HIGH PERFORMANCE INSTALLATION
OF CERAMIC TILES IN A TUNNEL WITH KERAFLEX MAXI S1

The 11.2 km Badia Nuova-Aglio stretch of Mountain-Pass Deviation includes what is considered to be the symbol of this intervention: the Base Tunnel.
The underground stretch includes the Poggio Civitella Tunnels (two tunnels 250 m long each) that are connected by an existing viaduct to the Base Tunnel (on the Bologna side). What makes this tunnel unique is the technical solution adopted to cover the surface of the tunnel sidewall. In fact, from the base of the sidewall up to a height of 4 m, thin porcelain tiles made by the company Cotto d'Este were applied, cover-ing a total surface area of 140,000 m^2.

CERAMIC TILES TO COVER THE TUNNEL

Apart from safety reasons, the material used to cover the tunnel surfaces was chosen for its functionality and cost-effectiveness. Motorway tunnels are normally painted with epoxy-acrylic resin which needs to be cleaned periodically (every 5 to 6 months) and then repainted every 4 to 5 years.
Even the most thorough cleaning operation, however, cannot be completely effective; the paint used does not cover any macro-pores in the concrete, which allows soot to gather in the pores and cause dark streaks on the surface.
The build-up of dirt on the walls of the tunnel reduces the luminosity in the tun-

IN THE SPOTLIGHT

KERAFLEX MAXI S1

It is a deformable (S1), improved (2) slip resistant (T) cementitious adhesive (C) with extended open time (E) classified as C2TE S1 according to EN 12004. It is used for interior and exterior bonding, up to 15 mm thick, on floor or ceramic tiles of every type and size on uneven substrates and renders; for interior and exterior bonding of stone materials; for spot bonding of insulating material in interiors. It can contribute up to **5 points** to obtain the **LEED** certification for eco-sustainable buildings.

» TOTAL SURFACE COVERED WITH PORCELAIN TILES:
170,000 M²

nel, which lowers the level of safety and/or increases the pow-er of the lighting required in the tunnel to compensate for the darkness.

With the aim of reducing cleaning and repainting operations in mind, and to maintain luminosity in the tunnel for safety reasons, this was the first time ceramic tiles had been used instead of paint in Italy.

The higher installation costs for this solution will be compensated for by the fewer and easier cleaning operations, the elimination of periodic repainting and the lower power of the lighting installed (around 40% less power than normally required in similar tunnels). Also, the surface of the walls is much smoother and has a more attractive finish compared with the surface of painted concrete.

The choice of fully bonded ceramic coverings, rather than mechanically anchored metal panels, is due to the increased level of safety if they are hit accidentally, since a ceramic tile would be broken without bending it, the opposite of what would happen with a metal panel which would become a serious hazard for other vehicles.

TECHNICAL PROBLEMS OVERCOME WITH KERAFLEX MAXI S1

The design and application problems that had to be dealt with prior to installation were due to the walls themselves, which rather than being flat were convex with a radius of around 6 m.

The ceramic tiles to be applied were 1 m x 1 m for the first row in contact with the road level and then 1 m x 3 m for the second row.

It goes without saying that the characte-

IN THESE PICTURES.
Large-size ceramic tiles were bonded in the tunnel with KERAFLEX MAXI S1.

CERAMIC TILES WERE INSTALLED IN THE BASE TUNNEL, THE LONGEST TUNNEL OF THE MOUNTAIN PASS DEVIATION

ristics of the adhesive used to bond the ceramic tiles and the technique used to apply the tiles all had to be carefully studied and tested by the client, together with the company installing the tiles, Pavimental S.p.A., the manufacturer of the tiles, Cotto d'Este, and with Mapei to identify the best adhesive system for this particular type of installation.

The adhesive used in this case was KERAFLEX MAXI S1 which, thanks to its special characteristics, fully complied with all the specified installation requirements.

One of these particular characteristics is its high thixotropy and, because of the curve of the substrate and the size of the tiles, the thickness of adhesive required varied from around 3 to 5 mm and the specifications required that the adhesive could not pour or detach before positioning the tiles. Also, the adhesive couldn't be subject to hygrometric shrinkage, in spite of the high and different thicknesses that had to be applied.

This proved to be a perfect example of the versatility of KERAFLEX MAXI S1.

A rendering machine with a pre-mixing unit was used to apply the adhesive on the substrate and on the back of the tiles and, in spite of adopting such an unconventional method to apply a cementitious adhesive, thanks to the special thixotropic properties of KERAFLEX MAXI S1, the amount of waste due to the mix falling to the ground was negligible. Also, the particularly long open and adjustability times of KERAFLEX MAXI S1 helped make the installation operations easier.

The high adhesion and sufficient deformability of KERAFLEX MAXI S1 made it possible to apply the adhesive on the particularly smooth, impermeable concrete substrate and on the back of the ceramic tiles reinforced with glass fibre meshes.

With the aim of guaranteeing their total resistance to de-icing salts and to the high levels of abrasion the ceramic tiles will be exposed to during cleaning operations, as well as a good cleanability in removing smog and dust, the joints were grouted with KERAPOXY CQ.

TECHNICAL DATA
Base Tunnel of the Mountain Pass Deviation along the A1 Florence-Bologna Motorway, Italy
Period of Construction: 2005-2015
Period of the Mapei Intervention: 2005-2015
Intervention by Mapei: supplying admixtures for injection mixes and products for the installation of large-sized porcelain tiles
Client: Autostrade per l'Italia S.p.A.
Design and Works Direction: Spea Engineering S.p.A.
Contractors: Todini S.p.A for the conventional excavation works and for the covering of the Base Tunnel; TOTO S.p.a. for the Sparvo Tunnel; Pavimental S.p.A. for the installation of porcelain tiles
Mapei Co-Ordinators: Mapei UTT, Rossi C&CA

MAPEI PRODUCTS
Admixtures for injection systems: Mapequick CBS System 1, Mapequick CBS System 2
Ceramic tiles installation: Keraflex Maxi S1, Kerapoxy CQ, Mapeflex PU45

For further information see www.mapei.com, and www.utt.mapei.com