NEWS

THE VSL-INTRAFOR MAGAZINE • ISSUE ONE - 2001

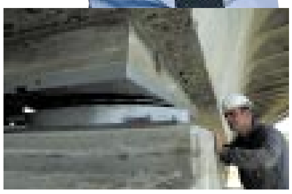
VSL

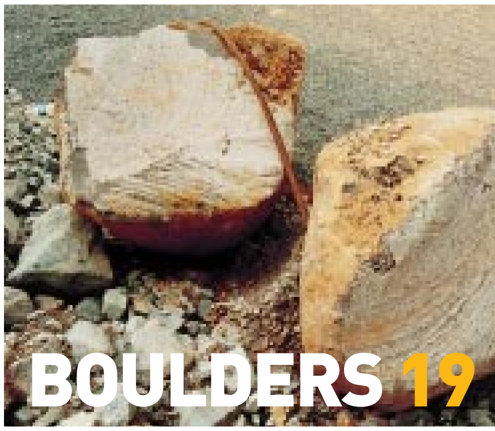
intrafor

Breaking new ground with Intrafor

Stays: the strand by strand method

highlights





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BY JEAN-PHILIPPE TRIN

EDITORIAL

A customer-oriented specialist platform

Our group has reached an important stage in its development. By pooling Intrafor and VSL resources, we have created a specialist platform that can offer its customers an extensive range of services in more than 40 countries. Our recognised expertise in high added value works, and our recent technological advances enable us to apply innovative and efficient solutions to our customers' complex projects. The Sucharskiego bridge in Gdansk, for example, demonstrates the efficiency of our new cable-stay system.

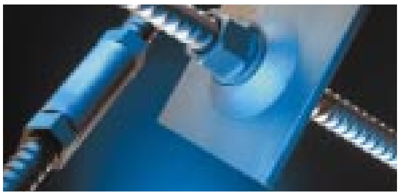
We are pursuing our R&D program with a view to developing new solutions that combine the use of diaphragm walls and post-tensioned floors. Car parks in urban zones are one of our main priorities. Backed by our network of engineers and technicians, we are able to successfully export a new technology across the world, giving main contractors a competitive edge to clinch new contracts.

VSL-Intrafor, which holds a leading position on its specialist markets, is standing by to take up the challenges set by its customers in their design departments.

VSL Bars

A promising beginning in Switzerland

→ **The VSL group**, in technical collaboration with the manufacturer Stahlwerk Annahütte, has successfully introduced the VSL Threadbar on the European market. The bar business is in constant progress ever since it was launched: 500 tons sold in 1999, 2,000 tons in 2000, +/- 3,000 tons forecast for 2001. Best seller is B 500 Ø 32 mm and the user list is growing: Spain, Switzerland, Germany, Portugal, Benelux, Taiwan.



As well as being used for rock bolts, soil nails and micropiles, this high performance Threadbar technology is also applicable to underground and tunnel construction operations. In many cases, its characteristics allow the diameters of B 500 standard quality bars to be reduced by a unit, resulting in more economical solutions for projects with similar strength and deformation parameters. ■

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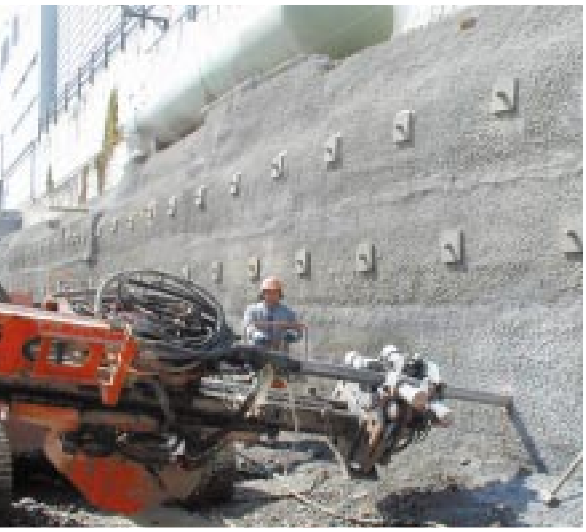


Ductal®

A rock-solid asset for VSL-Intrafor

→ **VSL – Intrafor is pleased** to announce that since March, Marcel Cheyrezy and his assistants Mouloud Behloul and Mireille de Buzelet, have joined the VSL-Intrafor network. They are responsible for the development of Ductal®, a product now entering into its operational use phase. While working for the Bouygues group scientific department, Marcel Cheyrezy carried out research on new concretes being developed, particularly ultra high performance concrete (UHPC) which is now being jointly developed with the French Lafarge and Rhodia companies under the name of Ductal®. The advantages of this high added value concrete are its great strength, attractiveness, extreme durability and the fact that it can be used without passive reinforcement, thus spectacularly reducing the thickness of structural elements.

Ductal®

Marcel Cheyrezy, Ductal Development Director

Superconcretes represent a major technological leap forward, allowing more daring, safe and attractive structures and buildings to be designed, while simultaneously cutting costs and construction time. Ductal® is being made available to VSL-Intrafor clients in a number of selected territories (initially Japan, Korea and Australia) to provide technical solutions combining the use of Ductal® and post-tensioning.

■ ***Contact: m.cheyrezy@bouygues-construction.com***

Vibroflotation
First application for soil improvement

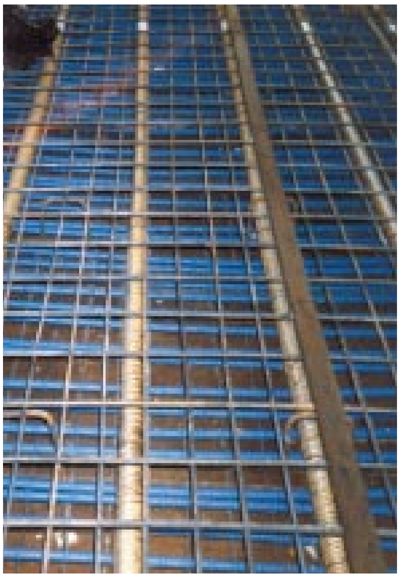
→ **The works for this project** in the port of Monaco involved laying fill on the seabed to provide a bedding for the caissons forming an outer breakwater. Vibroflotation is a technique often used in reclamation works. The treated fill settled by 8 to 10% of its depth with an increase of its relative density from 38% to 75%.

■ *Contact: c.lemonze@intrafor.fr*

VSoL
Breakthrough in Argentina

→ **VSL Argentina has been awarded** a first VSoL contract as part of the Rosario Victoria road link. This 60 km link between Rosario and Entre Ríos Province, across the Paraná River, will greatly improve traffic movements between Brazil and Argentina. VSL is responsible for the engineering and supply of 750 m^2 of VSoL walls for the abutments, using hexagonal panels. The main contractor is the Puentes del Litoral Joint Venture. The VSoL system was chosen for its technical performance and its competitive cost. A second project using 500 m^2 of VSoL walls is also underway. ■

Contact: vsldt@house.com.ar



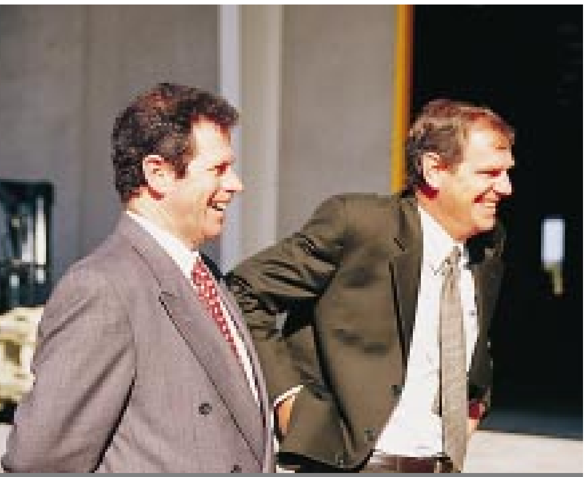
Foundation works in the network

Breaking new ground with

From left to right: Christian BESSON (Intrafor R&D), Jean-Philippe TRIN (CEO), Hans Rudolf GANZ (VSL R&D), Joëlle RANZINI (Legal), Thierry SERRES (Human Resources), Pierre DUSSAUZE (General Manager), Pierre BRON (VSL Marketing), Didier SOULARD (Finance).

By joining forces, both companies benefit from the other's expertise. Thanks to VSL, world post-tensioning leader, Intrafor now forms part of one of the most efficient networks in the construction market. Thanks to Intrafor, a major player in the special foundations sector both in France and Hong Kong, VSL has broaden its offering.

→ **Until now, VSL's geotechnical activity** was based on reinforced earth walls and anchor ties. With Intrafor, a company No 2 on the French deep foundations market – a sector that covers all construction fields: building, civil works, both in the public and private sectors and whether directly or subcontracted, VSL's product range has now considerably increased. This foundation market involves many small size contracts (certain pile contracts represent less than 30,000 Euro). In Asia, Intrafor's business volume is mainly in Hong Kong. Its activities include diaphragm walls, which are the company's core business, barrettes, and soil improvement projects. Intrafor is also developing specific foundation techniques such as instrumentation monitoring and vibroflotation.



The network's strength: shared experience, proactivity and communication. John Sindel, head of Australian operations, with Andrew Payne, responsible for Asia.

