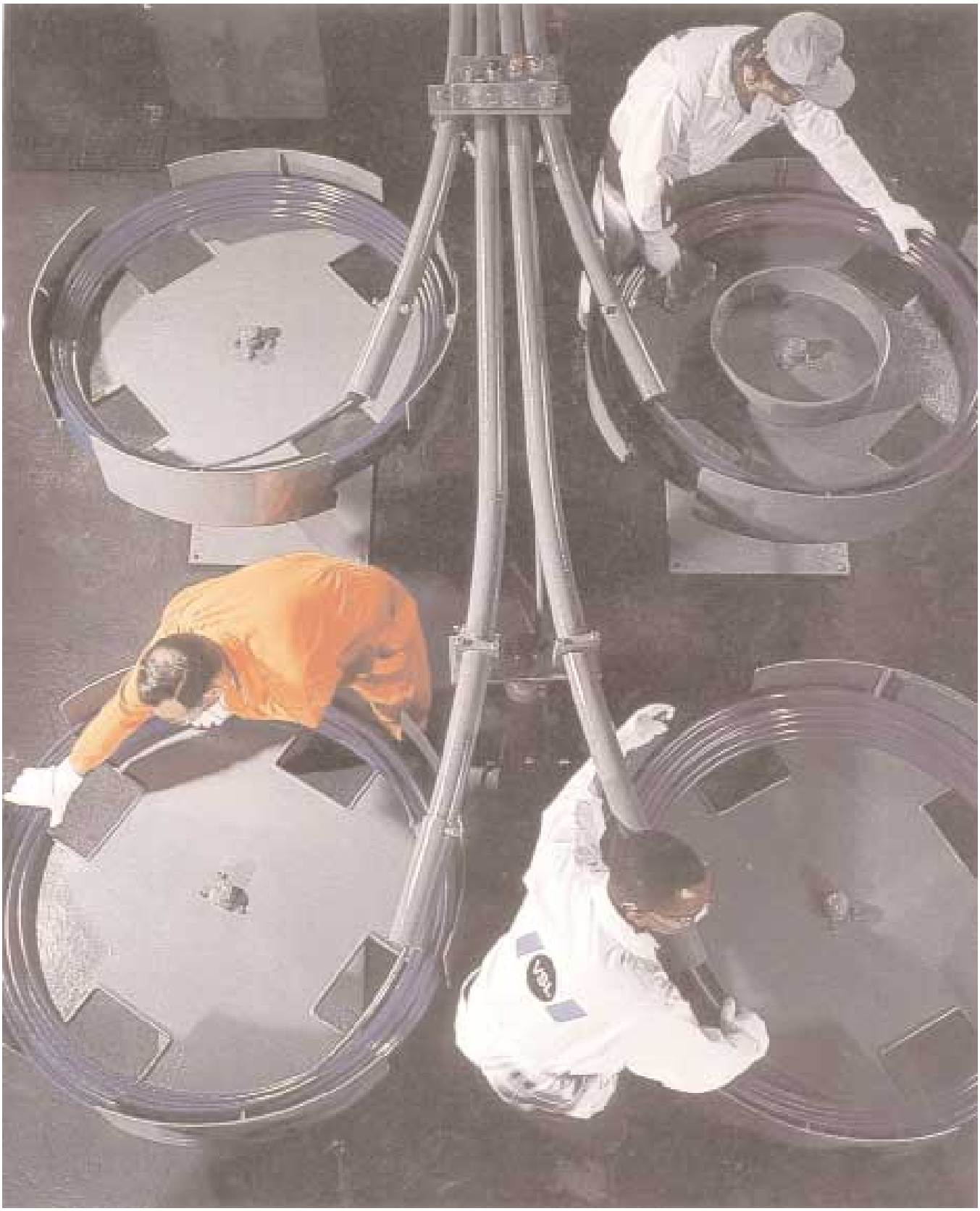
VSL NEWS

NUMBER ONE 1990



Editorial

Preparing for a decade of opportunity and change

As we enter the 1990s, it is already clear that the new decade will witness an exhilarating array of new beginnings and new directions. In business, industry, and society, our world is rapidly changing, creating exciting opportunities for those organizations who are in touch with their customers and prepared for change.

