

VSL*news*

THE VSL NEWS MAGAZINE • ISSUE ONE 2015

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Keeping our standards high

The VSL Academy, a unique training centre, has played an important role in sharing the best practices in post-tensioning techniques since it was founded in 2008. It provides essential added-value to our clients by increasing the technical awareness of our staff.

VSL works continuously to adapt to new needs and requirements arising from changes in technology and clients' expectations, as well as in the markets in which we operate. Continuous development of skills and key competences is now – more than ever – a must. The VSL Academy portfolio has been enhanced lately with the addition of new technical modules and management development programmes.

Strengthening our people's capabilities across the group not only ensures the highest levels of quality but also contributes to enhancing our clients' confidence that VSL will keep to these high standards in the long run.



Daniel Rigout,
Chairman and
Chief Executive Officer

business improvement

COMMUNITY ACTION

VSL supports school for the T'Boli



After helping victims of Typhoon Haiyan at the end of 2013, VSL has now launched another community project in the Philippines. VSL has chosen to support France Tiboli Solidaires in its work at a primary school for children of the indig-

enous T'Boli people in the town of Lake Sebu. France Tiboli Solidaires is an association that was created in 2010 by six volunteers from the same family. The School of Indigenous Knowledge & Traditions (SIKAT) was founded to cater for the educational needs of T'Boli pupils whose parents cannot afford to send them to public or private schools.

The school is born from local people's belief that education is a strong pillar for employment. It transmits knowledge crucial to the survival of their tribes and local teachers encourage students to learn in their own languages and support their community. The teaching is designed to be relevant, with clear and purposeful goals.

Ten years ago, there was no electricity and only one classroom

for 70 children – and they sat directly on the floor during lessons. Today, 150 children are able to study in better conditions, with individual desks, a new staff room for the teachers as well as a kitchen and restrooms with running water.

In addition to the involvement of VSL's local staff, *Terre Plurielle* – the Bouygues Construction Foundation – provides financial support. This helps pay the teachers' wages, buy school supplies and ensure a healthy learning environment. The funding has enabled the classroom restoration, waterproofing of the roof and the provision of the new facilities. These actions are aimed at encouraging the young children to continue their education while respecting indigenous traditions. *Terre Plurielle*'s grant of €10,260 means that the school's 138 children and their fami-

VSL'S QUALITY CONTROL PROCESSES

Ensuring success

Ensuring that VSL meets all project specifications and requirements is a top priority and one of the group's most demanding activities. It is essential to build structures that will last, even when heavily used or exposed to the harshest environments. The VSL Management System includes procedures focused on achieving this quality, at every stage from the initial design through completion to make the project a reality.

Quality control is used to verify that everything carried out meets all the requirements throughout the whole process. Ensuring quality is particularly demanding in construction because many

activities are a one-off, as most structures are unique. In addition, much of the work is done in the field rather than in the controlled conditions of a factory. Therefore previous experience alone cannot guarantee success. And, the more specialised the activity, the more crucial quality control tends to be.

VSL's quality control processes about designs and working methods go through iterative stages of review from the materials and equipment to the safety procedures. The end results are then checked by experienced senior people. Considerable thought also goes into the inspection and test plans so that they take account of all the relevant



specifications, standards and codes, internal requirements, laws and best practices.

Training is an ongoing process to ensure that everyone has the right competency to undertake the assigned tasks. Physical inspections and testing are carried out at all stages of the work to confirm that everything is as planned and that all materials are up to standard. Working to the latest versions of drawings and methods is essential with efficient document control as a key. ■

people

lies – together with the six staff – all benefit greatly from the partnership between VSL and the association. ■



Terre Plurielle

Terre Plurielle, Bouygues Construction's corporate foundation, has worked since 2008 to promote education, employment opportunities, healthcare and support for disadvantaged people wherever the Group operates. Since it was created, the Terre Plurielle Foundation has demonstrated its commitment, through projects that involve financial support as well as voluntary work by Group employees. These volunteers advise and assist local organisations in their operations or in carrying out individual projects, sometimes by making use of their professional skills. In the last five years, roughly 150 projects in 20 countries have been supported by approximately 170 employees throughout the world.

PRODUCTIVITY

Updating the maintenance software

The Intrafor Plant Department in Hong Kong is introducing a major upgrade to its Computerized Maintenance Management System (CMMS). The software has been in use for about two years and enables Intrafor to follow the life of its equipment, keeping track of locations and managing both regular and preventive maintenance as well as associated costs. It is also used as a stock management tool for purchasing and spare parts. The update includes additional functions such as fuel consumption management and new reports for easier interpretation of data. ■



PT IN BUILDINGS

Prize-winning project

The new 31-storey Belgrano Office in the centre of Buenos Aires features 22,000m² of post-tensioned slabs and beams out of a total of 52,000m² on the project. VSL Argentina provided the PT engineering and supplied and installed VSL's bonded monostrand slab system. The project for developer Raghsha, with LEED registration under the USGBC, won first prize in a sustainability competition run by the Central Society of Architects and the Argentina Green Building Council. ■

SPONSORING

Engineers without Borders

VSL Switzerland's recent community initiatives have included the financial support of civil engineers who wanted to put the knowledge acquired during their Master's studies to good use and decided to launch a development aid project. The scheme has been carried out in collaboration with the local branch of Engineers without Borders (Ingenieria Sin Fronteras Argentina) and entailed the planning and construction of two small concrete girder bridges in Northern Argentina. Works began in October 2012 and the carriageway deck was concreted at the end of December 2013. After load tests had been carried out, the bridges were officially inaugurated on March 29th 2014. ■

FIB

Outstanding Concrete structure

VSL is very proud to have been involved in the Mora Ferenc extradosed bridge project over the Tisza River. The project was a nominee for a 'fib Award for Outstanding Concrete Structures' given by the International Federation of Structural Concrete (fib) at its congress in Mumbai in February 2014. The Mora Ferenc Bridge has a 180m main span and opened in 2012 as part of the M43 highway link between Hungary and Romania. Contractor Hidepito, together with VSL, proposed the use of VSL stay cable saddles in place of anchorages within the twin pylons so as to simplify the pylon design and the constructability of the bridge. The awards are presented every four years at the fib Congress to promote international recognition of structures that demonstrate the versatility of concrete as a structural medium. ■

SPONSORING

Risk based auditing

VSL Intrafor has sponsored a seminar in Hong Kong on risk-based auditing in the construction and engineering industries. The event is being run by the International Register of Certificated Auditors (IRCA) and the Chartered Quality Institute (CQI). IRCA's technical manager examined the value of a management systems approach to health and safety management and environmental management and the benefits of risk-based auditing, using examples drawn from construction and engineering. ■

facts & trends



Canada Ontario stays

→ **Nipigon River Bridge is Ontario's first cable-stayed bridge** and features two spans, 113m and 128m in length. VSL's scope covers supply and installation of the post-tensioning in the deck and pylon as well as the SSI stay cable system, including friction dampers. Each span is supported by 11 stays arranged in three planes and installed strand by strand using winches. ■

