NEWS

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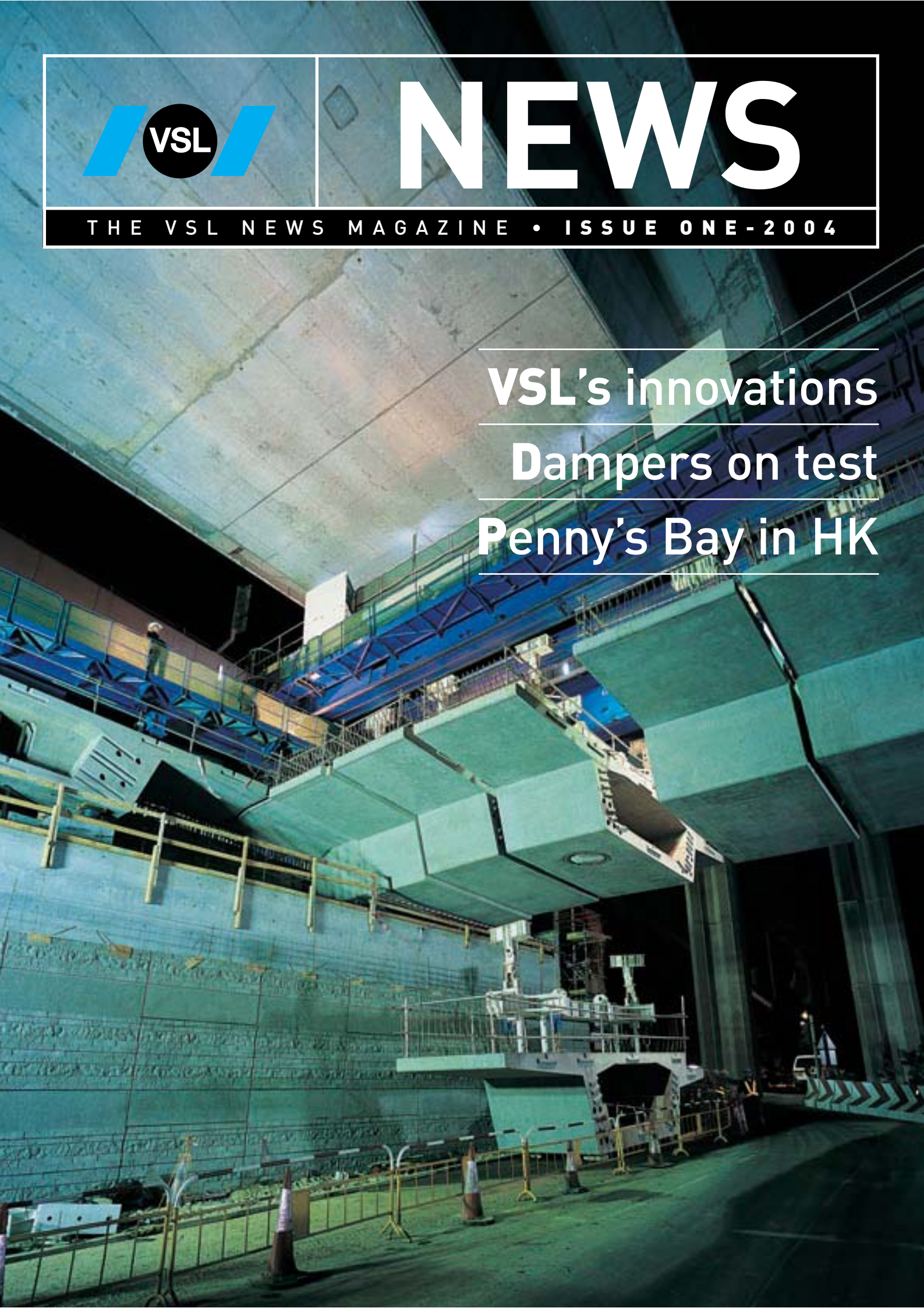

VSL's innovations

Dampers on test

Penny's Bay in HK

highlights

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EDITORIAL

Adding value with innovation

VSL has been investing in innovation for more than 40 years. Dedicated specialist teams and effective R&D programmes ensure that our projects benefit both from new developments and from continuous improvements in established techniques.

Any new technology must fulfil four key criteria: better quality; better reliability and long term behaviour; better productivity; better cost-effectiveness. Recent VSL developments that have achieved these demanding specifications include new post-tensioning systems, high performance grout and dampers for stay cables. Such innovations provide even more value than before, helping our clients as well as ourselves to gain a competitive advantage.

The VSL network believes that the sharing of know-how and best practice is a key factor in providing top quality services. We have launched an internal web-based technical forum to boost the process of spreading information throughout our 35 local subsidiaries. This allows us to exchange advice on best practice and ensures that good ideas are put into use straightaway, to the benefit of our clients.This feedback ensures we adopt the best possible approach in the package solutions we offer, especially for segmental bridges and complex superstructures. In particular, our recent jobs in Asia and South America have provided us with case studies showing how the quality of projects can be improved with more global technical input.

VSL specialists thrive on applying "good ideas made workable" to special projects. I also look forward to meeting our clients on projects around the world and presenting the full range of our innovative technologies that will add value.

Jean-Philippe Trin

Anchorages

CS 2000's Spanish debut

→ **The new high speed railway south of Barcelona features bearings and anchorages from VSL,** including Spain's first application of the VSL CS 2000 system. CTT-Stronghold won the contract to carry out the post-tensioning works and to supply POT bearings in September 2003. All the post-tensioning work was carried out with the CS 2000 system and 640 anchorages were installed. This was the first time that CS 2000 6-31 units had been used on such a large scale. The work included the supply of 58 POT bearings for 4 pre-cast viaducts as well as the supply of POT bearings and post-tensioning works for two major viaducts, Avernó and Anoia. ■ *Contact: pferrer@vslsp.com*

Footbridges

Mine openings

→ **Two years of concentrated efforts** have resulted in VSL in Chile achieving ISO9001:2000 quality management certification. The award covers the design, supply and construction of post-tensioning structures, mechanically stabilised retained earth walls and special projects. It also applies to the supply and installation of bridge expansion joints. Obtaining the certification has brought about improvements in VSL's operating procedures and at the same time will help the company to access specific markets such as the mining industry. ■
Contact: aavend@vslchile.cl

Diversification

Training strengthened

→ **A three day intensive sales team training session** for business development engineers was held in June 2004 as part of VSL's diversification into concrete repair and strengthening in Asia-Pacific for the petrochemical and oil/gas industries. VSL now has the capabilities to provide clients with condition evaluation services on top of repair work. Such services include field surveys, laboratory analysis and both non-destructive and semi-destructive testing. ■
Contact: adesilva@vsl-sg.com

Bontec1

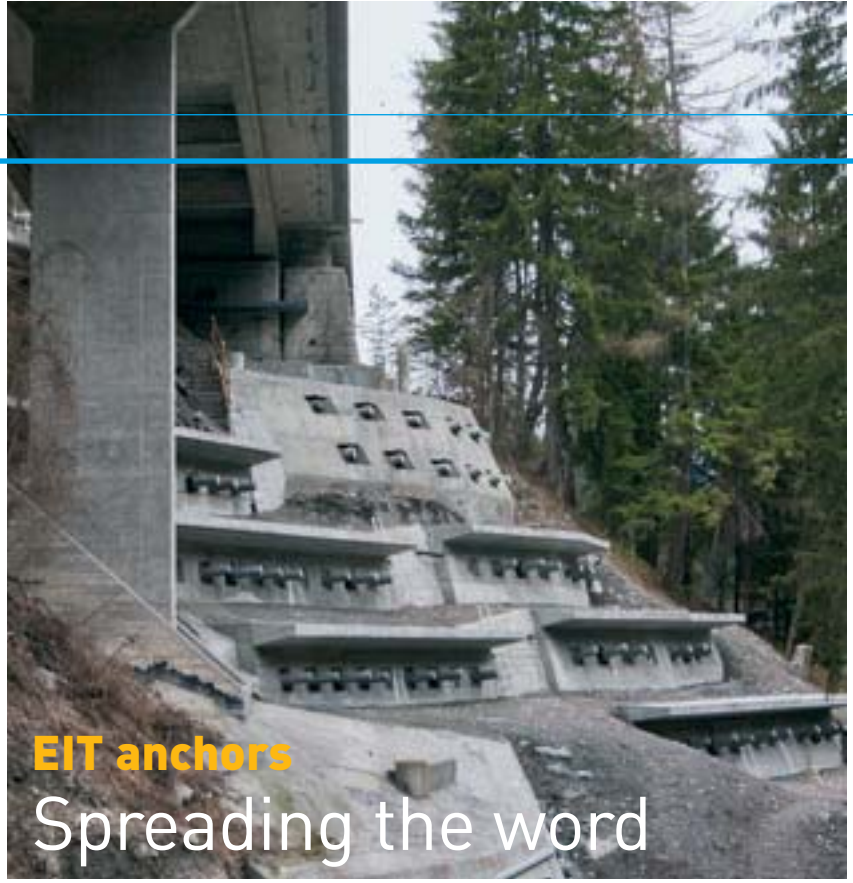
Proving its worth

→ **Demand for the new Bontec1** bonded post-tensioning system continues to grow. It has already been used for applications with a total area of 110,000m² across 13 projects, including offices, industrial buildings and universities. Bontec1 is an innovative encapsulated system for bonded post-tensioning using the VSL S5N anchorage with PE ducts. One of its main advantages is that any future modifications will be easier than if an unbonded system had been used. Use of the system is also starting to highlight cost benefits. Fewer reinforcement bars are needed, giving savings as steel prices rise. The total price is now slightly cheaper than for unbonded systems. ■
Contact: aavend@vslchile.cl

