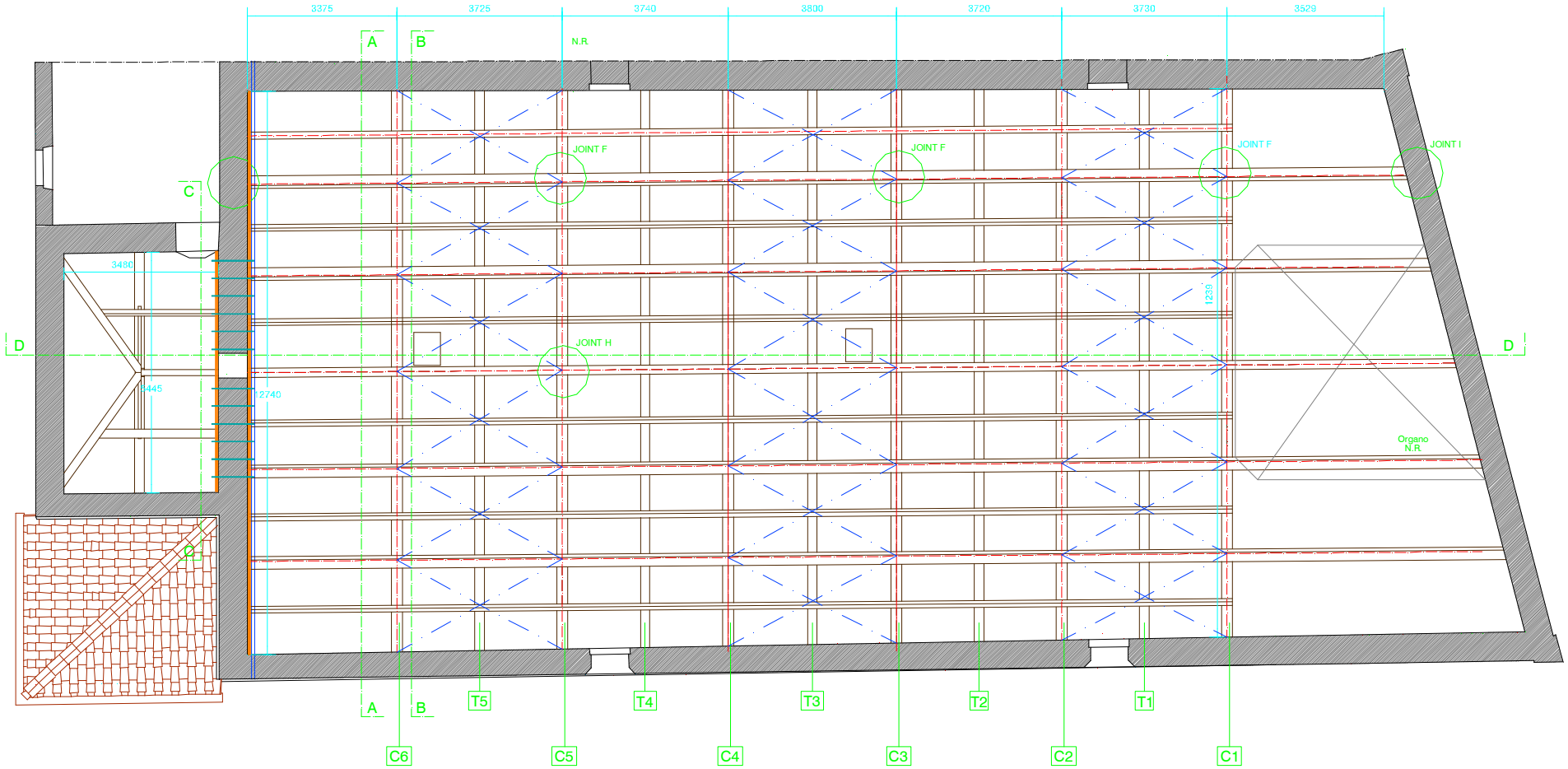
Arch to be strengthened

Arch strengthening

CASE STUDY N. 6

STRENGTHENING AND REPAIR OF A WOODEN TRUSS ROOF SUSTAINING A PAINTED CIELING

The interior of the Church



Plan of the roof structure

Typical strut-tie joint

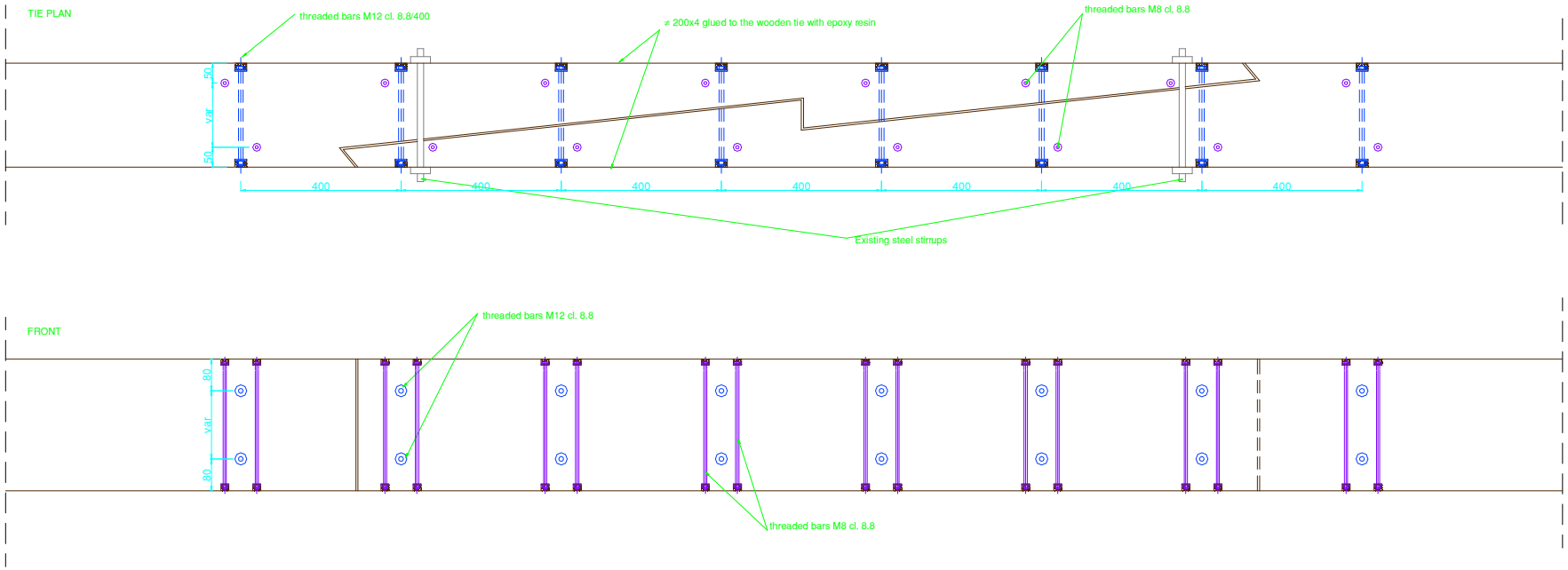