Shared technology

The very nature of these two companies means that they share common features, starting with their clients. VSL (approx. € 160.7 m turnover in 2000) and Intrafor (approx. € 118.7 m turnover in 2000) generally act as subcontractors to general contractors. They also have the same technological added value approach. The increasing level of shared research in the geotechnical and structure monitoring sectors will bring together engineers from both companies will contribute to developing new solutions.

Groene Hart in the Netherlands, a major foundations project: very deep foundations (20 m) without intermediate slabs, beneath the water table, anchored by 108 columns sealed into 52 metre deep barrettes.

In operational terms, the first result of this alliance was the creation of a single Central Management in January 2001, run by Jean-Philippe Trin and Pierre Dussauze. The resources and

Intrafor

teams of VSL in France and Intrafor are now together in the same building in Saint-Quentin-en-Yvelines. The teams in Asia will be brought together in Autumn 2001, creating a springboard for VSL throughout Asia.

Cross-corporate strategies

The initial development paths of this shared future have now been defined. A top priority is to create synergies in Asia to take advantage of the great potential that exists in China and India for infrastructure packages involving embankments and walls (VSoL®, Keystone), foundations and soil improvement works. Intrafor Branch S.A. works ▶

A competitive edge through combined technologies

VSL and Intrafor are merging foundation and post-tensioning activities to provide better solutions, money-saving methods, and efficient engineering.

Intrafor and VSL can combine their expertise in several fields such as open cut excavations in urban settings. Slab thicknesses can be reduced by using post-tensioning. This allows shallower excavations, decreased vertical and horizontal deformation, and more efficient transfer plates. Reducing the total height of excavations also reduces water pressure uplift on subgrades. Another field of application is Autofonçage. The pooling of Intrafor's usual cut & cover techniques and VSL's Autofonçage system will enable the companies to offer turnkey solutions for underground spanning structures such as underpasses (i.e. railway crossings). Interactions between post-tensioned slabs and soil supports, as well as between retained earth (VSol) and supports, are also possibilities. Ground anchors provide several areas for research: design, construction, durability and extractability. Last but not least, in-house laboratories of both companies have experts keen to develop their knowledge of grout mixes, mortars, and specific concretes, as well as instrumentation and monitoring techniques.

For the Caen water treatment plant foundations, Intrafor used a rheostatic concrete that permitted the installation of full height reinforcing cages for the 1,600 piles ranging in depth from 17 to 22 metres.

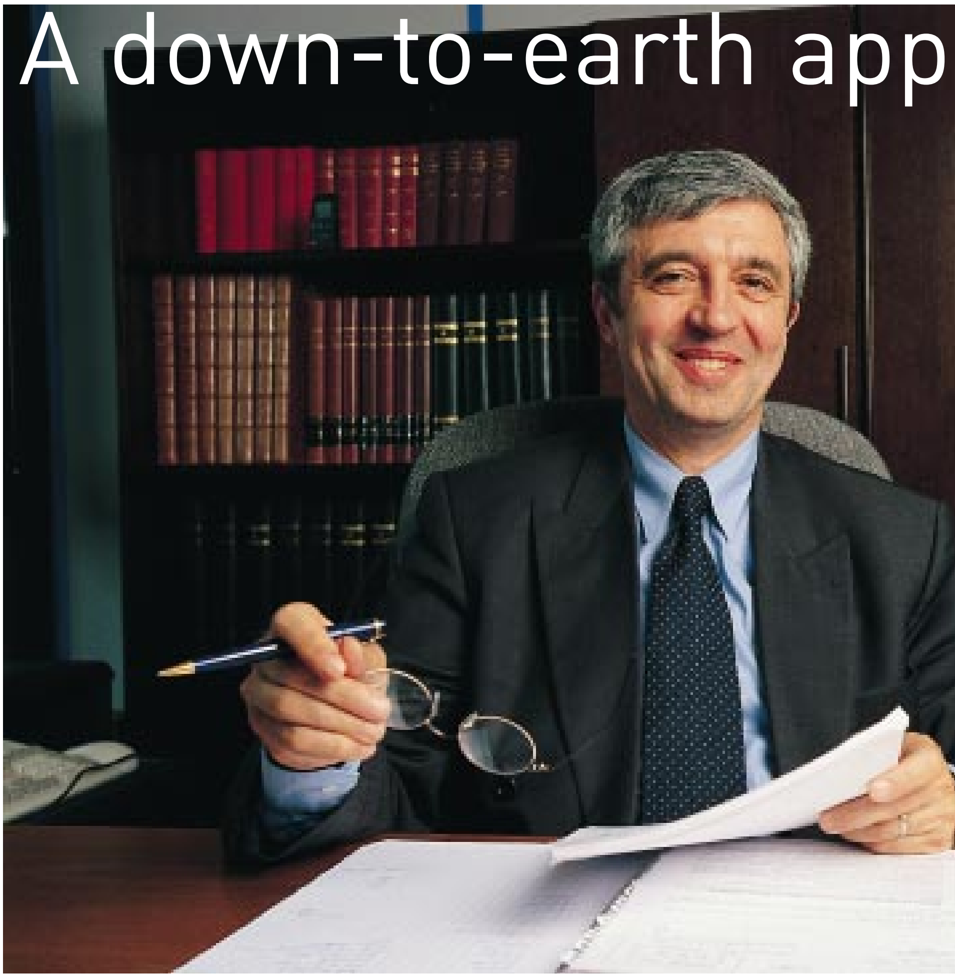
in Hong Kong on major projects, such as the Hang Hau Station (MTRC 601) and KCRC 300 now underway.
In 2001, Singapore should account for approx. 10% of the turnover. The use of the VSL network will also make it possible to market in selected European and Asian countries. Intrafor's new

VSL and Intrafor are now both connected to the same Local Area Network and share resources throughout the world.

marketing strategy is to implement cross-corporate flows between Intrafor and VSL profit centres, successfully manage large foundation projects in Europe, promote vibroflotation and soil improvement activities, and continue developing various foundation techniques such as continuous or secant piles, diaphragm walls, soldier pile retaining walls and soil-nailed walls. Major infrastructure tenders are also currently prepared. ■

Interview

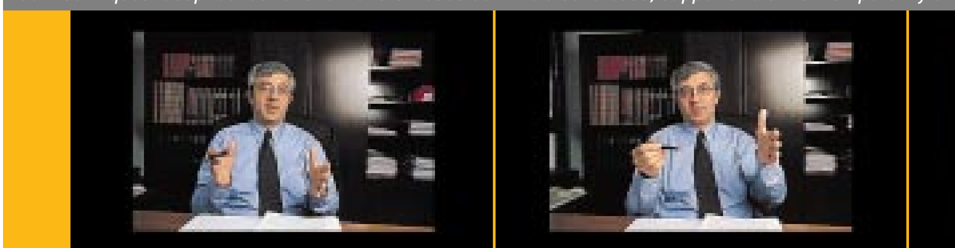
A down-to-earth app



While the skills of its engineering departments mean that Intrafor can be very involved from the earliest stages of a project - allowing it to suggest alternative solutions - its abilities are essentially based on the experience of those who are in the field.

Interview with Christian Besson, Intrafor R&D Technical & Plant Officer.

"Our techniques: deep foundations to transfer loads down to a solid base, supports to either temporarily or



What is the most appealing characteristic of your profession?
Christian Besson: The fact that it is highly technical and requires considerable field experience. We have learnt to expect the unexpected. You never quite know what you're going to come across. This, along with the vital role played by the workforce, is what makes the profession so attractive.

So how do you control the risks?
By making sure that we understand them and by constantly being on the lookout to react rapidly to any type of situation. In our business, once you've eliminated a few unreasonable solutions, you generally have to make the difficult choice between three or four different options. And the choice has to be made fast.

How do you make that kind of decision?
This is where experience comes into play. The more difficulties you've come across, the better you can cope because you've already run into the same problem. For example, if a site caves in due to a geological accident and if there's a risk of another collapse: the new situation is then fairly stable but any move could either improve it or make things worse and endanger life. As you can see, risk analysis is not just a technical issue. This is why it's vital to train young engineers.

What does it take to be a foundations specialist?
Generally speaking, you must be enterprising and sure of yourself, although this can occasionally lead to haste being mistaken for speed. You need to invest a great deal of time and be mobile given that operations are generally carried out over short time spans: between a week and six months, rarely more. And given the nature of the works, conditions are hard, so you need to be both level-headed and keen.

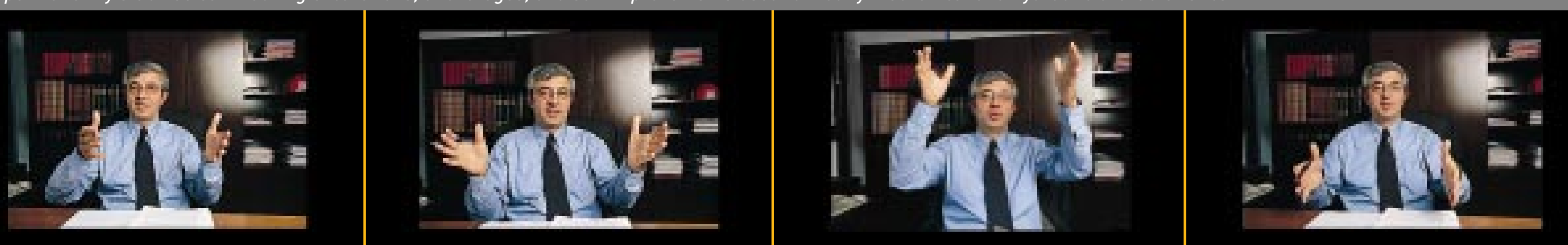
What are Intrafor's favorite technical fields?
Deep foundations to transfer loads down to a solid base, supports to either temporarily or permanently stabilise earth during excavations, anchorages, and the vast field of soil improvements used to modify mechanical and hydraulic characteristics.

