

ESTAÇÃO DO ORIENTE

In Lisbon's East Station, one of the world's most beautiful examples of contemporary architecture, Mapei solutions were used to meet the technological challenges of Santiago Calatrava Vall's "big machine".

by *Natasha Calandrino*



The Estação do Oriente, or East Station, project was one of a series of public works designed for Lisbon in conjunction with the International Exposition of 1998. Building this transportation hub was an opportunity to address several concerns simultaneously: the construction of this grand infrastructure project would enable the city to absorb the flow of Expo visitors and at the same time regain access to the Tagus River that had long been blocked off by the railroad.

Santiago Calatrava Valls, the architect of the station complex, needs no introduction. Having a doctorate in civil engineering and another

in architecture has given the architect a dual perspective that enables him to combine shapes and materials in a unique way. The Estação do Oriente won the 1998 Brunel Madrid award over 98 other designs from all over the world for projects completed between 1 January 1992 and 31 May 1998. The award is given for the best architectural, engineering or railway construction project, or for a work that contributes to improvement in the quality of railroad design.

Simple lines

The Estação do Oriente opened on 19 May 1998. It is Portugal's most important transportation hub and one of Europe's biggest, with a surface area of 150,000 square meters (1,600,000 sq ft). The station efficiently handles several modes of transportation, connecting the railway with the Metro system and the bus terminal, and even contains airport check-in facilities, besides providing direct access to the docks on the river. The complex contains private parking for 2,000 automobiles. The organizing element of the project is a bridge 19 meters above ground level that supports eight railroad tracks (see drawing no.1 on page 24). The station's most unique feature is its roof, a metal structure shaped like sixty stylized trees (drawing no. 2). The shape was inspired by such traditional symbols of Lisbon city life as the arches of the Aguas Lívres aqueduct and the trees on the hills of São Pedro de Alcântara park.

The interior of this monumental structure resembles a cathedral where sunlight filters through a series of porticoes in a play of light and shadow. Passengers come and go in a supremely functional yet practical, spacious and airy environment. Architecturally this grand public space forms a very simple figurative whole whose individual elements stand out in bold relief,





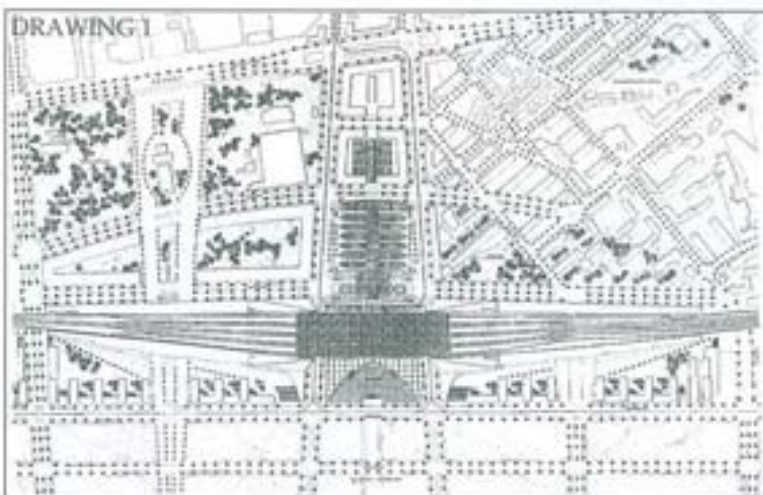
featuring architectural concrete, glass brick panels, Portuguese patterned flooring, metal roofing, and glass elevators.

Complex technology

Several factors affected the construction timetable for the station (Photo 1):

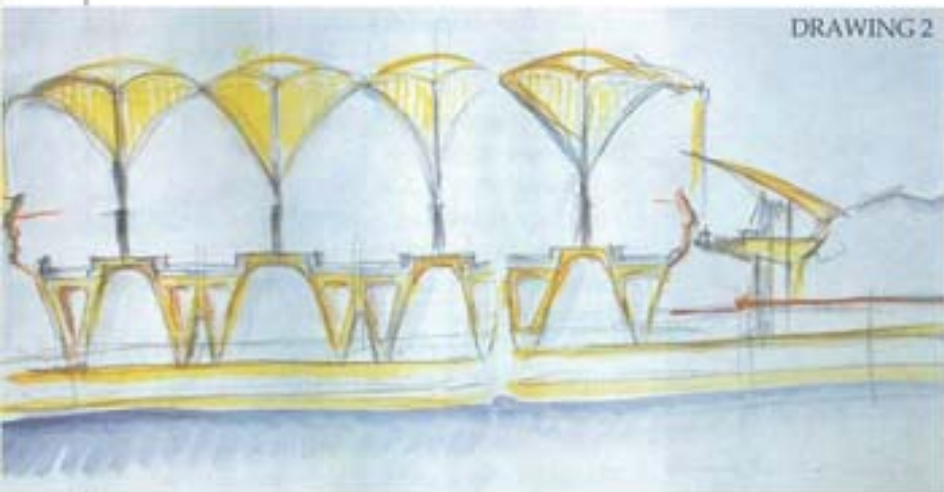
- **the deadline:** the opening of the station was planned to coincide with that of the Lisbon Expo on 22 May 1998;
- **railway traffic:** the Northern line of the railroad had to remain open for the entire period of construction;
- **craftsmanship:** the design was a unique combination of craftsmanship and modern technology, and as such was very labor-intensive;
- **risk of earthquake:** the area is at high risk seismically;
- **difficult access:** various other projects adjoining the station were under construction at the same time;

