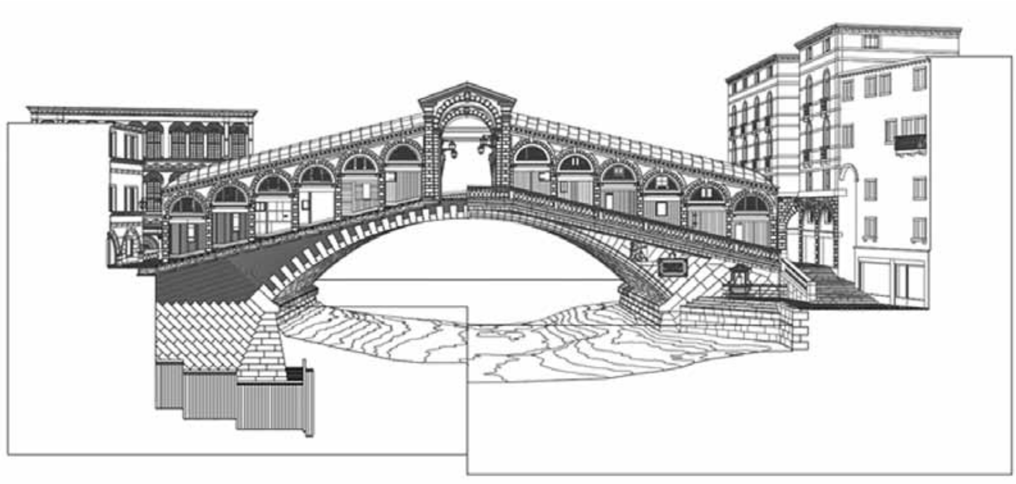
RIALTO BRIDGE IN VENICE

THE RENOVATION FOCUSED ON PRESERVING THE EXISTING MATERIALS, REMOVING THE DAMAGED ELEMENTS AND STOPPING ANY ONGOING DETERIORATION



RIGHT. A front view of the Rialto bridge, originally designed by Antonio Da Ponte.
BELOW. The Rialto bridge after completion of the renovation works.

Well aware of the need to preserve this world-famous symbol, Venice City Council decided to restore Rialto Bridge with an intervention to protect the structure from further deterioration while maintaining its functionality and its undeniable historical and artistic significance.
The restoration work was also made possible thanks to the support of Renzo Rosso and his OTB group, who sponsored the intervention with a contribution of 5 million Euros. Apart from handing over the work by the scheduled completion date, not all the funds set aside for the restoration had been spent so, in agreement with the City Council, refurbishment of the road surfaces under the Rialto Collonades was also approved.

HISTORY OF THE BRIDGE

Along with the Accademia, Scalzi and Costituzione bridges, Rialto is one of the four bridges crossing Canal Grande and is the oldest and most famous of the four.
The original bridge was made up of a series of boats and was called Quartarolo, the name of the coin used to pay the toll. This was replaced in the twelfth century by the first fixed structure, a bridge designed by the engineer Niccolò Barattieri which was supported by wooden posts. At a later date, the bridge was strengthened and widened by adding two lateral ramps that could be raised to allow boats to pass through and, from then on, it became known as Rialto Bridge, after the area in which it was built, Rivoalto. It was destroyed by fire in 1310 and then rebuilt, only to collapse again in 1444 under the weight of hundreds of spectators watching a boat parade. It was rebuilt again, but this time it was wider and had small stores along its two sides.
Following another collapse in 1524, it was decided to rebuild the bridge using Istria stone, an ivory coloured material particularly resistant to atmospheric agents and saltwater. After considering other proposals by Palladio, Vignola and Michelangelo, the local authority opted for a design by the Venetian architect, Antonio Da Ponte. Work commenced in 1588 and the bridge was completed three years later. The bridge has a single, 28 m wide span and all its weight is supported by foundations made up of 12,000 elm piles and larch planks which, to this present day, still bear the load of the 24 small stores on the bridge.

A WATER-BASED SITE

Over the years the bridge has been partially restored on several occasions and has also had new piping installed, but there had never been the need for such extensive and significant structural work. An analysis and survey of the bridge was carried out before commencing any work, which highlighted that the structure itself and the foundations were still in good condition, while the balustrade and parapet running along the two sides of the bridge were badly cracked and were in such a critical condition that they were a safety risk for users of the bridge. Also, the walls of the small stores were in poor condition and their external stone masonry facades had become detached from the internal brickwork.
Once the survey and an analysis of the problems had been completed, work got under way in 2015. Scaffolding was erected to create a raised area so that it wouldn't interfere with pedestrians passing over the bridge. The work was divided into separate lots in order to keep the bridge open to pedestrians and work on the pavements, excavation work and the disposal of waste material were mainly concentrated in the night shifts.
The structural work was divided into two

distinct areas, involving the balustrades and the facing walls of the stores. In the first case, the parapets were consolidated by adding duplex stainless-steel mantels and carbon fibre strengthening strips and cords, while for the second area, basalt fibre strengthening cords were used to tie in the stone walls and the brick walls.
The upper face of the bridge was then waterproofed with an elastic membrane to allow for the bridge's slight, natural movements.
Further work was carried out to clean the stones that form the lower face of the arched section of the bridge, the sides of the bridge, the parapets and the so-called Masegni stones – or large blocks of trachyte from the Euganean hills – used to make the pavements of the bridge.
The larger, heavier stones were removed, numbered, cleaned and then stored in a specially prepared site in a nearby square.
The small columns of the balustrades were also removed, numbered and restored. They were then set in place with molten lead and, once the lead had solidified, they were tapped into their final position; the same columns had previously been set in cement, which had caused the damage.
The final step was to remove all the dirt and pollution (layers of biological matter, graffiti and a thick, black crust) which also highlighted how the aggressive cleaning operations carried out in the 1970's had scratched the surface of the Istria stone.

