VSL NEWS

ISSUE TWO 1993

VSL

The VSL Composite System Has Taken Off

At last year's VSL Symposium in Montreux we unveiled our new VSL post-tensioning system. Today, we canreport the first successful applications. For instance in Denver, Colorado, a fifteen million litre tank has beenbuilt using both, the new VSL CS Anchorages and the VSL PT-PLUS Plastic Ducts. The front cover shows what a clean and workmanlike result can be achieved with the new system. Say good bye to do-it-yourself tape couplers and no unprofessionally fixed grouting tubes. The anchorages are highly practical and easy to install. On page 10 you can read more about The Denver Tank.

The development of the VSL COMPOSITE SYSTEM was very much in the hands of Dave Rogowsky. During the crucial period of the process of developing the system Dave was located at our headquarters, injecting ideas and coordinating efforts. We are very honoured to announce that - alter Prof. Dr. Peter Marti - another VSL staff member has been appointed to an academic position. Dave has started his new assignment as a tenured Professor with the University of Alberta in Edmonton, Canada, on August 16, 1993.

The outstanding careers of Peter Marti and Dave Rogowsky clearly demonstrate that VSL is more than just a hard-ware supplier in the field of post-tensioning.
We are specialist contractors providing optimized design and construction solutions to construction industry customers. Our engineers are eager to find technically sound answers to any construction problem. Together with our field staff, they establish hands-on and economical methods. Our aim is to provide solutions which bring optimum financial benefits to you, our clients. We know that we will only continue to prosper as long as our customers are satisfied with our products and services. If you need practical ideas combined with outstanding performance, call VSL !

Dave Rogowsky

Reto jenatsch
Group Chief Executive Officer

Cover :

What looks at the first glance like routine work is one of the first applications of The VSL Composite System combined with PT-PLUS duels at **The Denver Tank**

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The Bell at the Holy Cross Church Now Rings

An innovative method of retrofitting masonry structures makes its debut in the United States in the brick walls of the 104-year old Holy Cross Church located in Santa Cruz, California. Severe structural damage, inflicted during the 1989 Loma Prieta earthquake, dosed the church. Removal of the bell tower steeple testified to the severity of the damage.

Shortly alter the closing of the church, VSL Corporation began developing retrofit concepts to non only restore the structural integrity of the church, but also to fortify the church to resist the seismic forces of tomorrow. Refined structural analysis and material testing culminated in a definitive retrofit plan.

