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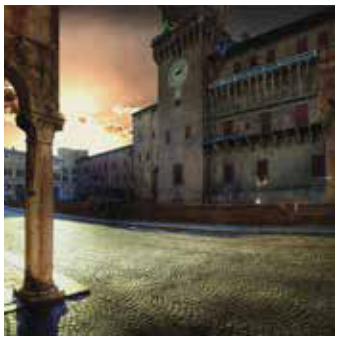
QA

YEAR07NR01
MARCH2018

RESTORATION OF CULTURAL HERITAGE: TECNIQUES AND SUSTAINABILITY

18TH-24TH MARCH 2018

18 MARCH
20 MILANO



21 MARCH
22 FERRARA

20 MARCH
PIACENZA

23 MARCH
PADOVA

21 MARCH
MIRANDOLA
S. BENEDETTO

23 MARCH
24 VENEZIA

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POST-EARTHQUAKE RESTORATION OF THE CLOISTER OF THE "SECOLARI" IN THE COMPLEX OF SAN BENEDETTO IN POLIRONE

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PREMISE

The monastery of San Benedetto in Polirone has been the subject of a substantial restoration (2006-2012) but unfortunately a few months before the ending of the restoration works, the earthquake damaged seriously all the buildings of the monastery. Such damage has made it necessary to survey all the parts of the complex with the aid of a laser scanner technology and several analyses to further understand the conditions of all bearing structures (timber or masonry structures), achieving a high level of knowledge of the whole complex. The earthquake hit the hardest in the portions of the complex called "Ala Giorgi" and the "Secolari" cloister, where the structural situation was already critical and the restoration was not accomplished yet.

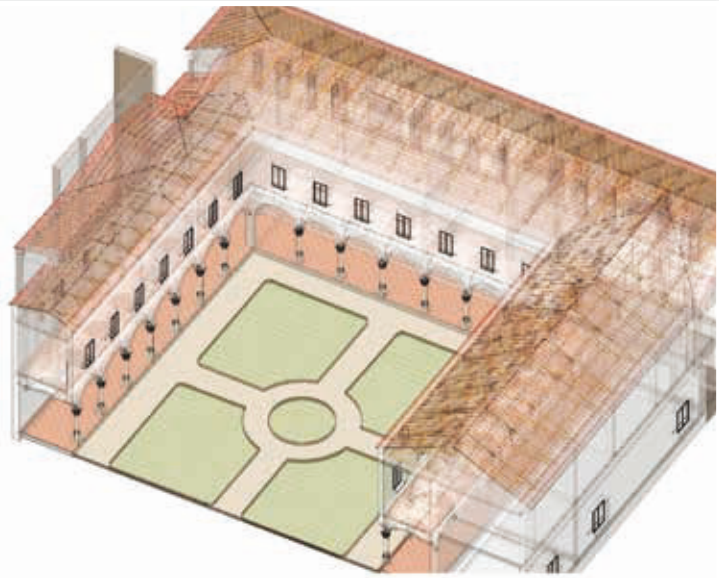
BACKGROUND HISTORY

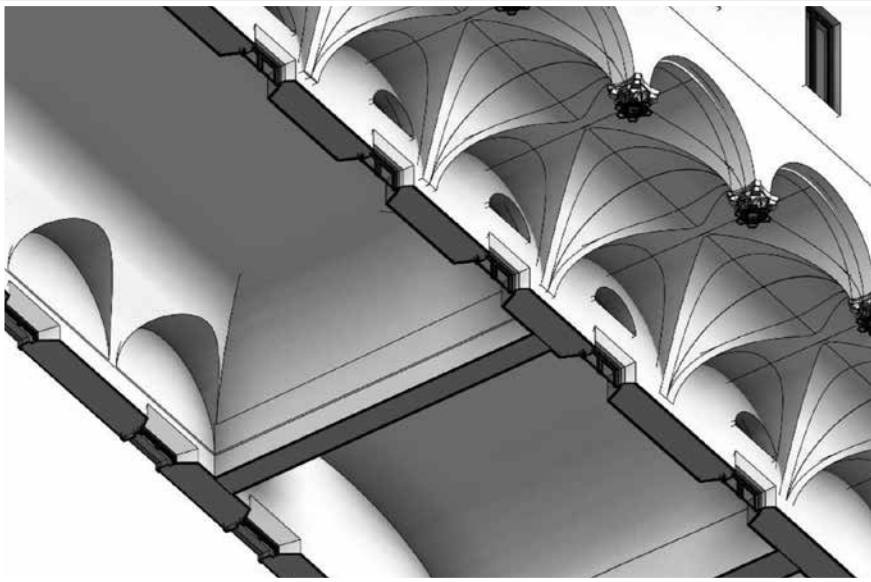
The monastery of Polirone, from its foundation in 1007 up to its suppression in 1797, was a great centre of European religious, cultural and artistic life. The beginning dates back to the founding of the Abbey by Tedaldo di Canossa in this area of strategic importance, especially in earlier centuries, because of its position dominating the course of the river Po. In the year 1077 the pontiff Gregory VII put the abbey under the spiritual jurisdiction of the monastery of Cluny, to which the monastery of Polirone was strictly linked throughout Middle Ages. However, the life of the Abbey was initially related to the Canossa family which founded it and later to the Gonzaga dynasty, whose rise to power in these lands and exerted control also over spiritual aspects of the monastic community. The association with

