VSL NEWS

THE VSL NEWS MAGAZINE • ISSUE ONE 2005

BRIDGES IN HK

VSL, partner of choice

Laayoune wharf

New protection for anchorages

highlights

Cover photo: Lai Chi Chok, Hong Kong, for Necso.

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EDITORIAL

VSL, partner of choice

With over 3 million square meters of bridge deck installed over the past 12 years, VSL has become the market reference for this specialized type of construction works. Our engineers and technicians are trained to play a vital role in both project preparation and execution. Within our "Special Projects" team, their missions focus on such operations and provide for rapid and efficient mobilization on behalf of clients.

Fully aware that prestressing techniques are a key to deck construction methods, our engineering staff seek to develop new products compatible with recent advances in installation equipment that serve to reduce cycles and continuously improve quality (e.g. duct couplers for segmental bridges).

VSL would now like to extend this specialist strategy in the aim of strengthening our technical capacity and claim its position as the best choice of partner for handling bridge deck jobs.

The various worksites presented in this issue of VSL NEWS magazine will help you discover the breadth of techniques now available as well as the means deployed for addressing project constraints, which are ever more challenging in geometry, scheduling and overall complexity.

Enjoy the issue!

Jean-Philippe Trin

Slabs

Spanish growth for PT slabs

→ **VSL Spain completed a total of six bonded post-tensioned slab contracts** in the Spanish market in the first three months of the year, the largest of which is at the new Lugo Hospital. It took just seven months to complete more than 31,500m^2 on the project using the latest Bondtech PT system as an alternative to the original proposal for traditional reinforced concrete slabs. Over the same period VSL has also worked on the new A Coruña International Fair Hall where it delivered the post-tensioning slab works and a cable-stay system to support the 7,000m^2 suspended roof. Post-tensioned slab construction is becoming popular in Spain, with contractors and consultants increasingly appreciating its benefits in terms of budget, schedule and quality.

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Certification

German endorsement

→ **VSL's Structural Preservation Division in Singapore and Thailand** had recently been certified by Germany's concrete and construction engineering association as concrete repair specialists. Certification by Deutscher Beton- und Bautechnik- Verein E.V. proves competence in the field of repair, injection and protection of concrete and reinforced concrete structures.

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ICRI 2004

Holcim heater scoops repair prize

→ **The successful post-tensioning of the cracked frame** of a 99m-high tower has been chosen as the International Concrete Repair institute's 2004 project of the year. The retrofit for the Holcim concrete preheater tower consisted of bonded post-tensioning installed in holes drilled in the beams. Precision drilling was needed as the holes were up to 26m long and had to avoid cutting the existing reinforcement.

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Jacking

VSL flatjacks help in Sydney tunnel

→ **VSL's expertise in jacking has been put to good use** in a number of critical activities on Sydney's new Cross City Tunnel. Services provided have included the supply and installation of VSL's largest flatjacks for the relocation of a 400t shaft. Cross City Tunnel dives under Sydney's central business district to improve east/west travel. The contract was awarded by the Roads and Traffic Authority of New South Wales to the Cross City Motorway Consortium. Moving the 400t ventilation shaft and staircase involved the use of flatjacks with a capacity of 13,650kN. VSL also provided jacks for work on other structures, including the transfer of loads needed to modify piers and foundations around the tunnel alignment. ■ *Contact: dtrayner@vslsyd.aust.com*

Slabs

VSL builds on Indian IT boom

→ **VSL India has been awarded more than 100 projects** as developers and contractors invest in major IT parks to provide facilities for software professionals. The growth is due to the number of overseas businesses establishing outsourcing companies there and a parallel expansion by Indian IT companies to meet the demand of global orders. This upturn has substantially increased building activities in many cities in India. The Indian Construction Industry market is 10 million m^2/year (IT, Malls, Office Buildings, Residential & Industrial); PT adopted buildings about 4 million m^2/year). VSL post-tensioned slabs have gained wide acceptance with developers and contractors as a cost-effective and quickly constructed solution. VSL India is

currently executing post-tensioned slabs for IT parks there at a rate of about 250,000m^2 every month. The company is already working as the nominated specialist sub-contractor for many world leading software companies including Infosys, Wipro, Satyam and Quark. IT parks are making extensive use of the VSL bonded PT system and VSL's 5S slab system, Among the projects is the prestigious Ascendas IT Park, Chennai. ■

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NOTE PAD

Network. *Specialist contractor Structural Preservation Systems, Inc. (SPS) has announced that it will acquire Florida-based waterproofing and concrete restoration business AquaShield, Inc. from The Continental Group, Inc. in Florida. With locations in fort Lauderdale and Tampa, SPS is already the largest specialty repair contractor in the state of Florida.*

PRU. *Adverse site conditions such as dust and rain cause no problems for the VSL's new portable reading unit (PRU). VSL Spain has been using the new PRU with two Monostrand Hc160 load cells on heavy lifting operations. Many different types of sensors can be connected to a single PRU which can both read and record all the values measured on site. The PRU can be configured to read details from each sensor in turn or to take simultaneous readings from a set of sensors.*

Bars. *VSL developed an alternative micropile design at La Maladiere Football Stadium, Switzerland. The parking structure required 1,300 uplift micropiles with an average length of 11m. Instead of using the B500 with a diameter of 50mm, VSL suggested S670 coarse threaded bars of 43mm diameter. A fabric sleeve over the entire length prevented uncontrolled consumption of grout and any pollution of the groundwater.*

New vaults. *Repair works of 4 Railway Tunnels in Central Vietnam are scheduled to be completed by march 2006. Ground reinforcement, Vault Demolition and drainage works are now almost complete, focusing at present on difficult tunnel entrances, and re-profiling of tunnel vaults using RC and fiber reinforced shotcrete.*

BRIDGE CONSTRUCTION IN HONG KONG

VSL, partner of

VSL has successfully erected over 3 million m² of bridge deck in the Asia-Pacific region over the last 10 years. Over the last two years in Hong Kong, VSL have played a key role in several challenging bridge projects, each of them different, with their own unique set of difficulties and constraints.

First of the VSL assets, the technical expertise and adaptability. As is typical in Hong Kong, working areas are becoming more and more challenging as new structures and bridges have to be built around or above existing infrastructure, often requiring heavy traffic to remain undisturbed during the works. This leads to very intricated projects. A good example of this is the Penny's Bay Contract achieved by VSL last year.

The Penny's Bay Contract 1 consists of a short six span bridge that is sandwiched between the MTRC line below and the highway bridge above, both of which provide vital links between the International Airport to the rest of Hong Kong. Consequently the design of the bridge deck was required to be very slender to allow sufficient clearance for the traffic between the surface of the deck and the soffit of the bridge over. This dimensional constraint also presented a challenge to VSL to be able to provide a launching girder that could safely operate in this space to erect the precast segments. In order to achieve this, a new launching girder was developed by VSL utilizing a substantial part of its existing equipment. All of the components were configured to fit within this restricted height and during launching only 200mm remained between the launching girder and the soffit of the bridge above. The erection work above the MRTC line was completed within 44 days, exactly in line with the original forecast project schedule. This was done with the highest degree of safety and without any disruption to the railway traffic.

Open mind as prerequisite

Creativity is another trump card in VSL's hand since finding the right solution to particular construction problems is a VSL obsession. To keep an open mind for new ways is a key prerequisite for success when facing specific requirements in fast track projects.

