NEWS

THE VSL NEWS MAGAZINE • ISSUE TWO-2004

VSoL®, the new retainer

Waldstadion lift

Three girders in Santiago

highlights

Green wall project - Autovía Espiñaredo, Spain. 18m high, 4,800m².

SANTIAGO METRO 20

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EDITORIAL

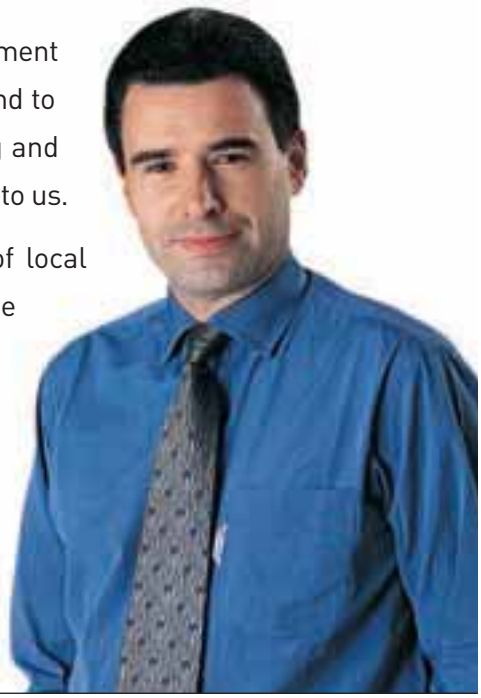
Offer continuous improvement

As 2004 has come to an end, VSL is continuing to successfully expand its geographical presence and introduce innovative, high-performance products.

Our position in India has grown stronger with the signing of contracts for over 116 projects in recent months. We have also diversified our activities with VSoL® projects and our first cable-stayed bridge there, which is being built in Goa. In China, we have moved into a new plant, a more modern and efficient facility that will be able to produce all VSL post-tensioning components to international standards. In Australia, we are testing new panels made of Ductal®, whose ability to withstand high-intensity explosions will make them an excellent solution for protecting sensitive sites. In Germany, our Heavy Lifting teams that are working on the new Waldstadium have put in place the roof support, whose size, weight and shape make it a very imposing structure. And in Chile, we completed in eight months the precasting and installation of segments for a viaduct for a 7,200-m section of Santiago's new light rail.

All these projects demonstrate our teams' commitment to developing innovative solutions for our clients and to delivering efficient solutions in terms of planning and cost to the complex technical challenges they bring to us.

VSL will keep on working through its network of local subsidiaries to offer clients the most up-to-date construction techniques and the benefits of a continuous improvement policy for VSL products.



Jean-Philippe Trin


Blast resistance tests

Ductal® in Australia

Less weight, more impact

→ **Production of Ductal® in Australia commenced in January 2003,** after installation of the mixing plant. The materials used are Australian except for the steel fibres and the silica fume. Precast Ductal® products have been supplied to three projects to date: Shepherds Creek, the first bridge in the world to be constructed using Ductal® for normal highway traffic; the attemperating weir at Eraring Power Station, NSW to contain salt-water spray with a design life of at least 100 years; M7 Freeway, Sydney, some 25mm-thick Ductal® panels to be used as permanent formwork slabs on a number of bridges with conventional precast pretensioned beams, to form the end diaphragm where access for removal of formwork was difficult.

Another project is just starting production at the Papatoete Railway Station : New footbridges providing a ramp access for pedestrians to cross the railway tracks are part of the station redevelopment. The weight reduction is very important as New Zealand is subject to high earthquake loading, and the lighter superstructure has enabled cost savings to be made in the substructure. In addition a research programme has been undertaken into the blast resistance of Ductal® panels. The results of the tests demonstrated the suitability of Ductal® for blast resistance and confirmed the design methods. The unique characteristics of Ductal® including exceptionally high energy absorption capacity and resistance to fragmentation, make it an ideal material for panels and components that may be affected by explosives, impact or shock loads. VSL Australia is now carrying out concept studies and preliminary designs of protection panels for embassies in two high terrorism risk countries.

■ *Contact: bcavill@vslsyd.aust.com*

Elongation calculations

New approach to tendon modelling

→ **Calculating the elongation of tendons is a common task in VSL.** The traditional approach was to use Excel tables, but these are difficult to adjust for complicated calculations and stressing procedures. VSL recognised the need for a new, native Windows application to calculate tendon elongations and stressing diagrams. CE2000 has been developed as the standard software solution, giving users a powerful tool for calculating the tendon elongation in all kinds of structures. It achieves high accuracy in describing the tendon geometry, even though the input is easy and the calculations are independent of the cross sections and structures. CE2000 works as a geometric pre-processor for the definition of tendon geometry without defining a cross section. It also acts as a calculation program for all possible stressing sequences. It supports the construction of tendon axes in both plan view and elevation and generates three-dimensional information for tendons along the axes. Powerful interactive functions allow the definition of general tendon points with few parameters. The software then creates a structural database and makes this information available for analysis in CE2000. ■ *Contact: mmeyer@vsl-sg.com*


Elongation tendon

Slabs

Bontec-1 proves popular in Spain

→ **VSL Spain has won contracts** for over 100,000m² of PT slab during the first nine months of the year. VSL Spain was chosen early in the year to implement a structural solution for a 33,500m² office development that Hines-Montisa is promoting in Madrid. Hines-Montisa required clear spans of 16.4m by 24m (from spans originally 8.1m x 8.1m) to adapt the office building to suit future uses. VSL worked closely with Rafael de la Hoz (architect), Pondio (structural designer) and Sacyr (main contractor) to provide the ideal structural solution. This involved the use of a two-way post-tensioned ribbed slab system for the 23,500m² office area and a two-way PT flat slab system for the 10,000m2 underground parking area. The contract with Sacyr was later extended to provide engineering and materials for the stainless steel façade system. ■

Contact: posso@vslsp.com

Stresshead system

FRP boosts strength of Swiss bridge

→ **VSL has recently upgraded a Swiss bridge** using post-tensioned plates made from FRP (fibre reinforced polymers/plastics). The 65-year-old bridge in Biel was originally designed for a load of 20t but now has to carry loads three times as large. Extensive reinforcement measures were therefore required. The StressHead post-tensioning system proved to be the optimal solution to enable the structure to meet today's demands. One system can take a maximum force of over 300kN, with a maximum prestress force of 220kN. ■

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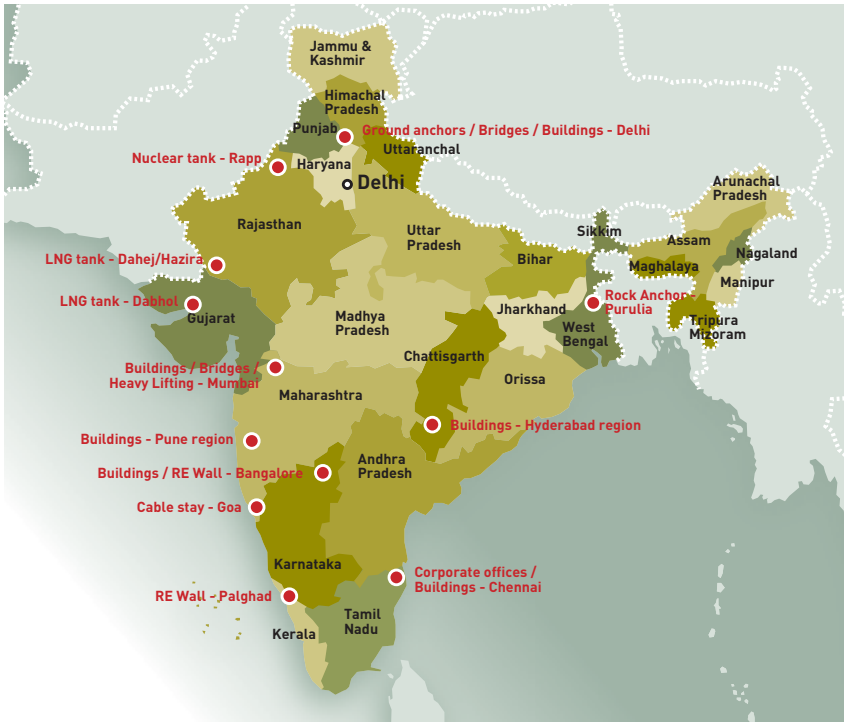
Quality policy

