Lifelong Learning Programme

NAEP
Národní agentura pro evropské vzdělávací programy

Concrete structures

Case studies

PIETRO CROCE
Department of Civil and Industrial Engineering
Structural division
University of Pisa

Leonardo da Vinci
Assessment of existing structures
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An existing building requires structural reassessment when:

its reliability is inadequate, also due to misuse or human errors;
the structure is modified and/or enlarged;
the category of use of the structure is improved and/or its design working life is increased;
the structure has been damaged or deteriorated by environmental, chemical or biological, attack or by more general time dependent effects;
the structure has been damaged by accidental loads, e.g. earthquake or explosion, or by settlements or by other unintentional events like impacts, vibrations, water losses and so on.

According to the flow charts reported in section 4, the investigation process involves the acquisition of all relevant information concerning:

the original design and structural conception of the building, as well as the reference structural codes, if any;
the sequence of structural modifications during its life, addition or demolition of structural parts and/or deep maintenance interventions;
actual material properties;
actual damage and/or crack patterns;
required performance level.

CASE STUDY N. 1

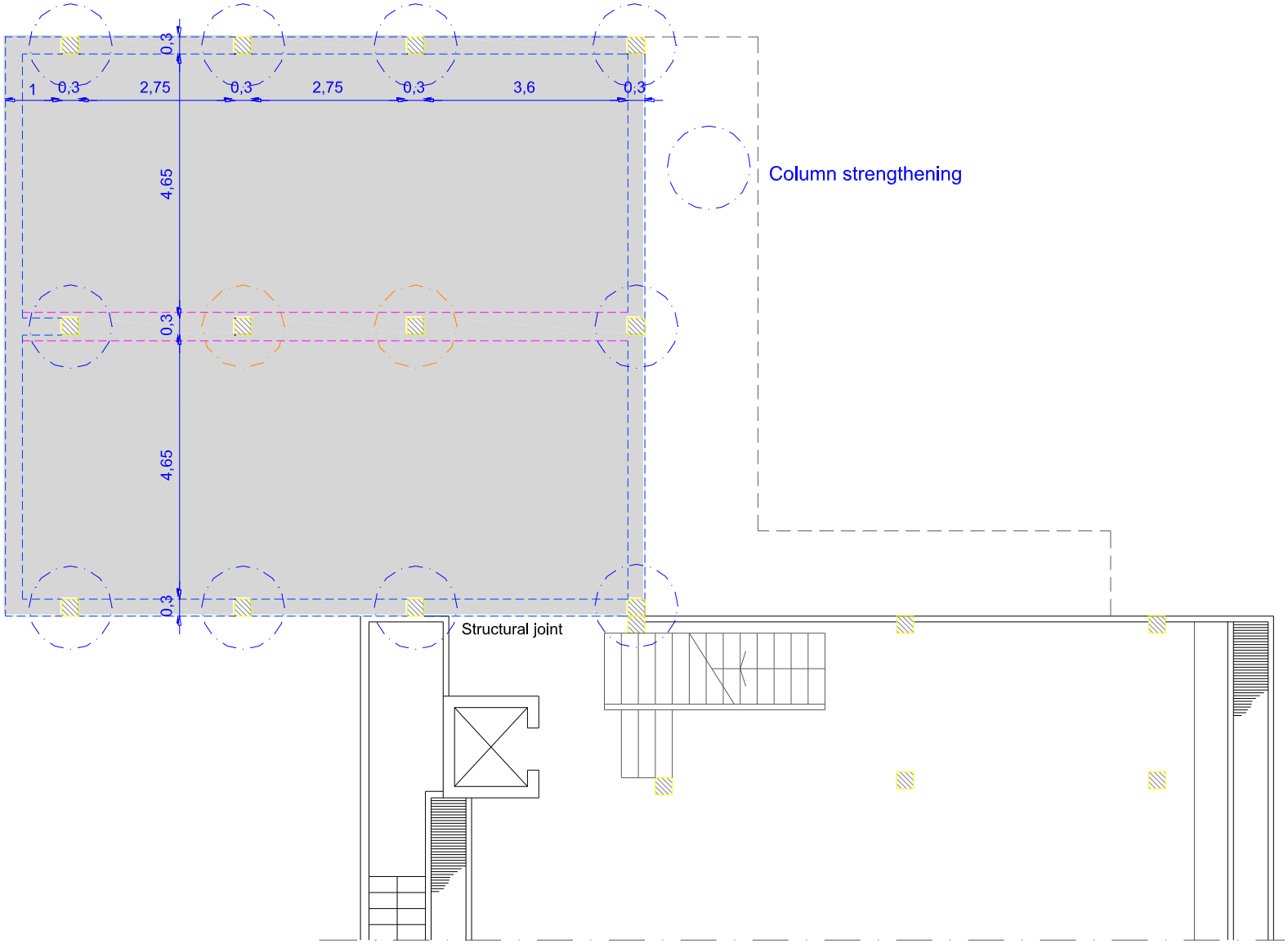
STRENGTHENING OF R.C. COLUMNS

General view of the building

Damaged columns

Corroded rebars

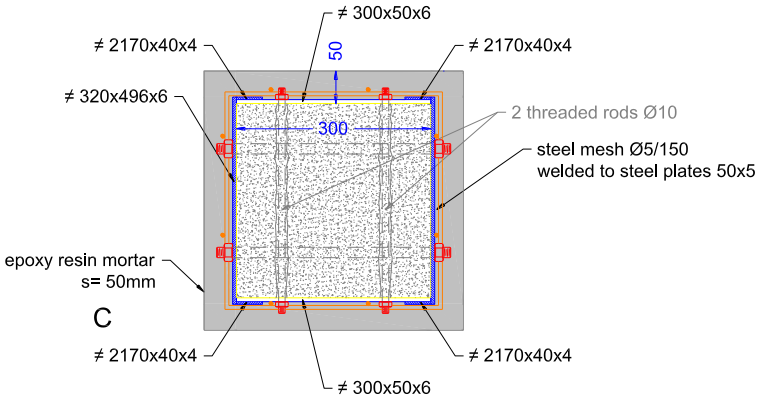
Cracking of concrete cover

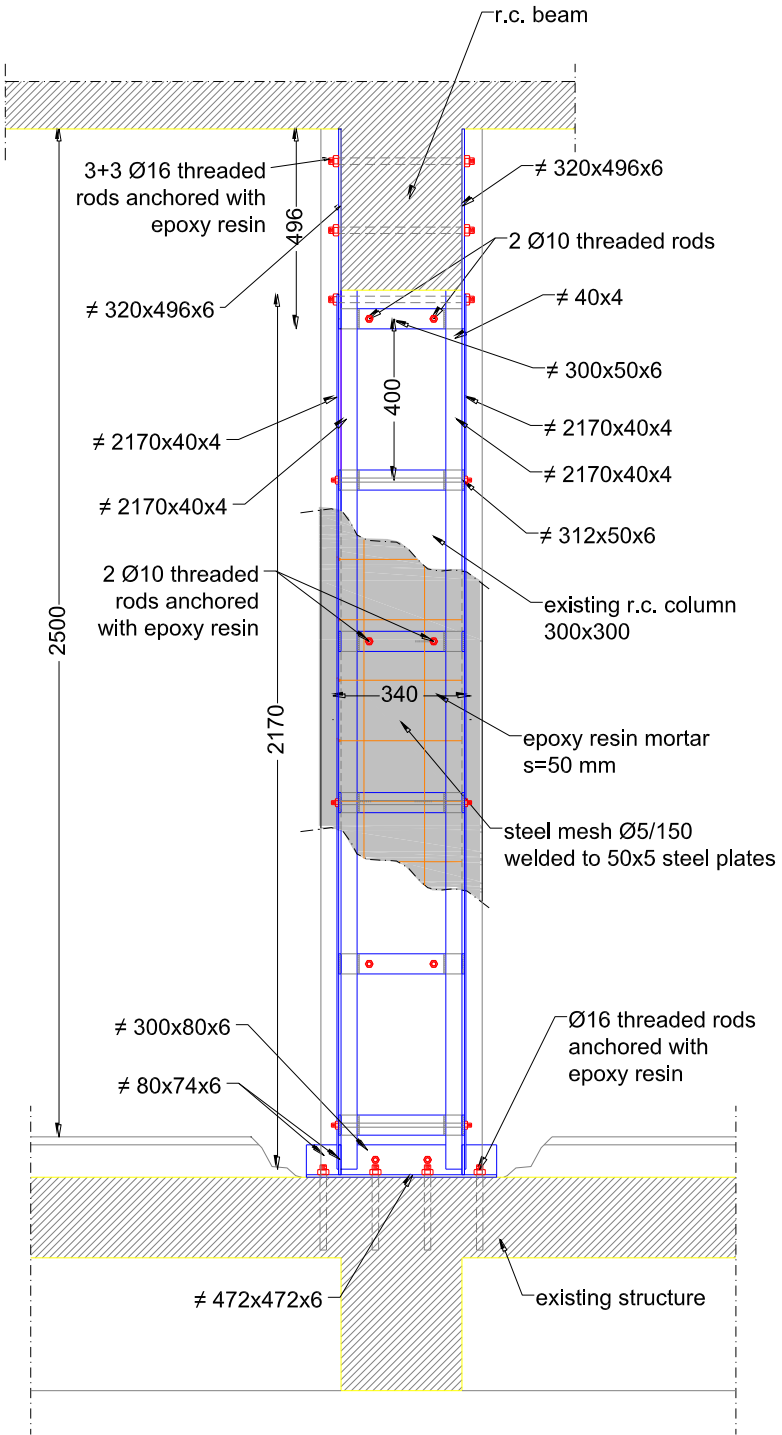


Building plan with indication of columns to be strengthened

Usually, two different techniques are used in the rehabilitation of damaged r.c. columns, according as FRP or steel is used as reinforcing material. In these cases two aspects must be considered in the choice of repair technique:

the needs of a good confinement od the concrete, which can be assured by both techniques,
and the efficiency of the reinforcement in transferring the stresses from the original column core, which carries the permanent loads, and the new parts, which can be obtained in a much more easy and reliable way using steel. In fact, while the additional steel reinforcement can be mechanically bonded to the existing concrete column using shear connectors, the FRP longitudinal reinforcement should 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)

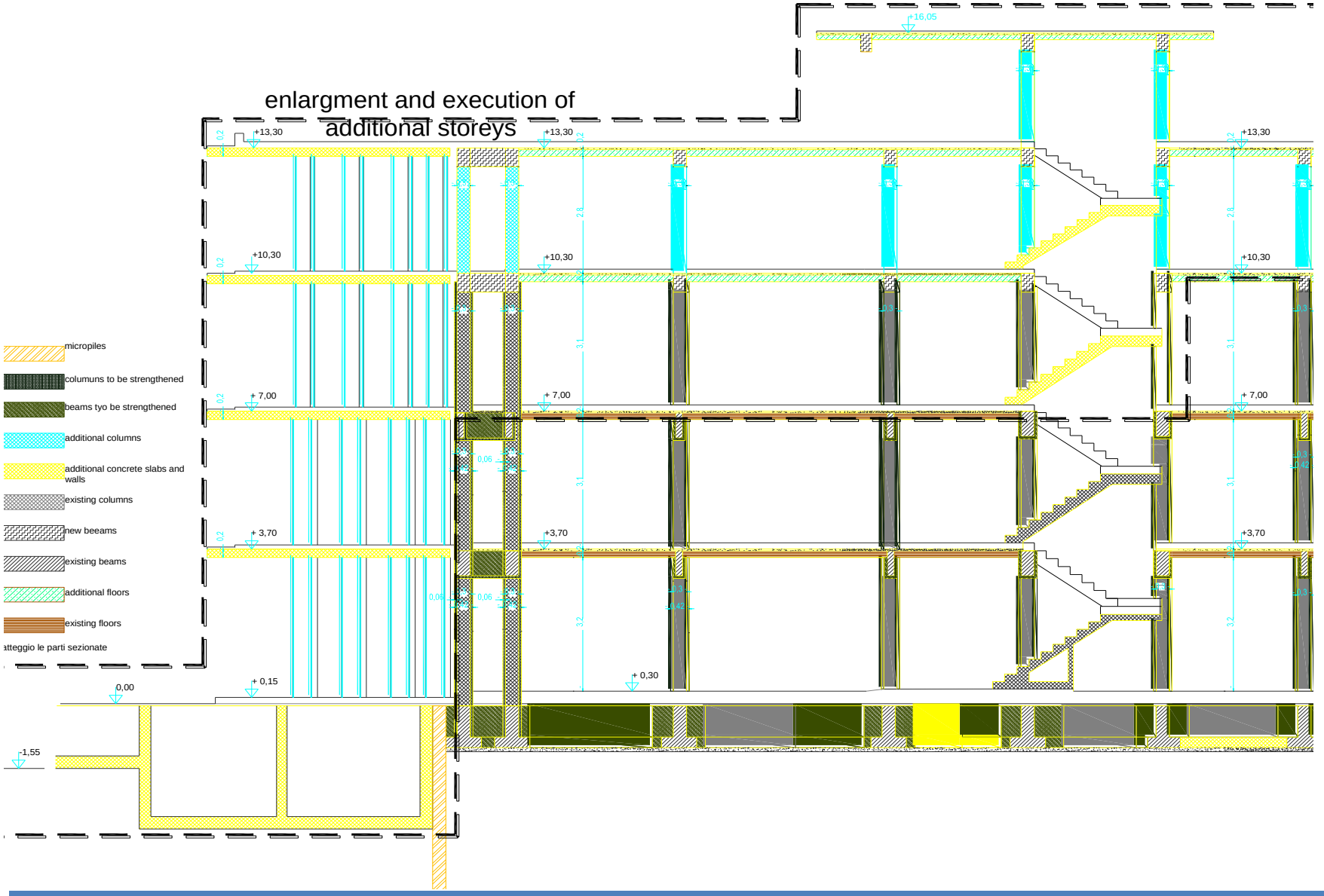
execution of the additional epoxy mortar layer (s=50 mm)