How do you give added-value to engineering projects?
Unfortunately, new ideas don't constantly pop up and we aren't able to develop technologies every day of the week! But we try to keep this frame of mind in our everyday activities, particularly in R&D. It is essential to begin by clearly understanding what the client wants and, while fully providing this, be able to come up with an idea that he has not considered. The best technical solution is the one that is the most profitable, both for him and for us!

What are the technical links between Intrafor and VSL ?
Intrafor has been using wedges around strands – the VSL post-tensioning process – for ages. We are now working in areas such as post-tensioned slabs associated with the consolidation of support soils, and the protection of structures around excavation works. Thanks to the new network, we can provide a global solution, particularly for the repair and maintenance sector.

What kind of changes can be expected in your profession?
Our future lies in a better understanding of all aspects of the soil and we are working to improve our knowledge, particularly in automation technologies. We will also need to have highly qualified workers to operate sophisticated equipment. Our business is essentially based on those who are out there in the field, given that it is these people who analyse all the soil data collected during site works. It is not enough to simply know how to use a computer. If you don't pull on a pair of boots and go and look for yourself, you can't possibly know what's going on. ■

permanently stabilise earth during excavations, anchorages, and soil improvements used to modify mechanical and hydraulic characteristics".



Foundation techniques in

Specialized skills and equipment are used to control settlement, strengthen foundations, improve soil conditions and stabilise slopes.

DEEP FOUNDATIONS

Driven piles: Steel H-section beams or thick-walled tubes are hammered down as far as possible to provide foundations in soft soils.

Barrettes: large rectangular section piles constructed using a grab bucket on kelly or cables, or 'hydromill' cutters. Barrette section is not dependent on the dimensions of the grab or cutter and can take many forms (e.g. a cross). Using a cutter, hard ground can be excavated to depths of 100m with very little vertical deviation. To complete the barrette a reinforcement cage is installed and the barrette concreted.

Bored piles: concrete pile of varying depth and diameter, reinforced with a steel cage. The founding depth required to meet the bearing load specifications is calculated according to soil characteristics at different levels. A number of drilling methods can be used. Maybe required to construct down to or into rock.

Micropiles: small diameter reinforced piles that are drilled and grouted to support structures in all ground conditions where only limited room is available for drilling rigs. These piles can accept working loads of up to 300 tons and be drilled to depths of around 60 metres. Used for structural support (underpinning existing and new structures, settlement prevention, seismic retrofit...) or for in-situ reinforcement (settlement reduction, structural stability, slope stabilization, soil mass strengthening)

CFA or PIP: A continuous boring auger is used to drill a pile (typically <1m diameter). Concrete is placed through the auger as it is withdrawn and finally a reinforcement cage is installed.

SOIL INVESTIGATION

Investigation: to determine soil characteristics by seismic investigation, penetrometers, drilling, crossholes and in situ tests (pressuremeter, inspection, gamma density, permeability...).

RETAINING WALLS

Diaphragm wall: retaining, supporting and/or water proofing wall e.g. a basement. A trench is constructed using a cable suspended grab or 'hydromill' cutter. A reinforcement cage is then installed and the trench concreted.

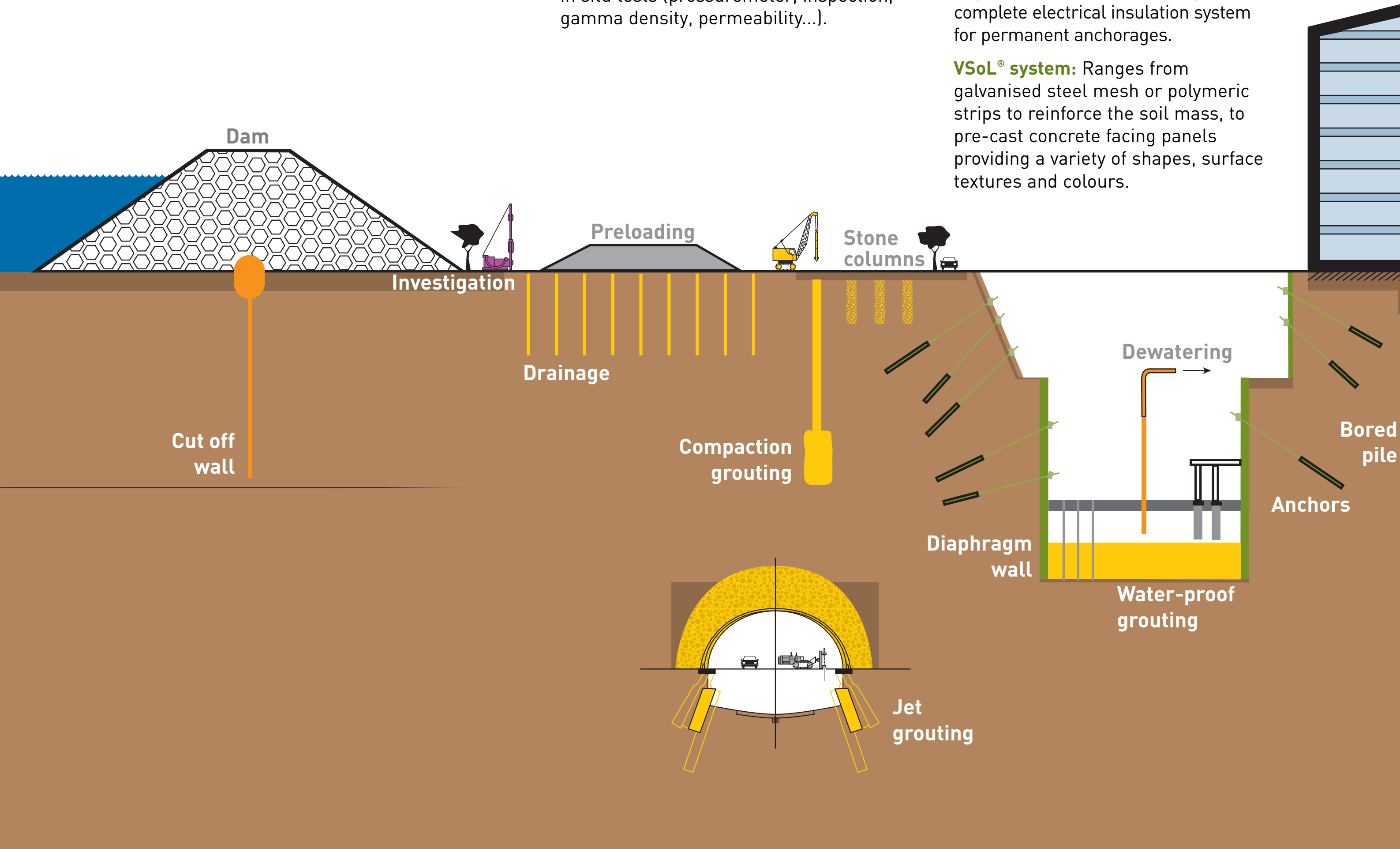
Precast Diaphragm wall: constructed using prefabricated elements to improve water tightness. Water-stop joints are filled with grout to give a good seal.

Nailed wall: retaining wall utilising anchors for support.

Berliner wall: non-continuous wall constructed from piles to retain excavations.

Ground anchor (or tieback): drilled and grouted, post-tensioned (stressed) passive or active ground reinforcement system providing resistance to uplift and lateral forces, used for retaining walls, buildings, bridges, dams, unstable slopes and to prevent water table uplift. Taking the form of strands or bars, the system can be temporary (during the construction phase) or permanent. VSL has developed a complete electrical insulation system for permanent anchorages.

VSoL® system: Ranges from galvanised steel mesh or polymeric strips to reinforce the soil mass, to pre-cast concrete facing panels providing a variety of shapes, surface textures and colours.



the field

SOIL IMPROVEMENT

Drainage and preloading: to consolidate compressive soils, before building construction, using vertical drains (to eliminate water and gas) and a certain height of fill acting as a preload, to be removed after consolidation. Atmospheric consolidation is when the fill load is replaced by applying a vacuum between a membrane and the soil to create the necessary pressure.

Soil mixing: mixing in-situ existing soil with additives (cement-lime) to obtain semi-rigid inclusions.

Dynamic compaction: Lift and drop a steel weight. Simple! For granular soils under uniform loaded areas.

Vibroflotation: soil compaction by vibration. A vibrator penetrates to the maximum soil depth and is then withdrawn step by step (typically 0.5m intervals) to allow gravel to flow into higher density positions at each step. Additional material is often required to compensate for loss of volume due to the increased density.

Stone columns: columns made of compacted gravel to reinforce and drain a cohesive soil. Compaction in not the primary goal.

Wet stone columns: flushing a hole with a vibroprobe and then creating a column by pouring gravel from the top. A widely used, fast and low-cost soil improvement method.