ISO 9001: 2000 certification for VSL India



→ **VSL celebrated completion of its fifth successful year in India** on 11th November 2004 and achieved another feather in its cap the same week, by obtaining ISO9001:2000 certification from LRQA. Certification encompasses the marketing, design and execution of post-tensioning systems and retained earth walls, together with marketing and execution of heavy lifting, ground anchors, stay cable bridges and bridges. The contract value of VSL India's bookings for 2004 had reached US$18 million by October, across 116 jobs. There are 200 workforce and staff members, plus 600 labour. Highlights of VSL India's contracts include the recently-completed 3rd LNG Terminal at Hazira, a first building job in Colombo, Sri Lanka and its first cable-stayed bridge, at Goa. ■

Contact: ganesh@vslindia.com

RETAINED EARTH WALL SYSTEM

VSOL®: the new

The VSoL® system has proved its merit throughout the world as a practical and cost effective construction technique for a wide variety of retaining wall applications. This area of activity is showing significant growth within VSL.

Available using steel mesh reinforcement as the VSoL® Steel system or with coated polyester straps as the VSoL® Polymeric system, this VSL technique uses a variety of panels shapes, sizes and finishes which connect to the soil reinforcement using simple, reliable connection details. When combined with compacted backfill these components form a reinforced internally stable soil mass suitable for approach ramps, bridge abutments and general retaining wall construction.
In addition to being a highly cost effective solution, in many markets VSoL® walls have an attractive appearance as well as providing a highly cost-effective solution.
Walls that incorporate a number of different patterns are becoming increasingly common in some markets and VSoL® walls are being chosen as a reliable way to create a high quality pre-cast finish.
Panels are available in many colours, textures and patterns to suit the architects' and engineers' aesthetic requirements.

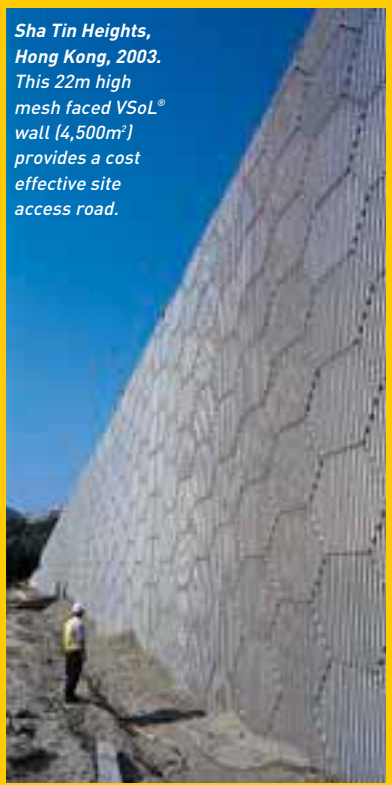
Increasingly popular

Success of VSoL® Retained Earth in the USA, Europe and Australia has prompted a greater emphasis on the promotion of the system in other parts of the VSL Network during recent years. More VSL profit centres are focussing on VSoL® applications and the benefits of VSoL® solutions are being applied to an increasing number of projects around the globe. By the end of 2003, VSoL® had grown to represent 10% of the value of all new projects signed by VSL.

retainer

Fast track temporary road

VSL Hong Kong is installing 5,250m² of VSoL® on the Shatin Heights tunnel section of the new Route 8 highway in Hong Kong. These walls form part of the portal works at both ends of the 1 km long dual three-lane Sha Tin Heights tunnel and follow the successful completion of a 22m high temporary VSoL® wall on the same project. Completed in September 2003 using steel mesh facing units the 4,500m² VSoL® temporary wall provided a novel, cost effective alternative for the site access road support. Working immediately behind temporary soil nailing operations, the VSL site team achieved installation rates up to 100m² of wall face per day on this congested site. In spite of poor weather conditions during part of the wall installation, backfilling of the site won fill proceeded at rates up to 1000m³ per day. VSL's current contract includes the design, supply and construction of 4 No. walls at the North Portal which form part of the conforming design from consultant Maunsell Asia Ltd and a 2,000m² 12m high wall at the South Portal which is a design alternative to the originally proposed bored pile wall. Construction of the South portal wall is currently underway and due for completion by February 2005. ■



Sha Tin Heights, Hong Kong, 2003. *This 22m high mesh faced VSoL® wall (4,500m²) provides a cost effective site access road.*

VSoL® market development has been particularly successful in the AsiaPac region, Chile and the UAE with the VSoL® Polymeric system. In Asia, VSL Hong Kong have worked on 17 different contracts in the last 5 years. VSL India have introduced the VSoL® solution to the market and are currently working on projects with a combined face area of over 125,000m². India's investment in road infrastructure has led to VSL India providing main contractors with packages that include installation as well as design and supply services. VSL India initially focussed on the VSoL® Steel system and is now introducing the VSoL® Polymeric system to help grow its share of a highly competitive market.

With numerous projects completed in Thailand, Indonesia and Vietnam and the first VSoL® projects completed in Malaysia, the

VSoL® as heavy load support 4,500m above sea

Collahuasi open cast copper mine, Chile (2003). VSoL® walls provide economic retained earth solutions at high altitude.

In Chile, VSL has been providing VSoL® solutions for 10 years with over 120,000m² of wall area now complete. VSL Chile is well known by the international companies building the new highways in the country which enabled VSL to take part in the first road concession in Chile and provide an overpass structure. In 2000 VSL built the first full VSoL® abutment and the first river wall in 2001.

The new program of urban road concessions from the Government in Santiago, is now giving VSL the opportunity to use the VSoL® System as an alternative to conventional reinforced concrete walls on new highway projects and VSL is currently working on approximately 40,000m² of walls on a number of projects.
VSL Chile has also successfully developed VSoL® applications in the mining industry. A VSoL® wall for the new crushing plant in Chuquicamata Copper mine, the biggest open cast mine in the world, has recently been provided. In 2003, another Retained Earth wall was needed in the Chuquicamata and Collahuasi mines and one in the Escondida mine has just been finished. In all three cases the walls, up to 35m high, support loads from the largest mine trucks available, plus strong seismic loading. The Collahuasi site is located 4,500 m above sea level, a world record. ■

Philippines and Singapore, VSL is now well established as a wall supplier and installer in Asia.
In Australia VSL has been particularly successful with VSoL® in Queensland and New South Wales where the recent M7 Westlink project in Sydney used 21,000m² of VSoL® walls on 45 structures.

Increasingly versatile

Since its development in California in 1981, the VSoL® system has been continually improved. In it's original form, VSoL® was developed using galvanised steel mesh reinforcement to withstand the forces within and applied to the reinforced soil mass. Through interlock and bearing the VSoL® mesh ladders develop the greatest soil to reinforcement interaction of any reinforced soil wall system. This leads to excellent performance of the finished structure.
In recent years the VSoL® system has developed to include the use of geosynthetic reinforcement in the VSoL® Polymeric system. ▸

VSL's and Australia's largest: 47 walls!

