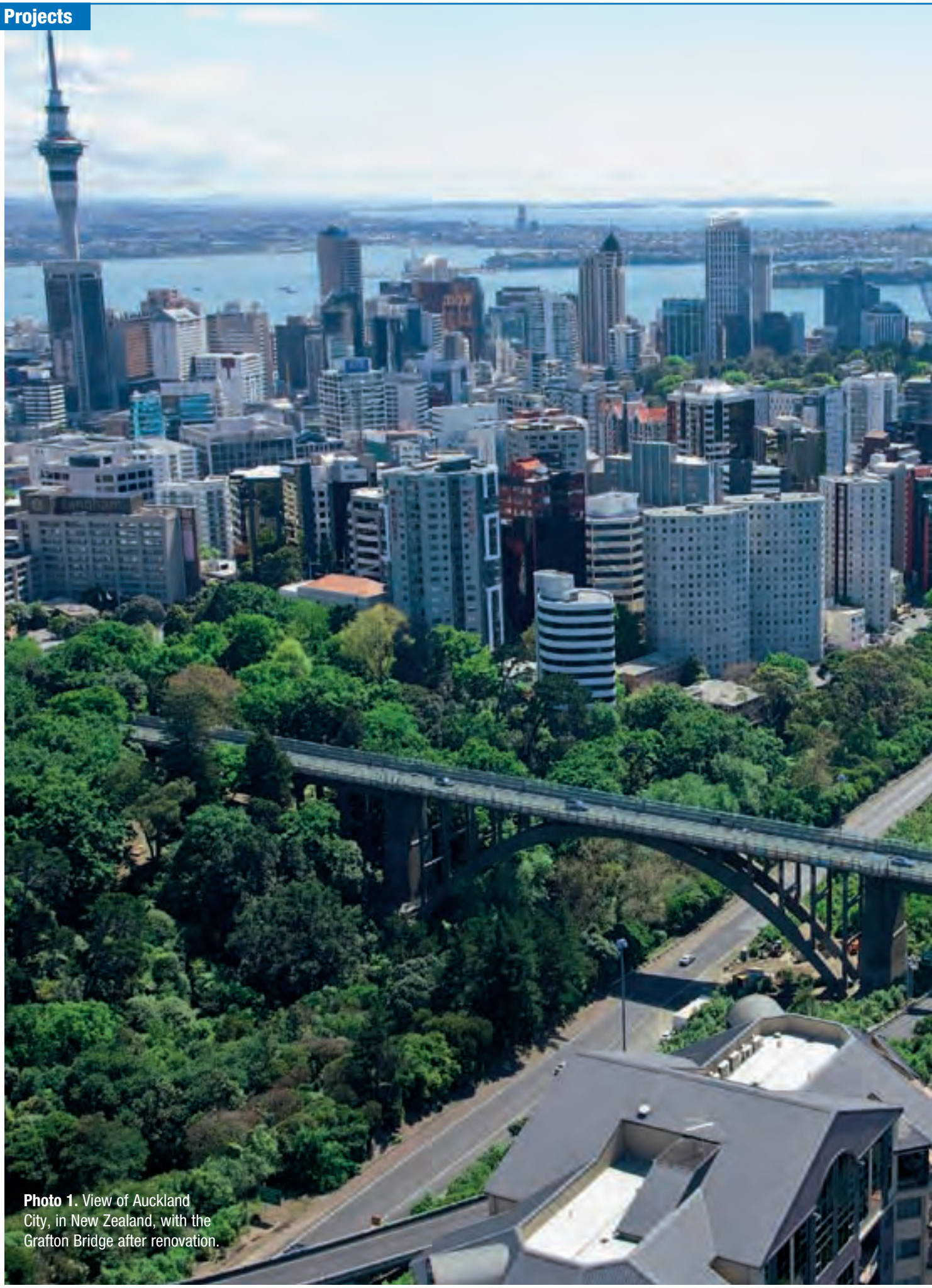

Photo 1. View of Auckland City, in New Zealand, with the Grafton Bridge after renovation.

1

Grafton Bridge in New Zealand

Mapei products were chosen for repairing the concrete structure

Grafton Bridge is a road bridge spanning Grafton Gully in Auckland City (New Zealand), connecting the city centre with the near-by suburbs. It was first opened in 1910 and today it is on the New Zealand Historic Places listing. Grafton Bridge spans about 98 metres and rises to a height of around 43 metres. Originally designed to cater for pedestrians and horse drawn traffic in 1906, the bridge had an 8 tonne vehicle weight limit imposed in 1970.