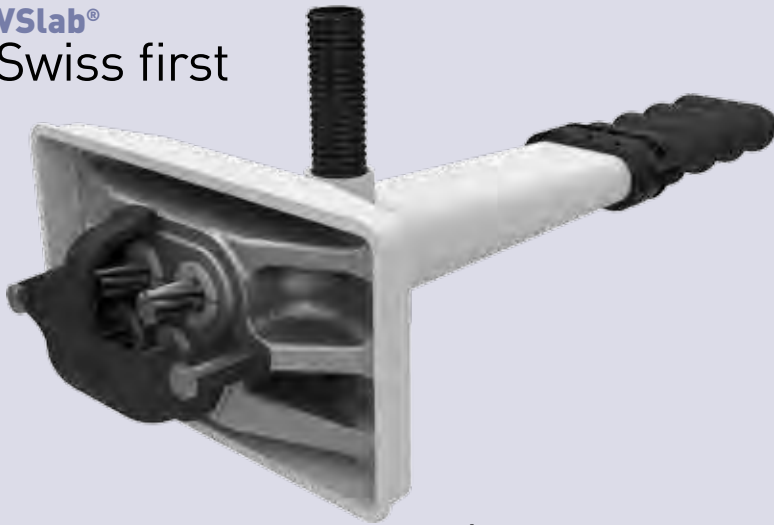
New contract

Bridging communities in Sydney



→ **VSL has taken a further step in becoming an established specialist** main contractor for bridge projects. Two of Sydney's newest communities - Rhodes and Wentworth Point - are to be connected by a new 550m-long bridge designed and built by VSL in joint venture with Brady Marine & Civil. The Homebush Bay Bridge is being developed by Fairmead Business, with ownership after construction passed to the government. The bridge, which will carry public transport, cyclists and pedestrians, includes a 330m-long bridge deck built over water by balanced cantilever method with precast segments. VSL has engaged Arup as the permanent works designer with Jacobs SKM as proof engineer. ■

VSlab® Swiss first



→ The twin 420m-long Viaducts La Rosière are being constructed as part of work on the N16 Highway, which crosses the Jura massif near the Swiss-French border. VSL won the contract for supply and installation of permanent ground anchors and 'category B' post-tensioning. In total, 10,000m of 6-12 tendons are being installed for the longitudinal post-tensioning, together with 9,000m of 6-4 tendons in the transverse direction. The project is the first Swiss application of VSlab® S6-4 anchorages for transversal post-tensioning. ■

New Contract Repeat success

→ VSL has secured a new contract with **Leighton India Contractors** on 'The Camellias', a residential project in Gurgaon, Haryana, for developer DLF. The work includes the design, supply and installation of VSL's Post-tensioning system in nine towers ranging from 18 to 38 storeys. This is VSL India's fourth project with Leighton and the repeat order recognises the high value placed on VSL's capabilities and proven performance. ■

New contract Stays for Petrovsky Bridge

→ **Mega Yapi** has awarded VSL the **subcontract** for the stay cable and steel deck launching works at the landmark Petrovsky Bridge in St Petersburg, Russia. General contractor ICA (a joint venture of Astaldi and Ictas) appointed Mega Yapi for the deck and pylon construction. VSL is responsible for the heavy-lifting and launching of the steel deck together with the supply and installation of stay cables; all are equipped with VSL's Friction-damper technology. Slipforming for the pylons began in September. ■



Award Engineering excellence on the Hunter Expressway



→ **VSL Australia and Thiess Australia** have won a coveted **Engineering Excellence Award** for their work on the Hunter Expressway. The award was for the match-precast vertically post-tensioned segmental piers on the project's viaducts, which stand up to 40m in height and which were constructed in ravines subject to both seismic activity and mining subsidence. The innovation successfully overcame significant constraints and brought improvements in safety, quality and productivity together with environmental benefits. ■

cover story

TRAINING FOR EXCELLENCE

The VSL Academy for higher standards



The VSL Academy, which was created in 2008 as a unique training centre for post-tensioning techniques has now evolved to become the comprehensive training facility for both, technical and management essentials, for VSL staff from around the world. Clients can also come and gain a better understanding of the advantages of working with acknowledged experts in specialist fields of construction.

cover story

TRAINING FOR EXCELLENCE



Practical hands-on training during post-tensioning training courses.

VSL has expended considerable effort in structuring and formalising its training at all levels of the company. When the Academy was created in 2008, the aim was to enable staff from around the world to be trained in post-tensioning techniques to enhance overall quality and performance standards. The scope of the technical training courses has now been broadened beyond VSL's core business technique, post-tensioning. Additional courses in other cutting-edge technologies have been added. Continuous development of skills and key competences are now, more than ever, vital in meeting today's construction challenges.

"VSL Academy is a brilliant tool serving the business," sums up one of VSL's HR directors. "The Academy in Bangkok provides excellent technical training. We have now broadened the scope and brought all our training efforts under the name of the Academy."

The technical streams and technical modules for non-technical employees have been joined by courses in management, personal development, ethics, sales and marketing. *"Today, we are driving the VSL Academy towards providing not only solid technical and management training but also offering personal development,*

*“
The VSL Academy
is a common
training platform
and forms the
backbone of
our managerial
culture.”*



Triple Certification

VSL Academy holds triple certification to ISO 9001 (Quality Management Systems), ISO 14001 (Environmental Management Systems) and OHSAS 18001 (Health & Safety Management Systems).

Working under these systems provides a framework that allows a real focus on the essentials, an effective approach to risk and better control of Academy operations. In addition, the approach provides a safe and environmentally friendly working environment for staff and trainees.

SGS Thailand, the independent certification body, visited the Academy in June 2011 to carry out the initial assessment. As part of the audit, the assessors observed training activities, verified the training documents and looked at the management processes used to drive continuous improvement. In the certification report, it was highlighted that the VSL Academy had shown that it provides a structured framework and systems for the management of training. In particular, SGS commented on the high qualifications of the trainers, who demonstrated good knowledge of VSL's technologies. SGS concluded that the Academy had also demonstrated effective implementation of its processes for providing training.

helping staff to be more efficient on site and also to further develop their careers."

Training has always been considered a strategic topic for VSL. In a business where technical excellence is vital, it is of utmost importance to retain skilled staff. This brings benefits for both the staff and the project in an industry where technologies and systems are constantly evolving.

"You are lucky to be part of a world-wide company investing in its people, says a human resources director to trainees. The Academy

is a unique step in a career and a great opportunity to network. VSL is present all around the world and there is a lot to learn from your colleagues - let's grow stronger together."

Spreading best practices

The ambitious training programme in post-tensioning techniques consists of two weeks of intense theoretical and practical work, each week ending with an assessment whether required practical skills have been acquired and a written exam to test the trainees' understanding of the best working procedures and technical details. Experienced staff conduct the Academy courses, which are based on the latest field manual to ensure that only the best practices are taught. The premises in Bangkok combine classrooms that create a genuine academic environment with space to work on full-sized mock-ups in the practical sessions, where trainees are thoroughly trained to carry out the work in line with best practices.

Trainees return to work on site in between their courses at the Academy. This allows them to put into practice the lessons they have learnt. This also allows them to train their colleagues with the aim of spreading best practices while at the same time improving productivity.

Through its offer and organisation, the VSL Academy ensures that all best practices are understood and applied correctly, and that all members of staff adopt the same high standards of quality. Information about technical improvements – large or small – developed at any of VSL's locations is disseminated by the VSL Academy to allow the entire network – and thus clients as well – to reap the benefits.

Bringing people together also enhances sharing the VSL culture and values. *"Not only how to put words onto paper but also a spirit that you share around the table in a meeting room, whether you are dealing with technical or management issues",* says a trainee. Technical excellence is vital for both staff and clients. A strong training policy is of strategic importance in improving the overall performance of the company and investment in well-trained staff is VSL's most valuable strategy in providing a top-quality service to its clients.

"The Academy, an essential resource for us as a company, is a library of best practices and expertise which helps to develop our core business, at the heart of what we do," says one of VSL's sub-regional managers. Contrary to what it may sometimes look like, post-tensioning is a specialist and complex activity, requiring thorough training to achieve specific quality of prestressed elements with high productivity and safety standards, he says. *"People need to learn best practices, and how to do it correctly and safely,"* he adds. *"Creating*



VSL operates around the world, and all members of staff adopt the same high standards of quality regardless of where the work is carried out.

cover story

TRAINING FOR EXCELLENCE

Mock-up for Heavy Lifting training.



Strand installation during Stay Cable training.

Installing polymeric VSoL® strips.



HDPE Duct Welding during post-tensioning courses.



THE RANGE OF COURSES

Pick your own

TECHNICAL AND VOCATIONAL SPECIALIST COURSES

Other than the post-tensioning courses, the VSL Academy has broadened its scope to become the comprehensive training platform for the whole Group.