As part of the Westlink M7 Project, in Western Sydney, in December 2004 VSL Australia completed forty-five permanent and two temporary VSoL® wall structures for the Abigroup Leighton Joint Venture. VSL's scope included the design and supply of materials for the walls, with a total area of 21,000m² of textured grey concrete facing panels, cast using poly-carbonate form-liners to provide a shot-blast effect. The VSoL® walls were completed over a twelve month period across a 40km stretch of the new motorway. In addition to the main alignment walls,

Westlink M7, Australia (2004). Horizontal curves required numerous tapering panels to accommodate the wall setback.

18 approach ramps were built using the VSoL® method. The largest wall on the project was 3,300m² with a maximum height of 17m. With the walls generally built at 5° to the vertical, all walls with horizontal curves required numerous tapering panels to accommodate the wall setback, requiring each panel to be individually detailed and delivered to suit the construction sequence. The M7 project is the largest urban infrastructure project in Australia at present. ■

Turnkey projects with Keystone blocks

Pasu Pati Project, Bandung, Indonesia, 2,600m² Blocks, an alternative also provided by VSL.

In addition to panel faced VSoL® walls, through its tie up with Keystone Retaining Walls Systems, USA, VSL is also offering segmental block faced wall solutions for retained earth walls in Hong Kong, India, Indonesia, Thailand and Vietnam.

By combining the benefits of a dry cast concrete block facing, with steel mesh or geogrid reinforcement, Keystone extends the range of cost effective retaining walls.VSL has the in-house capability to manufacture the Keystone blocks on site if required and is currently working on-site on Keystone projects in India, Indonesia and Thailand. ■

Middle East goes polymeric

EPIC Mesaieed Project in Qatar, 2004.

VSL Middle East have recently been awarded the contract for the design and supply of approximately 15,000m² of the popular VSoL® Polymeric wall system to a number of bridge and viaduct structures in Sharjah and Ras Al Khaimah. VSL is working with a variety of main contractors who have been awarded various packages along the new by-pass road starting from the Dubai Sharjah border then linking to Ras Al Khaimah, including Darwish Engineering, NCTC, Athena and Sharjah General Contracting. Design and shop drawings for Middle East VSoL® Polymeric projects are produced by VSL Dubai. ■

Dubai Marina project in Dubai,2003.

VSoL® at its peak for road widening

Following the successful installation of 5,000m² of VSoL® on the phase 1 of the Castle Peak Road Widening project, VSL Hong Kong was awarded two further contracts for the design, supply and installation of VSoL® walls on the 2nd and 3rd phases of the same project. Phase 1, was a full scope installation package from China State, with fill supply, backfilling, compaction and even compaction testing included in VSL's scope of work and undertaken by Foundation Technique, Intrafor's in-house materials and site investigation company. In addition, VSL supplied a further 6,500m² of facing panels to clad reinforced concrete walls with the same panel finish as the adjacent VSoL® walls, which where either unsuitable for construction using the VSoL® technique or not possible for re-design for timing reasons. On Phase 2, working for Maeda, VSL supplied and installed 5,300 m² of VSoL® and supplied a further 11,000m² of cladding panels for adjacent reinforced concrete walls. Phase 3, again with China State and due for completion in 2005 has the largest VSoL® requirement at 17,000 m² on 9 structures including 4 bridge abutments and a number of arches. The Phase 3 walls where the most technically demanding of the entire project and included two 13m high true VSoL® abutment structures supporting the bank seat loading - the first structure of this type carrying a highway bridge in Hong Kong. Individual walls up to 22m high where provided and VSoL® alternatives to viaduct structures and bored pile walls installed. All the VSoL® walls on the Castle Peak Road project were contractor proposed alternatives, developed by VSL, the main contractor and Babtie Asia. ■

Castle Peak Road, Hong Kong, 2001-2005.

Castle Peak Road, Hong Kong, 2001-2005.

This development increased the versatility of the system as the use of polymeric friction ties extends the range of projects and backfills where VSoL® can provide a viable and cost-effective solution.

Following this market growth VSL has recently initiated a VSoL® development programme, to further refine the system and methods with the target of improving the cost effectiveness of VSoL® solutions for its clients. Development activities will focus on reinforcement and facing options, reinforcement to panel connections, construction details, and installation techniques. ■

The stone look

Bois Roger A28 BOT Expressway, France (2004).

The Bois Roger area for the A28 BOT Expressway in France is an ecologically sensitive area and access in front of the wall was not possible. Hence only a light and smart system such as VSoL® Grille could be used. VSoL® Grille uses galvanized steel mesh panels to provide green or stone faced retaining walls.

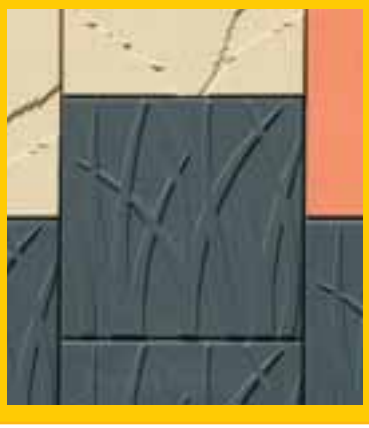
The 270m-long wall is inclined at 70° from the horizontal, with the design optimized to provide full embankment stabilization, maximum economy and meet the environmental requirements for this project to support a motorway carriageway. ■

Ferns and flowers for Sunshine Coast

This project (3,420m^2, 140,000m^3 of imported fill) near Mooloolaba, Queensland, provides easy access to the Sunshine Coast north of Brisbane. Client Queensland Department of Main Roads had specific architectural requirements for

Nicklin Way-Sunshine Motorway Link, Australia (2004).

the walls which included three different panel finishes placed in a random pattern: black concrete with a reed pattern; terra cotta concrete off form finish; beige concrete with a banksia flower pattern. All panel types were coated with an approved tinted anti-graffiti finish. To provide the detailed panel patterns, VSL developed concrete mould bases coated with epoxy paint for durability and ease of stripping. ■



Russia

High bridge, low degrees

→ **The recently-completed Neva cable-stayed bridge** provides the first permanent means of crossing the Neva River in St Petersburg with a central span clearance of more than 35m. VSL has been working as a subcontractor to Mostootryad 19 - one of the largest civil works contractor in Russia,- on the bridge, which forms part of the city's ring road project. The contract has covered installation of stay cables using the SSI 2000 system, including project supervision and the supply and installation of stay cable strands in 112 stay cables. The extremely low temperatures of a Russian winter made it difficult to cast concrete, constraining the schedule. ■ *Contact: jcampbell_russia@hotmail.com*

Dubai

VSL features in seven wonders bridge

→ **The Palm Island project in Dubai** has been conceived to create the eighth "wonder of the world". VSL Middle East has been appointed by main contractor Be-Six to supply and install the post-tensioning to the prestigious Gateway Bridge linking the island to the mainland. To increase the aesthetic appeal of the structure, statues of the seven wonders of the ancient world have been integrated into the design. Dynamic lighting will bring the bridge to life after dark. The bridge is actually a pair of six-span structures, each 360m-long and carrying five lanes of traffic. The structures are of a hollow cell box girder design, using VSL Ec 6-22 & Ec 6-12 anchorages with K-type couplers to provide continuity. Project developer Nakheel appointed the New York architect H2L2 for the concept and detailed design. Structural design consultant is Leonhardt, Andra & Partners of Germany. US transportation consultancy specialist Parsons is supervising the site works. ■ *Contact: vslburke@eim.ae*