This issue of VSL News is a prime example of the VSL Group's commitment to maintaining close lies with our markets through communication and constant improvement. The preceding two issues were presented with a new look, but this edition is a further step in the right direction. The old newsletter has evolved into a full-grown periodical, with an improved graphic format and articles which reflect the innovation and diversity of VSL'S worldwide construction activities.

Our lead story concerns the spectacular underpinning of a huge retail complex in Sao Paulo. Written by Ing. E. Rudloff, the partner of our Brazil affiliate, the story shows once more that VSL is non only synonymous with quality post-tensioning, but also with new problem-solving ideas to serve our clients. In the next article by Dr. H.R. Ganz, we present another innovative idea which has become reality : the VSL Post-Tensioned Masonry System. This system is now marketed in Switzerland through the joint efforts of VSL International Ltd. and brick manufacturer Zürcher Ziegeleien.

Next we present the latest developments of our five VSL Operating Units. Of specific interest are the various fascinating applications of VSL Post-Tensioning, including projects where VSL specialists have assisted with significant value engineering. In the US.A., a breakthrough is reported by the VSL Transit Systems Group ; after a reorganization of the Transit Division in 1988, a contract for a new system has been signed in Nevada, with many others to follow.

As the new editor of VSL News, we are pleased to introduce Ms. Therese Wenger, who also serves as the assistant to VSL Group Management in Berne, Switzerland. Therese has been with VSL since 1981, and is well-regarded for her diverse capabilities and dependability. She has taken over the editorial responsibilities from Hans Ulrich Aeberhard, who has left our group. Hans was the editor of the VSL Newsletter for many years, and made the publication one of high technical standards.

We also welcome Mr. Donald McDaniel, a native of California, who will serve as creative director for our periodical. He is responsible for assuring that our new publication meets the highest criteria for visual presentation and client communication.

Reto Jenatsch
Chairman of the Board and
Chief Executive Officer

Contents

Cover : VSL Monostrand post-tensioning tendons are automatically coated and sheathed by a computerised, high-speed extrusion process. The cover photo shows the payoff baskets of the Monostrand production line at VSL Corporation's Washington, D.C. fabrication plant.

Shopping centre in Sao Paulo expands — downward!

A 42-year-old shopping centre in Sao Paulo, Brazil, had to be enlarged and modernized. The site would not allow a horizontal addition and current building regulations required such à large setback that replacement with a new building was not practical. It was decided to extend the building downward three stories and build three additional stories on the existing structure.

In March 1988, RUDLOFF-VSL were asked to provide a technical solution and project design for the downward expansion. The challenge was to provide temporary support for the 76 reinforced concrete columns while they were extended downward. Each column carried an average load of 600 tonnes. As à further challenge, the shopping centre was to remain in use during the six-month downward expansion.

The solution proposed by RUDLOFF-VSL was to transfer column loads to temporary foundations with a steel strut and lie system, permitting the columns and permanent foundations to be extended downward. A major key to the project's success was the use of hydraulic jacks to ensure proper load transfer to the temporary foundations and to prevent excessive movements in the superstructure. After removing the old foundations, shafts for the column extensions were excavated. At a depth of approximately 20m, the shafts were belled to accommodate the new foundation. When all of the columns were extended, the underground space was excavated.

RUDLOFF-VSL provided the entire steel strut system, lifting jacks and pumps, as well as the post-tensioning of the concrete slabs. The slabs were cast in succession from the top down, that is, the lowest slab was cast last.

The project was completed on schedule, and with the experience gained, it is expected that with suitable soil conditions, this method of underpinning could be used for buildings with loads of 2,000 to 3,000 tonnes per column.

Strut and tie system provided temporary support to column while permanent foundations and columns were extended downward.

Ing. E. Rudlof
RUDLOFF-VSL
Sao Paulo, Brazil

Shopping centre remained in use during the entire underpinning and downward expansion.