Chile

Bridging the tracks

→ **VSL footbridges have earned a very good reputation** in the Chilean market. The use of post-tensioned trusses gives control over construction loads and deflections. The latest project involves the construction of four footbridges for the national rail system EFE, a major safety programme which includes the construction of many pedestrian bridges and the fencing of rail tracks. The EFE project is the first in which this footbridge has been used over a railway.
■ *Contact: aavend@vslchile.cl*



EIT anchors
Spreading the word

→ **Electrically isolated anchors** have represented the state-of-the-art for over 20 years and are now becoming increasingly popular outside Switzerland. They were first introduced in 1985 at the Stadelhofen Station in Zürich, where VSL installed some 950 electrically isolated anchors. This started a development that later became a code requirement in Switzerland. It is now an integral part of the EN 1537 norm for anchors and is attracting increased interest outside Switzerland. The method involves checking the quality of the corrosion protection by measuring electrical resistance. This determines the tightness of the encapsulation around the anchor and the isolation between the anchor head and the structure. A minimum resistance value means that the encapsulation and insulation are providing an adequate barrier, sufficient to prevent any damage from chemical attacks and stray currents. It is essential for the anchor to be robust and carefully assembled for the method to work. A recent application of the technique was on the Caselertobel Bridge in the Schinschlucht, in the Canton of Grisons. VSL secured the stability of the bridge pillars with 57 electrically isolated anchors. These were unusually long, measuring up to 60m, a challenge for VSL and Greuter Ltd., the drilling company. Force as well as electrical resistance can be measured at any time at fourteen of the anchors. ■

Contact: mrickli@vsl-schweiz.ch

NOTE PAD

More CS 2000. *VSL France has successfully completed the post-tensioning works for 4 bridges along the high speed rail linking Paris to Strasbourg: 26 units of CS 2000 6-12 and 156 units of CS 2000 6-19 have been installed. Work was completed in April, following on from VSL France's 1st application using CS 2000 last year.*

Award. *Puente la Unidad has won the bridge category of the Post-Tensioning Institute 2004 award, following its Grand Award from the American Council of Engineering Companies. Entries were based on creativity, innovation, ingenuity, cost effectiveness, functionality, constructability and aesthetics.*

Medal. *The British group of IABSE has launched an award for excellence in structural design, the Milne Medal. The first winner is Mr Srinivasan for his designs of Wadi Leban Bridge (Saudi Arabia) and Wadi Abdhoun Bridge (Jordan). Both structures feature VSL stay cables.*

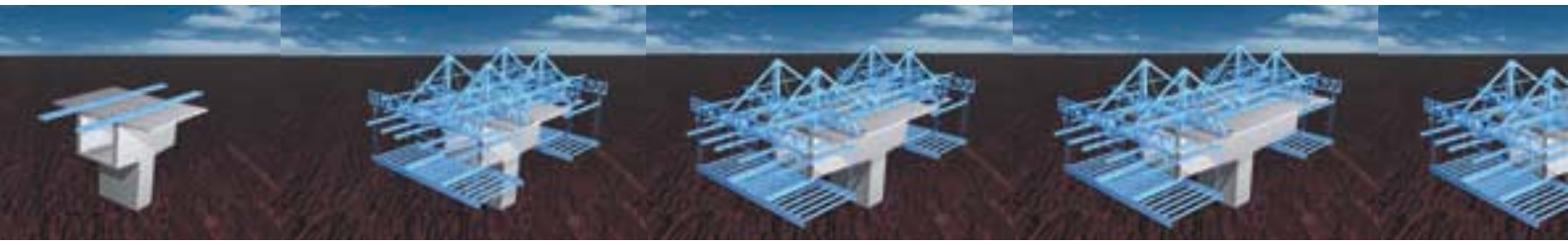
VIP at Fib. *French Minister of Construction Gilles de Robien visited the VSL booth at April's fédération internationale du béton (fib) meeting in Avignon. He expressed interest in post-tensioning and VSL activities and was presented with an art book on La Unidad Bridge.*

Tetris
UHP sewer pipes

→ **Founded in May 2004** as a joint venture between S.A. des Chaux de Contern (70.25%), VSL (9.75%), Eurefi (12.5%) and CD-PME (7.5%), Tetris Close Packing Technology has developed "tetrification", a micro-compaction technique derived from research conducted on ultra-high performance (UHP) concrete which enables obtaining maximum compactness for finely-graded mixes with very low water contents. Wastewater sewage pipes made of the new "Evolit" material feature a sizable gain in both mechanical and chemical strengths, lower pipewall thickness, outstanding use properties plus greatly-improved energy efficiency and environmental attributes. The three partners to this research venture plan on making user licenses available as of 2005 on the international market for sewerage and wastewater services and, subsequently, for urban heating distribution networks. ■ *Contact: jane.rousseau@vsl-intl.com*

VSL NETWORK

Sharing innova



VSL is a network and operates as such, believing that sharing know-how and best practice is a key factor in providing top quality services. The ability to spot and immediately transfer the best ideas which have been tested within the network serves VSL's aim: creating innovative solutions by adapting proven experience.
The solutions may be for clients or for one of 35 subsidiaries worldwide – or for both. An in-house convention held in May 2004 brought together a hundred VSL specialists and provided them the opportunity to highlight and develop this sharing network. Here is a selection of some of the recent VSL innovations that were on display.

Dismantling of launching girder with VSL strand jacks

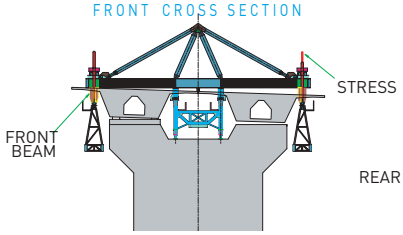
Purpose

VSL strand jacks have been successfully used as the means of dismantling a launching girder after completion of deck erection. Four sets of SMU-70 jacks were used in the removal of the 1,000t launching girder.

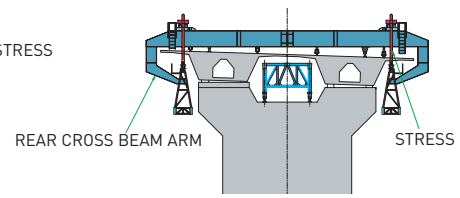
Description

The launching girder consisted of a long central beam positioned under the deck on the two piers. Two side beams were hanging front and rear on the cross beam. Conditions at the job site were challenging. The height of the pier was 40m to 50m above the sea level. The available space for dismantling of the central beam was just 100mm, which is the gap between the two viaducts. The lowering position was at sea level. Using this new method led to excellent results.

FRONT CROSS SECTION



REAR CROSS SECTION



Advantages

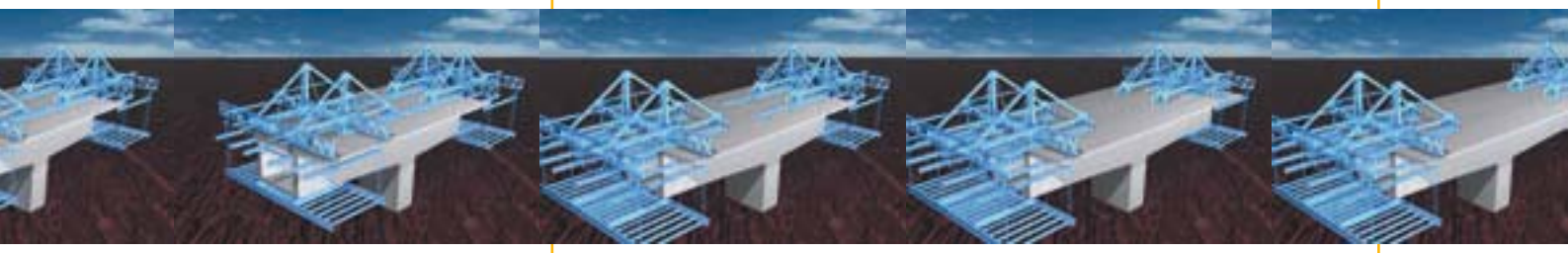
- The operation cost very little – just one fifth of the budget.
- The short construction period of 15 days (1/3 of planned schedule).
- Equipment was light, consisting of just four SMU-70.
- System simple and safe to use.

tion

VSL modular form traveller

Purpose

This formwork system for construction of cast in-situ bridges using the FC method was developed for easy reuse from project to project, to minimise investment in new steel and equipment and to reduce redesign costs for individual projects.