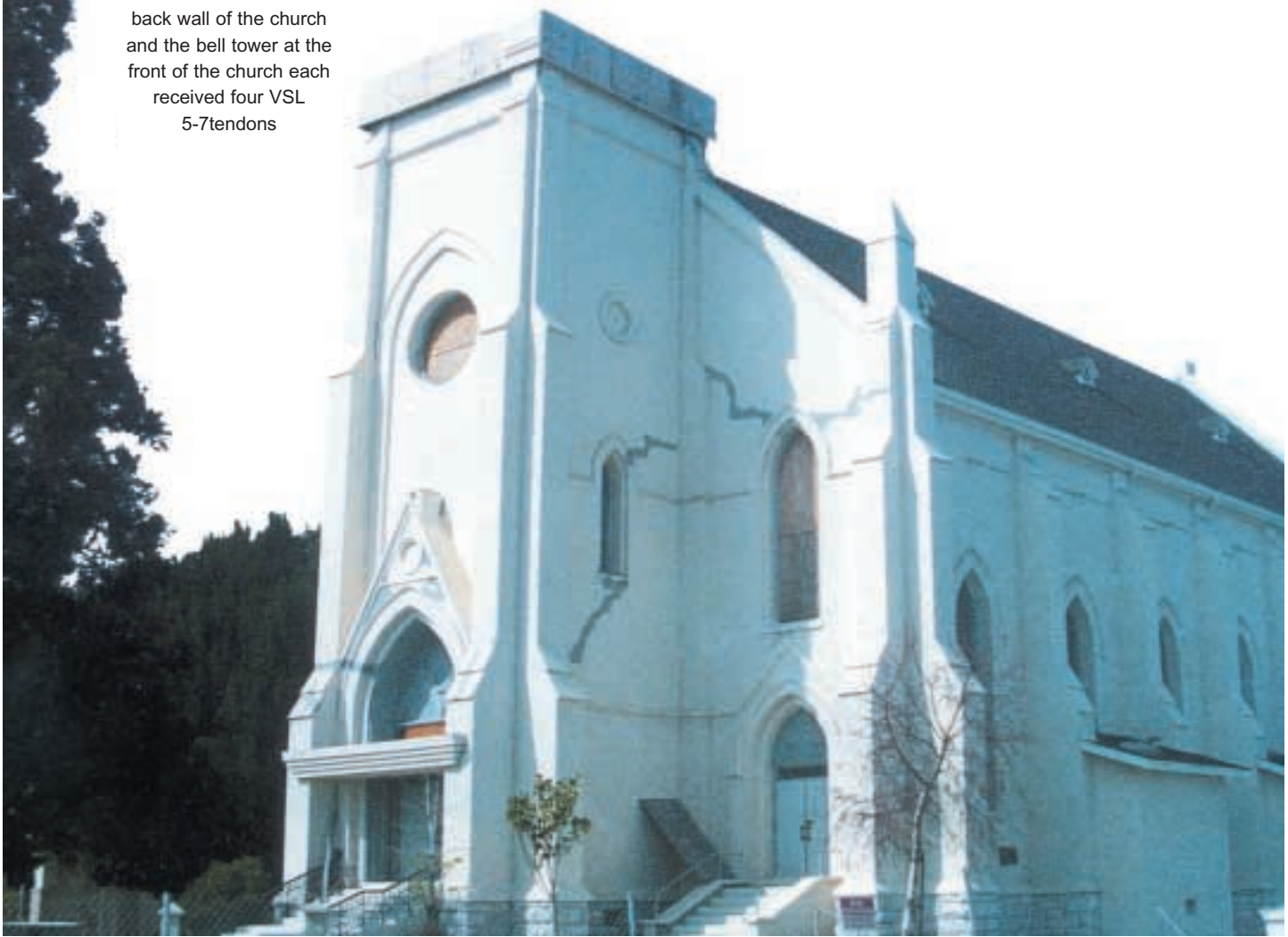
VSL designed and installed an in-plane roof truss to provide lateral stability to the buttresses, and at the same lime transfer a controlled amount of shear to the end walls and bell tower ; thereby enabling an accurate assessment and design for the shear acting on the walls.

VSL conduded its work by crowning the bell tower with a reconstructed steeple. The church reopened and now the ringing of the bell testifies to the new life that VSL can install into magnificent old structures.

On June 8, 1993, the Masonry Society has presented the first Haller Award to VSL Corporation for the HolyCross Church retrofit. The award honours the “creative use of structural masonry”. It is named after the late Swiss Professor Haller.

Holy Cross Church and lifting of steeple on October 17, 1992

First, VSL grouted the cracks in the masonry; then vertically cored one hole down each of the eight buttresses on be: sides of the church to receive a VSL 5-12 tendon which stabilizes the wall and fixes the buttress to the underlying foundation. In a similar fashion the back wall of the church and the bell tower at the front of the church each received four VSL 5-7tendons



Electrically Isolated Tendons for Anchors

VSL has since 1985 been providing in Switzerland ground anchors that were electrically tested. Such testing canbe conducted prior to transportation and at some stages of installation. These tests positively checked the integrity of the encapsulation of the bond and free length prior to stressing. There was however no established method to similarly check the electrical isolation and hence the complete encapsulation alter final stressing and during the design life of the anchor. This does non mean that corrosion will be a future problem but it does mean that these anchors lacked a Quality Control method that would conveniently provide assurance of adequate remaining life.

Combined with the development of VSL'S CS-Super configuration (see VSL NEWS number one 1993) the concept of complete electrical isolation was studied and introduced. It is obvious that if the steel elements are totally isolated from water and air throughout the design life then adequate protection against corrosion exists.