New post-tensioning system increases strength and height potential of masonry structures

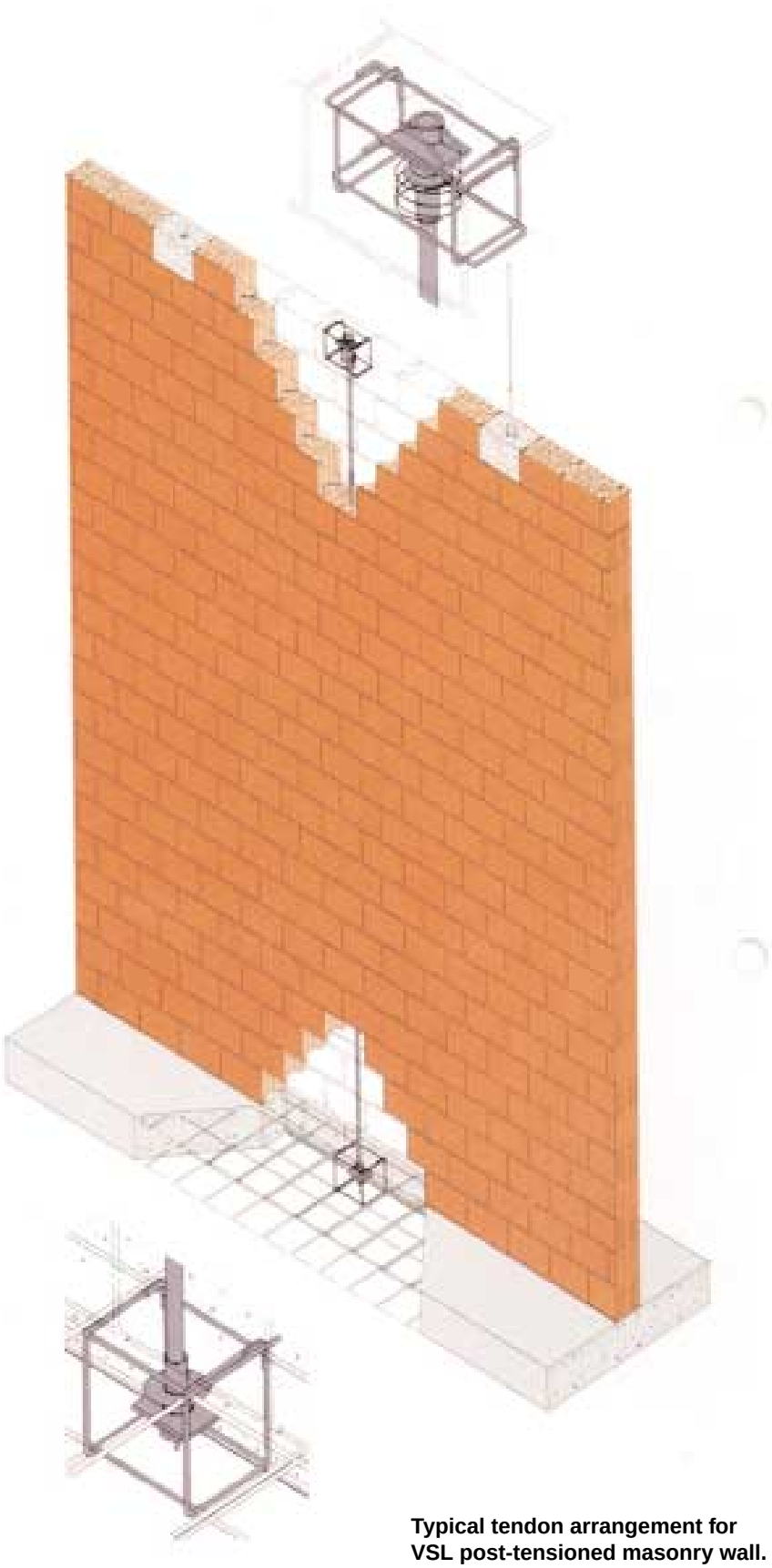
Masonry is an ancient construction material which combines high durability with excellent thermal and acoustic insulation properties. In addition, the building methods for masonry structures are simple and very flexible.