Egypt

Triple action

→ **VSL is presently working in Egypt on three major structures.** The Belair Hotel & Resort includes six buildings. Designed with post-tensioned slabs 220mm thick, and with 16.5m-spanning post-tensioning beams just 140mm thick. The Raya building in 6th October City (near Cairo) has also been completed recently and included installation of 80t of PT steel. This was built by Wally Construction Group and designed by EHAF with the cooperation of AACE. Use of post-tensioning beams has enabled slab thicknesses of just 140mm to be achieved, with continuous spans of 12m, 9m and 12m. The third recently-completed building was for Vodafone in Smart Village (near Cairo), where a total of 150t of post-tensioning steel was installed in less than four months. Contractor for the scheme was Hassan Allam Sons and it was designed by Engineering Consultant Group (ECG) with the cooperation of AACE. ■ *Contact: amr_abouhashish@pencon-egypt.com*

Czech Republic

S-6 system at university

→ **A four-storey building at the Rajská Budova, University of Economics, Prague** has been post-tensioned in both directions using the VSL S-6 system. The structure has a floor area of 11,500m² and the project used 13,300m of strand encapsulated in HDPE sheet injected with grease. Construction was completed in November. The main contractor is a consortium of Imos Brno, PSJ Holding and Strabag.
■ *Contact: psevcik@vsl.cz*

Russia

Spanning in Siberia

→ **Working conditions are tougher than usual at the Angara River bridge site** where VSL has been involved for several years with Mostootryad 125 as main contractor. The 1,600m-long double-deck bridge is being built beside the Baïkal lake in Irkutsk, Central Siberia where temperatures can go as low as -30°C or even -35°C. The spans are being constructed using the free cantilever method. The two 1,000m approaches have been constructed with cast in-situ post-tensioned beams. VSL is supplying PT material and equipment for the river spans and approaches. VSL is also supplying engineering, design, technical assistance and form travellers on the river spans. ■ *Contact: jcampbell_russia@hotmail.com*

New Zealand

Unconventional slab jacking

→ **The Strand project in New Zealand** demonstrates the latest in slab jacking technology. Here a 4 level car park uses "climbfloor" to form and lift 3 floors with a total area of 3,300m² to final position without the use of conventional formwork systems. Each floor is cast on the previous one and jacked up into position. The climbfloor system also couples with an edgeform / climbing screen system that delivers a complete slab casting system and with prestressing provides the potential for significant savings in both materials and labour costs. In this project 36 screw jacks lift/lower/rotate the slabs within a relative accuracy of 0.1mm. The screw jacks move the slab up or down in a synchronised and controlled manner by adjusting speed settings from 1 to 3.5 mm per sec. A rotary encoder plus other monitoring devices provide the data to the microprocessors that track slab position. Lateral stability is provided by external roller guides. Once installed the jacks can self-climb to the next floor negating any additional cranage apart for removal. De-bonding agents are used to separate the new slab from the previous and foam void formers are used here to create an optimised band beam layout. Utilising 2 sets of void formers enable the next slab to be edge formed, reinforcing laid, post-tensioning installed whilst the previous slab is still curing. When in the final position a variety of slab to column connections are used including bolted corbels to secure the slab. ■ *Contact: dtrayner@vslsyd.aust.com*

Australia

Time saving strands

→ **Hydraulic strand pusher machines** are helping achieve high productivity on a motorway crossing contract. VSL's sub-alliance partnership with the Abigroup Leighton Contractors Joint Venture is on target for completion in September 2005. Work is well spread over a number of work fronts, including a major crossing of the existing M4 motorway. VSL is using two of the new hydraulic strand pusher machines with automated pre-set lengths. These are greatly improving productivity for strand installation. ■ *Contact: dtrayner@vslsyd.aust.com*

Malaysia

Experienced specialist

→ **On the government-funded Chenor Bridge project** near Temerloh town, across the Pahang River, pre-cast I-beams were used to build the approach spans. The cast in-situ balanced cantilever method was chosen for the main spans. As one of the more experienced bridge specialist contractors in the country, VSL Malaysia has been chosen to design, fabricate, deliver, assemble and commission four pairs of form travellers, including the design of pre-setting levels and mid-span closure for all main spans, and supply and installation of approx. 700m of post-tensioning cable. ■ *Contact: ckchong@vsl.com.my*

Malaysia

Sentral role for VSL

→ **VSL Malaysia followed its successful work** on the first phase of Malaysia's Plaza Sentral Development with a key role on the second phase. This Phase 2 - the construction of two office blocks - is now under way with MRCB Engineering as main contractor. As in Phase 1, VSL Malaysia had been relied on to carry out post-tensioning works for the beam and slab system. The gross floor area is 29,445.45m^2. Duration of the project is two years, with completion due in February 2006.

Contact: ckchong@vsl.com.my

India

Stay cable system launch in Goa

→ **VSL has successfully completed the first SSI 2000 cable-stayed bridge in India.** This bridge across the Mapusa River in the Goa region has a total length of 235m. A single H-type pylon in reinforced concrete supports the 105m main span and 80m side span from 24 stays in two planes. Stays are directly anchored to the two outer main beams above deck level. The stays are overlapped at the pylon. Each main leg of the H-type pylon splits into two below deck level in a plane parallel to the bridge axis. The cross section of the pylon is increased above the upper cross beam to provide space for the stay cable anchorages. The stay cable anchorage sizes vary from 6-19 up to 6-43. The HDPE stay pipes are of yellow colour as Goan culture does not permit the use of black. VSL's scope of work on this project has included engineering, supply, installation and stressing of the stay cables.