The West Tsing Yi project in Hong Kong included the erection of segments that are unusually large and heavy, measuring up to 16,1m wide and 42m long and weighing up to 150t.
At the same time, the project was relatively small in size, involving only 249 segments, which made the use of a launching girder uneconomical. Combined with these issues, the access was difficult with some of the segments located out of the reach of cranes being located above and

choice

adjacent to steep slopes. In answer to these difficulties, VSL reduced the maximum segment weight to 100t by introducing a second stage cast for the heaviest segments, and designed a very innovative lifting frame.This new frame has the capability of lifting a segment at the pier location below the deck, then translating on the deck in either direction to the tip of the

KCRC East Rail, Lok Ma Chau CC202 – Hong Kong.
Construction of two 2km-long elevated railway viaducts. Independent portalised single deck span structure with the spans simply supported over the piers on free and guided bearings. Total 1,410 segments forming 89 spans. The low weight of the segments (25 to 30t), reasonable access, relatively low level of the viaduct and the fairly simple alignment led to reutilize the equipment that was previously used on the West Rail and East Rail projects, consisting to 2 sets of underslung gantries, self launching, loaded with cranes for span by span erection. Formwork system was used for the West end of the project, where the design of the box prevented the use of the underslung gantries due to the widening of the segment diaphragm at the piers. Erection was completed in 11 months.

Sha Tin T3 Viaducts – Hong Kong
Construction of several precast segmental balanced cantilever viaducts through heavily urbanised areas. Typical viaducts spans are 40m long with segments 2.5m long (6m to 17m wide, 25t to 90t). Within the project there are two three-span structures with spans up to 80m. Access around the site is very difficult with a lot of road and pedestrian traffic.
The majority of the erection work is carried out by overhead launching girder with segments being delivered along the newly-built viaduct to the rear of the launching girder. In total there are 1,807 segments forming 143 spans; erection started in March 2004 and is expected to be complete by the middle of 2006.

cantilever, and erecting the segment at the end. This equipment was able to handle very heavy loads in a difficult and confined area in an economical manner.

Time and money

Competitiveness remains a must in any of VSL's solutions. Time, quality and money are of the essence. Every project pushes contractors and subcontractors harder in their cost and risk assessments at the tender stage in order to be competitive in the increasingly cost driven market place.

The Lok Ma Chau Viaducts project in Hong Kong this year consisted of the construction of about 7km of simply supported precast segmental spans for the new rail link to the Hong Kong border for Kowloon Canton Railway Corporation (KCRC). Technically, this job did not include any particular challenge as the structure was relatively simple, at reasonable height, and with reasonable access. Hence, the project was let at a very competitive price. Based on our past experience on West Rail and East Rail projects in Hong Kong,

Segmental construction: what are the options?

Segmental construction is flexible and offers many different options in terms or equipment. Interview with Neil Thorburn, Manager – Major Projects in Hong Kong.

Precast segmental Bridge construction is now probably the most common method of construction of long or multiple span concrete structures for roads and railways. Why?
The reason why bridge decks are being precast lies in the desire to speed up construction and reduce costs. To minimize permanent structure quantities is of secondary importance. Precasting of bridge decks enables an industrialized production, that means mass production of standardized components.

How do you classify precast segmental bridges?
By the way the segments are erected. The erection method determine the geometry of the segments and the span arrangement. In basic terms a precast segmental superstructure is broken down into a series of transportable elemental segments which extendually over the full width of a structural element over a partial length. These segments are then prefabricated using "Match Casting", cast either by the "long line" or "short-line" method. By the "long-line" method the casting bed makes up the soffit of a complete cantilever or span and one or more formwork units move along this line. With the "short-line" method the form is stationary while the segments move from the casting position to the match casting position and then to the storage. In this process the individual segments that make up a span or cantilever are cast in a specific sequence in a precasting bed or cell with each segment being cast directly in contact with its predecessor such that the faces of the joint between the two segments are an exact match.

How does post-tensioning come into it?
The erection involves the lifting and positioning of the segments such that they can all be joined together in position using post-tensioning to form the final structure. When cantilever construction is used, the segments are erected in balanced cantilever starting from a pier by placing segments on either side in a symmetrical operation. This method requires an equal number of segments cantilevering for the piers. By the span by span erection, all segments for one span are placed on a temporary support truss or ground supports, are aligned, jointed and longitudinally prestressed together in one operation to make a complete span.

Internal or external post-tensioning or a combination of both may be used to stress the precast segments together. How do they compare?
Internal PT runs and is anchored with the concrete shell elements like top slab, bottom slab or webs. Additional reinforcement is just needed in anchorage zones to take care of locally high stresses behind anchorages. On the contrary external PT tendons run exposed inside of the segment box. At anchorage and deviator location heavily reinforced concrete elements like diaphragms and deviator blocks are required.

When do you need glue?
Depending on the design epoxy glue may or may not be applied to the segment joints. Decks designed with internal post-tensioning will require epoxy glue, while those with external post-tensioning usually do not unless there is a particular concern relating to water ingress in the joint area. The epoxy serves two main purposes: during erection it acts as a lubricant that helps to join the segments, and in the final stage it seals the joint against water ingress from the outside and is therefore a corrosion protection barrier. When internal post-tensioning is used then the epoxy glue and the grout in the ducts are the only protection of the strand against corrosion. For external post-tensioning the epoxy is not required since the whole tendon is encapsulated in an HDPE pipe.

Why do you sometimes use stressbars?
With epoxy glued joints the joining of the segments is achieved with temporary high strength stressbars which ensure that the joint has been fully closed and fitted and that the appropriate compressive stress has been applied across the face. These bars are usually omitted when dry joints are used, and the segments are pulled together by the permanent post-tensioning.

Amongst the current methods used for the erection of segmental structures and considering the advantages and disadvantages of each, how to choose the right one?
Although relatively simple in concept; akin to building structures out of giant Lego® blocks, the process requires careful thought, considerable planning and a high level of experience and expertise to be carried out successfully and safely. There is usually more than one solution to any given situation and the final choice will be very dependant on the actual situation on site and any other prevailing circumstances such as availability of equipment and expertise. ■

which utilized a similar structure, VSL was able to use its strong technical know how combined with experienced personnel and available equipment to provide an efficient and cost effective package to the main contractor (Maeda Corp.). The project was successfully completed ahead of schedule.

Alliance for flexibility

Conventional contract arrangements are finding challengers, who are eager to explore new ways of working together in order to achieve a better product at the end, with less contractual and financial problems. VSL are open and proactive in trying to implement new alternative contractual relationships and has adopted this for the Lai Chi Kok project: VSL has formed an Alliance with the contractor, NECSO Entracales, for the superstructure erection of this very challenging bridge which forms part of Route 8. The viaduct is situated in a very densely populated part of Hong Kong with complex existing roadways underneath, buildings in close proximity and very steep hillsides at one of the approaches. This alliance integrates the staff from the main contractor with those of