Like concrete, masonry has a relatively high compressive strength but possesses a low tensile strength. Because of this, it has been used primarily as a construction material for vertical members subjected essentially to gravity loads. In addition to axial loads, masonry walls are also subject to in-plane shear, ouf-of-plane transverse loads, and imposed deformations caused by deflections and volume changes of floor slabs. Under such conditions, walls with low axial force exhibit poor cracking behaviour and reduced strength.

To overcome the structural and performance limitations of conventional masonry structures, VSL has developed a new post-tensioning system for the construction of masonry watts. Post-tensioning will actively introduce any desired level of axial force in a wall to provide the required strength and crack control.

Post-tensioned masonry is non a new idea. In 1825, a post-tensioning method was employed for tunnel ling under the Thames River in England. The development of reinforced concrete in the fate 19th century led to the significant decline of masonry as a structural material. Only in the early 1950's did Europe experience a gradual revival of its use. Since the 1960's, a number of prestressed masonry applications have been reported, primarily in England. The applications include prestressed masonry water tanks, large walls in buildings, retaining walls and bridge abutments.

The new system developed by VSL utilizes high strength steel strand that is greased and coated with extruded plastic for maximum corrosion protection. A solid and durable duct around the monostrand tendons provides an additional layer of protection.

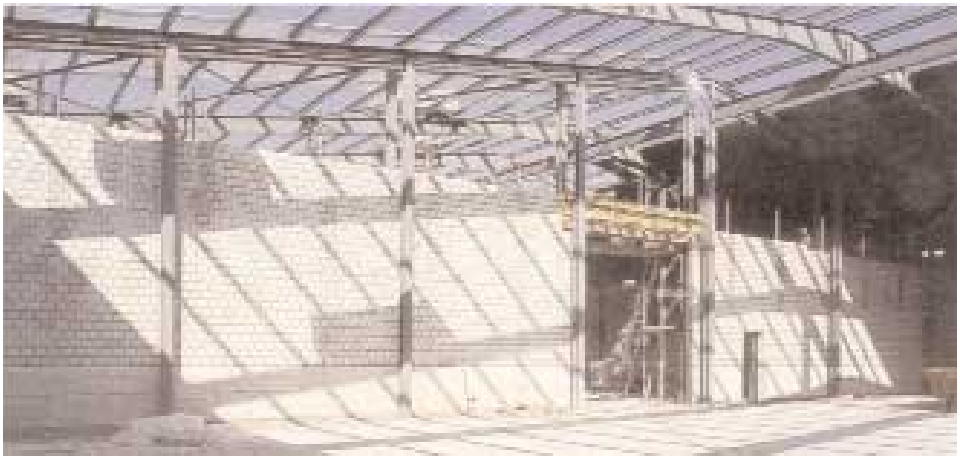


Typical tendon arrangement for VSL post-tensioned masonry wall.

Threading a duct segment

Introduction of monostands

Stressing of tendon



Post-tensioned fireproof factory wall under construction

The monostrand is easy to use in the field. It eliminates the multiple XXX of prestressing bars and provides superior tension capacity per weight of prestressing steel.

A typical VSL masonry tendon consists of a self-activating dead-end anchorage, a stressing anchorage placed in a prefabricated concrete element, the 15mm diameter greased and coated monostrand, and a steel duct. The dead-end anchorage at the lower end of the tendon is cast into the concrete foundation. During the wall construction, short duct segments are threaded to the anchorage or previously placed duct segments. This procedure allows the bricks to be laid easily because only a small number need be threaded over each duct segment. When the final wall height is reached, the last duct segment is cut to the required length and the prefabricated concrete element containing the stressing anchorage is placed. Monostrands are introduced through the stressing anchorage and duct into the self-activating dead-end anchorage. After the masonry reaches the specified strength, the tendons are stressed to a maximum of 75% of their ultimate capacity.

The VSL post-tensioned masonry system has been successfully employed for two recent applications in Switzerland. First, brick walls of a school in Zurich were post-tensioned to provide the strength required to resist ouf-of-plane transverse loads. The clay brick walls were 140mm thick and up to 4m high with large window openings. In the second project, a 250mm thick fireproof factory wall near Zürich was post-tensioned to withstand a wind velocity of 21m/s as a cantilever. Only 17 tendons were required for the 36m long wall, which was up to 8.8m high.