Heavy lifting certification provides consistent training for the key personnel carrying out all heavy lifting works. Trainees have theoretical and practical sessions covering heavy lifting basics and equipment maintenance. They are also taught about equipment installation as well as lifting and lowering operations and gain an insight into the hydraulic systems used together with an introduction to both installation and dismantling.

The stay-cable certification course covers the basic elements of the VSL SSI Stay Cable System. It provides consistent training for all the key personnel carrying out stay-cable works and ensures that in-depth knowledge about all aspects of site work is passed from trainer to trainee.

The VSoL® certification covers the basic elements in the VSoL® system and provides consistent training for key personnel, no matter where they work.

Operation of major equipment for bridge deck construction is taught through a series of tailor-made courses. A customised course is provided for each type of major equipment, including the gantries, travellers and lifting frames used on specific bridge deck construction projects. The engineer and supervisor assigned to the major equipment on a project need to have the relevant certification in order to obtain

VSL's compulsory internal operating permit for major equipment (MEOP). Once certified, they are able to take charge of the major equipment being used to launch the bridge or install its segments. The course is made up of four parts, with the first two modules carried out ahead of commissioning the major equipment. The final two involve practical training on the equipment itself once it has been set up.

The post-tensioning detailing certification course is designed to provide consistent training for VSL's key personnel carrying out this type of work. It covers all relevant aspects of detailing and teaches participants about the practical aspects of PT work.

The 'VSL System' course gives a hands-on introduction to all VSL specialist construction techniques and covers the five major systems used by the group: post-tensioning, stay cables, VSoL®, heavy lifting and bridge deck construction equipment. It also includes an introduction to other activities such as monitoring, infrastructure protection and foundations.

The post-tensioning auditor course is designed to improve post-tensioning standards within VSL. It trains and certifies staff to undertake post-tensioning site audits against the standards set out in VSL's audit criteria and the post-tensioning field manual. Trained auditors carry out twice-yearly internal audits of sites to monitor progress and identify best practices as well as non-compliant practices.

MANAGEMENT COURSES

EXP, The engineering excellence programme ensures experienced engineers understand their roles and responsibilities and assists them in developing their capabilities in managing the engineering aspects of a project effectively. The programme is aimed at engineers with at least four years of experience who are considered capable of managing large or complex scopes of work, and of managing teams of engineers, supervisors, surveyors and so on.

PMX, Project management excellence courses cover a wide range of topics that are essential for effective management of VSL operations. The target audience members are project staff who are ready to take on the challenges of managing large or complex projects.

GMX, General management excellence courses are designed to ensure understanding of the key business issues affecting VSL and to develop strategic thinking and the capability to lead teams and projects at a broader level. The courses strengthen the potential of both existing managers and potential managers.

PERSONAL DEVELOPMENT

The sales and marketing course enhances impact and confidence to better service the client on top of the technical solutions delivered, through innovation and added-value.

The ethics courses train on internal regulations and applicable law regarding competition law and prevention of corruption.



Work group meetings with senior managers to share know-how and experience.



Sales and Marketing courses.



cover story

TRAINING FOR EXCELLENCE

Checking on-site implementation

The VSL Academy carries out site visits and audits to verify that the objectives taught on its vocational courses are being achieved. Senior members of the Academy have been trained as internal auditors and carry out regular site audits.

The audits generally take place every two years; a typical site audit lasts two days. The findings are summarised in an action plan, which is presented at the end of the audit.

the Academy has given us a focus, providing a place where we could put all this expertise together. This is a central point where key people from around the world have access to expert teaching, using the right tools and equipment which ensures consistency in the way VSL carries out its core business."

It now forms the backbone of the key objective of providing the highest standards of quality and ever-better client satisfaction.

“
The VSL Academy is essential to gather people together and share our common culture.
”



Sharing best practices.

“One of the Academy’s great benefits for VSL is the consistent approach that is achieved. We can move our people and equipment from one country to another with no difference in approach.” says a regional manager.

Adding value for clients worldwide

Clients can be confident that VSL invests in ensuring that its members of staff have been well trained to adopt only the best practices, thanks to sessions taught by experienced staff working to the latest VSL manuals.

Gathering everything into the one Academy means that VSL can provide people from all over the world with the same training courses covering different stages, starting with basic introductions to topics such as PT and induction courses for engineers. Second-stage training is aimed at more

specialised and experienced staff, who may then progress further to a course for project managers. Here they can develop their management, as well as technical skills. At the top, high-level skills can be developed within the company to achieve the highest standards of management. We provide the same standards and courses everywhere in the world and take training and development as a long-term commitment.

External experts complement VSL’s internal experience to ensure a comprehensive approach to the different topics. *“The training courses are a real investment in key people and the recognition of their performance,”* says one of the external trainers of management courses. *“They create a network of managers to share best practices, to find the right resources at the right time, to perform better and to be more cost-effective on projects.”* Support staff and others in the

background also need to know about VSL's systems. In the longer term – in fact VSL has already started – the aim is to teach the clients' staff and engineers as well as government representatives, so that they also understand the needs and technicalities of what VSL is offering.

"It is also a great tool for showing clients and accreditation bodies that we are putting the effort in to make sure that our people know what they are doing and that we really are the experts we claim to be," he adds. VSL is also offering the opportunity for clients to visit the Academy and even gain hands-on experience there, which gives them greater involvement. "Generally I find that whenever clients have been to the Academy – or are simply aware that we have this training facility – they are impressed with the level of training we are providing to our people," he says.

Use it, enjoy it

VSL's training policy also helps addressing a key issue: striking a balance in development plans between the economic profitability of the businesses and their social and environmental impacts. The VSL Academy was developed as a strategic tool, and now has become a global resource that focuses on technical and vocational topics on one hand, with management and personal development on the other. One senior manager compares the academy to a library – a source of knowledge and expertise that should be used as such. *"Everybody has the potential to do something better," he says. "The focus of the Academy is to enable people to take that step, to develop, to get better, to do things more safely, to be more efficient and effective and to really understand and develop in their careers. Use it, enjoy it, learn from it and appreciate what is available."* ■

OPEN TO CLIENTS TOO

Brushing up on knowledge

Academy courses are also open to clients as part of the services provided by VSL. The post-tensioning on the Srirat Outer Ring Road expressway project in Bangkok is being carried out by VSL for CH Karnchang Public Company Ltd. Attending a free training course on external PT has given the project's Assistant Precast Yard Manager, Mr Kijtrong NUSONTHARA, a better understanding of VSL systems and methods.



Kijtrong Nusonthara,
Assistant Precast Yard Manager

Why did you decide to apply for such a training course at the VSL Academy?

I wanted to know more about post-tensioning systems, to use the technology on this site. I needed to know more about tendon protection.

How did it go?

We first followed the theory course. We then also watched the mock-up and we were shown how to install the strand. It was quite a surprise to discover the details of the grouting and the coil. We learned how to check elongation during the stressing process and the cement temperature, the viscosity, the water, the bleeding test, the volume test during the grouting process.

How many participants were there?

We were four people from this site; a consultant, a QC manager and two people from the construction team.

Have you made use of the course content?

Yes indeed. The teaching was very interesting. As an engineer, you learn all these topics, but then you forget... VSL is a good team. In fact, I would have liked more time there: five days would be very good! After the course, we spent an hour on our site teaching about stressing elongation and how to check each step of the process. And we also told more during the safety meeting on Saturday.

site insights

PT for bridges

Manila express



→ VSL has been appointed by contractor DMCI to carry out the post-tensioning of 2,043 girders on a 7.15km elevated expressway extension in Metro Manila, Philippines.

The expressway connects the international airport to Manila Bay. The current phase of the work is designed to carry 80,000 travellers a day and is expected to reduce travel

time from Manila Bay to the airport from 24.3 minutes to just 8.2. San Miguel Corporation is the project proponent for the privately financed scheme. ■

PT for slabs on ground

High loadings



→ VSL has carried out the design and construction of 6,000m² of pavement for a container storage facility. The VSL post-tensioned Slab-on-ground solution was selected because of its suitability for the high loadings and weak ground conditions encountered.

