Freyssinet
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Kuwait

Rehabilitation of the Bubiyan Bridge

freyssinet

Contents

AMERICA

ARGENTINA
Freyssinet S.A.
Buenos Aires
Phone: (54.11) 43 72 72 91
Fax: (54.11) 43 72 51 79

Tierra Armada S.A.
Buenos Aires
Phone: (54.11) 43 72 72 91
Fax: (54.11) 43 72 51 79

BRAZIL
STUP Premoldados Ltda
São Paulo
Phone: (55.11) 3873 27 34
Fax: (55.11) 262 85 02

Freyssinet
Rio de Janeiro
Phone: (55.21) 221 85 00
Fax: (55.21) 852 79 26

Terra Armada S.A.
Rio de Janeiro
Phone: (55.21) 233 73 53
Fax: (55.21) 263 48 42

CANADA
Reinforced Earth Company Ltd
Ontario
Phone: (1.905) 564 08 96
Fax: (1.905) 564 26 09

Freyssinet Ltée
Montréal
Phone: (1.450) 466 65 66
Fax: (1.450) 466 60 03

COLOMBIA
STUP de Colombia
Bogota
Phone: (57.1) 257 41 03
236 37 86
Fax: (57.1) 610 38 98

Tierra Armada
Bogota
Phone: (57.1) 236 37 86
Fax: (57.1) 610 38 98

EL SALVADOR
Fessic S.A. de C.V.
La Libertad
Phone: (503) 2 78 07 55
2 78 86 03
Fax: (503) 2 78 04 45

GUATEMALA
Presforzados Técnicos S.A.
Ciudad Guatemala
Phone: (502) 282 481
Fax: (502) 2500 150

MEXICO
Freyssinet de México S.A. de C.V.
Mexico D.F.
Phone: (52.5) 250 70 00
Fax: (52.5) 255 01 65

Tierra Armada S.A. de C.V.
México D.F.
Phone: (52) 5250 17 26
(52) 5254 54 00
Fax: (52) 5254 86 65

PERU
STUP del Perù S.A.
Lima
Phone: (51.1) 372 21 86
Fax: (51.1) 372 25 66

UNITED STATES
Freyssinet PTSC LLC
Chantilly, VA
Phone: (1.703) 378 25 00
Fax: (1.703) 378 27 00

Ménard LLC
Vienna, VA
Phone: (1.703) 821 10 54
Fax: (1.703) 821 14 79

The Reinforced Earth Company
Vienna, VA
Phone: (1.703) 821 11 75
Fax: (1.703) 821 18 15

VENEZUELA
Tierra Armada Ca
Caracas
Phone: (58.2) 574 90 38/10 61
Fax: (58.2) 574 77 50

EUROPE

BELGIUM
Cinec N.V.
Vilvoorde
Phone: (32.2) 252 07 40
Fax: (32.2) 252 24 43

Benelta
Vilvoorde
Phone: (32.2) 252 07 40
Fax: (32.2) 252 24 43

DENMARK
A/S Skandinavisk Spaendbeton
Vaerloese
Phone: (45.44) 48 08 25
Fax: (45.44) 48 12 45

FINLAND
OY Jannibetoni AB
Vaerloese

FRANCE
Freyssinet International & Cie
Vélizy
Phone: (33.1) 46 01 84 84
Fax: (33.1) 46 01 85 85

Freyssinet France
Vélizy
Phone: (33.1) 30 13 91 99
Fax: (33.1) 34 61 65 47

PPC
Saint-Rémy
Phone: (33.3) 85 42 15 15
Fax: (33.3) 85 42 15 10

Menard Soltraitement
Nozay
Phone: (33.1) 69 01 37 38
Fax: (33.1) 69 01 75 05

FYROM
Migal Inzinjering & Konsalting
Skopje
Phone: (389) 91 120 151
Fax: (389) 91 120 151

GERMANY
SBT Brückentechnik GmbH
Plüderhausen
Phone: (49.7181) 99 00 0
Fax: (49.7181) 99 00 66

Bewerhete Erde GmbH
Plüderhausen
Phone: (49.71 81) 99 00 70
Fax: (49.71 81) 99 00 75

GREECE
Freyssinet Hellas S.A.
Athens
Phone: (30.1) 69 15 926
Fax: (30.1) 69 28 137

Fredra
Athens
Phone: (30.1) 60 20 500
Fax: (30.1) 66 27 748

HUNGARY
Pannon Freyssinet
Budapest
Phone: (36.1) 209 15 10
Fax: (36.1) 209 15 10

IRELAND
Reinforced Earth Co.
Kildare
Phone: (353) 4543 10 88
Fax: (353) 4543 31 45

ITALY
Freyssinet Italia S.r.l.
Roma
Phone: (39.06) 6880 29 22
Fax: (39.06) 687 39 38

EUROPE

Freyssinet Italia S.r.l.
Milan
Phone: (39.02) 895 402 76
Fax: (39.02) 895 404 46

Terra Armata S.p.A.
Roma
Phone: (39.06) 806 87 275
Fax: (39.06) 808 82 64

NETHERLANDS
Samaco B.V.
Waddinxveen
Phone: (31.18) 26 30 888
Fax: (31.18) 26 30 152

Terre Armée B.V.
Breda
Phone: (31.76) 531 93 32
Fax: (31.76) 531 99 43

NORWAY
A/S Skandinavisk Spennbeton
Snarøya
Phone: (47.67) 53 91 74

POLAND
Freyssinet Polska Sp. z o.o.
Milanõwek
Phone: (48.22) 792 13 86
Fax: (48.22) 724 84 67

PORTUGAL
Armol-Freyssinet Ltda
Lisbon
Phone: (351.21) 716 16 75
Fax: (351.21) 716 40 51

Terra Armada Ltda
Lisbon
Phone: (351.21) 792 37 97
Fax: (351.21) 792 37 01

ROMANIA
Freyrom S.A.
Bucarest
Phone: (40.1) 220 35 50
Fax: (40.1) 220 45 41

SPAIN
Freyssinet S.A.
Madrid
Phone: (34.91) 323 95 50
Fax: (34.91) 323 95 51

Freyssinet S.A.
Barcelona
Phone: (34.93) 226 44 60
Fax: (34.93) 226 59 98

Tierra Armada S.A.
Madrid
Phone: (34.91) 323 95 00
Fax: (34.91) 323 95 11

SWEDEN
AB Skandinavisk Spaennbeton
Malmö
Phone: (46.40) 98 14 00

UNITED KINGDOM
Freyssinet UK
Telford
Phone: (44) 1952 201 901
Fax: (44) 1952 201 753

Reinforced Earth Company Ltd
Telford
Phone: (44) 1952 201 901
Fax: (44) 1952 201 753

SWITZERLAND
Freyssinet S.A.
Moudon
Phone: (41.21) 905 48 02
Fax: (41.21) 905 11 01

TURKEY
Freysas
Istanbul
Phone: (90.216) 349 87 75
349 87 74
Fax: (90.216) 349 63 75

Reinforced Earth Company Ltd
Istanbul
Phone: (90.216) 492 8424
Fax: (90.216) 492 3306

AFRICA

EGYPT
Freyssinet Egypt
Gisa
Phone: (20.2) 303 69 65
Fax: (20.2) 345 52 37
345 81 65

SOUTH AFRICA
Freyssinet S.A. (Pty) Ltd
Olifantsfontein
Phone: (27.11) 316 21 74
Fax: (27.11) 316 29 18

Reinforced Earth Pty Ltd
Johannesburg
Phone: (27.11) 726 6180
Fax: (27.11) 726 5908

UNITED ARAB EMIRATES
Freyssinet-TAI Middle-East
Abou Dhabi
Phone: (971) 2 667 9871
Fax: (971) 2 667 9872

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Freyssinet Magazine, 1 bis, rue du Petit-Clamart 78148 Vélizy Cedex - France. Tel.: 01 46 01 84 21. Fax: 01 46 01 86 86. Internet: www.freyssinet.com
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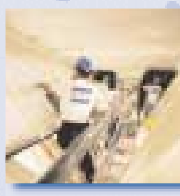