Dry stone columns: introduction of gravel at the bottom of the hole through a separate gravel duct alongside the vibroprobe.

Grouting: controlled injection of a self - hardening mix (grout mixes can include clay-cement, bentonite cement, mineral gels, organic resins) through drilling rods into the soil. This system is used to fill cavities and cracks, as well as strengthen and/or waterproof the soil. The spacing of injections is determined by local conditions.

Compaction grouting: Stiff, low mobility grout is slowly injected into loose soils, displacing and compacting the surrounding materials. Rather than being absorbed by the adjacent soil, the grout forms a "bulb" that compacts and increases the surrounding soil density by forcing it to occupy less space. This technique is used to control the settlement of existing foundations, improve soil conditions prior to new foundation construction, lift or align structures, increase soil bearing capacity and eliminate voids.

Jet grouting: using a high pressure jet, this system restructures the soil by introducing a cement grout that forms a hardened mix with the existing materials.

Soil freezing: to improve soil strength and tightness when excavating beneath the water table, using brine or liquid nitrogen.

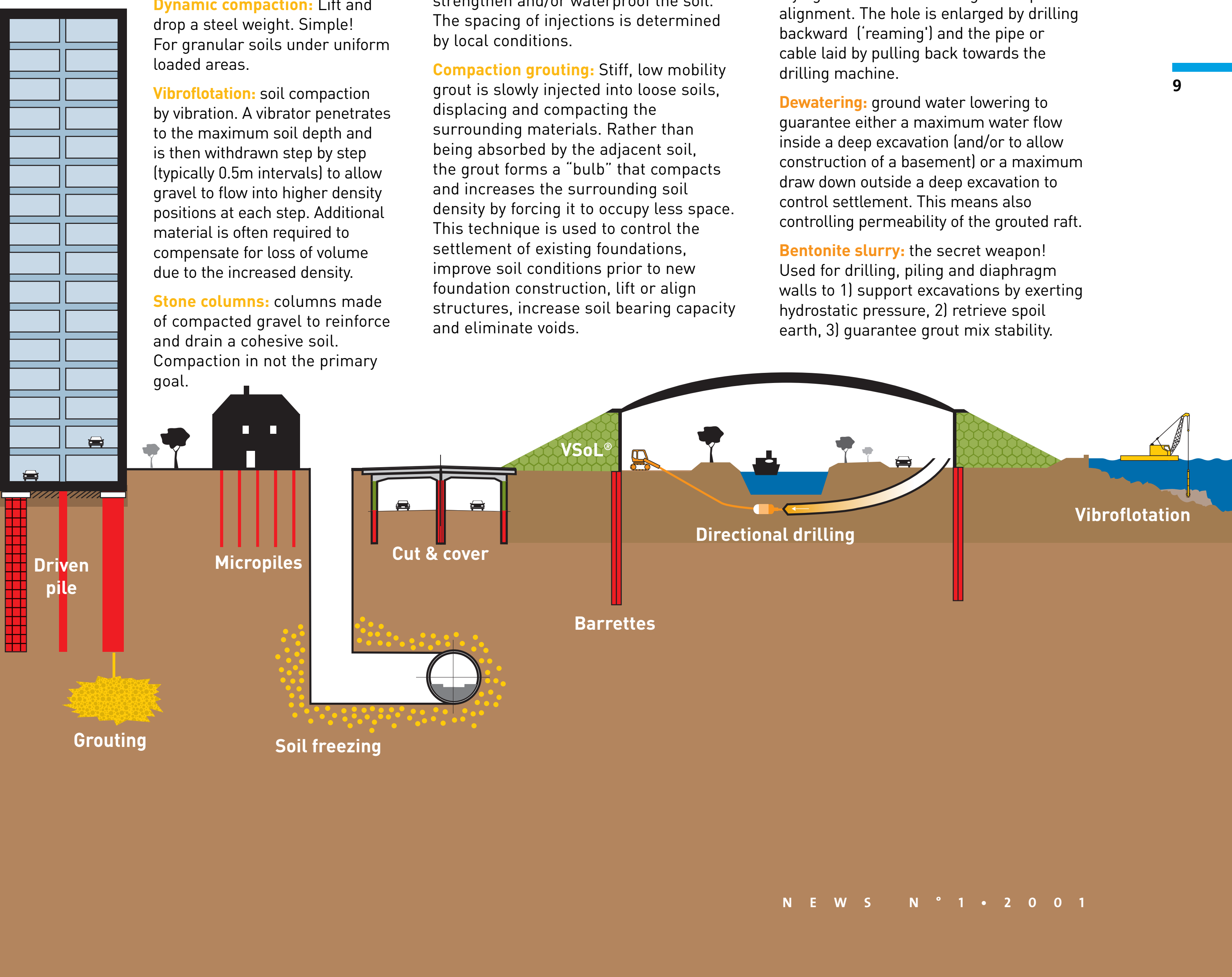
OTHERS

Cut off wall: watertight grout curtain wall in alluvial deposits beneath an earth dam.

Directional drilling: For pipe or cable laying. A hole is bored along the required alignment. The hole is enlarged by drilling backward ('reaming') and the pipe or cable laid by pulling back towards the drilling machine.

Dewatering: ground water lowering to guarantee either a maximum water flow inside a deep excavation (and/or to allow construction of a basement) or a maximum draw down outside a deep excavation to control settlement. This means also controlling permeability of the grouted raft.

Bentonite slurry: the secret weapon! Used for drilling, piling and diaphragm walls to 1) support excavations by exerting hydrostatic pressure, 2) retrieve spoil earth, 3) guarantee grout mix stability.



Japan

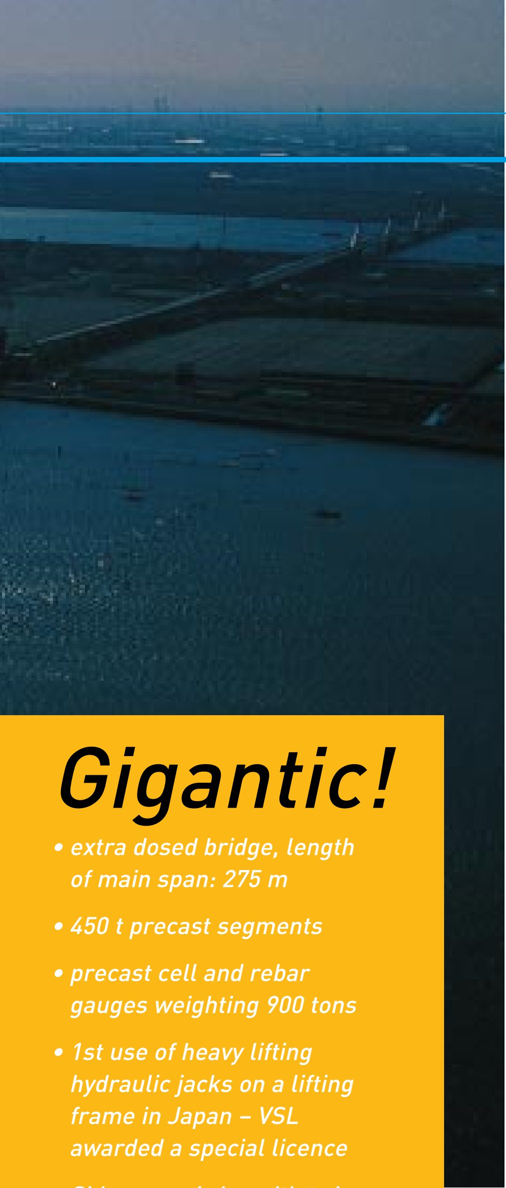
World record for extradosed bridge

→ **The "K1" Kisosansen Bridge Project** is now completed and VSL has successfully met the challenge presented by the side span erection. This critical final phase of the construction was the most important part of VSL's contract with the P.T.Y. (PS-Taisei-Yokogawa) Joint Venture.

VSL began the erection works and launched the side span girder onto the deck in July 2000. The 3,000 tons of equipment was delivered by barge, this being the only way to transport the very large components to the bridge site. A floating crane (300 tons) was used to lift each side span girder member into position. The standard cantilever arm was completed following several weeks of erection works using the existing lifting frame on one side of the cantilever and the side span girder on the other. The side span erection was carried out using the "Span by Span" method. The 12 segments, weighing a total of around 5,000 tons, were hung from the girder in October. This was followed by the closure pours and casting at each end, allowing the temporary stay cable release to take place in early November. After completion and load transfer to the bridge, the side span girder was launched back to its original position above the sea and then dismantled over a period of several weeks using the floating crane. The initial one week erection cycle which included the temporary stay cable installation was reduced to three days.

VSL had previously been awarded two other major sub-contracts for the same project: one for the design and supply of the formwork and lifting frames, and the other for geometrical control, technical assistance for the formwork erection, and technical management on site. The design, fabrication and commissioning for this technically challenging project, requiring close collaboration between Europe and Asia, was managed by Dominique Droniou, Project Manager. ■

Contact: ddroniou@vsl-hk.com



Gigantic!