Suspension of the cieling

Connection of the truss tie - Jupiter dart

Connection of the truss tie - Jupiter dart

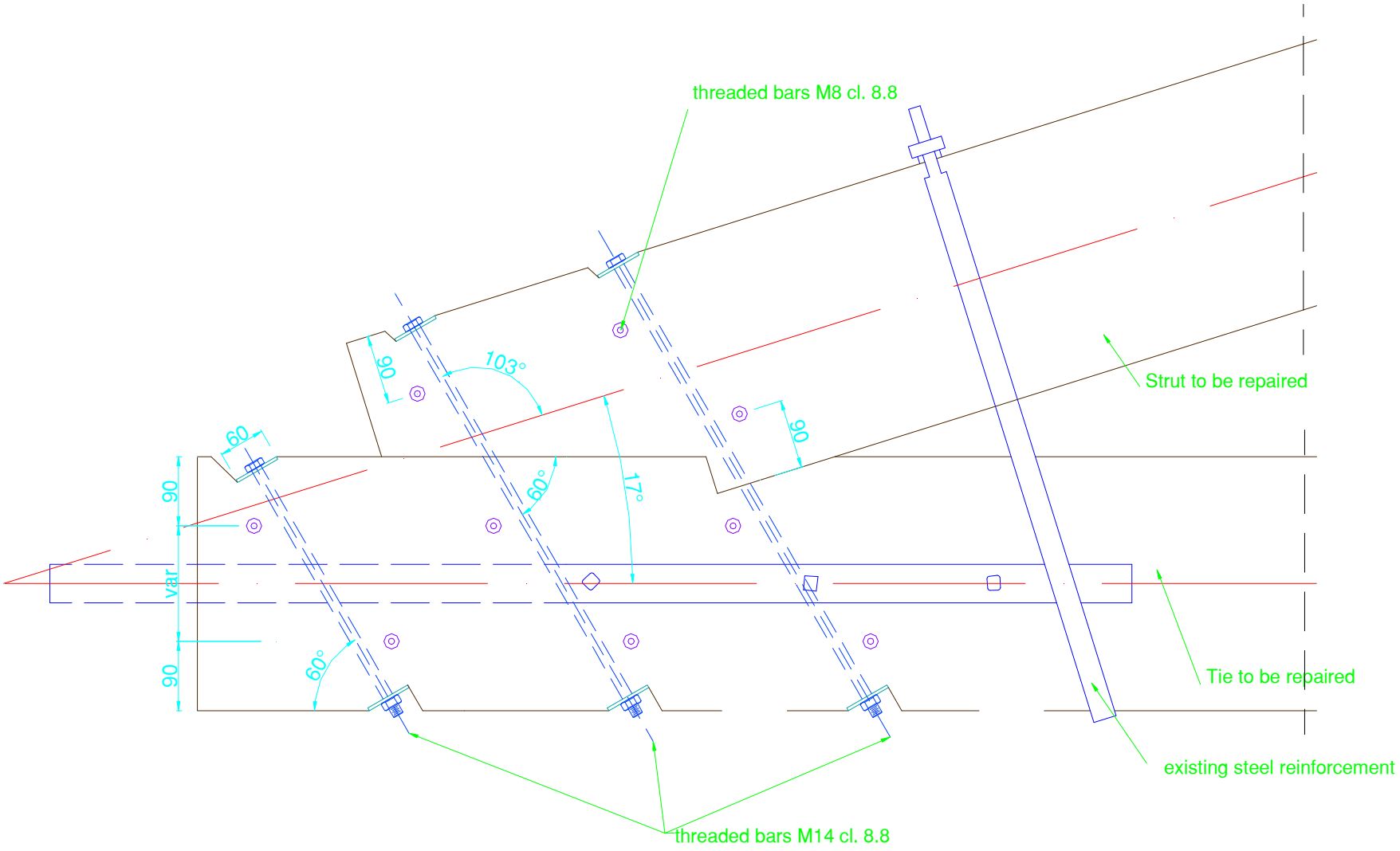
Repair of the strut

Repair of the truss and temporary chain

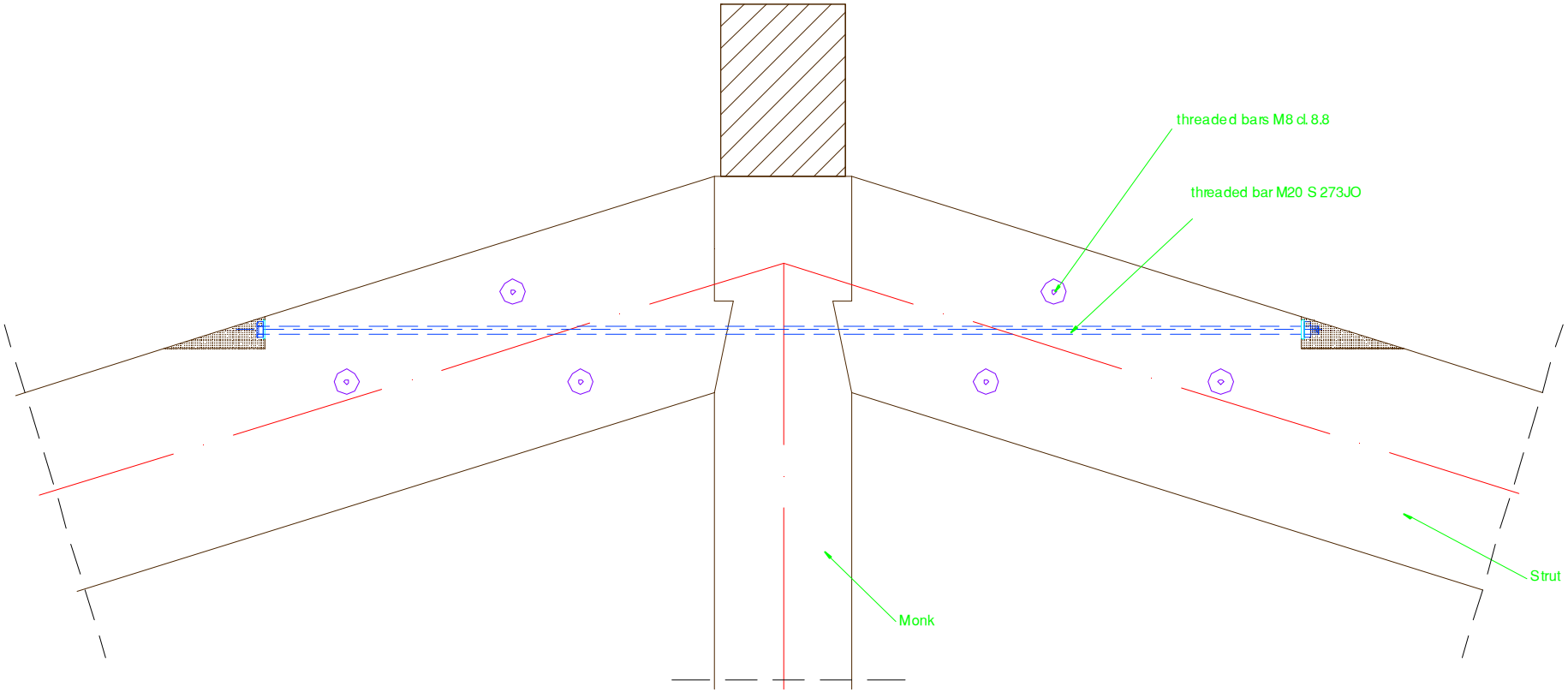


Repair of the Jupiter dart

Repair of the Jupiter dart



Repair of the strut-tie connection



Repair of the strut-monk connection

Repair of the strut-tie connection

Temporary suspension of the truss

Repair of a damaged head

Repair of a damaged head

Steel bracings

Strengthening of the facade wall

Thank you for your kind attention