ASIA

HONG KONG
Freyssinet Hong Kong Ltd
Kowloon Tong
Phone: (852) 27 94 03 22
23 39 83 70
Fax: (852) 23 38 32 64:

Reinforced Earth Pacific Ltd
Kowloon
Phone: (852) 27 823 163
Fax: (852) 23 325 521

INDIA
TAI Aimil joint venture
New Delhi
Phone: (91.11) 695 98 18
Fax: (91.11) 695 94 56

INDONESIA
PT Freyssinet Total Technology
Djakarta
Phone: (62.21) 830 02 19/22
830 56 89/90
Fax: (62.21) 830 98 41
720 69 36

JAPAN
F.K.K.
Tokyo
Phone: (81.3) 35 71 86 51/54
Fax: (81.3) 35 74 07 10
35 71 44 69

Terre Armée K.K.
Tokyo
Phone: (81) 427 22 1134
Fax: (81) 427 22 1134

KUWAIT
Freyssinet International et Cie
Safat
Phone: (965) 571 49 74
Fax: (965) 573 57 48

LEBANON
O.P.C.
Beyrouth
Phone: (966.1) 463 04 62
Fax: (966.1) 463 04 62

MALAYSIA
Freyssinet PSC (M) Sdn Bhd
Kuala Lumpur
Phone: (60.3) 782 85 99
Fax: (60.3) 781 55 30

Freyssinet Asia
Kuala Lumpur
Phone: (60.3) 282 95 88/75 88/
05 88/96 88
Fax: (60.3) 282 96 88

ASIA

Freyssinet APTO (M) Sdn Bhd
Kuala Lumpur
Phone: (60.3) 282 95 88/75 88/
05 88/96 88
Fax: (60.3) 282 96 88

Menard Geosystem Sdn Bhd
Kuala Lumpur
Phone: (60.3) 732 1581
Fax: (60.3) 732 1582

Reinforced Earth Management
Kuala Lumpur
Phone: (60.3) 634 6162
Fax: (60.3) 634 7212

PHILIPPINES
Freyssinet Philippines S.A.
Quezon City
Phone: (63.2) 921 3789
Fax: (63.2) 921 1223/6124

SINGAPORE
PSC Freyssinet (S) Pte Ltd
Singapour
Phone: (65) 272 96 97
Fax: (65) 272 38 80
Direct: (65) 276 39 59

Reinforced Earth Pte Ltd
Singapour
Phone: (65) 467 4977
Fax: (65) 467 0728

SOUTH KOREA
Freyssinet Korea Co, Ltd
Seoul
Phone: (82.2) 515-4182/4183/4184
Fax: (82.2) 515-41 85/67 07

Sangjee Menard Co Ltd
Seoul
Phone: (82.2) 587 9286
Fax: (82.2) 587 9285

TAIWAN
Freyssinet Taiwan Engineering Co, Ltd
Taipei
Phone: (886.2) 274 702 77
Fax: (886.2) 276 650 58

THAILAND
Freyssinet Thailand Ltd
Bangkok
Phone: (662) 266 6088/6090
Fax: (662) 266 6091

VIETNAM
Freyssinet International et Cie
Hanoi
Phone: (84.4) 826 14 16
Fax: (84.4) 826 11 18

Freyssinet International et Cie
Ho Chi Minh-Ville
Phone: (84.8) 829 92 28/29 31 09
Fax: (84.8) 822 35 08

OCEANIA

AUSTRALIA
Austress Freyssinet Pty Ltd
Sydney
Phone: (61.2) 9674 40 44
Fax: (61.2) 9674 59 67

Austress Freyssinet (VIC) Pty Ltd
Melbourne
Phone: (61.3) 9326 58 85
Fax: (61.3) 9326 89 96

Reinforced Earth Pty Ltd
Hornsby
Phone: (61.2) 9910 9910
Fax: (61.2) 9910 9999

NEW-ZELAND
Reinforced Earth Ltd
Drury
Phone: (64) 9 294 92 86
Fax: (64) 9 294 92 87

Fiscal year 1999

A solid balance sheet

Jean-François Gouédard* goes back over 1999.
He confirms that the improvement and extended life market will be one of the Group's essential growth factors.

*Jean-François Gouédard is the Freyssinet Group's Deputy Managing Director, Financial, Legal and Development Division.

"The year 2000 will be another year of growth in the improvement and extended life market".

Freyssinet published its 1999 annual report in May 2000. What significant facts were there in this year?

Jean-François Gouédard: It is sometimes difficult to maintain internal and external growth at the same time as financing a sustained research and development effort and keeping a sound balance, but we successfully achieved this in 1999.

The year was marked by strong growth in our activity and results, and by a new balance sheet in our specialties and Geographic Areas.

It is the result of a fairly complex compromise between a tailored sales approach with selective order taking, construction expertise recognized by the market resulting in good performances on our sites, and finally a range of innovative products at competitive prices satisfying our customer needs.

The activity growth (about 59%) is obviously largely the result of integrating the Terre Armée Internationale Group acquired at the end of 1998, and also another recurrent factor, namely the group's continuous internal growth of about 10%. This is a sustained rhythm following the trend of the years 1996 to 1998.

The consequences are that all our results are significantly stronger, despite relatively large non recurring expenses during the period, mainly due to reorganization and development of the Group. Note that the global environment was not very good; a weaker situation on some markets like Asia and the continuingly weak civil works sector in Europe.

What is the result of the new balance in activities between specialties and Geographic areas?

J.-F. G.: Freyssinet has a strong presence throughout the world including Europe, the Group's original market, Pacific Asia, Latin America and North America, and also in Africa that is a quickly developing market. Whereas in 1998, Europe represented 60% of sales and Asia-Pacific 30%, the activity in 1999 is now more balanced: 50% in Europe, 25% in Asia-Pacific et 20% in North America. As far as the specialities are concerned, the geotechnical activity went from 10% to 35% of the total partly due to the integration of Terre Armée Internationale and Ménard Soltraitement and partly to the development of Freyssinet's traditional geotechnical activity.

Note also the rebalancing between New works/Repair works in the Structures activity, with repair works accounting for half of the total.

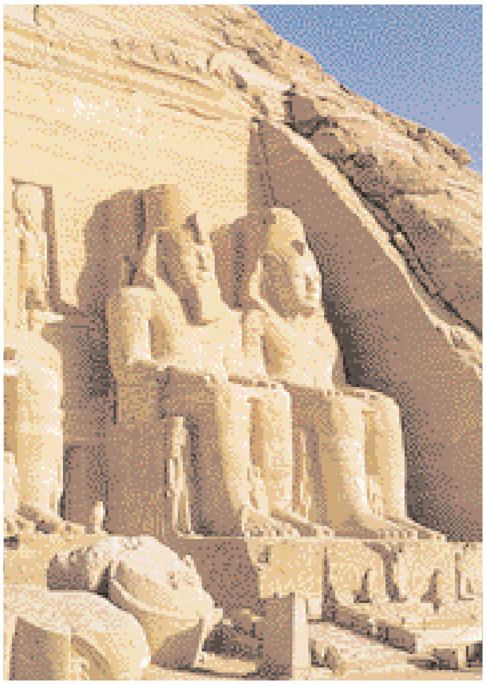
The year 2000 will be another year of growth in the improvement and extend-

Located to the North of Hô Chi Minh-City, the Saigon bridge has been strenghtened and widened by Freyssinet to accommodate two new traffic lanes.

ed life market, which will be one of the Group's essential growth factors.

Has Freyssinet been on this market for a long time?

