PRESERVATION OF XX CENTURY RESTORATION:

THE CASE OF PORTA VESCOVO IN VERONA

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Abstract

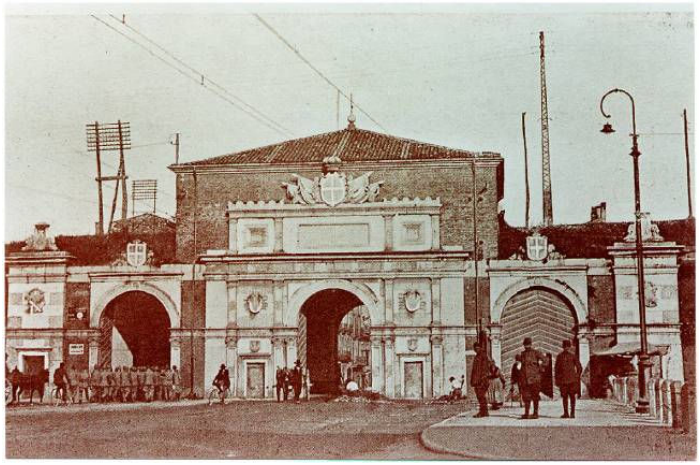
Porta Vescovo is one of the main gate to the city of Verona, through the city masonry walls.
Historical documents dates the construction of Porta Vescovo in 1520. Renaissance aspect remained until 1850, when a second cart way was realized and Porta Vescovo was heavily remodeled.
Between 1862 and 1863 Hapsburgs changed the shape of 1500 Porta Vescovo. Two lateral one store buildings were constructed in 1860, two new little towers and battlemented top were put on the outer side, but the sloping roof still remained untouched.
In 1920 new gates were opened in the curtain city walls near Porta Vescovo. Probably during this intervention, Genio Civile restored the cover of Porta Vescovo. Part of the climbing masonry arches that sustained the roof and the timber roof itself were demolished and a concrete slab was put as a cover for the building.
In 1952, after the Second World War, some restoration works interested the concrete slab.
In the past few years the Municipality of Verona carried out some study on the city gate: photogrammetric surveys, chemical analysis, damage evaluation, endoscope and georadar tests.
The concrete slab now shows evident signs of degradation, presenting large cracks and also lacunae. From these cracks, rain and water enter in the below structure and damage brick masonry and also the facades finishes.
The damage is due to the lack of compatibility between the preexisting structure and the 1920 intervention and to the bad execution of the concrete work, that makes the demolition of the concrete slab necessary to preserve the below part of the building.
The removal of a modern part is not proposed following aesthetic criteria, or giving preferences to an older historical period, but it is decided by chemical and physical phenomena.
The intervention project designed by the authors proposes the ancient timber tile covered roof and the remodel of the rain pipe system.

History and building description

Porta Vescovo is one of the main gate to the ancient city walls of Verona. (Picture 1)
Historical documents date the construction of Porta Vescovo in 1520, even if it seems that the works already started in 1517. The 1500's gate is a solid brick parallelepiped, with a cubic shape covered by a four pitch roof.

