

**The major project**

# FREYSSINET PRESTRESSING

ON THE HEBRON OIL FIELD

P. 10 CANADA

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# STRUCTURE Magazine

P.06 WORK ON THE HAMMERSMITH FLYOVER:  
CUSTOMER TESTIMONIAL  
P.07 CURRENT PROJECTS AROUND THE WORLD  
P.20 FOREVA® ULTRASOUND





# THE IMAGE



## BIRTOUTA-ZERALDA RAILWAY LINE Building viaducts for a railway line in Algeria

In 2015, Freyssinet finished building and installing the decks of three major viaducts on the future railway line that in 2017 will link the towns of Birtouta and Zeralda, in the Algiers region.

These prestressed concrete structures are a total of almost 2 km in length, and the team designed the decks and then supplied and installed the prestressing and the railway infrastructure-specific structural accessories.

Because the viaducts are located in an earthquake zone, they have been fitted with ISOSIM® earthquake protection devices developed and produced by Freyssinet. The new line will in particular provide access to the coastal towns in the greater Algiers area. It forms part of a region-wide railway development project and will improve transport options for residents of these areas, which suffer from significant road traffic congestion.



## The word

# Thank you

Freyssinet's recent projects include of course the third Bosphorus bridge in Turkey, for which we designed, supplied and installed the stay cables. With a span of 1,408 metres, the bridge set a new world record. In the United Kingdom, we have completed the work to repair the Hammersmith Flyover, a fascinating project involving a genuine technical challenge that we took up with gusto. In the Philippine capital of Manila, Freyssinet has repaired the Ayala Bridge and brought it into compliance with earthquake standards. In Hong Kong, we are continuing construction work on the Liantang 3 bridge and the viaduct section of the TMCLK link. In Newfoundland, Canada, Freyssinet is prestressing the concrete gravity-based structure for the Hebron oil platform. In Siberia, we have installed the prestressing on the Yamal LNG tanks. Let's not forget the repair work being carried out in Paris, France on the Halle Freyssinet, which was built by our founder and stands as a reminder of his remarkable innovations. It provides a genuine link between the techniques of the period and those that we use today.

We couldn't have achieved any of this without your confidence, and I thank you for it. I would also like to thank all of the Freyssinet teams.

We will continue down this path; we have some excellent projects under way and some exciting technical challenges to face, in both Construction and Repair. Whatever the field, whatever the country, we remain at your side, firmly committed to the success of your projects. Now more than ever, Excellence must be our watchword.



**PATRICK NAGLE**  
CEO OF FREYSSINET



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Structure Magazine provides a twice-yearly overview of our projects worldwide. The magazine complements our web site [www.freyssinet.com](http://www.freyssinet.com), which contains more news and information about our business.

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# 1408 metres



## The figure

This is the span of the Yavuz Sultan Selim Bridge, the third Bosphorus bridge in Turkey, which means that it beats the world record previously held by the Russky Island Bridge in Vladivostok, Russia, by almost 300 metres. Both bridges are fitted with Freyssinet stay cables.



## The latest



# 20 years!

**Freyssinet's big adventure in the USA began in March 1995.** At the time, the

company was a branch of PTSC, CCS Special Structures, and offered Freyssinet products under licence. In 2008, it became Freyssinet, Inc. The company's biggest achievements include the Leonard P. Zakim Bunker Hill Bridge in Boston, the Arthur Ravenel Jr. Bridge, the Consol Energy Wing Tip footbridge, the repair of 11 bridges in Richmond, the replacement of the bearings on the Two Howard St. Bridge in Baltimore and, more recently, the repair of the William V. Roth Jr./Chesapeake and Delaware Canal cable-stayed bridge in 2015.



## The contract

### Glasgow Subway

Freyssinet is carrying out repair work on the Glasgow subway system, including in particular grouting, cleaning the tunnel lining, track and drainage channel, repairing the lining (concrete and brick) and waterproofing by resin injection. A report by the Strathclyde Partnership for Transport (SPT) Operations Committee found that Freyssinet "had demonstrated that it had considerable experience in undertaking work of this type" and that its bid for the project was the "most financially advantageous". The Glasgow Subway, one of the oldest in the world after those in London and Budapest, carries 13 million passengers every year and is undergoing its first large-scale renovation in over 30 years.



## The event

**Freyssinet will be attending the international GasTech conference** alongside other major players in the LNG sector. The event will be held in Tokyo, Japan, from 4 to 7 April 2017.



## The phrase

**"The integrity of the platform is now guaranteed**

and it is working perfectly and without any restrictions. This is a major success for us, and we are extremely proud of this project."