Rock anchors : For rock anchors a process to extend the free length plastic duel to contain the anchor head, while allowing for standard stressing and inspection access, was developed. The anchor head encapsulation must cope with the high contact forces between bearing plate and anchor head and also provide for repeated access for inspection, force adjustment and the installation of force measuring load cells. The first use of completely Electrically Isolated Tendons (EIT) rock anchors was on the upgrading of the slope stabilisation for the northern portal of the Seelisberg road tunnel in Switzerland. This EIT anchor project was completed in 1992. It included 100 anchors with an ultimate capacity of 3350 kN and lengths up to 44 m.

Soil Anchors : The development work here had to be mindful of the soil drilling process. A connection technique between the free length duel and the load bearing isolation that was electrically tight and which could also provide the same type of access, as mentioned for rock anchors,

evolved. The first use of this type of EIT soil anchor was for the stabilisation of a railway curling at Dreispitz in Basel, Switzerland. In ail, 47 EIT soil anchors with an ultimate capacity of 1110 kN and lengths up to 30 m were installed during spring 1993.

Both types of anchors were successfully electrically tested while being subjected to their rated load capacity. The performance of the seals between component parts were tested by measuring the electrical resistance between the water filled inner void of the test anchor and the water filled outer surround.

The application of EIT techniques to ground anchors allows the use of effraient quality control methods to assure owners that their anchors still possess complete corrosion protection throughout their design life.

Brad Rathbone
VSL International Ltd.
Berne, Switzerland

Seelisberg tunnel

The Mekong River Bridge Project

The first bridge to cross the lower Mekong River is currently being built between Thailand and Laos near Vientiane, the Laotian capital. The bridge is a girl to Thailand and Laos from the Australian Government and was designed by Maunsell Pty. Ltd. and Sinclair Knight Pty. Ltd. The successful construction tenderer was John Holland Constructions Pty. Ltd.

VSL'S scope is the supply and installation of post-tensioning, and segment erection. The main structure has an overall length of 665 m consisting of five 105 m internal spans and two 70 m end spans. The deck is a 12.7 m wide single cell box girder with a variable depth ranging from 6.1 m at the piers to 2.6 m at the mid-span of the infernal spans, and 2.1 m at the transition with the approach structures. The balanced cantilever construction uses match cast epoxy jointed segments weighing up to 73 tons. Individual segments are temporarily supported by five longitudinal VSL CT stressbars.

The approach structures have overall lengths of 269 m and 240 m with maximum spans of 36 m. The deck is a 12.7m wide single cell box girder with a constant depth of 2.1 m for compatibility with the end spans of the main bridge. Longitudinal post-tensioning of all girders consists of a combination of 5-19 tendons and 38 mm diameter VSL CTA stressbars.

Balanced cantiever construction at Mekong River Bridge

David Pash
VSL Prestressing (Aust.) Pty. Ltd.
Noble Park, VIC, Australia

Sudirman Flyover

Located in the busiest and most important street of Jakarta Jalan Sudirman, VSL Indonesia was awarded the subcontract work to construct the superstructure of this first incrementally launched bridge in Indonesia. The award came alter VSL submitted an alternative design to the Main Contractor PT Wijaya Karya and the City Authority, saving time and money and

Overall bridge with casting yard in the background, and Jaunching nose position before reaching the pier, spanning the main street of Sudirman

avoiding disruption to traffic as compared to the conforming in-situ bridge design.

Work started in October 1992 with the casting yard. By fate December 1992 the first segment was cast. Segment lengths are typically 14.5 meters with end segments of 12 meters. A total of 12 segments for this 165 m long 30° skew bridge, with a slope of 5 %, were needed.

The bridge consists of two single box girders. Launching is carried out with two ZPE 200 jacks. Span lengths are 31-3337-33-31 meters. A safety system with emergency push button operation was provided. Construction cycles clown to seven days were achieved without steam curing.

Johannes Himawan PT
VSL Indonesia
Jakarta Indonesia

Mobil Oil Singapore Pte. Ltd., CCR/Aromatics Expansion

The heavy vessel installation contract at Mobil Oil Singapore CCP and Aromatics Expansion Project included 6 vessels ranging in length from 9 m to 95.3 m and varying in weight from 50 tons to 911 tons.

