VSL NEWS

THE VSL NEWS MAGAZINE • ISSUE TWO 2008

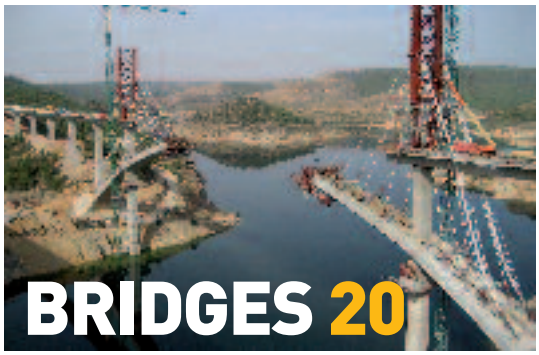
STRATEGY

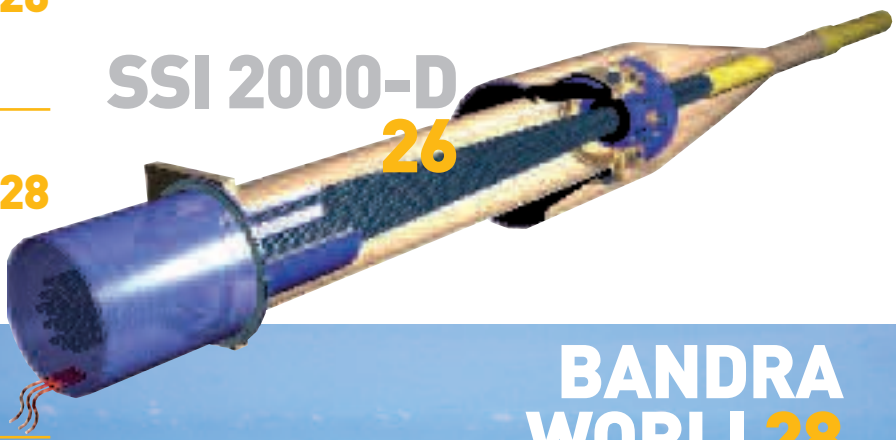
Training for excellence

Dry air system for stays

Bandra Worli Sea Link

highlights





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Cover photo : Training on safety

EDITORIAL

Well-trained staff: our greatest asset

In VSL's business, technologies and regulations are constantly evolving. Thus, continuous training of our staff is a must for us as a leading company. Over the years, VSL has undertaken considerable efforts in structuring and formalising training at all levels of the company to maintain our expertise at the highest level.

Our massive recruitment of staff in recent years has led us to implement new training initiatives, including a great new tool, the VSL Academy. VSL's training centre is a unique in-house university dedicated to post-tensioning techniques. The aim is to ensure that best practices are covered and applied, and that all members of staff adopt the same high standards of quality. Whatever technical improvements – large or small - are achieved in any of VSL's many locations, they are immediately spread by the VSL Academy to allow our entire network to benefit.

Technical excellence is vital for both the staff and the project. A strong training policy is of strategic importance to increase the overall performance of the company by contributing to ever-enhanced quality improvement – and productivity. Our training policy also addresses a key issue: striking a balance in our development plan between the economic profitability of our businesses and its social and environmental impact.

We believe that a well-trained staff is our most valuable investment in better service to our clients.

Jean-Philippe Trin, CEO

ACTITUDES

Changing the way we do business

For VSL, sustainable development means striking a balance in its development model between the economic profitability of its businesses and their social and environmental impact. Decisions at every level must take account of all three facets of sustainable development: economic, social and environmental, not merely economic.

According to the United Nations, development is sustainable if it *"meets the needs of the present without compromising the ability of future generations to meet their own needs"*. Sustainable development does not mean giving up on growth. Rather, it means developing in ways that can be sustained by the planet over the long term.

Sustainable development has three facets:

Economic: promote economic growth to create wealth for all by fostering sustainable patterns of production and consumption. This implies rational use of natural resources, sound corporate governance and professional ethics.

Environmental: preserve, improve and develop the environment and natural resources over the long term. Resource preservation involves reducing environmental impacts and managing and recycling waste.

Social: uphold social equity and fundamental human rights (as set forth in the Universal Declaration of Human Rights). For companies, this includes anti-discrimination measures, combating child labour, enhancing welfare policies and protecting workers' rights. The sustainable development approach of VSL is based on seven aims:

Foster a trusting relationship with our clients, based on consideration, transparency and innovation.
Building a genuine trust-based relationship with our clients means willing to listen, acting in complete transparency and offering performance guarantees in terms of quality, safety and the environment. Client trust is also determined by our capacity for innovation with a view to meeting their expectations, especially in terms of environmental protection.

Incorporate risk into the day-to-day management of the company.
In addition to clearly identified technical and financial risks, we want to step up vigilance on the environmental, social and reputation risks arising from our operations. Heightened vigilance in these areas implies enhancing existing procedures and improving employees' risk-management skills.

Lead our business sectors in terms of occupational health and safety.
We are determined to lead our sector in terms of safety, by continuously upgrading prevention, involving our partners and subcontractors in our approach to safety, increasing workplace ergonomics and expanding our road safety action. We also want to further improve the health of our employees, particularly by raising awareness of the dangers of alcohol, smoking and drug abuse.

Develop our employees' skills and promote equal opportunity.
We will make VSL a more attractive company by fostering the personal development of our employees, encouraging cultural diversity, increasing the numbers of female and disabled employees and giving all employees the opportunity to be responsible citizens.

Establish balanced, long-term relationships with partners, suppliers and subcontractors.
We intend to build genuine partnerships with our subcontractors by involving them in our progress plans for quality, safety and environmental protection and in combating illegal labour. With respect to our suppliers, especially in emerging countries, this means being stringent on quality and labour standards.

Ensure that our businesses respect the environment.
Integrating environmental concerns at VSL first means designing facilities that consume less energy and resources and that blend better into their surroundings. It also means reducing energy and natural resource consumption on our work sites as well as minimising the disturbance for local residents. Lastly, it means encouraging environmentally-friendly habits in every employee, because 2,900 small efforts to help the environment on a daily basis have a big impact.

Participate in the economic and social life of the regions where we operate.
We want to play an active role in the economic and social life of the regions where we operate, by supporting associations and organisations that help reintegrate people in difficulty and by providing financial assistance for actions in education, health and heritage preservation. ■

Milestones in sustainable development

1972: Limits to Growth, a report commissioned by the Club of Rome that models the impact of finite resources on economic growth.

1987: The concept of "sustainable development" appears officially in a report by the United Nations' World Commission on Environment and Development. Drafted by Gro Harlem Brundtland, then prime minister of Norway, the report defines the concept as development that *"meets the needs of the present without compromising the ability of future generations to meet their own needs".*

1992: The Earth Summit in Rio de Janeiro (the second UN Conference on Environment and Development), 173 heads of state sign "Agenda 21", a programme of action for the twenty-first century to foster sustainable development.

1997: 11 December in Kyoto, Japan, the countries that signed the UN Framework Convention on Climate Change adopt the Kyoto Protocol to reduce greenhouse gas emissions (including carbon dioxide, methane and nitrous oxide) after the year 2000.

2007: The conference of Bali culminated in the adoption of the Bali Road Map, which consists of a number of forward-looking decisions that represent the various tracks that are essential to reaching a secure climate future.