J.-F. G.: The Freyssinet Group is a leader in this field in Europe, and particularly in France. Some of our projects were done many years ago, for example raising the Abu Simbel temple in Egypt in 1967. Freyssinet's position on this market is very strong, and is not due to chance. The Group decided to specialize on this market long before the slowdown in new construction contract and the increase in budgets dedicated to building maintenance. Initially, know how, products and techniques developed by Freyssinet for new construction were used for repair applications.
We developed special purpose products and processes later on.
The excellence of our services for new works gave customers confidence in our technically advanced solutions for improving and extending the life of Structures.
No other company in the world has more experience in this subject than Freyssinet. It is a highly technical market, like new construction and geotechnical works, which requires good knowledge of materials and the behavior of structures.
The repair of the Channel tunnel damaged by the 1996 fire demonstrated Freyssinet's engineering expertise and its ability to manage tight deadlines and teams as a main contractor. Projects now under way such as the repair and widening of Saigon bridge in Vietnam, repair of Bubiyan bridge in Kuwait and the Brenner pass viaducts in Italy, the Burnley tunnel in Australia, are all examples of applications of our know how.



To be saved from the Aswan's dam waters in 1967, the Abu-Simbel temple in Egypt was raised by 63 m. Freyssinet's jacks were used to set the new columns into position.

Is Freyssinet's activity to improve and extend the life of structures the same throughout the world?

J.-F. G.: It exists in almost all countries in which we are present, but the proportion of this activity is relatively smaller in some developing countries and in countries in which the new construction market is still very strong. This is why there is an enormous potential in the market for renovations and extended structural life providing a challenge for the Group's continued development.

How does Freyssinet intend to develop this activity?

J.-F. G.: The function of the Transverse Pole within the Group is to share knowledge and experience by working jointly with subsidiaries with less experience in this field. We organize transfers of know how on sites or during training seminars dealing with commercial, technical and construction aspects.
The Group has its own techniques proven by our construction teams, so that we can offer innovative solutions in all countries.
TFC® (Carbon Fibre Fabrics) is an ideal composite material for the reinforcement of concrete, steel or wood structures, and is a good example of this. This patented product was put on the French market two years ago, and significant volumes of it have already been used.
It has been used in Malaysia, Italy and Australia over the last year.
Further growth is expected in the maintenance and repair market, and our subsidiaries are ready to take advantage of it. This is undoubtedly one of the springboards for the Group's future growth.

Canada

Route 23 made safe

The Reinforced Earth Company Ltd of Canada has recently built a culvert in Canada including 22 m high TerraClass™ retaining walls combined with a 20 m long TechSpan® precast arch with a 10 m wide span.
The Holdich Creek culvert on highway 23 in British Columbia was replaced as part of an emergency procedure funded by the Federal Government of Canada. The objective was to make an emergency spillway across the embankment, thus protecting the only road access to Revelstoke. The Reinforced Earth Company Ltd solution allows to minimize the length of the arch and the volume of backfill, thus enabling the construction time to be brought forward.
The erection of the walls took place throughout the night and during the day. The Reinforced Earth Company staff provided assistance throughout the whole construction period.

South Africa

TerraTrel™ walls

Reinforced Earth Co. Ltd is building 6000 m² of TerraTrel™ retaining walls on behalf of the South African Road Board at Kei Cuttings on National Route 2 (for its widening).
Soil nails are used to provide short term stability in order to accomodate the traffic loads and improve the overall stability of the road. The nails required for overall stability purposes are extended through the TerraTrel™ MSE mass.

Australia

A TechSpan® arch for the Mitchell freeway, near Perth

Henry Walker Eltin chose a full Reinforced Earth package consisting of a 115 m long and 7 m high of TechSpan arch of 17.7 m span to act as a rail underpass below the Mitchell Freeway, near Perth. The project included 1000 sq. m of Reinforced Earth retaining walls.
Construction costs are reduced because the arch is no larger than necessary to satisfy railway gauges and due to its minimum thickness. The TechSpan® tunnel consisting of 131 arch segments, was put into position in a single weekend during which the line was shut down. After this project, Reinforced Earth Pty Ltd has recently been awarded another contract in Western Australia for the supply of twelve bridge abutments to be built on the Kwinana Freeway in Perth.

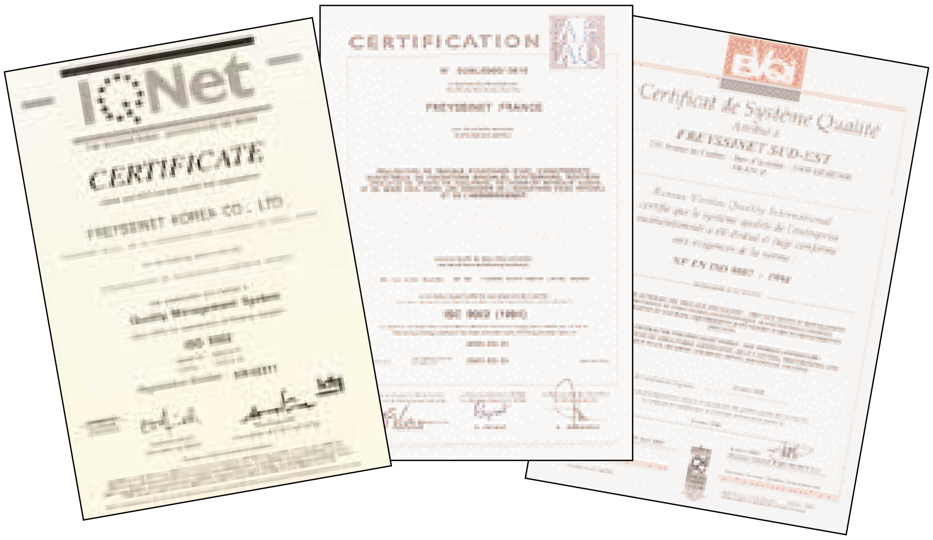
France

Compacting of old opencast mines

Ménard Soltraitement has been working on dynamic compaction of the Montrambert/ Pigeot industrial and business park in Saint-Etienne since April the 5th, 2000.
The site is on a former opencast mining area backfilled in 1990 and 1991.
The basic principle of dynamic compaction consists of transmitting high energy shocks to the surface of an initially compressible soil with low bearing capacity in order to improve its in-depth mechanical properties.
A particularly rigorous geotechnical check is carried out at the same time as these shocks are applied. In practice, the method used is to drop a weight of 8 to 25 t in free fall from a height of 15 to 25 m according to an impacts grid defined as a function of the site to be treated and the future structure.
The backfill on the Montrambert/ Pigeot industrial and business park covers 4 hectares and its thickness varies up to about 60 meters. The objective was to create a site with low settlements.
It was decided to improve the mechanical properties of the backfill over a thickness of 10 m below the surface to create a compact crust reducing differential and absolute settlements.
These results were achieved in two phases, using a high energy workshop (700 txm) capable of releasing a 25 t weight from a height of 25 m. The 3rd and 4th phases designed to compact a 0 to 5 m surface layer are carried out using a conventional compaction workshop (300 txm).

Quality

New certifications



Four new Freyssinet entities have been awarded company certification according to ISO 9000 standards (International Standardization Organization).

These certifications confirm the Group's ongoing commitment to the construction and supply of high quality works and products.

ISO 9001 certification: 1994
- Freyssinet (Thailand) Ltd, issued on March 13th 2000.

ISO 9002 certification: 1994
- Freyssinet, Rhône-Alpes region (France), issued on February the 29th, 2000;
- Freyssinet, South-East region (France), issued on March the 22nd, 2000;
- Freyssinet Korea Co., Ltd, issued on May 17th 2000.

Thailand

Wat Nakom In bridge

Wat Nakom In bridge and its access roads are constructed under five different contracts awarded to the SCITD joint venture (Sumitomo Construction and Ital-Thai Development). The first contract included the main bridge crossing the Chao Phraya, the approach viaduct, and two major bridges crossing over the Bangbuathong road on the Tonburi side and Phacharat road on the Bangkok side. These latter bridges are constructed span by span with precast segments and external prestressing. The main bridge is erected using the cast in-situ segments cantilever bridge method. The approach viaduct on the Tonburi side is composed of a cast in-situ box girder constructed span by span, while the approach viaduct on the Bangkok side is a cast in-situ segmental box girder. Freyssinet Thailand Ltd is responsible for the supply, installation, and technical assistance for all prestressing work and for the design of bridge construction methods.

