Soils & Structures

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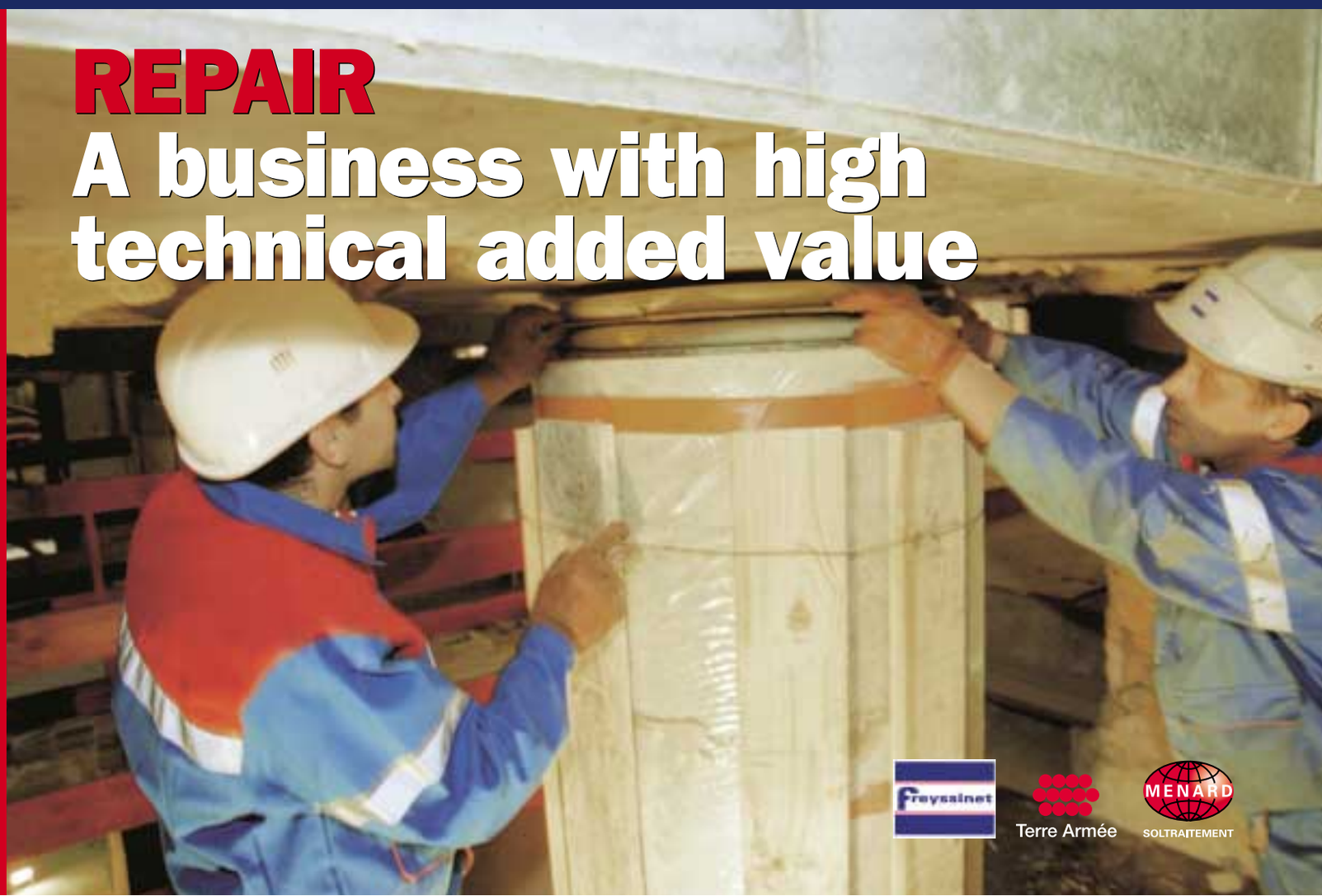


REPAIR
A business with high technical added value

freyssinet

Terre Armée

MENARD SOLTRAITEMENT

A well-suspended roof

A new ice rink has just been built on the former Olympic site in the Krylatskoye district in Moscow, Russia. The roof of the structure covers 30,000 m² and it is supported by 19 stay cables supplied and installed by Freyssinet.

Rehabilitation in the air

The Roissy – Charles de Gaulle (France) water tower, attacked by pollutants related to the nearby airport activity, has been rehabilitated. Freyssinet's team spent five months applying a corrosion inhibiter working from a platform 45 m above the ground, and treating reinforcing steel in the 20.5 m radius dish.

56 stay cables over the Vistula

Since July 2003, Freyssinet Polska has been working on the construction of Plock Bridge, that is a new 1,200 m long cable-stayed bridge carrying a dual carriageway road over the Vistula in the centre of Poland. After lifting the end spans, the contractor will supply and install the bearings and the 56 stay cables (560 t of steel) for the main bridge. End of construction planned at the end of 2004.

Retaining walls in Ethiopia

Work on consolidation of the road crossing the plains of Ahmar Mountain started in Ethiopia in February. Reinforced Earth South Africa (Resa) is participating on this site particularly with the construction of four 6 m high TerraTrel walls designed to stabilize a part of the road surface damaged by rock falls.

Sungai Prai: first segments lifted

Freyssinet has been working on Sungai Prai Bridge in Malaysia and began heavy lifting operations.
In January, the first two segments (200 t each) out of the total number of 1,400 to be used in the structure, were placed at the top of the 40 m high pier. This operation took 24 hours and made use of four jacks.

Strengthening of the Millennium plant

Freyssinet worked for 12,000 hours in three months between June and September 2003 to strenghten the leak tightness of five ponds at the Millennium plant effluent treatment station in Le Havre, France. The Freyssinet team made structural strengthening using a dry reinforced shotcrete process to construct strengthening shells, and then applied internal insulation by spraying polyurethane foam in order to reduce thermal shocks affecting the structures into which effluents arrive at a temperature of 50°C. The tanks were made leaktight semi-independently using an epoxy resin based lining. The entire outer structure was strengthened by TFC (350 m²) followed by acrylic waterproofing.

Road and rail

A new cable-stayed road and railway structure is being constructed over the Orinoco in north-eastern Venezuela. A total of 192 stay cables (1,300 t of steel) will suspend the 3,120 m long and 24.7 m wide composite steel - concrete deck structure.
Freyssinet will supply and install the stay cables and the bearings.

High stakes in Campione

In January this year, Freyssinet completed the lifting operation of the new casino roof in Campione, Italian enclave in Switzerland, that it started in October. The 1,100 t metallic structure was built on the ground and was lifted firstly by a 9 m step and then by two 10 m steps. Each time the structure was lifted, a 200 t intermediate floor was added. Freyssinet performed this operation using the latest strand lift jack system (8 jacks with a unit capacity of 300 t) controlled by a new supervision system controlling automatic lifting and control of displacements by laser sensors.

IN SHORT

WORK FOR STRENGTHENING OF A TEXTILE PLANT
Freyssinet Egypt has just completed a large amount of new strengthening work in Gharbeya, in the Mahalla delta, Egypt, by consolidating all roof beams in a 15,800 m² building, one of the most largest and oldest textile factories in the Middle East, by additional prestressing.