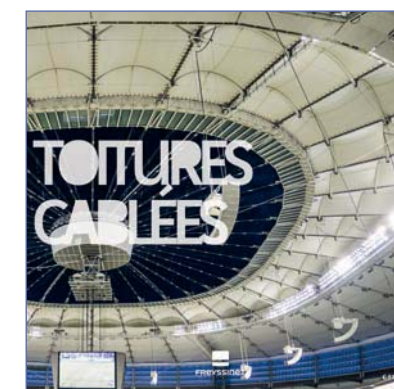
### At the 2015 VINCI Innovation Awards

(United Kingdom and Ireland region), Freyssinet won the Grand Prize for strengthening the Siri offshore platform using a cable-stayed reinforcement system. The Freyssinet H2000 was specially adapted to meet the project's requirements, particularly in terms of load and corrosion protection.

## The next big thing



**The collection of Freyssinet brochures is growing.** A "Footbridges" portfolio has been published, and another devoted to Cable-stayed Roofs will be out soon, showcasing some of our most impressive achievements (stadiums, concert venues, towers). It will be followed by a Construction Methods portfolio.





**BARRY WOODMAN**, PROGRAMME DIRECTOR, COSTAIN, HAMMERSMITH FLYOVER PHASE 2

# A significant technical challenge in the heart of London



**What challenges did the project entail, and what did you expect from your partner?**

From the start, Hammersmith Flyover was acknowledged to

be a very technical, very demanding project on a site with severe restrictions. Close collaboration between the client, the design team and the project team was vital for the success and safety of the job, which only caused minimal disruption to London's motorists.

**What were the keys to the success of the project?**

The ability to innovate and the precise phasing of the initial stages of the work were decisive. The Freyssinet team showed flawless commitment and flexibility that helped to tackle the

numerous technical and logistical challenges of the project.

**What stands out in your memory about this collaboration with Freyssinet in the heart of London?**

Freyssinet provided incomparable technical expertise and tailored, innovative solutions in terms of methodology, materials and equipment. This resulted in a significant reduction in the number of interventions on site, risks linked to the work site and the risk of construction defects. We were thus able to successfully reinforce this major element of London's infrastructure and fully meet the requirements of our client, Transport for London. /

**For more information**, see our special issue devoted to Freyssinet UK.

Download the magazine from [freysinet.com](http://freysinet.com).



# AROUND THE WORLD



## Japan MIYAKO-IRABU BRIDGE

AT the very southern tip of Japan, a sea bridge has been built to link the islands of Miyako and Irabu in the Okinawa archipelago. The 3,540-metre-long structure, made up of a central section with a metal deck and a further two prestressed concrete sections, is fitted with a prestressing system supplied by Freyssinet.





## Russia FREYSSINET STAY CABLES FOR THE KORABELNY BRIDGE

**All motorists coming from Scandinavia, Europe, Central Russia or the Balkans have to pass through the city of St Petersburg in Russia.** In order to ease the flow of traffic, the decision was taken to build a complex 11.5 km section of road to bypass the city to the west. As part of the project, Freyssinet is responsible for supplying and installing the stay cables for the Korabelny Bridge, one of the major structures on the bypass route. The bridge comprises 82 stay cables and has a span of 320 m. Freyssinet is also supplying and installing all of the dampers, together with the 32 lighting masts fastened to the stay cables.



## Brazil TRAIRI II WIND FARM

**In the state of Ceará, Brazil, Freyssinet is continuing to work on the Trairi II wind farm.** The company is in charge of designing and building 36 precast prestressed

concrete towers 119 metres in height, and has developed a special lifting tool known as Eolift®. The first towers were above ground in early 2016.





The major project

# FREYSSINET PRESTRESSING ON

## THE HEBRON OIL FIELD

### ➤ The essentials

#### — Project

Supply and installation of the prestressing for the base of the production platform for the Hebron oil field, off the coast of St John's in Newfoundland, Canada.

#### — Structure

The production platform will be used to store the hydrocarbons produced before they are exported. It will also stand up to the extreme conditions linked to its location, and to collisions with icebergs in particular.

#### — Duration

2012 to 2016.

## NEWFOUNDLAND, CANADA

**Located 350 km off the coast of Newfoundland, the Hebron oil field will come into production at the end of 2017. For the project, ExxonMobil opted to build a platform installed on a separate gravity-based structure (GBS) made of prestressed reinforced concrete.**

The GBS will rest on the sea bed at a depth of 93 m. It will have a storage capacity of up to 1.2 million barrels of oil. The structure rests on a base 130 m in diameter and 20 m high, and its construction requires 132,000 m<sup>3</sup> of concrete.