The S$ 600 million plant at Jurong set a world record with the installation of the largest xylene splitter fractionating column ever built. This is the largest of the 36 vessels erected by VSL Singapore Pte. Ltd., 5 of which utilized the VSL Modular Tower System for installation.

The Modular Tower System, quality fabricated from in excess of 600 tons of structural steel, has the capacity to tilt loads up to 2000 tons. However, being modular, various combinations of system are possible, ranging from a two tower system stabilized by guy wires to a 4 tower system without the need for additional stability. Precast concrete foundations also fabricated in modular form further enhanced the tower system stability.

The tower modules, each 10.5 meters long and weighing 10.5 tons, were rapidly erected and pinned together. Standardlifting beams and preassembled bracing was normally erected by crane, with only the 32 meter long, 80 ton head trusses being lifted into position using SLU-70 heavy lifting jacks. For the xylene splitter tower tilt, four SLU-330 ton jacks were positioned on sliding 'C' frames slung under the trusses. This allowed the tait vessel to be lifted through the towers and then slid horizontally into position over its foundations. VSL'S contract included fuit responsibility for lifting all 36 vessels.

John Davie
VSL Singapore Pte. Ltd.
Singapore

911 tons on the way up

VSL Japan delivers Quality Training for Quality Performance

The VSL network in Japan has grown extensively in recent times. Mindful of this growth and understanding the rewards of well trained personnel an intensive training workshop for 200 attendants was conducted to provide future operators, planners and construction managers with the needed know how.

The workshop dealt with the familiarisation of VSL construction methods, the operation for conventional post-tensioning and ground anchors. Precise operations and maintenance procédures for post-tensioning equipment from single strand jacks to 1500 t capacity jacks were demonstrated.

The Japanese construction industry will be well served by this capable team.

Shusuke Sakata
VSL Japan Corporation
Tokyo, Japan

VSL Group Efion a Major Force in New Taxiway Bridge for Hong Kong

Precast T-beams proved to be the most cost-effective solution for this bridge

As part of measures to cope with a rapid increase in Hong Kong airport's traffic movements a new aircraft Taxiway bridge connecting the existing runway and new apron parking bays was required. On this 13 month fast track contract, VSL Hong Kong in conjunction with VSL Redland Concrete Products played a major role.

VSL Hong Kong were contracted by the main contractor Dragages et Travaux Publics to carry out the design and documentation of the bridge superstructure, transportation and placement of the precast beams and the design and installation of the bearings and joints. VSL Redland were responsible for casting the 154 Post-tensioned T-beams at their « Little Montana Island» casting yard, in the People's Republic of China. This contract was the first Civil Engineering contract in Hong Kong to employ ISO 9000 quality standards.

The new bridge a 220 m long seven span structure was conceived using a maximum span of 36 m. The structure comprised of 1380 mm deep precast post-tensioned wide Range T-beams with a 220 mm thick concrete topping.

The beams were transported to Hong Kong Harbour by barge. Due to airport height restrictions, the installation procedure was complex requiring most work to be carried out at night.

To satisfy the loads from a Boeing 747400 and 175 mm movements at the joints, purpose designed 40 mm plate finger joints were employed. The bridge was supported on 207 large elastomeric bearings and employed auxiliary restraint devices to resist earthquake and aircraft breaking loads.

This project with its tight programme and demanding quality requirements has once again shown the VSL Group's reliability, strength and diversity in the technical and construction fields.

Trevor Gregory
VSL Redland Concrete Ltd.
Hong Kong

Barry Young
VSL Hong Kong Ltd.
Hong Kong

Tsing Ma Bridge Swings into Full Gear

Work is well under way for the construction of the 2.1 kilometer Tsing Ma suspension Bridge which will form one of the major links between the new Chek Lap Kok Airport and Hong Kong.

In August 1992 VSL was awarded the subcontract to construct the main concrete towers, eight approach piers and to post-tension the mass concrete suspension cable anchorages. all works being of a highly technical nature. For this work the VSL Group support worldwide has been called upon to provide the needed technical and construction experience.