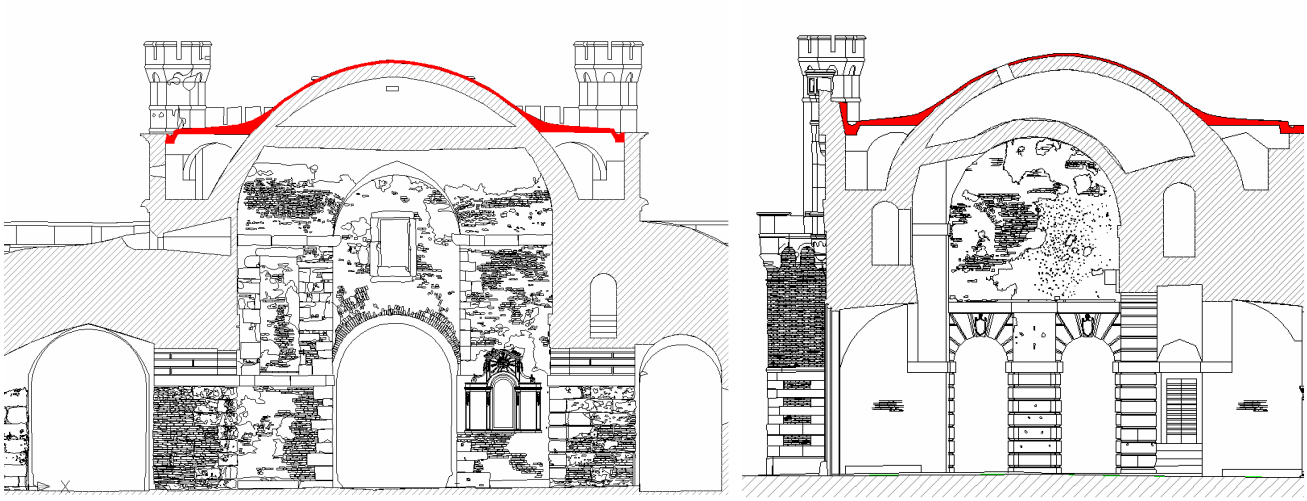
Picture 1 Porta Vescovo today-countryside

Inside there is a unique room, with the cart way and the guardian cabin, a cross vault covers the room. On the sides there are little rooms for guardians rest.
On the north side a winding stair reachs the upper level, from which the gate defense can be done and the gate can be closed. An unusual double vault covers these rooms. Over the vault there is the timber pitch roof.
Renaissance aspect remain intact until 1850, when a second cart way is realized and Porta Vescovo is heavily remodeled.
Between 1862 and 1863 Hapsburgs need a new cart way access to the hearth of the city and they change the shape of 1500 Porta Vescovo. In 1860, two lateral one store buildings are constructed, two new little towers and battlemented top are put on the outer side, but the roof pitches still remain untouched.
(Picture 2)



Picture 2 Porta Vescovo in XIX century -countryside

In 1920 new gates are opened in the ancient city walls near Porta Vescovo, in order to realize a faster link to the center of the city.
Probably during this intervention, Genio Civile restored the cover of Porta Vescovo. Part of the climbing masonry arches that sustain the roof and the timber roof itself are demolished and a concrete slab is put as a cover for the building. The slab coats the upper surface of the vault and it is connected to the perimeter wall with a concrete beam. The concrete cover has also cavities that work as rain pipe. In picture 3 it is shown the cross section of the concrete slab, whose upper part is vault shaded and lower part is plane.



Picture 3 Cross section-concrete slab in red

The slab has two different layers: the lower one is 5-6 centimeter thick and with a limited amount of steel reinforcement, the upper one is only 3-5 millimeter thick and presents a rose pigmentation obtained by using

oxides. Probably the second layer was put as a protection or to hide the concrete slab and to make it look like a masonry work. No documents show the contemporaneity of second layer with the lower one.
Several researches were carried out in the archives of the city and of many Bodies, in order to find documents about the XX century intervention on Porta Vescovo, but only some pictures taken during the demolition works have been recovered. (Picture 4-5)
In 1952, after the Second World War, new restoration works interest Porta Vescovo. No documents had been found relevant to this intervention, despite several searches.

Picture 4 Demolition of timber roof in 1920-1930

Picture 5 Other picture of 1930 roof demolition

Studies and surveys

Because of the lack of documentation on the near past intervention on Porta Vescovo and in order to study the condition of building before new works, the Municipality of Verona carried out some studies on the city gate: photogrammetric surveys, chemical analysis and damage evaluation.
From the photogrammetric surveys and from the material survey (Picture 6-7), it's possible to see the some concrete lacunae refills on the lower opening in the city side, that can be dated to the 50' intervention.
After the surveys phase it's possible to affirm that the XX century restoration on Porta Vescovo consisted most prevalently in the demolition of the timber roof and part of the climbing arch, the refills of lacunae and the construction of the new concrete cover. All the intervention were realized in concrete.
The damage evaluation also shows that today the concrete slab brings evident signs of degradation, presenting large cracks and also lacunae. From the cracks, water entered in the concrete and got in touch with the steel causing the oxidation of the inside reinforcement. The volume growth of the steel due to the oxidation broke the concrete and caused the collapse of some parts of the plane slab.