Description

An overhead system was selected due to its more favourable introduction of support reactions into the deck, its reduced self-weight and its possible use for cross-sections with more than two webs. VSL's modular traveller features:

- use of grade 40 steel with no need for SHS;
- a traveller launching system which provides longitudinal fixity for both uphill and downhill launching, through the use of double-acting long-stroke jacks connected by pins to the rail beam;
- rear tie-down of the traveller with 2 x 4 stress bars, all of them located outside of the webs.

Performance

The main performance characteristics are:

- bridge alignment - gradient up to 5%, horizontal curve greater than 500 m, superelevation up to 5%;
- segment geometry - segment length up to 5m, segment weight up to 180t (for a single box; higher for multiple boxes), single or multiple cell box girder, vertical or inclined webs;
- pier table length - minimum length 7.2m, minimum length for simultaneous installation of a pair of travellers 8.2m. ■

Competitive post-tensioned steel truss form

Purpose

VSL in Chile has developed a footbridge design for complete construction solutions in concrete that uses one continuous structure across all spans. A formwork system was needed.

Description

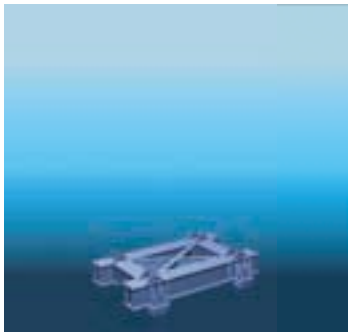
The construction of the forms starts with the assembly of the modules on the floor. After that the various modules are stressed together with individual strands. All the modules are lifted into position as one unit. The post-tensioning in the form is released after completion of the post-tensioning of the footbridge. Each module is then removed separately.

Advantages

- Pours are completed without interrupting the traffic; vertical and horizontal clearances are maintained during construction.
- The system is easy to mount and dismount.
- Use of post-tensioning reduces the force in the bolts in each connection, and allows control of vertical deformation. ■

COVER STORY

Tandem strand unit for continuous lowering and lifting

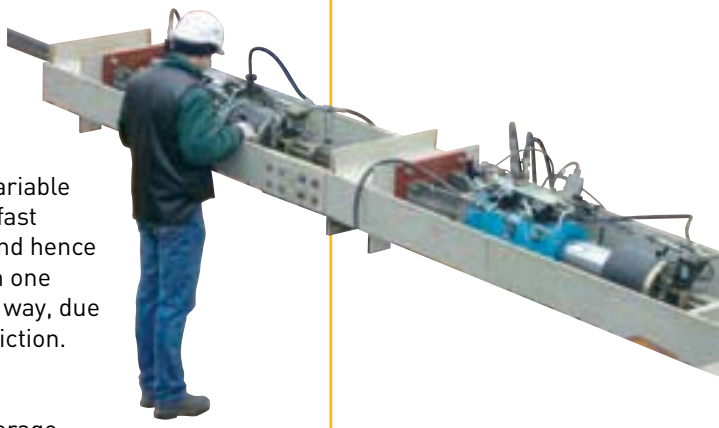


Purpose

Thyssenkrupp, a company active in steel structure fabrication and erection, was looking for a retaining system of 140t capacity that would combine with and follow the continuous propulsion movement of its in-house launching equipment. The purpose was to achieve a safe downhill launch of a steel bridge. VSL provided equipment for this operation, which involved lowering the load in a practically continuous movement.

Description

VSL had previously used SMU strand units for lowering loads or for retaining incrementally launched bridge structures with downhill launches. These produced a stepwise movement, similar to that of SLU in lifting. VSL adapted the tandem lifting equipment to work on the much more complex SMU lowering units.



It involved designing new pump controls, which result in variable piston speeds. This allows the extending jack piston to be fast enough to "overtake" the piston that retracts under load and hence to be in the right position in time for the load transfer from one anchorage to the other. The bridge moves in a continuous way, due to the elasticity of the retaining cables and to the sliding friction.

Main advantage

A continuous movement that allows an increase in the average lifting or pulling speed to values that were previously unimaginable. ■

Ultra-high performance material for blast and impact resistance

Purpose

Ductal® has an exceptionally high energy absorption capability and resistance to fragmentation, making it an ideal material for panels and components that may be affected by explosives or by high impact loads. The cost of Ductal® makes its use competitive only when its exceptional strength and durability properties can be exploited.

Description

Structural engineers are paying special attention to terrorist-resistant design of building structures and critical infrastructure. It was reported that 256 or so buildings were damaged in the Oklahoma bombing. In the case of the world trade centre, in excess of 300 buildings sustained some kind of damage. About 53 buildings within a 100m radius of the Bali bombing either collapsed or suffered serious damage. Therefore, it is not just high-risk facilities that need to be safeguarded. Protection is needed for all buildings that are close to the potential target. Two successful blast trials were conducted in may using bare charges of 5t of Hexolite. Ductal® targets consisting of 2m x 1m panels of 50mm, 75mm and 100mm thicknesses were located at 30m and 40m from the blast.

Advantages

- Effective blast and fire protection cover is provided for stay cables.
- This structural system for panels uses a new method of exploiting the high compressive strength of Ductal® and the high tensile strength of prestressing steel. The patented method allows large energy absorbing deflection. ■

Universal lower roller support

Purpose

The aim was to develop a standardised support for deck erection using both the free cantilever and span-by-span methods for a gantry's main girders which can perform correctly, regardless of gradient, super-elevation and curvature in plan.

Description

The universal lower roller support (ULRS) is the part of a bridge deck erection gantry which supports the gantry's main girders. The ULRS is itself placed on a lower crossbeam (LCB), which sits stationary on top of the deck or pier.

Advantages

- The system enables the transfer of longitudinal loads from the main girders directly to the base of the ULRS.
- It keeps the chain connection beam at a fixed vertical distance from the soffits of the main girders, even when the level in the main vertical support jacks is changed.
- The fixity system is independent of the magnitude of rotation in plan of the main girders.
- Commonly available gantry systems in the market have not come up with solutions to all of these issues and therefore often use the winch trolley's longitudinal movement system for the launching of main girders. ■

Post-tensioning connections to absorb deformations from seismic events

Purpose

The use of post-tensioning unbonded strands is combined with ductile steel reinforcement in the connections between columns and beams. This allows the structure to absorb considerable deformation during seismic events without structural damage or residual deformation.