VSL'S experience in continuous slipforming is essential for the construction of the 206 m high concrete towers. At a rate of 3 m per day the complex shaped towers with complicated reinforcement layout will be completed within 3 months. To provide temporary stability to the towers, eight steel trusses weighing up to 160 tons shall be lifted into position by the VSL Heavy

Lifting System and then stressed onto the towers. The eight approach piers will be constructed by the VSL climbform method. To meet the fast construction program four VSL climbforms have been mobilized to ensure the completion of each 60 m high pier within 80 days.

To restrain the suspension cables 520 tons of post-tensioning shall be placed in the two mass concrete anchorages. The 388 tendons of each anchorage comprise 30 individually greased and sheathed tendons placed in a mita steel pipe duct with a specially modified anchorage for connection of the suspension cables.

Barry Young
VSL Hong Kong Ltd.
Hong Kong

The fast growing Tsing Yi Tower at a height of 150 m with one of the piers in the foreground

The First Use of VSL CS Anchorages

Front view of the Denver Tank

Construction is currently underway in Denver, Colorado, on a four million gallon tank, the first project to use the new VSL Composite System and PT-PLUS Plastic Duct. The system was chosen be cause it provides the maximum corrosion protection available within the post-tensioning industry.

The CS 5-12 and 2 3/8 " (59 mm) diameter PT-PLUS Plastic Duct are used in the ring beam footing, and horizontally within the tank wall.

We are using our SO 6-4 and flan PT-PLUS Plastic Duct vertically in the walls to provide superior post-tensioning protection. The fully encapsulated VSL CP+ System is being used for the ground and roof slabs ; the concrete in these members will be poured in one monolithical pour.

VSL provided post-tensioning materials, labour and rebar labour. VSL also designed the post-tensioning system to meet the requirements of the structural design. And, VSL worked closely with the contractor to develop a compressed schedule which took six weeks off the completion date. The tank diameter is 200 ft (60.96 mi with a 19 ft (5.79 m) high cast in place wall.

Robert H. Allen
VSL Corporation
Lakewood, Colorado

Mynle Beach Convention Center SuperTruss TM

The City of Myrtle Beach, South Carolina, selected a fast track design/build method for the construction of their new $20,000,000 Convention Center. The winning team of Centex-Rooney (General Contractor), Bliss & Nyitray (Engineer), and Cannon (Architect) consulted with VSL during the bidding phase regarding the feasibility of post-tensioning two composite steel SuperTrusses TM spanning 240 ft which provided a100,800 sq.ft. (9300sq. m) column-free exhibit space.

Upon the award of the project, VSL was issued a contract to design, provide, and install the post-tensioning system in the SuperTrusses TM .

The SuperTrusses TM combine the use of two post-tensioned tendons, 5-15 strands each as the bottom tension cord, with high strength concrete (10,000 psi/69mPa) encased by a 20" diameter pipe as the top compression cord.

The post-tensioning tendons were to be stressed in stages to a final jacking force of 450 kips (2000 kN).

The flexibility provided by post-tensioning was clearly evident when it was determined that additional air handling units were needed alter the fabrication and erection of the trusses. The load of the additional units was easily accommodated by simply increasing the final jacking force from 450 kips (2000 kN) to

490 kips (2180 kN) ; taking advantage of the reserve capacity provided by the post-tensioning tendons.