Picture 6 Material survey-city side-concrete in red

Picture 7 Material survey-city side-concrete in red

Concrete rain pipe are positioned near the battlemented top and they also show evident signs of damage, as discontinuities and holes. From the cracks on the vault, on the plane slab and of the rain pipe, rain and water enter in the lower structure and damage brick masonry and also the facades finishes. (Picture 8)
The concrete work is rich in salt, which it releases when it gets in contact with water. These salts are a further injury cause to the below brickwork.[1]
Moreover the concrete slab does not permit perspiration and ventilation in lower room, increasing relative humidity and making it very high. [2]
Finally slab upper surface is covered by a green patina.
The damage is due to the lack of compatibility between the preexisting structure and the 1920 intervention and to the bad execution of the concrete work, but also to the air pollution. [3]

Picture 8 Concrete slab outer view

The 20's and 50's interventions on Porta Vescovo are a clear example of a typical way of intervention on ancient buildings realized in the XX century in Italy. They show the infinite trust generally accorded to the concrete and to the modern materials, considering them always the stronger and cheapest solution and thinking that they could be used everywhere. Due to the absolute trust in concrete the works were realized without carrying out any chemical study on the existing part of the building. Moreover the quality of the XX century intervention is very poor and in contrast with the high quality of the precedent works in Porta Vescovo.