Construction methods

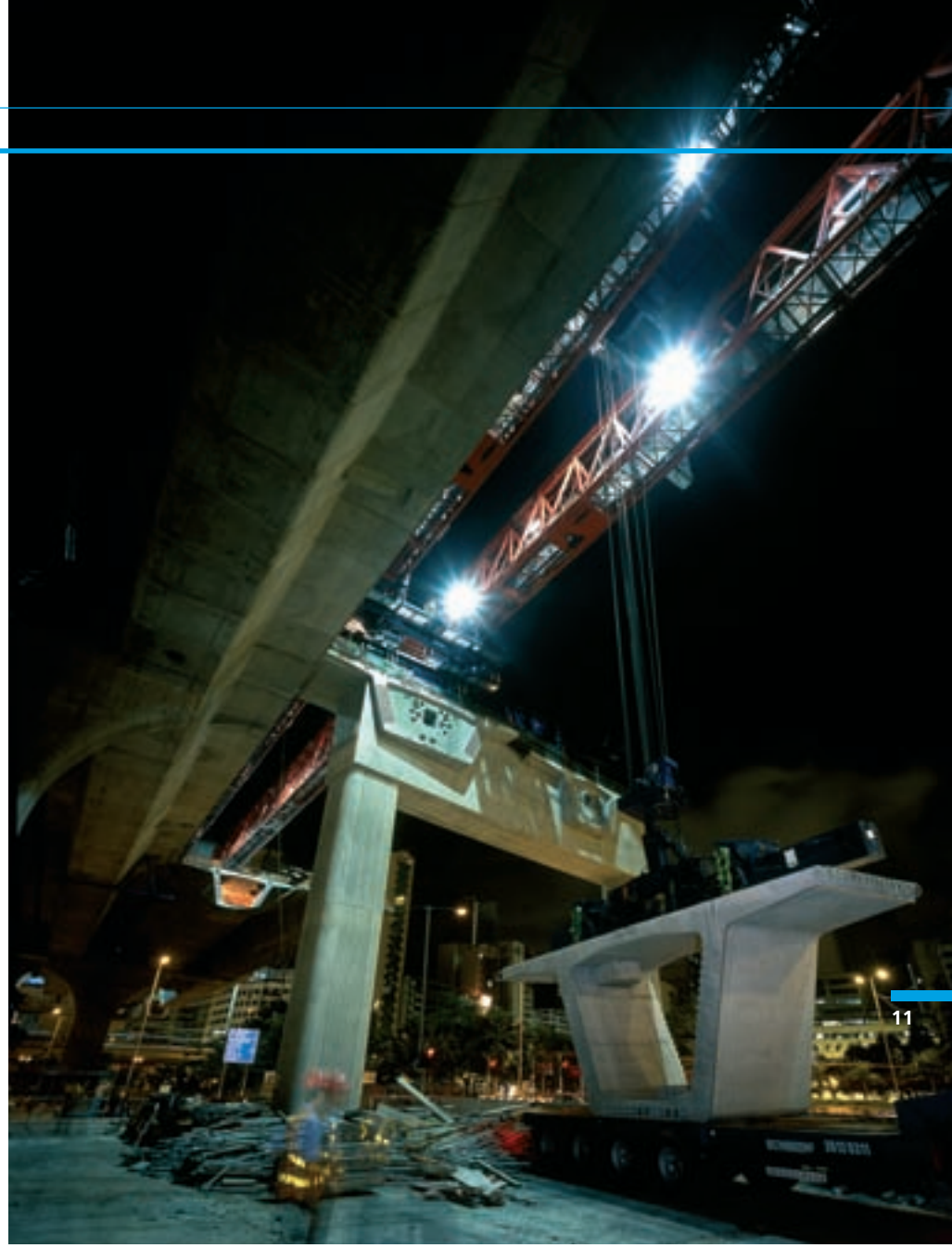
Span by Span Structures
- Overhead launching girder
- Underslung launching girder
- Crane on falsework

Balanced Cantilever Structures
- Crane
- Lifting frame
- Overhead launching girder

VSL, who provide the expertise via their technical and production staff. This arrangement gives the alliance the full access to VSL's technical expertise and eliminates the wasteful contractual issues that can beset traditional subcontracts.

Large scale, short programme

On large scale projects with relatively short programmes, contractors need more than anything else partners who can perform and produce with



Lai Chi Kok Viaduct – Hong Kong

Construction of a dual-deck high-level viaduct including several ramps and structures with very tight radius curves, high longitudinal and transverse gradients. The structure is designed as precast segmental balanced cantilevers with typical spans of 75m and segments 2.5m long, (8m to 15m wide, 40t to 100t). Pier heights range up to 45m and many of the piers are single column with twin decks supported off T heads. This meant careful consideration of the longitudinal and transverse balance during segment erection was required. The high level of the viaduct and the relatively difficult and generally highly urbanised access at ground level along with the need to keep the minimum additional loads on the cantilevers during construction, led to the choice of an overhead launching girder, although some spans – particularly on the ramps – are being erected by a combination of cranes and lifting frames. In all there are 1,771 segments forming 75 spans; erection started in late 2004 and is expected to be complete by the middle of next year.

Penny's Bay Phase 1 and 2 – Hong Kong.

Construction of small viaducts. The Phase 1 (4 months) of the project consisted of three-span viaducts crossing above the existing airport rail link and below an existing expressway with very little room in which to work. Typical segments: 15m wide, 2.5m long, 60t. To carry out erection, a special overhead launching girder was developed based on the re-use of two existing underslung girders. This produced a system which was able to fit within the very tight spatial constraints of the site. Segments were delivered from below, adjacent to the railway track, and lifted up into position by the winch on the launching girder. In total the 80 segments were erected in four months.

The Phase 2 structure was made up of up to six decks wide over six spans. Given the flat area, the relatively small number of segments, the low level of the viaduct and the good ground conditions, the spans were erected on falsework. In all 547 segments forming the 41 spans were erected in seven months.

BRIDGE CONSTRUCTION IN HONG KONG

Deep Bay Link North – Hong Kong
Construction of 5.4km of multi-lane elevated highway. Individual precast segmental spans joined both transversely and longitudinally with in situ concrete stitches. 3052 segments from 8.3m to 15.3m (maximum weight 80t) forming 222 spans. Given the relatively large size of the segments and the availability of reasonable access along the entire site, the erection work is carried out using overhead launching girders, loading from below, supported by falsework for some of the ramps and non-standard spans. Three overhead girders were used for the erection, which began in June 2004 and is scheduled to complete in September. Photo: the Construction of the main line pier crosshead above the KCRC West Rail lines using the type 2 gantry to support the formwork structure.

West Tsing Yi Viaducts – Hong Kong
Three viaducts to cross a cutting at a relatively high level and designed as a series of typically 75m span precast segmental balanced cantilever structures. Total: 249 segments (8m to 15m, 75 to 140t) forming 23 spans. To ease access and handling requirements the segments were delivered to site with a maximum weight of 100t and then additional sections such as wings or diaphragms were cast in situ after erection. Access below the spans was generally good although there were several areas where it was not possible to get a segment to a position directly below its erection location. This type of structure would normally be a prime candidate for erection by overhead launching girder, however the small number of spans and the need to relocate the equipment between the three viaducts meant that this would have been very expensive. The solution was to use a combination of crane erection and a custom-designed lifting frame system which was able to pick up the segment from any position below the span in question and carry it out to the tip of the cantilever where it could be fixed in position. Erection started in September 2004 and was completed in June 2005.

reliability. VSL can bring this confidence to contractors based on their past track record and their depth of experienced specialists.

The Deep Bay Link North and Shenzhen Western Corridor ongoing projects are good examples of this kind of requirements: these two projects form the major part of a new link from Hong Kong to Mainland China. It includes approximately 8.5km of dual deck elevated viaduct of which 3km are over water. The magnitude of these two projects, with their tight programmes requires significant specialist resources for the erection work of the viaduct. This led the Gammon team to engage VSL for the erection work. In total there are 4,854 precast segments to be erected over a period of approximately 14 months, utilizing four launching girders, two lifting girders and craneage. In addition to this there are 24 spans which are cast insitu constructed with the free cantilever method using 8 pairs of form travellers. There is a total of approximately 6,000 t of post-tensioning which are also supplied and installed by VSL on these two projects.

