



## The figures

**1,067 m** length of the bridge

**30.8 m** width of the deck

**56.20 m** height above sea level

**13 m** depth of the foundations

**18** piles

**45 m** average height of the piles

**67,000 m<sup>3</sup>** concrete used for the deck

**9,000 tonnes** of steel reinforcement

**15,000 tonnes** of steel used for the metal structures

**1,200** people working on the project

**20** sites working in parallel

### Genoa (Italy)

# RECONSTRUCTION USING MAPEI TECHNOLOGIES

MAPEI'S CONTRIBUTED BY SUPPLYING CUTTING-EDGE PRODUCTS AND THE SUPPORT OF THE COMPANY'S EXPERTS

The Genoa-San Giorgio Bridge, inaugurated on 3<sup>rd</sup> August, has replaced the Morandi Bridge, which collapsed on 14<sup>th</sup> August, 2018.

Reconstruction of the bridge, designed by Renzo Piano and built by Webuild and Fincantieri Infrastruttura, was completed in just two years, with the aim of making it a national model for the redevelopment of Italian infrastructures.

Mapei took part in this imposing work of civil engineering by supplying numerous products, including admixtures for the ready-mixed re-

inforced concrete to construct the piles, and as a consultancy service through the company's engineers and specialists, who were available round-the-clock from the very start of the project right up to placement of the last pour of concrete.

#### Characteristics of the new bridge

Compared with the Morandi Bridge, which was 1,182 m long, the Genoa-San Giorgio Bridge, at 1,067 m, is slightly shorter. Also, the new bridge does not follow exactly the same route and has been built around 20

m to the south of the old one. This decision was taken in order to shorten the schedule of works for its construction and to reduce any interference with the buildings below the bridge to a minimum.

The bridge is made up of a steel and concrete deck and a continuous truss divided into 19 spans (14 spans of 50 m, 3 spans of 100 m, 1 of 40.9 m and 1 of 26.27 m), with the whole structure supported by 18 reinforced concrete piles - 7 more than the Morandi Bridge - with an elliptical section measuring 4 m by 9.5 m.

“ We are so proud to have contributed to the construction of the new San Giorgio Bridge in Genoa. The supply of safe, certified and durable products and systems has always been our mission”.

Veronica Squinzi, CEO of the Mapei Group

Mapei supplied admixtures such as DYNAMON XTEND W400N, DYNAMON LZ 551 and MAPEFAST ULTRA for the concrete mix used to build the piles.

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The viaduct has a curved section (overall height 4.8 m in the middle) made from a structure of steel and concrete. The total width of the road section has been increased from the previous 18 m to 30.8 m and there are two 3.75 m wide lanes running in each direction, separated by a 2.6 m wide central reservation. Each of the two carriageways also has an emergency lane, which the

old bridge didn't have, and there is a 2.5 m high anti-wind and safety barrier running along both sides of the bridge. Made from glass to mitigate the bridge's visual impact and provide an uninterrupted view of the surroundings while travelling over the bridge, the barrier is also bird-friendly thanks to a series of special markings on the surface of the glass.

**Mapei's intervention**  
Construction of the piles.  
Mapei's Admixtures for Concrete Division was involved in the project 24/7, with each day split into three 8-hour shifts. Work was carried out incessantly to ensure technical support was constantly available at the three production plants producing the concrete in Chiaravagna, Genoa Harbour and San Quirico, owned by

Calcestruzzi SpA, a division of Italcementi. The piles were constructed by placing the concrete in a continuous cycle using a special type of formwork which is attached to the structure under construction. With this technique, support for the fresh concrete is provided by the concrete placed previously. Therefore, when the formwork is raised, the mechanical

properties of the previous concrete need to be sufficient to withstand the weight of both the new concrete and the formwork. The development of the mechanical properties of cementitious conglomerate is heavily influenced by the surrounding conditions at the time of pouring, particularly the temperature. The period in which the piles were constructed, between

**A requirement, which was particularly important for the client, was to guarantee an excellent exposed surface finish after removing the formwork from the piles**

THE CHRONICLE OF A RECONSTRUCTION

14<sup>th</sup> August 2018

At 11:41 a.m. the Morandi Bridge collapses, causing 43 deaths, thousands of people having to flee their homes and leaving an entire city split in two. The bridge, designed by Riccardo Morandi, had been inaugurated in 1967.