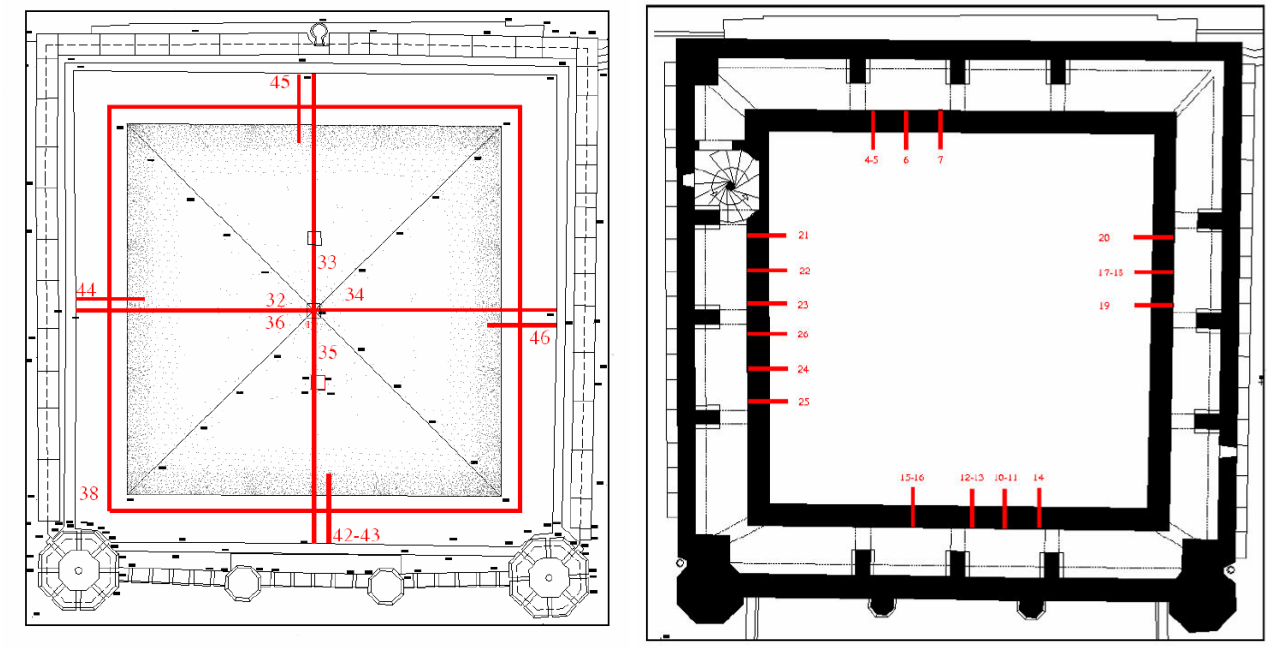
Picture 9 Concrete slab interior view

Picture 10 Concrete slab interior view

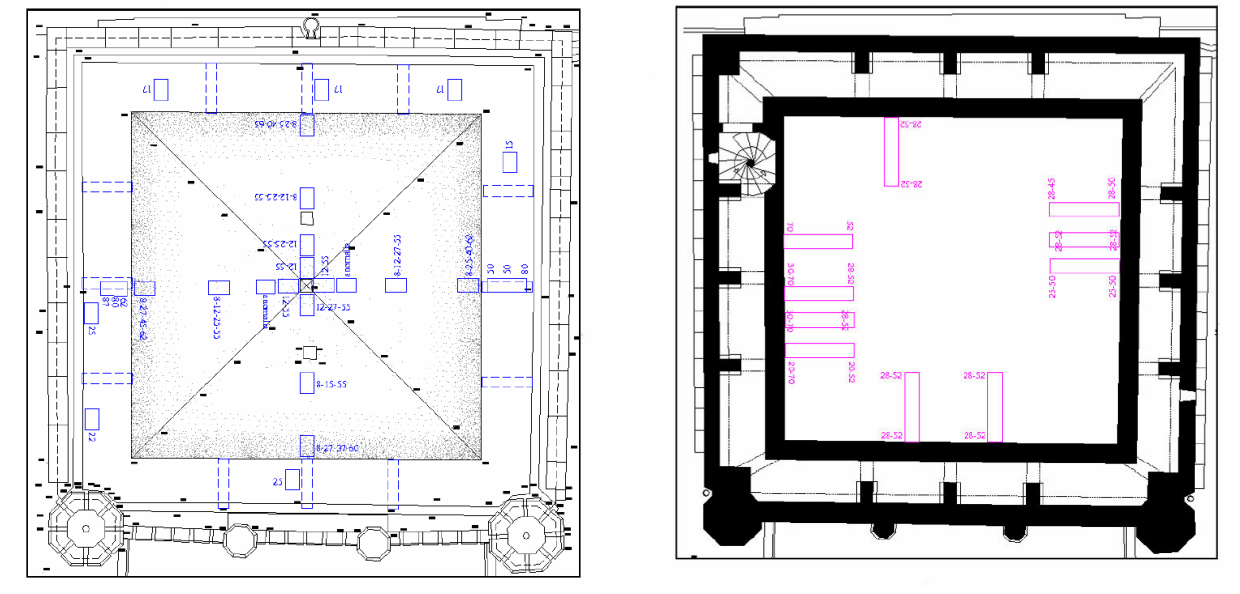
On site testing and investigations

In order to achieve the knowledge for the preservation design of Porta Vescovo, the Municipality of Verona supported a second phase of tests and investigations.
Only non destructive tests were carried out, in order to preserve the integrity of the building. Georadar and endoscope investigation were made on the concrete slab to know its real thick.
Three holes 12 mm diameter were made with chain feed rock drill to discover both the presence of holes and the bricks and mortar consistence and thick. A flexible optical fiber videoendoscope, 8.4 mm external diameter, was used.
Endoscopies picture from the top of the cover shows that in the center of the vault the concrete slab is 5 cm thick and masonry vault is 57 centimeter thick. (Picture 11)
Georadar tests integrated the geometric surveys. Electromagnetic wave penetrated for about 80 cm in the upper vault with 30 centimeter strips. Picture 12 shows the georadar path.
The investigation shows that concrete layer has a variable thick from 5 to 12 centimeters on the vault and from 15 to 25 thick out of the vault.