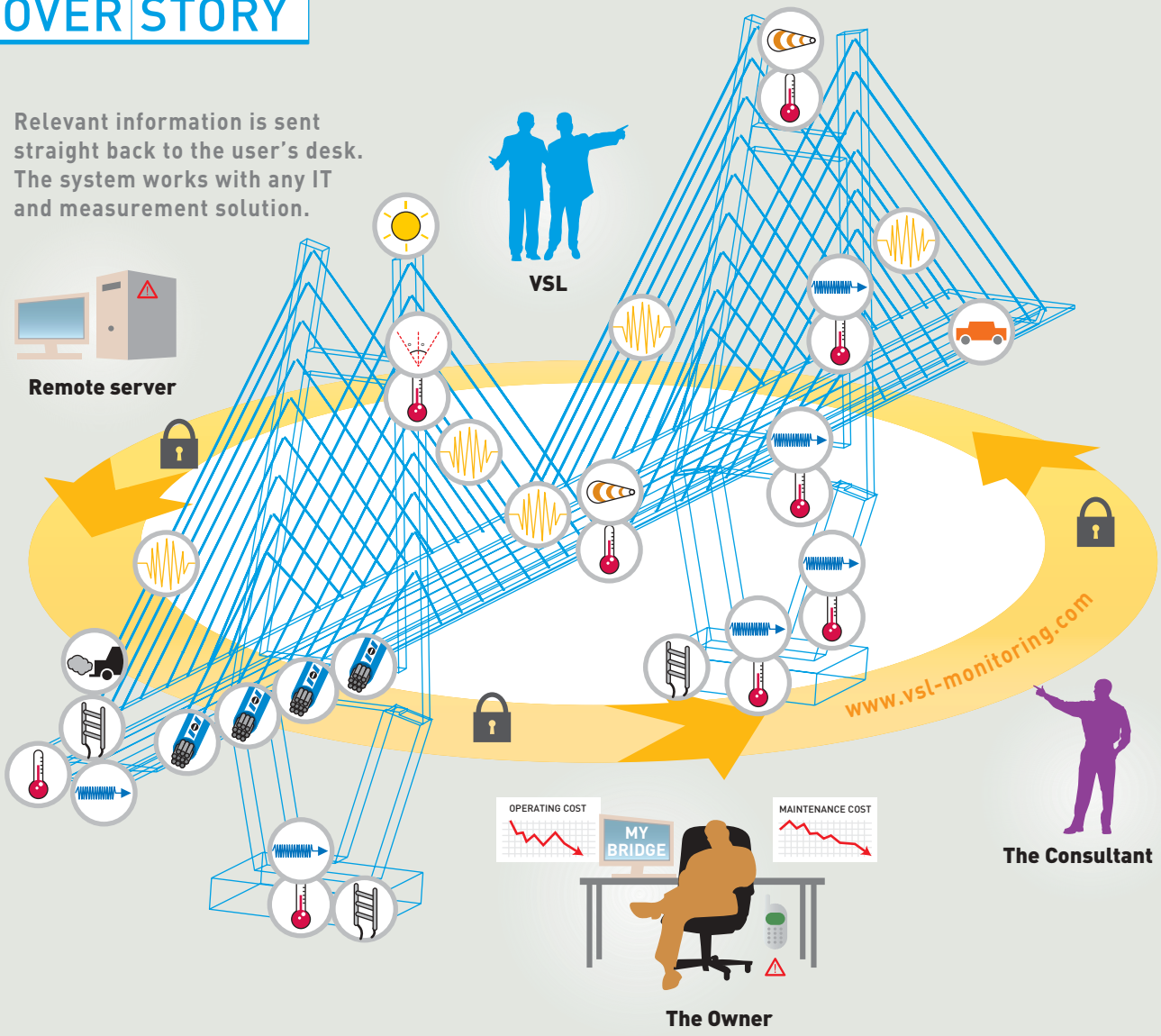
Description

A prefabricated building was built during the Expo Hormigón 2002 concrete show to demonstrate recent innovations in connection systems and erection. The building was designed with two frames in the longitudinal direction and two walls plus two frames in the transverse direction. The gravitational loads are supported by friction between the beam and the columns.

Advantages

- For low lateral displacements, this connection will stay closed and the structure will be similar to a regular cast in-situ structure. For large lateral displacements, the connection will start to open; the strands will work and will close the gaps after the event. Beams and columns are returned to their original alignment by the PT strands.
- Mild steel is included in the grouted ducts primarily to give the structure an adequate level of energy dissipation. ■

COVER STORY



Formwork for stitches

Purpose

In segmental bridge construction, stitch formwork has to be durable, rigid enough to maintain the curves of the outer webs, yet flexible and lightweight for ease of handling and installation. This formwork system is designed for quick and easy assembly by hand.

Description

Based on the actual segment shape, the outer formwork is divided into three parts: left outer wing, outer soffit and right outer wing. Only one or two workers are needed to assemble the outer formwork. The inner formwork comes in 14 small pieces, which can easily be carried and assembled into position. Wheels on the ribs of the outer formwork are used to "wheel" it to the next closure pour area.

Advantages

- Only two people are needed to wheel the formwork.
- No cranes or scaffolding are needed – just two strand jacks to hoist the outer formwork up.
- Inner formwork is secured in place. ■

Wind speed
measured in 3 directions
expressed in m/s

Temperature of cables, concrete
expressed in °C

Humidity
expressed in %

Rain intensity
expressed in mm

Sun intensity
expressed in W/m²

Traffic
expressed in km/h, veh./h, t, type...

Air quality
expressed in CO, NO_x, O_3, SO_2...

Cable force
expressed in kN

Structural vibration
acceleration expressed in g
vibration modes expressed in Hz

Angular movement
two directions expressed in °

Stress and deformation
expressed in µm/m and in mm

Material ageing
expressed in Cl^-, mV...

Inspection and investigation
paper and multimedia reports
laboratory or in situ tests

VSL DeMon, a service to provide a gateway allowing live monitoring of structures through the internet

Purpose

VSL has developed a service that allows an authorised client, user or owner of a bridge or other structure to have secure and easy access to monitoring data through the internet in real time.

Description

VSL DeMon Web is a combination of web services provided by VSL. The VSL DeMon Site software is installed on the structure, where it collects and filters the raw data – both static and dynamic – before sending it to a VSL DeMon Web server. VSL DeMon may be used with any type or number of sensors (from one to 1,000) and on any size of project.
Applications are:

- Temporary instrumentation during construction can include installation of stay cables, safety control, sound and vibration monitoring, stress and displacement control and processing of heavy lifting.
- Existing structures can be fitted with temporary instrumentation to examine aspects such as the validation of shrinkage hypotheses, identification of pathology and the validation of damping systems.
- The system can be used for permanent instrumentation including long term monitoring of complex structures, management of inspection reports, monitoring of safety and the behaviour in seismic environment.

Advantages

- Open platform compatible with all suppliers.
- High speed measurement and data filtering.
- Various wireless connections.
- Cost-effective fieldbus technology. ■

New version of automatic monostrand stressing system (AMS)

Description

Initial tension detection during lift-off of the existing AMS 3.0 system is based on a pop-off event taking place at the beginning of tensioning. However the pop-off may not happen in some circumstances, where the force is low or where the wedges are excessively greased. The new AMS 3.1 program responds to this with new features which determine the initial tension in any situation.

Advantage

The new AMS 3.1 is able to detect initial tension in strand during lift-off with, or without, pop-off of the wedges. ■

SITE INSIGHTS

Hong Kong
Net benefits

→ **VSL Hong Kong has used 4,500m2 of VSoL®** mesh wall to provide a novel alternative solution in securing the slopes for an important site access road for the Shatin Heights project in Hong Kong. The original intention was to use a geogrid reinforced slope for the access road support, but the 240m long by 22m high VSoL® wall proved more cost effective.
It also had other benefits.

The system uses steel mesh ladders and steel mesh facing units which are flexible enough to enable site modification to tie in with the existing rock slope. The VSL site team achieved installation rates of up to 100m^2 of wall face per day, working immediately behind the soil nailing operations giving temporary support to the cut face. ■ *Contact: richard.austin@hk.vsl-intrafor.com*

India
Reacting to a hot challenge

→ **VSL recently made its name in the Indian heavy lifting market** by successfully installing a 325t De Hydra Di-sulphate Reactor inside an operational refinery in Mumbai in February. VSL was assigned the contract by sub contractors, M/s Freight Wings PVT Ltd under the main contractor M/s Larsen & Toubro Limited. The reactor is 42m long with a diameter of 3.7m and is surrounded by pipelines carrying diesel at a temperature of 360°C. It was lifted to a height of 52.85m using VSL lifting jacks supported by two towers and a portal beam, then slid transversely and finally lowered onto its foundation.
The job was successfully completed in 17 hours by a skilled team of 17 members. ■ *Contact: ganesh@vslindia.com*

Hong Kong
Back-tracking

→ **For the prestigious Hong Kong building project,** KW P3,VSL Hong Kong supported the main contractor Sanfield and consultant Arup in finding an economical method for building a connecting deck spanning 30m between two towers, 135m above ground level: raising a 350t working platform by 106m during one night. This was achieved by installing SMU-70 jacks upside down inside the platform, climbing up a static lifting cable. The lifting/lowering equipment then remained in place during the construction of the upper floors. ■ *Contact: wschroeppel@vsl-schweiz.ch*

Hong Kong
Dual systems

→ **Two erection systems are in action** for the installation of pre-cast segments on the Lok Ma Chau Viaduct which extends the railway from the existing KCRC Sheung Shui station to the new Lok Ma Chau station. VSL's work includes the erection of the pre-cast segments as well as the supply and installation of permanent post-tensioning and grouting, bearings and single element expansion joints. Completion November 2004. ■ *Contact: henry.chan@hk.vsl-intrafor.com*

Hong Kong

Deep Bay projects on the starting blocks

→ **Gammon Skanska has awarded VSL Hong Kong a sub-contract** to erect pre-cast segments on the Deep Bay Link North and Shenzhen Western Corridor. The Deep Bay Project is a new cross-boundary road link between Hong Kong, New Territories and Shenzhen, Mainland China. Segment erection started in June with completion due by mid 2005. Deep Bay Link North has the largest structure, consisting of twin 5.4km decks. Three overhead gantries and a scaffold system are needed to erect 3,000 pre-cast segments, which weigh between 35t and 80t. Shenzhen Western Corridor has a length of 3.02km and is also a twin deck structure.

