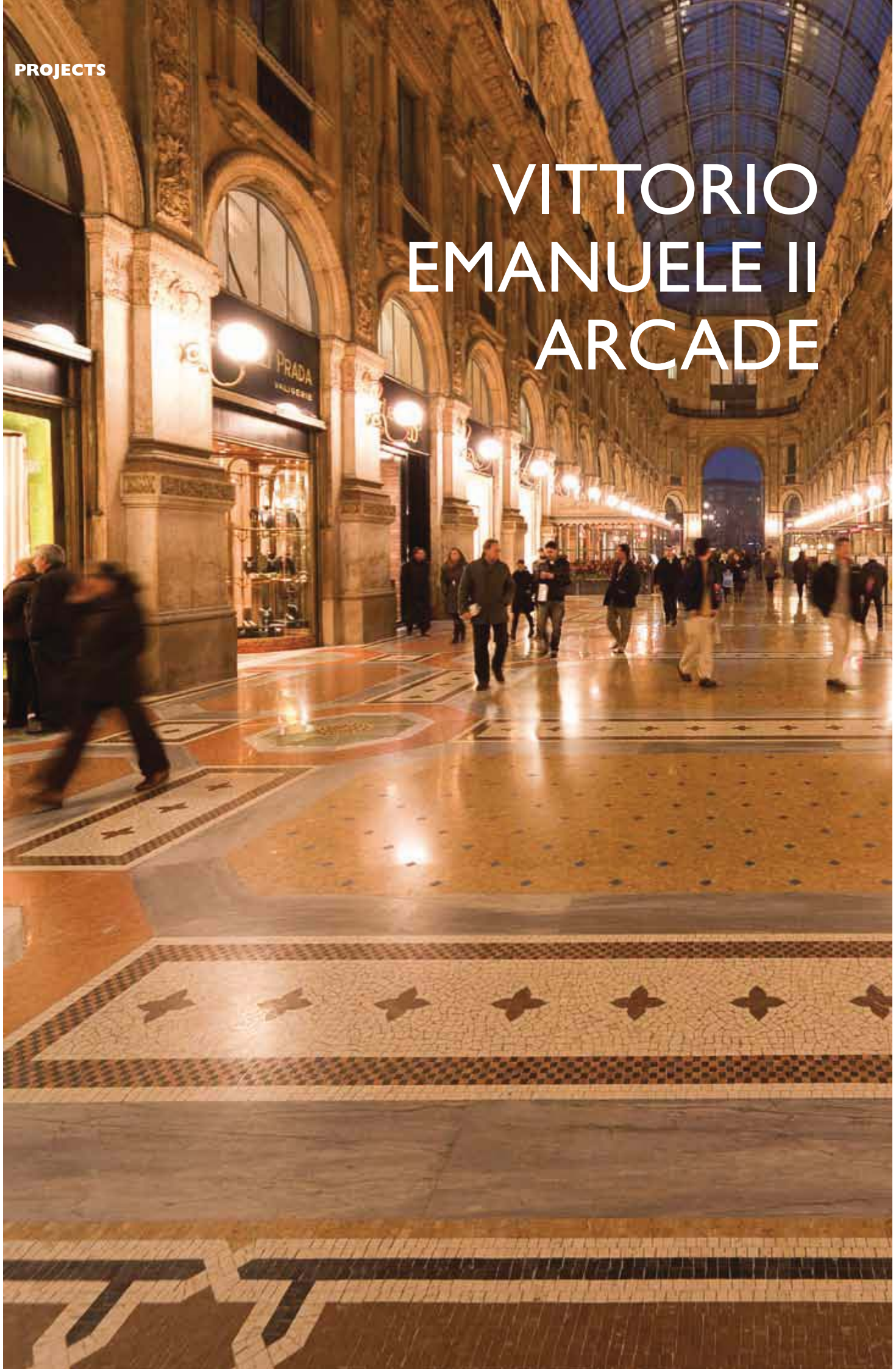


PROJECTS

VITTORIO EMANUELE II ARCADE





The mosaic floor of the “drawing room” of Milan has been brought back to its antique splendour

The mosaic floor of the Vittorio Emanuele II Arcade in Milan has been brought back to the original splendour, created in the second half of the nineteenth century by the architect Giuseppe Mengoni.

Between 2011 and July 2012, the Arcade, considered one of the symbols of the city, underwent conservative restoration work on the 5,868 m² of flooring, made up of 3900 m² of arcade and 1,968 m² of porticoes. A vast area of the mosaic flooring was removed, replaced and consolidated and 258 octagonal and circular inserts were restored.

The intervention included all the surfaces in natural stone (granite, Bardiglio and Rosso Verona marble), the marble mosaic tiles and the decorative elements which were replaced with new ones in the same colour and pattern as the originals.