#### Three years have gone by...

Freyssinet was awarded the contract for supplying and installing the prestressing for the GBS. A peculiarity of this project is the great length of the vertical tendons, due to the height of the structure and the choice of U-shaped tendons for the vertical prestressing. These tendons are 140 m long in the storage and external cells, and 234 m long in the central column. Consisting of 22 strands each, they were prefabricated onshore before being transported to the GBS. Freyssinet designed and manufactured special equipment for the purpose. For the same reasons, the sheath injection method was adapted to ensure that they were filled without any gaps. In 2014, after completion of the first level (27 m), the GBS was towed out into the bay a few hundred metres offshore. The operation was executed using nine towing points fixed to the structure by eight harnesses of Freyssinet tendons. The mooring anchors were also secured to the structure using prestressing tendons. As the

walls rise in height, the ballast is used to adjust the GBS' freeboard and keep it at about 20 m.

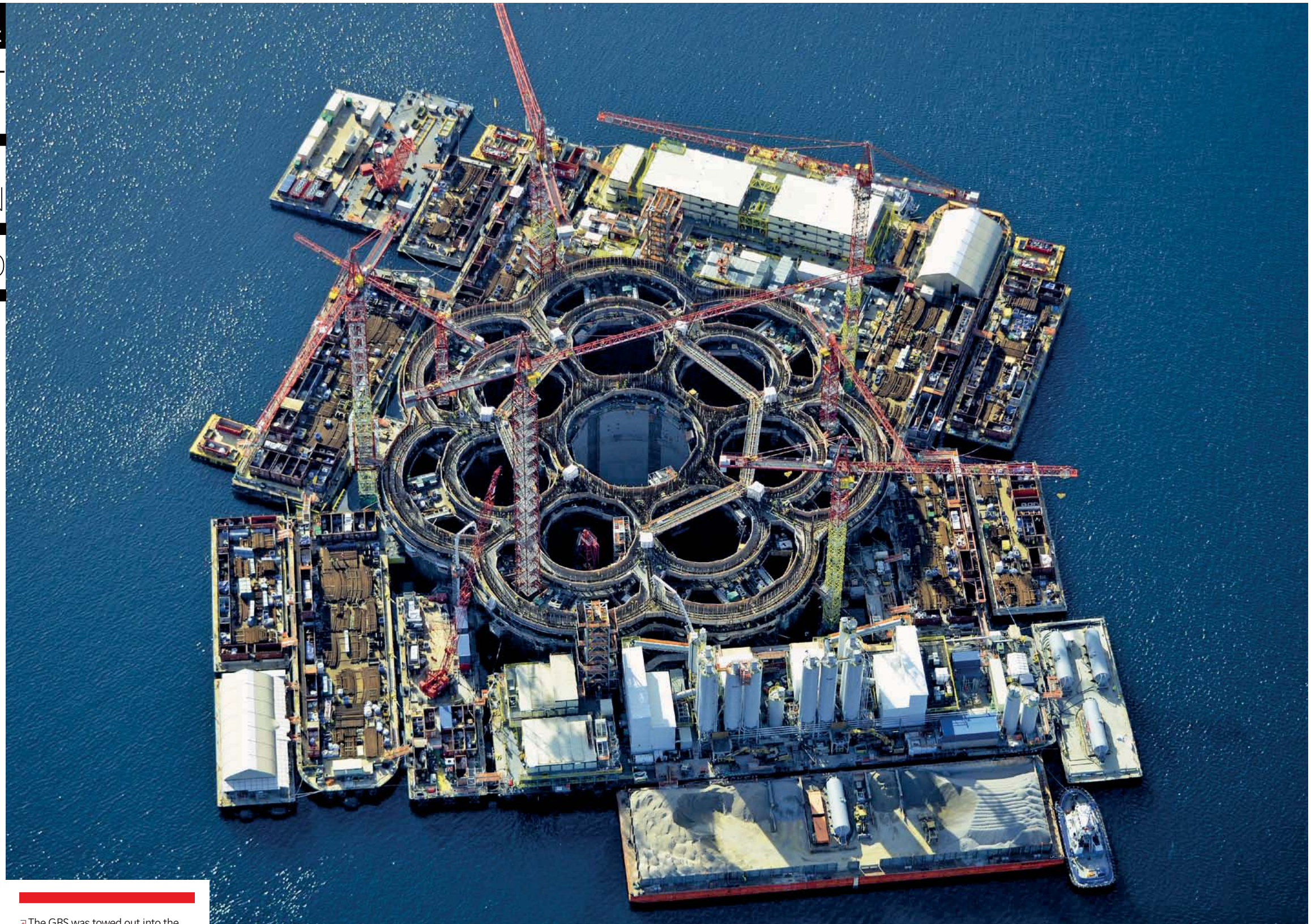