The slab is designed to support five-high container stacks and the 100t axle loads of container forklifts. The 400mm-thick concrete slab was constructed in four weeks using two pours, each of about 1,200m³. ■

Stay cables

Temporary support

→ The arched rail bridge over the Tajo River, in Spain at the Alcántara reservoir is 1,488m long with more than 20 spans. VSL is involved in the supply and installation of temporary stay cables used to support the balanced cantilever construction of the 324m-long central arch. ■





Heavy Lifting Custom-made gantry

→ **VSL was awarded a heavy lifting contract** to move a heavily contaminated nuclear reactor vessel for its final dismantling. VSL developed a custom-made gantry with automatic connections to move the 125t vessel while minimising activity in the contaminated area. The operation took place inside the containment building of the Zorita nuclear power plant in central Spain, where decommissioning has been under way since 2006. The equipment had to pass a 140t pre-load test at the workshop in Barcelona. ■

Heavy Lifting Ashgabat lift



→ **Use of heavy lifting was essential in meeting the tight time schedule** for construction of the 570t roof at a new convention centre built by Bouygues Bâtiment International in Turkmenistan's capital, Ashgabat. The 120m by 80m roof structure

was assembled in two halves on temporary supports at ground level. Each half was raised 13m by lifting at the extremities of the seven roof trusses before being connected to the final supports. ■

PT in buildings Raft foundation



→ **VSL has built a raft foundation** to carry the 34-storey Setia Sky88 apartment block in southern Malaysia. The foundation rests on piles and covers a surface area of

about 1,023m² to a depth of 2.5m. It uses 55t of 15.2mm-diameter strands, mostly with 6-19 tendons. Due to the depth of the structure, it was cast in horizontal layers. ■

PT for bridges Longest launch



→ **Launching has begun for South Africa's longest incrementally launched bridge.** The bridge is part of the Mount Edgecombe interchange north of Durban. Launching, post-tensioning, concrete placement and operation of the casting yard are all being undertaken by VSL. The 947m-long bridge is being launched from both sides; an in-situ stitch will connect the straight and curved sections. The project also includes a second bridge, 18m above ground and 443m long. ■



Heavy lifting Support act

→ The 2,091m-long **Burginsky Bridge over the Ob River** in Novosibirsk, Russia, features a 380m-span main arch standing an imposing 70m in height. VSL

was responsible for erecting the two temporary towers that acted as supports for the main arch during construction. The 60m-high towers were assembled by lifting

individual segments, each weighing up to 305t. For VSL the technique of assembling the arch and sliding it into place was a challenging custom-sized method. ■

PT for slabs on ground Warehouse pour



→ VSL in Australia has completed the design and construction of 5,000m² of post-tensioned ground slab for the Diageo warehouse in New South Wales. The slab, which is designed to support a 28m-high racking system, was constructed

in two pours over a period of three weeks. The automated racking system needs a stable base as excessive movements could affect its operation. The slab has to support 22t racking post loads. ■



Heavy lifting Arch completion

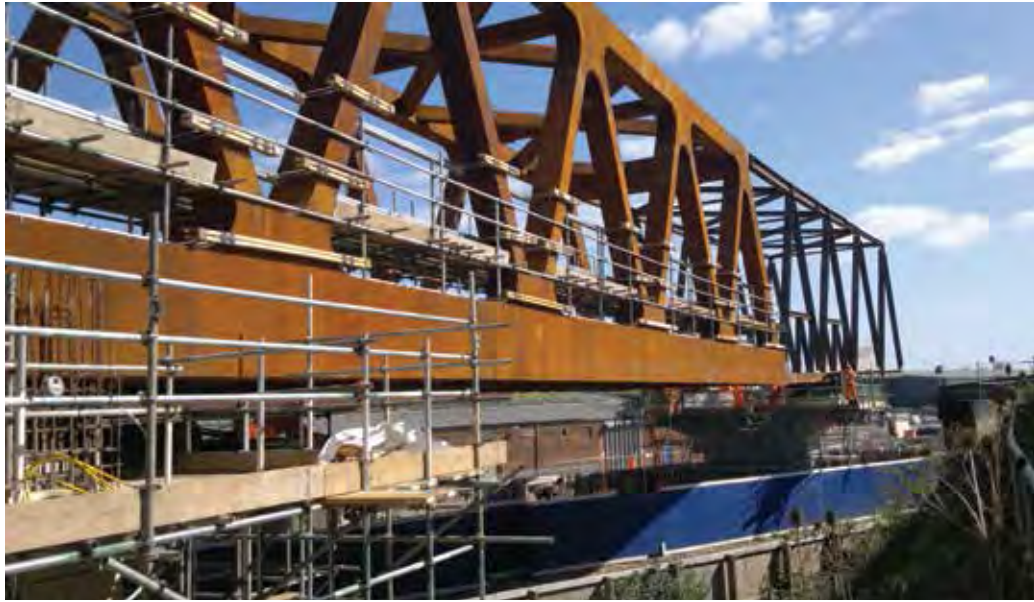
→ The arches of Kiev's **Podolsky Metro Bridge in Ukraine** are nearing completion. The bridge will carry six lanes of traffic on its upper deck, with a metro line below. VSL Heavy Lifting department and VSL Systems of the Czech Republic carried out the successful lifting and sliding operations of this bridge. With the support of temporary towers, two 80m-long segments weighing 650t were lifted 58m and slid 11m. ■

PT in building

Dual-purpose design



→ VSL has been involved from the **early concept stage** in the design, supply and installation of post-tensioning at a new home for the elderly in Charrat, Switzerland. The structure is cantilevered and has two floor slabs, linked with vertical PT bars for seismic strengthening. The PT has a dual purpose: strengthening the building and allowing a large free span. ■



Heavy lifting

London bridge launch

→ **London's Crossrail mega project includes construction of a flyover** over the existing railway at Stockley interchange. VSL launched the 1,475t curved steel bridge by 100m over a small crest using