Robert W. Sward
VSL Corporation
Norcross, Georgia

Bottom tension chords reflected up for stressing

VSL Provides Solutions for Intermediate Slabs in Malt House Silo

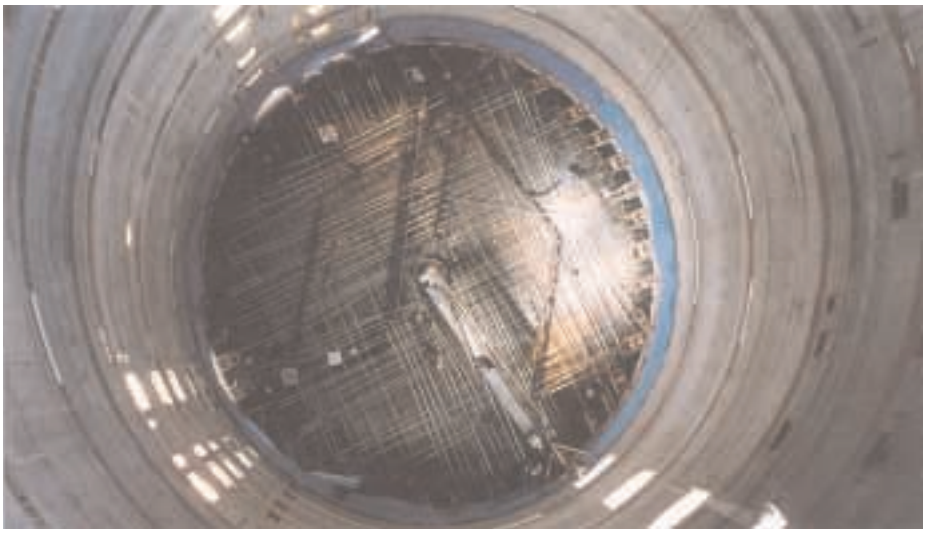
VSL Corporation is nearing completion of a contract for the design, material supply and installation, and lifting eight floors within a 290 foot (88 m) tall, 80 foot (24 m) diameter malting silo for the RAHR MALTING COMPANY in Shakopee, Minnesota.

The original contract documents were based on mildly reinforced concrete vola slabs, cast in place on formwork. VSL Corporation proposed solid, post-tensioned concrete floors cast at grade and lifted into position. The VSL alternative provided quick, economical construction and yielded a smooth finish on the underside of the floors as required by the owner.
This solution also eliminated the slow and difficult movement of formwork between levels through the small, exterior silo openings. The floors, which weigh as much as 1125 tons, span the silo without intermediate supports and are designed to carry live loads up to 600 psf (28 kPa).

Using VSL Heavy Lifting, the floors were lifted to heights ranging from 35 feet (11 m) to 270 feet (82 m) and were permanently fixed in place using a closure strip around the perimeter of the silo.

Keith W. Jacobson
VSL Corporation Minneapolis, Minnesota

Post-tensioned floor prier to pouring and lifting



EVRIPOS Bridge nears Completion

In December 1986, we reported in the VSL News Letter that VSL had been awarded the contract for supply of stay cables for the Evripos bridge in Greece, with completion expected by the end of 1988. Due to a number of delays, work on the stay cables did, however, not begin until 1991. installation of the stay cables was completed towards the end of 1992 and completion of grouting is planned for early summer 1993, to be followed by the wrapping of cables with white Tedlar tape.

The Evripos bridge carries a two-lane road between the Greek mainland and the bland of Evia. The bridge deck - a prestressed concrete slab just 450 mm thick – is carried by 144 VSL stay cables, ranging in size from 6-7 to 6-20, fanning out in two planes from the tops of two pylons. The cables are composed of bundles of 0.6" strands encased by an outer sheath of HDPE, which is subsequently injected with a cement-based grout. When grouting work has been completed, the cables will be cleaned and then wrapped with white Tedlar tape, which will improve the appearance of the bridge while also reducing the temperature variations in the cables.
The main contractor for the project is a joint venture formed by the Athens-based companies TEV S. A. and Hellenic Technodomiki S.A. The consulting engineer is Domi S.A., Athens.

VSL (Switzerland) Ltd. supplied the stay cable components and provided technical assistance and equipment. The post-tensioning for the bridge deck was supplied by VSL Systems S.A., Athens. With its main span of 215 m and its pylons rising to a height of almost Q0 m above sea-level, the Evripos bridge, in addition to providing much-needed relief of traffic congestion in the nearby town of Chalkis, will become the distinctive feature of this picturesque area.

