

MAPEI AND CITYLIFE: PROJECTS WHICH AIM HIGH





The CityLife project proposes a new approach to building and a new way of living to the city of Milan, by radically transforming how domestic and urban spaces are perceived and used.

And the obvious choice of partner for this important building site could only be Mapei which, thanks to their experience and the way the company is structured, has been able to transform a number of the construction challenges imposed by the residences designed by Zaha Hadid and Daniel Libeskind and for the tower designed by Arata Isozaki into reality.

The ability to handle projects in their entire complexity led to Mapei becoming a key player right from the very first casts of concrete, with their range of admixtures.

For example, particular attention was paid to construction of the foundations for the Isozaki Tower. In fact, a special mixture of self-compacting concrete (SCC) was formulated, suitable for this particular type of mass cast and for the construction company's choice to cast the concrete continuously without vibrating and without including construction joints in the foundations.

The more than 4000 m³ of UNI EN 206-1:2006 and UNI 11104:2004 XC2/XC4 exposure class concrete was cast in one single go, working continuously for 30 hours. The temperature of the concrete was then monitored for over one week.

Mapei's approach to innovation with respect for the environment found fertile ground in this project, which included the company's systems for installing parquet and ceramic on the floors and walls, both internally and externally. The MAPETHERM TILE SYSTEM was also used, which meant that thin porcelain tiles could be used for covering, in line with the design Libeskind was looking to achieve. The Mapei coatings and waterproofing systems were also used to meet all the design requirements. Further details about the progress of this important building site will be available in the next issues of *Realtà Mapei International*.

THE BUILDING INDUSTRY: INNOVATING BY DESIGN

A round-table organised by Mapei at CityLife to discuss architecture of today and tomorrow

On the 29th of June journalists, operators and designers were invited to a special event in Milan: the round-table, entitled "The Building Industry: Innovation by Design" and moderated by the Editor-in-Chief of the Italian economics newspaper *Il Sole 24 Ore* Roberto Napolitano.

The main focus was the CityLife project, in which Mapei is an active partner with innovative products and technical assistance. CityLife is the company engaged in the re-qualification of an area of around 255,000 m² in the historic Milan's trade fair area, which became available following the transfer of the trade hub to the Rho-Pero area of the city and was the subject of an international competition in 2004 aimed at its urban re-qualification. The competition was won by CityLife with a design by the architects Zaha Hadid, Arata Isozaki and Daniel Libeskind.

Work started in 2007 and should be completed in 2015.

Constructing a Network of Companies

The welcoming speech was given by Adriana Spazzoli, Operational Marketing and Communication Director for the Mapei Group. "Innovation has always been one of the favourite key words in Mapei that is taking part in such an important project as CityLife. An innovative project, yet woven into the very fabric that characterises the city of Milan, with respect for its traditions". Claudio Artusi, President and CEO of CityLife, claimed: "With the CityLife project, this area will become a world symbol for a new way of living urban quality".

Claudio De Albertis, Chairman of Assimpredil ANCE (the Association of the Building Companies for the Milan, Lodi, Monza and Brianza areas), highlighted the difficulties the Italian building sector is currently going through.

Daniel Libeskind: "This is the Right City to Experiment In"

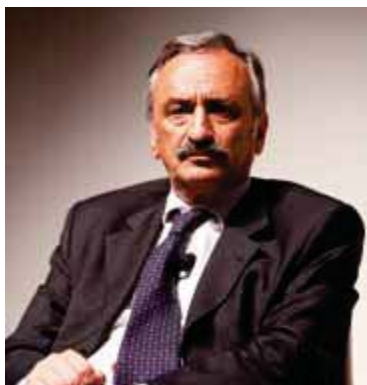
Daniel Libeskind, internationally-renowned architect, openly declared how en-

thusiastic he was about Milan. His professional touch in the CityLife project can be seen in the residences and in the tower. The American architect underlined how, in a globalised world, it is the cities themselves that are competing with each other, not only architecturally, but also through the sustainable solutions employed. He declared: "Milan has readily grabbed this opportunity and is carrying it forward with incredible courage. And I am proud to be a part of this adventure".