Two overhead gantries will erect approximately 2,000 pre-cast segments, ranging from 100t to 170t. ■ *Contact: dominique.droniou@hk.vsl-intrafor.com*

Malaysia

Lifting traffic woes

→ **The use of a lifter is minimising traffic disturbance** during erection of pre-cast segments for the 720m Jalan Gopeng Viaduct. Cranes would have caused far more disruption to travellers on the busy road leading to Ipoh town. Up to 4 segments are being placed a day, speeding up construction of the viaduct that will ease congestion. Each of the 282 segments is a single cell box and their weights range from 80t to 95t. The balanced cantilever method is used to erect most segments in the 48m to 60m spans. Launching is carried out by a combination of a short span stationary truss and lifters equipped with SMU-120 jacks. The truss is used for the pier segment and some of the span elements before being removed by cranes. The lifters are then assembled on both sides of the erected deck. Once each pair of segments has been put up, the cantilever tendons are stressed and the lifters can then be launched forward to pick up the next segments. A typical erection cycle for one cantilever is 14 days. The bridge level and alignment is monitored as the launching progresses. ■

Contact: ckchong@vsl.com.my

USA

Steel bonding cuts riser repair bill

→ **Use of VSL Hardwire SRP has cut the costs of repairs in Baltimore's Hippodrome theatre.** The original renovation included concrete structural repairs and strengthening of the main theatre and the balcony seating area. Investigations revealed that the risers also required strengthening to guard against cracking due to movement under loads. VSL steel-reinforced polymer (SRP) composites are thin laminates that are externally bonded to structural elements using epoxy adhesive. This can significantly increase the load carrying capacity. VSL Hardwire SRP was chosen for the Baltimore project to serve as additional reinforcement to provide tensile strength. The Hardwire SRP system is similar to fibre-reinforced polymer fabric and consists of ultra high-strength steel wires that are twisted together to form reinforcing steel cords. This application involved bonding the SRP to the back of the risers with epoxy adhesive. The VSL Hardwire SRP system reduces costs by using a less expensive material that nevertheless provides the advantages of the high shear strength of a composite system. ■ *Contact: bgallagher@structural.net*

Portugal

Fresh start for Figueira Da Foz

→ **Figueira Da Foz Bridge, a cable-stayed bridge in Portugal** constructed in the seventies, is being repaired and cleaned up. The bridge has a steel deck (a 225-m-long main span held by 24 stay cables) and two approach viaducts in post-tensioned concrete. VSL Portugal will be responsible for the repair of the stay cables, the post-tensioning reinforcement, the bearings, the replacement of seismic devices and the expansion joints. Stay cables include fixed anchors in the deck and a tensioning system featuring a saddle supported by steel shims on the top of the pylon. Cable wires and anchors are being inspected before proceeding with

repair and protection of all components. The pylon head will be protected and reinforced with high-strength VSL bars. The south and north approach viaducts, respectively 315m and 630m long, are made of 45-m-long prestressed concrete beams, which will be reinforced with external post-tensioning, using grouted and replaceable cables 3/0.6" and 4/0.6". Retrofitting is starting now with the repair of some of the original steel bearings and installation of new bearings and seismic dampers. The project is to be completed by January 2005. ■
Contact: ralmeida@vslsistemas.pt

Chile

Froilan Roa: expanding the offer

→ **VSL's scope of work in post-tensioning** contracts for civil works projects in Chile used to be limited mainly to design, supply of materials (duct, strand and anchorages), installation of components, and the post-tensioning itself. Today, however, it also includes forms, rebar, concrete and labour. VSL in Chile was given the opportunity to participate in the bidding for three bridges in the Froilan Roas project. After initially making a proposal for the post-tensioning works alone, VSL ended up winning the contract for all the construction works, including the abutments. ■
Contact: aavend@vslchile.cl

Spain

Double harp and saddle

→ **Last January, CTT-Stronghold (VSL in Spain)** completed installation of the stay cables on the new bridge over the Guadalquivir River in Cordoba, in southern Spain. The contract was awarded in March 2002. It called for the supply and installation of stays and post-tensioning on the Guadalquivir Bridge and five additional structures along with the design and supply of the steel saddle on the top of the pylon. Main contractor is OHL and designer is Carlos Fernandez Casado Consulting. The owner is Junta de Andalucia. PT totalled 425t. The stays are placed in a central double harp, with nine pairs of stays, ranging from 6-31 to 6-43, running through a metallic saddle in the pylon. ■

Contact: pferrer@vslsp.com

Ecuador

Pastaza: VSL's 100th cable-stayed bridge!

→ **VSL has been awarded a contract for a cable-stayed bridge** over the Pastaza River, a tributary of the Amazon River. The bridge is on the highway between Baños and Puyo. The lead contractor is an Argentine company, Jose Cartellone Construcciones Civiles SA and the designers are Cabjolsky-Amura, also from Argentina. The VSL SSI 2000 system will be used for the 64 stays that will support a composite deck of steel girders and concrete slabs. There will be a total of 81 tons of replaceable stays. Work on the pilings has already started, and cable installation should begin in October of this year and last 8 months. The project is located in the Amazon Forest, in the territory of the Shuara Indians. It takes several hours to reach the site. This bridge will be VSL's 100th reference in cable-supported structures. ■

Contact: epalos@vslsp.com

NOTE PAD

Cleaner city. *VSL has been helping the city of Pune in India to speed up the development of a world class, pollution-free township, Magarpatta. The 182 hectare site will include 12 post-tensioned towers each of approximately 30,000m². VSL suggested that a flat plate system would speed up the cycle time. This resulted in Tower 2 being completed in a record time of four months. VSL is now engaged in the construction of Tower 3, with more to follow.*

Olympic Ring. *VSL won a major contract as part of the ring road linking the two major athletic activities areas for this year's Olympic Games in Athens. The work has involved the supply and installation of 450t of post-tensioning for the Kifissos and Poseidonos Avenues interchange.*

Grecian walls. *Three VSoL® retained earth walls have been built as part of the Egnatia Highway, which crosses from Lefkopetra to Polimilos in Northern Greece. VSL carried out the design, supplied the materials and supervised the installation of the walls which total 8,700m².*

990 anchors. *VSL carried out post-tensioning of a voided slab on a cut and cover tunnel at the Madhuban Chowk intersection in Dehli for the Delhi Tourism and Transport Development Corporation. The base of the 60m-wide PSC voided slab slab of the underpass has been fitted with 990 permanent post-tensioned soil anchors to prevent uplift due to the high water table.*

U.A.E.

Sheikh Zayed: Post-tensioning and hangers

→ **The main contractor, Archirodon, has awarded VSL two separate packages** in the prestigious Sheikh Zayed Bridge project. Designed by the award-winning architect Zaha Hadid (see page 5), the bridge will be the main access route onto Abu Dhabi Island, in the United Arab Emirates. The first package is for the post-tensioning works of the concrete box girder decks, including the inclined concrete pier supports and pier pile cap foundations. The second package is for the supply and installation of the inclined cable-stayed hangers. VSL´s SSI 2000 system will be utilised for the hangers. The VSL post-tensioning tendons will be encapsulated using VSL's proprietary PT Plus polypropylene duct system in order to enhance corrosion protection. The hanger anchorage components range in size from 6-61 up to 6-127 strands and are fully encapsulated, with each strand separately protected inside the anchorage. ■

Contact: vslburke@emirates.net.ae

Dubai

Marina: from VSoL® to PT

→ **The main contractor, Carillion, has installed the final VSoL®** panel on the prestigious, 3-km-long Dubai Marina project. Over 20,000m² of the VSoL® polymeric soil wall system have been used to support a new service road. VSL Middle East has now been nominated for the design and supply of post-tensioning to the floor slabs on the new Marina Mansions high-rise tower. Atkins, the lead consultant on the project, gave VSL the PT contract for this 30-storey building ahead of the main contract award so that the post-tensioning design package will be ready for submission to the successful main contractor on day one of the construction programme. ■