Venezuela

The planned “Eastern Motorway“ project

The increased traffic between Caracas and the eastern part of the country makes a large motorway necessary. Tierra Armada SA will build about fifteen bridge abutments and their access ramps. The complete project will represent an area of about 15 000 m^2, of which 2 700 m^2 are already under construction. Reinforced Earth walls were chosen for safety and flexibility reasons, and due to the short construction times. All of this work forms part of a road network development plan funded by the Republic of Venezuela Ministry of Development. Tierra Armada SA is working as project leader, and supplier and technical adviser for retaining wall and abutment construction works.

Brazil

Cable stayed footbridge

Motorway operations concessions have introduced new concepts and new construction methods. Freyssinet is participating in the development of this market, and has just constructed a cable stayed footbridge for Nova Dutra, the company holding the concession for the largest road in the country between Sao Paulo and Rio de Janeiro. Construction was completed without interrupting traffic, the bridge being built in two parts at the side of the road. The deck and towers are made of steel. Concrete is used to fill the steel tower, the end spans acting as counterweights, the access ramps and the prefabricated slabs. The two parts of the footbridge were put into position by rotation using a system of monostrand jacks installed on the towers.

digest

Main figures

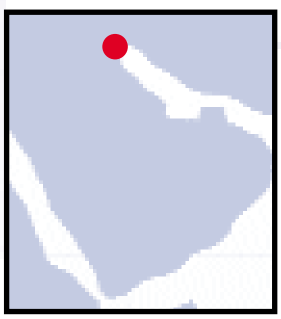
- Dates of construction: 1981-1983.
- Overall length: 2350 m.
- 4 destroyed spans.
- Span length of box-girders: 80 m.
- Weight of box-girders: 1010 t.
- Length of front nose and rear nose: 24.6 m.
- Weight of front nose and rear nose: 60 t.
- Launching speed: 0.45 m/minute

Freyssinet, who have already worked in 1995 to make the structure safe, are rebuilding the destroyed spans by incremental launching of box-girders.

digest

Launching

Rehabilitation of the Bubiyan Bridge

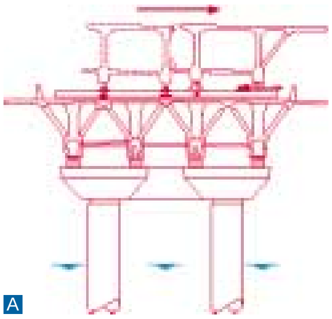


Bubiyan Bridge was seriously damaged during the Gulf War in 1991, when four of its spans were completely destroyed. Since 1999, Freyssinet has been repairing and providing general strengthening of this structure.

The Bubiyan Bridge, which crosses the Subiya Canal, links the mainland to Bubiyan Island, to the east of Kuwait. Built between 1981 and 1983 by Bouygues, this bridge is approximately 2.380 m long and has fifty-nine spans around 40 m long. In 1991, four of the structure's spans were completely destroyed (P8 to P10 and P48 to P50), opening 80 m long breaches. It suffered a lot of other damage, including perforation of a span and lifting of the deck at certain piers. Freyssinet, who had already worked in 1995 to make the structure safe, have been providing general strengthening of the structure and rebuilding the four destroyed spans since 1999. The contract, awarded to Freyssinet by the Military Engineering Department of Kuwait's Ministry of Defence, includes reconstruction of the four destroyed spans, repair and strengthening of the adjacent spans, i.e., spans 7-8, 10-11, 47-48 and 50-51, and the perforated span (45-46).

Box-girders with precast segments

The solution chosen by Freyssinet consists of rebuilding the four destroyed spans by assembling and launching precast segment box-girders on the intact spans. These reconstruction operations required prior repair of the damaged spans (replacement of the bottom slab, repair of concrete, making good, etc.) and strengthening of the structure by additional prestressing. To provide the prestressing, composed of 7C15 cables with ducted and greased strands for final strengthenings or standard strands for temporary strengthenings, concrete blocks and deviators were built. This structural strengthening allowed the segment assembly bench to be installed on the deck for reconstruction of the destroyed spans. A system of concrete longitudinal beams is used for positioning the precast segments, which, once they are assembled and fitted with a front nose and rear nose at their ends, are slid crosswise by transversal beams. They are then pulled by jacks mounted on an incremental launching beam.
The segments are manufactured 100 kilometres away from the site by a local subcontractor, Recafco. The new deck is composed of two parallel prestressed concrete boxes that



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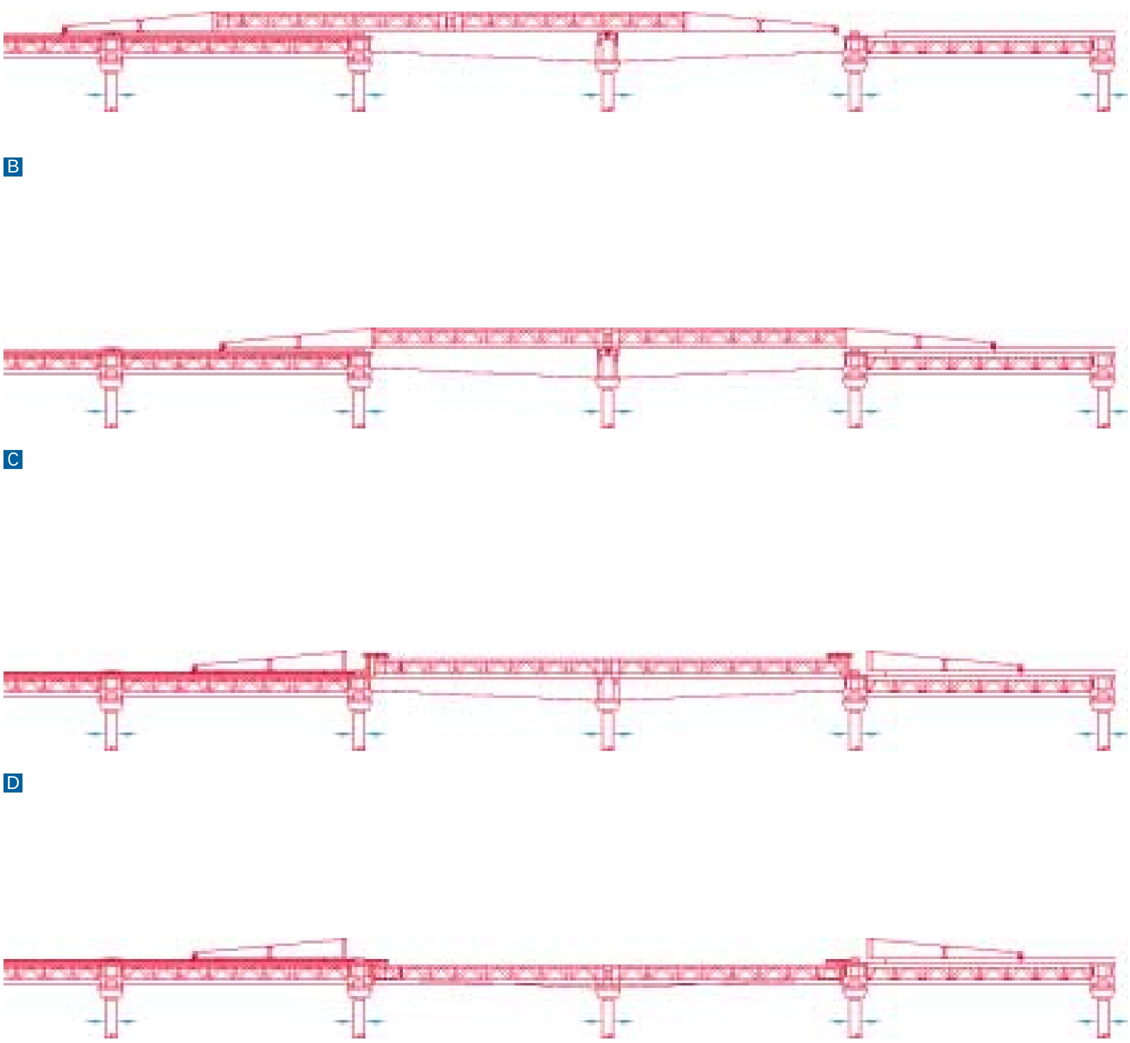