- **demolition and rebuilding of underground infrastructures:** the city's main water tunnel and its largest sewage line are underneath the station. These required construction of large tunnels deep underground.



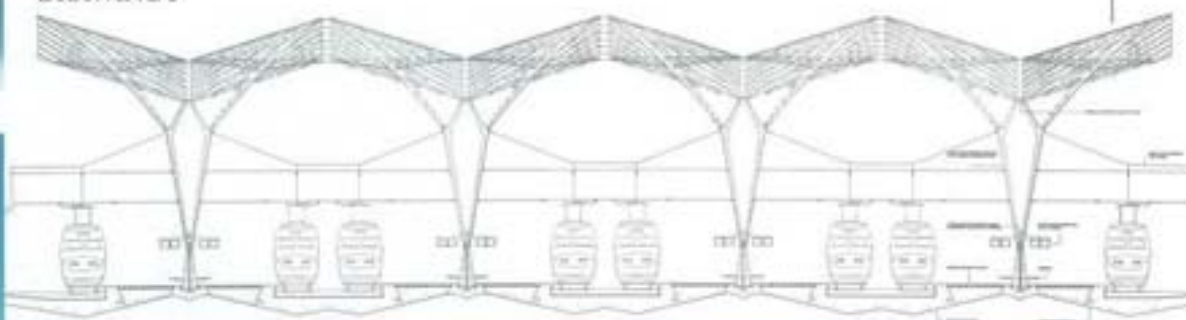
The bridge

The eight railroad tracks cross the area over a bridge covered by a modular metal structure 238 m (764 ft.) long, 68 m (218 ft) wide, and 28 m (89 ft) high that supports a glass roof (drawing no. 3). This metal structure forms a canopy that resembles 60 stylized trees and is made of cement, steel and glass. The steel supporting columns are embedded in concrete bases (Photo 2) and were first treated with MAPEFER*, a cementitious corrosion-resistant mortar for steel reinforcement used to protect metal surfaces from rust.





DRAWING 3



MAPEGROUT THIXOTROPIC* was applied where the tapering steel columns were embedded in the concrete. This product is a fibrous mortar with controlled shrinkage for the repair of concrete. MAPEGROUT THIXOTROPIC mixed with water forms a mortar whose thixotropic consistency enables it to be applied on vertical surfaces without formwork and without sagging, providing significant savings in time and money (Photo 3).

The train platforms feature glass concrete floors bordered by precast white cement blocks.

These, too, were treated with MAPEGROUT THIXOTROPIC, used in this case to even out surface imperfections in the concrete. MAPEFINISH*, a two-component cementitious finishing mortar for concrete was used in a white-colored version specially formulated for this installation to make the glass concrete floor and the cement

PHOTO 2



blocks the same shade of white (Photo 4). After they were finished, the precast blocks were set with KERABOND+ISOLASTIC*, a cementitious adhesive system with high bond strength and flexibility, and excellent waterproofing properties. The precast white concrete panels that make up the

