



Mapei supplied various solutions for the underground work to help make tunnelling operations using TBMs (Tunnel Boring Machines) flow more smoothly.

Paris Grand Paris Express

MAPEI SUPPLIED SOLUTIONS FOR UNDERGROUND WORKS AND INSTALLING CERAMIC TILES IN THE STATIONS. THIS MAXI URBAN MOBILITY PROJECT IS SCHEDULED TO BE COMPLETED IN 2030

With 68 stations and 200 km of automated metro lines, the Grand Paris Express is the largest urban mobility project in Europe. The new metro system, scheduled to be completed in 2030, weaves its way through important hubs, such as airports, research centres, universities and urban and suburban areas which, today, are difficult to get to. The four new metro lines (15, 16, 17 and 18) and line 14, which is due to be extended in both north and south directions, will link up to Paris's existing transport system. Most of the new metro system will run underground, passing through the areas covered by the "Grand Paris" project (which aims at turning Paris and the surrounding area into one of the world's largest metropolises of the 21st century) and linking them all together.

Thanks to this new infrastructure it will be possible to go from one side of Île-de-France to the other without passing through Paris and make it that much easier to reach the centre of the capital from the suburbs. The first important "phase" of the Grand Paris Express will be completed in time for the Olympic and Paralympic Games in 2024.

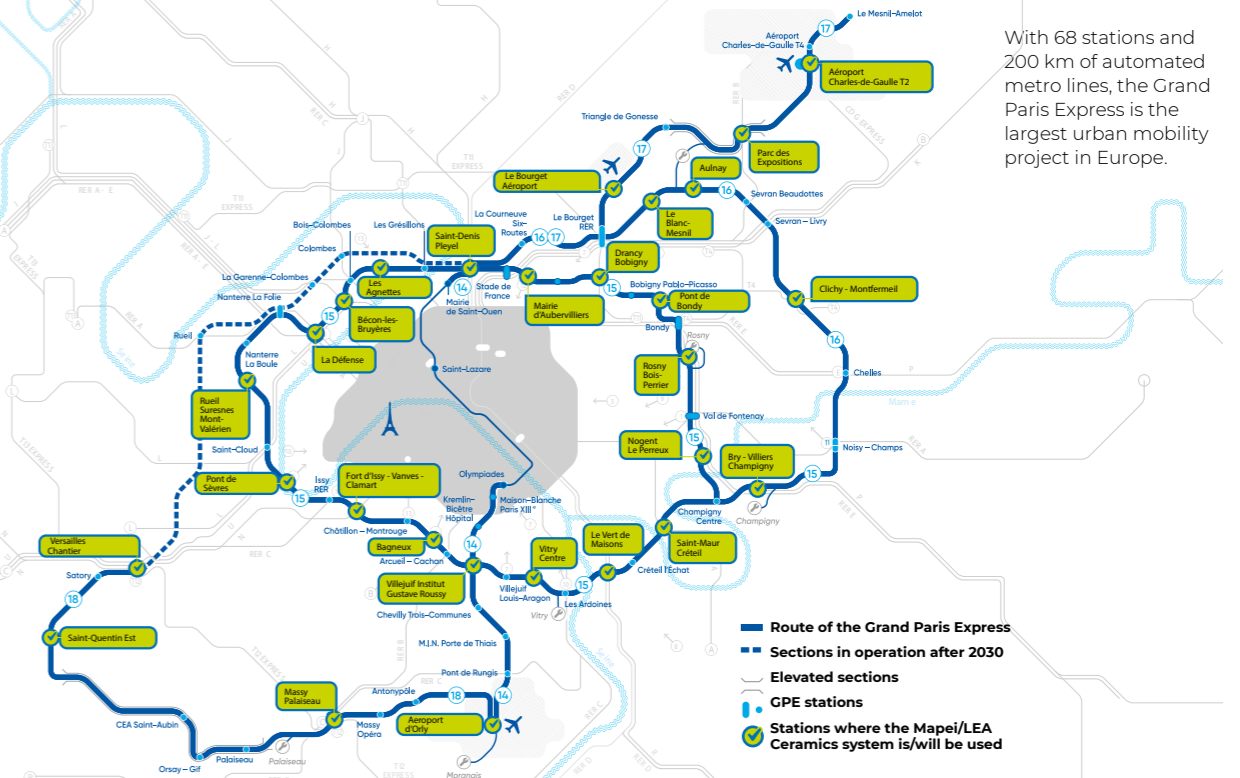
Line 15: many challenges for underground works