- extra dosed bridge, length of main span: 275 m
- 450 t precast segments
- precast cell and rebar gauges weighting 900 tons
- 1st use of heavy lifting hydraulic jacks on a lifting frame in Japan – VSL awarded a special licence
- Side span girder with twin stay cable beams weighing 3,000 tons
- Between Singapore (TCAA) and Paris (TPMP), 30,000 hours of design work
- 2,000 fabrication drawings
- 3,200 tons of steel manufactured in China
- 280 containers shipped to Japan

Taiwan

A High Speed Train project on the starting block

→ **The VSL-Rizzani de Eccher Joint Venture** is constructing the new 20 km viaduct for the Taiwan High Speed Train Project (C215).
The launching carrier is being designed in Europe.
The formwork is being designed in Italy and will be fabricated in Taiwan. The VSL-Rizzani de Eccher Joint Venture is subcontractor to the Obayashi (Japan) Fu Tsu (Taiwan) Joint Venture for Lot C215.
This challenging project (over US$ 40 million) is scheduled for completion by December 2003. ■
Contact: ddroniou@vsl-hk.com

Taiwan

A new viaduct design

→ **VSL Taiwan was awarded** the subcontract work for the construction engineering and segment erection works of this project (C310) designed by Sinotech Engineering Consultants Ltd. with Jon Engineering Corporation as Main Contractor. VSL's scope of works includes the design of the segment casting yard layout, supply and installation of the post-tensioning system (over 2,200 tons), and erection of the segments using the balanced cantilever method with an overhead launching gantry. Being the first of its kind in Taiwan, a great deal of interest was shown in the project, especially in the viaduct erection system.
The project consists of 2 parallel single cell viaducts (3,000 m long). Each viaduct has a typical width of 16.1 m and depth of 3.5 m. There are a total of 99 piers with heights varying from 32 m to 40 m.
To maximize site production, VSL is using a heavy stitch beam spanning across the cantilever ends prior to casting the closure segment at mid-span, and has strengthened the front leg of the launching gantry. These changes have led to improving the erection cycle time.
The double deck erection configuration is being used because the north and southbound lanes are both on a parallel deck. Segment erection began in May 2000 and completion is expected by early 2002.
■ *Contact: mpaice@ms37.hinet.net*

Argentina
Massive ground anchor concentration

→ **In order to reduce** serious flooding in an area affecting over 3,000,000 people, works are being undertaken to channel and increase the width of the Reconquista River north of Buenos Aires. IECSA awarded VSL a first subcontract for four railway bridges. VSL´s scope of works includes the supply and installation of PT components. This project is the first time in Argentina that corrugated ducts have been used to improve the fatigue resistance of bridge tendons. VSL was also awarded a second subcontract by CIMARG to supply PT components for 840 permanent ground anchors. This project will represent the largest concentration of ground anchors ever installed in Argentina. ■ *Contact: VSL Sistemas Especiales de Construccion Argentina S.A*

Philippines
Synergies in vibroflotation project

→ **VSL carried out its first vibroflotation project in the Philippines.** Using Intrafor's expertise, ground stabilizing activity was carried out in the busy and luxurious South Harbour area in the heart of Manila City. The main contractor was FF Cruz, using Advanced Foundation as its sub-contractor. A total of 1,846 stone columns with a depth of 16 meters per column were required to complete the first phase of the project. Works began on January 31, 2000 and were completed on April 04, 2001. ■
Contact: mphillips@pacific.net.ph

Philippines
Post-tensioned works at Manila's new airport

→ **The new Ninoy Aquino International Airport** (NAIA) Terminal III project (US$ 500 million), being built using a B.O.T. scheme, was awarded to Takenaka Corporation. VSL was awarded the design and post-tensioning works for levels 4 and 5 of the main terminal building. The structure is typically a flat slab (200-300 mm) spanning 9 m using S5-4 tendons. Over 53,300 m^2 of floor area will be constructed using 290 tonnes of post-tensioning. ■ *Contact: mphillips@pacific.net.ph*

Abu Dhabi
VSoL walls add camel humps to desert highway

→ **VSL Middle East** has recently completed the design and supply of VSoL polymeric walls for contracts 1 and 2 of the new Abu Dhabi to Dubai Trunk Road. During the project design phase, it was realised that the new road alignment would cut across traditional camel routes in the desert areas. The VSL solution to this unusual problem was to construct two camel-crossing underpasses using the cost effective VSoL polymeric wall System. Final design of the camel crossings comprised a reinforced concrete box structure to form the underpass with VSoL walls supporting approach ramps up to 9.0 m high and designed to take full containment crash barrier loading. Working closely with main contractor Copri Construction Enterprises,VSL Middle East supplied 8000 m^2 of VSoL wall on the project undertaken for the Abu Dhabi works department. ■
Contact: Stephen Burke.

Australia

Deep excavations

→ **With a 22 metre deep** footprint covering an area of 5,000 m^2, the MacArthur Centre development is a major excavation and shoring project in Brisbane's central business area. L & D Contracting Pty Ltd, earthmoving contractors, sub-contracted VSL to carry out the installation of 900 temporary ground anchors (up to 2,200 kN working load), and 2,400 m^2 of sprayed concrete panels for retention of the upper levels of weathered rock and clays.
The 22 metre deep excavation is predominantly through fresh phyllite (shale) rock with weathered clays in the top 3-5 metres.

Anchoring and sprayed concrete wall construction to the upper levels was carried out using an alternate excavation slot and rock buttress technique to maintain the excavation's stability. The project required anchors to be drilled to clear existing services below the road and adjacent structures.
The load transfer of the large anchoring forces is operated by sprayed concrete panels in the weathered rock areas, and by isolated sprayed concrete pads in the fresh rock faces.
One of the major design requirements was the preservation and protection of two Queensland Government Heritage listed buildings around the site.
Extensive anchoring through temporary structural concrete underpinning walls was required and restraint beams were fully anchored to the bed rock. ■
Contact: bcavill@vslsyd.aust.com

Chile

30,000 m^2 of joint-free slab!

→ **VSL 's efforts to promote** post-tensioned ground slabs in Chile have met with an unexpected success: covering 30,000 m^2, the 15-cm thick ground slab for the new Nestlé company distribution plant represents a world record for a joint-free slab. VSL's scope of works included the slab design, the supply of post-tensioning materials and their installation, as well as the general coordination of the construction sequences.
Given that this was the first ground slab post-tensioning project in Chile, initial testing was carried out for the client, La Casa de Piedra S.A. (the building owner).
On completion of tests, the area was divided in 32 sections, each providing three metre wide pour strips. The concrete was laid from the centre reaching outwards in a radial form that allowed two teams to work simultaneously, one on each side, without interruption.
The work was completed in 1.5 months with daily pours of approximately 600 m^2.
The main contractor for this job was Constructora Inarco S.A.
■ ***Contact: aavend@vslchile.cl***

NOTE PAD

***Seven launchers!** To erect the 8,500 segments over 10.9 kilometres on the new railway line from Hong Kong to the New Territories, the KCRC project (sections 201 and 211) is using no less than 7 launching systems and 2 form travellers.*

***More from KCRC.** Working with the Necso-China State-Hip Hing JV, a VSL-Freyssinet Joint Venture has been awarded a HK $150 m contract on the KCRC East Rail network (TCC200 & 300). The works are scheduled for completion in September 2002.*

***Accurate loading.** AUSPAC is researching a method to measure the anchorhead load of an unbonded tendon using an accurate electronic micrometer.*

***Recycled launch girder.** To erect the segmental balanced cantilever bridge for the impressive 2nd Freeway Extension project in Taiwan (C310), VSL is using the launching girder assembled in Hong Kong for the Hung Hom bypass. This girder, launched in 1978, was also used for Rambler MRT 510, Chung Ching Viaduct, Rambler Channel and Kwun Tong bypass projects in Hong Kong, and the St Maurice Viaduct in France.*

***Pollution-free injection.** Intrafor is consolidating an aqueduct in France's most famous forest, Fontainebleau. The works involve filling the external voids in the structure, waterproofing and injecting the interior cracks. The injection plants are directly linked to a water pollution detection system (turbidimeter).*

***Hola!** VSL IPSALA has moved its offices to a new address in the heart of Barcelona:*
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Malaysia

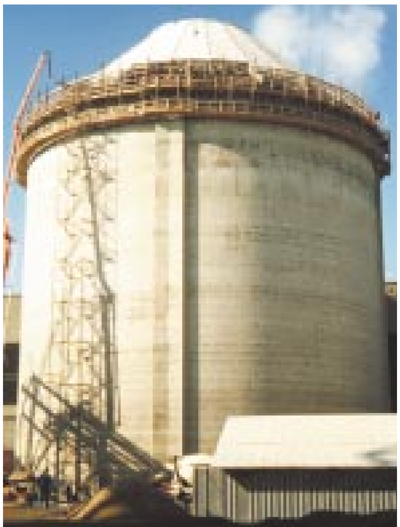
An elevated riverside highway in Kuala Lumpur

→ **The main aim of the Ampang – Kuala Lumpur Elevated Highway** running from the centre of Kuala Lumpur to the north-east suburbs of the city was to elevate the outdated Jalan Ampang roadway, being the only major feeder road from the area to the city. This highway is also the first elevated highway in Malaysia to be built along a riverbank.
VSL used the match-cast segmental method for the construction of this 7.4 km long highway which comprises 335 spans and 4,445 segments. The viaduct includes 13 ramps. The general span length is 45 metres although there are also a number of special spans with lengths of up to 53 metres. VSL's scope of works was the supply and installation of post-tensioning, the operation of three erection gantries and providing construction engineering services. The overall project was successfully completed by the end of 2000.
■ *Contact: vslma@po.jaring.my*