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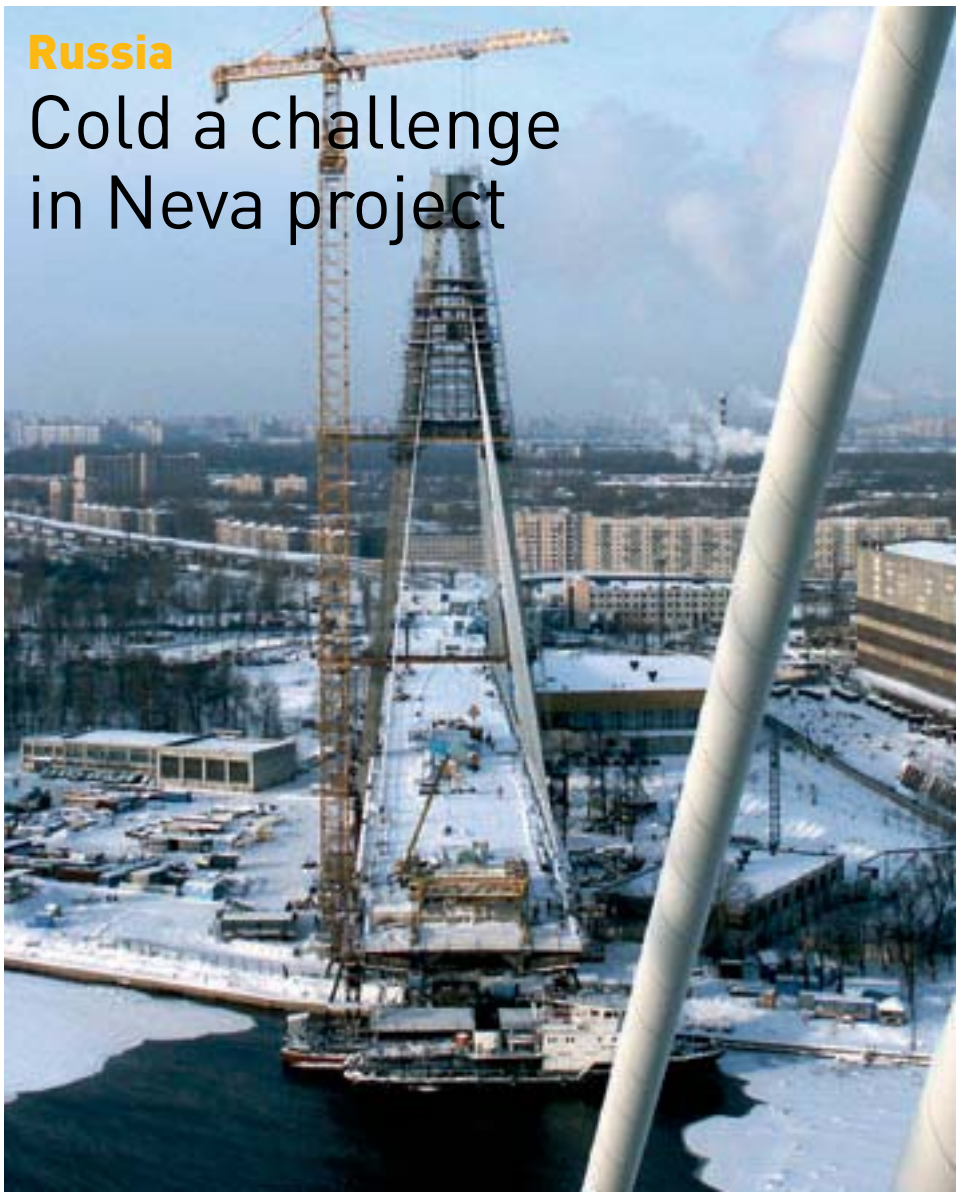
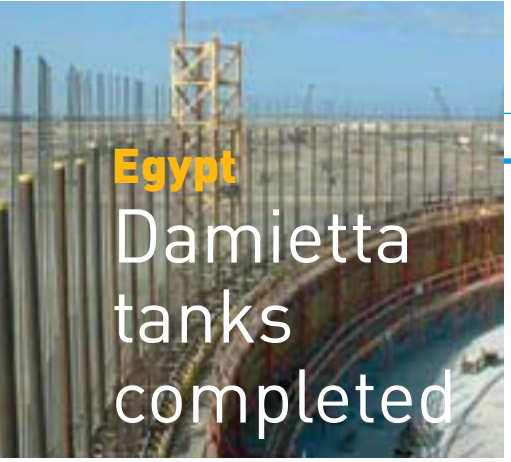


Russia

Cold a challenge in Neva project



Egypt
Damietta tanks completed

→ **The civil works on the two Damietta LNG tanks** were completed at the end of May 2004. After successful water tests in March and April, the doors of the tanks were closed in mid-May. More than 1,000 tonnes of strand were installed for the two tanks for Saipem. The work was done in a joint venture with Bouygues Civil Works. ■

Contact: cpetrel@vsl-schweiz.ch

→ **One of the most important crossings on the St. Petersburg Ring Road,** the Neva River cable-stayed bridge is a twin-pylon structure with a 382-m main span and two 174-m backspans. The deck and pylons are made of steel. The 24.9-m-wide, 2.4-m-high (during construction) and 12-m-long deck segments are fabricated by bolting together several sections to make the 120-t double-box girder segment.
Over 440,000m of galvanised strands have been individually greased, coated with a high-density polyethylene sheath stressed and stressed (SSI2000 stay cable system). The stay cable sizes vary from 13 to 91 strands.
Short and tough schedule constraints associated with the difficulties of casting concrete during the extremely low temperatures of a Russian winter has led to the use of 10XCHD steel (Russian grade) as a basic material. The supply of the stay-cable system and technical assistance for the installation of stays has been subcontracted by Mostootriad 19 to VSL. The installation of stays started in Aug. 2003 and is due for completion in summer 2004. ■ *Contact: jcampbell_russia@hotmail.com*

Qatar
Doha interchanges

→ **VSL Middle East has delivered successfully and on time** the soil wall and post-tensioning packages for the Salwa, Immigration, and Luqta Interchanges in Doha, Qatar.
The project included 11,000m² of the VSoL® polymeric soil wall system and 170 tonnes of post-tensioning to the bridge deck concrete box girders. The main contractor was J&P, and the consultant supervising the project was Technital. ■

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Oman
80 jacks in Muscat

→ **At the end of 2003, VSL Switzerland was awarded** the contract for the jacking and lowering of bridges in the second phase of a repair project in Muscat, Oman.
The first phase was carried out in 1998. On-site operations started in early January 2004 and are to be completed in September 2004.
More than 80 VSL jacks are being used as called for by the main contractor's sequence of works.
Other repair projects are expected in the near future in this area as part of the overall bridge repair programme. ■

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NOTE PAD

Jordan bridge. *VSL is working on the Wadi Abdoun cable-stayed bridge, a very technical project in Amman. VSL is modelling the entire structure to carry out stress analysis and geometry control during construction. Design, supply and installation of the stay-cable system as well as the post-tensioning works will be supplied.*

Economical jacking. *VSL France has won a large repair contract, thanks to an alternative in-house hydraulic jacking technique that provides significant savings: jacking of 12 bridges, replacement of the bearings, and the supply and installation of 400m of new expansion joints.*

Incremental launch. *A team of six VSL specialists is launching the deck of the La Bresle Viaduct on the A29 motorway in Normandy, France for Razel Civil Works Division, main contractor with three SLU 330 jacks at a rate of 30m per week. VSL is in charge of the full post-tensioning of the viaduct.*

French VSoL®. *VSL France has been awarded three retained earth projects in France: abutment walls at Homécourt (400m²), plain walls and abutment walls at Limoges (1,295m²), and walls made with steel-mesh facing panels (1,635m²) at Bois Roger, for the A28 BOT motorway. This project is the first time in France that 6.50-m-high walls have been used to support a motorway section of such dimensions (270m long and four lanes).*

Benelux

VSL in the saddle

→ **VSL is providing the post-tensioning** for the KW68 viaduct (Contractor: J.V. MD-AB Hoogstraten) in Hoogstraten, Belgium. The viaduct has a total length of 88m and is supported by two abutments and an intermediate support, with spans measuring 40m and 48m, respectively. The supporting structure consists of two massive post-tensioned concrete girders, each 1.5m wide and 2.35m deep. Between them is a concrete slab resting on prefab concrete transverse beams to carry the roadway. These beams are laid on a ridge on the side of each girder. After concreting, hardening and post-tensioning, each girder (89m long and 1,000t) was to be placed on its supports.
The distribution of forces differs greatly in the construction, transport and final phases. The post-tensioning was done in several steps and even partly removed. The post-tensioning is produced by eight permanent tendons, four temporary tendons, and four extradosed tendons per girder. Each saddle consists of a bundle of 37 curved steel tubes. To have access to the saddles during the threading of the strands and to allow some displacement of the structure during the stressing of the extradosed tendons, the top part of the stainless steel ducts is made slightly wider. ■

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Germany

1 new bridge in 10 days

→ **The old railway viaduct with its 12 arches spanning the Weiße Elster in Halle** had carried heavy traffic for 164 years. To meet the 10-day limit set for the replacement operation, the new bridge was to be built beside the existing one on a temporary substructure (general contactor: Alpine Bau). The new viaduct is a single-cell, box girder structure with a main span of 58m and side spans of 47m and 38m, respectively. Thirty segments and one closure were required to complete the bridge. The whole superstructure contains 166 cables of 19 strands and 96 shear needles (36mm diameter PT-bars).
The temporary substructure and the final piers beneath the existing arches were constructed simultaneously.
VSL's work was crucial to respecting the tight schedule: Eight tendons in the webs and four temporary tendons in the bottom-slab had to be installed and stressed before the traveller could proceed to the next segment. That work was completed in March 2004. However, the programme did not allow 30 cables to be stressed before all secondary loads were applied to the structure. Only three days before the bridge was shifted into its final position, VSL had to stress and grout those 30 cables inside the box without any recesses left for suspension of the stressing jacks. The superstructure was launched on 24 May 2000, as scheduled. ■

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Czech Republic

Arches, ties and tubes

→ **A new administrative building, the Pankrac House,** is being delivered close to the city centre of Prague. The main contractor is consortium Porr – Swietelsky, the subcontractor of the structural part is Skanska CZ. Since space for the foundation was limited because of nearby metro tunnels, a special structural system made of arches with ties and tensioned columns was required. The ties and tensioned columns are post-tensioned, using tendons with 2 to 22 strands. The upper floors with a 10-m span are post-tensioned with 4-strand tendons in flat ducts. ■

Contact: psevcik@vsl.cz

France

Luxury pool

→ **VSL France has been awarded a post-tensioning contract** (design, supply and installation) for the construction of the Larvotto Hotel terrace in Monaco. Located very close to the sea, the 4,200-m² slab terrace holds a luxury pool called the "Lagoon". The post-tensioning provided by VSL is 6-7 cables in both directions, totalling about 110t of strand. ■ *Contact: michel.guichard @vsl-france.fr*

France

Rail bridge shift

→ **As part of the construction of the A28 highway,** VSL France shifted a rail bridge into position on the Paris-Caen railway line in May 2004. During the 60-hour window for the work, 15,000m³ of earth were removed, and the railway bridge (3,500t) was slid into its final position using four 1,000-t heavy lifting units. ■

Contact: patrick.travers@vsl-france.fr

United Kingdom

Strand jacked bridge over live railway

→ **Geoffrey Osborne Ltd slid a 270-t bridge deck** into position over twin tracks of the London-to-Exeter and Bristol-to-Southampton railway lines. The deck slide is part of the £3 million Highways Agency safety project to upgrade the A36 Skew Bridge in Salisbury. Precast elements feature strongly on this project. Each footbridge consists of four precast beams and in-situ deck slab. Each beam is 26-m-long and weighs up to 50t. VSL supplied heavyweight hydraulic jacks to lift and suspend the deck from the temporary steel tracks working near a live rail line. The lifting beams, with the bridge deck suspended beneath them, were then pulled on phosphor bronze skates along the tracks by strand jacks. When in position, the deck was lowered onto the abutments. ■

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A typical application of VSL's will to develop alternative contractual relationships.