Energy Audit at VSL Singapore

VSL Singapore recently conducted their first energy audit. The audit was carried out at the main office, workshops and store, and initially covered electricity consumption. The main finding from the audit was that 2.3t of CO_2 emissions could be eliminated per year simply by turning off electrical appliances at night, or when not in use, and that several hundreds of Euro could be saved. While this may seem small, on the back of this it has been decided that a comprehensive study (including cost-benefit analysis) into energy saving devices and equipment for the office and existing workshops is worthwhile; a similar study into alternative energy sources (e.g. solar, wind) to partially power the new workshop are warranted; and, that arranging an energy audit by an external expert would likely bring significantly more savings. Step by step progress will lead to substantial savings. ■

Hard hats protect smart heads

A total of about 110 staff members, including labour, foremen, supervisors and engineers from different projects celebrated the 37th National Safety Day in the North Region, Delhi. The senior staff supported the day and insisted on the importance of quality, safety and environment to all the attendees. ■

VSL and the Lighthouse Club

The Lighthouse Club is a non-political organisation that raises money, through social activities, to assist less fortunate persons who are associated with the construction industry. VSL has been involved with the Club for many years in Hong Kong as a corporate member, and a number of staff have individual memberships. In 2008 the increased level of commitment has resulted in the company being invited to join the Lighthouse Club Asia-Pacific committee. VSL was also invited to join the Club's Hong Kong Safety Committee. In this role VSL will work on the preventive measures that will help avoiding accidents in the future. The Lighthouse Club and VSL's objectives align closely in many areas, assisting accident victims, education, safety standards, encouraging women to work in the industry, and simply being involved in the communities where VSL operates. ■

Kazakhstan

Capital projects for VSL

→ **VSL has opened up business opportunities in Kazakhstan** and is busy on key projects for the new capital, Astana. VSL Heavy Lifting is currently executing three projects for Turkish contractor Samko and VSL Special Projects is working on two arch bridges for Mega Yapi Construction. A very innovative method, proposed by Wiecon of Taiwan, is being used to erect Ramstore Bridge's 180m-span arch. The arch is temporarily hinged on one abutment and is lifted using a relatively small gantry to allow the addition of each segment in turn. The bridge's hangers are from the VSL SSI 2000 system and the longest is 60m. The scheme will be finished in October and will be followed by a second contract, called M3 Arch. A spectacular project involves the erection of the 130m-high central mast of the Khan Shatyr Entertainment Center. A temporary mast uses 16 SLU-330 strand lifting units to provide the required 2000t pulling and tie-back forces. The same equipment will lift five roof trusses of up to 500t for a new Indoor Stadium. ■ *Contact: christophe.petrel@vsl.com*

Network

Peruvian license

Right: Francisco Capurro (Director of SEC Perú), left: Carlos Ibargüen (General Manager of SEC Perú)

→ **VSL has announced that SEC Perú** (Sistemas Especiales de Construcción Perú) is its newly appointed licensee for the promising Peruvian market. The agreement with Lima-based SEC Perú will allow VSL to offer its services more efficiently to local and foreign contractors. SEC Perú's experience in post-tensioning dates back to 1995 and the licence extends its scope of work to include the full range of VSL construction solutions. The two companies are assessing new projects being tendered in Peru with the aim of expanding the scope of work and becoming the leader in specialist construction techniques there. The new arrangement allows VSL to offer an enhanced service to its clients in Peru. VSL had already worked on some major projects there in the past, including ground anchors for the 1980s Machu Pichu Dam, heavy lifts on the Camisea gas project between 2003 and 2007 and recent interchanges in Lima. ■ *Contact: ealonso@vslsp.com*

Bondtech

Spanish hospital success

→ **VSL Bondtech® PT slab technology** has enabled a significant development in the structural design of Spanish hospital buildings. In the last four years, CTT Stronghold (VSL in Spain) has used the Bondtech® system to provide solutions for four major new hospitals together with other smaller medical centres. A total of more than 180,000m² of PT Slabs has been installed, with spans of up to 18m. The VSL Bondtech® bonded monostrand post-tensioning system is ideally suited to the way that layouts often change to accommodate new equipment and uses while the hospitals remain in service by allowing easy openings in the concrete slabs. Specialist architects are taking advantage of the technology to introduce open, column-free areas in order to create flexible buildings without any major extra costs. VSL bonded post tensioning is also allowing the implementation of free cantilevers or transfer slabs. Specialised architects in Healthcare buildings are using bonded PT slabs in projects such as the new Lugo, Burgos or San Sebastian de los Reyes hospitals.

■ *Contact: posso@vslsp.com*

Ground Investigation Department

Unlimited growth

→ **Success in a stringent technical assessment** means that Intrafor Hong Kong can now tender for government ground investigation projects of unlimited contract value. The assessment, which was carried out by the HK Government's Geotechnical Engineering Office, has resulted in Intrafor's Ground Investigation Department being upgraded to Group II in the list of approved suppliers and specialist contractors. The first project carried out under the licence is a major ground investigation sub-contract awarded by the Dragages – Nishimatsu JV on the Hong Kong West Drainage Tunnel scheme. Research and development in ground investigation is also going strong with the development of Intrafor's own directional coring system, which is being fine-tuned using in-situ tests. ■ *Contact: mp.chan@vsl-intrafor.com*

Stay cables

Vilnius debut

→ **The Karoliniskes Footbridge in Vilnius is VSL's first project in Lithuania.** VSL is supplying its SSI 2000 stay cable system for the bridge, which was initially designed as a suspended structure using steel rods. Bridge contractor is UAB ViaCon Baltic. The bridge has two steel pylons, each with a pair of back stay cables of SSI 2000 6-19 with 14 strands. The main span is supported from two pairs of cables, which are made up of SSI 2000 6-12 with seven and five strands. The total tonnage of the plastic-coated strands is just 1,700kg as the maximum stay length is 22m. The cables were fully prefabricated prior to erection instead of using the strand by strand method. Because of this, the DS anchors inside the pylon trumpets were modified to use a compression fitting instead of wedges. ■ *Contact: mstrachota@vsl.cz*

Cable-stayed bridges

First for Turkey

→ **Turkey's first cable-stayed road bridge is being fitted** with VSL SSI 2000 Stay Cables. Manavgat Bridge's steel deck and pylon have been erected by Mega Yapi, which is VSL's licensee in Turkey. The bridge has been designed by Pöyry Infra Asia and is owned by the Municipality of Manavgat/Antalya. It has a single pylon and two spans of 102m. Steelwork has been manufactured by Aykon. A total of 28 stays, sized from 6-19 to 6-31, will support a 14m-wide composite steel deck. The 50t of replaceable stays are galvanised, waxed monostrands placed in an external PE pipe with no grouting. ■ *Contact: byildirim@megayapi.com*

Stay cables

Brazil's widest

→ **VSL SSI 2000 stay cables are being installed** on the Cidade de Guarulhos Bridge over Brazil's main highway from São Paulo and Rio de Janeiro. This is the first cable-stayed bridge in Brazil to be equipped with VSL Stays and, at 23.1m wide, features Brazil's widest stay-supported deck. The bridge has been designed by Outec Engenharia and is being built by Construções e Comércio Camargo Corrêa. It has a main span of 100m and a side span of 70m and involves a total of 123t of replaceable stays. The 27 stays that support the concrete deck are galvanised, waxed monostrands placed ungrouted in an external PE pipe. ■ *Contact: diretor@rudloff.com.br*

Awards

→ Miravelle Tower, a project completely designed by VSL Mexico (21,000 m² including foundations) has taken the first national place and the second international place in the OBRAS CEMEX Award in recognition of its construction and structural design.

→ At the 20th edition of the Argentina's Structural Engineering congress held in Buenos Aires in October 2008, the Pastaza cable-stayed bridge built in Ecuador was recognized as Remarkable Sructure of the years 2007/2008 and their designers (H. Cabjolky, C. Amura y M. Ameijeiras) together with the main contractor JCCC from Argentina received the prestigious José Luis Delpini prize. ■

COVER STORY

VSL Academy's facilities in Bangkok provide a strategic tool for staff training

HUMAN RESOURCES DEVELOPMENT

Training for Excellence

Technically demanding projects and the highest requirements in terms of quality of service reflect themselves in a resolutely proactive training organisation within VSL. Given the massive hiring of staff in the last years, new actions are implemented to properly train and to keep competent and expert staff.

COVER STORY

The VSL Academy experience also creates group cohesion

Training is the keystone within a human resources department and within VSL, staff training has become a strategic topic. In a business where technical excellence is vital both for the staff and the project and where technologies and systems are constantly evolving, it is of utmost importance to properly train and to keep competent staff. VSL is undertaking considerable efforts in structuring and formalising training efforts at all levels of the company.

The continuous development of VSL's staff is a key factor for an excellent performance. It is thus becoming vital to properly manage competences internally and structure training accordingly. For the permanent development of the asset "competence" in organisations, professional training and qualification measures are adapted to organisational and personal needs. VSL is increasingly specialised in their activities and faces highly competitive markets. Technically demanding projects and the highest requirements in terms of quality of service reflect themselves in a resolutely proactive training organisation within VSL. It is furthermore of great interest for the company to address the motivations and ambitions of the staff, to have a permanent exchange concerning ambitions and requirements in order to fulfil the needs of both, the company and the staff.

