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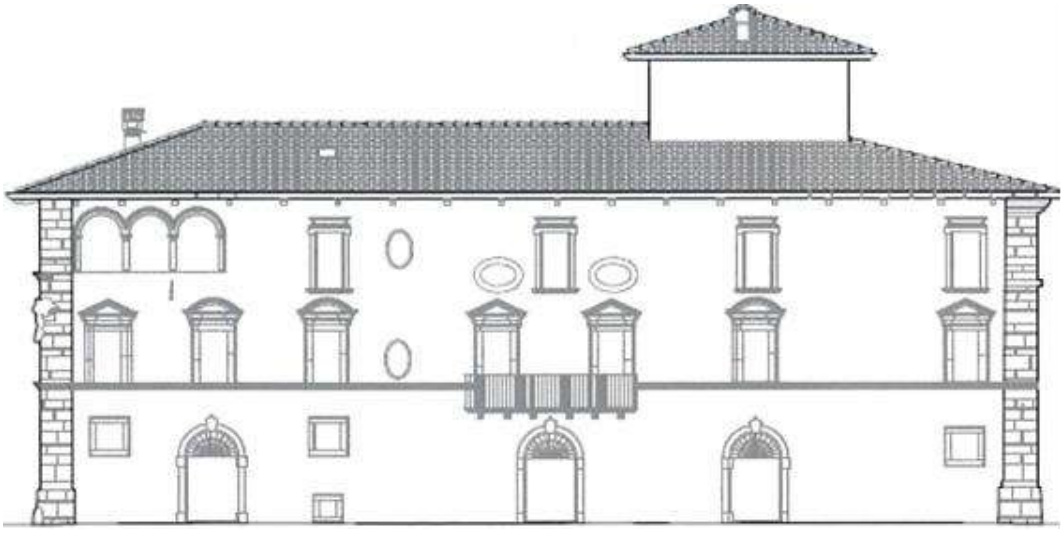
RESTAURO MONUMENTALE E ARCHITETTONICO
CONSOLIDAMENTO STRUTTURALE