The environment around VSL moves and obliges the team to constantly analyze and adapt to new situations, always more challenging. VSL Hong Kong has well understood this and fully dedicates to finding the best answer, whether financial, technical or operational, by working closely with its clients and partners. Experienced, safe, open minded, performing...The VSL permanent dedicated staff are well positioned to provide reliable service on any type of bridge project. Andrew Payne, regional CEO for VSL says: *"We have the ambition to be or to remain a partner of choice for our client's most challenging projects".* ■

Shenzhen Western Corridor- Hong Kong

Two 3km-long precast segmental balanced cantilever viaducts plus a cable-stayed bridge. Typical spans are 75m long with segments approximately 15m wide, 4m long and weighing up to 140t. Some pier segments weigh 170t when the in situ sections are included. Segment erection was carried out using a combination of overhead launching girder and lifting frames. The launching girder was capable of erecting parallel decks by translating sideways from deck to deck and could be loaded either from barges directly below the structure or from the existing deck that had been completed behind. Two types of lifting frames were used – simple conventional tip-mounted frames which were capable of lifting segments delivered by barge to directly below the cantilever tip, and more sophisticated lifting girders which were supported from the parallel decks and were capable of lifting segments from the temporary roadway between the decks and translating them sideways into their final location. In all the 1843 segments forming 84 spans were due to be erected between July 2004 and September 2005.

Courtesy of Dubai Palm Developers Nakhee

Dubai

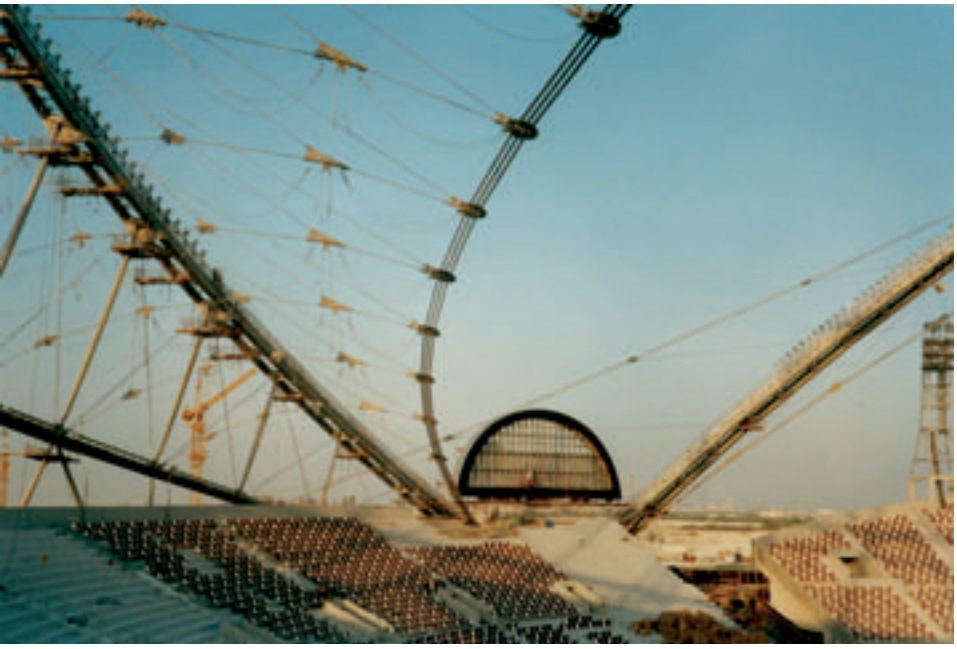
Golden Gateway for VSL

→ **VSL Middle East has recently successfully delivered** and installed the post-tensioning for the prestigious Palm Jumeirah Gateway Bridge project in Dubai. The project is configured as a pair of six-span bridges 360m long which curve away from one another as they approach the island. Cast in-situ, post-tensioned box girders incorporate VSL 6-22 multistrand anchorages and couplers, with precast concrete struts cantilevering out to support the deck. Cast stone representations of the Seven Wonders of the Ancient World are incorporated within curved sail like structures shaped like palm leaves embellished with gold. Client for the scheme is Dubai Palm Developers/Nakheel and the contractor is Belhasa Six Construct. ■ ***Contact: vslburke@emirates.net.ae***

Jordan

Pylon rising at Wadi Abdoun

→ **Ereclion has started for the first pylon of the complex Wadi Abdoun Bridge** in Amman following completion of the full construction design and preparation of the geometrical control by VSL's technical centre in Switzerland, Installation of the SSI 2000 stay cable system starts this summer. A new saddle has been developed to meet the requirements of designer Oar Al Handasah, VSL has been modelling the enlire structure to carry out stress analysis and geometry control during construction, New installation methods are also being implemented by VSL to reduce the time needed and minimise the architectural impact. ■ ***Contact: jb.domage@vsl-intl.com***



Qatar

Olympic roof

→ **VSL has played a key role in providing Khalifa Olympic Stadium** with a spectacular 80m-high lighting arch and an elegant new roof over the west stand. Stability considerations were of paramount importance and very high temporary support towers were required. VSL started by installing the main radial cables which involved raising them with a number of small strand lifting units. The main task was to pull and tension the large cables that hold up the roof and stabilise the lighting arch. These cables had to be pulled with millimetre accuracy through the concrete foundations to link up to their permanent anchorages. VSL used six SLU 330 jacks at each end to apply the required forces of up to 1,500t. ■

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Ireland

7,500t push

→ **It took VSL just 10 hours to move the new 7,500t Dundalk Western By Pass Bridge** into its final position supporting the Dublin-Belfast railway line. The 80m long bridge split into four spans was pre-constructed close to the final location using traditional in-situ method then "pushed" into position over Easter 2005. The first step was to remove 23,000m^3 of day embankment from beneath the railway to create a gap for the new bridge. 580 2x3 SLU were used to slide the bridge over a distance of 44m.
Six tendons connected the rear side of the bridge base slab to the front anchorages. The hydraulic jacks were then connected to the bridge and were able to pull themselves along the cables thus pushing the bridge into position. ■ *Contact: cpetre@vsl-schweiz.ch*

Dubai

Cooling off

→ **The last place to expect a ski resort might be Dubai** but it is now becoming a reality thanks to VSL's lift of a 2,800t capsule to house the upper part of the ski slope. So unusual is the project - including VSL's lift - that the Discovery Channel has been filming for its documentary series "Kings of Construction". Once the 33m lift was completed, works immediately resumed and over the last few months the structure had been taking shape quickly to meet the deadline for opening in September this year.
Ski Dubai will have a snow park with a 400m long ski slope, a ski lift with a midway station café and even a mural of the Alps on the walls to give the authentic mountain experience. Visitors can look forward to skiing in the morning and swimming on the beach after lunch. ■

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Palau

Island bridge trek completed

→ **An 18 month trek by VSL throughout the island of Palau** in the middle of the Pacific Ocean ended in April 2005 when the last of seven bridge superstructures was erected. Staff from VSL in both Australia and the Philippines worked closely with Daewoo and the US Corps of Engineers to complete this taxing project. Innovative construction methods were required throughout because of the inaccessibility of the project, a general lack of local resources, and on-going earthworks for the new 80km island ring-road. Pre-casting of hexagonal piles, T-beams and I-girders plus their transport and erection were all part of the project scope. ■