#### ...before the final sprint

After the winter break, work recommenced on 24 April this year. 1,500 t of prestressing remained to be installed (of the 2,400 t in the structure) by mid-September. Once the GBS has been completed and the top side installed using Freyssinet tensioning bars, the structure will be towed to its final location using around ten tugs: seven to apply a towing force of 1,350 t and three to apply a reverse force of 500 t. The tugs will also install the system to hold the GBS in position, made up of four anchors weighing 15 to 20 t.

Lastly, the GBS will be ballasted so that it rests on the sea bed, before receiving the treatment modules and being connected to the well heads.

## 2,400 t of prestressing

Sea depth: 93 m  
Structure height: 120 m  
Base diameter: 130 m  
Diameter of the central column: 35 m  
Reinforcement steel: 40,000 t  
Prestressing steel: 2,550 t  
Steel piping and structures: 5,500 t  
Well connections: 52



➤ The GBS was towed out into the bay a few hundred metres offshore.

### The partners

#### — Contracting authority

ExxonMobil

#### — Project manager

ExxonMobil

#### — General contractor

Kiewit-Kværner Contractors (KKC)



RODOLPHE, HEAD OF LNG/NUCLEAR OPERATIONS, FREYSSINET

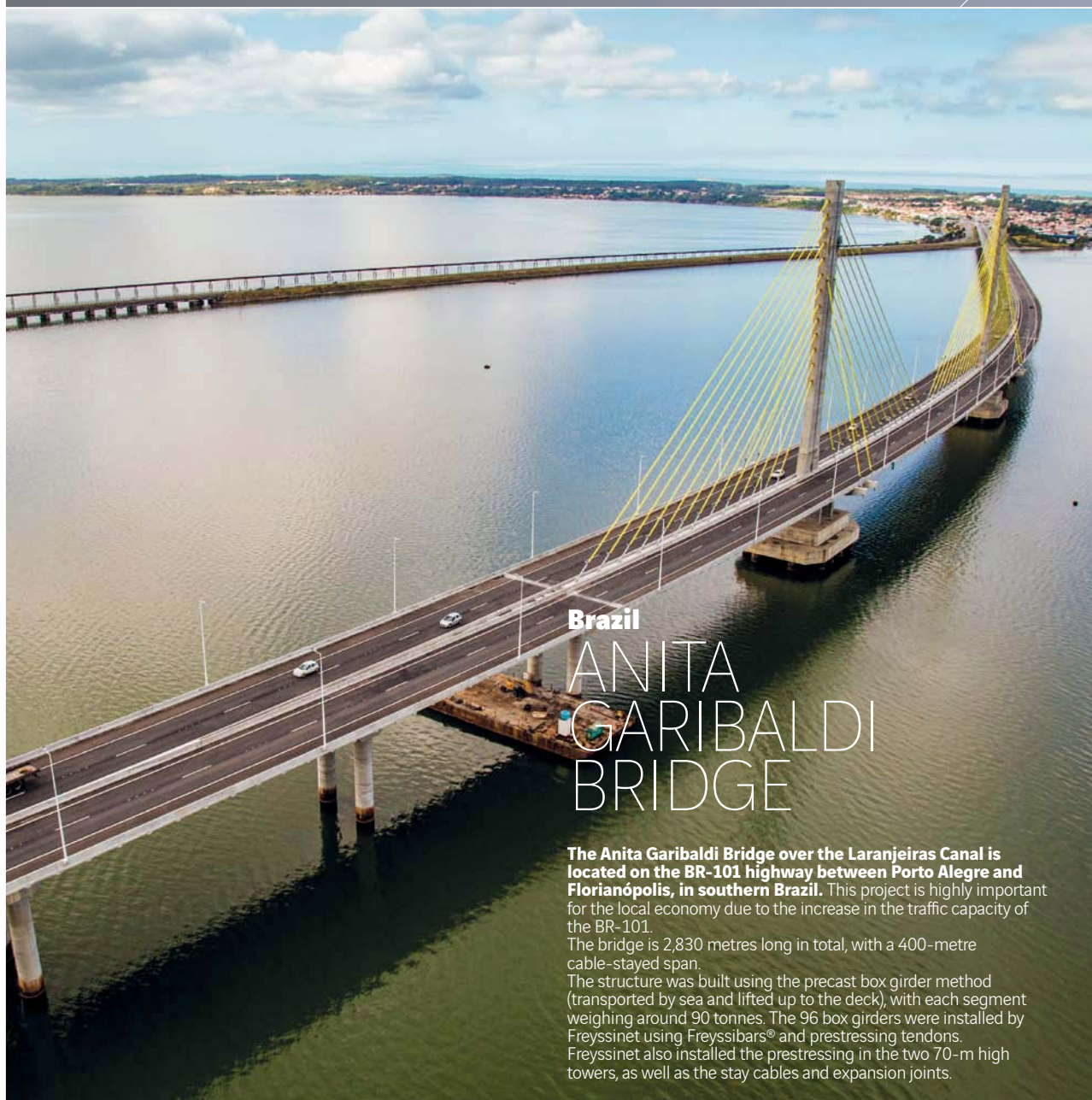
"The pressure on the project to build the GBS as a whole has been lifted. Freyssinet aims to be the partner in the success of the project through its technical expertise, flexibility and responsiveness."