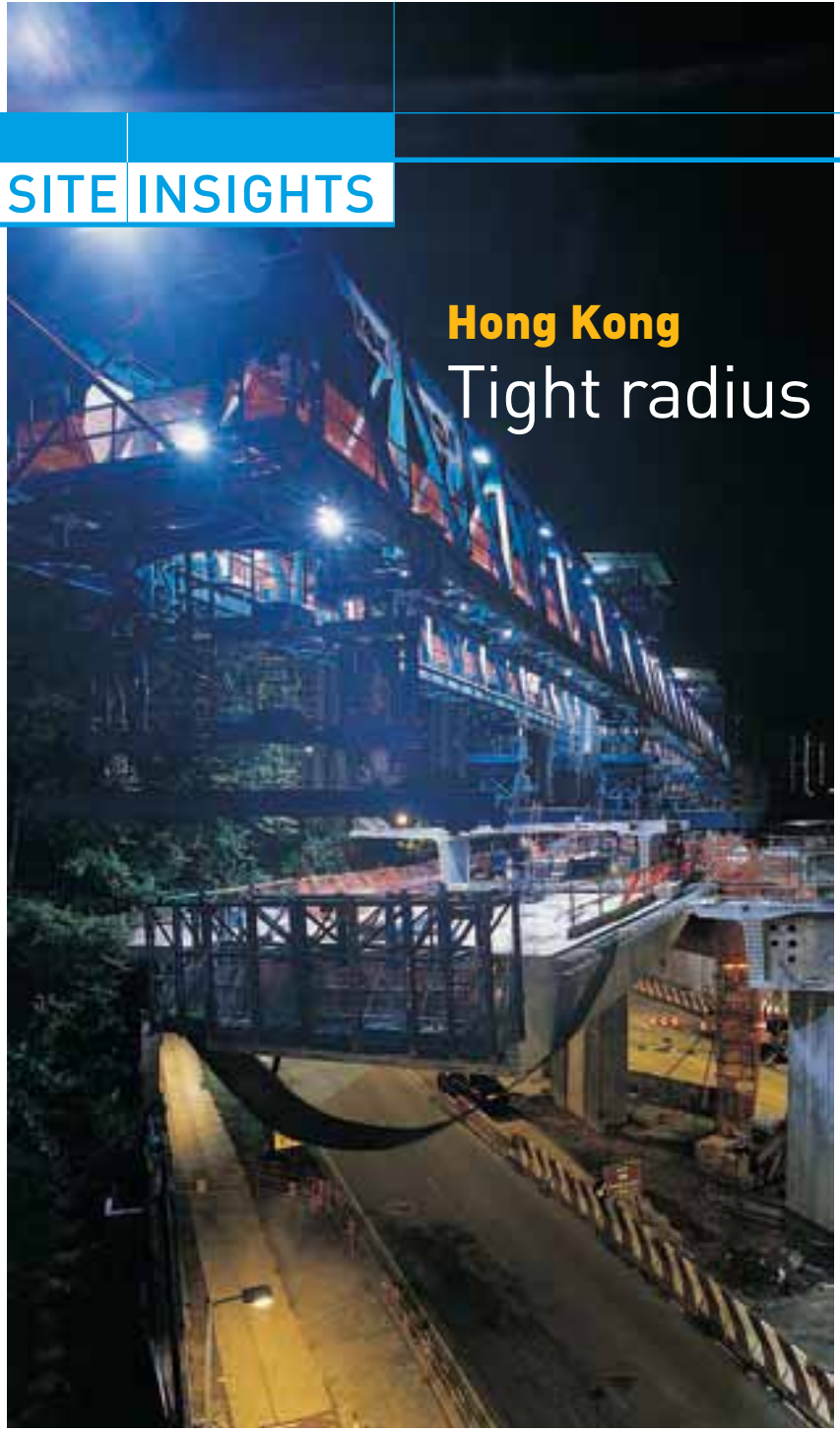
Contact: ganesh@vslindia.com

Thailand

Star turn for crosshead

→ **Building the new Third Stage Expressway in Bangkok,** Thailand could not be allowed to interfere with heavy traffic along the existing Bang Na Expressway. This posed an enormous challenge and VSL Thailand has developed a simple and cost-effective solution. The use of conventional propping for casting of the crosshead in the correct orientation would have caused serious interruptions. VSL Thailand therefore proposed an alternative method for constructing the upper portions: crosshead construction was to take place parallel to the existing expressway, with all work carried out within the confines of the traffic island separating the two carriageways. When ready, the crosshead can then be rotated into its final alignment by insertion of a two-part stainless steel plate and a series of Teflon plates between the upper and lower portions. Rotation takes place after the load is transferred and is carried out using strand jacks pulling against a jacking beam about a centring spigot. After rotation, the crosshead is fixed to the lower portion of the pier by stressing it down with a U-tendon system.

Contact: jmckenzie@vslth.com



Hong Kong
Tight radius

→ **Challenges abound on a major viaduct contract** VSL is carrying out in Hong Kong for a joint venture of Maeda, Barbican and Hsing Chong (MBHJV). VSL HK won the contract in September 2003 to erect the superstructure for the construction of Road T3 and associated work in Shatin. Construction started on site in February 2004. The project consists of several viaducts made up of 91 spans (1,806 segments) of varying segment weights and widths. All are built by the balanced cantilever method, working from multiple erection fronts. There is one launching gantry and a range of cranes. This is a very challenging project for VSL HK, both technically and in terms of site constraints. Spans vary in length, width and weight. Some have an extremely tight radius, requiring specific kinematics and the completed deck has extreme gradients and superelevation. There are restrictions on working hours and working areas, with most of the structure being built over existing roads which must remain in operation throughout the project. The contract has also involved the supply and installation of 1,600t of post-tensioning. Work started on site in February 2004 and the launching gantry is scheduled for relocation three times during the course of construction. ■ *Contact: michael.paice@hk.vsl-intrafor.com*

Hong Kong
Record drillings at Eagle's Nest Tunnel

→ **Intrafor HK has set a new drilling length record for Hong Kong.** Main contractor Leighton/Kumagai Joint Venture had issued its subcontractor Intrafor with the challenge to achieve a 2km horizontal investigation hole with directional control. The work involves the drilling with full coring of two horizontal directionally guided holes, 1,150m and 950m in length, as well as permeability tests and real-time monitoring of the net water outflow. The allowable drilling tolerance is a maximum inclination of 1% and a target at the drilling end within a semi-circle of 8m radius. The record-breaking hole was successfully achieved in October 2004. The investigations are part of the Eagle's Nest Tunnel project, the longest tunnel along Hong Kong's Route 8 from Shatin to Cheung Sha Wan. The two long horizontal holes were needed to obtain geological and hydro-geological information along the alignment. ■ *Contact: m-p.chan@hk.vsl-intrafor.com*

Korea

Accordeon effect on Ilsun Bridge

→ **Ilsun Bridge consists of 14 spans of composite post-tensioned concrete box girders** with corrugated steel webs. It is the first of its type in Korea. Hyundai Construction is main contractor for the bridge which is being built in Gumi city for Pusan Construction Management Office. This type of composite corrugated steel web post-tensioned concrete ILM bridge structure was first developed in France in the 1980s. Corrugated steel replaces the traditional concrete webs, which account for approximately 30% of the weight of a conventional PSC bridge. This method decreases the overall weight, extends the span length, and saves construction labour. Corrugated steel webs are 10% to 20% lighter than a traditional post-tensioned concrete box girder and have a high shear buckling strength. The webs have an accordion effect. Post-tensioning is efficiently introduced, and only to the bottom slabs, because of the accordion effect of corrugated steel webs which does not resist the axial force. ■ *Contact: hkkim@vslkorea.co.kr*

Vietnam

VSL frees up space in Hanoi

→ **Use of a VSL band beam slab system has saved money** and simplified the construction of a major project in Hanoi. VSL band beam slab technology gives large column-free areas, a simple layout, savings in materials, fast construction times and reductions in floor-to-floor heights. The building is situated in the city's Thanh Tri District and has a total gross post-tensioned floor area of 22,000m^2. The layout firstshowed a typical span of 6.6m by 6.6m using conventional reinforced concrete beams and slabs. VSL proposed a post-tensioned band beam slab, which cancelled a column grid and hence doubled the span length. This approach also helped solve many difficulties associated with a complicated column grid and the conventional reinforced concrete beams. Use of the system simplified installation and enabled the main contractor to achieve a fast construction time. The building floor plate was divided into three pours; each area could be undertaken by a small team which further reduced the overall cost. Several developers, owners, consultants and main contractors visited the site, and were convinced of the benefits of the VSL band beam slab technology .■ *Contact: tdl@vsl-vn.com*

NOTE PAD

U-shell for university. *VSL has come up with a weight-saving proposal for a contract to lift four transfer beams and a steel link bridge at the National University of Singapore. A U-shell design was proposed in order to reduce the weight of the pre-cast beams to a maximum of 230t each. The 32m-long beams had to be lifted to 28m above ground.*

Alternative for space. *VSL's alternative design for a complex in Hanoi, Vietnam, has brought great benefits with increased span sizes. For the Vincom City Towers, VSL proposed post-tensioning instead of the traditional reinforced concrete enabling the building to have 10m spans with a flat slab.*

