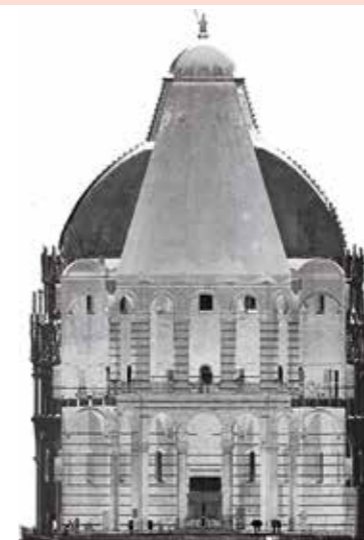


Pisa (Italy)

Baptistry of St. John

RENDER INSIDE THE CUPOLA RESTORED TO ITS ANTIQUE SPLENDOUR.
AN EFFECTIVE RESTORATION INTERVENTION THAT RESPECTS AESTHETICS



LEFT. A section of the Baptistery showing the truncated pyramid cupola and external semi-spherical canopy over the cupola.
IN THE FACING PAGE. Piazza Del Duomo (also called "dei Miracoli") has been a UNESCO World Heritage site since 1987.



With a circumference of 107 m and a height of 55 m, the monument rising in front of the western façade of Santa Maria Assunta Cathedral in Piazza dei Miracoli is the biggest Baptistery in the whole of Christendom. Construction of the building started in the 12th century but the work was only finally completed after more than two centuries. As testified by an inscription on two pillars inside the building dated 1153, construction work was initiated by the architect Deotisalvi:

MCLIII, MENSE AUGUSTI FUNDATA FUIT HAEC ECCLESIA; DEUSTESALVET MAGISTER HUIUS OPERIS (In August 1153 this Church was founded, Diotisalvi was the designer of this work).

Work on the Baptistery started again, after an interruption of one century, thanks to Nicola and Giovanni Pisano. The façade in Pisan Romanesque style is richly adorned with sculptures, many of which were transferred to the nearby Museo Dell'Opera Del Duomo. Inside the Baptistery, a women's gallery overlooks the central space, providing an enchanting prospective to observe the baptismal font in which Galileo Galilei was baptised in 1564. The roofing system of the monument is characterised by a double cupola: an internal one in the form of a truncated pyramid with a dodecagonal base and an external one in the form of a semi-spherical canopy. This architectural workaround gives the Baptistery excellent acoustics, but

Problems and solutions

The objective of the owner was to restore the deteriorated and damaged render inside the cupola of the Baptistery and bring it back to its original splendour. Restoration of the inside of the cupola required particular care for both the consolidation of the existing render, for which it was decided to leave in place, and for the new render. This required the use of products guaranteeing excellent compatibility and an excellent bond with the original substrates, while at the same time ensuring a colour and texture with a beautifully balanced final finish in line with the original look of the cupola. MAPE-ANTIQU STRUTTURALE NHL and the other products from the MAPE-ANTIQU Line, enabled this excellent result to be achieved.



LEFT. The gaps and voids from the putlog holes were repaired by filling and plugging them with the original bricks and MAPE-ANTIQUE ALLETTAMENTO.



RIGHT. Rebuilding the render on the intrados of the dome.

leaves the upper cupola more exposed and provides less protection from meteorological and climatic conditions, which led to its deterioration clearly visible from inside the building prior to the restoration work. The render on the intrados of the cupola showed clear signs of physical damage caused by external and anthropic factors: areas of missing render, portions of detached render, surface stains, cracks and the reappearance of putlog holes.

Winning teamwork

The restoration work, which got under way in the spring of 2021, was an excellent example of collaboration between the design team, technical support provided by Mapei to help choose the most suitable materials and technology, and perfect execution of the work by the restoration team. The complex design work coordinated by Roberto Cela, Technical Director of the Opera Della Primaziale Pisana organisation, had the assistance of Mapei Technical Services to help plan remedial work in line with the principles of restoration work and in full respect of the aesthetics of the monument. Impresa Cellini, a contracting company involved in restoration work on historic monuments and buildings since the end of the 19th century (with which Mapei also collaborated in restoration work on the Baptistery of St. John in Florence), was also part of this synergy. It was very impor-

tant to use materials which were chemically-physically and elasto-mechanically compatible with the original substrates, and products from the MAPE-ANTIQUE line played a key role as they are all completely cement-free and made from lime and Eco-Pozzolan, and developed specifically for consolidation, repair and restoration work on masonry of buildings of historic and artistic interest.