L'AQUILA

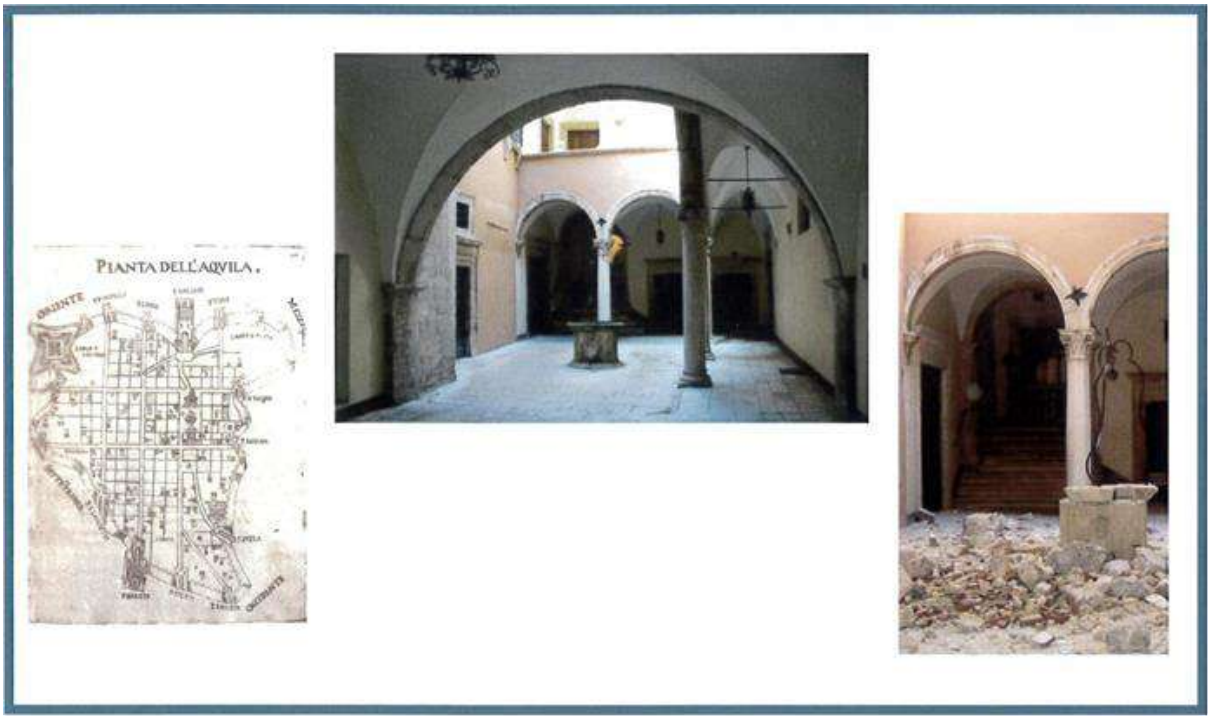
DRAGONETTI-CAPPELLI PALACE
XV CENTURY

SIESMIC IMPROVEMENT OF THE PALACE
DAMAGED BY THE SEISMIC EVENT OF APRIL 6th, 2009



BACKGROUND

In the XIII century a group of castellans from Abruzzo, to free themselves from feudal obligations, decided to regroup and found a new city.
A decisive role in this extraordinary and unique event was played by **Frederick II**, who in the year 1250 promulgated the **privileium constrzionis aquilae** inviting the "castles" to come together in a single reality; other sources indicate his son **Corrado IV**.
The territory was divided into four parts and a grid of roads with a geometric and cardinal pattern was built, following the layout of roman city.
Santa Giusta church was placed at the head of a quarter, and hosted the first episcopal curia (1258). One of the main axes of the new inhabited centre passed in frieze to the church with a north-south direction: on this side, on a side of the large square in front of the church, now largely occupied by buildings, the large Dragonetti palace was built.
There are no certain dates on the origins of Palazzo Dragonetti, but the importance of the family and the strategic location of the palace suggest that starting of its construction was contemporary with the construction of the church of Santa Giusta, certified since 1254.

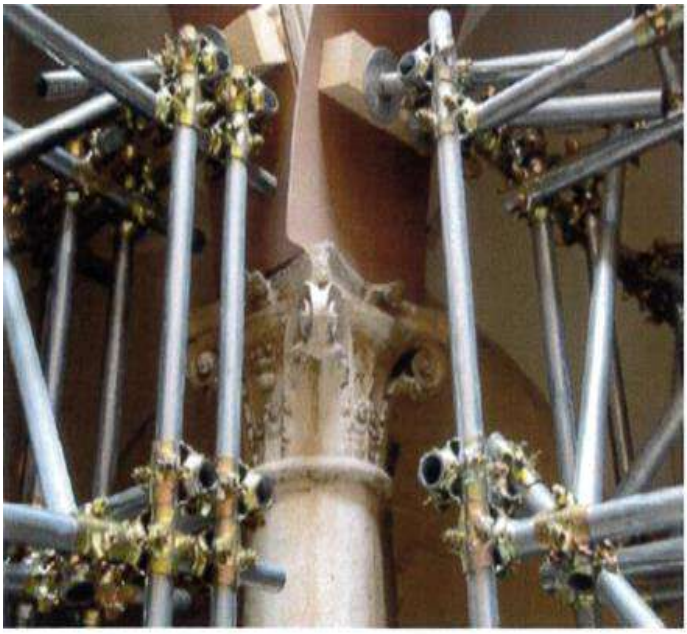


DAMAGES CAUSED BY THE EARTHQUAKE

The building reacted adequately to the earthquake, much better than newly built buildings; the walls showed discreet resistance capacity, quantified by rigorous in situ tests.
These are typical limestone walls of good resistance, with mortar bedding of substantial thickness. The positive reaction to the earthquake was obtained thanks to a regular architectural geometry, which allowed the efforts to be distributed over the entire building, by means of a satisfactory box-like behavior.
In fact, the feared **global collapse mechanism** did not occur, collapsed was limited to the turret, which allowed the occupants to survive.
Particularly effective has proved to be **the vaulted masonry system** of the ground floor.
Some interventions carried out in recent times, in particular the insertion of **metal chains**, have shown good efficacy, others less so.