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India

VSoL® record

→ **Use of six pairs of VSL form travellers** Completion of the VSoL® Retained Earth Walls on the NH-45 highway has marked another milestone for the use of the system in India, with a record 4,000m² installed in single month. The project included design, supply and installation of VSoL® panels and soil reinforcement for an 8,000m² installation to provide access ramps. VSL worked closely with the client, the National Highways Authority of India, and main contractor GMR/UEDI to compete the fast track project in less than six months. ■

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Australia

Flat out at Harbour Towers

→ **An innovative modular formwork system has been used** to speed erection of post-tensioned flat plate floorslabs for a development in New South Wales. VSL was subcontracted to supply and install post-tensioning to the car park, podium areas and transfer beams of the Harbour Tower as part of the extension to the Twin Towns Services Club & Resort in Northern New South Wales. The constraints of the existing building and the orientation of the new tower created an irregular column layout. The flat plate floor design allowed efficient installation of post-tensioning and minimised both the concrete and reinforcement needed for the slabs. The system enabled the programme of two slab pours per week to be met. ■ *Contact: smills@vslbne.aust.com*

Thailand

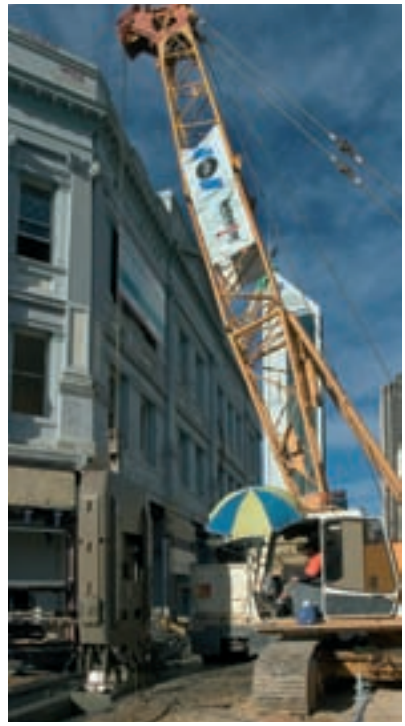
Jumbo lift

→ **VSL Thailand and VSL Switzerland joined forces** to provide a complex heavy lifting solution for the mammoth maintenance hangar being constructed at Suvarnabumi Airport in Bangkok, Thailand.
The hangar will cater for up to three Airbus A380s parked side by side. The completed roof truss covers an area of 270m by 90m, weighs nearly 7,800t and had to be lifted 30m.
As many as eighteen SLU jacks, of 120t to 330t capacity, were used at four lifting points. The roof was raised in three parts which were then connected together. Temporary lifting towers were needed. The roof truss was initially lifted higher than its final position to allow columns to be installed below. Props had to be kept in place to control the roof's shape until the door girder was complete. ■ *Contact: peguret@vsl-th.com*

Australia

Third diaphragm success

→ **VSL-Intrafor has mobilised resources from Hong Kong** to operate two excavation rigs building 12,000m² of 1m-thick diaphragm wall for Perth's new William Street underground metro station. The work is part of a link between Perth and Mandurah and is the company's third diaphragm wall in Australia. Ground works encompass barrettes at depths of up to 36m including the installation of 13 plunged columns. The scope of works also includes ground treatment consisting of 725m³ of jet grouting to a depth of 17m. One of the major constraints on site is the limited and congested working space.
The diaphragm wall and jet grouting are installed adjacent to historical structures that have to be protected. ■ *Contact: bhannan@vslsyd.aust.com*



Australia

World's first Ductal® road bridge

→ **VSL Australia has carried out the design and construction of the world's first Ductal® road bridge,** The recently-completed crossing of Shepherd's Creek, north of Sydney has a superstructure made of 16 precast pretensioned Ductal® beams and an in-situ reinforced concrete deck slab. The Ductal® I-beams are spaced at 1.3m, have a depth of 600mm and weigh just 280 kg/m. The 16m bridge carries four traffic lanes plus a footway and is both lighter and more durable than a conventional concrete bridge. Construction of the bridge is part of the authority's approval process for the use of Ductal® on the state roads. This has included evaluation of the materials, design procedures and constructability of the new material as well as load testing. ■
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Hong Kong

Skylift

→ **VSL was awarded the works for lifting a high level skybridge** linking the two parts of the new Nina Tower in Tseun Wan at the forty first floor. VSL's role involved lifting the 75t skybridge about 150m above ground from a temporary staging point at about 47m. Despite wind speeds of up to 40km/h, the operation was completed in just 11 hours. ■
Contact: apa@hk.vsl-intrafor.com

Australia
Having a ball

→ **VSL aided Sydney's 2005 New Years Eve celebration** when it helped raise and lower a decorative light ball as part of a co-ordinated light and firework display. The unusual application involved using VSL's multistrand system to stabilise of the crane boom and winch system to raise the ball on the famous Harbour Bridge. VSL worked against the unique backdrop with engineers from LCR Lindores Group to provide a lateral system that could be relatively easily installed and dismantled at height. The ball was pre-assembled and delivered under the bridge by barge. ■ *Contact: dtrayner@vslsyd.aust.com*

Hong Kong
Big freeze in HK

→ **Environmental and technical considerations led to VSL subsidiary Intrafor** using ground freezing for the construction of three cross-passages at the Lok Ma Chau tunnelling project in Hong Kong. A brine solution at -30°C was circulated through steel pipes in order to freeze the groundwater and create a 2m ring of ice around the cross-tunnel locations. This allowed safe excavation without risk of collapse. All of the freezing works were carried out from inside the main tunnels. It was one of the first applications of its kind in Hong Kong and was completed for Dragages HK and the Kowloon-Canton Railway Corporation. ■ *Contact: khalil.ibrahim@hk.vsl-intrafor.com*

India
Extradosed bridge

→ **VSL India has been awarded three packages of work** for the construction of the new 4km Second Vivekanada Bridge that will connect Kolkata with Howrah. One of the packages includes the supply of 128 cables for an 880m extradosed section. The cables are anchored at the deck and pass over the pylon in a saddle arrangement. The saddle is prefabricated using ultra high strength concrete with preformed holes. This enables the cable to be installed using the strand by strand method employed by the SSI 2000 system. VSL is also responsible for engineering and detailing for the precasting cells that are producing 70 segments a month. The third package is for 1,049Mt of external post-tensioning. ■ *Contact: ganesh@vslindia.com*

Australia

Orbital alliance for twin tunnels

→ **A new way of working is proving a success tor VSL** on Sydney's Lane Cove Tunnel. VSL is an alliance partner with Hyatt Ground Engineering and also has multiple subcontracts with the main contractor Thiess John Holland. The project involves the construction of twin 3.6km tunnels for the city's orbital motorway as well as major alterations to existing approach roads. The partnership with Hyatt is for 112 post-tensioned piles. These are 1200mm diameter and cantilever 12m to support an embankment requiring 77t of 6-31 tendons. The other contracts include rock anchoring of bridge abutments and multistrand post-tensioning of two bridges. VSL has also constructed 7,000m² of VSoL® walls to-date. ■ *Contact: bhannan@vslsyd.aust.com*