Partnering in Sydney

New contracting into orbit

VSL is taking a key role in Australia's largest urban infrastructure project under construction, the Western Sydney Orbital toll-road or Westlink M7 motorway. VSL and its client are experiencing a new way of contracting.

The Western Sydney Orbital toll-road or Westlink M7 motorway will divert Australia's heavy eastern seaboard highway traffic west around Sydney. The AUD 1.5-billion project involves the design, construction, operation and eventual transfer of 40km of "seamless" electronic tollway, including 7.6km of elevated structures with 146 bridges and over 25,000m² of retained earth walls. In addition to VSL's award of sub-contracts for the design, supply and supervision of retained earth walls, supply of equipment and personnel for post-tensioning operations, VSL has formed a "sub-alliance" partnership for the design, supply and operation of the specialist plant for placing the pre-cast elevated sections.

Enhanced decision processes

This "alliance partnering" assists in obtaining a "best for project" result: VSL brings its extensive pre-cast erection knowledge and experience. In exchange, the alliance enables VSL to be active in the decision making processes that influence its own work scope. In its "sub-alliance" arrangement with the contracting consortium of Abigroup & Leighton Contractors Joint Venture, VSL provides the skilled engineering, equipment, materials and key supervisionary roles on a secondment like basis with a management fee. Design work for VSL started in mid 2003. The project is expected to be completed in September 2005 and open for traffic by the end of 2006.

Western Sydney Orbital toll-road site.

VSL's scope of works includes:

- the provision of skilled personnel for construction design, management and supervision of superstructure erection and stressing operations for 32 segmental bridges involving 6 bridges / 82 spans by underslung gantry, 16 bridges / 69 spans by falsework systems and 12 bridges / 76 spans by balanced cantilevers.
- the supply of stressing equipment, components and personnel for 2,300t of internal & external PT in both situ works and for transfer stressing in the pre-cast yard.
- materials, plant and personnel for the grouting of 2,300t of PT.
- the design and supply of 20,000m² of 5 degrees inclined, textured panels, un-reinforced retained earth walls & components.

Superstructure erection involves placement of segments by crane either on to temporary falsework decking, or on to underslung self-launching gantries, and on balanced cantilever construction. Grouting utilises the VSL optimised grouting procedures for both systems.

20,000m² of VSoL®

VSL's original 5,000m² contract quickly expanded to up to 20,000m² of the 25,000m² of retained earth walls on the project. VSL designed, supervised erection and supplied the architecturally finished panels with galvanised reinforcing mesh and components. The walls cater for a combination of conditions including crash barriers with various heights, reinforcing lengths all with a 5 degree inclination.

This contract is a typical application of VSL's will to develop alternative contractual relationships. Such new contracts can be alliances, lump sum, cost plus, internal joint venture with main contractor for specialist work with partnering approach, bipartite or tripartite agreements... The overal trend is to move avay from traditional subcontract. In all cases, such approaches can only work if designed for the benefit or both the Client and VSL. ■

Western Sydney Orbital – M7

OWNER: WESTLINK MOTORWAY CONSORTIUM
Comprising: Macquarie Infrastructure Group, Transurban, Leighton Holdings and Contractors and Abigroup.
Concession: The Consortium has been granted a 34 year concession by the Roads & Traffic Authority of NSW on behalf of the Federal Government.

DESIGN & CONSTRUCTION CONTRACTOR: ALJV
Abigroup Leighton Joint Venture

RETAINED EARTH AND POST-TENSIONING:
VSL (sub-contracts)

DESIGN, SUPPLY AND OPERATION OF THE SPECIALIST PLANT FOR PLACING THE PRE-CAST ELEVATED SECTIONS:
VSL ("sub-alliance" partnership)


The VSL damper on test.

Friction damper testing

Long cables: high results

Dampers are to be installed on future cable-stayed bridges in China, particularly the Sutong Bridge. The Tongji University of Shanghai has recently tested the performance of various types of cable damping systems, including prototypes. The VSL friction damper achieved excellent results in these exercises.

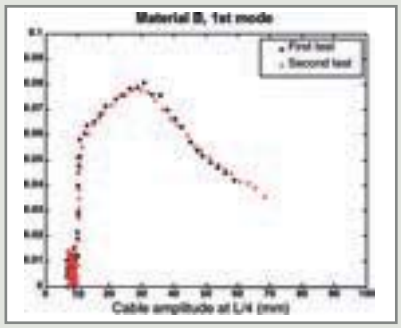
One of the objectives of the tests was to study the performance of cable damping systems. For very long cables (over 400m), the performance of the damper installed at deck level was to be increased by installing an additional damper near the pylon. However, the VSL system performed so well that this second damper should not be needed.
The dampers tested by Tongji University were mainly linear hydraulic systems. The VSL friction damper was also submitted for testing, although it is a non-linear system. Its efficiency was measured using different types of friction materials at two locations along the cable and with various values of friction force.

Damper location	1st mode	2nd mode	3rd mode
5,0 m	8%	7%	6%
3,5 m	6%	5%	4%

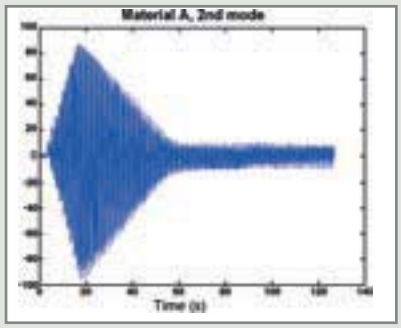
The VSL damper achieved excellent results.

Installation

As for all the other tested damping systems, the VSL friction damper was installed on a 216m-long parallel wire stay cable of 113mm diameter. The cable was stressed to 3950kN. The performance of the VSL friction damper was measured at two different locations in relation to one of the anchorages. The positions were 5.0m (2.3% of the cable length) and 3.5m (1.6% of the cable length). In both cases, the damper was tested with different types of new composite friction material developed by VSL. The cable was equipped with several acceleration and displacement sensors. Excitation was achieved by two men pushing the cable by hand at the correct frequencies. The friction damper was studied at the three first modes of vibration in a total of 19 tests.



The first curve shows the damping at mode 1 in relation to the cable deformation measured by the displacement sensor installed at a quarter of the cable length (L/4). The damper was adjusted to have its optimum performance when the amplitude of the cable deformation (at L/4) was around 30mm (data supplied by Tongji University).



Behaviour of the cable displacement at L/4. For about 20 seconds, the cable has been excited (at mode 2) to reach a 90mm deformation. After this period of excitation, the sharp decrease in the cable deformation over the next 35 seconds is due to the damper's action.

Main results

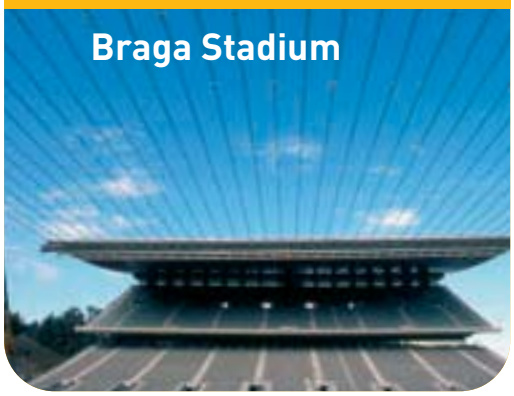
The tests demonstrated a high level of performance by the VSL friction damper and confirmed that this type of damper may be used not only for medium but also for long cables.
Being a non-linear system, the VSL friction damper is designed to perform at maximum efficiency at a defined low level of cable deformation. An efficient cable damping system has to:
a) increase the cable damping to a minimum value of 3%,
b) achieve this action with a damper installed near the anchorages (at a distance less than 3% of the cable length).
During the tests, the VSL friction damper achieved a damping of 8% at a distance of 2.3% and a damping of 6% at a distance of 1.6%.