Back to basics: VSL Academy

The transfer of knowledge and acquired experience by senior staff to new staff members is one of the possibilities to pass on not only the technical details but also the company culture and values. Given the evolution in recent years, the massive hiring of staff in new regions, such as India, Vietnam, the Middle East and Mexico, on the one hand and the retirement of experienced staff on the other, this intergenerational transfer is no longer guaranteed throughout the

Hands-on training is an essential part of the certification course

ever growing network. It has thus been decided to create the VSL Academy, a unique Post-Tensioning training centre in Bangkok.

VSL Academy officially launched its first certification class on February 11, 2008. To ensure that best practices are covered and applied, the training sessions are given by experienced staff and are based on the latest updated VSL Field Manual. Access to the various levels is stringent: a written exam has to be successfully passed to fulfil the requirements in stage certification. Before being admitted to the next level, the participants have to be involved in Post-Tensioning works for a minimum of one year. This is recorded in a Project Log Book commented and approved by their respective Project/Site Managers.

Groups are small and participants come from all regions of the network to foster company values.

VSL Academy on stage

The Certification scheme has been designed and structured into 3 stages. Stage 1 brings participants to Foreman level, Stage 2 to Supervisor level and Stage 3 to Site Manager level.
Upon successful training, students return to the work sites and start implementing procedures and tools they have learned about at the Academy. During the next months, VSL will be carrying out operational audits on these implementations and on the "effects" of the training courses in the day-to-day business. Efforts will be extended in 2009.

The Academy presently schedules one Certification class per month with 20 participants each. VSL Academy does not intend to limit its scope and Certification courses to Post-Tensioning works, other training sessions will be introduced on an on-going basis, new tools, new equipment, maintenance and cover other activities such as stay cable, heavy lifting.

To enable hands-on practical training, post-tensioning mock-ups have been built on the Academy's premises and further mock-ups are being designed to cover other appropriate operational procedures.

The VSL Academy is teaching people a lot. Courses are appreciated by the trainees as shown in the ratings. Pelle Gustavsson, VSL Academy's headmaster, says: *"In stage 1, we basically teach them how to walk. Stage 2 teaches them how to run, and in stage three they will run the obstacle course."*
Whereas stage 1 is the training on PT basics and fundamentals, stage 2 really goes into problem solving and some into other P-T techniques like external P-T. Finally stage three will cover more the theoretical part of the certification, where participants will have some

external lectures from our Technical centres adding to our student's knowledge.

Better understanding

Students' feedback underlines the better understanding that VSL Academy provides. Yuttana Mekruerod, project manager on the Bankuwat project in Bangkok says: *"VSL Academy trains us on how to work safely and properly. The course enables me to find solutions for difficulties I may encounter on a worksite. It gave me a better understanding of VSL techniques."* John Dan, project manager in Hong Kong, comments: *"VSL Academy was a very useful experience for me. It can help to refresh your knowledge. I have already started to implement techniques and tools on the site I am working on..."*

Transfer of experience to maintain highest standards

VSL Academy

We all speak the same language

Fredy Schwab, a senior engineer who is with VSL for more than 30 years, comments on the VSL Academy: *"The Academy is not good, it is excellent. It teaches us to speak the same language throughout VSL. This kind of training session could also be good for people that do not actually work on site, but also for office staff, quality control, purchasers... so that everybody uses the same words for the same tools. These training courses are very useful. The headmaster opens every session with: what is the best thing VSL has? The answer is: it is the Field Manual. And the second best: the telephone list. Whatever the question will be, you will be able to find someone within the VSL network who has already encountered the same or similar situations and he will be able to help you. The VSL Academy will help to bring everybody to a same level of knowledge, and it will of course create a group cohesion that is so important in our operations. Even experienced staff could come here, learn something and fresh up their memories..."*

Participants come from all regions of the network and learn to speak one common language.

The VSL Academy premises are also quite inviting for potential clients willing to witness the post-tensioning market leader's strong points in terms of in-house policy for quality of service, safety, and approach of proven or new technologies.

Enhance Safety

VSL's bridge and structure construction projects involve the operation of major items of machinery, which are usually designed or adapted to meet the specific conditions and constraints of the particular project. This means that VSL's equipment is usually one-of-a-kind, complex and controlled by multiple operators. It therefore requires a high level of engineering, coordination and skill in order to ensure safe and efficient operation. VSL has recently launched the permit system MEOP (Major Equipment Operation Permit) which has become compulsory for the operation of all major equipment on VSL projects to improve safety and efficiency.

The permit requires project staff to assemble and operate major equipment in accordance with strict requirements. A permit is granted only if a panel of expert auditors approve that all aspects of the equipment have been checked so that it can be operated safely, properly and effectively. Areas covered include design, fabrication, assembly and commissioning, as well as the on-site preparations. A permit is valid for a period of 6 months and has then to be renewed.

Managing Excellence

The continuous individual professional development is not only of strategic importance for the company but also for the staff member who has the chance to move on in his professional career. Originally initiated by the management of the Asia-Pacific region in 2006, the PMX – Project Management Excellence - training sessions have been created to train a new generation of Project

Best practices are acquired at the VSL Academy and implemented on the worksites

Back to basics and continuous training on safety

E-learning

E-learning is easy to be distributed and can be provided on many different supports. There is no limitation in time and space, no limitation in the number of persons to be trained. VSL is providing throughout the network CDs showing VSL techniques and methods. Furthermore, over 150 training videos concerning 8 activities, a total of 45 hours of VSL-specific training are available. Updates and new videos are continuously prepared and are available online for internal use only.

Managers, with a forecasted need of 25 new Project Managers per year in the Asia-Pacific region. The objective of these sessions is twofold: the main objective is to improve the knowledge and objective management capabilities and to prepare the personal and career development of managers with an identified potential. At the moment, the third training session is ongoing.
As of 2009, the principle of PMX will evolve and be upgraded taking into account the experiences of the last three years of training sessions and in order to further reinforce the acquisition of VSL's fundamental values and motivations. The sessions will also be extended to other staff in management positions.

No space or time limitations

E-learning or electronic learning is a training method that provides pedagogic contents on an electronic support (CD, Internet, intranet, extranet, interactive television, etc). It allows flexibility of the training, i.e. self-training upon demand, according to the individual rhythm. It is less cost-intensive, easy to be distributed and thus well adapted to VSL's network organisation. VSL provides and distributes such individual training online with specific videos and presentations.

Other training programs are also organised at Group level to develop competence. The international Ulysses and Marco Polo programs are for junior executives headed for senior management status. Participants take a good look at the world at large, business conditions and business organisations, which improves their perspective on the position, role and duties of the individual within the corporate environment. Another axis of training is bench marking in transverse functions, such as financial controlling, accounting and others. Experiences, potentially repeatable successes, best practices as well as new tools and procedures are shared between the different business units for the best

Well trained staff is VSL's most valuable stake

possible use. Last but not least, such sessions with middle and top management enhance a personal network within a multi-national and multi-cultural company.

At VSL it is considered the manager's task to discuss expectations and needs in terms of training and to provide appropriate measures. These actions are measured to fit VSL's priorities: *"Well trained staff is our most valuable stake to better service our clients*, says Thierry Serres, Human Resources Manager of VSL. *Staff members who enjoy their job increase the overall performance of the company. They contribute to VSL's success and ever enhanced quality improvement."* ■

Major Equipment Operation Permit

The MEOP includes the review of the following items: the site documentation, the inspection of the equipment assembled as well as the site organisation and staff experience and skills. Finally, a special emphasis is put on the enforcement of the rules and procedures related to the operations.

Project management excellence training

PMX sessions are organized in 4 courses of 3 to 4 days, in January, May, September and December. The place of the sessions changes depending on ongoing worksites and interesting projects, the availability of guest speakers or any other relevant event.
The program's content combines technical topics, planning, organization, risk management, result orientation with communication topics, leadership and management of change. VSL's managers thus transfer the fundamentals and culture of the company, promotes exchanges and useful networking throughout the group. The courses are also completed by external keynote speakers and information on the latest requirements.