# Construction

## Repairs



### Brazil

## ANITA GARIBALDI BRIDGE

**The Anita Garibaldi Bridge over the Laranjeiras Canal is located on the BR-101 highway between Porto Alegre and Florianópolis, in southern Brazil.** This project is highly important for the local economy due to the increase in the traffic capacity of the BR-101. The bridge is 2,830 metres long in total, with a 400-metre cable-stayed span. The structure was built using the precast box girder method (transported by sea and lifted up to the deck), with each segment weighing around 90 tonnes. The 96 box girders were installed by Freyssinet using Freyssibars® and prestressing tendons. Freyssinet also installed the prestressing in the two 70-m high towers, as well as the stay cables and expansion joints.

#### The essentials

##### ANITA GARIBALDI BRIDGE

###### — Project

It's a double whammy for this Brazilian structure, the third longest bridge in the country and the first bridge built in a horizontal curve with towers and stay cables on the central section.

###### — Operations

Installation of the deck (box girders), stay cables, tower prestressing and expansion joints.

###### — Duration

The work was completed in March 2015.

### France

## VeRCoRS, A SCALE-MODEL POWER PLANT

**In partnership with Nuvia, Freyssinet is supplying and installing the prestressing for a nuclear reactor containment vessel.**

The building is in fact a mock-up commissioned by EDF to test out the behaviour of such a structure under various operating conditions. For some years EDF has been conducting a research programme into the safety and service life extension of its nuclear power plants. The VeRCoRS (*Vérification Réaliste du Confinement des Réacteurs* - Realistic Verification of Reactor Containment) project is part of this effort, and is an experimental mock-up of a first generation reactor containment vessel. Over 500 sensors and 2 km of optical fibres have been installed on both the reinforcements and the prestressing tendons in order to monitor the behaviour of the structure.



#### The essentials

##### VeRCoRS, A SCALE-MODEL POWER PLANT

###### — Project

Construction of a nuclear reactor containment vessel mock-up, commissioned by EDF as part of the VeRCoRS (*Vérification Réaliste du Confinement des Réacteurs*, Realistic Verification of Reactor Containment) research programme.

###### — Operations

Supply and installation of the prestressing for the mock-up, which is 22 metres high and has an outer diameter of 20 metres (1/3-scale).

###### — Duration

Freyssinet started installing the prestressing in April 2015 and the mock-up was completed in autumn 2015.





## The Achievements

### Hong Kong

# TWO MAJOR CONTRACTS FOR FREYSSINET

Since the end of 2014, Freyssinet has been working on two major construction projects in Hong Kong: the viaduct section of the Tuen Mun-Chek Lap Kok Link (TMCLK) and the Liantang 3 (LT3) bridge near the Chinese border, both of which are balanced cantilever precast segmental bridges.

#### Tuen-Mun – Chek Lap Kok Link (TMCLK)

This structure will connect Lantau Island with an artificial island under construction extending Chek Lap Kok international airport. Freyssinet is installing the precast segmental deck, the prestressing by post-tensioning, the expansion joints and the bearings.

#### Liantang 3

This is part of a complex highway motorway interchange situated near Sheung Shui in the north of the country. Freyssinet will be responsible for installing the deck (precast segments) and prestressing by post-tensioning (over 1,500 tonnes in total).



#### The essentials

##### HONG KONG: TWO MAJOR CONTRACTS FOR FREYSSINET

###### — Project

Construction of two major structures in Hong Kong.

###### — Operations

Installation of precast segmental decks, prestressing by post-tensioning, expansion joints and bearings.

###### — Duration

The two projects will be completed by the end of 2017.



### Turkey

# BJK STADIUM

The new Beşiktaş stadium in Istanbul was opened on 11 April 2016.

