

PROJECTS

Different kinds of bridges, DIFFERENT KINDS OF REPAIRS



Different technology and different products employed to restore two bridges over the River Duero: one in concrete and one in stone.

In March, 2005 the Junta de Castilla y León Regional Council decided that work needed to be carried out on the two bridges, one in concrete and the other in stone, which are used to cross the River Duero along the stretch between Peñafiel and Pesquera de Duero, in the Spanish province of Valladolid.

The first phase of the operation involved repairing the concrete bridge. This structure was in more urgent need of repair, so that cars and lorries could cross the River Duero. Repairs to the ancient stone bridge, which is only a few metres from the concrete bridge, were planned for the second phase,

and it had already been closed to traffic. Each structure had problems of a different nature, which were solved by applying different, specific solutions, yet with both projects bearing the Mapei "hallmark".

Operations on the Stone Bridge

The stone bridge over the River Duero, which dates back to the VI century AD, is formed by seven arches and is reserved for pedestrians and light traffic only. Of the seven arches, the two central ones were completely ruined. A field analysis carried out by technicians from the Ibermapei Technical Service Department highlighted a series of

problems, which made the bridge dangerous for pedestrians. The main cause was that the structure had been left to its own devices over the years, and its conditions had gradually become worse and worse as time went by. Waste material had also collected over the years at the foot of the pillars which support the bridge, and weeds had grown in the joints causing the old mortar to crumble.

Further damage was also found by the technicians, with cracks in the columns which support the arches, no sealant between the stones in various portions of the masonry work and cracks in the vault of some of the arches, which had

provoked detachment of a number of blocks of stone.

The repair work on the stone bridge was divided into two separate steps.

The first step was to thoroughly clean the surface of the bridge using a high-pressure water washer.

The missing and damaged stones were then put back into place, and the joints between each row of stones were pointed using MAPE-ANTIQUÉ LC* cement-free hydraulic binder mixed with fine local sand. MAPE-ANTIQUÉ LC* is based on synthetic fibres and fine additives and features pozzolanic-activity. It is resistant to sulphates and is particularly suitable for renovation work on masonry subject to rising damp or else damaged by soluble



*On this page:
view of the serious damage of the ancient stone bridge which, before the repair work, had been closed to traffic.*

The operation required the rebuilding of the missing and damaged parts, repair of the cracks, consolidation of the arches and, lastly, pointing between the rows of stone blocks.

salts. The cracks in the vaults of the arches were repaired using MAPE-GROUT T40* thixotropic mortar and pointing was again carried out using MAPE-ANTIQUÉ LC* binder.

MAPE-ANTIQUÉ I* hydraulic binder was then injected to consolidate all of the arches, except the two central ones. MAPE-ANTIQUÉ I* is used to consolidate by injection and fill cavities, cracks and internal porosity in ancient stone and brick structures. The day before the binder was injected, the internal structure to be consolidated had to be thoroughly soaked with water, using the same holes which had been drilled ready for injecting the



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MAPE-ANTIQUÉ I*, which is a pre-blended binder resistant to sulphate, used to form slurry for injecting purposes. The product has a base of hydraulic-reaction inorganic materials, special additives and ultra-fine charges.

During the second phase, the bases of the two ruined, central pillars had to be reinforced where they come into contact with the water that flows in the River Duero, by forming a reinforced cement plinth followed by rebuilding the stone pillars and vaults.

Operations on the Concrete Bridge

The concrete bridge is used by vehicles to cross the River Duero. It features large arches reinforced by a series of lateral pillars, while the roadway is supported by beams and there are iron parapets, for safety purpose, running along the sides. A careful technical analysis brought to light a series of problems which "plagued" the bridge. In some areas, the reinforcement rods were clearly visible and oxidised, due to detachment of portions of the con-



crete. The condition of the bridge was rather serious, especially in the lower pillars of the arches and in the beams beneath the roadway. Also, because gravel with an inadequate grain size had been used during the original construction work, there was poor cohesion of the concrete to the substrate. During the survey, the technicians also found that the surface of the roadway had insufficient drainage.

The increase in stresses due to an increase in road traffic, which had not been calculated during the design phase of the structure, and a lack of sufficient maintenance over the years had done the rest.

The bridge no longer met the required safety conditions and, therefore, need-





On the facing page, at the bottom: details of damage of the concrete bridge. Notice the exposed, rusty reinforcement rods which were treated with Mapefer.

Below: after rebuilding the missing and removed portions, Elastocolor protective and decorative paint was applied on the entire surface of the bridge.

To the side: the bridge was reopened to traffic once the work was over.

ed drastic repair work.

Once the problem areas had been identified, the Ibermapei Technical Service Department defined a series of interventions using products developed for similar structures and materials, which were then presented to the client.

The first step was to clean all the surfaces to be treated using a high-pressure water washer. The deteriorated portions of concrete, or those in danger of detachment, were removed mechanically and the reinforcement rods which were in a poor condition were exposed.

The reinforcement rods were brushed to remove all traces of rust and loose parts, and were then treated with MAPEFER* two-component anti-corrosion mortar based on polymers in water dispersion. Once the MAPEFER* had dried, the areas of the structure where the damaged concrete had been removed were repaired using MAPEGROUT T40* thixotropic mortar. The final step was to finish off the surfaces by smoothing them over with MONOFINISH* one-component, normal-setting cementitious mortar.

The repair and sealing of the expansion joints on the roadway were carried out using MAPEGROUT HI-FLOW* fibre-reinforced, controlled-shrinkage fluid mortar and by applying a 1.2 mm-thick PVC membrane reinforced with polyester mesh.

Once the repair work had been completed, the entire surface of the bridge was treated with ELASTOCOLOR PAINT* elastic paint. Apart from leaving the structure with an attractive, even coating, this paint waterproofs concrete surfaces and protects them against aggressive agents present in the atmosphere.



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*Mapei Products: the products referred to in this article belong to the "Building Speciality Line" range. The technical data sheets are available on the "Mapei Global Infonet" DVD/CD or at the web site: www.mapei.com.

Elastocolor Paint:

protective and decorative elastic paint based on acrylic resins in water dispersion.

Mape-Antique LC: cement-free binder for light coloured dehumidifying mortar for the restoration of damp stone, brick and tuff masonry.

Mape-Antique I: cement-free fillerized hydraulic binder, for consolidating, by injection, stone, brick work and tuff structures.

Mapefer: two-component corrosion-inhibiting cementitious mortar for the protection of reinforcing rods.

Mapegrout T40: medium strength (40 N/mm²) thixotropic mortar for the repair of concrete.

Mapegrout Hi-flow: controlled-shrinkage fibre-reinforced fluid mortar for concrete repair.

Monofinish: one-component normal setting cementitious mortar for smoothing concrete.



TECHNICAL DATA

Bridges on the River Duero, located along the stretch between Peñafiel and Pesquera de Duero (Valladolid – Spain).

Work:

on the concrete bridge: treatment of the reinforcement rods, rebuilding of the damaged sections, smoothing and coloured coating;

on the stone bridge: structural strengthening, replacement of the missing stone blocks and pointing of the joints.

Year: 2005

Client: Junta de Castilla y León

Main Contractor: Constructora Hispánica S.A.

Building Contractor: Evotec

Mapei Co-ordinator: Manuel Angel López, Ibermapei SA