Spain
Expertise in action

→ **CTT Stronghold (VSL in Spain) is working on the construction of the Embalse de Contreras Viaduct,** which is one of the main structures on the Madrid – Valencia high speed railway. Upon completion, its arch will be the biggest concrete arch of a railway bridge in Spain. The project involves the installation of temporary stays, post-tensioning works using CS Anchorages and Couplers, as well as the supply of 30 pot bearings with capacities from 900t to 1,900t. The 587.25m-long viaduct's main span takes the form of a concrete arch. The 261m-long arch is built by the incremental cantilever method and is supported temporarily by stay cables, which are anchored to an auxiliary steel structure built on temporary and permanent piles. The stay system has been designed to ease the stressing and destressing operations through a combination of anchorage design, transfer beams and an arrangement of jacks. Main contractor is a joint venture, AZVI – San José, and the specialist subcontractor for the bridge is Estructuras y Montajes (Grupo Puentes). The project engineers are from designer Carlos Fernandez Casado and EIPSA. ■

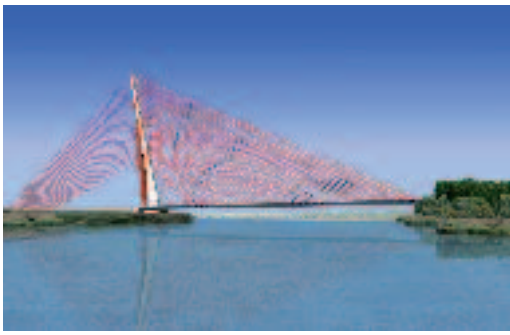
Contact: gislas@vslsp.com

Portugal
Parallel success

→ **Portugal's west coast highway crosses the River Mondego** through a 610.6m-long bridge designed by Armando Rito Lda. Each of the two independent 18.1m-wide parallel decks has two 135m main spans, two spans of 100m and side spans of 56.6m and 84m. Main contractor Somague Engenharia SA built the box girder decks using the cast-in-situ balanced cantilever method with seven pairs of form travellers. A fast cycle of two castings a week meant that cables had to be tensioned just 16 hours after each segment was cast. VSL Portugal supplied and installed 1,000t of post tensioning cables.

■ *Contact: ralmeida@vslsistemas.pt*

Spain
Talavera Y



→ **CTT Stronghold (VSL in Spain) has won a package of work** for a 318m-span landmark cable-stayed bridge at Talavera de la Reina. The 183m-high pylon inclines backwards and carries two parallel layers of stays for the main span as well as two sets of backstays. The backstays end at massive anchorages situated off to the sides, giving the stay cables a Y shape when viewed in plan. VSL's work includes the supply and installation of 152 SSI 2000 stays (90 m to 410m long), totalling 2,200t. VSL also supplies and installs dampers, both Gensui elastomeric and friction units. Another VSL role on the project is the supply and installation of 890t of PT. ■

Contact: pferrer@vslsp.com

Colombia

Coastal cables

→ **VSL has been awarded a contract on a cable-stayed bridge** with a 150m-long main span in Buenaventura, on Colombia's pacific coast. VSL's licensee in Colombia, Sistemas Especiales de Construcción will be responsible for the installation of stay cables for the Piñal Bridge, which is scheduled to begin in March 2009. Consorcio Puentes CF-C-116 is the main contractor for the bridge, which has been designed by Pedelta and is being built for client Instituto Nacional de Vías. Germán Escobar Ingenieros is responsible for the construction methodology. The 80t of replaceable stay cables

are from the VSL SSI 2000 range. There will be 80 replaceable stays equipped with saddles at the top of the pylon, ranging in size from 6-12 to 6-31. The project will use galvanised, waxed monostrands placed ungrouted in an external HDPE stay cable pipe. ■ *Contact: agonzalez@vslsp.com*

Spain

Accurate arch

→ **Post-tensioning by CTT Stronghold** (VSL in Spain) was successfully completed in June on one of the main structures of the high speed railway in north-west Spain, following a spectacular heavy lifting operation at the end of last year. The Eixo Viaduct, close to Santiago de Compostela, has a total length of 1,224m, with 24 piers and typical spans of 50m. Use of a 100m arch for the central span provides the required structural response to one of the main constraints of this kind of structure: the braking forces generated by trains. A similar solution was adopted for the Miraflores Viaduct, completed by VSL in 2005. The central arch was constructed vertically in two 1,100t halves. The arches were then lowered, rather than lifted, in order to minimise the forces involved. VSL was awarded the contract to lower them into position ready for the closing pour, with the lowering works carried out by VSL Switzerland and CTT. It took just one day to lower each half arch. The jacking system allowed precise adjustment prior to the final closing pour. Deflections and forces were closely monitored throughout the operation. The main contractor was Estructuras and the consultant was Pondio. ■ *Contact: jmartinez@vslsp.com*

Spain

Complex lifts for Cortegada

→ **Two dramatic and complex lifting operations have been carried out** by CTT Stronghold (VSL in Spain) for the new Cortegada Viaduct over the Miño River in north-west Spain. The 250m-long viaduct has a main span of 182m, with two 2,700t triangular concrete cells forming the abutments. CTT Stronghold was awarded the post-tensioning works, the design and supply of pot bearings, as well as the design and execution of the heavy lifting operations. One of the cells was cast in situ while the other – 20m high by 72m long - was constructed perpendicular to its final position on a temporary bearing. The first operation involved rotating it. CTT Stronghold designed and fabricated a special 4.8m-diameter rotation system on which the whole concrete structure was built. Once the load was balanced, the controlled rotation took less than an hour. The structure was lifted onto jacks once it had been rotated by 85º to enable demolition of the rotation table and installation of the permanent bearings. The second heavy lifting operation involved the erection of the 86m central part of the main steel span, delivered to site by river and raised 25m on lifting cables in just six hours. Client for the project was Xunta de Galicia, the main contractor was Arias Hermanos and the consultant was Pondio. ■ *Contact: jmartinez@vslsp.com*

UAE
PT on the beach

→ **VSL has started work on Al Zeina,** one of several precincts of Abu Dhabi's Al Raha Beach development. The 7km waterfront scheme is being undertaken by developer Aldar, which has formed a joint venture with Laing O'Rourke for the construction work.
The precinct consists mainly of residential accommodation across 14 low-rise buildings plus townhouses and villas. Optimisation of the post-tensioning design has enabled a significant reduction in the reinforcement required, leading to cost savings for the Client and improved cycle times for the installation. The peak of the works will see the installation of more than 250t of post-tensioning per month and the total works represent in excess of 400,000m^2 of post-tensioned slabs. Completion is scheduled for June 2009. ■ *Contact: Ismail@vslme.ae*

UAE
Pinnacle of success

→ **An efficient and safe solution proposed by VSL Heavy Lifting** has enabled the complete and accurate prefabrication at ground level of the Dubai Mall Hotel's 35t pinnacle, thus reducing the project's overall construction schedule. A 50m pinnacle tops the 225m-high hotel tower. VSL Heavy Lifting proposed the erection method to the main contractor, CSHK Dubai Branch. VSL's scope of work encompassed the lifting of the pinnacle as well as the design of the lifting platform and guide system. Wind was a critical factor for the lift. The pinnacle followed guides installed by VSL on the building façade in order to avoid any contact between the spire and the hotel's glass cladding. The pinnacle reached its final position smoothly within two days. ■
Contact: david.gratteau@vsl.com

UAE
Marine ties

→ **Dutco Balfour Beatty has awarded VSL Middle East a supply order** for 242t of marine ties for a new floating, production, storage and off-loading quay facility in Dubai. The quay is being constructed for Drydocks World - Dubai. The 50-year design life and marine environment dictate the need for enhanced corrosion protection. The surface is prepared to a St2 finish in accordance with ISO 8501-1. A primer is then applied and a bituminous tape is wound onto the bars. The corrosion protection is being carried out in the new VSL Bar Facility in Dubai. Bars are supplied in lengths of 11.8m and coupled on site to a total length of 31.5m. Two diameters of grade S670 bars are used – 57.5mm and 63.5mm.■
Contact: shemi@vslme.ae

Côte d'Ivoire

Super bowl for Abidjan

→ **VSL has lifted and secured a 5,000m³ water tank** as part of a project to pump drinking water from underground to new water towers for distribution to the ever-growing population in the upper part of the capital Abidjan. Twelve SLU 330 lifting units were equally distributed around the shaft to lift the 2,700t tank to a height of 35m before it was fixed into position using post-tensioning with compacted strands. Every element, including PT and grouting, had to be installed and embedded at ground level prior to the lift. Once in the final position, 18 PT cables were stressed to fix the bowl. Then, the 12 lifting cables were released and converted to serve as further PT cables, so that a total of 30 vertical tendons Edy 6-31 support the tank. ■ *Contact: david.gratteau@vsl.com*