18<sup>th</sup> December 2018

Marco Bucci, Mayor of Genoa, is nominated Special Commissioner for its reconstruction and decides to assign all works to a consortium comprising Salini Impregilo and Fincantieri, which then develops the original design donated to the city in September by Renzo Piano.

15<sup>th</sup> April 2019

The site for the reconstruction of the Polcevera Viaduct is opened and for three months operates in parallel with the team demolishing what remains of the old bridge. From that moment on, and right up until all site work is completed, around 1,200 people are involved in the work: the target is the construction of one pile per month.

28<sup>th</sup> June 2019

One carriageway of the motorway is closed, along with all roads within a radius of 300 m, and more than 3,000 people have to evacuate their homes. Demolition of piles 10 and 11 of the Morandi bridge commences, a high-risk operation followed closely by people from all around the world.

1<sup>st</sup> September 2019

Formworks start operating simultaneously on four fronts. And so starts the concept of working simultaneously rather than in sequence, a major factor in enabling work to be completed in such a short space of time.

12<sup>th</sup> February 2020

The new bridge starts to take shape: a 100 m-long steel beam is raised over pile No. 9, the one that crumbled two years previously causing the collapse of the bridge, to a height of 40 m.

2<sup>nd</sup> March 2020

The third and final 100 m central span is erected over the railway

lines. The operation is carried out with the site operating at reduced staffing levels due to the Covid-19 pandemic.

19<sup>th</sup> April 2020

The last of the 19 spans is placed in position at a height of 40 m and work on the 1,067 m-long steel and concrete deck is finally completed: the city of Genoa, at least from a visible point of view, becomes one again.

3<sup>rd</sup> August 2020

Two years after the collapse, the Genoa-San Giorgio bridge is inaugurated by the President of the Italian Republic, Sergio Mattarella.



The combination of cutting-edge admixtures, with the capacity to modify hydration reactions and the hardening rate of cementitious materials, has ensured the achievement of the expected results

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DYNAMON XTEND W202 N, DYNAMON LZ 551 and EXPANCRETE PLUS admixtures were supplied for the concrete poured on the deck.

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June 2019 and January 2020, meant that the concrete had to be poured in a range of very different temperatures.

The mix designs included the following admixtures that guaranteed that the mechanical properties between the various pours of concrete at these different temperatures remained constant:

- DYNAMON XTEND W400 N, liquid admixture for high quality concrete, specially formulated to make concrete with a low water/cement ratio and negligible loss in workability while being transported and unloaded on site.
- DYNAMON LZ 551: a multi-purpose, modified acrylic polymer-based super-plasticiser specially

developed to maintain the workability of concrete.

- MAPEFAST ULTRA, a latest-generation chloride-free liquid hardening accelerator for mortar and concrete, containing nanoparticles of complex hydrated silicates, obtained through an exclusive synthesis process, characterised by its very high specific surface area (see the dedicated article in this issue of the magazine).

The final requirement, and one that was particularly important to the client, was that the exposed concrete surfaces needed to have an excellent finish once the formwork had been removed, with as few surface defects as possible, and that it should have a uniform colour that enhances the



## Admixtures: invisible but indispensable

WE SPOKE WITH PIETRO LATTARULO, MAPEI'S ADMIXTURES FOR CONCRETE DIVISION

**What were the most difficult problems you came up against during construction of the piles and how did you overcome these problems?**

Mapei's collaboration in the project started with construction of the reinforced concrete columns supporting the bridge, which in this case feature an elliptical form and are made from concrete cast using climbing formwork. To guarantee consistency of the most significant properties and enable the piles to be constructed in a continuous cycle meant guaranteeing their mechanical properties over a specified period of time, for which we used the latest, cutting-edge Mapei admixtures with the capacity to modify the hydration process and hardening rate of cementitious materials, so as to be sure they achieved the expected levels.