B

C

D

E

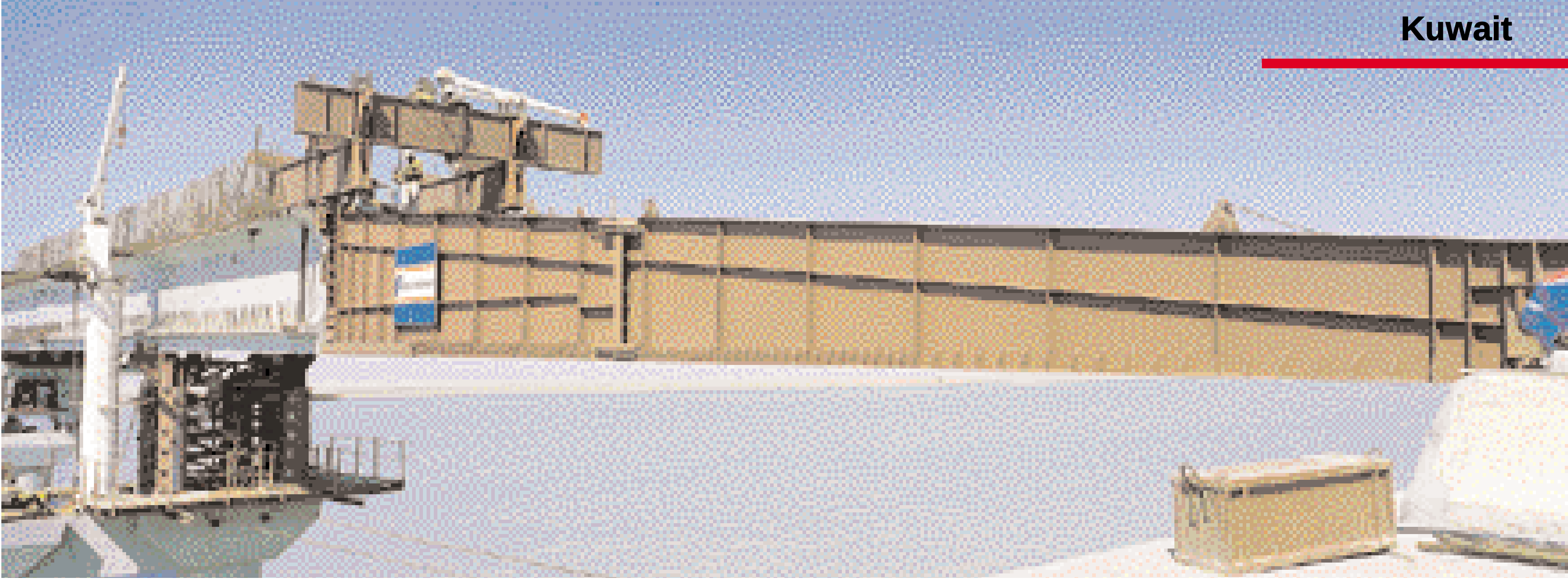
A - Precast segments are assembled on the existing deck and form a box-girder. The box-girder is slid crosswise until it is aligned on sliding saddles.

B - The box-girder moves on Teflon supports at an instantaneous tracking speed of 0.45 m per minute.

C - At the end of launching, the span rests on three bearing lines at the piers.

D - Positioning the end support towers. Loads are transferred from the front and rear noses to the support towers. The front and rear noses are removed.

E - The box-girder is lowered in 10 cm stages until it reaches its final bearings.



are necessary for the launching operation, and which are connected by top and bottom slabs after positioning and connection to the existing deck. For aesthetic reasons and to ensure the structure's overall consistency, the segments have the same appearance as the original deck: sloping struts connecting the cantilever of the top slab to the bottom slab. The segments are brought by truck to the site, placed by a gantry crane on Teflon skids installed on longitudinal rails, then pulled by a winch to their final position. Once the 35 segments are unloaded, they are assembled on the existing deck by gluing and by centred prestressing to form a box-girder more than 80 m long, i.e. over two spans, and weighing 1 010 tonnes (950 tonnes without the front and rear noses).

Launching and lowering of the box-girder

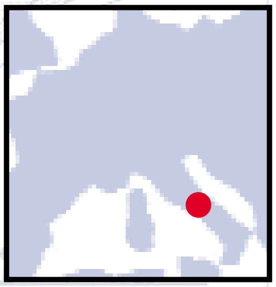
The ends of the box-girder are fitted with a front nose and a rear nose, 24.6 m long. It is shifted crosswise until it is aligned on sliding saddles. Apart from the additional prestressing, spans adjacent to the destroyed spans are strengthened by steel bars, 36 mm in diameter. The central pier, which bears the new span, is cable stayed on each side of the existing deck to take the horizontal loading caused by incremental launching and has five steel temporary support towers for docking the front nose. The box-girder is launched at an instantaneous tracking speed of 0.45 m per minute by two cable jacks located at the rear of the span. At the end of launching, it rests on three bearing lines at the piers. This operation is very tricky because of the 2.8% downward slope of one of the spans, requiring constant checking of the coefficient of friction in order to control the spans gliding movement.

For lowering the span, the front nose, rear nose and sliding saddles are removed. The new span now rests on a system of thirteen 5 m high support towers (four at each end and five on the intermediate pier) where jacks are installed. This equipment takes over from the front nose and rear nose, which are disconnected from the concrete. The span is gradually lowered in 10 cm stages, bearing on the four 250 tonne jacks at each end of the beam and on the 900 tonne jack on the intermediate pier. All these operations are continually monitored. Once the lowering operation is finished and the span is resting on its final bearings, concrete keying joints are cast in situ at each junction of the box-girder and the old deck. Continuity between spans is provided by installing final prestressing consisting of steel bars in the bottom flange, and Freyssinet 12C15 and 19C15 cables in the box-girder.

Participants

Client and Project Manager: *Military Engineering Projects Department, Ministry of Defence, Kuwait.*
General contractor: *Freyssinet.*
Consulting engineer: *PX Consultant/ Europe Etudes Gecti.*

Milan-Naples motorway



TechSpan® arches with a large span

Terra Armata has recently built arches with an impressive span, at the entrance and exit of two tunnels, before their widening.

The very busy A1 motorway links the Italian cities of Milan, Roma and Naples. It needs to be widened from two to three lanes in each direction. The two tunnels in Orte a Fiano, 35 km north of Rome, need to be widened by 11 m to carry these additional lanes.
Terra Armata proposed the construction of approach tunnels at the entrance and exit of the two tunnels. This solution uses the TechSpan® process that enables faster construction of an arch by means of prefabricated half-shells assembled with a keyed joint.

A large span

Night time construction reduced interruption of services to the very dense daily road traffic. Thus twenty-eight arch segments with widths varying between 1.10 m and 1.80 m and weighing 35 t, were put into position. Each arch is composed of two half-shells and has a great span of 21 m. These 20 m high arches are supported on 4.5 m deep upstands, thus enabling prefabrication of shorter and lighter weight shells. These TechSpan® arches are amongst of the largest arches in the world

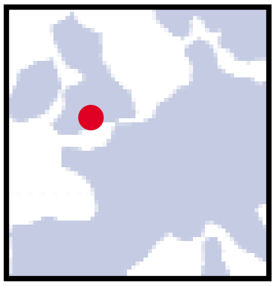
Fast and simple construction

The half shells are transported from the storage area by a tank carrier. Two cranes are used initially to assemble them. Once a number of arches have been assembled and longitudinal stability has been achieved, a single crane is sufficient for the remaining assembly operations. A cast in-situ concrete beam connects the half shells together when all the segments have been installed. An average of seven to ten TechSpan® arches are assembled every ten hours.
Terra Armata worked as a subcontractor for the Ferrovial Agroman Company, and has benefited from the technical assistance of the Tierra Armada design office.

Participants

Client: *Autostrada Spa.*
General contractor: *Ferrovial Agroman.*
Specialized contractor: *Terra Armata-Italia Spa.*

Prestressed concrete slabs



ExCel: Post-tensioned concrete slabs

Freyssinet constructed the post-tensioned concrete slabs for the new London exhibition centre within very tight construction periods.