In 2008 a strengthening project was launched and was intended to expand the use and extend the life of this historical Auckland landmark. The strengthening project was designed to upgrade the structure to carry current and future traffic loadings to become a dedicated bus corridor as a major link in Auckland City Council's Central Connector Project.

This is an initiative to deliver 64,000 passenger journeys per weekday via public transport in and around Central Auckland. The original design did not cater for earthquake loading and these works include seismic retrofitting of the bridge columns. Surveys prior to commencement of works and subsequent inspections found numerous cracks, voids and spalled concrete as well as levels of carbonation requiring remedial action.

Interventions to solve these problems were implemented to preserve the integrity of this wonderful 100 year old example of architectural engineering. The Fletcher Construction Company, trading as Brian Perry Civil, was awarded the contract for the restoration works at Grafton Bridge.

Strengthening works consisted of 750 m^3 of reinforced concrete to the base of the two main piers, column extensions and foundation piles.

The contractor requested that products for concrete repair, epoxy resin for injection and the anti-carbonation coating would be manufactured by a single supplier. Various manufacturers were invited to submit proposals and perform on site trials.

Mapei was selected as the preferred supplier of these materials after approval by the client, the Auckland City Council's Engineers and Heritage Architects appointed to assess the products' technical and aesthetic merits.

The Schedule of Works

The sheer scale of required repairs was soon established and the final surveyed quantity included:

- concrete spalling repairs: 75 m^2 (364 identified areas)
- crack repairs: 805 lineal m (526 identified cracks).

For crack injection and ancillary works Mapei offered ADESILEX PG1, two-component thixotropic epoxy adhesive, EPOJET LV two-component epoxy resin with very low viscosity, and LAMPOSILEX ultra fast-setting and drying hydraulic binder. For the bridge's concrete repair Mapei supplied MAPEGROUT THIXOTROPIC shrinkage-compensated fibre-reinforced thixotropic mortar; PLANITOP 400 fast setting shrinkage-compensated thixotropic mortar ideal for cortical restoration and

Photo 2. MAPEFER 1K was used for protecting the reinforcement rods.
Photo 3. Applying MAPEGROUT THIXOTROPIC on reinforcement rods treated with MAPEFER 1K.

the finishing of reinforced concrete; PLANITOP 430 fine-grained, thixotropic, fibre-reinforced, controlled-shrinkage, medium-strength mortar; MAPEFER 1K one-component corrosion-inhibiting cementitious mortar for the protection of reinforcing rods and MAPEFILL GP general purpose shrinkage compensated grout (N.B. This product is manufactured by Mapei Far East, a subsidiary of the Mapei Group located in Singapore).
Remedial repairs including resin injection of cracks were carried out by trained staff of Brian Perry Civil, New Zealand Industrial Abseilers and Certified Concrete Repairs, a New Zealand professional company specializing in concrete repair.

Application of the Anti-carbonation Coating

The largest extent of the project, in terms of material supply was the application of the anti-carbonation coating. In this case, MAPELASTIC was chosen as the most suitable product, due to its long term, successful track record and the fact the project required a cementitious coating as part of the restoration of the structure.
MAPELASTIC is a two-component flexible cementitious mortar for waterproofing, which can be also used for protection against the penetration of carbon dioxide and other aggressive atmospheric elements. Shrinkage cracking in concrete columns, beams, road and railway viaducts repaired with products from the MAPEGROUT range can also be protected by the application of MAPELASTIC.
Application of the coating was a difficult process due to access, height constraints and other issues. The bridge crosses a 19th century cemetery and 8 lanes of a busy inner city motorway network.

IN THE SPOTLIGHT

PLANITOP 400

It is a fast-setting shrinkage compensated thixotropic mortar for cortical restoration of concrete by applying a single coat of mortar at a variable thickness between 1 and 40 mm. It is used for deep cortical restoration of vertical and horizontal concrete surfaces.
PLANITOP 400 is a pre-mixed powder composed of special hydraulic binders, selected fine graded aggregates and special additives prepared according to a formula developed in the Mapei research laboratories. Mixed with water, PLANITOP 400 becomes an easily workable and thixotropic mortar that can be applied on vertical surfaces in a thickness up to 4 cm per coat. It can be subjected to loads 4-5 hours after its application. Because of its very fine graded aggregates and high content of synthetic resins, PLANITOP 400 can be applied by trowel. Once PLANITOP 400 has hardened completely, it has the following characteristics: strong adhesion to the concrete; good resistance to wear; high mechanical strength. PLANITOP 400 meets the requirements defined by **EN 1504-9** ("Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - General principles for the use of products and systems") and the minimum requirements claimed by **EN 1504-3** ("Structural and non structural repair") for structural mortars of class **R3**.