USA

Post-tensioning for a cement clinker silo

→ **VSL recently completed work** on a particularly large (40 m diameter, 48 m height) silo for the Ash Grove Cement Company in Chanute, Kansas. Post-tensioning was chosen as the primary hoop reinforcement for several reasons given that slip form construction demands massive levels of manpower for a relatively short period. Reducing the quantity of mild reinforcement contributes to maximizing the slip rate and minimizing the manpower, leading to the post-tensioning being removed from the critical path of the slip. This decreased amount of mild reinforcement congestion also results in higher-quality concrete placement and more accurate positioning of the mild reinforcement and post-tensioning ducts. VSL's scope of works included optimising tendon sizes and spacings, providing the post-tensioning system, pushing the strands into the ducts, and stressing and grouting the tendons. ■
Contact: bgallagher@structural.net



USA

50% reduction in pours for tunneling works

→ **The Route 29 tunnel,** which is a bypass around Trenton city centre (NJ) is believed to be the first longitudinally post-tensioned, cut and cover tunnel constructed in the United States. The use of post-tensioned concrete increased the pour length to 30 m, reducing concrete pours by 50%. The 700 m long concrete tunnel stands 6 m tall and has a maximum width of 39 m. The original design concept was conventionally reinforced concrete with 15 m pours for the floor slab, roof slab, centre and east wall. VSL, working closely with the PKF-Mark III/NCI JV and Frederic R. Harris design-build construction team, was responsible for the west wall lying alongside the Delaware River, which uses 760 mm square columns spaced at 6 m centres. The base and roof slabs have a maximum thickness of 915 mm and 760 mm respectively at the centre wall haunch. The walls have a maximum thickness of 610 mm. The floor slab, centre and east wall were designed using VSL 5-12 and 5-19 longitudinal tendons. The roof slab is post-tensioned by 5-19 longitudinal and 5-31 transversal tendons. The use of VSL K couplers allows the post-tensioned system to be continuous across each construction joint. VSL's scope of works includes design services and the installation of the post-tensioning. Completion of the tunnel construction is scheduled for summer 2002. ■
Contact: bgallagher@structural.net

Australia

Thin slabs for big ambitions

→ **VSL has proven its capacities** in Australia with the completion of the Austrack project. This is an intermodal rail freight station set on a series of ground slabs able to accept the repeated passage of forklift trucks with axle loadings of up to 80 t. VSL designed the entire structural slab system and installed 160 tonnes of post-tensioning last April. Ground slabs provide an alternative to reinforced concrete solutions and VSL tendons axially compress the concrete, meaning that the slab thickness can be reduced by 30% without requiring additional reinforcement. The result is large joint and crack-free surface areas. This solution could well represent a new opening for foundation works and post-tensioning in building design in Europe. ■ *Contact: ccheong@vslmelb.aust.com*

Germany

Customized slide

→ **One of the main links** between Germany and Poland is the Oder bridge in Frankfurt-Oder. Given the steadily increasing traffic levels, the decision was taken to replace the old bridge. The new bridge was built in a temporary position alongside the old one, just in front of the existing customs building. This required the moving of the customs building to a new location to provide access to the construction site and permit a subsequent temporary traffic diversion onto the new bridge. VSL Heavy Lifting was awarded the sliding contract by the German contractor Porr. The 300 tonne customs building, a steel structure with large glass windows, was initially lifted by 0.2 m. It was then slid by 0.5 m to the east in order to separate it from an annexe building. This was followed a 21 m slide to the south and then a 35 m slide to the west. The operation was successfully carried out in the first week of March 2001. The building will be returned to its initial position at the end of 2002. ■ *Contact: ftrenkler@vsl-schweiz.ch*

Korea
A roof for the Football World Cup

→ **In 2002**, France will have to defend its football world champion title in Korea and Japan as these two countries will be hosting the next World Cup. A number of new stadiums are now under construction for this purpose and one of them, the new Pusan Stadium located 600 km to the south of Seoul, will also be used to host the 2002 Asian Games. VSL was awarded the contract by Pfeifer of Memmingen, Germany, a leading cable roof structures specialist. The first stage involved lifting the complete roof structure off the ground using 48 SLU-70 units. Once this was completed, the upper radial roof cables were pinned into position. The second stage, being

the tensioning of the roof structure required the installation of an additional 48 SLU-120 units. During this phase, the pulling forces were rapidly increased until the lower radial roof cables could be connected. The total quantity of 96 lifting units represents a new record for a single project. ■

Contact: psiegfried@vsl-schweiz.ch

Australia
D-walls for a river crossing

→ **The VSL-Intrafor JV is completing the finishing works** on the Cooks River Crossing project in Sydney for the Baulderstone Hornibrook and Bilfinger Berger JV. The contract represented 12 months of work and included the construction of a 13,000m^2 diaphragm wall with thickness ranging between 1 and 1.2 metres, and the installation of 108 one metre diameter permanently cased bored piles. The project was completed in three phases and had to comply with height restrictions due to air traffic, as the site is very close to the airport runway. ■

Contact: gkilidjian@vslsyd.aust.com

USA
"W" configuration in Colorado

→ **VSL completed** the construction of the 52 metre diameter and 7 metre wide Colorow Reservoir in Denver, Colorado. The bottom slab, wall, and roof slab are entirely post-tensioned to maintain compression in the concrete elements under all loading conditions and ensure minimal long-term maintenance of the structure. A total of five weeks was required to place the ten individual full-height wall segments. A unique feature of this structure is the efficient "W" configuration of the wall post-tensioning tendons. Biaxial compression is applied to the wall due to the vertical and horizontal curvature of the tendons.

One advantage of this configuration is the elimination of stressing pilasters typically required for walls where tendons are placed orthogonally. Access for placing the strands, stressing, and grouting was provided from the top slab decking. VSL provided the installation of mild reinforcements in addition to supplying and installing the post-tensioning systems. The project was an overall success due largely to the combined pre-planning efforts by VSL, Jennison Construction, and Plains Engineering. ■ *Contact: bgallagher@structural.net*

France

A rush job on the A6 motorway

→ **Working with Bouygues TP**, VSL recently carried out an unusual operation, being the dismantling of an acoustic shelter over the A6 B motorway between Kremlin-Bicêtre and Gentilly, at the southern entrance to Paris. Some elements were showing signs of weakness due to corrosion and there was a risk that they might become dangerous if weighed down with snow in winter.

The chosen method was to use multiple role adjustable length footbridge beams to act as work platforms, decks to load components and supports for the hydraulic saw. These beams were supported on the cornices and positioned over the shelter using a telescopic crane. The works required an exceptional level of organisation: just a month of preparation and 21 days of work to cut the shelter into sections (331 elements representing a length of 850 m) and remove them.

The works were completed a week ahead of schedule, allowing this main road access to Paris to be opened four days earlier than planned. ■ ***Contact: jf.cubille@intrafor.fr***

France

PT providing a new lease of life

→ **A black spot on the holiday trail** was recently removed thanks to the works carried out by the Bouygues Civil Works, VSL and Dalla Vera partnership on the St-André-de-Cubzac bridge crossing the river Dordogne along the road network serving the Bordeaux wine region. VSL first replaced all 72 supports, lifted the deck by removing the cantilever joints and repaired the pavement joints. The bridge lifting operation was computer-guided using the VeRSO TM system which provides a lifting accuracy to the nearest 10th of a millimetre. In addition, external post-tensioning using twenty 486 metre long cables - a record- was also installed to reinforce this ageing bridge. This solution avoided the installation and tensioning of additional anchorages. Rehabilitation represents a promising market in France for ageing bridges built in the 1970s. ■ ***Contact: jf.cubille@intrafor.fr***