Claudio Guido: Innovation and Eco-sustainability

Claudio Guido, Works Director for CityLife, underlined how the keywords for this project are innovation and eco-sustainability. He said: "The fulcrum of the project is the traffic-free residential area, a zero-emissions zone with a balanced mix of housing, offices, shops and services immersed in a large, new public park".

Guido talked in detail about the Isozaki Tower, 202 m tall with a structure mainly in reinforced concrete. Particular attention was paid to construction of the foundations for the Tower. In fact, a special mixture of self-compacting concrete (SCC) was formulated, suitable for this particular





type of mass cast and for the construction company's choice to cast the concrete continuously without vibrating and without including construction joints in the foundations. Mapei developed a specific mix design for the concrete. The pozzolanic admixture MAPEPLAST PZ 300 was used to reduce the heat of the cast concrete, while the super-plasticising admixture DYNAMON SR 914 was used to reduce the amount of mixing water. The anti-shrinkage admixture MAPECURE SRA 25 was also used (for the last 50 cm thick layer of cast concrete), as well as the viscosity modifying admixture VISCOSTAR 3K.

Gennaro Fiscina: Design Ideas and Their Execution

Gennaro Fiscina, Construction Director for CityLife, highlighted how construction techniques very similar to those applied when constructing infrastructures were employed.

Fiscina said: "We realised that we had to develop specific tools and equipment that would allow us to carry out the operations according to the construction phases and specific safety norms. Therefore, special equipment was developed".

To the side. From the left: Adriana Spazzoli, Mapei Group's Operational Marketing and Communication Director; Claudio Artusi, Works Director and CEO of CityLife; the American architect Daniel Libeskind with Giorgio Squinzi, CEO of the Mapei Group; Gennaro Fiscina, Construction Director of CityLife.

Above. From the left: Gilda Boiardi, Editor-in-chief of *Interni*; Pasquale Zaffaroni, Product Manager of Mapei Building Product Line; Fiorella Rodio, Mapei Major Projects Division Director; Paolo Buzzetti, President of ANCE.

Gilda Bojardi: Design, Spectacle, Experimentation

The speech given by Gilda Bojardi, editor-in-chief of the design magazine *Interni*, concentrated on experimentation and practises applied to displays, with particular attention on those organised by *Interni* since the 1990's for the "FuoriSalone" event in April. In The aim of the activities is to stimulate creativity and allow designers and companies to develop a common path and new synergies. Boiardi's presentation included three different styles of furnishing for the show apartment in the residences designed by Daniel Libeskind. The use of Mapei wall coatings allowed the style to be interpreted each time with the proper tones and shades.

Pasquale Zaffaroni: Mapei Research and Innovation

Pasquale Zaffaroni, Product Manager for Mapei's Building Product Line, stressed how the resources Mapei invests into research are a powerful propellant for growth. Mapei was the first European company to patent a new family of acrylic-based, super-plasticising admixtures. These products allowed the entire ready-mixed and pre-cast concrete industry to produce fluid concrete with very low water/cement ratios, with extended workability for complex architectural forms, and to cast concrete in hot climates without having to add water.

The foundation slab had been cast for CityLife using the latest generation of Mapei acrylic super-plasticisers, where the heat of hydration generated had to be closely monitored to prevent cracking.

As for waterproofing systems for the damp environments, Mapei has opened a new path by producing Mapelastic, designed to protect infrastructures against atmospheric agents and corrosion.

Fiorella Rodio: Mapei Architectural Solutions Guide

"Systems in the construction sector must be chosen by taking into consideration their characteristics of compatibility and durability in relation to the project itself". This was the concept stressed by Fiorella Rodio, Mapei Major Projects Division Director. "The durability of a structure" she went on saying is a necessary condition for sustainability."

Then she explained Mapei's contribution to green building: "To develop innovative technologies that achieve new levels of excellence, and develop new, eco-sustainable systems to help buildings earn points for LEED certification of buildings". This was just the aim in mind behind the publication of the Mapei Architectural Solutions Guide, an interactive tool to help choose the most appropriate eco-sustainable system to complete a project.

Giorgio Squinzi: CityLife Has Become a Symbol

Paolo Buzzetti, Chairman of ANCE, the Italian Association of Building Companies, spoke about the difficult situation the Italian construction industry is in and claimed that CityLife represents a perfect example of the path to follow to overcome it. Giorgio Squinzi, Mapei Group's CEO and President of Confindustria (the Confederation of the Italian Manufacturing and Service Companies), underlined that CityLife is a real "plan to transform the city". Squinzi said that he was "Particularly proud and delighted about the new layout that this area will have".