Another advantage of the non-linear VSL friction damper is that it achieves its maximum damping even if its adjustable friction force is lower than the theoretical value. This is not the case with linear hydraulic dampers. The tests clearly demonstrated this advantage: a reduction of about 25% in the friction force had practically no effect on the maximum damping of the VSL damper.
With this level of performance, only one friction damper installed near the deck anchorage should be sufficient to stop the vibration on very long cable (about 500m). The need for the second, including the maintenance cost at the pylon, is avoided. ■

Foundation and slab post-tensioning with cables and stays anchorage block. Reinforcement with VSL bars

VSL's play in the Euro cup

Braga Stadium



José Alvalade Stadium

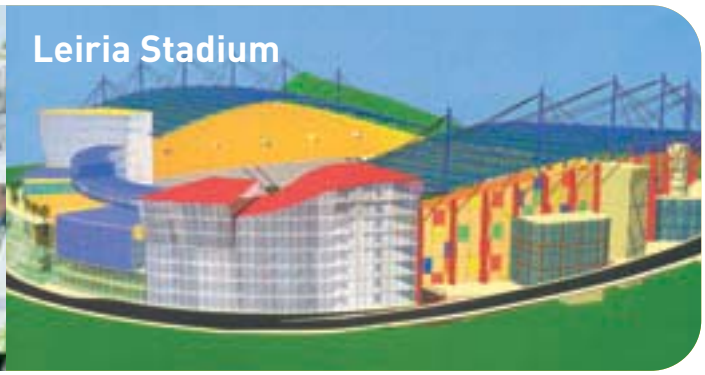
Radial frames and circular beams cable post-tensioning

Connecting metalic and concrete structure with VSL PT bars

Roof locked coiled cables, VSL's installation

Radial frames and circular beams cable post-tensioning

Leiria Stadium



Boavista Stadium

Roof support metalic beams lifting

Penny's Bay contract 1

Small room big games

Hong Kong is *the* place today for highly technical bridge construction. VSL has been practising creativity for years. It shows at Penny's Bay contract 1...

1 Opening the way to Mickey's stage

The Penny's Bay area of Lantau Island in Hong Kong is the site of a new Walt Disney Theme Park which will be opened in 2006. VSL Hong Kong was awarded four contracts on the infrastructure works, covering the construction of two bridges and four VSoL® Retained Earth walls forming the approach ramps to the road bridges. The last contract to be awarded, the Penny's Bay contract 1 bridge, covered the erection of a road bridge to provide access from the site over the Airport Express and Mass Transit Railway (MTR) railways. This bridge provided the final section of road access between the Disney Theme Park, the Expressway and train station.

2 *Squeezing in and adjusting to constraints*

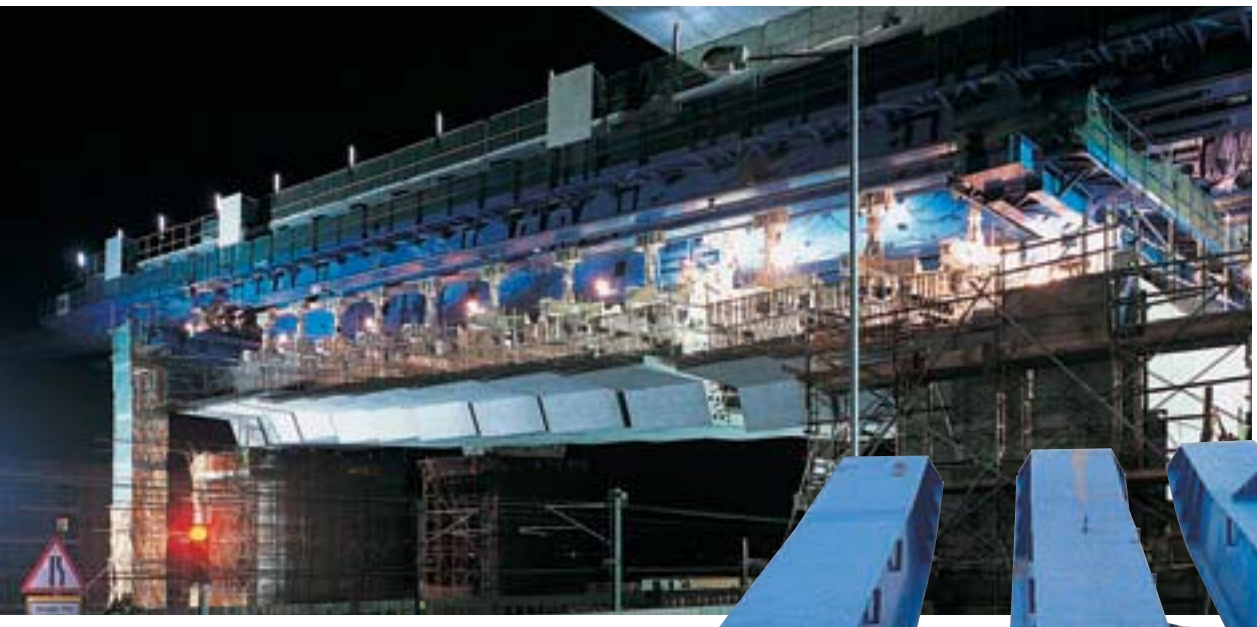
SHARP RADIUS
The bridge consists of twin decks each 11.0m wide, with three continuous spans 35, 31 and 36m long respectively. With a sharp radius on plan and a super elevation of about 6%, the bridge is squeezed underneath the Expressway, and above the railway lines. With all these constraints already in place, the bridge box was designed as a continuous structure to reduce the depth of the deck.

SMALL HEADROOM ABOVE THE BRIDGE
The highway above prevented the assembly of the gantry next to the bridge. The equipment had to be assembled about 80 meters away from the first span, and had to be launched in three stages to the erection area. Clearances between the gantry and the bridge above were as low as 200mm.

WORKING OVER THE AIRPORT EXPRESS AND MTR LINES
The erection works were conducted between 1:30 and 4:30 am on limited days per week, whilst the power to the rail lines cut off. Specific precautions and contingency plans were developed in conjunction with MTRC to cover any potential risk and emergency measures that would have had to be implemented in the event of a problem which might of impacted on the safe operation of the railway.

3 *Erecting each deck in 3 stages*

Stages 1 and 2 included the construction of a full span, each made from10 to 12 segments weighing between 50 and 60 tons and a quarter of the adjacent span, made with three segments match-cast against the pier segments, built in cantilever. Stage 3 comprised the closing of the last span. The pier segments were erected by crane and the gantry was subsequently launched over the pier segments. The segments of each span were assembled together and temporarily prestressed, prior to be connected to the pier segments with an in-situ stitch. When the concrete of the stitches reached 20MPa, these assemblies where then pre-stressed for each stage in two sequences of four tendons each of 6-37 configuration.



4 *Re-cycling reliable VSL launching equipment*

For this project, VSL used a new span by span overhead-launching gantry. The main two trusses of the equipment were made with one pair of beams which formed part of the under-slung gantries that were previously used on the West Rail and East Rail projects in Hong Kong. A lower cross beam and upper cross beam mounted with a 90t winch, plus other bracings and components were added to create a very stable and robust gantry.

TECH SHOW

5 Following-up with previous projects

To create the abutment and provide the approach ramps to the bridges, VSL Hong Kong was awarded a full installation package for 4,000m² of VSoL® Retained Earth walls on the contract 1 project. Installation work for the walls followed the erection of a further 4,000m² of VSoL® on the Penny's Bay contract 2 project which formed part of the same site access road. To match the architectural finish of the walls with that used for the contract 2 walls and on other parts of the Penny's Bay site, the walls were built using 2.4m wide x 1.8m high panels which incorporated three different patterns and textures on a single panel face.

6 *Achieving total isolation of the columns from the backfill*

With bridge loads supported on 1.8m diameter piles close behind the panel facing, an effective means of isolating pile loads and movement from the retained earth block was required.

A precast concrete split shell system was used to provided a cost effective and rapidly installed way of maintaining a clear void between the columns.

7 *Keeping the schedule smoothly*

The works started in January 2004 with the assembly of the gantry. Erection works started early March 2004 and where substantially complete by June. To enable assembly and launching of the girder for the bridge erection, completion of the South abutment was critical to the programme, as the approach ramp was used as a support platform for girder assembly and launching. Following launching of the girder, final installation of wall panels, copings and bank seat thrust relief walls where completed. In addition to the concrete faced walls, VSL supplied and installed a number of VSoL® mesh faced walls as temporary works, as a quick and cost effective way of allowing adjacent activities to continue as the permanent walls were built.The erection work over the Airport Express and MTR lines were executed without any disruption to either traffic or equipment from MTRC.

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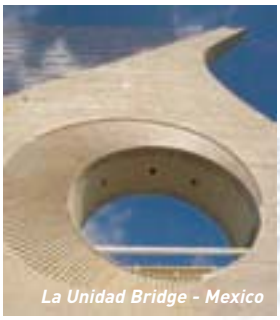
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