**What part did Mapei play in the final surfaces of the piles?**

A particularly important requirement of the client was that the exposed surfaces needed to have an excellent finish once the formwork had been removed, with no surface defects in the concrete, and that the colour had to be uniform. The requirement was achieved to the full, thanks not only to the correct design mix for the concrete, but also to MAPEFORM W60, a form-release agent in water dispersion for concrete.

**Once the piles had been completed, it was time to cast the slab for the deck. What factors had an influence on the choice of products?**

For this phase, too, various design factors had to be taken into consideration, such as the particularly high mechanical properties required, the rate of compensated-shrinkage, which had to be maintained within specified limits, and extended workability in hot weather, because the concrete for the slab was actually placed in June, 2020.

**From the amount of products used we can get a sense of how challenging it must have been for Mapei to guarantee the right level of technical support. How did you organise your work?**

Through incredible teamwork, and by being perfectly synchronised with the manufacturer of the concrete so that the most suitable materials were employed to achieve the properties required, with our mobile laboratories stationed in the mixing plants to check the concrete and make sure the values corresponded with the results we achieved in the lab and, lastly, by constantly monitoring the site throughout its entire duration.

**It must have been a very important experience for you?**

Concrete admixtures are invisible because, from the moment they are introduced into the concrete, they no longer exist physically. However, they are indispensable to achieve the performance properties prescribed in technical specifications and to construct infrastructures that remain durable over the years. To have played such an important part in the construction of this great work brought enormous satisfaction to every department and division of our company.

“Less than two years after the collapse of the Morandi Bridge, and especially today when the memory of this tragedy is more alive than ever, the inauguration of the new bridge is a clear demonstration of how the dedication, commitment and passion people have for their work can create something exceptional and sustainable.”

Marco Squinzi, CEO of the Mapei Group

matic effect of the perfection of the structure.

The requirement specified by the client was achieved to the full, thanks not only to the correct design mix for the concrete, but also to a form-release agent that left the surfaces with a high quality finish.

After carrying out a series of mock-up tests on site, the team decided to use MAPEFORM W60, a form-release agent in water dispersion that forms a non-stick coating on formwork with a rough or smooth surface.

#### Building the deck

Once erection of the metal structure had been completed, the slab of the deck was poured using compensated-shrinkage concrete to prevent the formation of cracks being triggered during the plastic shrinkage phase. This particular phase of the work also required concrete with high mechanical properties, a

controlled rate of shrinkage within specified parameters and extended maintenance of workability in hot weather. The slab was poured in June, 2020 using a concrete mix designed to achieve high mechanical properties after a short curing cycle to facilitate surface-finishing operations.

As in the case of the piles mentioned previously, the results were achieved by using a combination of specific products:

- DYNAMON XTEND W202 N: an acrylic superplasticizer, specially formulated to make concrete with a low water/cement ratio and a good maintenance of workability.
- DYNAMON LZ 551: a multi-purpose, modified acrylic polymer-based super-plasticiser, specially developed to maintain the workability of concrete.
- EXPANCRETE PLUS: a plasticizing expansive admixture for shrinkage-compensating concrete. To

prevent excessive evaporation of the mixing water, which could then lead to surface cracking, the kerbs along the sides of the slab were treated with MAPECURE WG, a water-based, film-forming curing agent with anti-evaporation properties.

#### DYNAMON XTEND W 202N

Acrylic superplasticizer, specially formulated to make concrete with a low water/cement ratio and a good maintenance of workability.

FIND OUT MORE



#### TECHNICAL DATA

##### Genoa-San Giorgio

Bridge, Genoa (Italy)

**Construction period:** 2019-2020

**Designers:** Renzo Piano, Stefano Russo (Design Manager), Alessandro Zanguo, Alessio Montanari and Giovanni Spadolini, Renzo Piano Building Workshop

**Intervention by Mapei:** supplying products and technical assistance to formulate the mix design for the concrete

**Executive design:** Andrea Nardinocchi (Technical Director) and Andrea Perego (Project Engineer),

Italferr

**Client:** Genoa Reconstruction Commission: Marco Bucci (Special Commissioner), Piero Floriani and Ugo Ballerini (Sub-Commissioners) and Roberto Tedeschi (General Manager)