108 T OF FLOOR PRESTRESSING
A tire factory has recently been constructed to the south-east of Bangkok, Thailand, on the Chonburi coastal industrial zone. All floors in this factory are prestressed by post-tensioning. Freyssinet Thailand installed 50 t of strands (19C15 anchors) for two 96 m long tunnels; 34 t (4S13 and 5S13 anchors) for a two-storey building (6,874 m²); 24 t for a second three-storey building (3,010 m²).

2,000 MATCHSTICK CMCS IN MARSEILLES

Ménard Soltraitement used "matchstick" CMCs (small diameter controlled modulus columns) on a first site in Marly-la-Ville in 2003, and they have now used them once again in Marseilles to consolidate a site on which shops will be built. The company installed 2,000 CMCs with a diameter of 25 cm over a 3,000 m² area within three weeks, respecting constraints in the specification including limitation of absolute settlements to 15 mm and differential settlements to 2 mm per 2 m.

PRESTRESSING OF TANKS
680 t of prestressing were installed in six months on two 84 m diameter and 40 m high cryogenic tanks located in Idku, 50 km to the east of the town of Alexandria, Egypt. The work was done by Freyssinet International and its Egyptian subsidiary, subcontracted from VINCI Construction Grands Projets.

ALAIN MARTINEZ-FORTUN

The added value of prevention - safety

Alain Martinez-Fortun promotes management of prevention and safety at work inspired from the model used in the English-speaking world, and talks about the increase in popularity of this subject in companies.

Soils & Structures. - All companies are now concerned by risk prevention. Is this a fad or a reality?

Alain Martinez-Fortun. Risk prevention has become reality. Its organization includes three development phases, and globally we are only at the beginning of the process. The first phase that I will call "prehistoric", to be deliberately provocative, is the company's response to its external obligations and constraints, customer requirements and national regulations. The second phase is organizational and corresponds to setting up a safety service, identified procedures and prevention plans. The third and final step is the approach by management systems. At this stage, risk prevention forms part of the company culture. The road towards this final step is long and complicated because there are many taboos related to safety in Latin countries. But significant progress has been made.

What safety references are used?

Until very recently, in terms of safety, the only reference was provided by British standard BS8800 published by the BSI (British Standard Institute). Things have changed since 1999, due to actions taken by the BSI which has been working in cooperation with large offices and worldwide experts in safety, and has resulted in publication of the OHSAS 18001 document (Occupational Health and Safety Assessment Series), which is a new international document supported by the International Labour Organization and has become a national standard in many countries. It is recognized by all major certification organizations, it is compatible with ISO 14001 for the environment, and ISO 9000 version 2000 dealing with quality, and is now "the" existing reference standard that harmonizes practice. This document also helps to set up a QSE (Quality, Safety, Environment) system within companies that involves the entire company management. I think that in the next three years, market pressure will result in the publication of a new ISO standard on safety. Moreover, the OHSAS 18001 reference document is an organizational approach that enables the company to manage its risks in terms of work safety, to improve its services and to organize the structure of its internal and external policy. This in no way substitutes for the quality approach but is complementary to it. These performances result in savings or rather "lower expenses" that are attractive to the contractor and also to its customers.

What is the cost of safety for a contractor?

In public works in France, the cost of non-safety is equal to 10% of the total salary bill, which is equal to the cost of health insurance

From management to commitment

Alain Martinez-Fortun has occupied general management functions as Plant Manager in the automobile industry, chemical and pharmaceutical industries and polymer transformation industries for 26 years, usually within large American multinational groups. He has a scientific background and has always been interested in different aspects of management, and particularly multi-cultural aspects. He is very enthusiastic about health and safety problems in companies and he has realized that many countries in Europe are far behind English speaking countries in this subject, since there are many taboos and the managerial dimension has not been understood. He was trained by DuPont in the United States, and had the opportunity to implement programs created by DuPont, considered to be the reference in this field.

He became a consultant in 1997 to help the different managers in large groups set up a genuine "safety culture". He discovered the BS8800 guide followed by OHSAS 18001 in 1999, and was quickly convinced that this safety management system would become the "reference of all references", probably through ISO. He wrote a book entitled Manager la sécurité – une volonté, une culture, des méthodes (Managing safety - a will, a culture, methods) (Insep Consulting Editions) and many articles in different journals, and he is now working for large international groups working in a wide variety of fields, such as Delphi Automotive Systems, Kimberly-Clark, Total, Glaverbel, Houillères du Bassin de Lorraine (Lorraine Basin Coalmines), Ahlstrom, Viessmann, Eurostamp, Soluxtrafer, Saint-Gobain, PAM, VINCI, Danone.

contributions (CRAM) and absenteeism. Experience has shown that contractors can usually make enormous savings of the order of 4 to 8% of the total salary bill in this subject. Setting up a safety approach can give a fast return on investments, which obviously also benefits the final customer.

Apart from direct costs, there are also repercussions on the contractor's image, particularly when the company is quoted on the stock exchange or belongs to a group quoted on the stock exchange. Most investments on the financial market now originate from pension funds that make economic and ethical evaluations of companies. A company that neglects safety takes the risk of being sanctioned by the market.

Therefore what is the starting point for the safety approach?

I argue for non-negotiable criteria before starting to set up an efficient safety approach. The very recent setting up of automatic radar systems on French roads is a good example of this subject and in my opinion it should be transposed to safety at work. Computerization of checks has made it possible to set up non-negotiable criteria on the road, and this system works. In a company, this triggers a change in the behaviour of employees. The starting point is determined by defining principles that will never be questioned, such as wearing a safety helmet, safety shoes, etc. The company can then set up a more ambitious risk prevention program.

What objectives should be fixed?

I recommend that the number of lost-time and non-lost time accidents should be reduced by a factor of two every year until a figure that can be morally accepted in the long term is obtained. This is an investment for the entire company, that often needs outside help in taking the first step. When I was managing a plant in Lorraine, I used this principle to obtain an average frequency of 0.2 over seven years. But it is true that it is easier to obtain these results in businesses in which operations are repetitive; project management for public works projects which are always unique and are performed in different environments makes the task much more complicated.

How does the customer benefit from a risk prevention policy?

Your customers will benefit from many advantages if you adopt a safety approach. I will start by mentioning the reduction of criminal risks for the owner and the main contractor. There is also the image: a clean well-organized site gives a very good external image and provides a good example for other persons working on the site. It also reduces risks of disputes with local government authorities concerned such as labour inspection, professional prevention organizations in building and public works which often cause delays or work stoppages. Finally, enormous savings are possible by setting up a risk prevention policy and are often passed on to the customer, which is an added value. ■

Freyssinet: safety objective

Risk prevention plays an important role in the organization of responsibilities and project management, and is a daily commitment at Freyssinet that is now working on setting up an SMS (Safety Management System). This approach involves specific actions on sites and is being generalized to all employees.

A business with a high technical added value

Much of Freyssinet's reputation is founded on post-tensioning and stay cables, which tend to overshadow repairs, which accounts for a large share of its activity. The company's expertise and technical culture are extremely valuable in the repair business

What is the optimum way of combining steel and concrete? This was the basic question asked by Eugène Freyssinet in the late 1920s, and was the starting point for the first prestressing patents followed by a technical revolution that would take Freyssinet's engineers onto the largest bridge and tunnel sites in the world for 20 years after the war. Then, a deep-seated culture of structures was formed combining expertise with design, development of construction methods and techniques, which were to become the heritage and the trademark of the company, at the same time preparing the company for an important turning point in its history. Then the construction market gradually changed at the end of the 1970s. "Installation of post-tensioning represented 90% of Freyssinet's activity in 1976, but now it only accounts for 10%" said Philippe Zanker, Director of Freyssinet's Division in France. During these years marked by a reduction in the amount of new construction, the company needed to focus its activities, basing itself on its know how and the new market needs. The result was a new activity, namely repair, that now accounts for a large portion of Freyssinet France's turnover, although it is often eclipsed by the development of prestigious cable-stayed structures.