the congregation of Santa Giustina of Padua in 1420 marked the beginning of a process of renewal in which there was the rebuilding of a great number of the monastery buildings, including the complex of San Benedetto in Polirone, later redesigned by Giulio Romano in 1540. Renaissance represented a new lease of life for the monastery, characterized by a lot of renown artists of the Italian Renaissance who worked at the Abbey as Correggio, Paolo Veronese or Giulio Romano himself.

THE CLOISTER OF THE SECOLARI

Cloister was among the most characteristics areas of the monastery because it served as a connecting function and it represented the place where the great part of the monks' life took place. The majority of large monastery buildings such as San Benedetto in Polirone, had more than a cloister and each of which was used for specific activities. At present in San Benedetto in Polirone, there remain three cloisters: Saint Benedict's cloister which is adjacent to one side of the main church, Saint Simeon's cloister created in 1458 and the cloister known as that of the "secolari". The third cloister was built in three different stages: the first before the fourteenth century, the second dating from 1474, characterized by the connection of the pre-existing buildings with the porticoes and the construction of corridors above the east and north sides, and finally the construction of the great staircase and the enlarging of all the cloister windows at the end of the seventeenth century. Cloister of the "secolari" is a designation which goes back to the sixteenth century when the ground floor of the east and south sides was used as a guest quarters for the poor and for pilgrims, instead the upper floor accommodated the higher ranking guests.
The cloister develops on four sides characterized by round arches supported by marble columns, masonry vaults in the porticoes, ground and in the upper floors while the attic has timber structures as roof.





CONSOLIDATION AND SEISMIC IMPROVEMENT

The earthquake of May 2012 provoked serious consequences on the cloister, in particular on the south and east wings, used as warehouse of the adjacent civic museum. The previous interventions aimed mostly to an overall re-functionalization and a seismic improvement of the bearing structures. Obviously, the first priority was to secure the structures from further decay and collapse, so the arches and the main entrance of the museum were supported with wooden provisional structures and new ties were located at the extrados of the vaults at the first floor in order to contrast the overturning of the east façade.

The next stage was the geometrical survey of: all ties in place (position, dimension and state of conservation), vaults, masonries, roof structures and the map cracking order to identify all the pre-existing weaknesses.

Such surveys regarding the cloister, have been carried out through a BIM (Building Information Modeling) approach, involving the generation and the management of a parametric three-dimensional model. Such approach has allowed to divide the building in categories of objects called “families”) and create a dynamic database of all parts of the cloister, identifying problems before executions phases.

The main structural weaknesses identified were attributable to: masonries not connected to each other’s and not toothed into the pre-existing structures as consequence of several interventions over time, insufficient number of ties that were not able to restore an effective transversal containing action and finally the presence of prompting roof structures.

Concerning the roofs, they were completely restored and seismic improved with the insertion of a new wooden curb in the south and east wings of the cloister and a metal’s one in the norther and west sides. Such intervention was necessary to connect the perimeter walls each other and with the wooden trusses of the roof and to ensure the “box behaviour” of masonries structures meaning that the building acts as a jointly assemblage of walls and roof. The whole intervention was improved by the insertion of a series of steel

cross elements under the bent tiles, working as bracing elements. Furthermore, every joint of the existing roof structures, needed to be verified and evaluated on a case-by-case basis and where appropriate, strengthened with steel elements. In case of the absence of a bottom chord in roof structures, it has been added a steel tie in order to improve the mechanical behaviour reducing acts on the masonries and preventing out-of-plane responses.
As regard the cracks on masonries and vaults, every crack was accurately opened along its entire length, trying as more as possible to preserve original plasters and decorations, then a consolidating mortar was injected through the crack in order to re-establish the continuity.
Moreover, the material filling the sides of vaults was removed and replaced with lightweight material connected to the walls and the mechanical behaviour was also improved with the insertion of new ties, working as a relevant protection element, able to restore an effective containing action.
All wooden architraves have been verified and replaced, where appropriate, by a metal element so as to increase its resistance.
In conclusion, concerning all the above mentioned works, it is relevant to highline that the complexity of the interventions was depending on the impossibility to apply a standardized approach, considering that each element is different from others and respecting in each stage the historical and artistic value of the building.

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