execution of the surface finish

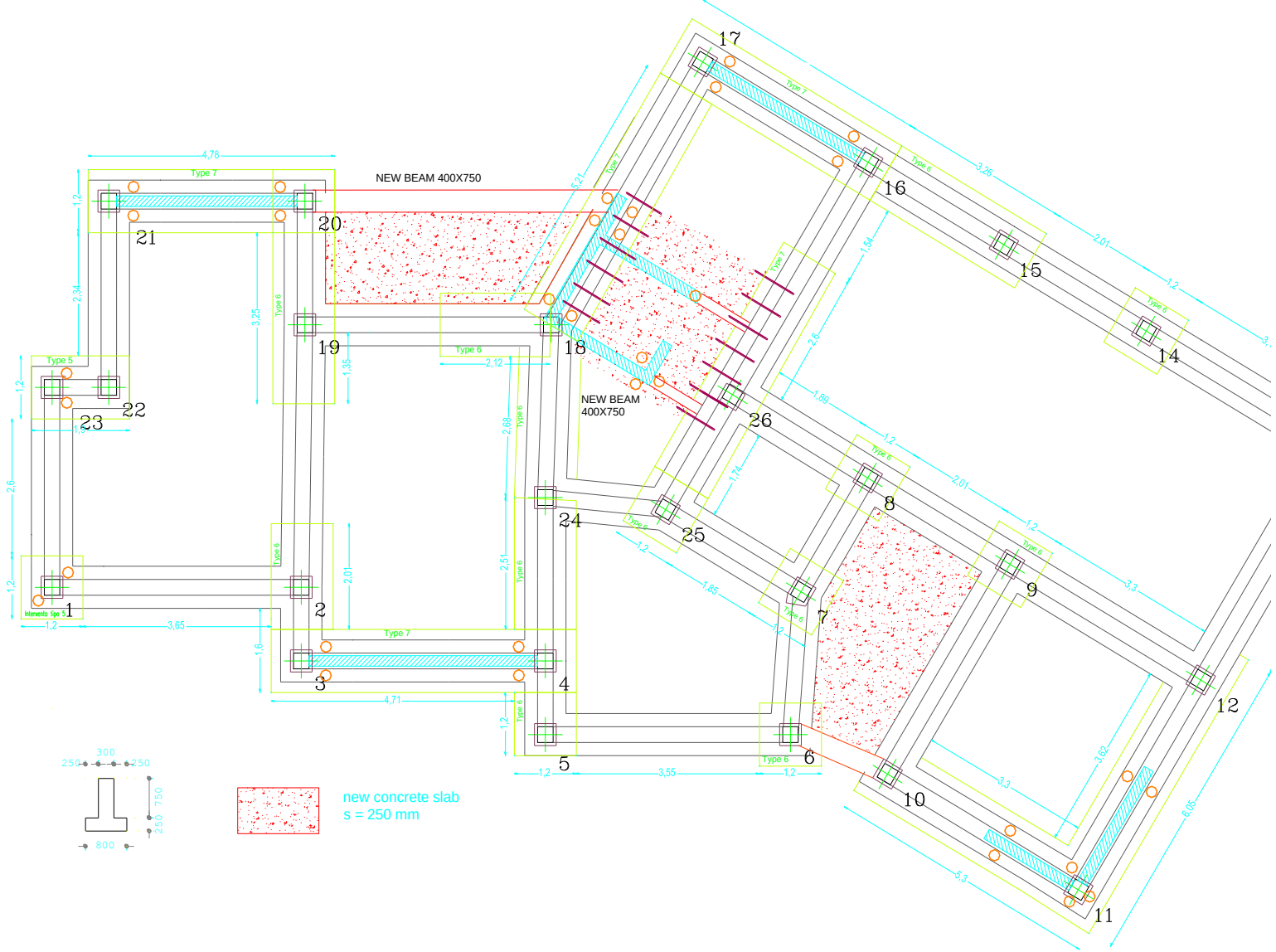
CASE STUDY N. 2

EXECUTION OF ADDITIONAL STOREYS

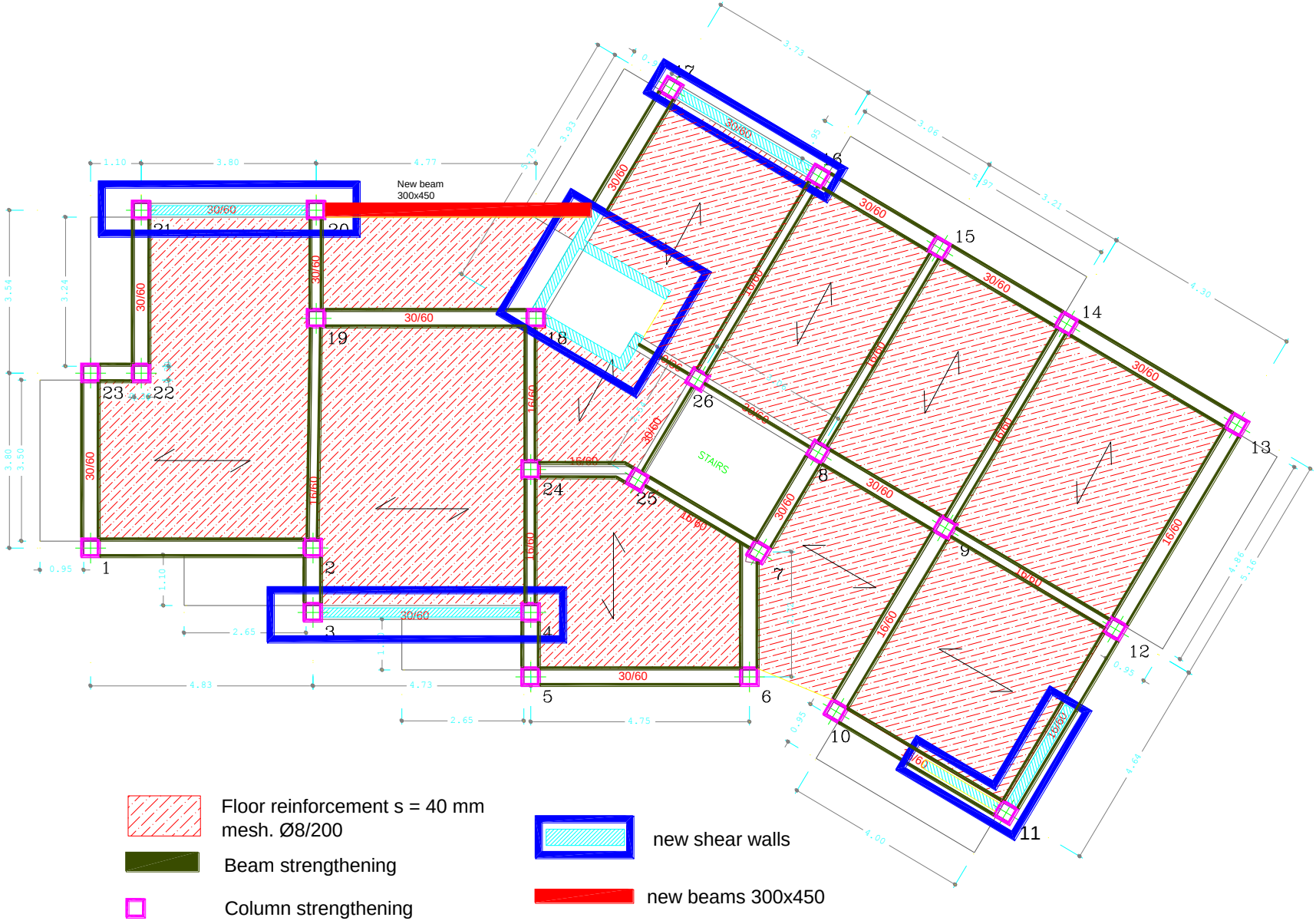
General view of the existing building