Picture 11 Endoscope test



Picture 12 Georadar run on the cover and form inside



Picture 13 Georadar results

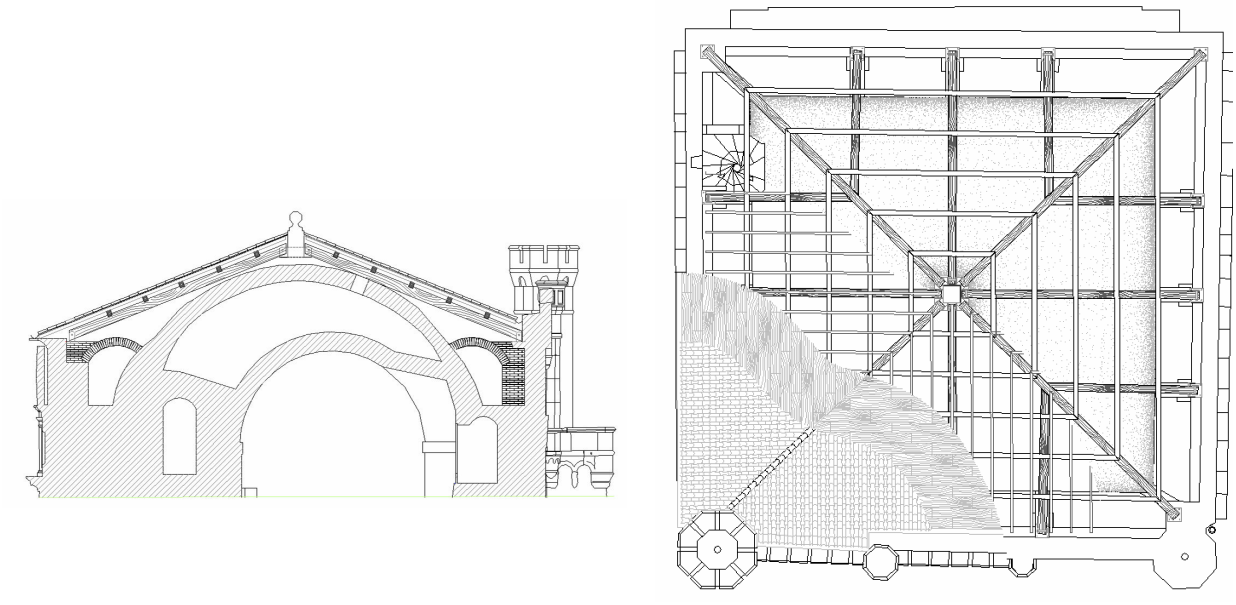
Preservation aim

The design of the actual Porta Vescovo intervention is based on the criteria of minimum intervention, structural compatibility and chemical-physical compatibility and reversibility.
The aim of the design is the preservation of the building, designing only the strictly necessary interventions to permit the construction to survive through the time. The interventions have to respect the preexisting, in chemical and physical effects, without bringing any kind of damage to the building.
According with this criteria, some times it's necessary to lose a part to preserve the rest of a building. The choice is made on scientific principles, that came from chemistry and physics, and never from the criterion of beauty and oldness. The today historical conscience realized that the judgment of beauty changes through the time and what today is considered unpleasant, tomorrow could become beautiful.
Also eliminate, choosing by the age, can bring to the same conclusion.
The criterion of the reversibility is the most difficult to follow, first of all because sometimes some parts have to be eliminated, then because a complete reversibility is impossible: any intervention leaves his tracks

on the building. But, in order to avoid problems like those now Porta Vescovo shows, it's necessary to design the intervention that is the most reversible as far as possible.