Philippe Zanker emphasizes: "The genesis of this reorientation is of capital importance to understand the added value of Freyssinet's repair business, which always includes an overview of the structure, including the design. This sets us apart from the competition, which is often limited by its specialization in one or another specific technique." At the same time, this genesis illustrates Freyssinet's field of action which concentrated on bridges and tunnels until the 1990s and then became more and more in demand by contractors for other types of structures such as buildings, tanks, silos, water treatment plants, functional structures, etc.

Strengthening by post-tensioning

Philippe Zanker also mentioned the historic and symbolic link between post-tensioning and repairs. He illustrates this by repairs works to preserve the Le Havre shipping terminal in 1934 at a time when Eugène Freyssinet's process had not yet been broadly accepted, and then discussed applications of post-tensioning in strengthening and repair: "post-tensioning was originally intended for use in structures at the time of construction, but can now be added afterwards to restore or increase the structure's load bearing capacity. The stress distribution in the load-bearing section can be modified using cables added to the outside of the structure and tensioned; this is "additional post-tensioning" the only active method of improving the load bearing capacity of the structure". We are now using passive methods that consist of adding steel onto the structure, we started by gluing steel plates and we now use the Carbon Fibre Fabrics (TFC) patented process that quickly replaced glued plates after 1996. This innovative and patented application originates from a partnership initiated in 1995 by Soficar, a carbon fiber manufacturer, with the LCPC (Laboratoire Central des Ponts et Chaussées – Central Bridges and Roads Laboratory), Ato-Findley (today known as Bostik-Findley), a resin specialist, and Freyssinet, and has many advantages including incorruptibility of the material, lightweight and flexibility of installation, making it easy to understand the rate at which its popu- ▸▸

Freyssinet's repair activity, always include an overview of the structure, including the design.

WATERPROOFING

Freyssinet's structure renovation techniques are particularly suitable for the maintenance and repair of drinking water storage structures, which are frequently affected by damage that threaten their watertightness as they age. Unlike repair work that is often proposed and is restricted to the application of a surface coating, techniques used by Freyssinet deal with the causes of damage (either structural, physical or chemical) and guarantee the long life of structures.

SHOTCRETE

Concrete is often "poured", but it may also be sprayed in the form of wet or dry material with a powder consistency, by a flow of compressed air in the pipe. Shotcrete may be used alone or combined with other techniques such as Carbon Fiber Fabrics (TFC) or additional prestressing, and can be used for restructuring work on all types of structures. The application precision and the spraying speed, which guarantees optimum compactness of the concrete and forms a perfect bond to the support, can be used to make or rebuild a wide variety of architectural shapes. At Freyssinet, shotcrete work is done by certified operators, following qualifying training approved by Asquapro, the French Association for Quality Assurance on Shotcrete and Mortar Spraying, an organization to which many public works companies adhere.

ADDITIONAL POST-TENSIONING

Additional prestressing consists of adding external forces designed to modify the state of stress in an existing reinforced concrete, prestressed concrete, brickwork or wooden structure, to restore or increase the original load bearing capacity. Freyssinet has a wide experience in its original business of prestressing, and proposes optimized strengthening solutions by additional prestressing that satisfy international standards and regulations and benefit from recent progress in the field.

RÉGÉBÉTON

All concrete structures affected by the weather and aggression by pollutants present in the soil, water contaminated by deicing salt or exposed marine environments are affected by physicochemical modifications that provoke or accelerate corrosion of reinforcement. Régébéton is one technique that Freyssinet uses for depollution of Clorides and Carbon dioxide and regeneration of reinforced concrete durability. The process consists in an electrochemical method that extracts polluting elements such as chloride ions from the material, and increases its pH to a passivating level. Régébéton acts in depth without altering the appearance and authenticity of the surfaces or causing any force redistribution, and is an ideal tool for preservation of monuments and the protection of reinforced concrete structures.

►► larity increased. The dry shotcrete (Torkret) process is another important repair method used by Freyssinet and was acquired by Freyssinet France in 1985, and uses a steel-concrete combination. The concrete is transported by compressed air as a dry mix as far as the operator's shotcrete gun, without the use of any formwork or propping. It is immediately hydrated before being sprayed at a speed of 100 meters/ second onto the surface to be repaired or the structure to be strengthened, if necessary with the addition of passive (reinforcement) or active (post-tensioning) steel embedded in the concrete. Even if similar principles are used, all of these processes have their own application fields, corresponding to their specific capabilities; additional post-tensioning is used particularly for large structures such as bridges, while shotcrete and TFC are used more frequently for everyday's structures such as buildings and industrial facilities.

Philippe Zanker continued by telling us that recent additional post-tensioning projects include putting the AU76 viaduct on the A320 into a safe condition to increase the strength of a viaduct made of independent prestressed concrete beams in which the passive reinforcement was severely corroded, and Orly Airport aircraft bridges crossing the RN7 for use by future heavier aircrafts. Shotcrete is used in many projects such as repair and strengthening of an industrial plant in Le Tréport, in the Seine-Maritime department, that had been damaged by a fire and in which 63 beams were reconstructed in seven months, and the façade of the Triangle building in Montpellier which was treated against the effects of reinforcement corrosion. Finally, a good illustration of the use of TFC for repair work is the site recently completed with Sogea Construction in Montpellier on the Gambetta car park, where the slab had lifted after flood events. "Apart from these and other unforgettable projects such as the "lightning" repair of the Chunnel arch (on which 250 persons worked during three shifts seven days a week for 60 days in 1996) and the strengthening of CNIT bearings in La Defense at the end of 1990s, the repair business also includes modest sites that have to be completed in a week without stopping operation of the structure." Regardless of their size, these operations open up new fields of exploration for research and form a powerful innovation motor. The company decided to work with concrete chemistry specialists, to help solve concrete pathologies and particularly corrosion phenomena

Regardless of their size, these operations open up new fields of exploration for research and form a powerful innovation motor

UNDERPINNING & STABILIZATION

Freyssinet teams use their expertise with micro piles, columns and nailed walls, ground anchors and lifting to broaden their field of repair actions in underpinning work to restore or consolidate the stability of all types of buildings (office buildings, residences, historic monuments, etc.), or even lifting or raising these structures.

TFC

Bonding of additional carbon fiber strengthening, and uses a material capable of resisting tension forces to participate in the transfer of structural loads, to supplement defective or insufficient internal reinforcing in an existing structure. TFC is easy to place; it can be molded perfectly to match irregularities in the shape of the support, and increases the ultimate load and ductility of the structure.