Tunisia

Twin for Tunis

→ **Construction work has just started** on the new Z4 interchange at the Avenue de la République and Rue d' Italie in Tunis. The new 825m-long viaduct will be adjacent to the existing one, and will ease traffic congestion by increasing access capacity into and out of the city. Following completion in October 2010, the new viaduct will be used for vehicles leaving Tunis while the original one will be reserved for vehicles entering the city. VSL Tunisia will provide the 400t of post-tensioning, as well as the elastomeric and pot bearings as a subcontractor to the Tunisian contractor Chaabane. This is VSL Tunisia's second project there, following the soon-to-be-completed Radés La Goulette Bridge. ■ *Contact: k.doghri@bouygues-construction.com*

NOTE PAD

Alexandrovskaya Ferma. *VSL installed 34 stays up to 105m in less than a fortnight on an incrementally-launched curved cable-stayed bridge in St Petersburg, Russia. Work took place above 21 railway tracks without disruption to the rail services. The main contractor was Mostootriad 19, with design by Guiprostroymost St Petersburg.*

Colour fast. *Blue stay cables are being installed on the 2nd Bolshoya Okhta Bridge in St Petersburg designed by Guiprostroymost St Petersburg. VSL's work with main contractor Mostotrest follows the success of the 1st Bolshoya Okhta Bridge in 2005. The aim is to install 30 of the 6-19 cables, ranging from 5m to 27m, in less than two weeks to support the 160m-long main span.*

Czech innovation. *VSL has completed its first Czech Republic project featuring electrically-isolated prestressed tendons. The Nove Spojeni project is a 325m-long railway bridge. The special requirements were to use internal and external electrically-isolated tendons and external PT cables allowing additional stressing in future. VSL developed a modified external anchor to meet the project's needs and installed sensors to measure long-term stresses.*

Parallel award. *Bilfinger Berger has awarded the stay cable work for the Smaalenene Bru to VSL Norge A/S. The bridge near Oslo is VSL's first parallel-strand cable-stayed bridge in Norway. The scope of work for the single pylon bridge includes the supply and installation of 28 VSL SSI 2000 stays, ranging in size from 6-55 through to 6-85 and to be equipped with VSL's Gensui vibration damping system.*

Estonia

Talinn premier

→ **Post-tensioning works for the slabs in the new Väike Paala office building** in Tallinn marks VSL's first real step into the Estonian market. A leading local company, OÜ Mapri Projekt, awarded the work to VSL. The building consists of five floors with a maximum span of 7m by 7.5m and slab thicknesses of 200mm. Each floor is cast in three parts in typical construction cycle of two weeks per level. VSL is using the unbonded slab system, with the stressing S-6 and passive SF-6 anchorages at each level. The total amount of monostrands is more than 30t. VSL's work began in June and the last strand was stressed in September. ■ *Contact: pvanek@vsl.cz*

Ireland

Bridge in full swing

→ **The construction of Ireland's 340m-long five-span Mulroy Bay Bridge** is now in full swing and will improve access to the northern part of the region. VSL is installing the 150t of post-tensioning and monitoring the bridge's geometry, having completed the construction engineering. Main contractor Ascon - a key player in civil engineering in Ireland and a staunch VSL partner - is now taking less than a week to construct two cantilevered segments. Two pairs of form travellers - one on each pier – are being used to build the main spans as cantilevered segments cast in situ. Construction is going well and is on target to bridge the central 100m span before the end of the year. The adjacent abutment spans were cast in situ on scaffolding. ■ *Contact: bruno.thierry@vsl.com*

United Kingdom

VSL at the BBC

→ **Slabs and transfer beams for the extension of the BBC's Broadcasting House** in the heart of London feature post-tensioning by VSL. VSL's scope of work includes the supply and installation of all post-tensioning materials and equipment, together with supervision. The frame contractor is Byrne Brothers, working for general contractor Bovis Lend Lease. This building consists of eight levels of post-tensioned flat slabs as well as transfer beams with multi-strand tendons, located at the second floor. Construction of the 6,700m² of slabs requires VSL to install 53t of 0.6" (15.7mm)-diameter strand. The tendons are stressed with 624 SO and H6-4 slab anchorages with PT-PLUS® plastic ducts. More than 20t of strand and 60 anchors CS 6-37 will be used for the transfer beams. ■ *Contact: julien.bazin@vsl.ch*

Switzerland

High speed hangar

→ **The complete steel roof structure** for a new hangar at Basel Euroairport was lifted into place in a single day. The choice of roof erection method was a deciding factor in completing Jet Aviation's hangar in record time. The roof, including cladding and insulation, was lifted to its final level. Construction began at the end of 2007, with the first plane rolling into the hangar on 20 April. Losinger was the contractor and VSL was involved from the early design stages to ensure successful and timely completion. ■ *Contact: daniel.junker@vsl.com*

UAE

Island platforms

→ **Taisei Corporation has awarded VSL Middle East** a contract for precasting of walkways and housing platforms for a major new residential area within Dubai's prestigious artificial island projects. Palm Jebel Ali is the second of three Palm Island projects under development by Nakheel in Dubai. There are 504 'waterhome' platforms, each consisting of a 26m-long and 13m-wide slab which is supported monolithically on two longitudinal post-tensioned beams and five secondary, transverse reinforced beams. The weight of each platform is about 285t. The 134 T-shaped post-tensioned walkway beams vary in length from 20m to 34m and are 1,100mm high and 850mm wide on top. VSL's contract covers the precasting as well as supply and installation of all PT components. ■ *Contact: patrick.arnold@vsl-intrafor.com*

Switzerland

Rail upgrade

→ **VSL is installing pre-grouted electrically-isolated bar anchors** as part of a major project to enhance Swiss rail capacity. Zurich's main rail station is a terminus, which creates a bottleneck as use expands. A double rail lane will bypass Zürich to link Altstetten and Oerlikon in a large bow, providing more and better connections. VSL Switzerland is working in a joint venture, providing temporary and permanent soil nails. Due to stray currents all permanent bar anchors must be electrically isolated and meet stringent code requirements. The project involves the installation of a total of 7,567 anchor heads with 72.5km of pre-grouted electrically-isolated passive B500 bar anchors and 178 prestressed permanent and electrically-isolated strand anchors. ■ *Contact: christophe.candolfi@vsl.com*

United Kingdom

Ageless anchors

→ **VSL (UK) has just completed the first stage of a contract** to test, adjust and monitor some VSL ground anchors installed more than 30 years ago and has found them to be in remarkable condition. The anchors form part of London's River Thames Flood Defence Scheme and had not been maintained or tested since installation. Large numbers are submerged twice daily with the tide and some have been under water since the mid 1970s. Many were found to be 'as new' and over 60% of the 123 tested to date were close to the load at which they had originally been locked. The remainder were reloaded back to original values with no failures, resulting in 100% success. The client, the Environment Agency, is both impressed and delighted. The results are a tribute to the VSL Ground Anchor System and demonstrate its quality, reliability and durability in withstanding the test of time in such a hostile and corrosive environment. ■ *Contact: christophe.petrel@vsl.com*

Korea
Business extension

→ **VSL Korea has diversified its business** with a contract with Posco Construction for structural and post-tensioning works on a tank as part of the extension to the Gwang Yang LNG Terminal. The 200,000m³ above-ground full containment tank has an 86.4m outer diameter and height of 52.8m. The tank consists of a base, nine wall sections, a ring-beam and roof. It requires 3,800t of rebar, 24,000m³ of concrete and 1,100t of 0.6" (15mm) strand. Post-tensioning involved 88 horizontal tendons and 132 vertical tendons using GC6-27 anchorages. Prefabricated bundles of 27 strands with lugs in their ends are inserted into steel pipes for the vertical tendons, while corrugated steel sheaths are used horizontally. ■

Contact: hansshin@vslkorea.co.kr

Singapore
Core expansion

→ **VSL is continuing the expansion of its Ground Engineering business** with new operations in Singapore. The project is for a diaphragm wall at Chinatown Station, part of an extension to the underground railway network. Work was awarded to VSL Singapore in December 2007 and diaphragm wall excavation started in April. It involves construction in just eight months of 1.25km of diaphragm wall, with 25,000m³ of excavation and concrete together with installation of 3,000t of reinforcement. The core of the diaphragm wall team is from Intrafor Hong Kong, but the project has provided an opportunity to combine other resources from VSL Asia. The constraints which make this project a challenge include the site location on a major road in a busy commercial and tourist area,

working space limited to a 10m-wide strip and 80m of 20m-deep diaphragm wall to be built under a bridge with a clearance of only 6m. Gammon Construction is main contractor for the project, which is due for completion in early 2009. ■

Contact: xavier.heurtaux@vsl-intrafor.com

Hong Kong
Flood alert!