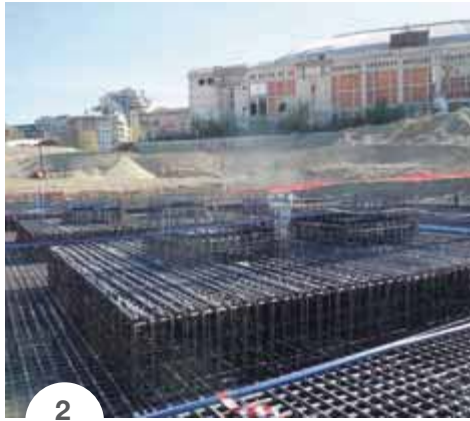
A careful preliminary analysis highlighted which components were in good condition and which needed to be replaced, and all the elements were repaired, grouted and then veiled to help them all blend in well. At daytime mosaic layers, craftsmen, marble layers, technicians worked three shifts on the floors. Work was completed by polishing and then applying a protective treatment on the surfaces.

The restoration site was well organised so that the normal life of the Arcade and the shops

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Photos 1 and 2. The flooring prior to restoration work.
Photo 3. After removing the inserts and the damaged areas, EPORIP was applied and the gaps were rebuilt with MAPEGROUT T40.

Photos 4 and 5. Where possible, the inserts were repaired in the workshop. The petals in the insert were bonded with KERALASTIC T.

in the gallery could continue as normal. The flooring was also sub-divided into lots of smaller areas so that the work would have less impact on the shops.

Restoration work was carried about by a specialized company with the cooperation of Mapei, whose R&D laboratory was made available to select and check the products, and technicians from the company were present on site every day.

The works were completed within the forecast time according to the project designed by arch. Pasquale Francesco Mariani with official appointment from Milan City Council's Cultural Affairs and City Heritage Technical Department.

The Floor inserts

In 1967 the last renovation intervention on the Arcade's floor was carried out. Thereafter, no relevant repair work was ever made. Restoration work was therefore necessary, not only to make the floors more presentable, but also for the safety of the pedestrians. In the

middle of 2011 work started, and the first operation was on the octagonal decorative inserts (which used to illuminate the arcade from below), made from bronze with Plexiglas elements.

The inserts were completely deformed due to the stresses in the flooring and concentrated loads from passing vehicles. Beside, the flooring around them suffered from water infiltrating into the areas under the Arcade.

The inserts were completely removed, re-stored in the workshop and then put back in place with new Plexiglas using special techniques and precautions to prevent water from infiltrating again. The substrate was cleaned up by removing all the deteriorated areas. A layer of EPORIP epoxy adhesive, especially suitable for monolithic sealing cracked screeds, was then applied to bind the underlying substrates and form a solid, monolithic bond with the MAPEGROUT T40 medium-strength, fibre-reinforced thixotropic mortar, used to re-build the housings for the inserts. The mortar was applied using specially made



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Photo 6. The inserts before the restoration work.

Photo 7. The restored insert placed and fastened with ADESILEX PG1 RAPID.

Foto 8. The inserts' joints were sealed with MAPESIL AC.

Photo 9. The substrate was consolidated with PRIMER 3296.

Photo 10. NIVORAPID + LATEX PLUS was used to level the substrate repaired with PRIMER 3296 before installing the mosaic with ELASTORAPID.

Photo 11. The mosaic expert Mr Aquino visited the building site to provide assistance.



templates for each insert to match their original thickness, so that the inserts that had been removed could be put back in place without having problems of flatness.

The 25 mm thick Plexiglas petals in the inserts were bonded with KERALASTIC T two-component, high-performance polyurethane adhesive with no vertical slip, which also guarantees that the whole system remains watertight. The petals were then sealed with MAPESIL AC pure, anti-mould, acetic silicone sealant, with BioBlock® technology, for movements up to 25%.

The inserts around the edge could not be taken to the workshop, so they were straightened out, polished, coated and then sealed directly in place. Here too the system used included the application of KERALASTIC T on the back of the petals as well as to bond the petals directly on the metal portholes.

In this case too, the petals' joints were sealed with MAPESIL AC.

Strengthening the Substrate

Mr. Aquino, a mosaic expert, visited the building site, which was very useful for the works directors and mosaic layers since, as for the laying substrate, there was no official documentation.

Indeed, during the 1967 restoration intervention, only the mosaic surfaces had been re-



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Photo 12. Localised consolidation of the flooring with PRIMER 3296.

Photos 13, 14 and 15. EPORIP and MAPEGROUT SV FIBER were used to restore the mosaic of the Bull, damaged by the weather and pedestrian use. The tiles were installed with KERAPOXY.



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stored without involving the substrates which was still the same as in 1865.