PHOTO 3

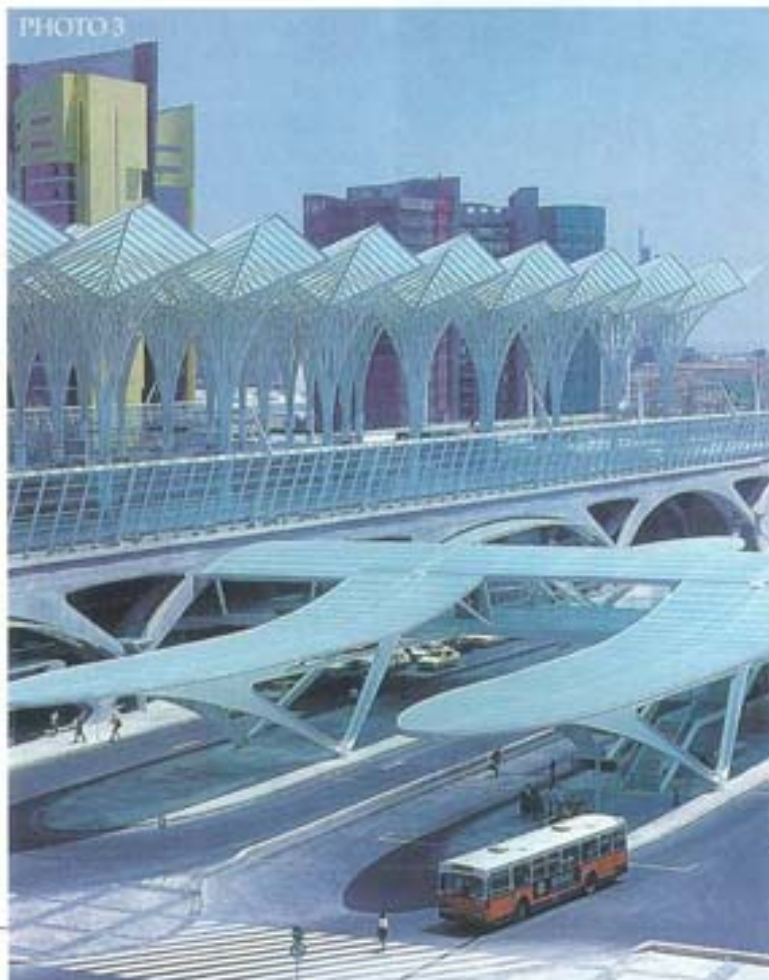
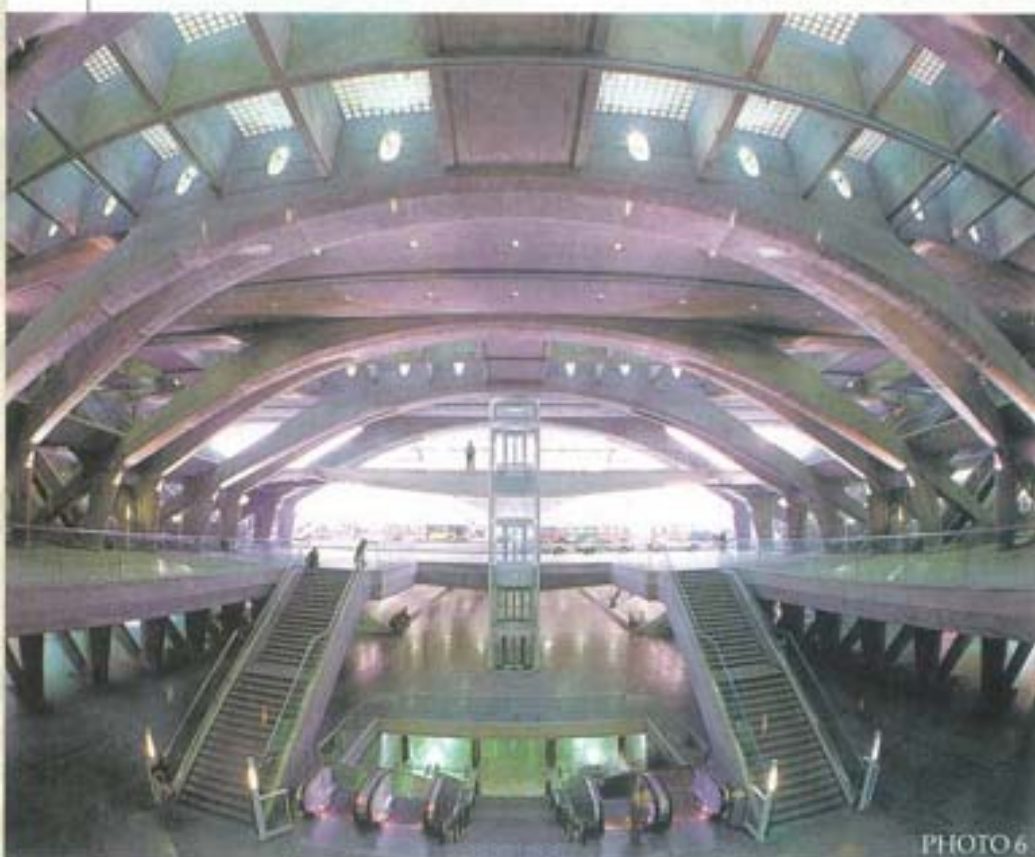
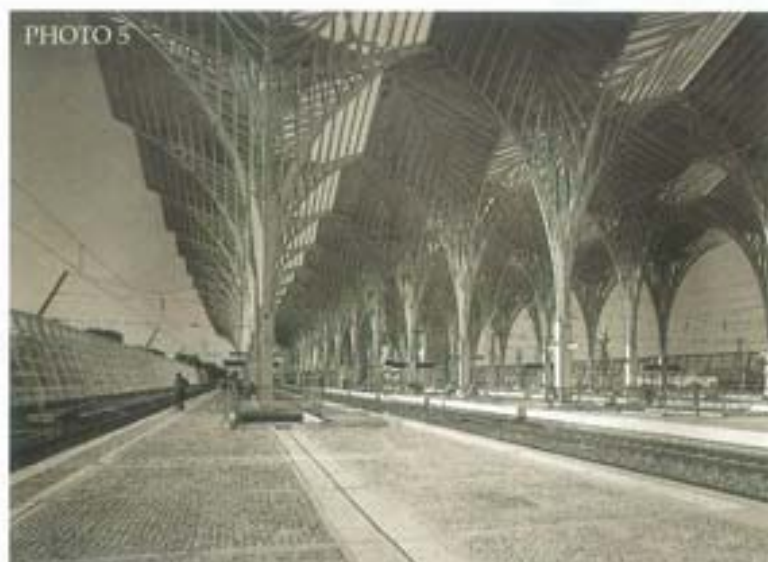