Preservation design

The XX century intervention on Porta Vescovo brought damage to the building. The preservation of the concrete slab is difficult work due to the state of damage of the slab itself.
According to the criteria now exposed, the aim of the design is to preserve the whole building.
The preservation of the concrete slab would keep the memory of certain kind of intervention typical of the past century and the XX century shape of East Verona gate.
Unluckily the concrete slab brings damage to the remaining parts of the building and to preserve them from other injury it is necessary to remove it. The removal of a modern part is not proposed following aesthetic criteria, or giving preferences to an older historical period, but it is decided by chemical and physical phenomena.
When the concrete cover will be removed, Porta Vescovo will need another cover, in order to preserve the lower structure.
The intervention design proposes the ancient wooden tile covered roof and the remodel of the rain pipe system.
Verona is defined a seismic area by Italian law and the design is supported by a seismic vulnerability analysis of the building that will also improve the seismic behavior of the structure.
Porta Vescovo will present a new four pitch roof, tile covered, in order to reintegrate the shape. The structural system will be different from the old one, in order to respect the criterion of recognizability and to avoid any kind of damage to the Porta's structure.
The concrete slab will be completely removed, but the bond beam. The bond beam will be corrosion inhibited, consolidated and the lacunae will be refilled in order to preserve it and to use it as a support for the new laminated timber roof and to maintain a bonding effect. The timber structure will only lean on the concrete bond beam without any kind of interaction with the masonry vault.
The climbing masonry arches will not be demolish, neither reconstructed o remodelated. They will not present any kind of shape change.
The new laminated timber roof will be recognizable from inside the Porta Vescovo building, because of the shape and the material. It will be self bearing, without transmitting any kind of horizontal force to the vault and it will be ventilated. It will not bring to Porta Vescovo any kind of structural or finishing damage.



Picture 14 Roof project

Conclusion

Many investigations and test had been carried out on Porta Vescovo in order to study its damage and damage causes. The XX century intervention on the city gate bring injury to the remaining part of the

building because it is incompatible chemically and physically and because the work quality is low. In order to respect the rest of the monument, the demolition of concrete parts is needed. The intervention, as proposed, will follow the criteria of minimum intervention, structural compatibility and chemical-physical compatibility. But it will be very difficult to follow the criteria of reversibility.

Bibliography

AA.VV., L'architettura militare veneta del Cinquecento, Ed. Electa, Milano, 1988.
G. BARBETTA, *Le mura e le fortificazioni di Verona*, Ed. Vita Veronese, Verona, 1970.
L.V. BOZZETTO, *L'architettura militare asburgica a Verona*, in AA.VV., *Il Veneto e l'Austria, Vita e cultura artistica nelle città venete 1814-1866*, Catalogo della mostra a cura di S. Marinelli, G. Mazzariol, F. Mazzocca, Ed. Electa, Milano 1989, pp. 396-407.
E. CONCINA, *Verona veneziana e rinascimentale*, in AA.VV., *Ritratto di Verona. Lineamenti di una storia urbanistica*, a cura di L. Puppi, Verona 1978, ed. Banca Popolare di Verona, pp. 268-316.
DA LISCA, La fortificazione di Verona dai tempi romani al 1866, Verona 1916.
V. JACOBACCI, *La piazzaforte di Verona sotto la dominazione austriaca 1814-1866*, Ed. Cassa di Risparmio di Verona Vicenza e Belluno, Verona, 1980.
G. MAZZI, *Il Cinquecento: i cantieri della difesa*, in AA.VV., *L'architettura a Verona nell'età della Serenissima*, a cura di P. Brugnoli e A. Sandrini, Ed. Banca popolare di Verona, Verona 1988, pp. 149-190.
P. PEDEFERRI AND L. BERTOLINI, *La corrosione del calcestruzzo negli ambienti naturali*, McGraw-Hill, Milano 1996.
L. FRANKE AND I. SCHUMANN, *Damage atlas-classification and analyses of damage patterns found in brick masonry* European Commission - Protection and Conservation of the European heritage, project EV5V-CT92-0108 -research report n°8 vol 2, 1998
R. ANTONUCCI, *Restauro e recupero degli edifici*, Maggioli Editore, Rimini 2001.

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