Located in the historical part of the city, the capacity of the stadium has been doubled. The 41,000 spectators are now seated beneath a cable-stayed roof designed by Freyssinet. The company also supplied and installed the roof components and lifted it to a height of around 21 m using 40 HTE strand jacks developing a total tensile force of 6,000 t.

#### The essentials

##### BJK STADIUM

###### — Project

Design, construction and lifting of the cable-stayed roof.

###### — Operations

Supply and installation of locked-coil cables, supply and installation of connectors between the cables and the structural steelwork, lifting the roof and technical support for the installation of ancillary components.

###### — Duration

Freyssinet's operations took place over a period of nine months.





# Construction Repairs

Solutions  
**Foreva**



## Netherlands EWIJK BRIDGE

In the eastern Netherlands, near Nijmegen, Freyssinet is applying its repair solutions to the Ewijk Bridge, a cable-stayed structure on the A50 motorway. The brief involves replacing all the locked-coil cables with cohesive strand cables. As a result, the saddles for the locked-coil cables must also be changed. Freyssinet is therefore manufacturing and installing multi-tube saddles, which will help deviate the cables strand by strand. They are the largest multi-tube saddles ever built by Freyssinet (192-strand units). During the first few months on the project, Freyssinet was given additional tasks, including reinforcing the piers using Freyssibars®, designing and supplying provisions for the dampers and reinforcing the girders supporting the saddles inside the towers.



### The essentials

#### EWIJK BRIDGE

##### — Project

Repair and replacement of the cables on the Ewijk Bridge, located on a strategic route linking Rotterdam and its port infrastructure to Germany and Central Europe.

##### — Operations

Replacement of all of the locked-coil cables with cohesive strand cables.

##### — Duration

Work started in February 2014 and was completed in April 2016.

## France

# SAINT-CLOUD VIADUCT

The Saint-Cloud Viaduct in France crosses the Seine a few kilometres outside Paris. Located on the A13 motorway, one of the major routes into the French capital, it is made up of 16 spans, seven of which cross the river over a distance of 529 metres and nine of which form the 554-metre access viaduct.

The structure was built between 1972 and 1974, and is now experiencing reinforcement corrosion problems. Freyssinet is working to install a cathodic protection solution. Following analysis of the condition of the reinforcements and painstaking marking, 45,000 anodes will be installed inside the structure. Another 10,000 anodes will be installed on the outside after hydroblasting, removal of loose material and dry-process shotcreting. The application of a paint finish will complete the work.



### The essentials

#### SAINT-CLOUD VIADUCT

##### — Project

Repair and corrosion protection of the Saint-Cloud Viaduct, a prestressed concrete box girder bridge 1,100 metres long in total, and a major traffic route for the greater Paris region.

##### — Operations

Installation of a cathodic protection system inside and outside the structure.

##### — Duration

The work will take a total of two years, without interruption to traffic (apart from temporary closures already scheduled in the motorway maintenance programme).







## Australia

# REPAIRS AND REINFORCEMENT AT THE PORT OF MELBOURNE

As part of a major port development project in Melbourne (Australia), Freyssinet is responsible for repairing and reinforcing several quays at the Webb Dock terminal. The aim is to reconfigure Webb Dock so as to increase its handling capacity; the new facility should be able to receive at least a million containers per year. Freyssinet's task includes in particular concrete repairs, repairs to the steel piles, and the installation and continuous monitoring of an impressed current cathodic protection system. The teams are showing unfailing commitment in order to meet the very strict completion deadlines. A submersible access platform has been designed and implemented specifically for the project, and includes an innovative containment system to avoid polluting the surrounding waters.