Ramp in Riyadh. *VSL has achieved some repair works for the ramp No 4 at Cairo Interchange. This ramp is one of the main access roads of Riyadh. VSL scope of works included jacking the ramp, replacing some bearings, sliding the bridge back into position and fixing the joints. VSL has also jacked three bridges between Riyadh and Dammam and replaced the bearings.*

High-speed launch. *CTT-Stronghold has been awarded three separate contracts since April to carry out post-tensioning works and supply POT bearings for the new high-speed railway from Madrid to Valencia in Spain. VSL is supplying strand totalling 1 million t as well as 220 POT bearings. The project involves the installation of 1,810 anchorages, using an impressively wide range of units including 6-12, 6-15, 6-19, 6-24 and 6-31.*

Argentina

Anchoring the Andes

→ **RN 7 is the international route that links Buenos Aires in Argentina with Santiago in Chile.** It runs through the Andes mountain chain at about 3,000m above sea level, and is the main border crossing. Two snow sheds are being built above the route, near the border and just a few kilometres away from South America's highest peak, Aconcagua Hill (6,959m). The snow sheds will save the need to close the route during winter, when great quantities of snow accumulate. The horizontal forces that the snow generates in the roof are retained by 138 permanent rock anchors supplied by VSL Argentina. Chediack is main contractor and Fundaciones Especiales is carrying out the drilling. ■

Contact: vslargen@correo.com.ar

Thailand

Superhangar for air giants

→ **Sino-Thai Engineering & Construction has begun construction** of Thai Airways' latest maintenance hangar at the new Suvarnabumi Airport in Bangkok. The hangar will allow three giant twin-deck, four-aisle Airbus A380 airliners to be parked side by side. VSL Thailand and VSL Switzerland joined forces to provide the heavy lifting solution needed to allow this mammoth structure to come to realisation. The completed roof truss covers a plan area of 270m by 90m and in total will weigh approximately 7,800t. Lifting was broken down into three parts. Height of lift was 30m. Supporting perimeter columns are located directly under the line of the perimeter trusses, preventing their use as supports for the lifting equipment. Temporary lifting towers were used in specific locations during lifting. ■ *Contact: jmckenzie@vslth.com*

Spain

Silo design saves concrete and steel

→ **Post-tensioning allows a considerable reduction** in the amount of concrete and steel reinforcement needed for silo walls. It also enables much better control of cracking during the structure's life time. Owner Cementos Rezola - a subsidiary of Italcementi Group - decided to build a new silo with a capacity of 45,000t at the Añorga cement plant in San Sebastián. Contractor Estructuras Domo chose a post-tensioned solution: a silo with a concrete roof. The 38m-diameter and 27m-high silo is post-tensioned with 64 horizontal rings of 12/0, 6" (152mm) strand cables alternating over 120°. Cables are distributed in the wall so that their centre-to-centre distance increases with height. The silo wall is supported on 119 elastomeric bearings placed horizontally and also vertically. CTT-Stronghold was awarded the slipforming contract as well as the post-tensioning works and the supply of elastomeric bearings. The project will be completed at the beginning of 2005. ■ *Contact: rroussillon@vslsp.com*

Korea

Extradosed method

→ **Noksan Bridge is the first Korean application of the extradosed method** of bridge construction. Pusan Regional Maritime Affairs & Fisheries Office is the owner of this new bridge which links Pusan New Harbour with the expressway. Daewoo Construction Company is the main contractor and VSL Korea was responsible for the entire construction of the substructure and superstructure. Work was completed in just 21 months. The project is due for completion at the beginning of 2005. ■ *Contact: hkkim@vslkorea.co.kr*

Colombia

Bridge quartet

→ **Sistemas Especiales de Construcción is working on four prestigious structures in Colombia,** including the record breaking Barranca-Yondó bridge. This bridge over the river Magdalena is being built by Conconcreto. It has a central span of 200 m - a record in Colombia for this kind of bridge. Plastic duct has made its arrival in Columbia on the 92nd Street Viaduct in Bogotá, which is also being built by Conconcreto. The Caldas Avenue Viaduct - also in Bogotá - is being built by PESA. It is made up of 30m-long post-tensioned beams, 40 of which need to be executed in less than three months. Completing the quartet is the Juncal Bridge, also over the River Magdalena with Consorcio Alto Magdalena as contractor for the project. ■ *Contact: agonzalez@vslsp.com*

Heavy lifting in Germany

The biggest convertible in the world

One of the world's most spectacular roof structures was lifted into place over Frankfurt's newly renovated "Waldstadion" sports arena during June and July. There was tremendous time pressure to avoid disruption to the football season.

The total pulling capacity of the 88 units exceeded 21,000 t.

The roof lift in figures

- Weight of roof : approximately 3,000t
- Weight of cables: approximately 600t
- Length of all cables: approximately 16km
- Installed jacking capacity: over 21,000t.

The Waldstadion should be the biggest convertible in the world, as the roof's 9,000m² central section can be retracted and folded away within 20 minutes. The roof consists of a double-layered cable net structure, which will later be covered by a membrane. There are 44 radial cables, anchored to a compression ring running 709m around the top of the stands some 35m above the centre of the field. All 44 cables are also anchored to a massive central node, from which will hang a video cube with 10m-long sides.

The first activity was to remove the grass from the pitch and to replace it with gravel. All the components for the roof structure could then be laid out and assembled on this working surface and over the stands.

Ring of fire

Time pressure was tremendous as the roof had to be anchored into its final position during the short summer break in the football season. The lifting operation was executed in two stages. In a first step, the upper radial cables were pulled with 44 strand lifting units over a distance of about 30m. Work

44 cables anchored to a massive central node.

paused halfway through this operation, to allow installation of the flying masts between the upper and the lower levels of the tension ring. Although called a ring, this has an almost rectangular shape, a little larger than the pitch itself. It has been dubbed the "ring of fire" because all the flood lights are suspended there. By the end of eight days, all 44 cables had been anchored at the compression ring. The design has been optimised and the ring is very slender, weighing only 1,440t. Temporary struts stabilised the compression ring throughout the operation. Even so, the cable forces and movements had to be monitored within very tight tolerances. Information was continuously fed to the consultant for comparison with the calculated values.

Like a raw egg

The equipment was then reset for the pulling and tensioning of the lower radial cables. Two strand lifting units were installed for each radial cable for this second step of another 25m. The total pulling capacity of the 88 units exceeded 21,000t. The temporary struts at the compression ring were removed when only about 1m remained to be pulled. In this final

stage, all the 44 cables had to be pulled simultaneously within millimetres to prevent local overstressing of the compression ring. "Even though it's a structure of 3,000t, it had to be treated like a raw egg," said the project manager.

At 4.13pm on 16 July 2005 the last pin was set and the entire roof cable net was in its final position, ready to serve as a worthy venue during the 2006 football World Cup. ■

Owner: Waldstadion Frankfurt Gesellschaft für Projektentwicklung, Germany

Client: Max Bögl Stahl- und Anlagenbau, Neumarkt

Architect: von Gerkan, Marg und Partner, Berlin

Engineering consultant: Schlaich Bergermann und Partner, Stuttgart

Strand jacking operations: VSL (Switzerland).

Repair & Strengthening

Working high to challenge cracks

The Preheater Tower in Colorado, USA is perhaps the largest ever application of post-tensioning for a retrofit project. It was successfully carried out to a fast-track schedule, despite challenging circumstances that included working high on the exposed structure through a cold winter in severe wind conditions.