→ **Hong Kong's Water Supplies Department** adopted the VSL Climbform system for the construction of a 40m-high draw-off tower at the Lower Shing Mun Reservoir on a site that was at constant risk from flooding. VSL HK worked as specialist sub-contractor to Ming Hing Waterworks Engineering Company from March to June on a contract that included the design, supply and operation of the Climbform system. The biggest challenge lay in the risk of flooding of the works area. At times of heavy rain, the Water Supplies Department would open a flood gate adjacent to the draw-off tower to release water. This would flood the entire site within an hour. Personnel and equipment had to be on standby at all times ready for emergency evacuation. Fortunately, there was only one 'black rain' storm during the project and the Climbform had reached a height just above the flood. VSL HK is expecting further work on the project, to design, supply and install formwork to construct a corbel on top of the tower and replace an existing footbridge. ■

Contact : alice.lin@vsl-intrafor.com

India

Highway completion

→ **VSL India is nearing completion** of the 9.5km Bangalore-Hosur precast segmental elevated highway project and is achieving a four day cycle per span, which is 20% faster than originally envisaged. The highway is crucial for reducing congestion. Engineering challenges that VSL has solved include the heavy lifting of the 1,000t launching gantries at the start of the project and the complex erection of spans over the existing Nandi flyover. This success has led to a new contract on the Bangalore Nelamangala expressway, to be erected with an even faster cycle. ■ *Contact: m.phillips@vslindia.com*

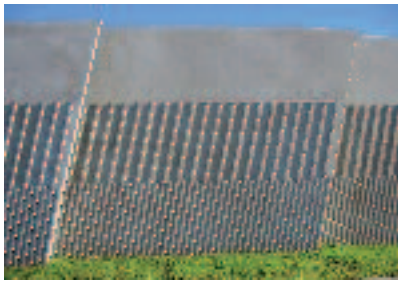
Hong Kong

Steadying the stock market

→ **Intrafor Hong Kong has successfully avoided shaking the Hong Kong stock market** thanks to tight vibration control during its recent project on the extension of the MTRC Airport Express and Tung Chung Line railway tunnels.
The 40m-long MTRC overrun tunnel is supported by 11 barrettes and surrounded by a 1.2m-thick continuous diaphragm wall, founded on granite at an average depth of 35m. The excavation of 7,300m^3 of soil and rock was difficult due to the presence of boulders, deep compacted reclamation fill and a variable rock level. The proximity of sensitive structures such as the International Finance Centre which houses the HK Stock Exchange, meant that vibrations induced by the excavation, and particularly the chiselling, required monitoring to keep vibration velocities under the 15mm/s limit. ■ *Contact: Anthony.mak@vsl-intrafor.com*

Australia

Oversized precast panel



→ **The Bonville Bypass Project in New South Wales,** required VSL to detail, cast and supply 6,222m^2 of featured oversized, precast concrete noise wall panels within just four months. The panels are up to 5.4m high by 7.7m wide, 130mm thick and weigh as much as 13t. To improve appearance the panel design incorporated sections of 25mm-raised ribs. VSL cast the panels on site for ease of transportation. Production involved stripping, lifting and casting a new panel out of each of six moulds on a daily basis. 170mm slump concrete with a high early strength of 25 MPa was required to allow removal from the moulds after just 18 hours. Shrinkage was controlled by use of saturation curing and by wrapping panels in plastic for seven days. The scheme's design is by SMEC Australia and the main contractor is Abigroup Contractors. ■ *Contact: dtrayner@vsl-australia.com.au*

Korea

Immersed debut

→ **VSL Korea is carrying out Korea's first immersed tunnel project** as part of the Busan-Geoje Fixed Link project, which also includes bridges. The works cover casting of concrete, rebar fabrication, operation of forms and installation of some 2,500t of internal PT for the 3,240m-long tunnel. Construction and immersion of sections of tunnel has already begun. The tunnel has eight elements, each made up of eight segments, and its cross section measures 9.75m high and 26.5m wide. The work will be followed next year by VSL's installation of 570t of stay cables for one of the project's bridges. ■ *Contact: hansshin@vslkorea.co.kr*

Australia

Growing relationship

→ **The award of an additional contract on Brisbane's Northern Gateway Upgrade project** is testament to VSL's relationship as an Alliance Partner on the scheme's main bridge, the 2nd Gateway Bridge. Queensland Department of Main Roads awarded Leighton Abigroup Joint Venture (LAJV) the contracts for Kedron Brook Bridge and the Southern Bifurcation Bridge. VSL was appointed in January to carry out the post-tensioning of the bridges and was also responsible for design and supply of stressing platforms. Kedron Brook Bridge involved the post-tensioning of 17 headstocks each with eight tendons of up to 25 strands. Safety was paramount and extra precautions were taken when installing and relocating platforms, with inspections from VSL and LAJV. Daily tool box talks helped avoid potential safety risks. Headstock post-tensioning took seven to nine working days at the start of the project. By the fourth headstock, the cycle time had been reduced to five days and to just four days by the sixth. ■ *Contact: smills@vsl-australia.com.au*

Australia

Gateway milestone

→ **A milestone had been achieved recently on Queensland's 1.6km-long 2nd Gateway Bridge** with the erection of the first set of halving joint segments on the north side of the river approach viaduct. VSL Australia is in an alliance with Leighton Abigroup to construct the duplicate bridge for Queensland Motorways as part of the Gateway Upgrade project. Each halving joint is formed from two pairs of lower and upper L-shaped precast segments (145t and 185t respectively), which were erected using a 600t crawler crane. The two sets of halving joint segments will each contain two permanent sliding bearings and are temporarily held together with three 400t support jacks, grout pads and stress bars pending completion of the cantilevers and installation of the bearings. To date, four 71m spans on the lower end of the approaches have been erected by crawler crane. A 165m-long launching gantry is being assembled for use at the higher piers. The project's casting facility achieved a milestone recently with the cast of its 100,000th tonne of precast products. The 260m main span is progressing with the pier construction. ■ *Contact: Jonathan.Davies@lajv.com.au*

Australia

Cost-saving tank design

→ **VSL Australia was awarded a contract** to design and build a 20 megalitre precast post-tensioned water storage tank as part of the Tarago Water Treatment Plant upgrade. This is one of several 'alliance' type projects to increase supply and storage capacity for Melbourne Water Corporation. The alliance's construction partner, Baulderstone Hornibrook, proposed a post-tensioned concrete tank as an alternative to the conforming steel design. This achieved significant cost savings and a shorter construction schedule for the 73m-diameter tank. VSL's scope of works included the design of the tank's base slab and walls, supply and installation of post-tensioning and supply of 78 precast wall panels. The base and ring-beam were concreted in a single 4,188m² pour in 13.5 hours, which eliminated the risk of water leakage through slab joints. The 6m-high tank wall was made up of 300mm-thick precast panels. It took 37 days to cast the panels in VSL's Thomastown Precast Yard. They were erected in four days, and then connected together with in-situ concrete stitches before horizontal and vertical post-tensioning to achieve a watertight structure. The hydro-test was successfully passed. ■ *Contact: gioannidis@vsl-australia.com.au*