Summary of the additions and of interventions needed to reassess the building (longitudinal cross section)

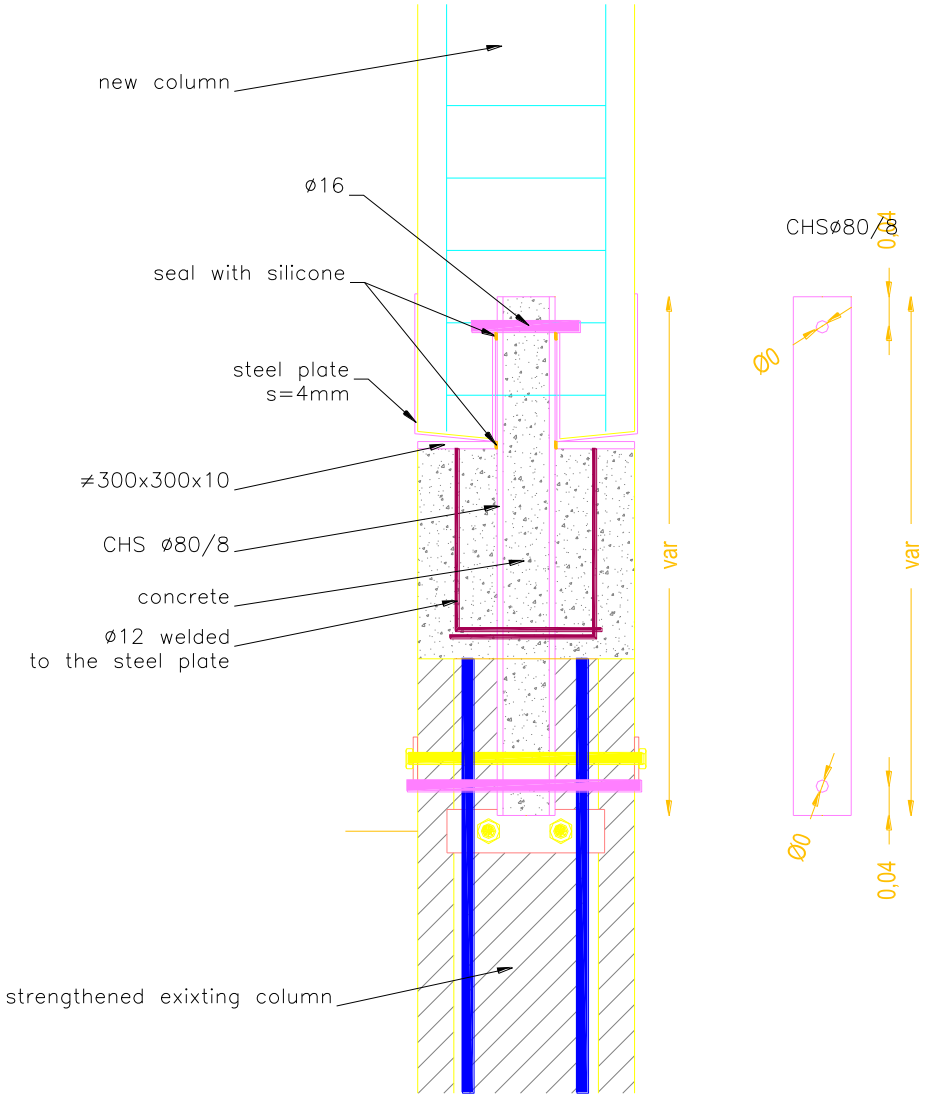


Summary of the additions and of interventions needed to reassess the building (foundations)