Philip Wallace
VSL(Switzerland) Ltd.
Lyssach, Switzerland

A view of the bridge following cable installation. Detail : The exposed deck anchorages

TROLL (GBS) Biggest in the World

TROLL (GBS) - the biggest platform in the world, now under construction

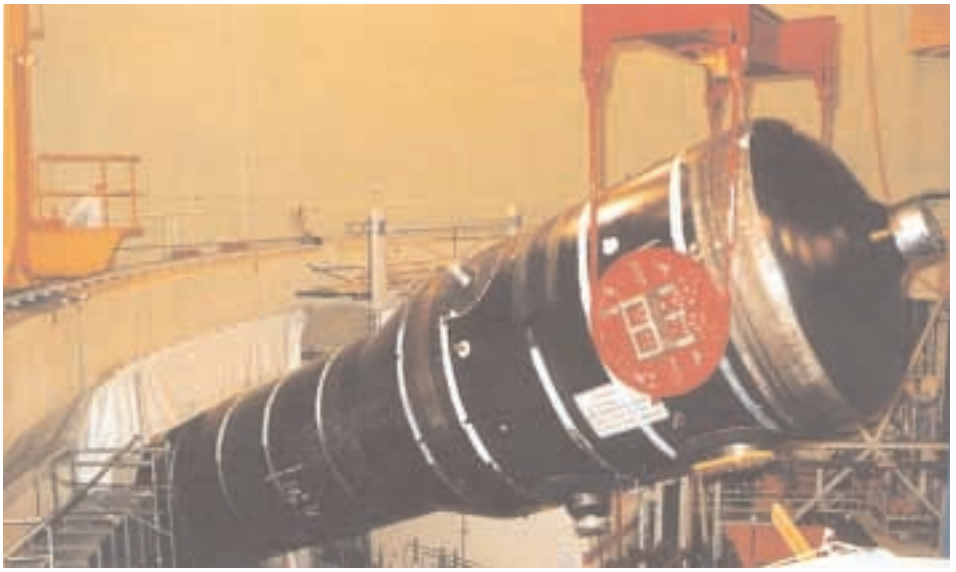
The gravity base structure (GBS) for the Troll Gas Field in the Noah Sea has now been under construction by Norwegian Contractors A7S for two years.

The giant GBS will be 369.4 meters high. The completed platform, including topside, will be towed to the over 300 meter deep ; XXX field in July 1995. From there it will extract gas from the biggest sub-sea gas field in the world serving Europe with Gas for several decades. The design operating life for the structure is 70 years.

Norske Shell A/S, as operator for the Troll Phase 1 development project have an engineering, procurement and construction contract with Norwegian Contractors A/S. VSL Norge A/S has a full service post-tensioning subcontract with Norwegian Contractors A7S. In ail, approximately 9'000 tons of VSL Post-Tensioning Systems, installed by VSL Norge A/S, will be at work in the structure.

Kalle Nilsson
VSL Norge A/S
Stavanger, Norway

VSL Heavy Lifting Exchange Steam Generators at Nucelar Power Station



Exchange of steam generator

The Beznau Nudear Power Plant in northeastern Switzerland was commissioned at the end of 1969. The decision to replace the two steam generators of Unit 1 was essential for assuring the reliability and economy of future operations at the plant.

The exchange was a complex undertaking, as neither the overhead polar crane at the facility, nor the access locks, were designed for handling a complete steam generator.

The consortium of Siemens (Germany) and Sulzer (Switzerland) entrusted the transport of the new steam generators into the containment area, and the handling therein to VSL.

Special lifting and transport equipment, along with a temporary opening in the containment wall, enabled the exchange of the massive steam generators. all vertical and horizontal movements were carried out using the VSL Strand Lifting System.

VSL'S scope of services on the project included detail planning of movements, design, supply, erection and dismantling of temporary steel structures such as sliding tracks with carriages, a temporary support to reinforce the polar crane and a temporary portal on the crane.

The actual exchange work took place in April/May 1993. Working under a tight schedule and tight conditions, VSL completed work on the project ahead of schedule.

Ferdi Trenkler
VSL (Switzerland) Ltd.
Lyssach, Switzerland

Strengthening the Viaduct Oleron

The 2,862 m viaduct links Oleron Island with the mainland of France. The superstructure of the bridge consists of a prestressed single-cell box girder constructed roughly 30 years ago using 3.30 m precast segments. The viaduct is separated by eight expansion joints into 9 sections roughly 320 m long. The main spans are 79 m long. After a recent structural evaluation it was decided to strengthen the box girder.