**Main contractors:** Pergenova ScpA: Webuild SpA - Fincantieri Infrastructure SpA: Alberto Maestrini (President), Nicola Meistro (CEO), Francesco Poma (Project Director), Riccardo Zen (Vice Project Director), Umberto Russo (Construction Manager),

Luigi Russo (Technical Manager), Stefano Mosconi (Site Director), Carmine D'Auria (Safety Manager), Gianpiero Le Pera (Quality and Environmental Control Manager) and Renzo Rossi (Site Manager)

**Site Management:** Rina Consulting SpA: Roberto Carpaneto (Project Director), Andrea Tomarchio (Design Manager), Carlo Vardanega (Technical Director), Mario Bordi (Technical Manager) and Alessandro Aliotta (Construction Supervisor)

#### Mapei distributor:

Calcestruzzi SpA

#### Mapei coordinators:

Admixtures for Concrete Division, Technical Services, Mapei SpA (Italy)

#### MAPEI PRODUCTS

**Admixtures for concrete:** Dynamon XTend W400 N, Dynamon XTend W202 N, Dynamon LZ 551, Expancrete Plus, Mapecure WG, Mapeform W60, Mapefast Ultra

For further information on products see [www.mapei.com](http://www.mapei.com)

# With sound know-how, then everything is possible

INTERVIEW WITH BRUNO ZAMORANI, MAJOR PROJECTS DIVISION, MAPEI SpA

**A construction site that is a concentration of technologies and different areas of expertise to construct an infrastructure that has been built to last.**

**What did it mean to you to follow a site of this type?**

**And what was the most complex problem you had to overcome?**

As a citizen of Genoa, I can honestly say that this site was a deeply moving experience and my attention and dedication went beyond what I would normally apply to a traditional site.

For both myself and my colleagues who worked on the site it was undoubtedly a challenging job, in that the schedule was extremely tight and the pace of the site was frenetic, with teams working 24/7. This meant we had to be available outside normal working hours; they needed us to be there and we were always present with great enthusiasm, for Genoa and to give the best possible image of our Company, on what has become an historic site and, as such, an extremely visible one.

As far as the biggest problem is concerned, I would have to say that coordinating the various activities was extremely complex because we had to be aware of everything that was going on in real time, of what our colleagues were doing and of what the numerous other different workers were doing.

In so doing, we all had a perfectly clear picture of how the various phases of the site were evolving at any given time.

**From Renzo Piano to Marco Bucci, Mayor of Genoa and Special Commissioner, everybody stressed the importance of teamwork in order to complete the bridge. Who did you interface with on site and how was your relationship with them?**

In my role, I dealt mainly with those in charge of quality aspects and with the main contractor's technical personnel, and we often met to discuss solutions to overcome the various problems as and when they arose. The discussions I had with Renzo Piano to define certain architectural and aesthetic aspects of the bridge were particularly important and rewarding. I believe that the opportunity to collaborate with this great architect gave us all a further drive to do our best, proud in the knowledge to have proven that we were up to the challenge. I totally agree with what Renzo Piano and Marco Bucci said: teamwork on this particular site was one of the reasons behind the results we achieved and has shown once again, as if there were any need, that by pursuing a common objective you can achieve great results.

**The various work phases overlapped partially instead of being carried out in sequence. Was this something new or have Mapei technicians already worked in a similar situation?**

On many of the sites we generally follow, the more delicate phases have to overlap to a certain extent. I think this modus operandi has become quite common in the



Bruno Zamorani with Renzo Piano.

construction world, where every project is carried out at a particularly frenetic pace. The fact that the bridge was completed in record time shows that, if there is sound know-how behind everything, then everything is possible.

**How did the period of lockdown due to the Covid-19 pandemic affect your work on site?**

The period of lockdown was a further disruption for health and safety checks and for the attention to personal safety, but the contractor, suppliers and sub-contractors certainly showed that they were able to adapt straight away as and when the situation changed.

And Mapei also showed, once again, that it is an extremely reliable partner, working non-stop to supply both the materials needed for the site and the technical support to go with them.