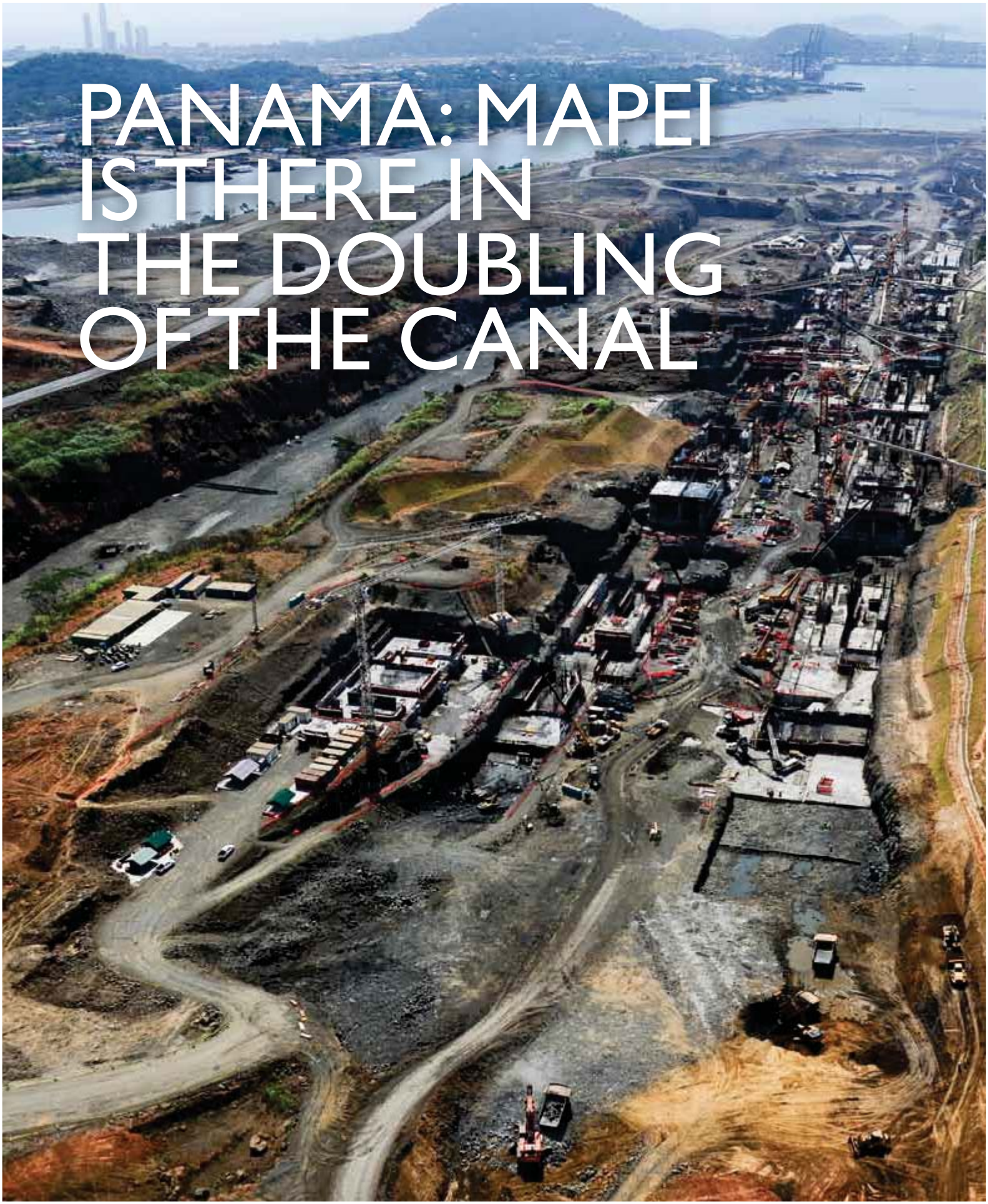
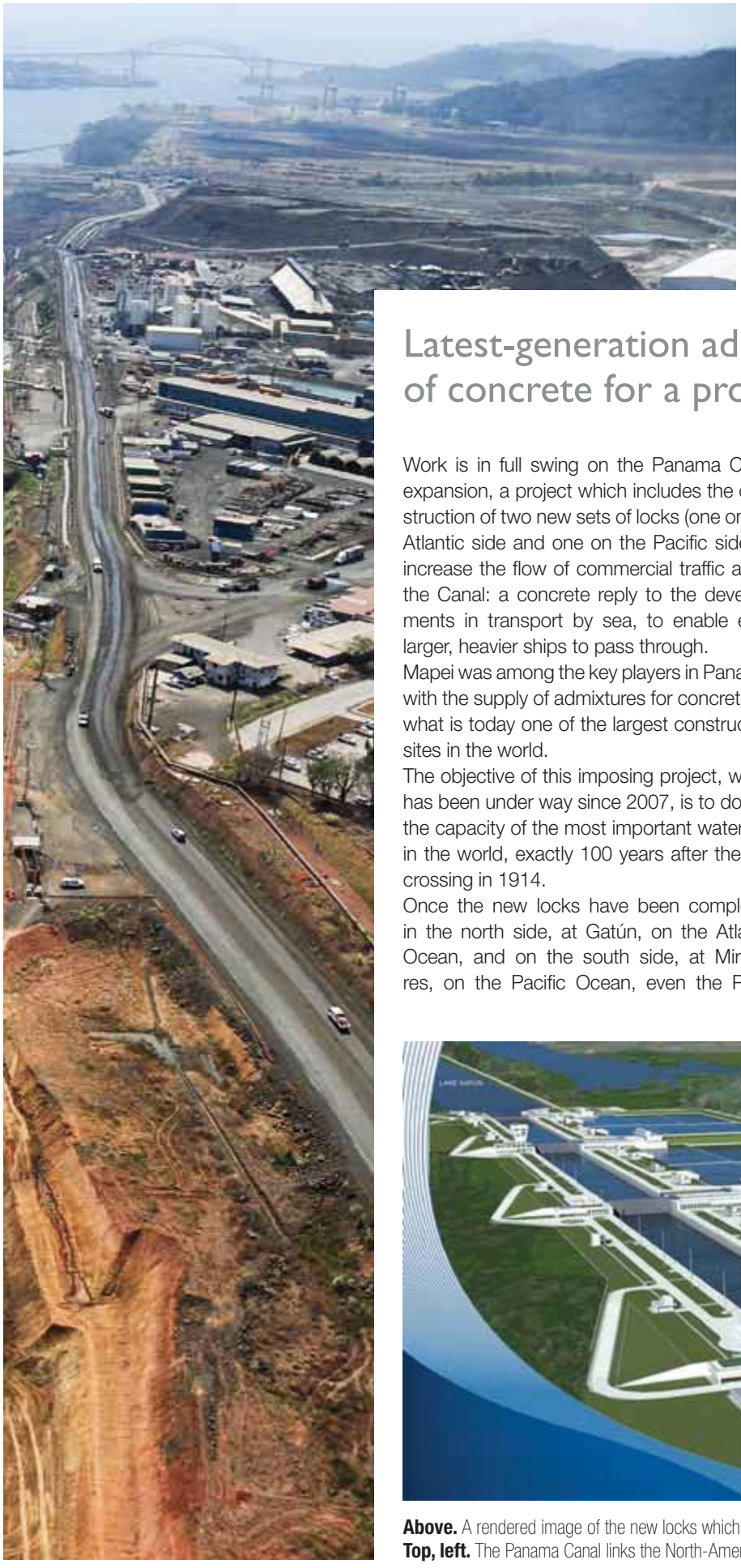
PANAMA: MAPEI IS THERE IN THE DOUBLING OF THE CANAL