Line 15 will be divided into 3 parts, East, West and South and will run around the outskirts of the city. With its 33 km of lines, it will run through 22 towns and districts and will make it much easier for one million inhabitants to move from one part to another. Construction of the line is divided into various lots. Going into detail, lot T2A, whose construction has been commissioned to the Horizon consortium, consists of 4 stations, the entrances to two tunnels, secondary works (emergency exits, access for emergency vehicles, etc.), a double tunnel and a single tunnel that connects the Infrastructure Maintenance Site (IMS) to the main line.

The excavation work for the tunnels started in February 2020 and was carried out using a variable density TBM (Tunnel Boring Machines) in a "slurry" mode.

For the backfilling injection of the annular gap, created during the TBM advance between the soil and concrete segments lining, the Horizon consortium decided to use a two-component grout consisting of component A (grout made by water, bentonite, cement and a retard-

THE MAP OF THE NETWORK



With 68 stations and 200 km of automated metro lines, the Grand Paris Express is the largest urban mobility project in Europe.

ing agent) and component B (accelerant). Two-component grout systems are the most widely used backfill systems in the world of TBM tunnelling, whereas in France this technology was not particularly popular and a mortar without accelerant used to be the preferred method.

Mapei, world leader in the supply of products for two-component backfill grouts, offered its experience and supplied three chemical products used to prepare a grout that would fit the requirements of this site.

The most widely used product was MAPEQUICK CBS SYSTEM 3. This is a liquid accelerant which, when added to component A of the mix just before being injected into the annular gap, very quickly transforms the grout into gel. In so doing, the mix sets and starts to develop its mechanical properties after a very short time, which is very important for the stability of the excavated tunnel and concrete lining.

Apart from the accelerant, Mapei also supplied the two additional products required to make component A, namely MAPEQUICK CBS SYSTEM 1, a retarding agent, which helps to maintain and extend the initial workability of the grout (up to 72 hours after being prepared), and MAPEBENT API 2 bentonite, which is needed to stabilise Component A, while also providing it with the rheological properties needed to make the pumping of the mix over long distances possible.

Beside chemical products, Mapei also provided technical support to carry out the laboratory tests, which then led to the development of two different types of two-component mixes: one with very high mechanical

properties, which the Horizon consortium required for specific areas of the tunnel (such as the entrances and exits of the stations), and one with more common properties, used in other areas of the tunnel.

Lastly, MAPEBENT API2 bentonite was also used for the preparation of the slurry used by the variable density type TBMs. This bentonite slurry has a dual function: to maintain the stability of the tunnel face during TBM excavation (so that TBM can advance safely) and to transport the excavated soil while keeping it in suspension inside the pipes running along the tunnel. For this application, MAPEBENT API2 was chosen by the client after a long series of tests carried out in an external laboratory where its performance and properties were compared with those of numerous other types of bentonites available on the market.

In certain phases of the tunnelling works, MAPEDISP FLS was also added to the bentonite slurry. This product is a liquid dispersing agent which allows TBMs to excavate smoothly in particularly cohesive soil by improving its fluidity and reducing its adhesion to the metal components of the TBM.

A highly effective flooring system for half of the stations of the new lines

Thanks to a very fruitful collaboration with the tile manufacturer LEA Ceramiche, Mapei France developed a system to install the flooring in half of the 68 stations of the Grand Paris Express. The worksite begins in 2022 with the opening of the Orly airport station and is scheduled to end in 2030. The request from the client was, first and



Various Mapei solutions were and will be used to prepare substrates and to install ceramic flooring in the new stations of the Grand Paris Express.