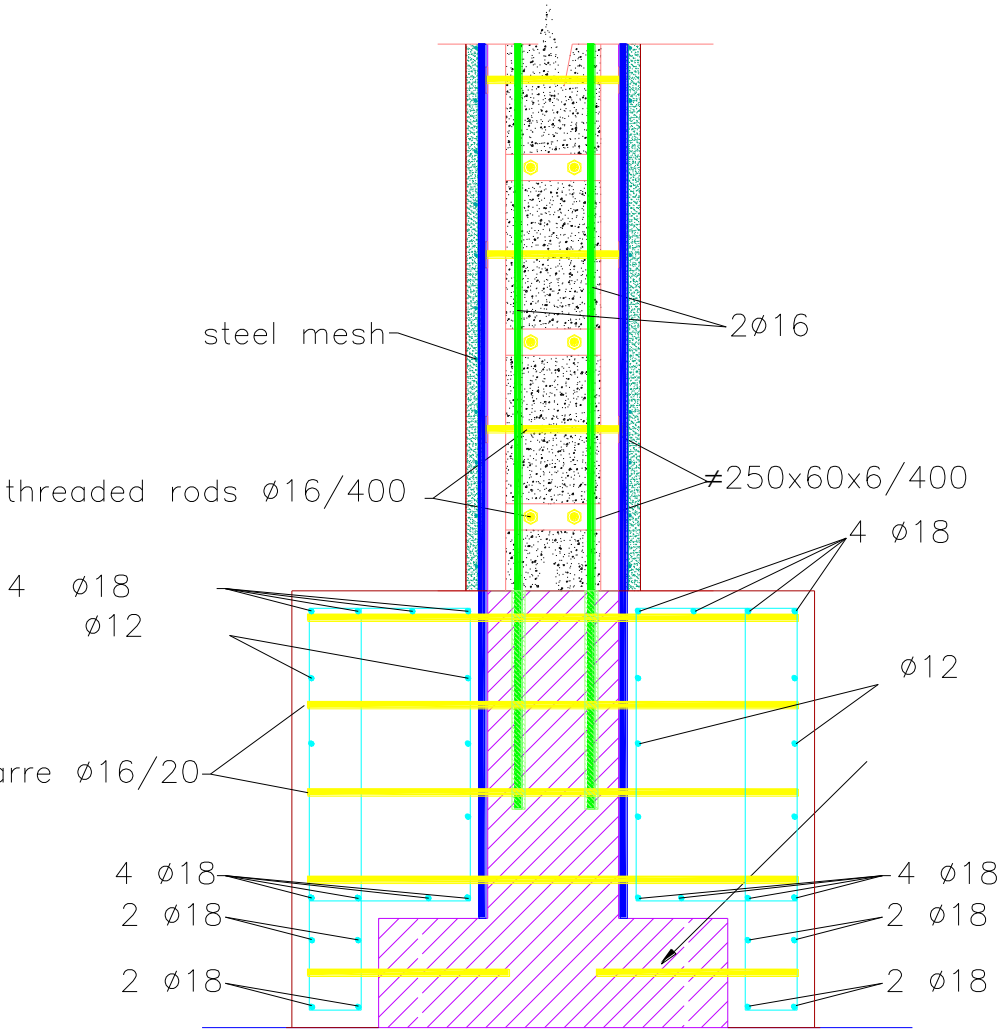


Summary of the additions and of interventions needed to reassess the building (first floor)