The Portland Precalciner Cement Plant in Colorado produces 1.9 million tonnes of cement a year. It has a reinforced concrete frame structure with equipment that extends up almost 120m. This equipment thermally processes raw material before feeding it to a dry-process cement kiln. Cracks were discovered in the concrete columns at three different levels just two weeks after the kiln's initial start-up. These cracks coincided with the terminations of flexural reinforcement in the concrete beams. Investigations concluded that the beam flexural reinforcement anchorage into the columns would need strengthening for both negative and positive moments. All the beam/column joints required retrofit, either to strengthen the joints, or to reduce demand on them.

Through the concrete

VSL developed a post-tensioning solution to get the plant back into operation quickly while avoiding interference with equipment or peripheral steel framing. This involved strengthening the tower by installing post-tensioning tendons in core holes drilled through the concrete columns and perimeter concrete beams at each level; and installation of PT bars . The post-tensioning tendons consisted of 0.5" (12.7mm) diameter, 1860 MPa low relaxation strands. Anchorages adopted were Type E 5-19, E 5-31 and E 5-37. The project used over 80,000m of strand - there were 114 tendons, each receiving 19, 31 or 37 strands. Specially-designed galvanized bearing plates transfer the stresses safely into the concrete.

It was essential to allow for the frame shortening that would result from tensioning. The repair team therefore released the original connections between beams and columns and retrofitted new connections to accommodate slip.

The original connections had been the primary means of transferring wind loads and so the team also had to retrofit an alternative load path. Columns were strengthened for shear by PT anchor bars, with over 1,000 anchor bars installed on the faces of the tower columns.

Top recognition

VSL's repair strategy meant performing many tasks simultaneously, with work carried out around the clock, six days a week by three shifts of some sixty people each.
General contractor for the scheme was Structural Preservation Systems and the post-tensioning supplier was VSL in Dallas, Texas. The unique post-tensioning retrofit resulted in a structure that is stronger and more durable than the original tower. VSL's repair and strengthening efforts on this project have gained top industry recognition with the 2004 Post-Tensioning Institute Award of Excellence, as well as a 2004 International Concrete Repair Institute Project of the Year award. ■

Stay cables

Liz Bridge: 18 stays in a single week

The 18 stay cables of Portugal's Liz Bridge were installed in the record time of just one week.

The Liz Bridge is part of the access route to the new Leira football stadium which was built in Portugal for the 2004 UEFA European Championship. The bridge owner is Leirisport and the designer is Grid - Professor Antonio Reis.

Construction was to a particularly tight schedule. Main contractor Soares da Costa achieved completion of the pylon and the 196m deck within just two months. VSL Portugal's challenge was to install and tension, strand by strand, the 18 stay cables within a week.

Each of the six stay cables of the main span is composed of two parallel cables spaced by 0.85m. These are anchored in the axis of the deck section by two passive anchorages located beneath the concrete deck. The total length of the stay cables in the main span varies from 20m to 58m. The six stay cables for the approach spans are composed of one cable anchored in the longitudinal axis of the pylon and in the axis of the deck cross section.

No assembly on site

To achieve this, the VSL SSI 2000 stay cable system has been installed on the bridge with 25 strands for each cable of the main span and 55 strands for each of the cables of the approach spans. The deck of the bridge was fully concreted on scaffolding. The VSL stay cable anchorages were installed during the construction of the deck and the pylon. The VSL SSI 2000 anchorages were fully prefabricated in the workshop so that there was no assembly operation on site. The pylon and the deck were fully constructed and equipped with the stay cable anchorages by the time the VSL stay cables installation team started work.

Pre-cut stay pipes

The HDPE stay pipes were prefabricated on site and pre-cut to length for the 630 strands. The pipes were installed using the main contractor's tower crane located at the pylon in order to achieve the one

week installation time. These stay pipes can also be installed using small VSL winches. Each stay pipe was installed and supported by one strand tensioned to the pylon and to the deck anchorages. All 18 stay pipes were then installed within three days by a single team of three people. Two independent VSL teams installed the strands and carried out the tensioning operations, one on the main span cables and the other on the back span cables. They worked during the same period when the stay pipes were being installed, with a time-lag of two days.

Lightweight equipment

Lightweight equipment enabled high productivity. VSL used equipment specially designed for the stay cable installation, in particular with the use of two small VSL winches. Each cable was installed by a team of three. Two teams were at work day and night and each team could install two stay cables in 10 hours. The 630 strands of the 18 stay cables were installed and tensioned within five days, using two AMS monostrand jacks of 20kg weight. This allowed the bridge to be opened to traffic in time for the first match of the European Championship.

The biggest challenge was for the main contractor. Close co-operation between the partners was however the key to success. The flexibility provided by the VSL SSI 2000 stay cable system allowed the schedule to be optimised. ■

Bridges

Three girders and a first in Santiago

The contract to build Santiago Metro's fourth line is a priority project for the Chilean State and has a high profile. The project is also notable as it marks Chile's first use of launching girders to erect pre-cast segments. VSL has met the challenge by assisting the client efficiently with technical aspects of this major scheme.

1 Client

The contract Metro Linea 4 was awarded to VSL Systemas in July 2003 by the main contractor VEI, a consortium of three Chilean companies: Vial y Vives, Echeverría & Izquierdo and Icafal.
This 7,200m-long pre-cast segmental viaduct runs south to north in the outskirts of Santiago as part of the extension to the existing Metro.

2 Scope

VSL was responsible for:
- *design and fabrication of the pre-cast plants: six long benches and six cells*
- *design, supply and operation of the three launching girders;*
- *post-tensioning and grouting activities;*
- *supervision of the pre-cast yard and the erection works;*
- *the supply of elastomeric bearings.*

3 *Bridge*

The viaduct is composed of 35m-long spans, 214 in total. The spans are isostatic, supported by four neoprene bearings, with nine to eleven prefabricated segments (3.5m long), post-tensioned by 10 to 18 tendons, each with 12 cables of 15mm diameter. Each segment weighs about 40t and is 10m wide by 1.8m high. Three spans have been erected on scaffolding as the clearance below the existing high-voltage line did not allow for the use of launching girders.

4 Segment fabrication

The pre-cast yard was designed by VSL and was composed of six long benches for span fabrication and six cells for fabrication of the segments on piers. Three pier segments were fabricated each day and two standard segments were completed on each bench every day. In a normal cycle, 15 segments were fabricated every day. Special moulds were installed to make five special curved spans. VSL provided all the post-tensioning equipment.

5 Erection works

Three launching girders each worked night and day to erect between 60 and 78 spans. One of the girders was designed by VSL Singapore and fabricated locally. One span was to be erected every two days; some were erected in just 26 hours. The specifications did not allow the use of inserts crossing through the segments: 0,6" (15,2mm) cable and light inserts for the temporary PT were used instead of traditional threaded bars. The post-tensioning activity - which was on the critical path of the erection works - was achieved within 8 to 10 hours.

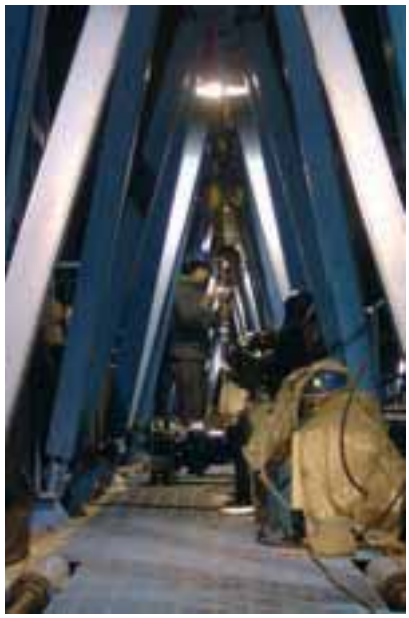
TECH SHOW

6 ***Schedule***

The first spans were erected by the end of February 2004. The three launching machines were commissioned at almost the same time, enabling 15 segments to be constructed every day from March. The erection work was completed by early October. Grouting, guard rails, joints and bearings were then installed within a month. Partial handover to the client could start as early as July 2004.