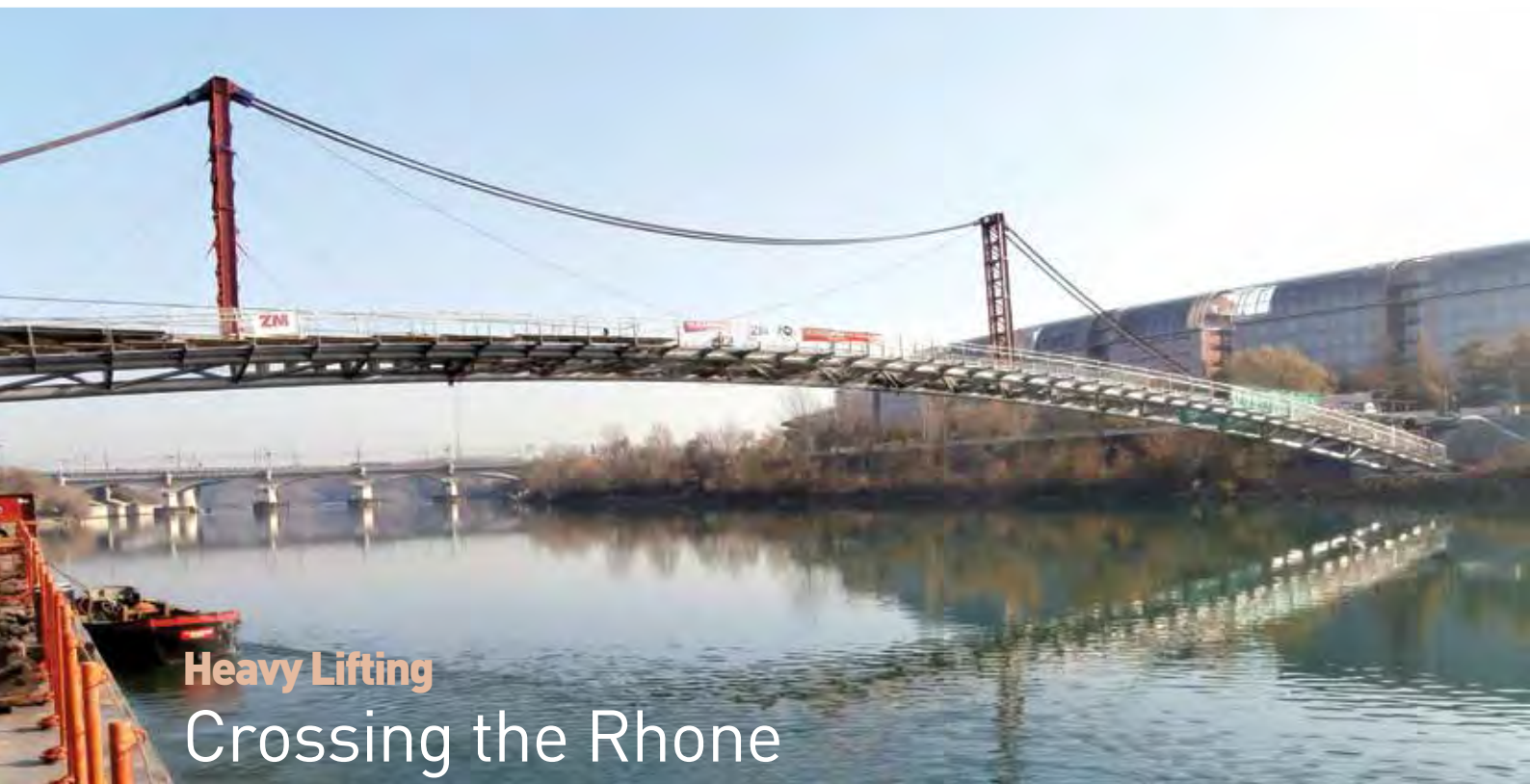
a heavy lifting method specially developed for this challenging operation, which allowed meeting a tight time schedule and high safety standards. ■

VSL form-travelers

Travelling along the coast



→ **A VSL Form-traveler has recently finished its work** at Taiwan's Changhua Coastal Industrial Park where it has been building a pair of bridges of almost 300m in length. The eastbound and westbound structures both have 10.75m-wide decks and most of their length is made up of 254m-long, four-span continuous cantilever box girders. The VSL Form-traveler had a modular design that allowed the truss and the width of the bottom slab to be adjusted according to the changing bridge cross-sections. ■



Heavy Lifting Crossing the Rhone

→ **Disruption to traffic on the Rhone River in Lyon, France, has been avoided** by assembling the main part of a new footbridge onshore and transporting it to site

on pontoons. VSL was responsible for stabilising the 160m-long, 700t section of the Passerelle de la Paix in Lyon during transport and installation. An adjustable bracing

system using strand bundles and temporary towers enabled VSL to control the flexible bridge structure during installation. ■



PT and stays for bridges Welcome arrival

→ **An eagerly awaited new pedestrian and cycle bridge** over the Labe River in Čelákovice, Czech Republic, features post-tensioning and stays installed by VSL. The 242m-long footbridge has two pylons supporting a 156m main span and 43m side spans. The deck

is made of 20 precast ultra-high-performance concrete segments, with the free cantilever method used for main span erection. VSL was responsible for the installation and stressing of all temporary and permanent stays. The footbridge was built by Metrostav. ■

Stay cables In the saddle

→ **VSL's third generation saddles** are being used in the construction of a 1.92km bridge in Bihar, India. The Arrah-Chapra Bridge is an extradosed structure built by balanced cantilever method using precast segments. A single plane of stays passing over 18m-high pylons is used to support the 16 spans of 120m. VSL was awarded a contract for the supply and installation of the VSL SSI Stay Cable System. The total stay quantity is 470t and the project incorporates 80 VSL saddles, the first of which have now been installed. ■



PT in special structures

Record-breaking silo

→ **VSL has supplied the post-tensioning** for a record-breaking sugar storage silo at the sugar mill in Ceske Mezirici. The 50,000t-capacity silo is by far the largest in the Czech Republic, where the second biggest has a capacity of about 30,000t. Duct installation was carried out by the contractor Tazene Konstrukce and started at the beginning of July while strand installation stressing and grouting were completed at end of September 2014. ■

VSoL®

Two-stage walls



→ **An unusual two-stage operation** is being implemented to build retaining walls on the Majura Parkway project. VSL was awarded a design and supply contract using 7,088m² of VSoL® to create a total of 19 walls up to 12.5m high. Four of the walls will feature an Australian first, with a galvanised mesh-faced wall being built initially followed by the later installation of 2m by 2m precast coloured panels once the backfill has settled. ■



Heavy Lifting

Skidding into place

→ **Two new cranes have been installed at the London container terminal** in Tilbury, London, to increase the capacity of the container port at the Thames. The 900t container cranes were assembled on site and VSL was responsible for the complete operation needed to skid them into place. Each crane was skidded by 160m into its final position on the dockside rails. ■

Heavy Lifting

Crocodile net

→ **A cable-net roof designed to look like a coiled crocodile** has been successfully installed by VSL at Bursapor football team's new arena. The team's mascot is a crocodile – timsah in Turkish – which gave the idea both for the roof design and the stadium's name. VSL carried out the 48-axis lifting and tensioning of Timsah Arena's cable-net roof. ■





Ground Engineering

Launching race in Tuen Mun

→ **Intrafor Hong Kong has more than 150 people and 16 items of heavy foundations** equipment working around the clock to meet the launch dates for two tunnel boring machines. Two shafts are being built

together with the related ground treatment works for the northern landfall of the Tuen Muen – Chek Lap Kok sub-sea tunnels. The project features 50,000m³ of diaphragm wall excavation up to 60m deep with special

'T-panels', 380,000m³ of vibro-compaction and 10,000m³ of jet grouting. Work will start on the southern landfall in 2015 to receive and disassemble the TBMs. ■

Ground Engineering

Three cutters at once



→ **Intrafor has successfully completed 75% of the diaphragm walls** required for the Hung Hom MTR interchange station. Construction started in July 2013 and will be completed in May 2015. The works include a 1,075m-long diaphragm wall and 29 barrettes for a total of 40,000m³ of excavation. There are 287 diaphragm wall panels, ranging from 20m to 65m in depth. At peak, the project involved three cutters and six excavation cranes specifically modified to suit the low headroom of 5.5m to 6m. ■

Ground Engineering

TaM for ground improvement

→ **Intrafor is using the Tube a Manchette (TaM) grouting technique** to carry out large-scale ground improvement works underneath the Airport Express rail line in Hong Kong. Ground conditions are very challenging and 16 drill rigs have been working 24/7 to form 2,600 holes for the installation of 67,000m of TaM pipes.