The "ExCeL" centre will provide an enormous 65 000 m² exhibition space when it opens in 2001. Access to the building is very accessible since the car park is on the ground floor and exhibition space is located on the first floor. The specified live load for the exhibition floor is high, equal to 20 kN/m² on average. The centre is designed for events for which high capacity lifting vehicles (for example 25 t cranes) are necessary to install the stand, or for exhibiting heavy equipment (such as 62 t Challenger tanks or 40 t lorries).

The specified live load for the exhibition floor is very high, 20 kN/m² on average, thus facilitating heavy equipment exhibitions.

A rapid solution

The original solution proposed the use of 0.8 m thick reinforced concrete ribbed slabs supported on 1 m deep reinforced concrete beams. The Harrington Company considered that this design was too complex to satisfy the construction schedule, and asked Freyssinet to design a post-tensioned construction schedule. The adopted proposal was to use a 0.24 m thick slabs spanning onto 1.5 x 0.475 m deep band beams. The beams are aligned with the longitudinal axis of the building, which simplifies table forms placement and removal operations under the slab, on a reduced time basis. The formwork under the beams was an in-situ strip. Using this system, a nine-day cycle was achieved between one concrete pour and the next with production peaking at 5 500 m², seven pours per week.

Extensive prestressing work

The grid is generally 7.8 m square, except in one area in the south hall where it is 10.5 m by 9.1 m, where section sizes increase to 0.3 m and 2.1 x 0.475 m beams. The exhibition space is split into two halls, north and south, each 375 m long and 86 m wide. Movement joints divide both areas into three blocks, the largest measuring 145 x 86 m. Each hall is being concreted with site-batched concrete in 36 typical pours, each 31 x 29 m.

The many reinforced concrete shear walls in the original design have been replaced by steel cross-bracing, which is left slack while the slab shorten under the effects of stressing, thus allowing the fast track programme to be maintained.

Freyssinet also built the two lorry access slabs which carry a 2/3 HA loading and the West Podium slab, which spans 22 m. The total post-tensioned slab area for the project is 78 600 m².

Participants

Client: *ExCeL Plc.*
Architect: *Moxley Architects.*
Structural engineer: *McAlpine Design Group.*
Main contractor: *Sir Robert McAlpine Ltd.*
Structural concrete: *P C Harrington.*
Post-tensioning contractor: *Freyssinet Ltd.*
Work commenced: *November 1999.*

Prestressed concrete slabs

A reconverted flour mill

The conversion of the Gateshead flour mill into an art centre requires improvements and partial transformation of the building.

The transformation of the former Baltic flour mill into a modern art centre is an ambitious project. The mill was built in Gateshead in the early 1900's on the banks of the river Tyne, and forms an integral part of the landscape. The main 55 by 31 by 14 m high building has been gutted, and three post-tensioned concrete exhibition floors and three reinforced concrete mezzanines were then added.

Each exhibition floor is suspended on five post-tensioned beams that span 18.2 m. New 'T' shaped columns have been constructed 2.3 m inside the façade to allow access for stressing the two 12K 15 tendons in each beam. On level 2, the beams are 1.2 m deep and 0.45 m wide at the soffit, tapering to 0.65 m at the slab. The slab consists of 0.15 m in-situ concrete poured on Omnideck precast planks spanning the 5 m between adjacent beams.

A complex geometry

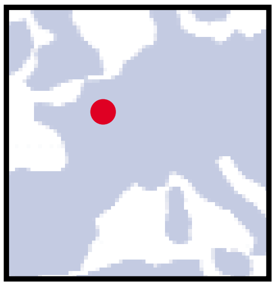
The Omnideck floor consists of a thin base of concrete into which steel lattices are cast as support. Short term they span unaided, long term they act integrally with the structural topping. On levels 3 and 4, there is a 0.225 by 0.45 m deep ventilation duct within the beam and a 0.32 by 0.1 m deep channel along the top of the beam, both along the full length of the beam. To accommodate these requirements, the beam width increases to 0.65 m at the soffit and 0.85 m at the slab, the depth remaining at 1.2 m.

This complicated geometry was modelled using the RAPT (Reinforced And Post-Tensioned) program developed by PCDC. This allows beams with tapered sides, internal voids of various shapes, and flanges at the top, below or part-way up a beam. The floors were designed for 5 kN/m^2 of live load together with an allowance of 60 kN over a 1.75 m square area for heavy exhibits. Finishes add an extra 2.3 kN/m^2. As construction of this landmark project nears completion, the art world is preparing for an exciting new venue.

Participants

Client:
Gateshead Metropolitan Council.
Architect: *Ellis williams Architect.*
Consulting Engineer: *Atelier One.*
Main Contractor: *DBG Construction Ltd.*
Specialized contractor: *Freyssinet.*

To accomodate the art centre, the Baltic flour mill structure is transformed to receive three RC floors and three RC mezzanines.



Vincennes

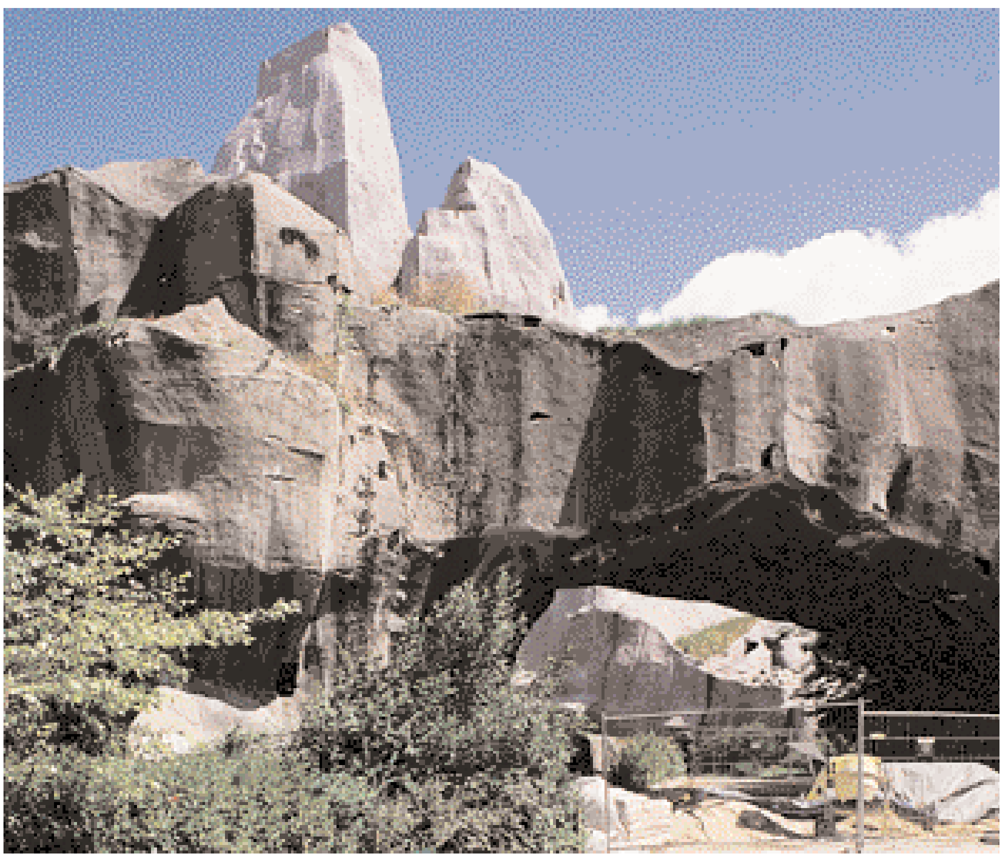
Paris zoological gardens

Freyssinet is currently repairing various structures in Paris zoological gardens.

At the request of the Natural History Museum and I.E.E., Freyssinet is mainly working on the Fauverie building (adjacent to the Large Rock), on the Passage des Algazelles et des Fennecs, and Passage du Poste des Gardes. For all these structures, the volumes must be meticulously reconstructed, identical to the originals. This operation faces certain difficulties, considering the absence of detailed drawings of the artificial rocks. Their shells are reconstituted by shotcreting around 6 cm thick.