He continued by saying, "As President of Confindustria, I believe that this building site is an extraordinary achievement, and is emblematic of how Italy should behave to get out of the crisis and to create new jobs".

Minimal Dynamic. The domestic spaces are linear and dry, using light colours and essential forms for the furniture, objects and accessory items.



Together they create a contemporary atmosphere, minimalist yet welcoming, that expresses refined taste and modern comfort. The large terraces, that seem to extend the external domestic areas, are used to add even more personality to the home.

The Interni proposals

SHOW APARTMENTS AT CITYLIFE

To make the new way of living offered by CityLife more real and perceivable, a show apartment from the Libeskind residences has been created in one of the pavilions at the former trade fair to transmit how it feels to actually live the spaces.

The apartment has been studied right down to the smallest detail, with three different proposals from the magazine *Interni* (with the help of Studio Ravaioli and Silenzi) and one by the magazine

AD. Mapei was also involved in creating the apartments, with their solutions to install the floor and wall coverings and various coatings products.

The internal wall coatings DURSILITE and SILANCOLOR MARMORINO, thanks to their colours and texture, have become an integral part of the interior designs proposed, and underline the balance between the container and its contents.

The Interni proposals

of domestic bliss and softness. The large terraces overlooking the city and park are used to amplify the internal spaces, and become additional rooms which can be used for socialising and entertaining, but also for just chilling out and contemplating.



Classic Contemporary. This style has been used to express a classic and elegant taste. The neutral and natural tones for the walls and the textile coverings offer a pleasant sensation



The AD proposals

The Grand Milan (first act).

The first interior design project proposed by AD evokes the atmosphere of the highly refined interiors of Milan from the time of the Milanese architects Piero Portaluppi, Guglielmo Ulrich, Gio Ponti and Franco Albini. The grey walls, floors in light, natural yet never invasive wood, and furnishings play on the emotions of a kind of decorative contamination. Top quality details, discreet and soft, sensorial lighting, a rich offer of domotics and a well thought out lay-out of works of art complete the scene.

Show Homes in the Residences

Two show apartments were also created in the residences currently under construction, one in the Zaha Hadid complex and the other in the Libeskind complex. Mapei is also present in these apartments with systems to install the flooring and waterproof substrates and, in particular, with wall coatings. Show apartments were created throughout 2012 and Mapei, with its approach to the project, has become a genuine partner for designers who wish to create the new spaces of tomorrow.



Bohémien Chic. This apartment combines freedom of expression alongside a much refined taste in the choice of objects. The target is a new category of consumers that demonstrate special attention to the themes of sustainability and ecology. It is at the cutting-edge of new homes as far as energy performance and lower consumption are concerned. It is an environment open to contamination from different eras and styles, in which works of art and antique ethnic furniture are featured alongside more contemporary accessories.

ISOZAKI TOWER

Low heat hydration and pressure on the formwork reduced to a minimum through new types of concrete

The new tower designed by the architects Arata Isozaki and Andrea Maffei in the new CityLife district, an important urban re-qualification site in the city of Milan (Italy), was inspired by the *Endless Column* sculpture by Constantin Brancusi, a metaphoric representation of a building stretching without limits in its search to reach the sky. When finished it will be slightly more than 200 m tall, one of the tallest buildings in Italy. The tower is designed to accommodate up to 3,800 people over a total floor space of 53,000 m². There will be 50 floors in the tower, 46 of which are for management and business use. The design of the tower comprises a reinforced concrete structure with steel-concrete modules reaching a total height of 223 m from the level of the foundations (207.2 m from road level). The foundations are made of a foundation slab on piles, where the piles act as elements to reduce the amount of settling.

Characteristics of the Ground

The ground where the building site is located is in the middle of a rainwater plain on which, due to the frozen layers melting in the Northern Italy area during the current geological era, a thick layer of river and glacial debris and sand has deposited.