Two automatic grouting stations together with 32 grout pumps were deployed to inject 17,000m³ of grout to improve soil properties for future box-jacking activities. Drill hole alignment on the project is crucial and so three sets of Gyro borehole surveying systems have been used to avoid clashes. ■

PT in building

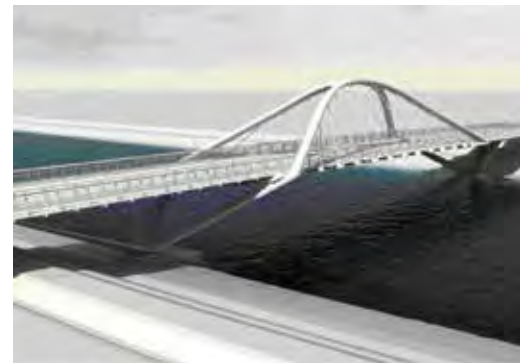
Flash-card plant

→ **VSL has been awarded a fast-track design and construction contract** for SanDisk's new four-storey production building at Batu Kawan, Penang, Malaysia. The scope of work includes

the supply and installation of 80t of 12.7mm-diameter strand to a tight schedule. It will take 21 consecutive pours to create 11,200m² of high-capacity post-tensioned slab. ■

Stay cable

Barcelona link



→ **VSL is supplying and installing its SSI stay cable system** for the hangers of a new arch bridge at El Prat del Llobregat, Spain. The bridge forms part of a new road between Barcelona airport and the harbour. The 104m span connects to the arch via two planes of 11 hangers. ■

Damper for stay cable

Wadi Leban retrofit

→ **Friction dampers have been added to each of the 248 VSL Stay cables** of the iconic Wadi Leban Bridge in Saudi Arabia. After 14 years of service, the government commissioned the installation of VSL's Friction dampers to mitigate cable vibrations. VSL designed, supplied and installed the dampers as well as carrying out the inspection of the cables on this beautiful structure. ■





Bridge construction partner Curved link

→ **VSL has completed the construction of a 3 span 220m-long pedestrian bridge** linking Singapore's Merlion Park and the waterfront promenade in front of the Esplanade at Marina Bay. The 6.5m-wide curved bridge with a

curvature radius in plan of 232m and a main span of 94.5m has a post-tensioned concrete box-girder superstructure, which varies in depth from 3.6m at the piers to 1.5m at the abutment and the centre of the main span. VSL was

responsible for the full construction of the superstructure by cantilever method, including supply and erection of the precast box segments as well as supply and installation of the post-tensioning and bearings. ■

Monitoring

Nhat Tan nervous system



→ **VSL has completed the supply and installation of the monitoring equipment** that will form the 'nervous system' of the longest cable-stayed bridge ever built in Vietnam. The scope for VSL on the Nhat Tan Bridge includes structural

health monitoring, traffic control and data archiving to assist in future design work. The system features GPS stations, stay-cable load cells, strain gauges and sensors to measure vibration, temperature, wind and humidity. ■

Ground Anchors

Swiss rock anchors

→ **A total of 150 rock anchors are being supplied and stressed in Biberbrugg** in central Switzerland. The permanent anchors of types 5-3, 5-4 and 5-5 are electrically isolated in accordance with Swiss standards. All anchor heads are adjustable and 10% of them are equipped with an electrical load cell for future monitoring. ■





Ground Anchors Secure quay

→ A quay wall on Lake Zug in central Switzerland has been secured using type 5-6 permanent ground anchors. The anchors were initially stressed to a temporary load to secure the wall during construction. They were then tested to the proof load and anchored with their design load. A particular challenge was that all work had to be done from a pontoon. ■

PT for LNG tanks Ichthys update

→ Construction of the Ichthys Project's storage tanks, in Australia, is well under way, with VSL now mobilised for the start of post-tensioning. The contract was awarded by Laing O'Rourke and comprises the post-tensioning of two 165,000m³ LNG tanks and two LPG tanks. All four tanks use VSL's AF6-12 anchorages for the vertical post-tensioning and a combination of VSL's GC6-27 and GC6-22 for the horizontal tendons. VSL's scope includes design assistance, supply of PT components and supervision of the installation carried out by Laing O'Rourke and VSL labour. ■



Repair and strengthening Major milestone

→ VSL Australia is in the final stages of the Tarban Creek Bridge rehabilitation project having completed all the major project milestones. The project is VSL's first as principal contractor reporting directly to Roads & Maritime Services of New South Wales. The major task was the casting in place of two 284m³, post-tensioned, 36m-long cross

beams that form part of the new 20m-high portal pier structures under the deck of the existing arch bridge, which spans a tributary into Sydney Harbour. The works showcase VSL's integration of core capabilities including construction methodology, innovative temporary works and techniques, reliable PT systems and the management of complex tasks. ■

Repair and strengthening Stress and test

→ Balfour Beatty Civil Engineering awarded VSL a subcontract to restress the 64 prestressed spiral-strand cables on the 240m-long main span of Kessock Bridge. The work also included cable-force verification after each stressing stage using VSL's Vibratest system. VSL Technical Centre Europe designed stressing equipment that could be easily relocated from cable to cable. Work was carried out simultaneously on four fronts, enabling completion ahead of schedule. ■



technical report

BOX JACKING

VSL showcase for Hong Kong debut

To push a section of a highway tunnel into place under Hong Kong's busy airport railway, a 'box jacking' technique never used before in Hong Kong is underway by VSL.

To install a stretch of new highway under a busy railway, which will remain in use throughout the year-long operation, box jacking - which has never been used in Hong Kong before but has proved its worth elsewhere - will be used. Both carriageways of a precast 70m-long stretch of highway tunnel will be pushed into place beneath the Airport Express Line (AEL), the umbilical cord from Hong Kong to the airport, the ground in front will be gradually removed.

Intrafor and VSL Heavy Lifting teams have been preparing for the delicate task for more than a year,

by carrying out extensive ground treatment to ensure that the railway will not subside when the tunnel is installed.

Work is now entering a key stage. The jacked section - part of the Scenic Hill Tunnel on the airport island - takes the form of an open-ended concrete box structure. Installing the structure underneath the existing railway creates considerable challenges and imposes strict project constraints as the line remains in operation for almost 20 hours a day. Access is limited and noise permits are required to work night shifts and on Sundays.



Settlements must be less than 50mm.

Carrying out the work requires close coordination with the main contractor and a complex design approval process involving many parties. Above all, it is essential to keep settlements of the railway to less than 50mm.

Hong Kong Link Road (HKLR) is one of a series of strategic projects being implemented to connect local transport networks to the region's latest 'mega project', the Hong Kong-Zhuhai-Macao Bridge (HZMB). The link road will open up access to the new, direct route connecting Hong Kong, Macao and the Western Pearl River Delta. The HKLR starts at the boundary of the Hong Kong Special Administrative Region (HKSAR). It runs over 12km to the new boundary crossing facilities, which are being built in the north eastern waters off the island of Chek Lap Kok, home to Hong Kong International Airport.

Building the HKLR involves extensive engineering as almost all of the route is either on viaduct or in a tunnel. One of the key contracts began in May 2012 and involves the HK\$8.875 billion section between the scenic hill ending at the future Hong Kong Boundary and Crossing Facilities (HKBCF). The project brief covers the design and construction of 2.6km of tunnels and at-grade roads, together with associated tasks including 23ha of reclamation. The 1km dual three-lane tunnel section takes the road under Scenic Hill, Airport Road and the AEL to minimise the environmental and visual impacts. The client for the project is the Highways Department, whose resident engineer is Arup. China State Construction Engineering (Hong Kong) Ltd is the main contractor, working with engineer Atkins. A subcontract team of Intrafor, VSL Heavy Lifting and URS Benaim is responsible for the tricky box jacking operations

The team has been able to draw on VSL's experience of an operation carried out successfully for Brisbane's Airport Link project in 2011. The work involved jacking two adjacent 65m-long precast concrete tunnels under six live Queensland Rail lines in a continuous operation, believed to be the world's largest single box-jacking ever undertaken. In Hong Kong, the tunnel's eastbound carriageway has three lanes heading towards the boundary crossing facilities and there are four lanes for the westbound carriageway, heading towards the main bridge. The two carriageways are being jacked into place on a skewed alignment



as separate sections. Tunnel 1 is 70m long, 23.5m wide and 14.5m high and requires 24,000m³ of excavation. Tunnel 2 is 13m high and 10m shorter as well as being narrower, with a width of 18.5m. Some 14,500m³ of material will be removed for Tunnel 2.

Space constraints for the construction access shafts also mean that the number of segments for each of the two tunnel sections had to be increased to five, rather than the optimum four. Intrafor's work began long before the start of the jacking operation, as the ground had to be treated to ensure that the railway wouldn't settle during the excavation. The ground in the area of the jacking is primarily composed of soil and rock fill over bedrock. Carefully controlled and monitored grouting has taken place to bring it up to the specified design parameters.