Taiwan

Speedy travel

→ **Use of six pairs of VSL form travellers** is enabling rapid progress on eight bridges on the Kaohsiling Metropoiitan Mass Rapid Transit System. The cantilever structures of seven bridges have already been successfully completed. VSL form travellers were selected to meet a tight schedule in a difficult site environment. The bridges form a viaduct crossing over rivers, major road intersections, railways, and historic houses. They are being built by the free cantilever method using segments of up to 160t. As well as providing the travellers, VSL is supplying technical services including calculations and site supervision. The project's owner is Kaohsiung City Government and the main contractor is Ta-Chen Construction & Engineering. ■ *Contact: jchang@vsl-tw.com.tw*

China

Back to Nanjing

→ **The final deck segment of one of the world's largest cable-stayed spans** has been successfully positioned well ahead of schedule using VSL's heavy lifting technique. VSL was awarded a contract in March 2004 for erection of steel segments on the Nanjing Yangtze River Third Bridge project, following on from its success in 2000 on the second bridge. The Third Bridge's main span of 648m makes it the third longest in the world and required erection of 41 segments of typically 258t. VSL lifted the segments simultaneously at both sides of each pylon thus limiting the out-of-balance load. A lift of 40m was completed in less than three hours. ■ *Contact: fchang@vsl-tw.com*

NOTE PAD

VIP at Sinu bridge. *President Alvaro Uribe of Columbia saw VSL's work at first hand when he visited the Sinú Bridge site. VSL is working there through licensee Sistemas Especiales de Construcción.*

Royal heritage. *Four levels of prime retail space are being created through VSL's installation of 24,500m² of post-tensioned slabs, temporary anchors and flat-jacks at Brisbane's Queens Plaza in Australia. The PT retail floors were a mix of multi-strand transfer beams and mono-strand post tensioned slab.*

Coal face. *VSL Australia has strengthened its role in the mining sector with the award of four VSoL® Retained Earth Walls at the Foxleigh Coal Mine. Some 1530m² of precast panels will be cast.This project involves design and supply of 2 bridge abutments and 2 dump hoppers for trucks up to 250 tonne capacity.*

Vacuum sealed. *VSL has carried out a thorough inspection of tendons on the Cline Avenue Bridge in Indiana, USA. Vacuum grouting was used to fill any voids to protect the previously exposed strand.*

France

Hatching a plan

→ **VSL in France has been carrying out the lowering works** for six large concrete structures that form part of the sixth bridge over the Seine at Rouen. The bridge is set to end more than 30 years of traffic jams for local residents. The giant shells form the foundations for the main pylons and the ship impact protection. VSL strand jacking equipment has been used to lower the massive 3,000t egg-shaped foundations into position with millimetre accuracy. ■ *Contact: psiegfried@vslschweiz.ch*

Portugal

Showcase bridge repairs

→ **Portugal's first cable-stayed bridge** has been undergoing one the country's biggest-ever rehabilitation and retrofitting projects. Soares da Costa has been carrying out repairs to Figueira da Foz Bridge in collaboration with VSL Portugal.

A wide range of repairs were needed including post-tensioning, steelwork treatment, expansion joint replacement and the retrofitting of structural bearings and seismic devices. Retrofitting is now under way to ensure that bearings and seismic dampers are up to modern standards. Four viscous damping devices with capacity of 500kN are being fitted at each abutment to take care of horizontal shock transmission. This has required a detailed deslgn of anchor concrete blocks and reinforcement of the abutments. ■ *Contact: cmoniz@vslsistemas.pt*

Portugal

Pinpoint accuracy

→ **Tolerances of just 2mm are being achieved by VSL Portugal** on a series of heavy lifting projects. Schemes such as the expansion of the A1 highway require very high precision synchronised operations completed in short periods. For this project highways operator Brisa decided to reinforce the deck of one of the overpasses instead of building afresh. The 1,150t deck was lifted 280mm to within a 1.2mm tolerance using a set of 22 jacks controlled by the Verso® synchronising system. The A8 western highway featured a similar lift to achieve enough clearance in an inclined overpass. This consisted of rotating the 2,500t deck around the axis of one of the abutments in order to obtain a 1m lift in the opposite edge. The complex operation using 32 jacks was successfully completed in five days. ■ *Contact: cmoniz@vslsistemas.pt*

USA

Hi-spec parking

→ **VSL has fabricated more than 1.8 million metres** or its fully-encapsulated monostrand post-tensioning system for an 8,000-space parking garage at Baltimore Washington Airport. Design of the state-of-the-art garage called for durability and minimal maintenance with a fast track schedule. VSL ensured compliance with very strict quality control criteria and provided site technical assistance. ■ *Contact: cprior@structural.net*

Spain

Half-arches for speed

→ **VSL in Spain is carrying out the heavy lifting** needed to erect arches for the N-340 motorway near Herradura in the province of Granada. Construction time is shortened by building each 900t half-arch on falsework at ground level with a hinged articulation. VSL then installs a temporary modular structure, retention and pulling cables. The lifting operation itself takes just one day using two SLU 330 units. This process is then repeated for the second half-arch, followed by a closing pour. The project also serves to demonstrate the performance of large units from the CS-system. VSL is supplying and installing 1,400 of the CS 6-27 and CS 6-31 models as well as almost a hundred PU-900 pot bearings. ■ *Contact: jmartinez@vslsp.com*

France

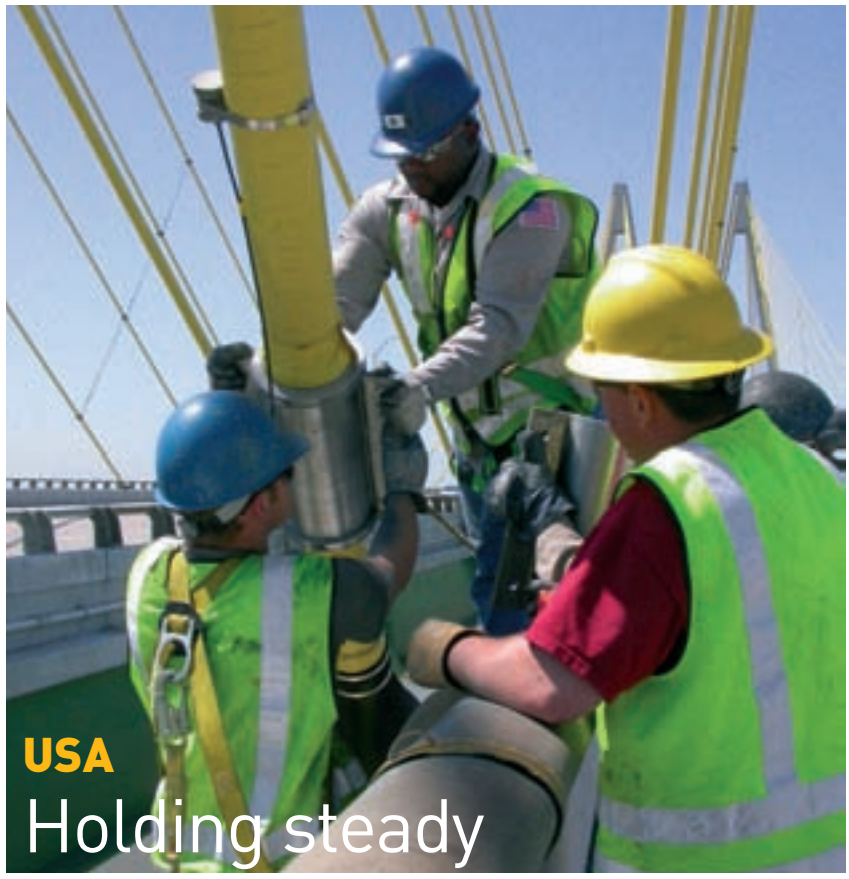
Raw stone

→ **An unusual façade with prestressed stone columns is being built** at Marseille's Saint-Charles rail station with the help of VSL. Some 64 columns stand at a height of 12m to 15m and each is made of 17 blocks of raw stone. Post-tensioning cable is threaded across. Special anchorages have been made for the project, based on the VSL SSI 2000 system for stay cables. ■ *Contact: michel.ripert@vsl.france.fr*