THE RESTORATION PROJECT

The first aspect to take into consideration for the restoration of Rialto Bridge was its historical, architectural, construction and cultural significance, not only for the inhabitants of Venice.
The objective for the design engineers was the restoration, maintenance and arrangement of the entire structure: a conservative and long-lasting intervention which would stop the bridge from deteriorating any further and bring it back to its original look.
Apart from preserving the materials and treatments applied over the centuries to combat wear and tear of the bridge, the aim of the work was to remove all the deteriorated elements and features, treat them to stop any ongoing deterioration and put them back into their original place, and prevent other forms of deterioration in the materials.
According to the static survey of the bridge, the vaulted roof was found to be compliant with current static safety norms and standards and sufficient to support the design loads.
The readings taken in the small stores showed that minor but effective strengthening work was required by adding a chain at the start point of the arched sections.

MAPEI'S CONTRIBUTION

The maintenance project for Rialto Bridge also involved Mapei Technical Services and the application of various Mapei systems.
To consolidate the balustrades of the bridge parapets, it was recommended to inject them with MAPE-ANTIQUE I in order to strengthen the structure and improve its mechanical strengths.
MAPEROD G pultruded carbon glass fibre bars, characterised by their high tensile strength, were then inserted into the guide holes.
The installation bed for all the steps on the bridge was formed by applying a layer of MAPE-ANTIQUE STRUTTURALE NHL mortar. This is a high-performance mortar for transpirant render and masonry work, based on natural hydraulic lime and Eco-Pozzolan.
This product is classified as GP according to EN 998-1 standards and as G according to EN 998-2 standards.
A layer of MAPE-ANTIQUE STRUTTURALE NHL mortar was also applied on the arches of the bridge and the surface was treated with a coat of PRIMER SN two-component, solvent-free epoxy resin-based primer before applying PURTOP HA two-component polyurea waterproofing membrane by trowel.
This product is part of the PURTOP line of products and features high resistance to chemicals, high elasticity and high tear strength.
For some of the work on the roof of the stores, Mapei Technical Services proposed MAPEPLAN waterproofing membranes by Polyglass, a subsidiary company of Mapei Group.

The joints between the stones immersed in the waters of Canal Grande were pointed by injecting STABILCEM very fluid expanding cementitious binder admixed with MAPEPLAST UW anti-washout powdered admixture that has been specifically developed for underwater concrete. In the areas of pavement that needed to be structurally strengthened, the stone slabs were bonded and sealed with ADESILEX PG2 two-component thixotropic epoxy adhesive for structural bonding.
Rialto Bridge was officially inaugurated last May to coincide with the 57th edition of the Venice Biennale International Architecture Exhibition.

PHOTO 1 and 2. The joints between the stones immersed in the waters of Canal Grande were pointed by injecting STABILCEM binder admixed with MAPEPLAST UW.
PHOTO 3 and 4. A coat of PRIMER SN was applied before using PURTOP HA two-component polyurea membrane.
PHOTO 5. The balaustrades of the parapet along the bridge were consolidated by injecting them with MAPE-ANTIQUE I. MAPEROD G pultruded glass fibre rods were then inserted into the guide holes.
PHOTO 6. The stone slabs were bonded with ADESILEX PG2.

IN THE SPOTLIGHT

PURTOP HA

Manually-applied two-component, polyurea waterproofing membrane for small to medium size terraces and flat roofs, and for repairing surfaces waterproofed with hybrid polyurea and/or pure polyurea membranes. It offers excellent tensile strength and tear strength; high static and dynamic crack-bridging capacity, including at low temperatures; elongation capacity of more than 500%, and excellent resistance to alkalis and diluted acid. It requires no reinforcement.

TECHNICAL DATA

Rialto Bridge, Venice (Italy)
Original design: Antonio Da Ponte
Period of constuction: 1588-1591
Period of the intervention: 2016-2017
Intervention by Mapei: supplying products for strengthening the balustrades, waterproofing the arcades, preparing the installation bed for the steps, pointing the joints of the stone immersed in water, installing stone slabs
Design: Alberto Chinellato; structural and conservative restoration: Andrea Marascalchi; scientific consultant for restoration: Eugenio Vassallo
Client: Venice City Council
Works direction: Roberto Benvenuti
Contractors: Setten Genesio, Lares Srl, Lithos Srl
Installation company: Graffito Srl
Mapei coordinators: Pasquale Zaffaroni, Davide Bandera, Giulio Morandini, Mauro Orlando, Michele Orlando, Claudio Azzena, Mapei SpA (Italy)

MAPEI PRODUCTS

Consolidating balaustrades: Mape-Antique I, Maperod G
Preparing the installation bed for the steps: Mape-Antique Strutturale NHL
Waterproofing the arcades: Primer SN, Purtop HA
Pointing the joints underwater: Mapeplast UW, Stabilcem
Bonding the stone slabs: Adesilex PG2

POLYGLASS PRODUCTS:

Waterproofing the roofs: Mapeplan membranes

For further information on products see www.mapei.com and www.polyglass.com