Australia

Taking the pressure

→ **The Insituform-developed PolyFlex pipe rehabilitation system** was recently used to renew more than 1.5km of sewer pressure main for Caboolture Shire Council (CSC) in a highly innovative Australian first. The original 200mm-diameter ductile iron cement-lined main was commissioned in 2003 but aggressive industrial waste discharges had already eroded the lining and started to corrode the iron wall as well. The pipe runs directly under or adjacent to major roads, including a recently-upgraded highway. The client therefore specified structural trenchless rehabilitation with a design life of 50 years. Out of the various tenders received, CSC awarded the rehabilitation contract to Insituform Pacific Pty Limited based on the use of its exclusive PolyFlex system. This system uses standard high density polyethylene (HDPE) pipe to create a new internal liner. The HDPE pipe is temporarily reduced in size using the PolyFlex roller reduction machine, to allow easy insertion. The compressed pipe is then 're-rounded' within the host pipe using hydrostatic pressure to provide a close-fitting liner. The longest single installation was 288m. In total, 22 small excavations were required to take account of valves and tight bends. One of the key challenges was the requirement for a temporary above-ground flow bypass system. ■ *Contact: dgamboa@vsl-australia.com.au*

NOTE PAD

Patterned panels. *VSL in Australia was awarded design and supply of 16,700m² of patterned VSoL® Retained Earth Walls up to 14m high and of 2m by 2m grey facing panels, to be painted on site for the Logan Motorway Interchange in the surbubs of Brisbane. Wall design allows for crash barrier loads, horizontal loads at the abutments and loadings on the panels being used as formwork at the abutment areas.*

Double first. *Intrafor HK Ltd has completed its first project in Abu Dhabi: the basement shoring system for the prestigious Corniche Hotel including a first for the region - a full instrumentation package including inclinometers, piezometers, standpipes, tilt plates, crack tell-tales, settlement markers, load cells and strain gauges. Work included 8,200m² of 30m-deep diaphragm walling through underlying sand and rock strata. Intrafor's BC40 cutter was used, supported by a mechanical grab.*

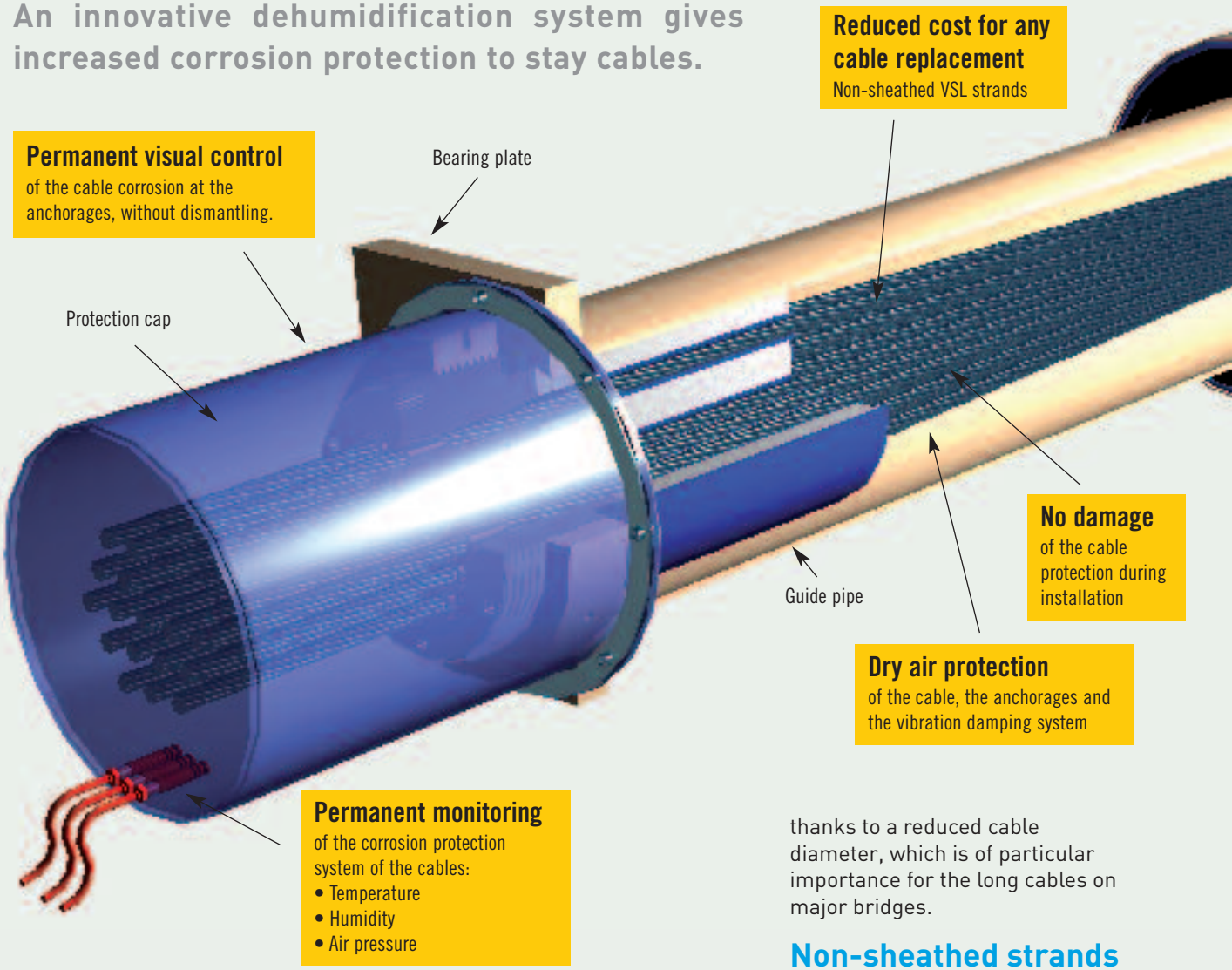
Busway beams. *VSL in Australia was awarded PT works on the bridge headstocks, viaduct beams and tunnel roof slabs for the Boggo Road Busway in Queensland. VSL was also responsible for supply, installation and stressing of CT stress bars for the dual gauge beams. Challenges included working safely around live railway lines while meeting the schedule.*

Repeat business. *After the successful completion of two packages of VSoL® Retained Earth Walls for China State Construction Engineering HK, VSL Hong Kong will shortly start a four-year contract for the design, supply and installation of 20,000m² of VSoL® on 10 structures as part of the Anderson Road development and site formation project in Kowloon.*

SSI 2000 SYSTEM DEVELOPMENT

The VSL SSI 2000-D sys

An innovative dehumidification system gives increased corrosion protection to stay cables.

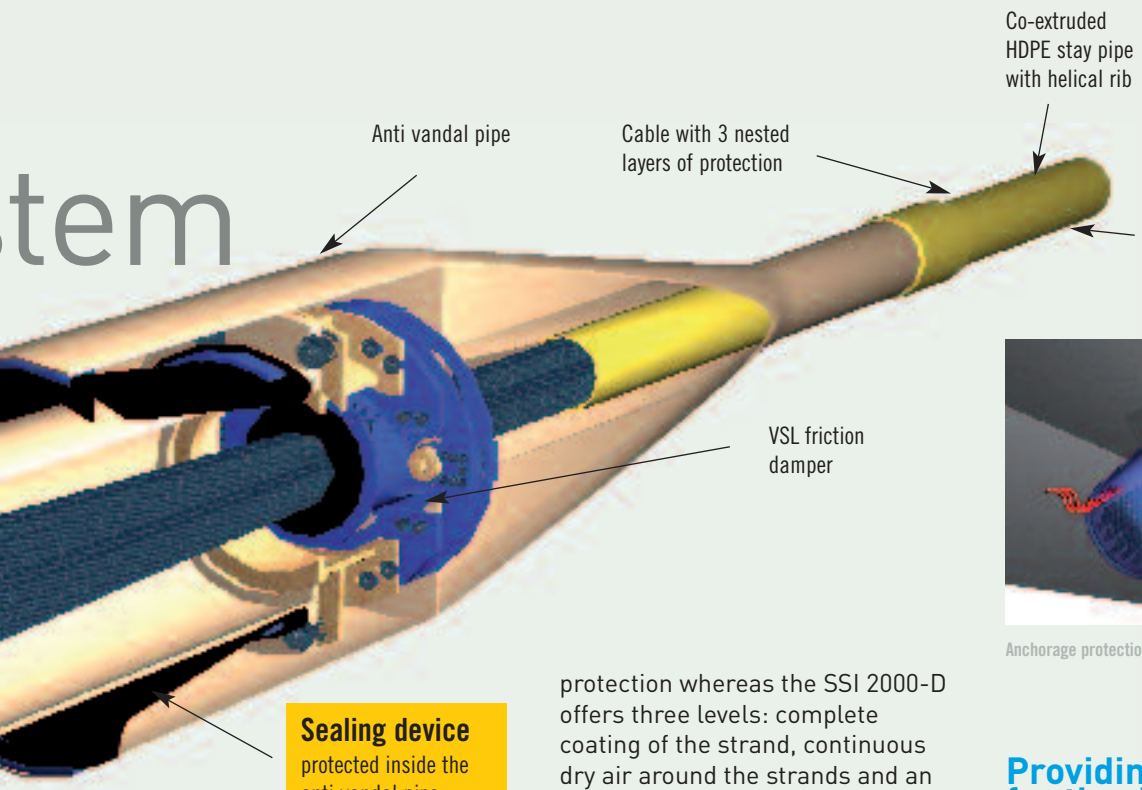


The use of dehumidification or dry air systems to protect steel decks started in 1971 and it is now a highly-regarded solution. It has later been applied also to suspension cables. The efficiency of dehumidification has been proven in the protection of the cables of several suspension bridges, including those of the Akashi Kaiyko Bridge's 1991m-long main span. Long-term experience on steel deck protection has confirmed the low maintenance costs of dehumidification systems and their high reliability.