A special case, the nuclear industry

NTS is a subsidiary of Freyssinet based in Marseilles and was originally specialized in the post-tensioning of nuclear power plants. Now that the years of construction have ended, NTS has specialized in working in potentially radio active environments. NTS masters all processes used by the Freyssinet Group, and performs various structural repair and strengthening works on behalf of EDF (Electricité de France) the French Electrical Distribution Authority. In a context where the need for safety of installations faced with seismic risks is increasing, Freyssinet has recently reinforced two thin steel plate tanks at Fessenheim power station in the Haut-Rhin region, France, by application of TFC belts – this is a previously unused application, since the process had only been used for concrete structures in the past.

caused by aging and exposure of structures to pollution. Régébéton, which is a process for concrete realkalinization & chloride extraction, was thus introduced and received two innovation awards in 2001, by Siemens and VINCI. The same dynamic explains the development of structural equipment (bearings, expansion joints) and very specialized construction processes.

This know how combines brains, reactivity and technical control, and makes the reputation of Freyssinet repair sites. Benoit Lecinq, Manager of Freyssinet International's Technical Department, told us that "this constant is based on a special division of the design office based in Velizy composed of engineers, and on technical departments in Palaiseau and Marseilles that provide methods and technical solutions to the Freyssinet France's eight Regional Operation Centers and teams responsible for sites in other countries. Except for Spain, England and the United States, where Freyssinet subsidiaries are each getting into the repair business in their own way, international sites are usually controlled by experienced expatriates of Freyssinet France, capable of training and supervising locally recruited construction teams". For about ten years, Freyssinet has thus been working in Eastern Europe, firstly in Romania and then in Kosovo, on strengthening projects for bridges built during the Soviet period, or the repair of bridges damaged during the war. Freyssinet is working on the shotcrete repair site for the Haivan railway tunnel in Vietnam, and its specialists are working in Libya to install additional circular prestressing to repair and strengthen potable water supply pipes (4.50 m diameter) that cross more than 1,500 km of desert.

"Much of the future of the repair business is in developed countries, said Philippe Zanker, where we know that about 1% of the value of all assets should be set aside for maintenance every year. These budgets are not yet mobilized even in "rich" countries, and the largest parts of budgets are still set aside for new works. But this situation could change with the coming of sustainability." ■

SOILS/**VAL-THORENS AVALANCHE PROTECTION**

309 jet grouting columns on a moun

Ménard Soltraitement selected the fast and economic jet grouting technique to build the foundations of an avalanche protection in the centre of Savoy.

A LARGE NUMBER OF ALPINE WINTER sports resorts nestling in the high valleys are connected to main highways by roads exposed to avalanches. This is the case of Val-Thorens, perched at an altitude of 2,300 m in the Vanoise mountains in Savoy, with an access from Moutiers along a departmental road. This road passes through a 300 m long corridor subject to avalanches and rocks falls at an altitude of 2,050 m, that road personnel need to clear regularly during the winter.

5,000 hours work

Faced with this situation, the Savoy General Council, with the assistance of the Société d'aménagement de la Savoie (Savoy Development Company), made the decision to build an avalanche protection in 2003. Construction of this reinforced concrete tunnel structure that is open on the lower side, was awarded to the GFC Construction – Ménard Soltraitement group, with GCF Construction doing the civil work and Ménard Soltraitement doing the soil improvements.

The structure is located on poor quality ground in which there are many springs and streams, and therefore Ménard Soltraitement proposed the column jet grouting technique that eliminates the need for deep foundations, so that surface foundations composed of foundation blocks and tie beams can be used. Ménard Soltraitement thus constructed 309 columns with a diameter of 80 to 90 cm at depths of up to 15 m with lengths varying from 5 to 11 m, between mid-October and the end of December 2003 in two and a half months (5,000 hours of work). These columns were then drilled in order to check their construction quality and to produce grouted oil tubes within them, in preparation for the civil engineering work.

PARTICIPANTS

- **Client:** Savoy General Council
- **Client consultant:** Savoy Development Company
- **Engineer:** BET Tonello IC
- **Civil Engineer works contractor:** GFC Construction
- **Specialized contractor:** Ménard Soltraitement

THE JET GROUTING SITE IN NUMBERS

- **1.500 m³** of injected cement grout
- **1.200 t** of binder
- **3.000 m** tonnes of oil tubes

This work was carried out in parallel with preliminary earthworks operations and the installation of anchor tie rods on the upper side of the site, and took place at the roadside without interrupting traffic, with alternating traffic on one lane. The civil work started in mid-April, with delivery of the avalanche protection planned for autumn 2004. ■

***Jet-grouting*, is a foundation construction technique that eliminates the need for earthworks, and can be used on a very small site that accommodates a grout batching plant and site facilities on a very small area. This advantage also made it possible to maintain single lane traffic to the resort throughout the duration of the works.**