Fauverie building

The Fauverie building, which supports an artificial rock, was extremely deteriorated and needed urgent repair. The work consists in partial repair of the shell of the artificial rock, demolition of the posts and beams of the load-bearing structure and their complete reconstruction, after concrete repairs of the damaged areas. In parallel, the protection of the six glass roofs located under the shell, which were damaged by falling pieces of concrete, is improved by 8x23 thick planks whose ends are bedded in the brick walls, and decking in 40 mm thick close boards. It is protected by a roof composed of ribbed galvanised steel pans that provide water-tightness. The purpose of this work on the glass roofs is to provide sufficient temporary protection so that the underlying premises can be used.



From "Passage des Algazelles" to "Passage du Poste des Gardes"

Passage des Algazelles, a busy path used a lot by the public, was also very deteriorated, as was its supporting structure supporting it, composed of three reinforced concrete truss girders. In addition to reconstructing the posts, beams, diagonal members and haunches in reinforced concrete, Freyssinet is repairing the suspension elements of the underside of the passage by means of stainless steel threaded rods with galvanised struts fixed above the beams. Work on the passage known as "Passage du Poste des Gardes" consists in repairing the shell of the artificial rock; the internal structure is in satisfactory condition. The zoological gardens remain open to the public throughout the entire works. Therefore great care is taken to provide a safe, pleasant environment for visitors as well as for the animals.

Participants

Client: *Muséum national d'histoire naturelle (Natural History Museum)*
Project Manager: I.E.E. (Ingénierie, Etudes, Entreprise)
General contractor: *Freyssinet.*

Brisbane

A new rail link

Austress Freyssinet Pty Ltd is participating in the construction of a viaduct to carry the new rail link between Brisbane and its airport.

In April of 1998 the Queensland Government and the consortium Airtrain City link (Transfield Constructions, Macquarie bank and Reduct) entered into a legal agreement to develop a connection between Brisbane's existing rail network and the international Airport. It was established on the basis of a Queensland Government mandate which required that the public transport system in South East Queensland be upgraded by providing a high quality, environmentally friendly and acceptable alternative to the motor car for journeys to Brisbane Airport. The consortium awarded the design and construct package to Transfield Constructions.
The project comprises a 8.5 km elevated electrical spur line. The track viaduct is supported on piled foundations and concrete columns spaced at 30 to 45 meters apart and spanned with precast concrete girders. Overall 2300 piles ranging from 12-40 m in depth and 1200 precast girders averaging 75 tonnes each will be required to complete the project.

Manœuvering flexibility: the Freyssinet solution

Austress Freyssinet Pty Ltd seccured the contract for all post tensioned elements located throughout the structure. These are the transverse stressing of the girders, vertical stressing of the columns and horizontal stressing of the headstocks. The transverse stressing pinned together the 3 No precast I girders that spanned between the columns. It is formed of 10 No tendons per span that are inserted perpendicularly through the flanges of the precast girders 5 top and 5 bottom at 6 m centres. Each tendon comprises 4 x 12.7 mm low relaxation strands. A crew of two men working from a boom lift can cut strand, install, stress and seal two single spans in a day.

Originally the design called for a 29 mm bar for the transverse post-tensioning but it was considered that the rigid bar might incur difficulty with installation if there was a slight misalignment of the precast girders. Austress Freyssinet Pty Ltd proposed the strand alternative to allow the flexibility for manoeuvring through misalignments. For this proposal however, Austress Freyssinet Pty Ltd had to overcome the problem of the substantial loss of load due to wedge draw on a tendon length of only 3 m. The development of a hydraulic lock off nose for the mono strand jack that applied significant load to the wedges prior to releasing the strand reduced the draw in losses to only 5%. The five piers that bridged the gateway motorway each required 12 No x 27C15 vertical tendons. These were installed in two stages, firstly a 3 m long dead end was cast into the pile cap while the balance was installed during fabrication of the columns. The strands were connected between the two stages with mono strand couplers.
The rail link will be brought into commission over the four months beginning January of 2001.

Participants

Client: *Air Train City Link.*
Engineer: *EGIS.*
Main contractor: *Transfield Constructions.*
Specialized contractor: *Austress Freyssinet.*

Kuala Lumpur

The “bottom feed” method

The stone columns on the Kajang Ring Road were constructed using a clean and fast technique.

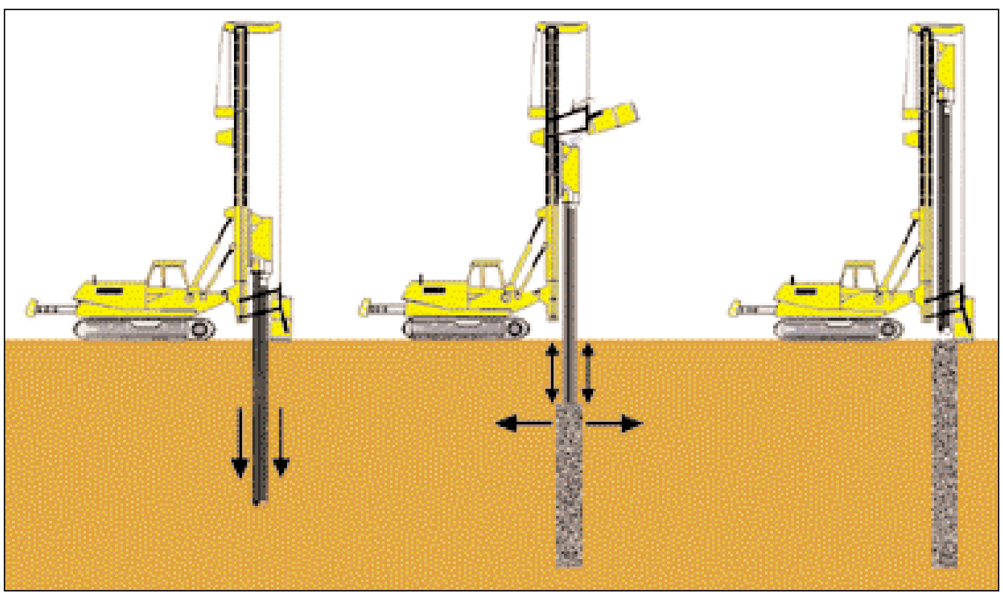
Menard Geosystems, the leading soil improvement specialist contractor, recently used the bottom feed dry method of installing stone columns for the Kajang Ring Road project in Kuala Lumpur. The work was done using the Terrafirmer rig specially designed for the purpose and powered by a 300 HP Caterpillar engine, capable of drilling at a rate of 0.5 to 1 m per minute. The average daily production rate is about 300 m of stone column per day per rig. Apart from the speed, this method is also remarkable for its clean working environment. The Vibroflot (the compaction unit) penetrates to the required depth aided by vibration, compressed air and thrust. There are no water jets, unlike conventional methods. Hence, the working area is not flooded and there is no ground water pollution.

Kajang Ring Road

The site is located to the south of Kuala Lumpur city.
The 4 700 m^2 site consists of silty clay and sandy silt. The standard SPT (test to measure soil strength) N value varied between 3 and 8. The thickness of this layer varies from 4 to 8 m. Below 10 m, there is a layer of very stiff clayey silt with SPT N > 15. The stone columns were designed to support a 9 m high embankment with total design load of 180 kN/m^2. Preliminary cone penetration tests were carried out. The stone columns were built to a maximum depth of 10 m, on a 1.6 m triangular grid. Two rigs were employed, firstly a conventional pendulum Vibroflot suspended from a crawler crane (with gravity feed from the top) and the Terrafirmer. The total number of 9 800 stone columns were constructed.
Throughout the installation process, the quality control of the stone columns was closely monitored by an on-board computer controlled QC system and plate loading tests were carried out on the completed stone columns. The load carrying capacity of each stone column exceeded 25 tons.