### The essentials

#### WEBB DOCK TERMINAL

##### — Project

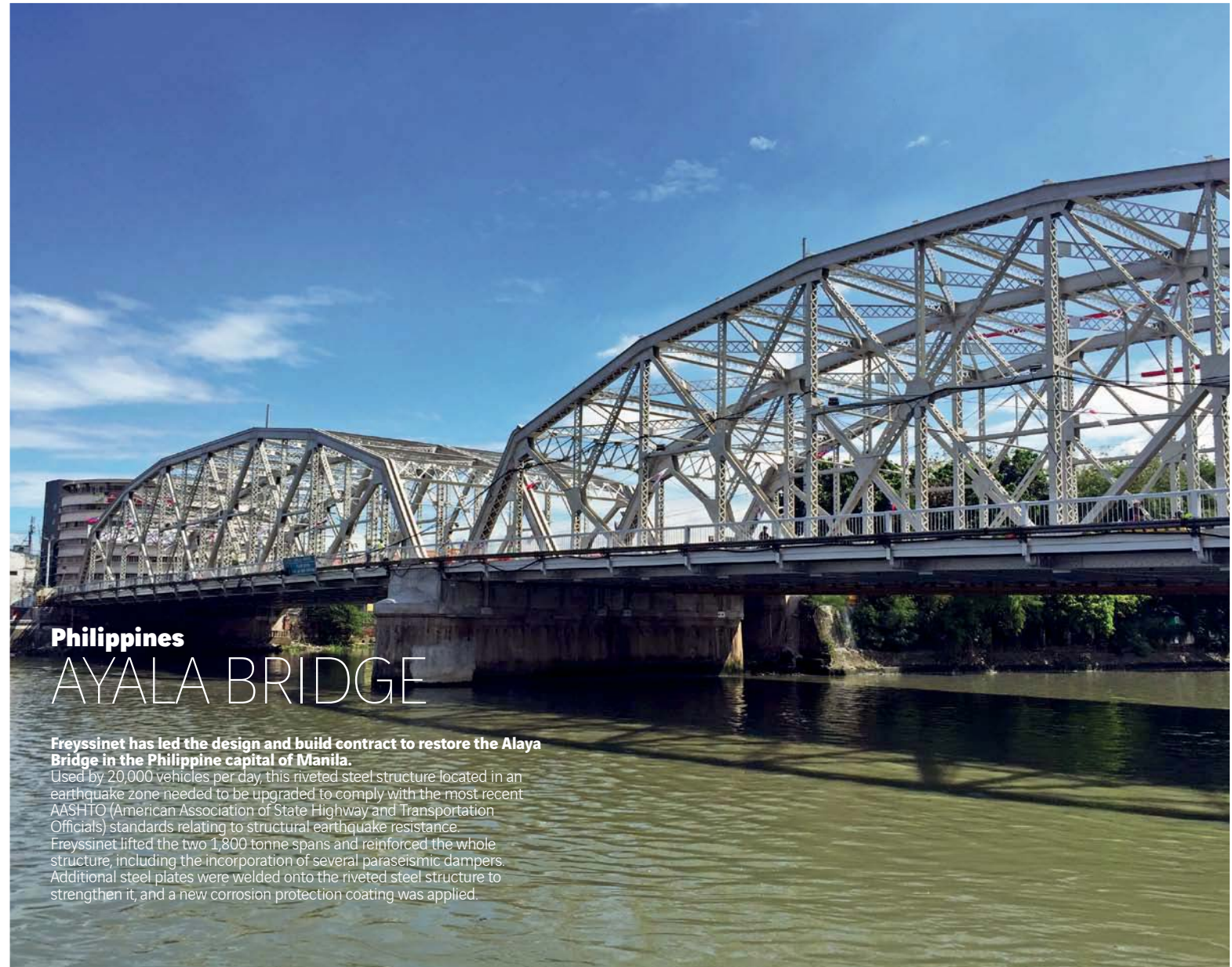
Repair and reinforcement of several quays at the Webb Dock terminal in Melbourne, Australia.

##### — Operations

Concrete repairs, repairs to steel piles, installation of an impressed current cathodic protection system.

##### — Duration

Work began in January 2015 and should be completed by summer 2016.



## Philippines

# AYALA BRIDGE

Freyssinet has led the design and build contract to restore the Ayala Bridge in the Philippine capital of Manila.

Used by 20,000 vehicles per day, this riveted steel structure located in an earthquake zone needed to be upgraded to comply with the most recent AASHTO (American Association of State Highway and Transportation Officials) standards relating to structural earthquake resistance. Freyssinet lifted the two 1,800 tonne spans and reinforced the whole structure, including the incorporation of several parasismic dampers. Additional steel plates were welded onto the riveted steel structure to strengthen it, and a new corrosion protection coating was applied.

### The essentials

#### AYALA BRIDGE

##### — Project

Repairing the Ayala Bridge in Manila (Philippines) and ensuring compliance with earthquake standards.

##### — Operations

Lifting of the two 1,800 tonne spans, reinforcement of the whole bridge, reinforcement of the steel structure, installation of new bearings and parasismic devices.

##### — Duration

The work took place between June 2014 and February 2016.





# Foreva® Ultrasound

A unique method of protecting prestressing reinforcements against corrosion

## • The problem

Due to their design, some structures are highly vulnerable to prestressing wire breakage. Prestressing reliability is a major concern with regard to user safety and traffic continuity. As the prestressing tendon reinforcements inside the concrete are difficult to access, solutions for treating chloride contamination are currently scarce.