Latest-generation admixtures for 5,500,000 m³ of concrete for a project in progress

Work is in full swing on the Panama Canal expansion, a project which includes the construction of two new sets of locks (one on the Atlantic side and one on the Pacific side) to increase the flow of commercial traffic along the Canal: a concrete reply to the developments in transport by sea, to enable even larger, heavier ships to pass through.

Mapei was among the key players in Panama, with the supply of admixtures for concrete for what is today one of the largest construction sites in the world.

The objective of this imposing project, which has been under way since 2007, is to double the capacity of the most important waterway in the world, exactly 100 years after the first crossing in 1914.

Once the new locks have been completed in the north side, at Gatún, on the Atlantic Ocean, and on the south side, at Miraflores, on the Pacific Ocean, even the Post-Panamax maxi container ships will be able to navigate along the 80 km long canal. These ships, up to 366 m long and 49 m wide, can carry up to 12,000 TEU (Twenty-Food Equivalent Units, the standard international volume for ISO container transport), compared with the 4,400 TEU currently allowed for the so-called Panamax ships.

Today, the Panama Canal is an artificial channel that crosses the Panama isthmus for an overall length of 81.1 km, joining the Atlantic and Pacific Oceans.

The new waterway is scheduled to be completed in 2014, the centenary of the inauguration of the existing canal.

The Canal expansion project is the result of an agreement between the Panama Canal Authority (ACP), a Panama Government body delegated to running the infrastructure, and the Grupo Unido por el Canal (GUPC) consortium, comprising of Sacyr Vallehermoso

Above. A rendered image of the new locks which are currently being built at Panama Canal.
Top, left. The Panama Canal links the North-American and the South-American continents.

(Spain), Impregilo (Italy), Jan de Nul (Belgium) and Constructora Urbana (Panama) companies, with an overall value of 3.22 billion US dollars.
The total cost of the project is 5.25 billion dollars, and will be financed by the government by increasing toll charges by 3.5% for the next twenty years.

Restructuring the Original Canal

The project also includes restructuring work on the original canal.
And in this case too, Mapei offered a contribution for renovation and consolidation work for the Gatún Lock, located approximately 30 m below ground and considered to be the most imposing reinforced concrete structure ever constructed. This project uses a special type of concrete and Mapei has supplied admixtures to make it: PLANITOP 15, an inorganic powder product added to the concrete cast into formwork, and the liquid admixture MAPECURE SRA, specially formulated to reduce the formation of cracks caused by hygrometric shrinkage in normal and self-compacting concrete.

THE CANAL IN NUMBERS

Inauguration of the Canal: 15th of August 1914
First Official Crossing: the Ancon ships in 9 hours 40 minutes
Length of the Canal: 80 km
Dimensions: maximum depth 12 meters, variable width from 240 to 300 m in Lake Gatún and 90-150 m in correspondence with the so-called Culebra Cut
Canal Operating Mechanism: through a system of locks divided into compartments, with entry and exit gates to lift the ships, which then navigate to Lake Gatún to be lowered down to sea level
Dimensions of Chambers in the Locks: 33.53 m wide, 304.8 m long
Number of Workers During Construction of the Canal from 1904 to 1913: 56,307 from every part of the world
Number of Employees in September 2010: 9759
Average Time Required to Navigate the Canal: 8-10 hours for average size ships
Number of Ships Navigating the Canal from 1914 to 2010: 1,004,037

Two Enormous Locks

The key elements of this project are the two enormous locks, one on the Atlantic coast and the other on the Pacific coast.
Work includes excavating and dredging the canal access on both sides for a total length of 11,2 km and a total width of 218 m.

Above. A schematic layout of the Canal, from the locks at Gatún to the locks at Miraflores.

A BRIEF HISTORY OF THE CANAL

The Panama Canal is one of the most important feats of engineering in the world, and is a must for anyone visiting the city. It was dug out in one of the tightest points and in the lowest part of the Central Cordillera of the isthmus, which links the North American and South American continents. It takes a ship from 6 to 10 hours to navigate the Canal, which is made up of various elements: Gatún Lake, the Culebra Cut and the system of locks (Miraflores and Pedro Miguel on the Pacific side and Gatún on the Atlantic side). Gatún Lake, whose waters are fundamental for the functioning of the inter-oceanic waterway, was the largest artificial lake in the world for a number of decades. The locks system, which allows ships to carry out a change in level of 26 metres and so avoid having to circumnavigate South America, used to be the most imposing reinforced concrete structure ever built. Constructed by the United States between 1904 and 1914, it is 81 km long and is still a symbol of the strategic importance that the isthmus has maintained since the 16th century, and today is still one of the most important communications routes in the world.

The Canal today has two lock lanes. The new project consists of adding a third lane through the construction of two lock facilities. Every new lock facility will have three consecutive chambers named lower, medium and upper chamber regulated by four sliding gates, designed to move the vessels from the sea level to the level of Gatun lake (27 m) and back down again.

Each chamber will have three lateral water reutilization basins for a total of 9 basins per lock and 18 basins in total. Like in the existing locks the new locks will be filled and emptied by gravity, without the use of pumps (200 million liters for each crossing).