PHOTO 4

glass cement floors were joined with white KERAPOXY®, a two-component epoxy sealant with exceptional bond strength and mechanical and chemical resistance that hardens without shrinkage in a few hours (Photo 5).

Access to connections

The center section of the station complex is built on several levels. Access to the railroad station and the metro system is fourteen meters above ground level. A glass-enclosed walkway with panoramic elevators leads down to the bus terminal and parking lots. Nine meters above ground level the atrium and



which time concrete was being poured non-stop. Because the roof was not yet built, the concrete had to be protected from atmospheric agents, especially rain, with ANTIPLUVIOL S®, a siloxane resin-based, colorless water-repellant protective compound. ANTIPLUVIOL S is a transparent liquid that penetrates deeply and reacts with the natural moisture present in the concrete to form a water-repellant coating inside the pores and capillaries. Because of its special formula, ANTIPLUVIOL S does not create a film and as a result it remains permeable to water vapor, while providing exceptional resistance to alkalinity and ultra-violet rays (Photo 8).

retail areas are arranged around a bare space from which escalators descend to the ground-level plaza facing the river docks.

All the floors in the center section were covered with grey granite installed over screeds modified with PLANICRETE®, a synthetic rubber latex for cementitious mixes that improves flexibility, bonding and workability. The granite floor was grouted with ULTRACOLOR®, a fast-setting, fast-hardening cementitious grout that, unlike conventional grouts, forms no surface efflorescence (Photos 6 and 7). It took almost three years to complete the bearing skeleton of the station, during





Precision machines

The highly technical content of Santiago Calatrava Vall's buildings (Photo 9) have made his work famous.

They have been described as enormous machines in which function plays the prime role. Yet his highly plastic and expressive design solutions are the product of an artistic quest for form that results in a bold style of architecture with a high visual impact on the surrounding landscape. The Catalan architect's exploration of form and space finds expression even in highly complex projects such as the Estação do Oriente that would be impossible without the help of the most advanced building technology.



The Technical Data Sheets for the products mentioned in this article are contained in Mapei Binder No. 1, "Ceramic Tile Installation Products" and No. 3, "Building Specialty Line".



TECHNICAL DATA

Project: Estação do Oriente, Lisbon, Portugal.

Built: 1995-8

Architect: Santiago Calatrava Valls

Project Managers: Calatrava Valls, S.A./Tecnep Lda/Sofrerail

General Contractor: ACE (Agrupamento Complementar de Empresas): Edifer - Soconstroi - Bpc - Somague - Necso

Mapei products*:

• for canopy over platforms:

MAPEFER
MAPEGROUT THIXOTROPIC
MAPEFINISH

• for precast blocks:

MAPEGROUT THIXOTROPIC
MAPEFINISH
KERABOND+ISOLASTIC

• sealant for concrete panels:

KERAPOXY

• granite floor installation:

PLANICRETE
ULTRACOLOR

• waterproofing for concrete:

ANTIPLUVIOLS

Mapei coordinator: Jean-Pierre Toussier

*The products mentioned in this article are manufactured by Mapei in Europe.