The profile of the surface of the site where the tower is being constructed typifies the stratigraphic layout of the Milan area (from top to bottom):

- fine, granular material in a layer from 5 to 9 m thick;
- river deposits, comprising mainly sandy



pebbles and sand with a gravel matrix with no or very little silt, in a layer from 37 to 40 m thick;

- glacial and river deposits, interposed with layers of silty sand, around 10 m thick, and layers of sandy and clayey silt from 1.5 to 4.5 m thick.

Testing

To assess the interaction between the piles and the ground, two load tests were carried out on test piles 1 m in diameter and 33 m long, which were loaded until they reached their structural limits. The aim of the tests was to determine their load-yield curve and calculate their lateral strength and the resistance of the heads of the piles. The results confirmed the assumptions made during the design phase, and the main theories about the mechanical behaviour of a pile-ground complex.

Foundation Slab

The foundation slab is rectangular and measures 63.1 m by 27 m. It varies in thickness from 2.5 m to 3.5 m and, because of the mixed nature of the foundations, sits on both the underlying ground and on 62 drilled piles. The piles are 33.2 m long, 1.2 m to 1.5 m in diameter and are made of C32/40 XC1 S5 class concrete.

This type of foundations was chosen mainly because of the mechanical characteristics of the ground on which it has been installed and the size of the loads transmitted to the foundations by the tower, around 1430 MN (143,000 tons) in combined service use.

The designers believe that mixed foundations offer more advantages compared with traditional foundations – direct and indirect – and, at the same time, respect the safety and service assessment criteria according to current standards and the in-service performance requirements of the tower.

A structure was designed which, compared to the previous solution with direct foundations, required 60% less concrete and 45% less steel reinforcement for the foundation slab, at the same time guaranteeing 40% less settling compared with surface-based foundations. From a structural point of view, the most stressed areas of the foundation slab, located below the pillars of the tower, were reinforced on the inner side with four layers of steel reinforcement in each main direction. In the central area of the floor slab, where the design loads were lower, the typical steel reinforcement on the inner side comprised two



layers in each main direction.

The specified dimensions of the foundation slab and steel reinforcement were determined considering a maximum flexural load of around 31 MNm (3,100 tonnes-m) and around 42 MN of shear load (4,200 tonnes) in the most stressed section.

The reinforcement was then checked to verify that it respected all the design limits regarding maximum strain and cracking when in service, as well as the shrinkage of the concrete during the curing phase.

Checks

The foundation slab itself would easily pass all the geological and structural safety checks. However, to bring the structural stresses and settling of the foundation slab within acceptable limits, piles were included to reduce settling. The length of the piles in particular was carefully calculated in order to contain the amount of secondary consolidation as much as possible.

Above. View of the complex steel reinforcement in the foundation slab.

Below. View from above of the building site.

PROJECTS



BUILDING SITE MANAGEMENT

The client, CityLife S.p.A., awarded the contract for works management operations for the whole of the New Urban Hub project to ATI Ingegneria SPM - Studio In.Pro. The Building Site Manager and Works Manager are respectively Stefano Perotti and Claudio Guido. The Building Site Management team, with more than 30 years of experience operating in the public and private infrastructure sector, civil works and plant work, offer all their knowledge and experience gained from managing the largest building sites in Italy over the last decades with a staff of more than 150. Both companies have always aimed at excellence by uniting the professional activities of their teams with the most highly advanced applied technology available in the sector, and offer transparency, rapid interventions and efficiency to the entire production and control system, thanks also to the use of sophisticated proprietary software systems such as Piattaforma Projectmate 2.0, which has been used for projects with a value of more than 20 billion Euros.

Formwork

The foundation slab was cast in two steps, the first to a thickness of 2.5 m and the second for the remaining metre of thickness. The forms for the future lift shafts were also created within the foundation slab.

In order to cast the mono-block concrete slab, around 550 m² of panels with metal ribs were used, supported by high load-bearing shoring props.

Each prop was placed in position to counteract the pressure of the cast slab on an area of just 1.35 m² (every metre of frame had to withstand a pressure of 30 kN/m²). Around

Above.

Detail view of the concrete casting process.

Below.

The on-site laboratory.



the perimeter, lateral protective walkways were installed to make it easier for the workers to carry out their work. Around 4150 m³ of concrete were needed for the first phase, and a further 1050 m³ for the second phase.

Characteristics of the Cast Concrete

The foundation slab was so large that the concrete was considered a mass cast.