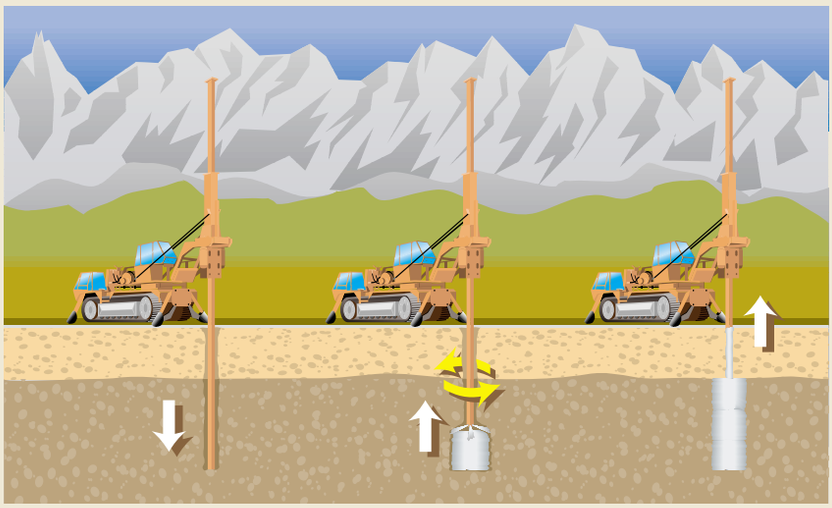
tain side

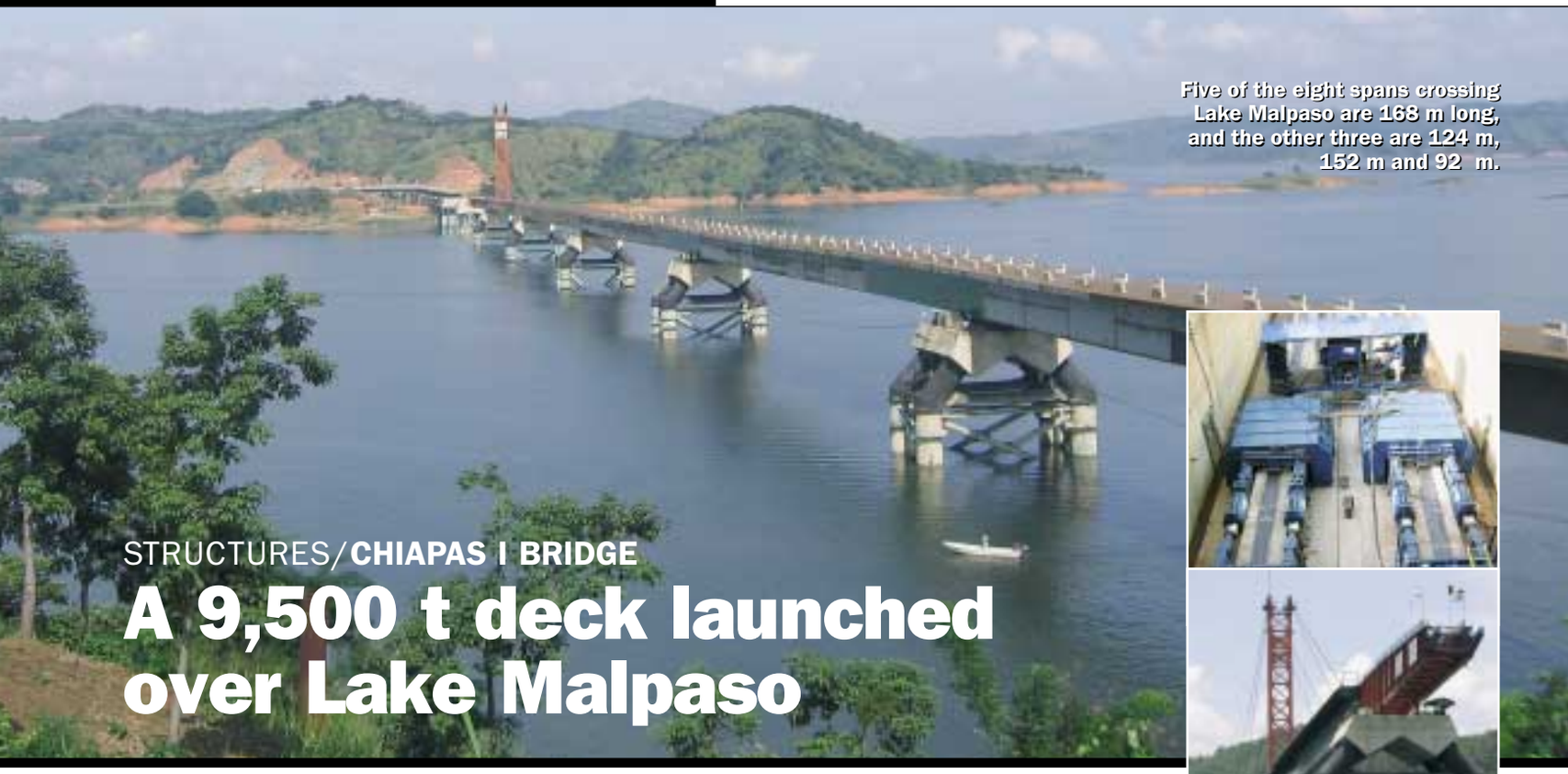
Consolidation in three steps

Treatment of ground containing buried networks or structures; construction of building or bridge foundations, tunnel headworks, work with limited headroom, foundation underpinning - there is a very wide variety of applications for jet grouting, usually in ground that cannot easily be grouted by conventional methods. In practice, the process consists of treating the soil in-depth; a high pressure cement based grout jet is injected (450 bars) to destructure the soil and transform it into a soil-grout mix with defined mechanical and dimensional characteristics.

Jet grouting columns are installed in three phases; design of the treatment; destructive drilling of small diameter (about 15 cm) boreholes down to the bottom level of the ground to be treated; construction of columns with a defined diameter (up to 2 m) by simultaneously tripping out and rotating the drill string.

Excess fines that rise up along the annular space and overflow on the downstream side of the production site are usually reused in backfill.





Five of the eight spans crossing Lake Malpaso are 168 m long, and the other three are 124 m, 152 m and 92 m.

STRUCTURES/**CHIAPAS I BRIDGE**

A 9,500 t deck launched over Lake Malpaso

Chiapas I bridge over Lake Malpaso, Mexico, has just been opened to traffic after more than a year of construction, to which Freyssinet de México made a major contribution.

THE NEW BRIDGE over Lake Malpaso behind Malpaso dam is the final link in the motorway connection from Mexico to Tuxtla Guterriez, and it de-isolates Chiapas. It is remarkable due to its 1,208 m long straight and flat deck supported on eight jacket type metal piers and a concrete abutment, and it is also exceptional due to its construction methods consisting of precast, placement of piers, and incremental launching of the deck.

The piers were assembled on an area set aside on the lakeshore about twenty kilometres from the site, and were floated and towed by boat to their final location. Four contractors worked on this operation, including ICA Ingenieria, the main contractor who made the floating design, Ultramarine and Oil State that designed the element transport system with ICA; and finally Freyssinet de México that supplied the handling material and performed displacement operations as part of a subcontract awarded by ICA.

Floating in three phases

The piers were constructed on two rails at a spacing of 20 m on the prefabrication area. Floating from this ramp took place in three phases; horizontal displacement of the structure using four hydraulic jacks with a unit capacity of 150 t; launching on the transition area (which had a radius of curvature of 60 m) and retaining by four jacks; finally on the last part, lowering into the lake by successive passes, using two jacks with a unit capacity of 300 t. Once the piers had been installed in the lake, incremental launching of the 9,500 t superstructure (a construction method entirely calculated and operated by Freyssinet de México from abutment No. 9) could be started. The system used included four jacks with a unit capacity of 800 t and four jaws, and temporary sliding bearings installed on abutment No. 9 and on the piers. The deck was equipped with a front steel launching nose and with a temporary 44 m mast supported by four pairs of stay cables, to compensate deck deformations under the effect of ambient temperature and its self weight. This system made it possible to land on the piers in complete safety by lifting the front steel nose during each incremental launching. Deformations in the horizontal plane were resisted by prestressing bars. A painstaking geometric check was carried out continuously during the launching phase, by the Engineering Institute at Unam (Universidad Nacional de México – National Independent University of Mexico).

At the end of launching and before lowering the deck to its final elevation, Freyssinet de México installed the final Tetron GG type bearings on each pier. The last service performed by the company was to supply and install Cipec WP type expansion joints at the two ends of the bridge. ■

PARTICIPANTS

- **Client:** Mexican Ministry of Communications and Transport
- **Main Contractor:** Ingenieros Civiles Asociados (ICA) SA de CV
- **Specialized Contractor:** Freyssinet de México, SA de CV

STRUCTURES/**KIEZMARK BRIDGE**

A solid combination

New combination of techniques on a Polish strengthening site

THE 1,000 M COMPOSITE steel-concrete structure crossing the Vistula in Kiezmark in northern Poland is one of the longest bridges in the country. The General Highways Division appointed Freyssinet Polska to strengthen the bridge, in co-operation with Freyssinet FIC technical department and the PPC production plant to provide a technical solution satisfying the requirements of the specification. The result was an innovative solution combining prestressing and stay cable techniques. "The tendons are composed of conventional, galvanized strands inserted in an HDPE duct, while the jaws and anchor blocks are derived from Freyssinet stay cables. This combination optimises strengthening" says Krzysztof Berger, the Freyssinet Polska General Manager. The stay cable technology was also used during the construction phase since the tendons were tensioned using the patented Isotension process, normally used for stay cables. A total amount of 40 t of prestressing steel was used for strengthening. ■

PARTICIPANTS

- **Client:** General Highways Division
- **Main Contractor:** the Mostostal Warsawa-Necso Group
- **Design:** WIK Gdansk design office
- **Specialized contractor:** Freyssinet Polska, in cooperation with Freyssinet FIC and PPC

SOILS/**OMAHA WHARF**

TerraClass gets its feet wet

A 445-HECTARE INDUSTRIAL wasteland on the bank of the Missouri river in Omaha, Nebraska, U.S.A., is the location of a 281 million dollar development program designed to revitalize the city. The highlights of the project include a conference centre, covering 23,225 m^2 and a Hilton hotel near the centre of the site. Stabilization of the banks of the river was required before various riverside developments could be started.