An analysis of the stratigraphic layout showed that the substrate was around 7 cm thick and the lean mix layer (made up mainly of sand, cobbles and glass) was around 10-15 cm thick, and its surface strength was generally inadequate.

It was then discovered that the original flooring had been installed without expansion joints and that the substrate had not been strengthened, factors which could lead to cracking due to hygrometric shrinkage and concentrated loads.

The first operation was to obtain sufficient load-bearing capacity and strength in the substrate without damaging the entire flooring. PRIMER 3296 consolidating and anti-dust primer in water dispersion, with micro-particles of acrylic polymers and good penetration capacity, was applied, therefore, in the areas with poor mechanical strength.

Working on the Mosaic

The mosaic layers had to carefully remove the mosaic tiles using tiny electric grinders and chisels to prevent damaging the areas of flooring that were still in good condition. Some of the tiles were used again to recompose the pattern of the original mosaic.

White ELASTORAPID two-component, high-performance, highly-deformable, quick-setting and drying cementitious adhesive with no vertical slip and extended open time was used to install the mosaic tiles by "embedding" them in the adhesive. The mosaic was then sanded and polished 24 hours after installation. This operation was carried out in December when temperatures were quite low. The adhesive was applied on the back of the tiles (with the back-buttering method) so that there was full contact between the marble and the substrate.

ELASTORAPID was also used to install the stars and all the glass paste decorations in the flooring. Marble was then removed from around the inserts, especially the Rosso Verona and Bardiglio slabs, which had been damaged beyond repair.

Positioning the Inserts and Marble Slabs

After completing the inserts in the workshop, each one was placed in position and bonded with ADESILEX PG1 RAPID two-component, rapid-setting thixotropic adhesive for structural bonds. All the edges of the metal frames were fastened in place so that there was a



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monolithic grip with the MAPEGROUT T40 mortar used to rebuild the substrate.

Once the inserts had been fastened with ADESILEX PG1 RAPID, the surfaces were levelled with NIVORAPID (quick-drying, thixotropic, cementitious smoothing compound) + LATEX PLUS (elasticising latex).

This system allows for particularly high compressive strength and also to work well around the delicate metal frames and the original substrates repaired using PRIMER 3296.

At this point, the Bardiglio and Rosso Verona marble slabs were installed around the inserts and in other areas of the surface. Once the surface of the substrate had been cleaned adequately, a coat of PRIMER G, synthetic resin primer in water dispersion with a very low emission level of volatile organic compounds (VOC), was applied by brush to improve adhesion. White ELASTORAPID was applied using the back-buttering method to install the marble. The marble around the inserts was installed leaving a wide gap to prevent compression problems. The expansion joints were then sealed with MAPESIL LM neutral silicone anti-mould sealant with BioBlock® technology for stone for movements up to 25%.

Repairing the Substrates

During inspection work, areas of the surface which were completely damaged had been noticed and these areas had to be completely rebuilt. Therefore Mapei suggested the use of a complete system of innovative products such as MAPECEM PRONTO, MAPEGROUT SV FIBER and EPORIP.

First, around the healthy areas in the original flooring, EPORIP epoxy adhesive was injected to make a monolithic bonding of the damaged substrate. The substrate was repaired over the EPORIP layer while it was still fresh using MAPEGROUT SV FIBER quick-setting and hardening, fibre-reinforced, hi-flow cementitious mortar with stiff steel fibres. Using this system, work could be carried out very quickly, even in bad weather.

Restoration of the Bull

The mosaic representing the bull, considered a lucky charm on which every year thousands of people leave their mark, deserves a special mention. To prevent vibrations damaging the Bull, the mosaic was framed and then carefully removed using tiny grinders to remove the tiles. First EPORIP was applied and then, after waiting the proper time, the substrate was repaired with MAPEGROUT SV FIBER quick-setting and hardening, compensated-shrinkage hi-flow mortar, especially suitable for repairing concrete and fixing drains, man-holes and urban architectural fittings in place. The bull was then installed using KERAPOXY two-component, high-performance, anti-acid epoxy and adhesive with no vertical slip for laying and grouting ceramic tiles and stone material. The adhesive was applied on the back of each tile before placing them in position on the installation bed. The following morning, a few hours after the repair work had been completed, the bull was ready for use once again.

The End of a Complex Operation

The final phase of the intervention was to grout the flooring. The colour of the polyester resin-based grout varied according to the colour of the mosaic and original grout. This operation over the entire surface of the flooring allowed the polishing to be carried out with polishing disks after a very short time.

Work on the Porticoes

In February 2012, repair work also started on the porticoes in the arcade. The same procedure was used for the circular inserts; they were removed, restored, the metal was cleaned and treated and then the Plexiglas petals were installed with KERALASTIC T and the joints were sealed with MAPESIL AC.