Restoration work on the render

All the render in poor condition and any loose material were carefully removed. The masonry was then cleaned until a sound, compact substrate was obtained. The gaps and voids from the putlog holes were repaired by applying MAPE-ANTIQUE ALLETTAMENTO cement-free, salt-resistant mortar made from natural hydraulic lime and Eco-Pozzolan. For the new render, a layer of MAPE-ANTIQUE STRUTTURALE NHL was applied by trowel. This is a cement-free, fibre-reinforced mortar, made from natural hydraulic lime and Eco-Pozzolan, which is used to make breathable render compatible with the mechanical performances of the existing masonry. Once the mortar had cured, it was skimmed with a coat of MAPE-ANTIQUE NHL ECO RASANTE GROSSO, a coarse-grained, breathable mortar made from pure natural hydraulic lime with the same texture as the original render to create a balanced finish.

COMPATIBILITY OF MATERIALS: RESPECT FOR THE PAST AND NEW TECHNOLOGIES



WE SPOKE WITH ILARIA CELLINI FROM IMPRESA CELLINI SRL, THE COMPANY THAT CARRIED OUT THE RESTORATION

Your company has been working in the restoration field for years and you even have a branch of the family tree that leads to Benvenuto Cellini. Is it important to be familiar with construction techniques used in the past to have the correct approach to restoration work?

Yes, it is very important. I would

go as far as to say that it is indispensable to be familiar with the construction techniques and materials they used in the past. Just as important, however, is to carry out an in-depth analysis of the structure you intend working on to identify any restoration work carried out previously and what materials and techniques were used. This allows you to intervene with the maximum respect for the "structure", which is particularly important nowadays where schedules for restoration work are more and more compressed and there are so many materials available on the market, many of which appear to be the same but actually differ enormously in terms of what they are made from and their performance. The right product needs to be chosen very carefully, first and foremost according to the type of problems you encounter. Also, it

is important that the products are chosen in such a way that they are compatible, in chemical-physical and elasto-mechanical terms, with the materials originally used. Choosing a product that is not compatible with the materials and construction techniques used in the past can result in an intervention being unsuccessful or its sudden deterioration. Even though the materials we use nowadays are modern, they are the result of continuous research work that "uses" the past as a starting point, but which represents a point of strength in the present. Another aspect is the application method adopted: this is where the experience and, above all, the expertise of the restorer comes into play, a prerequisite for successful conservative renovation and restoration work.

What were the most challenging technical problems you

encountered during the restoration work on the Baptistery of St. John and how did you tackle them?

I wouldn't call them difficulties as such, but rather the optimisation of all the phases of site work to comply, on the one hand, with the requirements of the client and, on the other hand, to respect the schedule required by the material chosen. The client required all the preparation work of the materials to be carried out outside to prevent dust building up inside the structure. This meant that every phase of the intervention had to be carefully planned so that the materials, once they had been prepared, were applied within the timeframe specified by the manufacturer, bearing in mind also that the work was carried out in the hottest time of the year, which accelerates the setting time for any product. To achieve this, we set

up a kind of "assembly line" which involved various personnel: once the products had been mixed outside, they were taken into the structure and delivered to the various teams working on the scaffolding so that they arrived at the level required for their application.

Similarly, when removing and transporting the damaged and deteriorated render and mortar down to ground level, this was carried out before the operations mentioned previously to create as little dust as possible.

Nowadays, paying particular attention to innovative materials is a fundamental requisite. Mapei always starts from the traditions and knowledge of the past when developing products. How much does it help to be able to rely on innovative products such as those proposed by Mapei?

Nowadays it is very important

to use products with the same characteristics as the original materials used to build historic structures and which, at the same time, help accelerate the actual execution time of works. For work such as that of the Baptistery in Pisa, if we had used traditional materials such as slaked lime and sand, we would have had to wait more than three months for the mortar to cure correctly, which would have been incompatible with the schedule for that site. With the mortars supplied by Mapei we were able to optimise the curing time for the rendering and masonry mortars and, as a result, reduce the overall execution time of the work to meet the requirements of a client that is always very cost-conscious, and also optimise hire charges for scaffolding which nowadays has quite a significant impact on overall work costs for conservative renovation and restoration work.



ABOVE. Portions of render detached from their substrates were consolidated and re-bonded by injecting MAPE-ANTIQUÉ F21.