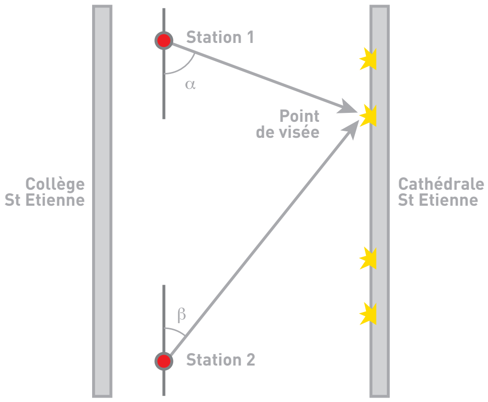
France

Ultra-fine grout to rescue a cathedral

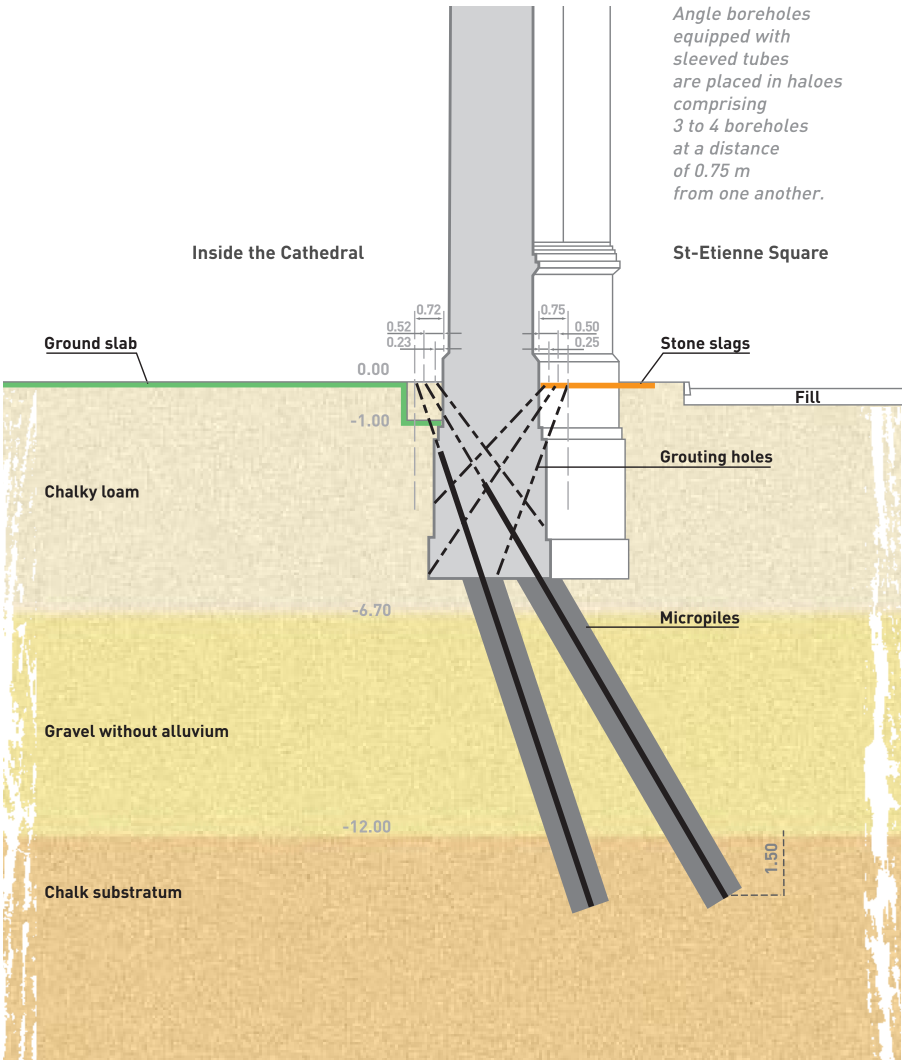
The progressive tilting of the top of the west facade had resulted in the walls to the Saint-Etienne cathedral (1650) in Châlons-en-Champagne developing cracks. Intrafor, responsible for the construction of jet grouting columns, had also noted the bad condition of the foundation masonry: 30 to 40% of the sand and clayey gravel had been washed away. Specific injections were carried out using an ultra-fine grout patented in 1989 by Intrafor, being a finely ground cement (12 microns) with addition of a chalk milk and a dispersant to maintain the cement in suspension to improve the penetration of the grout into the chalky quarry stone.

To carry out the work, angled boreholes equipped with sleeved tubes were placed in haloes comprising 3 to 4 boreholes at a distance of 0.75 m from one another. The grout was slowly injected at an average rate of 70 litres an hour with a pressure limited to 400 kPa. Three months of injection were needed to create the jet-grouting columns. The lifting of the facade was controlled by a rotary laser and four detection cells, a system that immediately stopped the injection as soon as a 1 millimetre tolerance was exceeded. These works represented nearly one million euros for Intrafor.

Contact: p.farrando@intrafor.fr



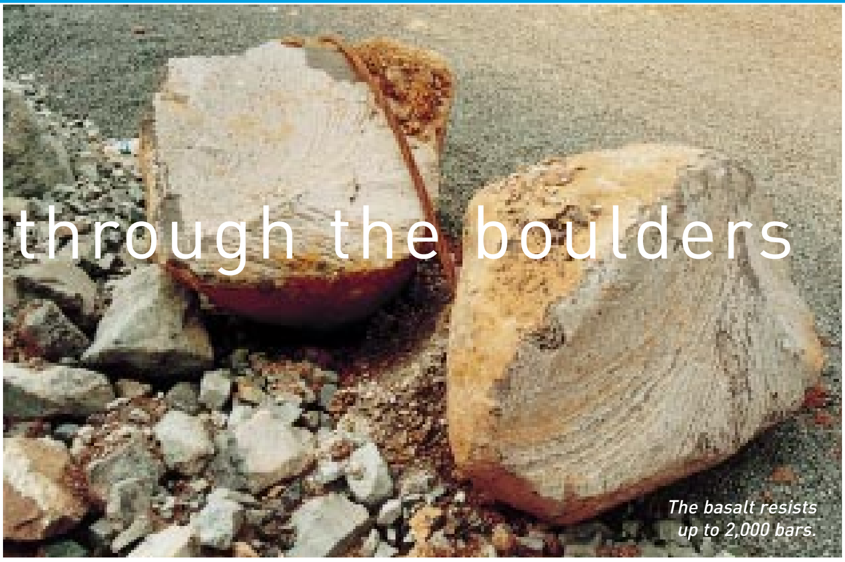
A support control system on the west facade of the cathedral using four detection cells automatically stops the injection process as soon as the 1 mm tolerance level is exceeded.



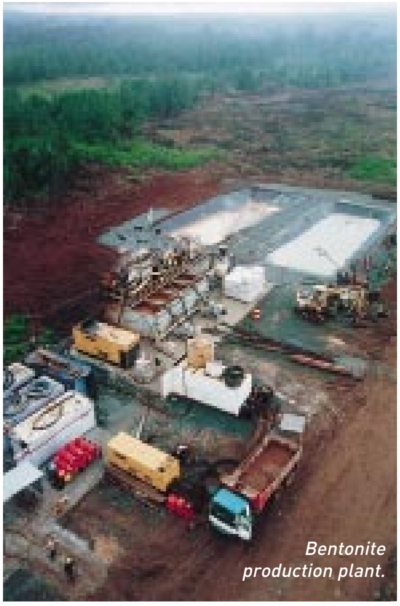
Angle boreholes equipped with sleeved tubes are placed in haloes comprising 3 to 4 boreholes at a distance of 0.75 m from one another.

Mauritius

Intrafor cuts through the boulders



The basalt resists up to 2,000 bars.



Bentonite production plant.

→ **In Mauritius, upstream from** the Midlands dam now under construction (Bouygues for the civil works, DTP for the handling of materials and Intrafor for the cut off wall), Intrafor is constructing a 30,000 m^2 diaphragm wall anchored to the rock. Taken down to an average depth of 14 metres, this 0.65 m plastic concrete flexible screen is intended to pick up soil deformations during the construction phase and prevent water from passing under the dam works. The nature of the soil, comprising rocky banks of basalt and large isolated boulders (from 2 to 8 m across) with a resistance of up to 2,000 bars, made the digging operations particularly difficult and the cutter had to be specially equipped to cut through them. The operation lasted six months. ■

Contact: p.congiu@intrafor.fr

The centre of the island receives 4,000 mm of rainfall a year and cyclones from November to May.

INSTALLATION OF STAYS

Strand by strand, the way up!

Instead of fully prefabricated cables, VSL in Poland used the strand by strand method to install the stays for the Sucharskiego Bridge. Step by step, here's how the story went.

1 Several advantages. *The strand by strand method allows perfect parallelism of the strands, high erection speed, simple and repetitive operations for local labour, reduced construction loads thanks to light equipment, and the flexibility to adapt to the main contractor's schedule.*

2 No waste. *The erection of the stay pipes starts with shipping the pipes to the site in 12 m lengths and welding them with an automatic fusion mirror welding machine to the required length to meet geometric and thermal conditions.*

3 Rolled to storage. *After the welding operations, the total length of stay pipes is moved on trolleys to its storage location.*

4 ***First step.*** *The first stay pipe is erected with the first strand installed. This strand is connected at both ends to the anchorages and then stressed to raise the stay pipe. The strands are then pulled one by one through the stay pipe, connected to the anchorages and individually stressed.*

5 ***No crane required.*** *The stay pipe is lifted from the deck to the pylon with winches supplied by VSL. Anchorages are pre-fabricated on site in a protected area under well controlled conditions. There is no anchorage assembly on the bridge on the critical path of stay erection.*

6 ***Pull up & pull in from the top.*** *The winch installed on the pylon enables the strand, fixed to the lifting cable, to be lifted inside the stay pipe. The stay pipe is temporarily fixed to the pylon during the strand installation.*

7 ***Individual protection*** *is ensured for the strands throughout the installation process thanks to the patented VSL anchorage system.*

8 ***Safely prepared.***
The strand installation begins with strand end preparation on a workbench. They are then fed and going through a guide wheel to the stay pipes.

9 ***Tinker, tailor made....***
The seven Ø15.7mm wire strands, manufactured according to VSL specifications, are supplied to the site on wooden reels and protected against damage.