PLANITOP 430

It is a pre-blended mortar in powder form, made up of cementitious binders, fine-grained, graded aggregates, special additives and synthetic fibres.
When PLANITOP 430 is mixed with water, it forms a thixotropic mortar which is easy to apply, even on vertical surfaces, at a thickness of from 5 to 35 mm without formwork. It is used to repair the concrete cover on deteriorated concrete structures following corrosion of the reinforcement rods. It meets the requirements defined by **EN 1504-9** and the minimum requirements claimed by **EN 1504-3** for structural mortars of class **R3**.

5

6

This necessitated a major component of the coating programme to be carried out during night closures of the motorway between 11 p.m. and 5 a.m. The application of MAPELASTIC was carried out by Topcoat Specialist Coatings, a Mapei applicator experienced in these types of coatings.
The product system encompassing MAPEFER 1K, MAPEGROUT THIXOTROPIC and MAPELASTIC was chosen to meet the local current regulations which focus on the complete repair system rather than on single products.
WALLGARD GRAFFITI BARRIER, a reversible graffiti-resistant protective barrier, was then employed as the means to protect the base of all piers and columns.
By strengthening for increased road traffic demands, providing a robust and stable structure to resist seismic events, restoring the bridge's appearance and fabric, as well as installing an enhanced layer of durability to the bridge: these inerventions have extended the working life of one of Auckland's most treasured landmarks.
Thanks to Mapei, Grafton Bridge, which celebrated its 100th birthday in 2010, has now re-opened to traffic and enters a new role in Auckland's rapidly expanding transport network.

7

Photo 4. Small cracks in the concrete were filled with EPOJET LV epoxy resin.
Photos 5 and 6. Preparing and applying MAPELASTIC for waterproofing and anti-carbonation protection.
Photo 7. View of Grafton Bridge after completion of the works.

TECHNICAL DATA

Grafton Bridge, Auckland (New Zealand)
Period of Construction: 1906-1910

Period of Intervention: 2008-2009
Intervention by Mapei: supplying products for the bridge's repair and the application of an anti-carbonation coating
Client: Auckland City Council
Design Engineer: Will Pank from Beca
Works Director: Ashley Cooper
Contractor: Brian Perry Civil
Mapei Co-ordinator: Darren Smith, Mapei New Zealand

MAPEI PRODUCTS

The products mentioned in this article belong to the "Building Speciality Line" range. The technical data sheets are available at the web site: www.mapei.com. Mapei products for the protection and repair of concrete surfaces and structures have been awarded the CE mark in compliance with EN 1504.
Adesilex PG1 (CE EN 1504-4): two-component thixotropic epoxy adhesive for structural bonding.
Epojet LV (CE EN 1504-5): two-component epoxy resin with very low viscosity for injection.
Lamposilex: ultra fast setting and drying hydraulic binder for plugging water leaks.
Mapefer 1K (CE EN 1504-7): one-component corrosion-inhibiting cementitious mortar for the protection of reinforcing rods.
Mapefill GP: general purpose, shrinkage-compensated grout. N.B. This product is manufactured by Mapei Far East, subsidiary of the Mapei Group located in Singapore.
Mapegrout Thixotropic (CE EN 1504-3, R4): shrinkage-compensated fibre-reinforced thixotropic mortar for the repair of concrete.
Mapelastic (CE EN 1504-2, coating **(c)**, principles **PI**, **MC** and **IR):** two-component flexible cementitious mortar for waterproofing balconies, terraces and bathrooms.
Planitop 400 (CE EN 1504-3, R3): fast-setting shrinkage-compensated thixotropic mortar for cortical restoration and the finishing of reinforced concrete.
Planitop 430 (CE EN 1504-3, R3): fine-grained, thixotropic, fibre-reinforced, controlled-shrinkage, medium-strength mortar for repairing concrete.
Wallgard Graffiti Barrier: reversible graffiti-resistant protective barrier for all surfaces.