The new lock chambers will be 427 m long, 55 m wide and 18 m deep for a total length of 1,5 km. The two enormous reinforced concrete structures will be completed with a new canal access on the Pacific side.

It will be the Italian company Cimolai, from Pordenone (Northern Italy), that will supply the new gates. Work will involve constructing 16 aluminium plate sliding gates, each one measuring 28 m in height, 58 m in length and 16 m in width.

The locks will be transported to Panama by sea and then installed on site between July 2013 and January 2014.

Cutting-edge Admixtures for Durable, Long-lasting Concrete

Mapei admixtures were selected to build all concrete structures including mass concrete as well as marine concrete, to be used to make the external sides and internal sides of the concrete locks, respectively.

The latest generation in admixture technology was introduced, and will be used to make 5,500,000 m^3 of concrete designed specifically for this grand structure.

The aim is to ensure, through special tests on concrete, that the building will last 100 years.

The first tests, carried out at the GUPC consortium site laboratory, started in Panama in September 2010.

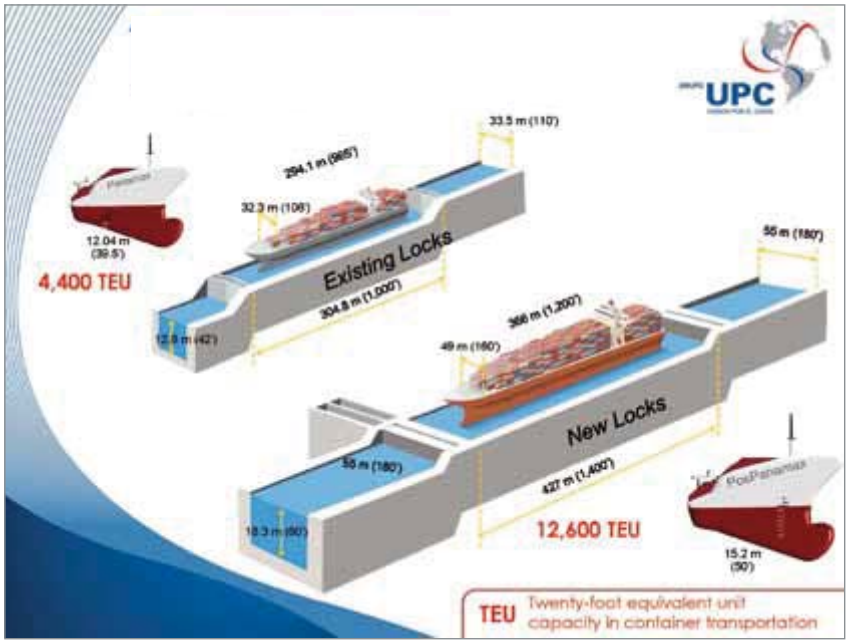
Cement paste samples were tested to verify the compatibility and to find the best plasticising capacity of various samples of admixture in combination with the types of cement scheduled to be used on the structure (CEMEX cement, type II ASTM and Panama cement, type II ASTM).

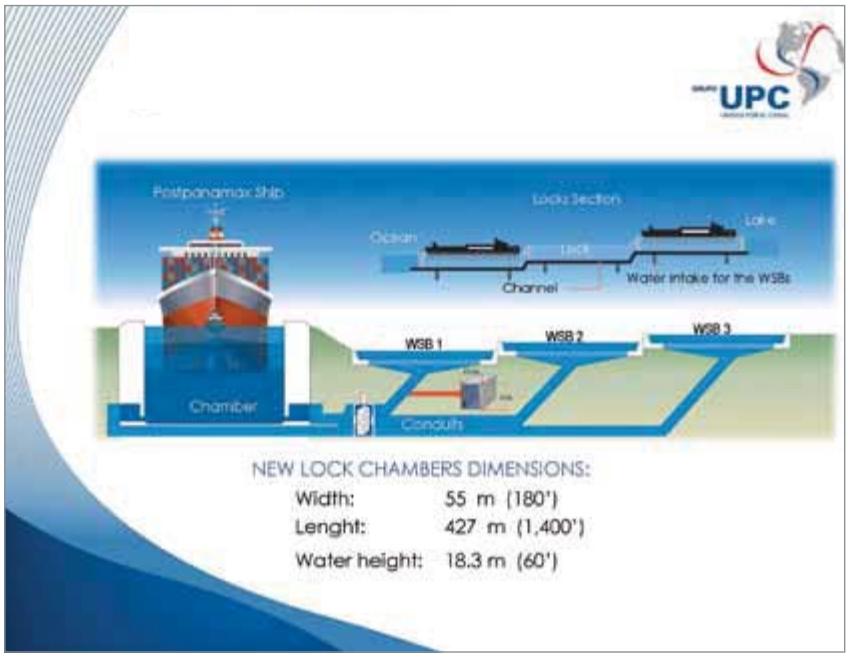
In the first phase of testing, to overcome problems which arise when using complex raw materials (basaltic aggregates and basaltic pozzolan), admixtures from many other competitors on the international market were also tested. After numerous checks, carried out in the purpose-built Mapei laboratory in Panama, and then by cross-referencing the results