Portugal

Caparide refurbishment

→ **Refurbishment and strengthening of Caparide Viaduct** was the first complex project of this nature undertaken by VSL in Portugal. The project is part of the expansion of the A5 Highway and included the restoration of the concrete with cementious-based mortars, crack injections with fluid epoxy resin, external post-tensioning and strengthening with carbon fibre reinforced polymer laminates. Bearings also had to be replaced which involved the assembly of six major support towers tor the hydraulic jacks. But once these were in place, the bearing replacement was an easy task thanks to a VSL-developed technique that preserves both the upper and lower plates of the existing bearing and inserts new bearings specially adapted to lit. This avoids the need for major surgery to the pier heads or beams. ■ *Contact: mrosado@vslsistemas.pt*



USA

Holding steady

→ **The need to mitigate stay vibrations prompted VSL's appointment** to furnish and install viscous dampers and cable restraints at the Fred Hartman Bridge in Texas. Rain combined with wind used to cause the vibrations at the cable-stayed bridge over the Houston Ship Channel. In total, VSL installed 176 dampers and 24 cable restraints. Two lanes of traffic were closed at all times while crews worked 18m to 67m above the deck. Each damper was anchored to the deck by a galvanized pedestal with six threaded rods. ■ *Contact: cprior@structural.net*

Repair works in Morocco

Sizable constraints for

The knowledge acquired by VSL in the diagnostics and expert evaluation of signed now exceeding €3 million. Morocco's Laayoune wharf project, nearing

The loading dock is located 3.5 km offshore.

The "wharf" refers to a series of structures, including an access bridge and a pumping platform. This is the second contract VSL has won here and it encompasses the dismantling of the pumping platform. The first job entailed disassembly of the site's double-deck access bridge. One deck serves as a roadway while the other supports two conveyors used for transporting phosphate from a treatment plant on the waterfront to a loading dock located 3.5km offshore. Seawater needed for treating phosphate was, until recently, pumped using a pumping station midway across the bridge, 1.75km from the waterfront.
This platform, which had become obsolete and derelict, is being dismantled by VSL through the application of the company's full range of experience in heavy lifting and structural displacement within an offshore environment.
The access bridge contains 2 x 35 isostatic spans of 45m each and composed of 2 + 3 post-tensioned beams weighing 165t apiece.

The pumping platform has three spans with 10 PT beams each; these beams are connected to one another by means of six cross beams of PT concrete as well as by transverse prestressing at the level of the compression flange.

Structural pathology

The multiple problems with the concrete stem primarily from seawater spray and from a seal damage at a water conduit. The prestressed concrete was exposed to heavy attack and the

structural facelift

engineering structures has generated a cumulative value of contracts completion, is a good example of VSL's skills in structural repair.


Structural pathology.


Beam fitted with 12 SMU 40 jacks and full-scale hydraulic launching and sliding system.


Cutting method.


Platform during deck cutting.


A steel lattice beam serving as a temporary support for the metallic replacement caisson.

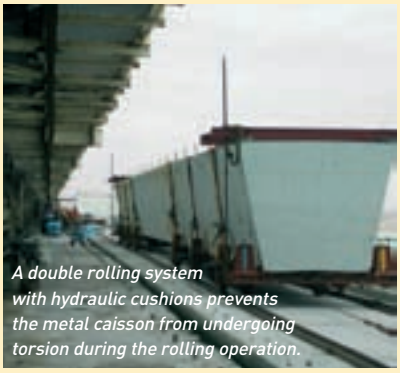

Sections weighed 110 tons each.

prestressing cables were highly corroded, thereby leading to large cracks and spalling in the concrete. This pathology in turn caused a structural failure risk since some of the prestressing cables (whole cables or just some strands) had been cut by excessive corrosion. The Moroccan client Somagec requested VSL to define a method for disassembling the road deck in order to replace it with steel caissons, spanning 45 m and weighing 80t each. VSL was selected to undertake the design and method studies along with the supply of all necessary hydraulic equipment, execution of the deck-removal stage plus technical assistance.

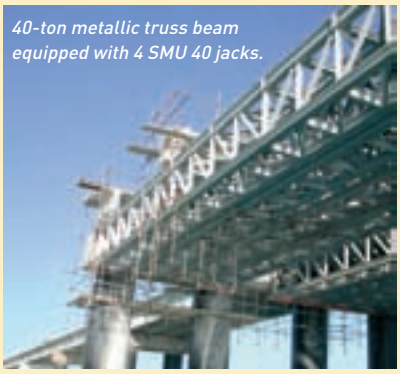
Proposed method

Maritime hazards such as wind and heavy swells made it impossible to use floating cranes to dismantle the existing beams (330t per span). VSL developed a launching beam 135m long, weighing 280t and offering a 660t loading capacity. This beam had been fitted with 12 SMU 40 jacks as well as a full-scale hydraulic launching and sliding system.

1) This launching beam enabled an entire span to be supported during the cutting of the deck into three 110t sections. The cutting method and all equipment were also supplied by VSL. Once the concrete blocks had been removed and the launching beam moved, VSL's teams installed a metal lattice beam serving as a temporary support for the steel replacement caisson.



A double rolling system with hydraulic cushions prevents the metal caisson from undergoing torsion during the rolling operation.



40-ton metallic truss beam equipped with 4 SMU 40 jacks.

Beam lowering after deck cutting.

This same beam was then used for removing the metal beams that served to support the span.

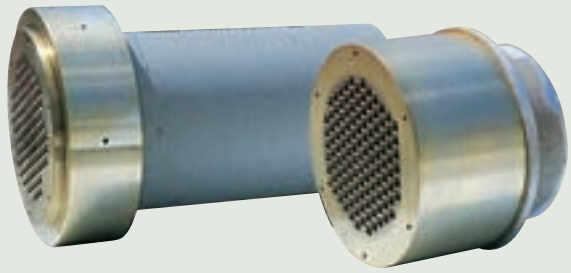
2) Conveyance of these caissons was performed by means of a double rolling system with hydraulic cushions in order to prevent the metal caisson from undergoing torsion during the rolling operation. Once set into place, the caisson was lowered onto its supports by successive "unjacking" operations using a system of alternating jacks designed and supplied by VSL. Performing works on the platform was made more difficult by the fact that the old concrete beams were not independent, but instead remained connected to one another. In order to deal with this situation, VSL designed and installed metal truss beams underneath the post-tensioned concrete beams as a means of providing temporary support. The load could then be transferred by 30t jacks placed between the truss beams and the concrete beams.

3) Once secured in this manner and after re-anchoring the transverse prestressing, VSL proceeded in the same way as for the access bridge, this time using a 40t metal truss beam equipped with 4 SMU 40 jacks. This same beam was then used to remove the steel beams that served to support the span.
Due to these successful repair works, VSL was awarded in August 2005 another contract for an extra 36 months of similar works. ■

Anchorages

New corrosion protection technique

The CTT factory in Barcelona has manufactured the first SSI 2000 stay cable anchorages featuring a new enhanced corrosion protection system.