In this case too, to repair the housings and load-bearing capacity of the support clamps for the inserts, MAPEGROUT T40 repair mortar and ADESILEX PG1 rapid-setting thixotropic adhesive were used.

IN THE SPOTLIGHT

ELASTORAPID

It is a two-component, high-performance, highly-deformable, quick-setting and drying cementitious adhesive with extended open time and no vertical slip, class **C2FTE S2** according to **EN 12004** standards.

It is suitable for internal and external walls and floors, and is used to bond all types and sizes of ceramic tile, natural stone and artificial materials moderately sensitive to moisture (corresponding to class B of dimensional stability according to Mapei standards), which require the use of a quick-drying adhesive.

It helps to earn **2 points** towards **LEED** (Leadership in Energy and Environmental Design) certification.



The work carried out on the marble slabs, on the other hand, was different. Here workers had to deal with the results of several intervention operations carried out in the last 100 years using different installation techniques and slabs with different thicknesses.

Therefore, different laying techniques had to be used in this case.

Once the damaged part of the marble had been removed, if the gaps to be filled were as thick as 10-15 cm, the slabs were put back in place using MAPESTONE TFB 60 (pre-blended mortar with high compressive strength and good resistance to de-icing salts and freeze-thaw cycles, exposure class XF4, for installation screeds for architectonic stone flooring) after applying a layer of bonding slurry made

Photo 16. Installing the marble slabs with white ELASTORAPID.

Photo 17. In the porticoes adjacent to the arcade, the marble slabs were re-positioned using MAPESTONE TFB 60 where the gaps were 10-15 cm thick. Where it was possible to install the slabs directly on the concrete substrate, ELASTORAPID was used.



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Above. View of the Arcade after completion of the works.

from PLANICRETE synthetic latex rubber to improve the mortar's adhesion and strength. In other areas, where the thicknesses would allow, the marble was installed directly on the concrete substrate using white ELASTORAP-ID. All the expansion joints created around the perimeter of the inserts were sealed with MAPESIL LM.

Some of the pieces of marble which could no longer be reproduced were treated with epoxy-based resin so that they could withstand routine concentrated loads, such as the passage of road cleaning vehicles. In this case an epoxy-based system was used. Once the damaged areas of the marble slabs had been removed, they were rebuilt with MAPEFLOOR I 900 system with QUARTZ 1.9 mixed with coloured MAPECOLOR PASTE.

MAPEFLOOR I 900 epoxy binder was also used as an adhesion promoter on the marble slabs to create a monolithic grip, and to

consolidate deep down into the structure of the stone. For the final grouting of the flooring, two different solutions were used, according to their chemical nature (cementitious products or epoxy-based materials). The floors in one of the porticoes was grouted with MAPESTONE PFS PCC2 pre-blended, polymer-modified mortar with a low modulus of elasticity, high compressive strength and good resistance to de-icing salts and freeze-thaw cycles, exposure class XF4, for grouting architectonic stone floors.

The floors in the other portico was instead grouted with polyester resin. Work was completed by polishing the flooring and applying a final treatment to protect the surface.

The restoration of the Vittorio Emanuele II Arcade floors required time, high-level craftsmanship, high-tech products and methods. Mapei gave their contribution and the results fully satisfied the client.



TECHNICAL DATA

Vittorio Emanuele II Arcade, Milan (Italy)

Period of Construction: 1865-1878

Designer: Giuseppe Mengoni

Period of the Intervention: 2011-2012

Intervention by Mapei: renovating and consolidating substrates; installing mosaic tiles and stone slabs; grouting and sealing joints; restoring the floor inserts.

Client: Milan City Council's Cultural Affairs and City Heritage Technical-Department

MAPEI PRODUCTS

Renovation and installation of floor inserts: Adesilex PG1, Adesilex PG1 Rapid, Eporip, Keralastic T, Latex Plus, Mapegrout T40, Nivorapid, Mapesil AC

Consolidating and repairing the substrates: Eporip, Mapegrout SV Fiber, Mapegrout T40, Mapecem Pronto, Planicrete, Primer G,

Project and Works Management: arch. Pasquale Francesco Mariani Orlandi; arch. Silvia Volpi; Supervision: Libero Corrieri, Alberto Artioli; Operational Management: Simone Ascione, Vittorio Alfieri (Milan City Council)

Building Site Direction: Paolo Maggi

Laying Company: Trivella SpA

Laid Materials: mosaic tiles and stone slabs

Mapei Distributors: Centro Edile Antonini, Gruppo BEA

Mapei Co-ordinator: Paolo Giglio, Mapei SpA (Italy)

Primer 3296, Quartz 1.9

Installing mosaic tiles and stone slabs: Elastorapid, Kerapoxy, Mapecolor Paste, Mapefloor I 900, Mapesil LM, Mapestone PFS PCC2, Mapestone TFB 60.

For further information see the website www.mapei.com