VSL France has been commissioned for this work based on the merit of a VSL alternative solution. VSL is fully responsible for furnishing, installing, stressing and grouting the external post-tensioning system, including all ancillary concrete work related to anchoring and deflecting the tendons, in all Q bridge segments.

The external post-tensioning system for the strengthening consists of a VSL 6-35 tendon, with an anchorage force of 7000 kN, attached longitudinally inside the box girder along each web. The tendons, roughly 300m long, are anchored near the expansion joints into added concrete diaphragms which are fixed to the bottom slab and each girder web with prestressed bars. The tendons are deviated at the piers and at midspan of each span. VSL'S External Post-Tensioning System is ideal for strengthening structures of all kinds, offering many advantages : the system provides great capacity with virtually no increase in structure weight ; fire protection and corrosion protection are easily attained ; the tendons are accessible for visual inspection and monitoring ; and, when necessary, the system can be readily replaced.

Pierre Bron
VSL France S.a.r.l
Egly, France

Rebuilding Stade Charlety

The new Stade Charlety Arena, under construction in Paris, will serve as a first class 20,000 seat sports arena complex and a l400 seat mufti-purpose room complete with offices and underground parking.

Post-tensioned precast concrete frames are the primary structural elements supporting the 20,000 seat arena. The concrete frames provide lateral stability to the arena, and carry the gravity loads

Charlety during erection of precast frames and stands from the concrete stands

from the concrete stands and the eight long-span steel roof trusses.

VSL'S work on the project includes post-tensioning the 52 frames on the level of the lower stands using four VSL 5-7 strand tendons per frame, and post-tensioning the 16 frames on the level of the upper stands using six VSL 6-7 strand tendons in conjunction with two VSL 6-4 strand tendons. 4 to 5 m short tendons are used for fixing in place the steel tie-clown plates for the long-span steel roof trusses atop the upper frames.

VSL'S reliable involvement on the project, from pre-tender consulting through final installation and stressing, is a significant a significant contribution to the timely construction and long-term integrity of the new Stade Charlety Arena Complex.

Pierre Bron
VSL France S.a.r.l
Egly, France

Prestressing the Leaning Tower of Pisa

The world renowned Leaning Tower of Pisa in Italy has been strengthened by Preco S.r.l. of Milano, VSL'S licensee in Italy. The strengthening, in accordance with the temporary interventions decided by an international committee for safeguarding the tower (Comitato Internazionale di Consulenza per la Salvaguardia della Torre di Pisa), utilizes 18 VSL Hoop Tendons around the exterior of the tower to prevent buckling of the tower's marble cladding.

The International Committee stipulated that the circumferential tendons be non-destructive and non-deteriorating, allow incremental tendon loading and unloading, provide precise force monitoring during stressing, permit future adjustments and force monitoring, and have minimal impact on the appearance of the tower. To eliminate the possibility of XXX the marble, lubricating compounds on ire tendons, for inhibiting corrosion and reducing friction, were prohibited.

Responding to the challenge, VSL International Ltd. devised an optimum solution verifying the system on a full-scale test installation on an existing, round, concrete, water tank prior to performing the work on the monument itself. The jacking force on the tendon was monitored and verified by a load cell, a hydraulic pressure gauge, and measured tendon elongation.

The system uses a galvanized o.6" monostrand, housed in a polymere PVDF duct, and anchored by a Rush-mounted center stressing anchorage block (90 x 70 x 500 mm) which bears on a tendon sliding part to protect the marble. Encapsulation of the galvanized anchorage block, along with surface treatment of the wedges, / assures long-term corrosion protection for the system.

The «extraordinary» care exercised by VSL/Preco in the design, testing and installation of the circumferential prestressing for strengthening the Leaning Tower of Pisa assures that the Monument will remain "extraordinary".

Alberto Lodigiani
Preco S.r.l.
Milano, Italy

Circumferential prestressing single strand anchorage body

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