Work on the extensive grouting operations began in August 2013 and was completed in December 2014. The grouting serves a number of purposes, including creating a mass of treated soil to provide a water cut-off and to increase lateral stability during excavation. Carrying out the grouting required the drilling of about 1,800 holes, with a total length of 68km, having to grout 17,000m³ of ground, using



a variety of mixes. For instance, a quick-set cement grout formed an instant water cut-off of the ground-water flow and cement-bentonite grout in different mix proportions was used to fill voids in the rock fill. Crews worked around the clock, to operate the drilling rigs and two state-of-the-art automatic computerized and fully instrumented grouting stations.

Additional means of ensuring the stability of the AEL included the installation of anchor ties and a roof of



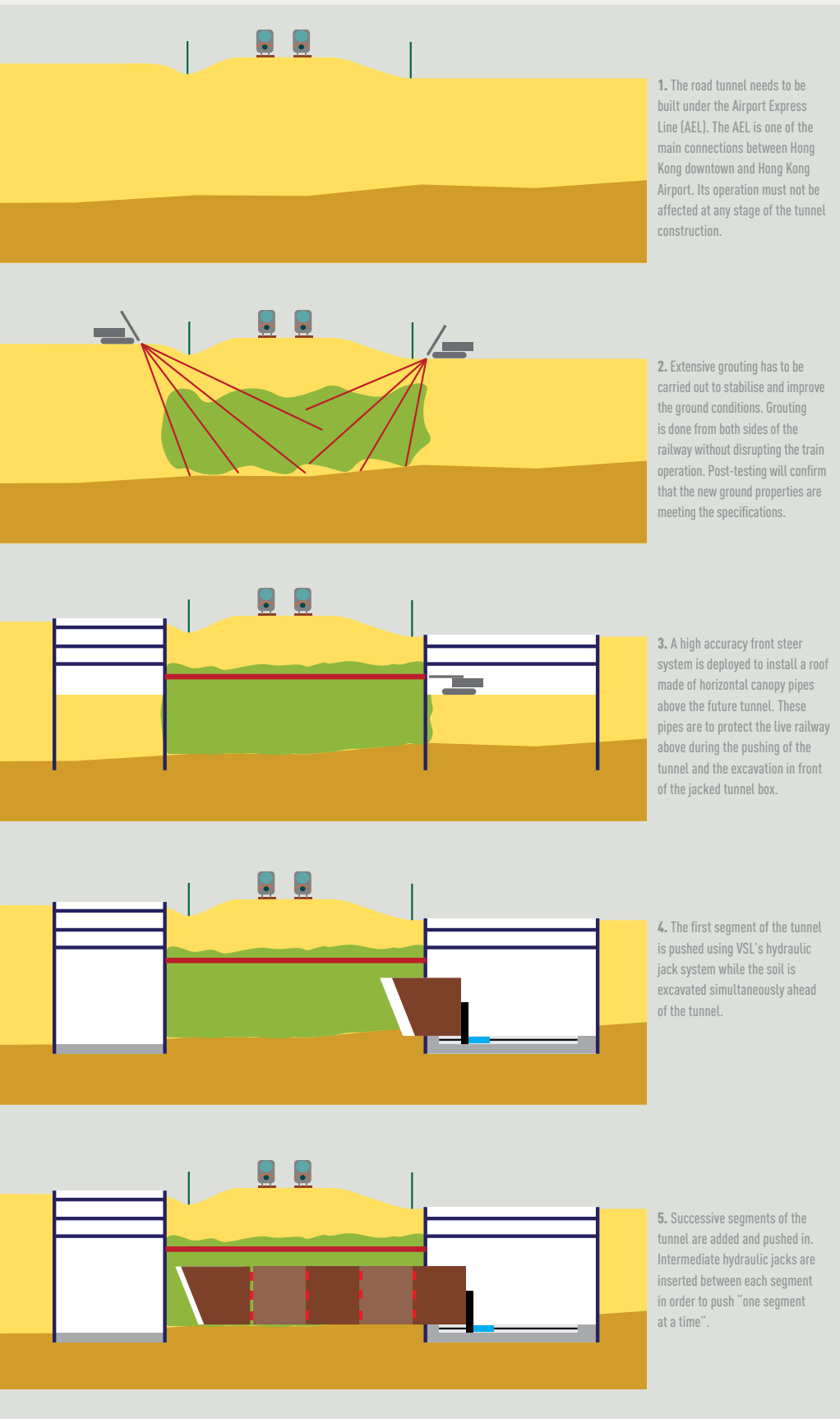
Additional means of ensuring stability were anchors ties and a roof of canopy pipes.

canopy pipes – also containing ties – above each tunnel. The 65m-long steel canopy pipes reduce settlement as well as providing stability at the face during excavation. In total, 46 of the 816mm-diameter pipes will be installed for the project, fitted with the help of two horizontal drilling rigs operated 24 hours a day, seven days a week.

Anchor ties, which are 65m long, run between the shafts at the eastern and western ends of the jacked section, to improve the shafts'

technical report

BOX JACKING



stability as well as reducing settlement of the railway. There are two layers of ties. At 1m below the datum level, 18 VSL ties have been installed. The other layer is inside the canopy, at 4.5m below datum, where 46 ties are required.

The actual box jacking operation can begin once the ground has been rigorously prepared. Use of the technique – known in full as mined box jacking – involves pushing pre-cast tunnel box segments forward while the ground is excavated at the front. All of the excavated material is transported to the rear of the box segments for removal. The tunnel box is fitted with a shield at the front, which engages with the rock mass and provides protection for the excavating equipment. The box advances into place by being pushed forward by hydraulic jacks of 24,000t capacity, which react off a slab positioned behind the rear segment and intermediate jacks set up between segments. The alignments of the shafts' head walls and back walls are skewed to the tunnel alignment by 35°, further complicating the operation.

The excavation started in December 2014 and is due to continue until January 2016. Then, the actual box jacking operation will start. ■

DAMPERS IN BUILDINGS

Efficiently mitigating vibrations

Vibrations not only generate discomfort but can also damage structural components, and in extreme cases, can lead to failure: either as a result of high-energy events such as earthquakes or from more common sources such as wind.



VSL offers a wide range of damping solutions based on the use of the VSL VE damper. This damper incorporates super-high-damping rubber, which instantly converts vibration energy into heat energy through shear deformation. Building vibrations resulting from wind forces, traffic, human activities and even severe earthquakes are controlled by the damper.

VSL has been carrying out a multitude of projects in Taiwan, which lies in a seismically active zone, on the 'Pacific Ring of Fire', and at the

western edge of the Philippine Sea Plate. Most of Taiwan's earthquakes occur off the east coast and cause little damage but the last major one struck in 1999 and claimed 2,415 lives.

Many modern buildings in Taiwan are therefore constructed with earthquake safety in mind and VSL Dampers are currently being installed on a number of high-rise buildings. These include the Twin Park project, a concrete residential building located in Zhubei City. The building is 21 storeys in height and in total 76 sets of VSL Damper systems will be installed between the second and fourteenth floors, using a 1.5m-high, wall-type system with one VSL VE damper per set. They are integrated into prefabricated steel panels that are installed directly into the structure during construction.

Wall-type dampers are also being installed on the Xiang Yu project, a concrete residential building in the Zhonghe District of New Taipei City. In this case, there are two VSL VE damper units in each of the 1.5m-high units. In total, 26 sets of VSL Damper systems will be installed between the second and fourteenth floors of the 26-storey structure.

Damper installation is also taking place at a 37-storey-high concrete residential building in Kaohsiung City. A total of 36 sets of VSL Damper systems are being installed from the eleventh to the nineteenth floors of the building. The VSL wall-type damper systems in this case are 1.35m in height. VSL started installation work in June 2013 for completion in 2015. ■

Construction with earthquake safety in mind.



DEVELOPING INFRASTRUCTURE IN EQUATORIAL GUINEA

Gateway to the capital

A booming oil industry has brought rapid growth in the economy of Equatorial Guinea, creating demand for new expressways to expand the country's transport network. Key projects include the construction of signature cable-stayed river crossings providing access to the country's new capital city.