The group's American subsidiary, The Reinforced Earth Company, working in co-operation with Lamp Rynearson & Associates design office on a subcontract to Hawkins Construction company, proposed an alternative to the specified river bank stabilisation solution. Submerged walls built on driven piles supporting MSE (Mecanically stabilized earth) walls were replaced with a 10.6 metre high, partially submerged Reinforced earth structure with TerraClass cladding. ■

STRUCTURES/**SOLIGNANO BRIDGE**

Strengthening under traffic

SOLIGNANO BRIDGE IN THE PARMA REGION, Italy, carries national road 308 over the Taro River and the A15 motorway. This 8.40 m wide bridge comprises nine 30 m spans and was built in the 1950s, but needed repair. Freyssinet Italy worked as a subcontractor to the Dallara Costruzioni Company, and it's scope comprised strengthening and replacement of the fittings. Conventionally, the deck was strengthened by anchorage of new reinforcement, and some beams were strengthened by cold gluing of Carbon Fibre Fabrics (TFC). On the other hand, one variant studied by Freyssinet and the design office was selected for soffits, which were consolidated by additional prestressing using six unbonded strands per span, anchored into reinforced concrete blocks fixed by prestressing bars. This technique is attractive because it does not need any heavy handling systems.

Freyssinet used a lifting system to replace the bearings and expansion joints, so that it could complete the work without interrupting traffic on the river and motorway. ■

STRUCTURES/**FLOIRAC BRIDGE**

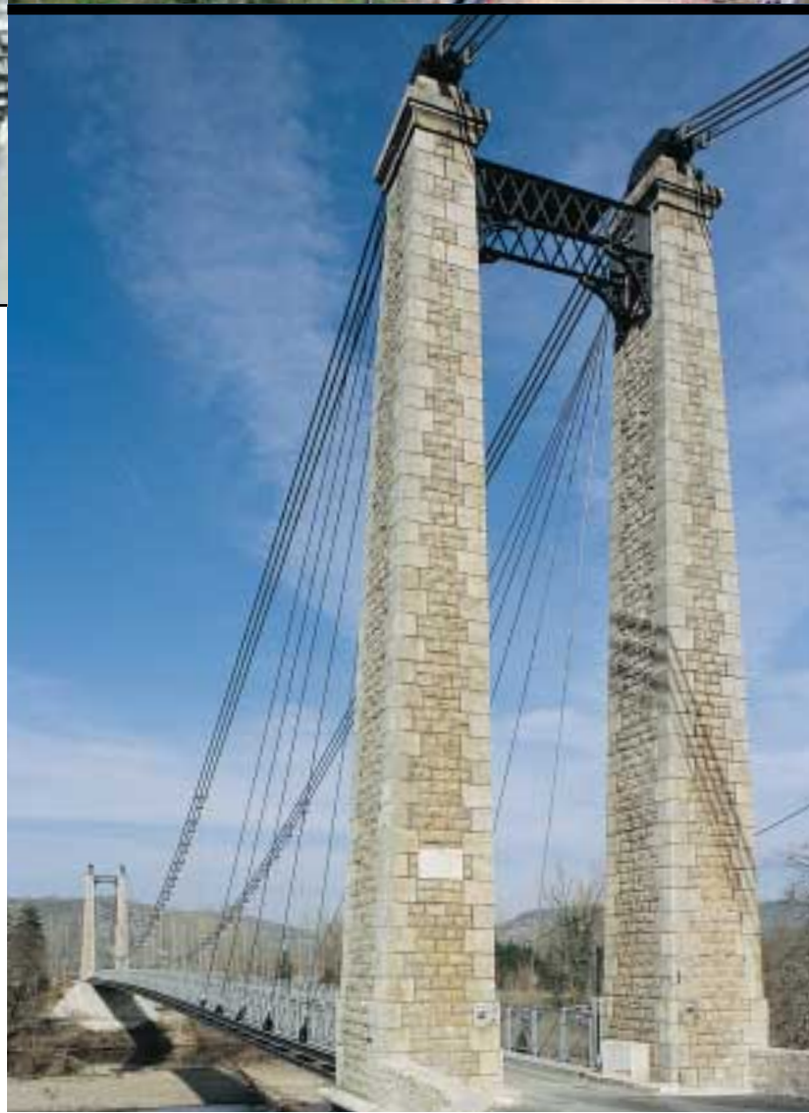
Ready for another 100 years

The Floirac Bridge, in France, soon to celebrate it's centenary was reopened to traffic after a year of repair and strengthening work.

MIRET BRIDGE over the Dordogne in Floirac, in the Lot region of France, is a 140 m long suspension structure built in 1912 and supported by 17 m high masonry towers. It has deteriorated over the years, and it became less and less capable of satisfying current standards. Thus, its load bearing capacity was only 1.5 t, and traffic on the old bridge had to be suspended in bad weather. Rejuvenation and strengthening had become necessary, since the Lot General Council wanted to increase the bridge's load bearing capacity to 3.5 t at the same time.

An innovative equipment

The job was awarded to Freyssinet France as the main contractor and work began in February 2003. It consisted of firstly redeveloping and strengthening existing anchor foundations using anchor tie rods and then disassembly and replacement of the entire deck and suspension. This was a wonderful opportunity to use the "temporary cables system" method, an all-new process developed by Freyssinet engineers and which had been awarded prizes at the VINCI 2003 Innovation competition. The temporary working cables are supported by the existing towers and are fixed on anchor foundations, and support a handling carriage used to put elements of the steel deck into place one after the other. After the disassembly phase, the same equipment is used to transport elements of the new decking before they are permanently fixed to the new suspension. "This solu-



PARTICIPANTS

- **Clients:** Lot General Council
- **Engineer:** DDE
- **Consultant:** Ingerop
- **Main contractor:** Freyssinet France

Freyssinet specializes in the repair of suspension bridges, and has developed a method derived from cableways for handling heavy loads over long spans.

tion was used once before on the Laroin footbridge, and also enables final geometric adjustment of the deck before attachment of the hangers and placement of the plating" says Laurent Bonnesteve, Freyssinet engineer. Miret Bridge was renovated two months ahead of the program and was inaugurated and reopened at the end of December, after the load tests were carried out successfully. ■

STRUCTURES/**MARINE PARADE BRIDGE**

Exemplary team work

The small town of Southport North of Liverpool, United Kingdom, has renewed its access to the sea front by construction of a new bridge incorporating the latest progress with Freyssinet stay cables.

THE OLD STEEL BEAM BRIDGE constructed in 1895 to connect Southport to its sea front was closed in 1990 for safety reasons and was later demolished, to make way for the construction of a new Marine Parade cable-stayed bridge. The Group's British subsidiary, Freyssinet Ltd, was appointed in early 2003 by Balfour Beatty, the main contractor responsible for construction, for the design, supply and installation of stay cables and prestressing of deck beams.

The asymmetric structure includes a single A tower (50 m high) above the 150 m long deck formed by a reinforced concrete slab supported on prestressed transverse girders. Two planes of stay cables support the central span (80 m) and the suspension comprises a total of 18 Freyssinet HD stay cables (each composed of 19 to 55 strands, with a total of 55 t of monostrands). All stay cable strands are individually protected to enhance the durability in the aggressive environmental conditions of the region, and the cables are inserted inside a white HDPE (high density polyethylene) pipe.