10 ***Follow the shuttle !*** *The strand is fixed to the lifting cable inside the stay pipe using a special coupling device before being passed through the pylon anchorage via the strand's anchorage hole. The lifting cable then pulls the strand up into the stay pipe. A hoisting shuttle connected to both the lifting cable and strand is used to return the lifting cable to the bottom of the stay after strand installation. Once the strand and shuttle reach the pylon, the hoisting shuttle is disconnected, the strand pulled completely into the anchorage and the pylon anchor wedges installed.*

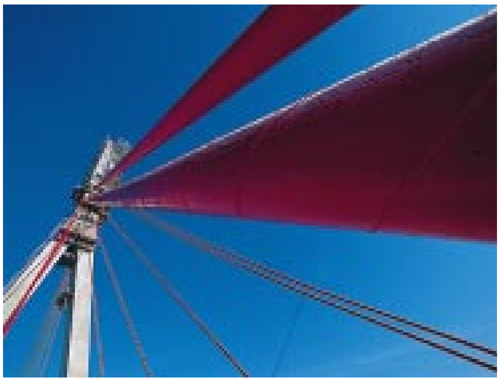
The lifting cable is then disconnected from the strand, and the bottom end of the strand cut and threaded through the deck anchorage before being stressed. The lifting cable is then threaded through the next pylon anchor block hole, the hoisting shuttle connected to the lifting cable and both then returned through the stay pipe to the bottom of the stay for the next strand installation cycle.

11 ***One by one.*** *The strand by strand installation method ensures that all strands are parallel. Each strand is first stressed to a level that satisfies the required stay force specified by the engineer, and ensures that the same force is applied to all individual strands. In the subsequent stressing operations, each strand is stressed to a specified stay elongation.*

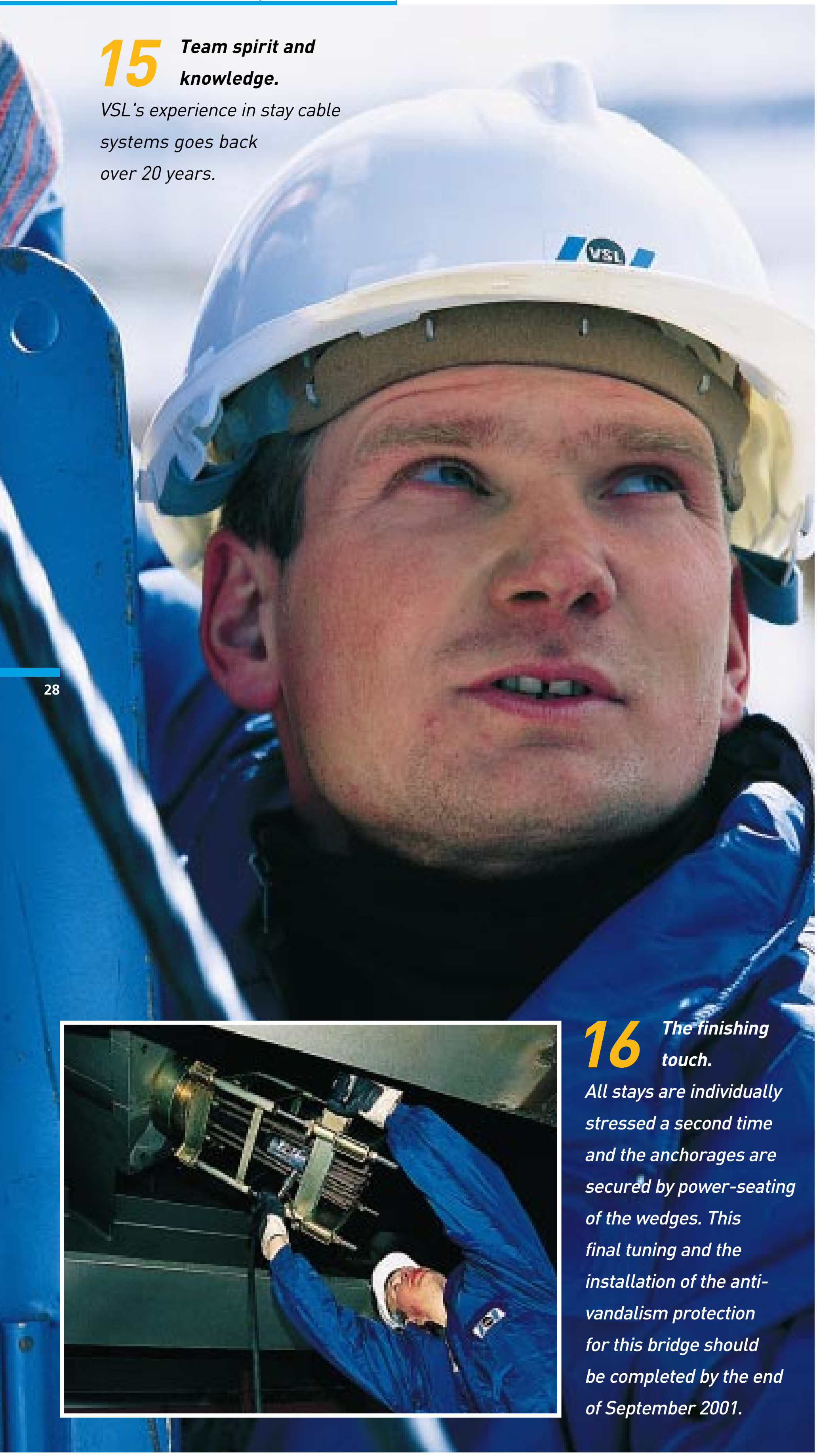
12 ***Speedy stressing.*** *On the Sucharskiego Bridge, 6 to 8 strands were installed per hour. By using prefabricated anchorages, VSL's system is optimised and simplifies cable installation on site, avoiding delicate anchorage assembly on the critical bridge erection path.*

13 ***Lonely jack.*** *Once installed, the strand is stressed from the stressing anchorage. All tensioning operations can be carried out using a monostrand jack weighing less than 20 kg.*

Pick a colour! *The High Density Polyethelene (HDPE) pipes can be black or coloured. External helical ribs reduce cable vibration caused by rain and wind.*



14 ***Slender looks.*** *The new generation of cable-stayed bridges are longer and more slender. As a result they have higher flexibility and require additional stay stressing operations. VSL's specific lightweight Automatic Stressing System controls each operation during construction and logs a record.*



15 ***Team spirit and knowledge.***
VSL's experience in stay cable systems goes back over 20 years.

16 ***The finishing touch.***
All stays are individually stressed a second time and the anchorages are secured by power-seating of the wedges. This final tuning and the installation of the anti-vandalism protection for this bridge should be completed by the end of September 2001.

The Sucharskiego project.
Construction works for this project over the Martwa Wisla River near Gdansk (Poland) began in 1999 and will be completed in 2002. The overall deck comprises one 25 m long span, one 230 m long main span and four 26 to 39 m long back spans. The main span is supported by cable stays from a single pylon, and equilibrium is provided by stays to the back span. Total length is 372 m, pylon height is 100 m and the quantity of strand for stay cables is 425 t. Sixty stay cables are to be installed. The units vary between 31 and 55 strands, and are 60 to 215 m long.
The client is the Polish Road Administration and the main contractor is a joint venture between Demathieu & Bard (France) and Mosty-Lodz S.A. (Poland).
VSL Polska is the subcontractor for the installation of the stay cables. The VSL's scope of works comprises design and installation of the stay cables including materials, supervision, labour and equipment.

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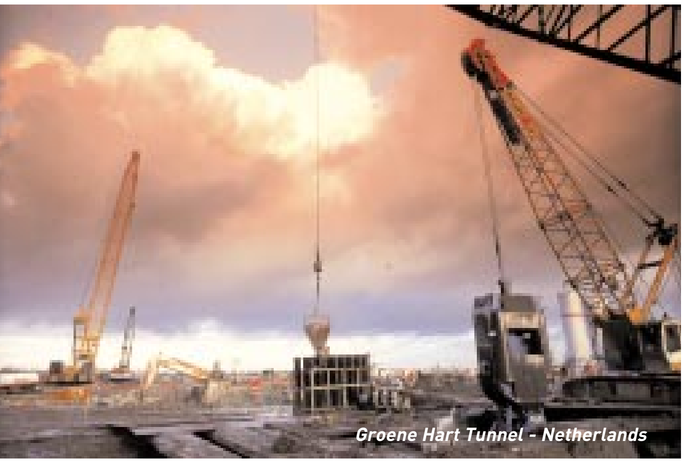
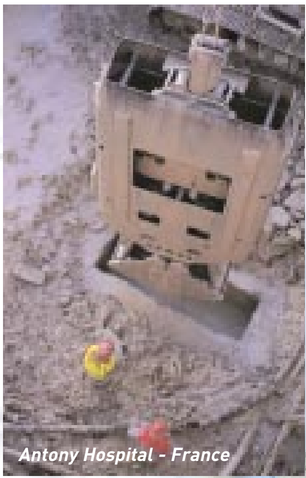
Joining forces for your projects



Groene Hart Tunnel - Netherlands

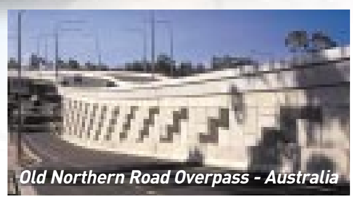
Kisosansen Bridge - Japan



Antony Hospital - France

Manhattan Heights - Hong Kong

- Post –Tensioning
- Deep foundations
- Stay cables
- Soil improvement
- Heavy lifting
- Climb form and formworks
- Retained earth
- Superstructure erection
- Diaphragm walls
- Special construction methods
- Grouting
- Ground anchors
- Repair & strengthening
- Vibroflotation
- Dewatering



Old Northern Road Overpass - Australia

Sydney Southern Railway - Australia

Pakse Bridge - Laos

VSL

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