7 ***Context***

The area in Santiago's outskirts is urbanised and so public safety has been a constant priority. In addition, the impact on the environment has been minimised to avoid disruption to the everyday lives of local residents.



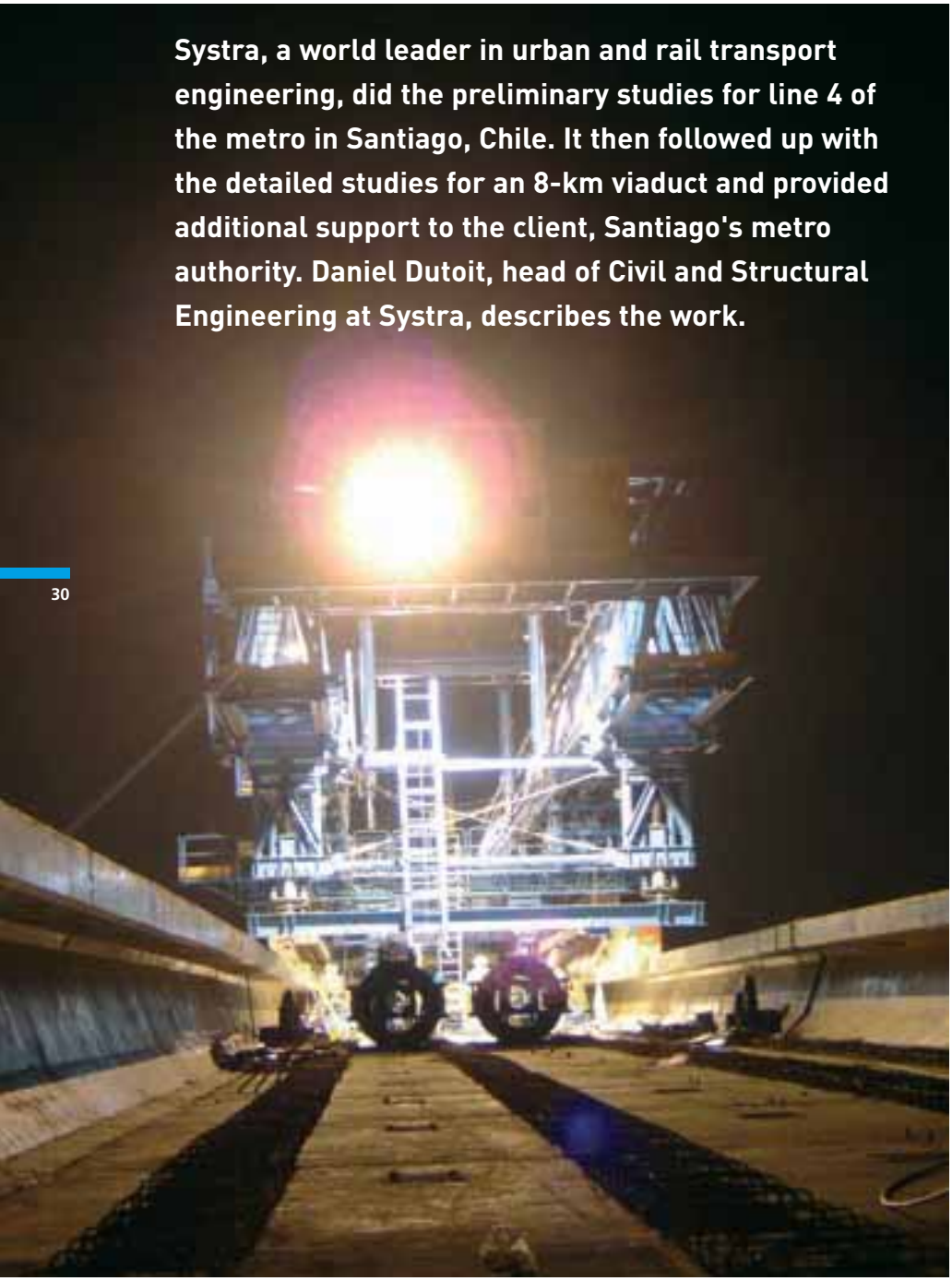
8 *Achievements*

The Metro Linea 4 project also includes tunnels and stations. It has a very high profile in Santiago and in Chile as a whole and is classed as a politically high-priority project. Using launching girders to erect pre-cast segments was a first in Chile. VEI and Metro promoted the technique, including presenting it to Chile's President, Ricardo Lagos. VSL has been able to assist the client efficiently in solving the technical challenge and achieving the targets, while managing 13 nationalities on site. VSL's performance in terms of keeping to schedule has been noticed. The project has also demonstrated VSL's ability to extend the range of activities in countries with no previous experience of this kind.

Interview

Look for optimisation!

Systra, a world leader in urban and rail transport engineering, did the preliminary studies for line 4 of the metro in Santiago, Chile. It then followed up with the detailed studies for an 8-km viaduct and provided additional support to the client, Santiago's metro authority. Daniel Dutoit, head of Civil and Structural Engineering at Systra, describes the work.



Daniel Dutoit, head of Civil and Structural Engineering at Systra.

What do think of the interaction with VSL in the line 4 project?
It has been very good! We have made some big improvements in construction methods. Among other things, that included the temporary load requirements during the construction in a country with a lot of seismic activity. VSL was very careful in setting these limits. It was quite a challenge.

Is it especially risky working here?
We weren't given a lot of time, and the political deadlines related to the construction were important. It's always risky, but the time allotted for projects gets shorter and shorter.

Are these U-shaped segments a Systra speciality?
Yes, we have in fact developed special structures for viaducts located in urban areas. This U shape allows the rails to be placed at a lower level. The structural element can then serve to reduce noise, the danger of derailment and the visual impact, with an integrated barrier. We are very satisfied with the finish of the concrete. The quality is very clean. VSL's long line technique also allows each segment to be concreted against the preceding one. The assembly of the segments on the site allowed for the lowering of the assembled span around a seismic shear key at pier top.

What future do you see for structures like these?
Right now we are designing or building over 100 km of viaducts with U segments around the world. They are less costly than tunnels, which is an advantage for developing countries. More and more urban transport projects are being undertaken. Systra is developing its offer of advanced solutions, where optimisation is possible thanks to its partners' expertise. In Santiago, assembling the segments by complete spans was a solution that enabled VSL to implement specific methods in an operation they are very familiar with - for example, using three launchers at the same time. ■

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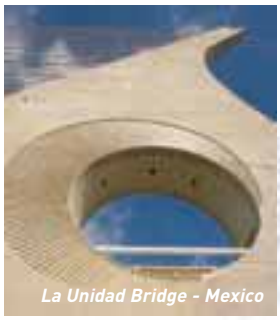
Kisosansen Bridge - Japan

Your post-tensioning partner


Roof for Airbus A380 - France


La Unidad Bridge - Mexico


Chongquing Masangxi Bridge - China


Manhattan Heights - Hong Kong

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


Seonyu Footbridge - Korea


John-Paul II Bridge - Poland


Austrack Project - Australia

VSL

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