THE FIGURES OF THE PROJECT

68
STATIONS

200
KM
OF FULLY-AUTOMATED
RAILWAY LINES

4
NEW LINES

1
LINE (14)
EXTENDED IN TWO
DIRECTIONS

2016
START OF WORKS

2030
SCHEDULED COMPLETION
OF WORKS

MAPEI QUALITY AND RELIABILITY FOR THE FLOORS IN THE STATIONS



by **Didier Bourgeois**

The floors in the stations of the metro are amongst the architectural components most exposed to wear and attack from various agents, due to both the high level of pedestrian traffic and routine maintenance work. However, it was also necessary to have a uniform “identity” for all the stations of the Paris Grand Express network, from their entrance right up to the platforms. This identity is reflected in the creation of a continuous “identifying journey” for the floors in the stations of the Grand Paris Express. Research carried out by Société du Grand Paris (SGP) in 2015 showed that, as

far as ceramic flooring is concerned, and considering the intense stresses the station floors need to withstand, meeting the requirements of class P4S of the UPEC reference system would not be sufficient. SGP, therefore, set itself the challenge of finding a solution suitable for the specific type of use and that would meet the requirements of the stations. It became immediately clear that the solution could not simply consist of different components selected independently from each other. Rather, a complete system had to be employed that would meet particularly severe technical criterion

in order to achieve performance properties often higher than the standards required for UPEC certification. As a result, in 2016 SGP started to consult with potential suppliers and, after more than four years of work, two complete solutions were selected that would meet SGP’s expectations in terms of performance properties, aesthetics and cost. Following a particularly intense and objective technical evaluation the solution proposed by Mapei, partnered by LEA Ceramiche, Pedrazzini and CS France, was found to be a particularly satisfying and high quality solution

for the floors in the stations exposed to such intense passenger traffic. Mapei demonstrated considerable commitment throughout this selection process and stood out for the consistency, professionalism and availability of its representatives. The proposal from Mapei is, quite literally, the “binder” of this solution for the floors and provides concreteness and consistency. Throughout the entire development process of the solution chosen, apart from being an unlimited source of ideas and proposals, the Mapei team instigated the constant dialogue with its partners

regarding the technical aspects and showed understanding for the needs expressed by the other members of the group. The organisation by Mapei of special, dedicated training sessions for future floor installers, and the use of the company’s own training facilities, is a very important element that we are taking into consideration for our next construction projects which are currently at the development stage.

Lead materials analyst for the Grand Paris Express Project



Ceramic floor and wall tiles were installed in the new stations along Line 14 using Mapei products such as GRANIRAPID, KERALASTIC T, ULTRALITE S2 QUICK and ULTRACOLOR PLUS.

foremost, for floorings that would be sufficiently resistant to very high levels of pedestrian traffic. The system consists of a screed, adhesive, grout for tile joints and sealant for expansion joints by Mapei France, ceramic tiles by LEA Ceramiche, expansion profiles by CS France and pododactile system by Pedrazzini. The screeds will be made from new formulations, called MAPECEM X'PRESS or MAPECEM PRONTO X'PRESS, of existing ready-to-use, pre-blended Mapei mortars that have been widely used for a number of years. 37,5 x 75 cm light-coloured porcelain tiles will be installed on these surfaces using KERAFLUID HPR or KERAFLUID N adhesives, manufactured and distributed in France by Mapei France, before grouting the joints with KERACOLOR GG or ULTRACOLOR PLUS mortars to obtain a colour matching the colour of the flooring. The expansion joints will be sealed with MAPEFLEX E-PU21 SL, which is especially suitable for surfaces subjected to high levels of pedestrian traffic. To make sure the installation work will be executed to perfection and get the most out of the finished surfaces, the installation companies will undergo a special training at MAPEI ACADEMY, the training centre located at Mapei France's facilities in Toulouse St-Alban.

4 new stations along line 14

Ever since it first opened in 1998, Line 14 has made a name for its level of innovation: in fact, it was the first line in the world to be fully automated. It has just been extended northwards by 5.8 km with 4 new stations to improve the transport conditions of its 610,000 daily users. The line's extension is part of the Grand Paris Express project which, by 2024, will include extending the line even further to the north, up to the station at Saint-Denis Pleyel, and to Orly Airport to the south and its connection to lines 15, 16, 17 and 18. The four new stations (Pont-Cardinet, Porte de Clichy, Mairie de Saint-Ouen and Région Île-de-France) are characterised by an architectural style that is simple yet, at the same time, elegant, which also had an influence on the materials chosen to build the stations. These include white porcelain tiles for the floors and walls in the areas where the trains wait and transit. To install the tiles on 6500 m² of surfaces, Mapei supplied a complete system that also included preparation of the substrates with ULTRAPLAN MAXI FIBRÉ self-levelling skimming mortar and repairs to certain sections of deteriorated concrete substrates using PLANITOP 400 F rapid-setting class R3 mortar.