Consolidation of the existing render

The render that had become detached from the masonry, for which it was decided to leave in place, was consolidated and re-bonded to the masonry by injecting super-fluid, lime-based slurry. The first step was to drill a series of holes. All traces of dust were removed from the substrate with a hand-pump and then syringes were used to inject a slurry made up with MAPE-ANTIQUÉ F21. This injection slurry was developed by Mapei for another project: the consolidation work on the frescoed vaulted ceilings by Giotto and Cimabue in the Upper Basilica of San Francesco in Assisi, which was damaged by an earthquake in 1997 (see *Realtà Mapei International* no. 5). On that occasion Mapei developed MAPE-ANTIQUÉ F21, a super-fluid, cement-free, salt-resistant fillerized hydraulic binder, made from hydrated lime and eco-Pozzolan, ideal for injection slurries for consolidat-

ing masonry and render, including the frescoed ones. MAPE-ANTIQUÉ F21 may be applied without having to wet the substrate beforehand: the water-retention additives contained in the binder prevents water contained in the product from staining the surface of high-quality finishes. Also, because there are no soluble salts or free lime in the slurry, the product cures perfectly with no efflorescence phenomena. Indeed, free lime inside masonry to be consolidated, not being able to find any air (CO₂) for carbonation, could remain as a paste for a very long time and temporarily compromise the effectiveness of the structural consolidation work.



Find out more
MAPE-ANTIQUÉ NHL ECO-RASANTE GROSSO

TECHNICAL DATA
Baptistery of St. John,
Pisa (Italy)
Period of construction:
12th-13th century
Original designers:
Deotisalvi, Nicola and
Giovanni Pisano
Owner: Opera Della
Primaziale Pisana

**Year of the restoration
intervention:** 2021
Intervention by Mapei:
supplying products for
restoring and rebuilding
render
Works direction: Roberto
Cela (Technical Director,
Opera della Primaziale
Pisana)

Main contractor: Impresa
Cellini
Mapei distributors: Lupetti
Renato Srl
Mapei coordinators:
Giacomo Maestrelli and
Alessandro Giari,
Mapei SpA (Italy)

MAPEI PRODUCTS
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Antique Strutturale NHL,
Mape-Antique NHL Eco
Rasante Grosso, Mape-
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products visit mapei.com

**THE IMPORTANCE OF EXPERIENCE
AND SOFTWARE SYSTEMS**



ROBERTO CELA, TECHNICAL DIRECTOR
OF OPERA DELLA PRIMAZIALE PISANA

Piazza Dei Miracoli in Pisa is one of the most important artistic and tourist attractions in the world. What kind of monitoring work does the Opera Della Primaziale Pisana organisation carry out in order to conserve the integrity and functionality of the monuments in the square?

Piazza Del Duomo and its monuments has been a UNESCO World Heritage site since 1987 and the task of the Opera Della Primaziale Pisana organisation is to conserve the entire square so that it can be enjoyed by future generations. The craftsmen working for the organisation are the first line of defence and a kind of “emergency service” if any conservation work needs to be carried out, in that they are specialised in various aspects of restoration work and are on site on a daily basis. Some of them have been trained to work at height suspended from cables so they can also check the features at the top of the monuments, otherwise they would not be able to reach them. Nothing gets past the eye of an experienced professional and their knowledge of buildings when assessing the state of conservation of our monuments. Software tools are also a fundamental help in reducing the level of risk. In fact, we are currently validating a software system that associates direct observation with specific algorithms that are able to define the level of risk and, as a result, the level of alarm in order to programme the successive inspection or prioritise targeted conservation work. And the aim of this activity is to safeguard the monuments, but also to ensure the safety of tourists and worshippers.

What critical areas have you identified within the cupola of the Baptistery?
The Baptistery is around 55 m high and has a diameter of 45 m. The roof is made up of a truncated pyramid-shaped cupola partially surmounted by a semi-spherical

inner cupola. This “void” is extremely large if we consider that the one in Pisa is one of the largest Baptistery in the world. The intrados is covered with render that has not been decorated and, over the years, it has been showing signs of deterioration and detachment, caused mainly by water infiltrating through the roof. When it was decided to intervene on the render, the main problem was how to erect an enormous scaffolding structure suspended from the women’s galleries that would allow us to reach the entire surface of the intrados of the cupola.

What technical aspects did you concentrate on and what factors were the most challenging?

First and foremost, chemical-physical and elasto-mechanical compatibility with the materials used for the masonry structure below and with the old mortar, which goes “arm-in-arm”, as with most work carried out on historic monuments, with the need to work on a medium to long-term basis and, as a result, guarantee the durability of the work undertaken.

The final aesthetic aspect of the restoration work is surprising. What part did Mapei Technical Services play in the work?

We had support from Mapei experts right from the design phase to identify the most suitable products and methods for specific work, and they also worked alongside us during all the various site activities to validate the choices we had made by carrying out analyses in the laboratory to verify the compatibility of the products with both the old mortar and the ancient substrates, suggesting coating products and their composition and texture, as well as providing support to the craftsmen so that everything was applied and installed to perfection.

Choosing and applying materials should be viewed on a medium to long-term basis