A simplified design

The solution proposed by Freyssinet included a very compact anchor system, so that the structure design could be simplified, particularly for the tensioning chamber. The need for upper guide tubes was eliminated, thus reducing difficulties and costs related to transport and assembly. The scaffolding was also simplified.

"The main difficulty with tensioning was the irregular arrangement of stay cables in the fairly slender tower" says Ian Campbell, the Operations Manager of Freyssinet Ltd. The problem was identified in advance, and a solution was found at the design stage through close co-operation between Freyssinet and Arcadis Paris (formerly EEG) in order to identify an optimised tensioning sequence and to verify that all forces could be resisted by the deck and the tower. Freyssinet's engineering department based in Vélizy, France, did the stay cable design, and the materials were supplied from PPC, the Group's factory. Stay cables were prepared in advance on the deck, in order to reduce assembly times and to respect the program. This organization made it possible to install all tensioned cables using the Freyssinet patented Isotension system in only four weeks, in January 2004. ■

PARTICIPANTS

- **Client:** Sefton town council
- **Consulting Engineer:** Babtie
- **Main Contractor:** Balfour Beatty
- **Specialized contractor:** Freyssinet Ltd.

STRUCTURES/**RIO TINTO WHARF**

Saved from corrosion

After several years of being abandoned, Rio Tinto wharf in Huelva, Spain, has been given a new lease of life, but the ore industry has been replaced by leisure activities.

RIO TINTO WHARF COMBINES wood, steel and fill, and forms part of the history of Huelva, witnessing the expansion of the mining activity in Andalusia, at the end of the nineteenth century. The structure is 1,165 m long and half of its length is within the Rio Tinto estuary, and it was designed and built by the English engineer George Barclay Bruce in 1875. It was put into service in March 1876 and used by the Rio Tinto Ltd Company that operated pyrite mines in the region; it was to make an important contribution to the Andalusia port's activities for more than 100 years before it was abandoned in 1980.

The structure was exposed to an aggressive marine environment and its condition deteriorated, until there was a threat that it might collapse. After several maintenance and renovation campaigns, in 2001 it was decided to transform the wharf into an area reserved for hikers and tourists, and the Freyssinet SA Company, the Group's Spanish subsidiary, was appointed to reconstruct the platforms on which wagons used to travel, to their original condition. Freyssinet SA has long experience with the restoration of old metallic structures (it renovated the Sagunto blast furnaces near Valencia in 1999), and it was particularly important to maintain as many original elements of the wharf as possible, and to replace only the most severely damaged parts by accurate replicas.

Elondo and eucalyptus for platforms

The work started in 2003 with the replacement of the steel lattice beams at the wharf lower level (143 t of steel) and to repair or reconstruct the most severely damaged steel sections of the structure (60 t of steel). The work continued by passivation of steel using a coat of zinc rich epoxy paint. The teams then reconstructed the wood platforms identically (constructed from elondo and red eucalyptus), composed of a grid of 4 to 7 mm thick, 0.20 m wide and 1.10 m long slabs on 300 m^2. All that Freyssinet SA needed to do after fitting the final elements - installation of stairs and accesses for the handicapped, installation of architectural lamp-posts, plantations, etc., was to make way for hikers and tourists. ■

SOILS/**CHICAGO SKYWAY**

An economic choice

Reinforced earth walls will replace the old steel viaducts on one of Chicago's access motorways, in the United States

THE 12.5 KM LONG CHICAGO Skyway is a toll motorway built at the end of the 1950s to provide access to the town centre from the east, and is now being repaired. This works program will continue until 2005, and it is worth a global amount of 250 millions dollars.

The selected procedure is to extend the life of the bridge by about forty years, while reducing maintenance costs. This will be done by replacing half of the steel viaducts by elevated roads supported on fill. Reinforced earth technique is well adapted to the economic part of the specification, and will be widely used on the new structure and has already been selected for the viaduct package in 106th street, in which it is planned to readjust the level of the road surface and to construct 11,000 m² of Reinforced earth walls to replace the existing structure and its entry and exit ramps. The company awarding the works, Riteway Construction Services, chose Reinforced Earth Co. to supply temporary and permanent Reinforced earth retaining walls, and for the precast parapets. This preference is justified by "Reinforced Earth Co.'s technical experience, commercial competitiveness and know how", says Matt McCoy, the Project Manager at Riteway Construction Services. ■

SOILS/**SAINT-AVOLD MINE**

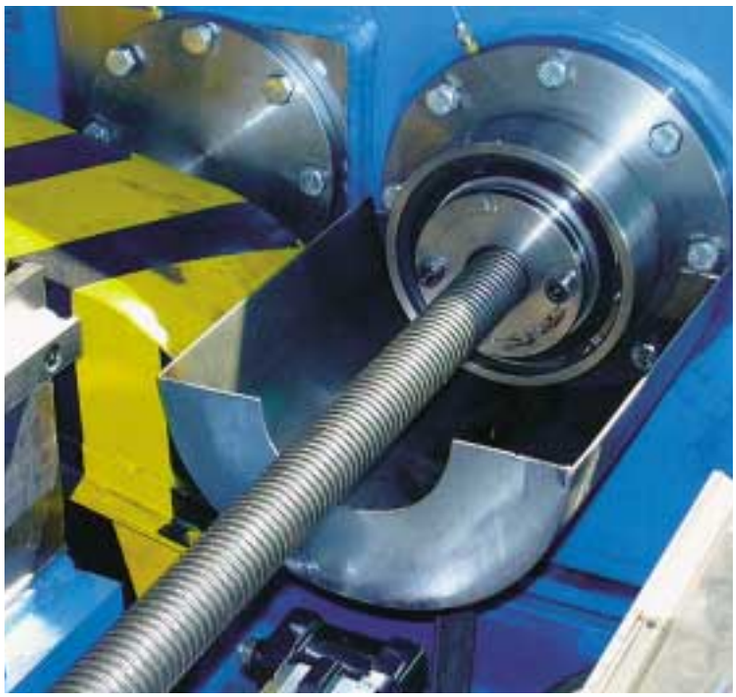
The remembrance shaft

SINCE THE "BLACK FACES" disappeared from the pit-bank of to Saint-Avold mine in the Moselle department 18 years ago, the only remaining trace of the intense activities carried out on the site between 1908 to 1972 and then from 1976 to 1986, is the headframe over the Sainte-Fontaine shaft. This structure is constructed above a 6.50 m and 1,040 m deep shaft, is classified in the supplementary inventory of historical monuments, and was used for the extraction of coal. The Lorraine coal mines have appointed Ménard Soltraitement to consolidate this shaft, and to prevent any collapse in this area. "We completed the ring beam between elevations –4 and –15 m under the elevator using a conical ring made by jet grouting" says Michel Bic, the project engineer at Ménard Soltraitement. The method chosen was the double jet method, in other words injection of pure cement grout assisted by a water jet, which gives a better control over the column diameters, namely a 7 to 14 m diameter and 1.3 m thick concentric ring surrounding the shaft.