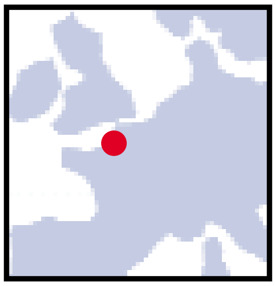
Participants

Client:
Jabatan Kerja Raya Malaysia (PWD).
Engineer:
Arup Jurunding & Isotech Consult.
Main contractor: *Sunway Construction Bhd.*
Specialized contractor: *Menard Geosystems.*



Using a compaction unit to install a stone column. This operation is usually carried out in successive 30 to 50 cm steps. The stone column acts as a load-bearing element and vertical drain.

France



Berck-sur-Mer

Hospital renovation

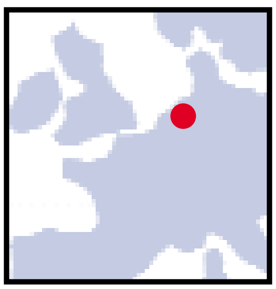
Freyssinet uses the TFC® gluing technique to strengthen the floors of a hospital building.

The Hopale Group includes all specialised hospitals in Berck-sur-Mer, in the Pas-de-Calais Department of France. One of the buildings had to be strengthened as part of a project to change its function. This work, awarded to Freyssinet, was designed to strengthen the floors on three levels in the building.
This essential strengthening was necessary due to insufficient reinforcement in the beams and also to create a number of openings. The TFC® (Carbon Fibre Fabrics) gluing technique was adopted instead of the originally designed steel reinforcement solution. TFC® saves time in the general construction planning, limits space occupied in false ceilings and reduce the constraints for department operators and patients, all work being done within the hospital without interrupting the hospital service.
Freyssinet's work was done between mid April-and mid-June, and included about 400 m^2 preparation of the underside of the floors and the placement of 1 400 m^2 of TFC® in two, three and four layers. Flocking was done on the TFC® after installation in order to make it fireproof.

Participants

Client: *Groupe Hopale.*
Engineer: *Sogisnord.*
Main contractor: *Freyssinet.*

Netherlands



A cable stayed bridge

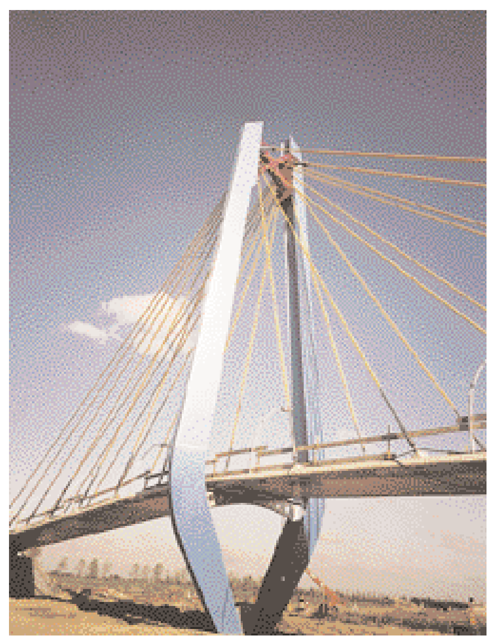
Amsterdam Schipol airport

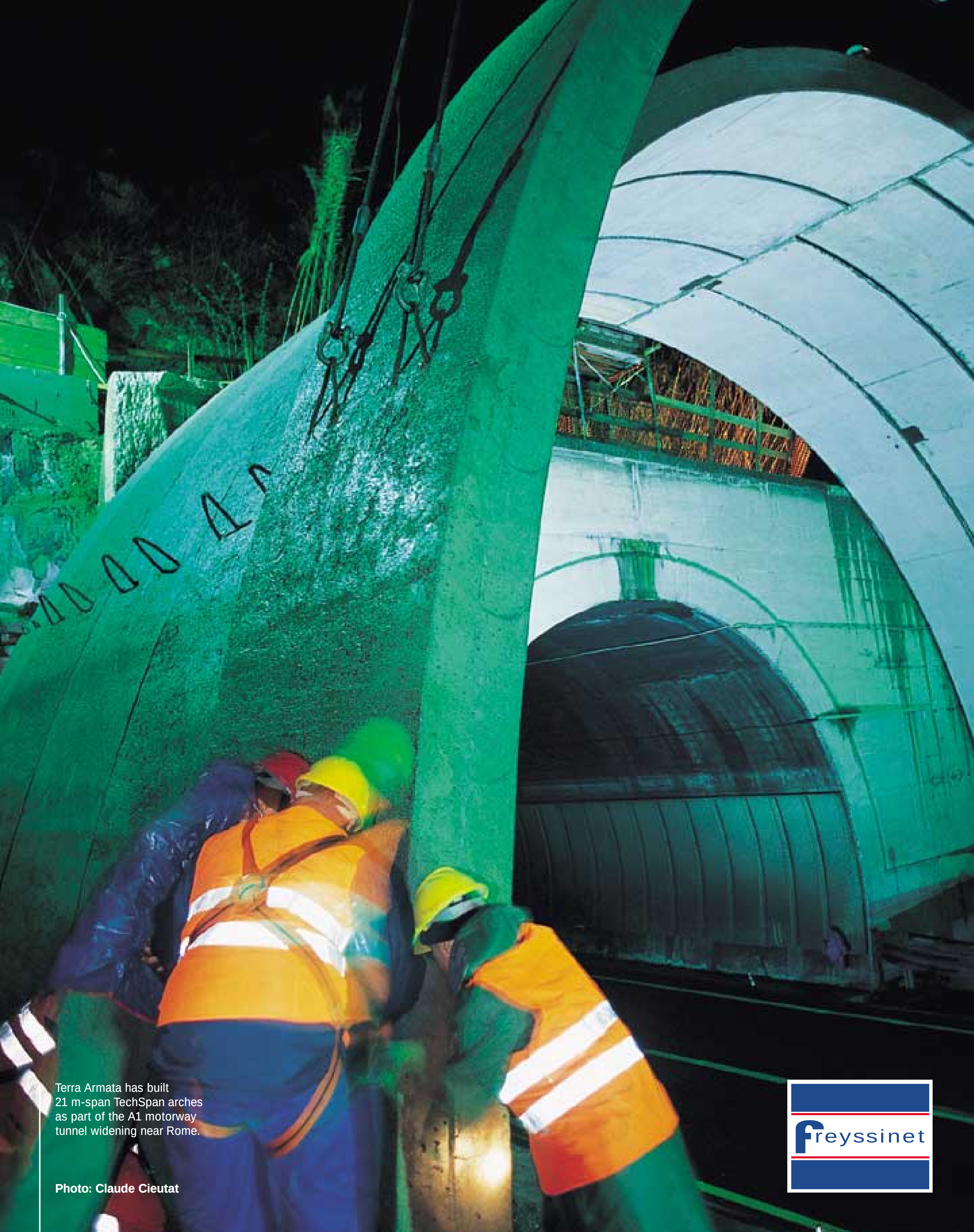
A cable stayed bridge specially designed to blend into a landscaped park close to Amsterdam.

A beautiful park is currently being laid out in a typical Dutch landscape near Amsterdam airport. A communications network has been developed in it including roads (some reserved for public transport), footpaths and cycle tracks. It will host the Floralies flower show in 2002.
A cable stayed bridge was chosen to carry the footpaths and cycle tracks over the motorway. It was decided to build the pylon in the shape of a tulip to give a more aesthetically pleasing look to complement the existing surroundings. The concrete deck is carried by 22 Macalloy bars and is retained by 2 Freyssinet stay cables. The bars are brought to site fitted with their couplers, and after being installed they are stressed by special prestressing couplers and the tools necessary for their use developed and supplied by Samaco especially for this project. Each stay cable consists of a pair of 15.7 mm cables anchored in the abutments. The longest bar is 55 meters long and the side stay cables are 44.4 meters long.

Participants

Client:
Amsterdam Schipol airport.
Engineering: *Engineering Office Amsterdam.*
Specialized contractor: *Samaco,*
Dutch subsidiary of Freyssinet.





Terra Armata has built
21 m-span TechSpan arches
as part of the A1 motorway
tunnel widening near Rome.

Photo: Claude Cieutat