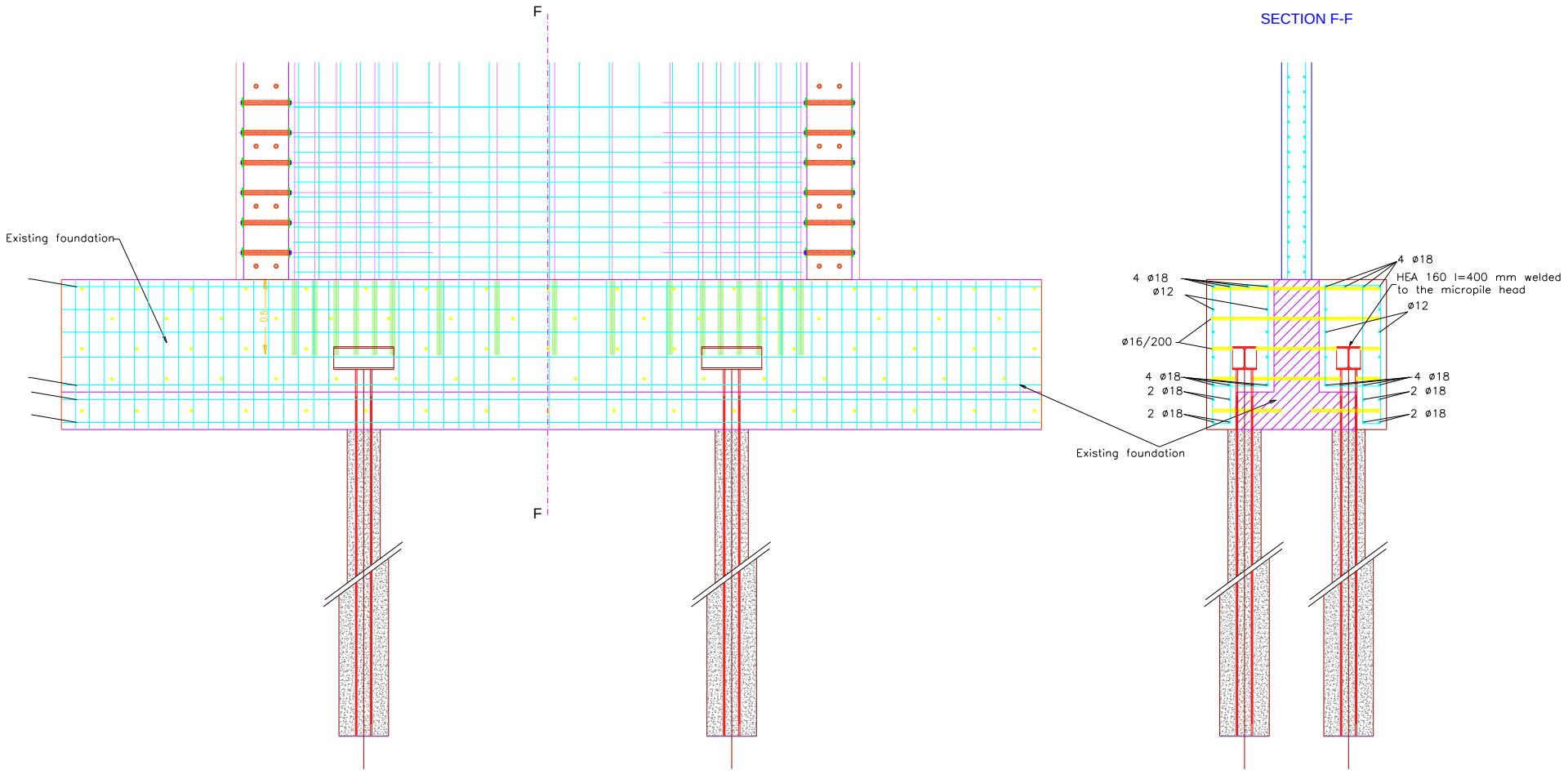
Preliminary investigation phase



“Hinged” connection between the new and the existing column



Foundation enlargement



Micropiles and shear wall

Beam reinforcement

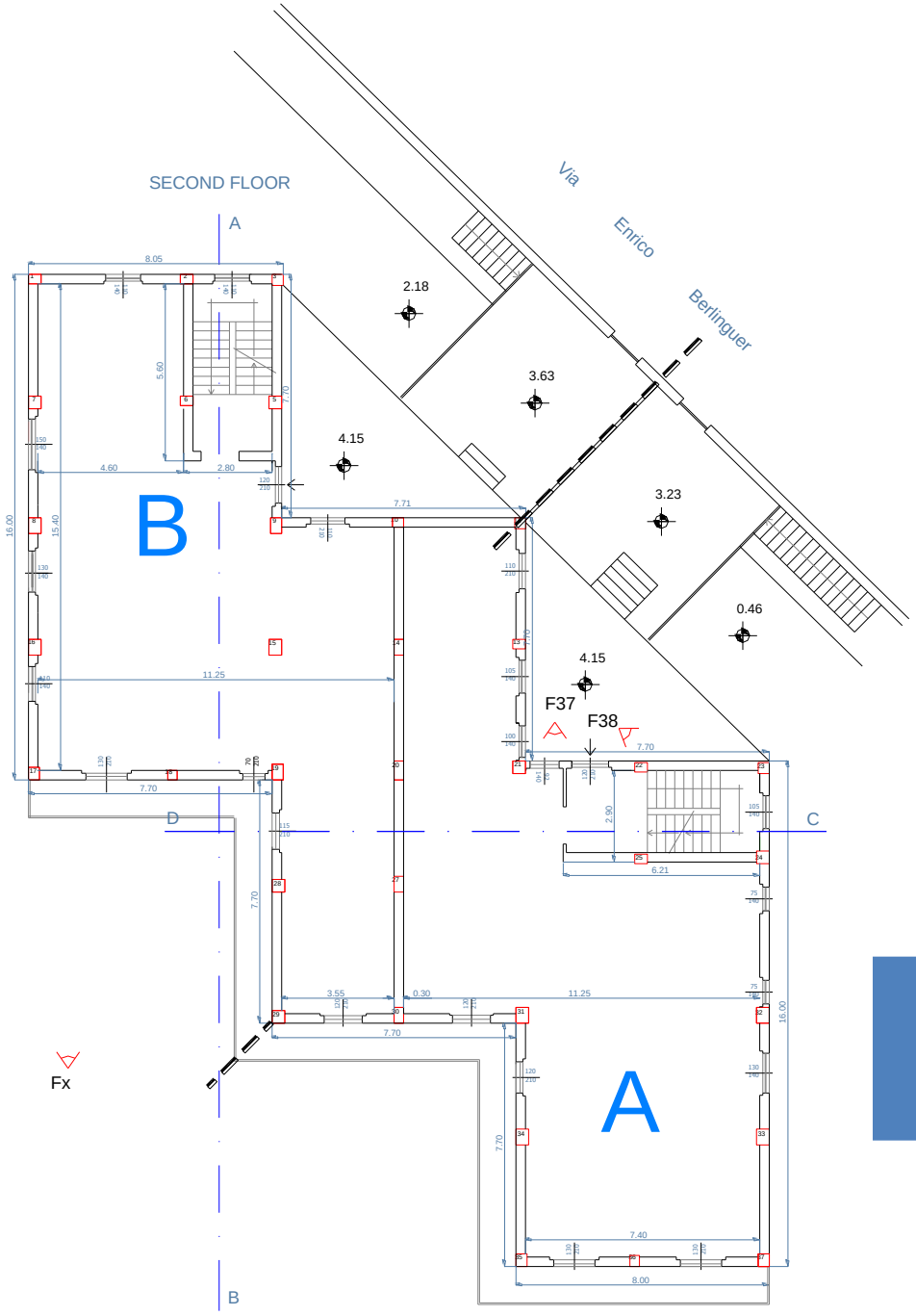
Some picture during the execution