## • The solution

With Foreva® Ultrasound, Freyssinet offers a technique for injecting an inhibitor solution into the cement grout around the tendon and distributing it so that it completely covers the surface of the prestressing wires. This solution stops corrosion activity to secure and extend the life span of structures requiring treatment. The existing grout is impregnated with the inhibitor solution using an ultrasonic pump that generates ultra-rapid high- and low-pressure cycles. The solution impregnates the pores and microcracks present in the grout and covers the entire surface of the reinforcements.

## • Advantages

- > Preventive and curative treatment
- > Extends tendon life span
- > Applied without structure operating restrictions.

Reinjected grout

Original grout

Treated strand

Injected micro-grout



 **The year**

# 1973

## The Ekofisk tank

It was in 1971 that Freyssinet (known as STUP at the time) started building the Ekofisk tank, a 90-m tall vertical cylindrical structure for supplying the oil tankers moving around the oil reservoir of the same name. On 30 June 1973, having travelled 320 km across the North Sea, the tank reached its destination in the middle of the reservoir.

Source: STUP newsletter - July/August 1973

## Around the world...

### ...In July

**Release of *Queen*, the first album by rock group Queen**, which saw poor sales. They later had a string of successes, starting with the second album, *Queen II*. The group was named best British group of all time in 2007, ahead of the Beatles and the Rolling Stones.

### ...In October

**The world faced the first oil crisis in its history.** Shortages occurred and the price of a barrel of oil rocketed. Many countries decided to review their energy policies and there was extensive building of nuclear power plants.





The Soletanche Freyssinet 2015 Annual Report is available in French, English and Spanish. You can download it from [freyssinet.com](http://freyssinet.com) or by scanning the code opposite.



#### PORT OF SÈTE: COMBINING TECHNOLOGIES

**The port of Sète on the Mediterranean is being transformed to meet demand from containerised traffic.** Soletanche Bachy has built quay H, a structure 470 m long with a draught of 14.5 m. The work started in September 2014 with the construction of a breakwater. It continued in 2015 with vibro-compaction soil improvement operations by Menard and the construction of a diaphragm wall 530 m long and 29.5 m deep. Seventy passive

anchors made up of 160-mm diameter steel rods were used to retain the wall, and are some of the biggest installed in France. Operations are continuing in 2016, including civil engineering, earthworks, controlled modulus columns, marine work and the installation of the quay accessories (bollards, fenders and running surfaces).



#### Construction of three peninsulas for the La Mer project in Dubai

**For six months local Menard subsidiary Menard Vibro has been working on the La Mer project,** which will see the construction of three peninsulas (North Peninsula, South Peninsula and Headland) to accommodate a beach, an entertainment and leisure complex and residential areas. Deep compaction work was required before building could begin. Almost seven million cubic metres of soil were vibro-compacted to depths of between 12 and 16 m. The site was first cleared and then backfilled to create the final platform at +4.5 DMD (Dubai Municipality Datum) before an area of around 470,000 m<sup>2</sup> was compacted using the high-energy dynamic compacting method.



UNITED STATES: OVER 290,000 M<sup>2</sup> OF REINFORCED EARTH® WALLS FOR THE I-4 ULTIMATE PROJECT

**The I-4 is one of the main interstate highways in the United States, linking the West and East coasts of Florida.**

With a view to relieving traffic congestion on this 33-km route, the I-4 Ultimate project will see the creation of four toll lanes (two in each direction). At the same time, the intersections along the highway will be improved. The concession agreement for this PPP (public-private partnership) runs for 40 years and the construction period is set at six years.

The Reinforced Earth Company (RECo) USA has signed the biggest contract in its history for this large-scale project, and will supply some 290,000 m<sup>2</sup> of Reinforced Earth® walls. /



#### SAINT-LAURENT-DES-EAUX EDF SITE

**Nuvia is continuing to grow its logistical support business for operators and maintenance operations on nuclear sites.** The company has extended its activities in the field, including by winning a new contract on the EDF site in Saint-Laurent-des-Eaux, France (reactor A). It has developed and implemented innovative technical solutions to substantially reduce dose impacts, particularly with a new mobile fuel pool filtration unit.



Yavuz Sultan Selim Bridge  
Turkey



**FREYSSINET**  
SUSTAINABLE TECHNOLOGY

Yavuz Sultan Selim Bridge  
Turkey

#### NEW STRUCTURES

- Cable-stayed structures
- Prestressing
- Construction methods
- Structural accessories

#### REPAIR

- Bridges and tunnels
- Buildings
- Water civil engineering structures
- Industrial structures
- Historic buildings



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