Thus, the strengthening consists of 118 columns with a diameter of between 0.9 m and 1 m, drilled to a depth of 16 m in jet grouting, forming a 17 m diameter wall surrounding the shaft and stressed in compression only. A test phase was carried out near the site before the work started to define column characteristics and precise construction parameters, so that the work could be completed in two and a half months using a single jet grouting batching plant. ■

R&D

A new prestressing bar: Freyssibar



Fabrication benches are used for continuous threading of the Freyssibar bar

Freyssinet has long experience in research and development for metallurgy and threading, and has developed a new prestressing process called Freyssibar. It includes a complete range of bars threaded by upsetting over their entire length, obtained by cold drawing and fitted with all anchor, butt connection and coupling accessories. The field of applications of Freyssibar is very varied, starting from prestressing strengthening to anchor rods and including all applications using tensioned bars; prestressing of concrete elements (tower mast, deck top slab, etc.); pinning of concrete structures (pinning of external additional prestressing deviators); prestressed ground tie rods; anchors for bridge suspension cables (adjustment); connections of steel noses (prestressed assemblies); temporary segment hangers (lifting); hangers for mobile formwork travellers (lifting).

The first deliveries started in February 2004, and the first customers were delighted with them. Optimised steelworks before construction in a country rich in raw materials (manganese, iron ore, chromium, etc.) resulted in an excellent quality and competitive product.

The very strict quality requirements are not limited to the metallurgical composition and mechanical performances of the product, but they also with production equipment, with the fully automated 12 m drawing bench; continuous threading machine, tensioning machine in accordance with international standards. "We have designed and made new and specific machines for the product and we have defined manufacturing procedures, inspection and test specifications in order to provide our customers with an optimum quality product", says Alain Huynh, responsible for Project Control. All these efforts have resulted in impeccable quality validated by tests carried out in independent laboratories, and in accordance with the requirements of applicable European standards. ■

If you would like any further information or if you want to order a brochure, please contact Freyssinet at freyssibar@freyssinet.com.

The production plant: the threading machine in the foreground, and the drawing bench in the background.

EXPERTISE

Diagnostic of anchors on the Leman motorway

The Swiss National Roads Division of the Infrastructures Department in the Canton of Vaud hired Freyssinet Suisse to make a preliminary diagnosis and to finalize development of processes, before the 3,340 ground anchors walls located on the Vennes – Chexbres section of Leman motorway in Switzerland were inspected. Six walls with 26 anchors were thus thoroughly inspected in order to analyse the residual tension in the tie rods and to evaluate their condition and safety. The first phase consisted of marking and identifying anchor heads (several models used in construction). Freyssinet Suisse engineers then worked in cooperation with Freyssinet International and Co. (France) to develop two innovative systems of checking the residual tension in the cables by weighing, in other words by separation at the anchor heads. One of the systems was suitable for Freyssinet 12-wire anchor head models installed in 1969, and the other was used for 12T13 type anchors used in 1970, and both methods were successfully used to make the inspection without interrupting motorway traffic. ■

ENVIRONMENT

A well integrated site

Reconciling work and protection of the environment is a golden rule that we always respect in our activities and was strictly applied during construction of the suspension footbridge in the heart of Macritchie Natural Park in Singapore, and it largely controlled the design and methods used. Since the access trail stops 100 m before the construction site, all the materials had to be carried by hand. This constraint was taken into account by Freyssinet Singapore engineers, who decided to build the towers from small steel sections. Freyssinet also proposed to replace the anchor foundations by ground anchors; this choice reduced the volume of concrete to be used and risks of pollution. ■

QUALITY

Renewal of certificates

Freyssinet agencies in the Paris and Rhône-Alpes regions (France) were awarded the first renewals of their ISO 9001 version 2000 certificates, on February 1 and 5.

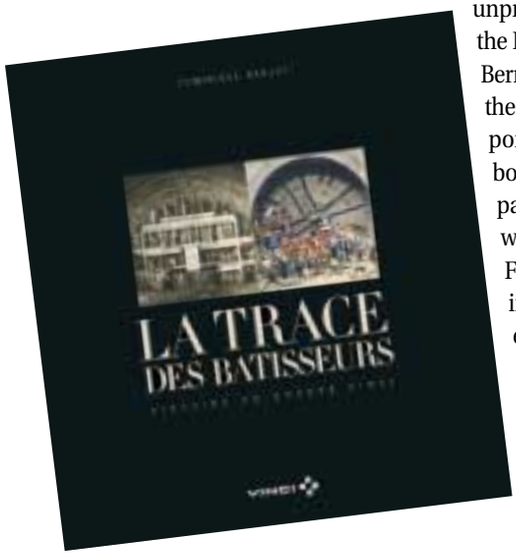
EDITION

A stirring page in the history of VINCI

La Trace des Bâtisseurs (In the Footsteps of the Builders) was published in late 2003 and it relates (in french) to VINCI's genesis through the history of its constituent companies. Its story is long and thrilling, since it follows the movement that began in the XIXth century, and continued throughout the XXth century through world wars, reconstructions, crises, nationalizations, etc.

This unique research work was carried out through co-operation set up between VINCI and the CNRS (Centre National de la Recherche Scientifique - National Centre for Scientific Research) in 1999, and Dominique Barjot, professor at Paris Sorbonne university and currently director of human and social sciences at the Ministry of Research, was asked to write the book.

In addition to 600 beautifully illustrated pages, including a summary table and indexes, the book mentions or retraces the history of almost 400 companies, without forgetting the men concerned. Obviously, Eugène Freyssinet takes the leading place as one of the most important players, since the prestressing revolution at the end of 1930s was the starting point for the unprecedented growth of the Entreprises Campenon Bernard Company, one of the five "founding" components of VINCI. The book also includes many pages describing Stup, which was to become Freyssinet International in 1976, and its leading engineers and recent history.



Available by order on the www.amazon.fr website. ■

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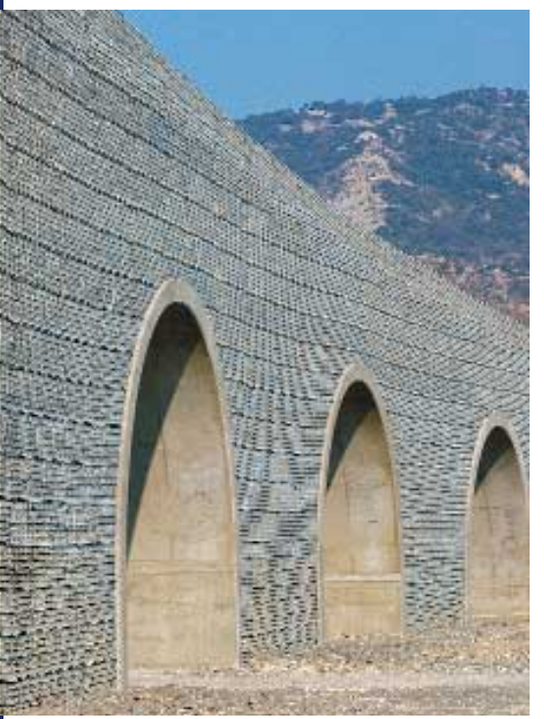
ZOOM
Steel grid facing for Valence ramp



Terre Armée SNC, has designed and supplied 14,840 m² of TerraTrel panels for retaining walls for the access ramp of the second Rhône bridge, now under construction in Valence in the Drôme Department in France. 14 arches designed to carry river floodwater pass through this 1,100 m long ramp that is up to 15 m high.

FREYSSINET

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