The building at the end of the works

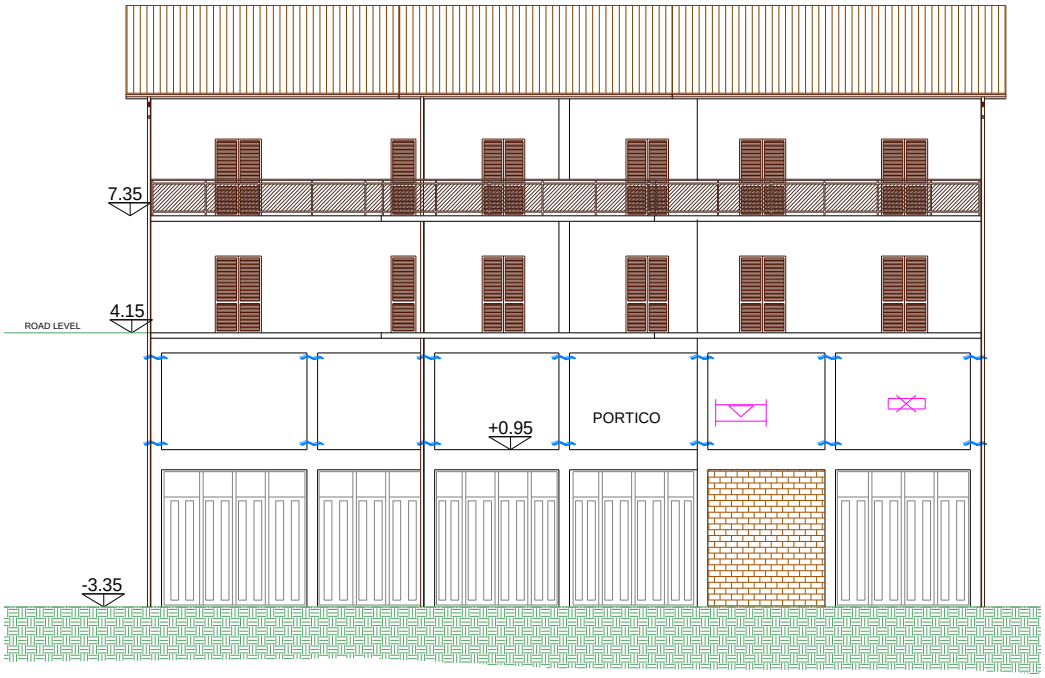
CASE STUDY N. 3

REPAIR AND STRENGTHENING OF AN EARTHQUAKE DAMAGED BUILDING

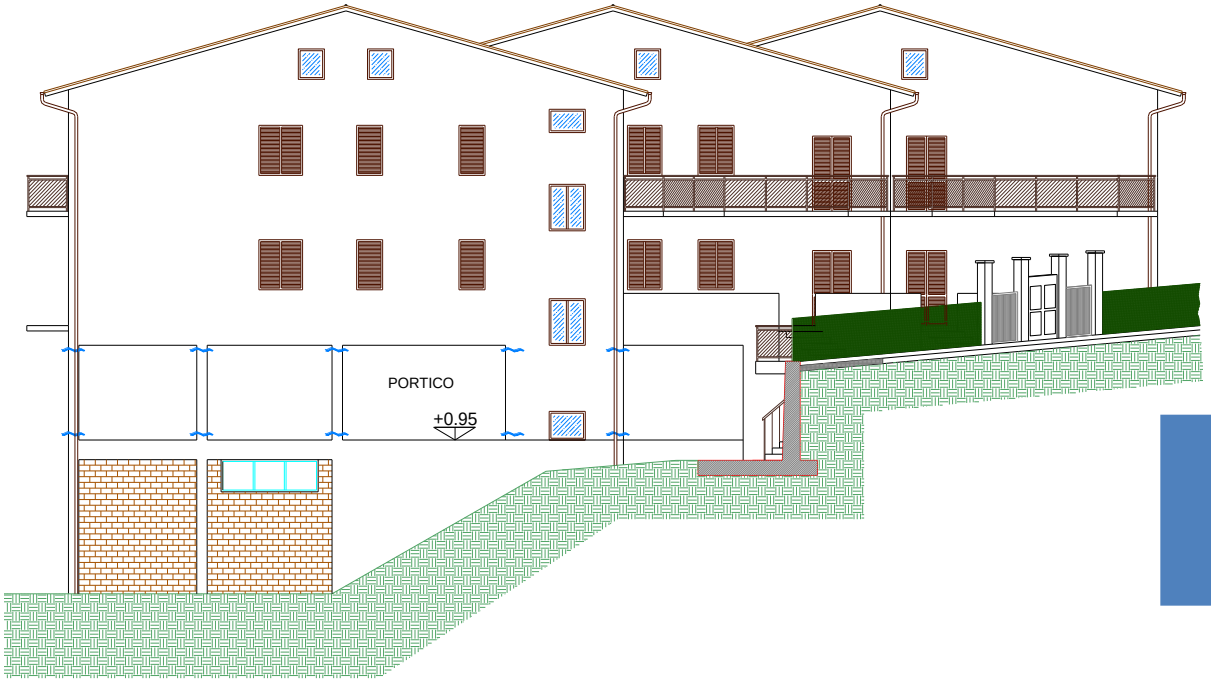
Views of the existing building



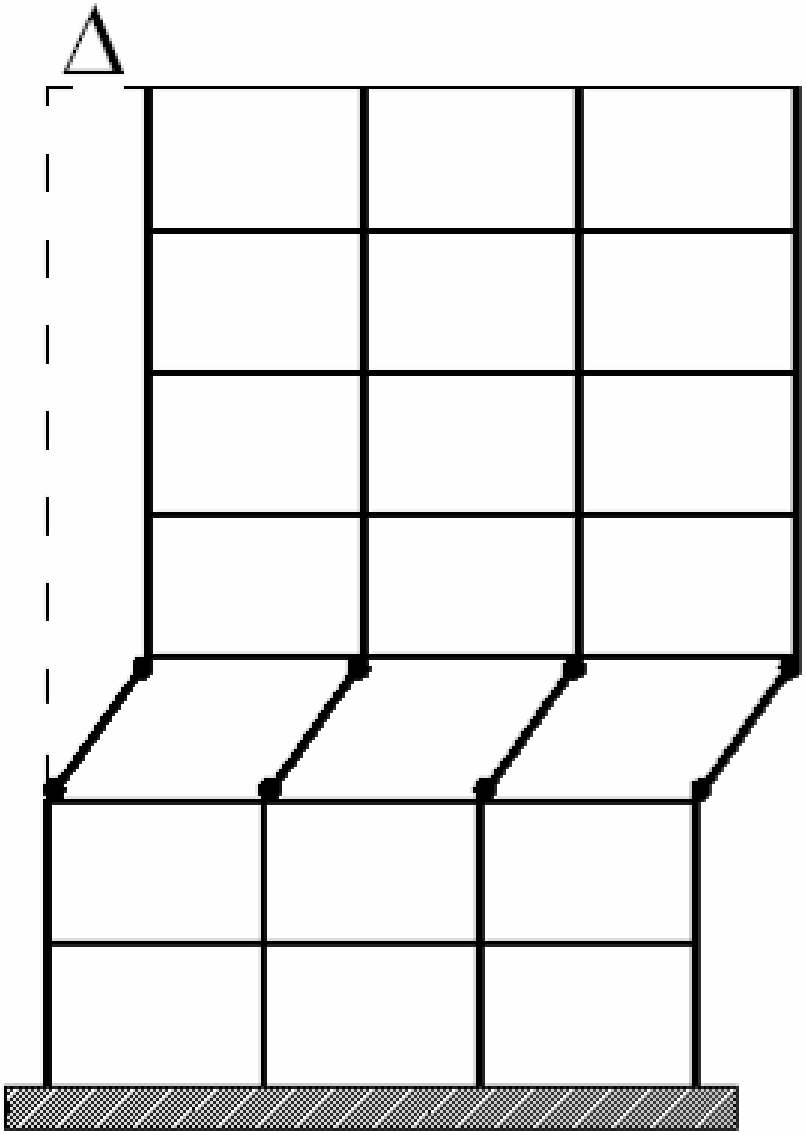
Plan of the 2nd floor