Equatorial Guinea is building a new city, Oyala, which is set to replace Malabo as the country's capital. Construction of the new capital creates a need for high-quality infrastructure and VSL has been providing its bridge-building expertise.

A consortium led by Bouygues Bâtiment Guinée Equatoriale (BBGE) won a design and build contract for two cable-stayed bridges over the Wele River in the future city of Oyala - also known as Djibloho. VSL was appointed by BBGE to provide the technology used both for the post-tensioned tendons and the stay cables of the two bridges. Pedelta designed the bridges as well as provided construction engineering services.

The new bridges are part of a bypass road serving Oyala, which is located a one-hour drive from Mongomo and 2.5 hours from the country's largest city, Bata. The aim was to create iconic bridges that would provide a striking gateway to the new capital while respecting the natural environment. The remote location of the bridges meant that access to the site was difficult and so it was important to minimise the amount of materials used and optimise the construction schedule.

The resulting cable-stayed design was chosen as a balance between aesthetics and costs. The studies had also considered a concrete box girder bridge. Bridge types including pre-cast concrete I-beams were ruled out early on for aesthetic reasons.

The bridges carry two lanes of traffic in each direction, separated by a median strip. Cyclists and pedestrians can cross the bridges using 2m-wide dedicated paths. Included in the design is decorative lighting of the stay cables, primarily for aesthetic purposes.

The deck-level anchorages for the stay cables could not be positioned in the centre of the deck, which led to a solution using two planes of stay cables anchored to H-shaped pylons. Each bridge has two pylons reaching a height of 21m above deck level. The pylon legs are splayed outwards at the top, for aesthetic reasons. A red metal cross-beam, fitted with its own lighting, serves to connect the upper parts of the towers. A semi-harp configuration is used for the cable stays and the back-stays are anchored at the ends of the deck.

The VSL high-strength, multistrand stay cables use a maximum of 19 strands with a tensile strength of 1,860MPa. The strands are galvan-



The remote location of the bridges meant minimizing the amount of water used.

ised and have additional protection from individual high-density polyethylene (HDPE) sheaths and from grease between the strands. There is also an outer HDPE sheath, which incorporates double helical ribs as a means of preventing vibrations induced by rain or wind.

Deck's longitudinal beams are prestressed concrete girders. Compared to a solution with steel girders, costs were similar for both options but the prestressed concrete solution had greater advantages as the materials were more readily available near the site. The deck section is composed of two longitudinal beams connected by cross-beams spaced at 3.35m, which are also of prestressed concrete.



Underslung form-travelers were used to build the main span, avoiding any impact on the river.

Each bridge's deck is 23.6m wide, 1.55m deep and approximately 150m long, made up of a central span of 81m, 27.5m-long side spans at both ends and a 7.5m-long transition slab at each abutment. The structures are supported by micro-piles, with lengths between 18m and 23m at the towers and between 16m and 18m for the abutments, depending on the depth of the rocky substrate.

The pylon legs are of solid reinforced concrete until the first anchor and then have a hollow cross-section with an internal steel box that provides anchorage for the stay cables. The pylons were built using 5m elements, which were cast in place.

Both vertical and transverse support are provided for the deck at the

abutment, and transverse support only at the pylons. All these supports are elastomeric bearings.

The decks of the two bridges were cast-in-place whereas the side spans were built on falsework standing on a reclaimed land. Underslung form-travelers were used to build the main span by cantilever method avoiding any impact on the river. Other advantages of this method included savings in time and costs, high quality control and the ability to use local labour.

Four form-travellers were used for the two bridges.

The stay cables were installed in advance of concreting each main span deck segment, which was carried out in 5m-long sections.

The permanent post-tensioning was applied on completion of the deck.

The abutments were among the most challenging aspects of the project since they have to transfer both downward and uplift forces from the bridge deck elaborated foundations through elastomeric bearings. This solution avoids the potential cable fatigue problems of other solutions that were studied, for example using post-tensioning to anchor the deck to the abutment footing. Retained earth behind the abutment ensures that there is no pressure on the abutment walls and reduces the shear force, allowing the use of very thin concrete sections for the abutment with a corresponding reduction in their foundations. ■

MILTON-MADISON BRIDGE

The Big Slide

One of the largest bridge slides ever undertaken has been carried out to position the new superstructure of the Milton-Madison Bridge in the USA. The owners chose a method for replacing the bridge that minimised the closure of the crossing during construction. VSL's expertise on similar projects made it the partner of choice for this critical operation.



tech show

MILTON-MADISON BRIDGE



1 Tackle the needs of modern traffic

The Milton-Madison Bridge spans over the Ohio River to link Milton in Indiana with Madison in Kentucky. It first opened to traffic in December 1929. After more than 80 years in use, the bridge was deteriorating and its deck was too narrow to handle modern traffic. A local referendum led to the selection of a design for a new steel truss bridge similar to the old structure. It was decided to retain the original piers and upgrade them to carry the new superstructure, which is twice as wide as the old one.

2 Avoid disrupting the traffic

The operation involved building the bridge's new truss next to the existing structure on temporary piers while the old crossing was kept open to traffic. After completion of the new truss, traffic was rerouted onto the new structure - still on its temporary piers - while the old truss was demolished and the original piers refurbished. The complete new truss was then slid laterally by 16.8m onto its permanent piers and the route was reopened to traffic.



3 Assemble the new main spans

The first step in preparing for the 'big slide' was to assemble the spans numbered 2 and 3 on barges near the river bank. With a length of 182m, span 2 weighed 1,660t; the 222m-long span 3 had a weight of 1,805t. Each of these spans was floated into position on barges. In two separate operations, the spans were then raised by eight strand lifting units positioned on temporary sliding beams installed on top of the temporary piers.





4

Watch the clock

The Ohio River had to be closed to all shipping traffic for the lift of span 3, which created a tight schedule for the operation. A further challenge came from the weather conditions, including storms and high water. VSL benefited from its extensive experience on similar projects and completed both lifts within the available time frames.



5

Monitor the lifts

Both lifting operations for the main spans were monitored by the Greenville control system, working using wireless transmission. Inclinator sensors were used to check that the truss sections remained horizontal throughout the lifts.

6

Carry out the record-breaking slide

In a single operation, the 740m-long, 13,845t truss that forms the main part of the bridge was slid laterally by 16.8m, setting a new record for North America and perhaps the world. In preparation for the move, a temporary working platform had been mounted on each of the five refurbished piers. Two SLU-330/550 units, a pump and a sliding track system were installed on each pier to move the new truss into place. The crossing was then closed to traffic. It is the only bridge for 42km upstream and 72km downstream and so the impact on traffic was severe, creating another very tight time constraint.

There are smaller concrete approach spans at each side of the new bridge. The concrete span on the Kentucky side of the river had been slid into place before the 'big slide' using two SLU-40 strand lifting units, one at each pier.



Key data for the new bridge

Total length: **970m**

Width: **12.19m**

Number of piers: **5**

Number of spans: **4**

The new bridge reopened on 17 April 2014, just a week after the entire 740m-long truss had been slid laterally into place.

7 Stop at precisely the right place

For the sensitive sliding operation, VSL's Bravo control system was used. This allowed the jack pressure – equivalent to its pulling force – and the distance travelled to be precisely monitored at each of the five piers. The Bravo system can operate with a variety of distance sensors; here lasers were chosen as they offer high accuracy in the measurement of long distances. The laser was attached to the pier and measured the absolute distance to a target reflector on the truss. The final position was reached to within a tolerance of +/-2mm.

MILTON-MADISON BRIDGE HONORED

The American Society of Highway Engineers (ASHE), Great Lakes Region has recognized the Milton-Madison Bridge Project with its prestigious "Project of the Year" award. A couple of weeks later, the Milton-Madison Bridge Project got national recognition once more. On December 4, 2014, at the National ABC (Accelerated Bridge Construction) Conference in Miami, it was named "Best Project" for 2014 in the lateral slide category.



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