THE SEISMIC IMPROVEMENT INTERVENTION

Palazzo Dragonetti is a building of protected historical value, therefore the intervention was based on the **Principles of Conservation**, indicated in the **Ministry for Cultural Heritage and Activities Guidelines.**
These are repairs to local damages and seismic improvement of the building as a whole, some of which are schematically described below:
· **reinforcement of the walls against gravitational** loads by means of the so called unstitch-stitch, injections of natural hydraulic lime and the use of metal rods with the function of artificial diatons;

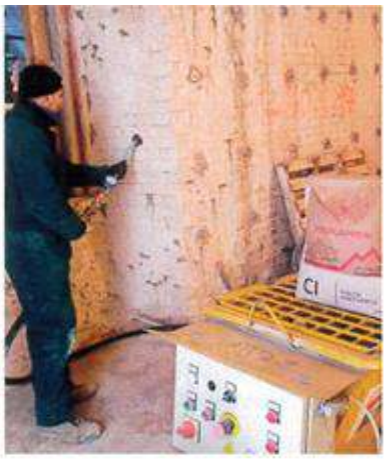


· **reinforcement of the walls against forces in and out the plan (floor)** by means of low-thickness natural hydraulic transpiring lime plaster, reinforced with carbon fiber sheet;
· **reinforcement of the vaults** by restitching of cracks, insertion of wedges to restore the state of loads transmission thanks to the shape restoration, application of carbon fiber sheet tapes to prevent the opening of hinges, cause of collapse;
· **hooping of the building** on various levels by application of high elastic modulus carbon fiber sheet tapes (CarbonIAR system);
· **consolidation of the floors** by means of reinforced hoods connected to the walls to allow the transmission of seismic loads;
· **metal hoops** on openings and for replacing fractured architraves;
· **formation of flat steel tie** rod at the top of the walls;
· **insertion of metal tie rods**.

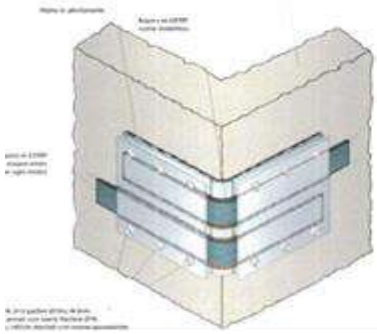
With these interventions, the building's ability to respond to seismic actions with box-like behaviour is ensured, avoiding the formation of local and global kinematic mechanisms, within the limits of the design approach of **seismic improvement**.

The design team is made up of the late **Prof. Francesco Benedettini**, professor at the **L'Aquila University**, **Ecopiano of Padova** studio, architects **Loris** and **Marcello Fontana**, and **Giannantoni's Studio** of Eng. **Andrea Giannantoni** from Foligno, professor of the **University of Ferrara.**

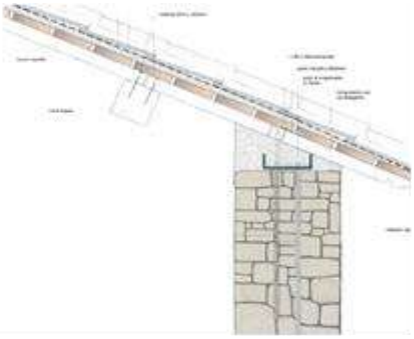
NATURAL HIDRAULIC LIME PLASTER REINFORCED WITH CARBON FIBER NET



INJECTIONS OF NATURAL HYDRAULIC LIME



HOOPS WITH CFRP
(CONSTRUCTION DETAIL)



FLAT TIE ROD STEEL

VALIDATION TESTS OF INTERVENTIONS THE EFFECTIVENESS

An important and articulated in situ test campaign allowed to validate the results of the seismic improvement interventions.
It is about **Normal Tear Tests** relating to the consolidation of the vaults with carbon fiber sheet tapes**, Shear Tear Tests** relating to the consolidation of the walls using natural hydraulic lime plaster reinforced with carbon fibers, provided by the **CNR DT 200/2004** document, dealing with the consolidation of masonry buildings using composite materials.
Tests were also carried out by **transmitting elastic waves** in the walls, to check the effectiveness of the injections, **Extraction Tests** of the metal bars used for the formation of artificial diatons, and finally the classic **tests with double flat jacks**.
Tests has been carried out by the **UNILAB laboratory in Perugia**, chosen for its specialized expertise.

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