A cast is defined as a mass cast when its thickness does not allow the heat generated during the hydration phase of the cement to be dispersed constantly and progressively. Problems connected with this type of structure include the differences in temperature between the various areas of the cast and differences in temperature between the centre of the structure and the surrounding temperature. This problem potentially causes the formation of cracks.

Special care was required to design the mix used for the slab, along with all the necessary precautions to protect and cure the cast concrete in order to reduce potential hazards caused by the differences in temperature once the concrete had been cast.

Specifications of the Concrete

Apart from the exposure class, mechanical strength and all the other important characteristics of the concrete, the specifications, defined by the project designer, also included the curing phase and the protection of the

structure to limit the differences in temperature within the concrete:

- maximum temperature at the core of the cast concrete: $70\text{ }^{\circ}\text{C}$, defined as $T_{\text{max}} \leq T_{\text{fresh concrete}} + \Delta T_{\text{hydr}} \leq 70\text{ }^{\circ}\text{C}$
- $\Delta T_{\text{surface-core}} \leq 20\text{ }^{\circ}\text{C}$, with ΔT defined as the difference in temperature between the surface of the concrete and the core of the cast concrete.

The aim of the preliminary tests was to define:

- Heat of hydration of the cement
- Temperature development of the concrete mix
- The use of thermocouples embedded in the cast concrete to monitor the temperatures.

After discussions with the construction companies (Monvil Beton, IA, DL) and the building site managers, Mapei suggested the use of SCC (Self Compacting Concrete), so that the construction company could cast in a continuous way to form a monolithic, homogeneous slab.

Approval of the Mix

It took several months of careful testing to approve the mix. The solution proposed by the concrete supplier Monvil Beton and Mapei was based on the construction company's request to cast the concrete in a continuous way without vibrating, and without any construction joints in the foundation slab. When the mix was designed, a constant pouring of 35 hours was established using two Monvil Beton concrete mixing units. Because it was difficult to estimate the final increase in temperature of the concrete, in particular at the core, it was decided to contain the increase in temperature of the mix as much as possible.

This conclusion led them to opt for the use of mineral additives, to optimise the cement content and to check the mechanical strength of the concrete after 60 and also after 90 days of curing, rather than after 28 days, in compliance with the type A Checks according to the Italian Technical Standards, reaching the strength levels prescribed after 60 and/or 90 days.

Components of the Mix

The final concrete mix was obtained by using class 32.5 CEM III/A blast-furnace cement, aggregates from a quarry owned by the manufacturer of the concrete and limestone fillers containing MAPEPLAST PZ 300 powdered mineral additive with pozzolanic activity. The superplasticizer DYNAMON SR 914 was used in combination with VISCOSTAR



3K viscosity modifying admixture, to form a C32/40 LH XC2-XC4 SCC concrete with high self-compacting properties and controlled development of heat hydration.

The tests were carried out on site on concrete cubes protected with insulating panels to create semi-adiabatic conditions.

The tests were monitored using thermocouples, which demonstrated that the thermal characteristics of the mix complied with the specifications. The required tests also included the values of its tensile and flexural strength carried out by certified laboratories, as well as tests to determine the hydraulic shrinkage of the mix. In the next issues of *Realtà Mapei International* we will provide our readers with updated news on the works' progress at this building site.



Above. Concrete casting by night.

Below. From left on: Giorgio Villazzi, Monvil Beton's CEO; Adriana and Giorgio Squinzi, Mapei Group's Operational Marketing and Communication Director and CEO respectively; Claudio Artusi, CityLife's President and CEO.

TECHNICAL DATA

Isozaki Tower, Milan (Italy)

Period of Construction: 2012-in progress

Project: Arup Italia

Works Direction: Claudio Guido (ATI SPM-INPRO)

Contractors: S.G.F. - I.N.C. SpA (Milan, Italy) (consultancy: Franco Mola); sub-contractor: Impresa Bacchi (Milan)

Formworks Supplier: DOKA

Concrete Supplier: Monvil Beton (Cusano Milanino, Italy)

Mapei Co-ordinators: Pietro Lattarulo and Gianluca Bianchin, Mapei SpA (Italy)

MAPEI PRODUCTS

Admixtures for Concrete: Dynamon SR 914, Mapeplast PZ 300, Viscostar 3K.

For further information see the website www.mapei.com