Front view



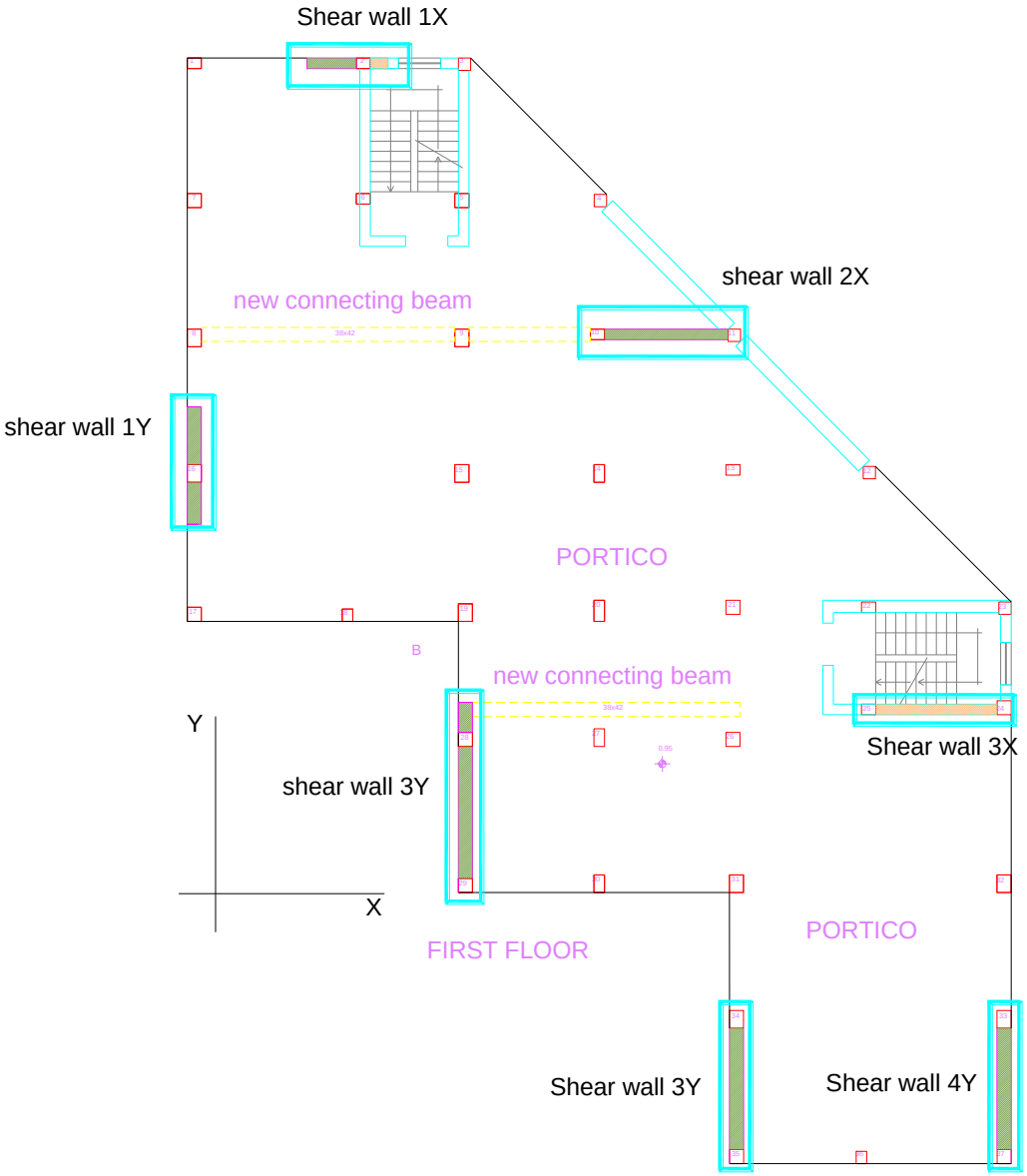
Side view



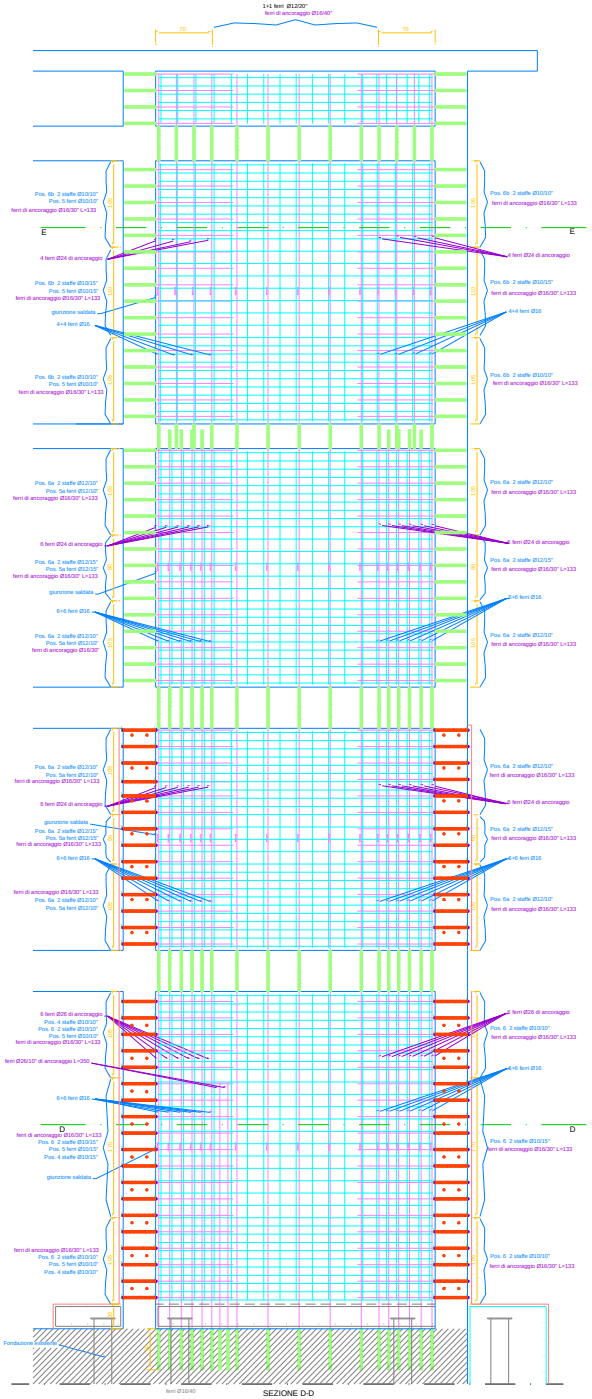
Shear type collapse mechanism

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

Imagination is much more important than knowledge

(Albert Einstein)

Thank you for your kind attention