SSI 2000 anchorage with the original corrosion protection system.

VSL SSI 2000 anchorages are protected for a durability of 100 years in the most aggressive environments. The inaccessible components of the anchorages now have a protection system that lasts the entire 100 years without maintenance, as they are sprayed with aluminium and/or zinc.
VSL worked with a Danish consultant, who has a great expertise in the field of corrosion, in order to define this new corrosion protection technique and confirm that the VSL stay cable systems would comply with the new requirements of high durability in aggressive environments. The standard EN ISO 12944-2 has been used to determine the impact of the bridge environment on the anchorage's protection systems. This standard is now proposed by many consultants in their project specifications.

Several types of protection are used on stay cable anchorages, for example:

a) Painting
This is the most usual protection on steel structures. But its durability is limited to about 15 to 20 years in the most aggressive environments. During installation of the bridge anchorages, care must be taken to avoid scratching the protective painting. VSL does not recommend the use of this protection if such a risk exists during the handling operations.

On the VSL SSI 2000 anchorage, paint is specified mainly for maintenance of the accessible anchorage components.

b) Hot dip galvanizing.
This is the most common protection. It is economical, safe and practised in many countries. The thickness of the coating may be limited - depending on the geometry of the components – and this protection cannot be used for long durability (100 years) in the most aggressive environments.

c) Electro galvanizing, yellow chromating, or similar.
Until now this type of protection has been used on some components of VSL anchorages but it has a limited durability and cannot achieve the new VSL specifications of high durability in the most aggressive environments. With the new protection system, this type of protection is replaced by metal spraying.

d) Zinc and aluminium metal spraying.
This type of protection allows an expected durability of 100 years in the most aggressive environments, particularly with aluminium. One advantage of metal spraying is the possibility of locally varying the thickness of the coating. Metal spraying with zinc and/or aluminium is now used for the protection of the VSL SSI 2000 anchorage. In the component assembly, threads are generally the most difficult details to protect. The threads of the SSI 2000 stay cable anchorages are now protected by an aluminium metal coating. ■ *Contact: yves.bournand@vsl-intl.com*

Anchorage protected by aluminium metal spraying.

International Exhibition Centre

Major roof lift in Hong Kong

VSL has lifted the roofs of the International Exhibition Centre in Hong Kong. 85,000m² of steel structure were raised using VSL's heavy lifting technique in 14 lifts, the largest part measuring about 7,000m² (87m x 80 m), the size of a football field.

1 ***Erection of the permanent structure on the ground***

Ten days are spent assembling each roof at a level 2.5m above ground to allow convenient access to every assembly point underneath the roof. All M&E networks - including the electrical, fire-fighting water pipes and air-conditioning - are completed prior to the roof being lifted.

2 ***Temporary structure***

The roof loads are transferred to the ground by a temporary steel structure during lifting and until the load transfer is completed. That temporary structure includes:

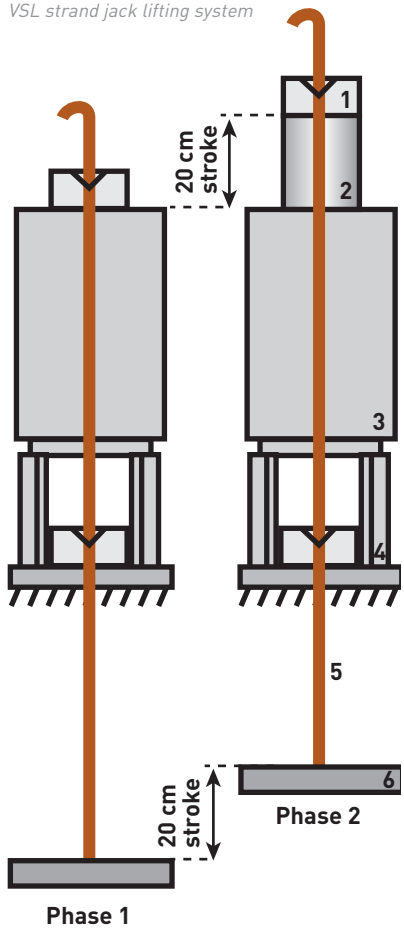
- *Columns, resting on the pile cap, and tied up against the permanent columns. They support the lifting platform at the top.*
- *The balancing beams and associated counterweight. These are installed where the pile cap cannot take the eccentric loading. In that case, the loads are brought back to the centre of the pile cap by these balancing beams.*
- *The lifting platform at the top, including the jacks resting on sledges. The sledges allow the jacks to translate the load by +/-50 mm in every direction. For the multi-purpose hall, the platforms are erected at the top of the permanent columns directly.*
- *The strand bundle and the connection pieces to the permanent structure. The strand bundles are made with up to seven strand left and right handed.*

Overall, 230t of fabricated steel are required for this project.

3 Equipment

The 7,000m² of the roof are lifted using up to 24 hydraulic jacks - each of 70t capacity - and their associated hydraulic pumps. These jacks are installed on the temporary structure, which provides a support, and connected on the other end via a strand bundle to the permanent structure to be lifted.

VSL strand jack lifting system



1 - Upper anchorage
2 - Jack piston
3 - Hydraulic jack
4 - Lower anchorage
5 - Cable (strands)
6 - Roof

4 ***Lifting operation***

Lifting speed averages 3m per hour and is carried out in a very controlled manner. The duration of the lift is four hours.

5 ***Monitoring of the lift***

The 7,000m² of roof goes up and the surface defined by the lifting points has to remain flat. The key constraint is to ensure that all the lifting points (up to 18) remain within a tolerance of 20mm. In practice, tolerances of about 10mm are achieved.

6 ***Installation of the permanent supports***

Rotation and fixing of the elbows and supports are completed once the roof has reached its final level. Grout at the bearings over the concrete piers has to reach 20MPa prior to the load transfer.

7 ***Load transfer and removal of the temporary works***

Once all supports are completed, the load can be transferred from the temporary steel structure to the permanent substructure of the building. This operation does not generate a visible movement of the lifting points, but only an invisible transfer of load to the permanent substructure. The duration of the load transfer is four hours.

Once freed from the permanent loading, the temporary steel structure can be dismantled and removed. In some cases, this operation requires access by crane through the roofing.

VSL's scope of works on the IEC site

The new International Exhibition Center in Hong Kong is being built by Dragages Hong Kong within walking distance of the new airport of Chek Lap Kok. Three halls up to 290m long and 80m wide will cover an overall area of about 85,000m^2. Height restrictions due to the nearby airport had prevented DHK from using the conventional method of lifting by crane and so it turned instead to other methods of heavy lifting. VSL became involved at a very early stage in the design process of the permanent structure and worked closely together with the client to optimise the design and ensure there were convenient lifting points in the trusses to be lifted. The exhibition centre roof has been lifted 15m as 14 loads of 400t to 800t at a rate of 3m per hour, using up to 24 hydraulic strand jacks for a single lift. VSL was responsible for lifting the steel frame, and its subsidiary Intrafor carried out the deep foundations using piles. During the development of the scheme, VSL was also awarded the checking of the permanent structure in its temporary state to withstand the loading generated by the lifting operations. A further consideration was the possibility of the impact of typhoon wind loading applied to the uncompleted structure. The last lift took place in April 2005 and the IEC is due to be completed in December 2005. ■

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Roof for IEC, Hong Kong


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Manhattan Heights - Hong Kong

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


Seonyu Footbridge - Korea


John-Paul II Bridge - Poland


Austrack Project - Australia

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