The Metro Factory

La Fabrique du métro (or Metro factory) was a specific wish of Société du Grand Paris which is behind the Grand Paris Express project, and is a display that allows visitors to "immerse" themselves in this grandiose infrastructure project. It features a reconstruction over an area of 100 m² of a metro station with its characteristic materials, equipment and furnishings. It is located in the Docks area of Paris in Saint-Ouen-sur-Seine.



Different areas of use, different types of substrates and different performance properties required for the finished surfaces called for the use of different types of adhesive. The ceramic floors in the corridors were installed with KERAFLUID N adhesive and the joints were grouted with ULTRACOLOR PLUS. The tiles for the walls were bonded with ULTRALITE MULTIFLEX, while the tiles for the vaulted ceilings were installed with ULTRALITE S2 QUICK. KERALASTIC T two-component polyurethane adhesive was used to bond tiles onto the steel doors. The adhesives chosen to install the ceramic flooring on the station platforms were KERAPOXY CQ and GRANIRAPID. The tile joints were grouted with KERAPOXY DESIGN. In

this case, the products were chosen because they needed to provide guaranteed insulation from electric current, in compliance with the French standard NF C 15-100. ULTRAPLAN MAXI FIBRÉ, PLANITOP 400 F, KERAFLUID N and ULTRALITE MULTIFLEX are manufactured and distributed in France by Mapei France.



Find out more
GRANIRAPID

TECHNICAL DATA

UNDERGROUND WORKS

Line 15, lot T2A, Paris

Period of construction:

2019-2021

Period of the Mapei

intervention: 2019-2021

Owner : Société du Grand

Paris

Project management:

Systra

Main contractor: Horizon

consortium including

Bouygues Travaux Publics,

Soletanche Bachy France,

Soletanche Bachy Tunnels

and Bessac et Sade

Intervention by Mapei:

supplying products for

TBM exaction works

Mapei coordinators:

Edgar Doledec and Jérôme

Darras, Mapei France

Photos: Edgar Doledec,

Horizon

MAPEI PRODUCTS

Underground works:

Mapequick CBS System 1,
Mapequick CBS System 3,
Mapebent API2, Mapedisp
FLS

INSTALLING CERAMIC FLOORS IN HALF OF THE 68 STATIONS

Period of construction:

2022-2030

Owner: Société du Grand

Paris

Suppliers: Mapei France,

LEA Ceramiche, CS France,

Pedrazzini

Period of the Mapei

intervention: 2022- 2030

Intervention by Mapei:

supplying a complete

system for installing

ceramic floors in about half

of the 68 new stations

MAPEI PRODUCTS

Building screeds:

Mapecem X'press*,

Mapecem Pronto X'press*

Installing ceramic tiles:

Kerafluid HPR*,

Kerafluid N*
Grouting tile joints:
Keracolor GG, Ultracolor
Plus
Sealing expansion joints:
Mapeflex E-PU 21 SL

NEW CERAMIC COVERINGS IN 4 NEWS STATIONS ALONG LINE 14

Period of the works: 2019-

2020

Owner: RATP

Design: AZC 15/17

Installation companies:

Chantiers Modernes

(Vinci Group), Brezillon

(Bouygues Group)

Period of the Mapei

intervention: 2019-2020

Intervention by Mapei:

supplying products for

preparing substrates and

bonding and grouting

ceramic tiles on walls and

floors

Mapei distributors:

Raboni and Carmat

Mapei coordinators: Yves

Pradeau, Dominique Avet,
Bryan Brissonnette, Mapei
France
Photos: Yves Pradeau e
RATP (Bruno Marguerite,
Xavier Chibout)

MAPEI PRODUCTS

Preparing substrates:

Ultraplan Fibré*

Concrete repair: Planitop

400 F*

Installing ceramic floors:

Kerafluid N*, Granirapid,

Keralastic T, Ultralite S2

Quick, Ultralite Multiflex*

Grouting joints: Ultracolor

Plus, Kerapoxy CQ,

Kerapoxy Design

*These products are
manufactured and
distributed on the French
market by Mapei France

For further info: mapei.com
mapei.fr