In these pages.

The two locks are currently being built, one is on the Atlantic Ocean and the other is on the Pacific Ocean. They are 1.5 km long and feature huge size.

The sketches below show a comparison between the existing locks and the new ones.





with the GUPC laboratory, in mid December the admixture DYNAMON XP2 was judged to be the only solution suitable for use with the materials which had been actually chosen and which will be used in future on both the Atlantic side, where they are using Panama cement, and on the Pacific side, where they are using CEMEX cement. This led to Mapei's winning the Short Term Supply Contract.

In early 2011, after starting production of the concrete and aggregates, several serious problems concerning a considerable loss of mechanical strength and durability in the concrete were solved thanks to the contribution of Mapei. In this phase, Mapei's support was concentrated on various activities: a study and new chemical and mineralogical characterisation of the raw materials used (fine sand, pozzolan and cement); technical suggestions and advice to help make a correct choice for the flocculating and coagulating materials used to treat the water for cleaning the aggregates; a chemical and petrographic analysis and control of the pozzolanic activity of the fine basalt sand to reduce or optimise its content of natural pozzolan.

Following a request from the client, Mapei then started to develop a new product which could work well with the new mix designs being verified at the GUPC laboratory. After an arduous competition, which included participants from our competitors, Mapei technicians managed to design a new, highly-evolved admixture called DYNAMON XP2 EVOLUTION 1, with the name chosen to give a sense of continuity to the enormous amount of work previously carried out on the old admixture. This product featured better maintenance of workability and application properties, in dosages even lower compared with the competitors.

The 21st of December 2011 is the date of

Above.
For this building project Mapei developed a new tailor-made admixture: DYNAMON XP2 EVOLUTION 1. The concrete made with it features excellent workability and ease of application.

Above. Mapei admixtures were selected to make the mass concrete structures and for the marine concrete to be used to make the external sides and internal sides the concrete locks, respectively.

the final contract for the New Panama Canal project. Formalised with the signatures of Giorgio Squinzi, CEO of the Mapei Group, and Bernardo Gonzales, Project Manager for GUPC, it represents a success story for Mapei. A victory which is the fruit of perfect team work and a consolidated *modus operandi* which included constant technical assistance on site to solve both large and small problems, and the decisive support of the Mapei Research & Development laboratories which investigated every material to find the most advanced technological solutions to make the best products.

TECHNICAL DATA

Panama Canal, Panama City and Colon (Panama)
Period of Construction: 1910-1914

Period of the Mapei Intervention: 2010-2014
Intervention by Mapei: supplying admixtures for the concrete used for building the new canal's locks and renovating the existing ones
Project: Mike Newberry (CICP, Panama), Bernardo González (Grupo Unido Panama Canal, Panama)

Client: Administración Canal de Panamá
Contractor: GUPC (Grupo Unido Panama Canal), including Impregilo (Italy), Sacyr Vallehermoso (Spain), Jan de Nul (Belgium) and Constuctora Urbana (Panama)
Works Director: eng. Bernardo Gonzales (GUPC)
Mapei Distributor: Mapei Construction Chemicals Panama S.A.
Mapei Coordinator: Roberto Saccone, Mapei SpA (Italy); Thomas Lundgren, Mapei Corp. (USA)

MAPEI PRODUCTS

Preparing the concrete mix for the renovation of existing locks: Planitop 15 (only distributed on the America contents by the Mapei Americas subsidiaries) and Mapecure SRA

Preparing the concrete mix for the construction of the new locks: Dynamon XP2 and Dynamon XP2 Evolution 1 (specially developed by Mapei for this project)

For further information see www.mapei.com.