VSL has developed the VSL SSI 2000-D system which extends the same technology to the use of stay cables. SSI 2000-D is an evolution of the well-established SSI 2000 system. The technology provides high durability and low wind drag, thanks to a reduced cable diameter, which is of particular importance for the long cables on major bridges.

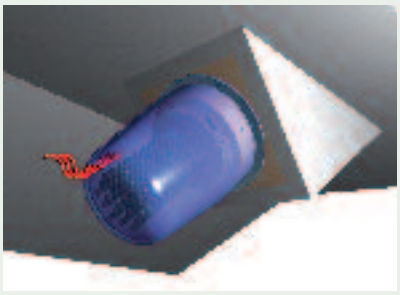
Non-sheathed strands protected by dry air

The complete stay cable system is designed so that the strands are located within an airtight enclosure along their free length and along both anchorages. The cable, anchorages and any vibration damping system are all protected against corrosion. The airtight HDPE stay pipe is connected at one end to the pylon and at the other to the deck anchorage. The cable is composed



Reduced cable diameters
Strand cable with the lowest outer diameter allowing reduced cable wind load

Sealing device
protected inside the anti vandal pipe



Anchorage protection cap allowing visual inspection of cable

of non-sheathed strands manufactured with a protective coating such as galvanising.
A dehumidifier unit, which is generally placed inside the pylon, is equipped with air-pushing fans to maintain a low but permanent pressure of dry air along the cable length. This permanent pressure prevents any ingress of water from the outside environment into the cable. The dehumidifier unit placed within the pylon supplies the dry air at the pylon anchorages. The dry air flows from the pylon anchorages to those at the deck where it is vented to the environment. The space between the steel strands inside the HDPE pipe allows circulation of the dry air around them, with a pressure at the deck anchorage that is slightly above atmospheric pressure.

Additional levels of corrosion protection

The main tensile elements of standard stay cable systems are designed with two levels of protection whereas the SSI 2000-D offers three levels: complete coating of the strand, continuous dry air around the strands and an airtight enclosure provided by the stay pipe.

Permanent monitoring of the cable corrosion protection system

The cable protection is permanently monitored. A protection cap is installed at the deck anchorage and is designed for the connection of sensors to measure the humidity, air pressure and air temperature, as well as the dehumidification control system.
The anchorage protection cap can also be designed to allow permanent visual inspection of the strands and wedges without any need to interfere with the system. This significantly reduces the time and costs involved in the long-term maintenance of the cables.

The dry air combined protection

Providing protection for the deck

The SSI 2000-D Dehumidification System can also be used to achieve complete protection of bridge decks that are designed as steel boxes. The dry air flowing along the cables can be fed into the compartments of the deck instead of being vented to the environment.

Reduced cable diameters

The SSI 2000-D system is based on VSL's standard SSI 2000 system and uses the well-established wedge/strand anchorage technology. The technology allows a 30% reduction in cable diameter compared to the standard system, resulting in significantly reduced cable wind loads on the individual stay cables. ■

BRIDGE CONSTRUCTION

A landmark bridge for Mumbai

VSL is playing a key role as a bridge construction partner for Hindustan Construction Company (HCC) in the Bandra Worli Sea Link across Mumbai's Mahim Bay, India, scheduled for completion in 2009.

1 ***Twin bridge with 2 times 4 lanes***
The crossing consists of approach viaducts, which have typical spans of 50m and are continuous over four to five spans, and two cable-stayed bridges, the Bandra and Worli cable-stayed bridges.
The viaduct is made up of twin southbound and northbound bridges, each carrying four lanes of traffic. The bridge decks are composed of precast concrete segments. Each of the twin northbound and southbound Bandra bridges has a single pylon and two 250m spans, while the Worli bridges have two pylons and a main span of 150m. In addition, a link bridge at the southern end provides a connection to the mainland.

2 ***Tackling an offshore bypass***

The Bandra Worli Sea Link Project in Mumbai, India, is an eight lane 3.7km-long offshore viaduct west of the Mumbai Peninsula. Once completed, it will provide an alternative connection across Mahim Bay between the districts of Bandra in the north and Worli in the south.

The project is the first phase of a Western Link, which is designed to provide an offshore bypass all the way down to Nariman Point at the southern tip of the peninsula. Rough sea conditions at the project's offshore location mean that all construction work has to stop from May until September during the annual monsoon season.

3 ***Multiple contracts***

VSL has been awarded the supply and installation of 4,590t of post-tensioning tendons; the construction engineering; the supply of special equipment for the two overhead gantries and their heavy lifting during commissioning as well as the engineering for gantry relocation; erection of 256 segments for the cable-stayed bridges; the installation of 424 fully-prefabricated stay cables (picture) with VSL strand technology; and the supply and commissioning of a third overhead gantry for the erection of segmental spans for the link bridge.

4 ***Precasting of unique shapes***
VSL's scope of work includes construction engineering comprising resegmentation of the bridge decks; design and detailing of the casting yard and match-cast short line cells; production of segment shop drawings and geometry control for the segment production. A typical segment weighs between 80t and 140t and is 18.6m wide, 3m deep and about 3m long. It has three longitudinal voids and a curved "fish belly" underside.

5 ***Barge or trailer delivery***
The approach viaducts are erected span by span using VSL-designed overhead gantries. These gantries allow segments to be delivered either from below by barge or from behind, by trailer along the previously-erected section of the viaduct. Where delivery is from behind, field segments have to be suspended at two levels to allow the final segments to be fed in.

6 ***Relocating a giant***
A dramatic operation with an Asian Hercules, one of the biggest floating sheerleg cranes in the world, was required to relocate the two 1,200t overhead gantries used for approach span erection. The main challenges for this operation, whose engineering HCC entrusted to VSL, were the shallow water depth and the rough sea conditions around the Bandra bridges.

7 ***The Bandra cable-stayed bridge***
The project reached a major milestone with the completion of one of the Bandra bridges, when the last pair of segments of the southbound carriageway was erected end of May, about five months after erection of the first stay. The Bandra cable-stayed bridges have an overall length of 600m with two 250m-long main spans suspended from 128m-tall four-legged pylons. Each bridge has two inclined planes of stays in a semi-fan arrangement anchored to the deck at 6m spacing.

8 ***The Worli cable-stayed bridge***
The Worli cable-stayed bridge is 350m in overall length between expansion joints and consists of two 150m cable-supported main spans flanked by 50m conventional approach spans. A centre tower with an overall height of 55m above pile cap level supports the superstructure by means of four planes of stay cables in a semi-fan arrangement. Cable spacing is 6m along the bridge deck.

9 ***State of the art outlook***

The unique structure will emerge as a landmark for the city and will be an 'intelligent' bridge with state-of-the-art systems for traffic monitoring, surveillance, information and guidance, instrumentation and emergency support. It will feature a modern toll plaza of 16 lanes with automated toll collection systems. After the Goa Bridge (2004) and the second Vivekananda Bridge (2007), the Bandra Worli Sealink will be VSL's third stay cable bridge reference in India and by far the biggest to date.

Owner:	Maharashtra State Road Development Corporation, Ltd.
Consultant:	Jacobs engineering Group - SVEDRUP/HNTB Dar Al-Handasah Consultants
Main Contractor:	HCC
Specialist subcontractor:	VSL India Pte Ltd

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