An increasing number of people prefer masonry structures over concrete due to masonry's aesthetics, variety and high durability. Masonry construction procedures also provide an inherent flexibility for the shape of walls non easily achievable with concrete. Thus, post-tensioned masonry offers new potential for innovative and cost-conscious structural engineers.

The VSL post-tensioned masonry system is marketed jointly in Switzerland by VSL International Ltd. and brick manufacturer Zürcher Ziegeleien.

Hans-Rudolf Ganz, Ph. D.
VSL Western
Campbell, California

VSL rock anchors rehabilitate Warragamba Dam

VSL has recently completed the fabrication, installation, and stressing of 102 permanent rock anchors at Warragamba Dam. The work was associated with the raising and strengthening the 30-year-old structure.

A total of 420 tonnes of 15mm high tensile strand was used for the 16,500 kN capacity anchors which had a maximum length of 112m, making them the highest capacity and longest anchors ever used in Australia. Stressing of the anchors within galleries with limited working space required a specially commissioned stressing jack. all of the anchors are fully encapsulated, monitorable and restressable.

Gareth Pickering
VSL Prestressing (Aust.) PtY. Ltd.
Thornleigh, New South Wales

The raised and strengthened Warragamba Dam.

Post-tensioned flooring system chosen for 56 level Melbourne building

The Bourke Place project is a 212m rail concrete building situated in Melbourne's City Centre. Currently under construction, the project is due for completion in mid-1990.

A VSL post-tensioned band beam flooring system was chosen as the most suitable for the 59,000m2 of office space, due to favourable economics and speed of construction. The system consists of a 125mm thick floor slab and 400mm deep x 1000mm wide band beams at 4.7m centres. The beams typically span 10.8m from the perimeter to the core. The beams are haunched at the ends to allow air-conditioning and other services to pass without increasing the floor to floor height.

P. Tilley
VSL Prestressing (Aust.) Pty. Ltd.
Noble Park, Victoria

Bourke Place climbform at level 18 with post-tensioned floors at level 13.

Climbform in place and post-tensioned deck under construction for World Square project, Sydney

VSL climbforming : The sky is the limit in Sydney

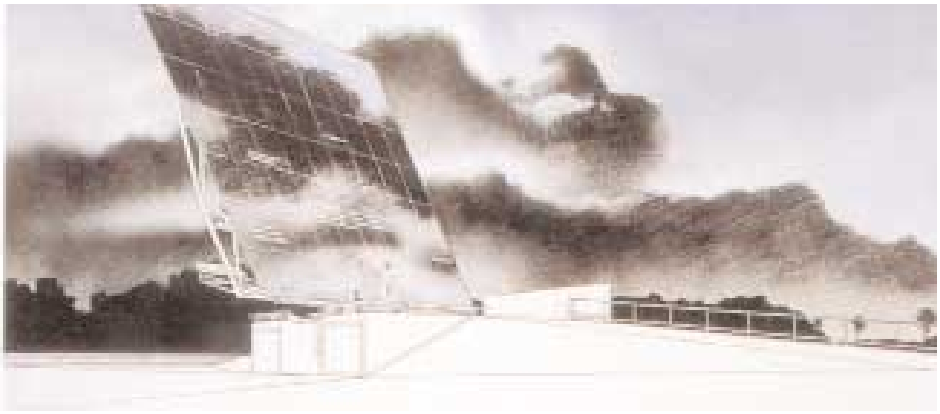
The World Square development in Sydney's central business district will be one of the largest prestressed concrete structures in the world. Begun in 1986, it will take over 7 years to complete and cost nearly one billion dollars.

VSL Prestressing (Aust.) Pty. Ltd. has been awarded the climbing formwork contract for the first tower building, and the post-tensioning contracts for this tower and the total podium. VSL will install nearly 150, 000m2 of post-tensioned slabs in the project and will use over 700 tonnes of prestressing strand.

The completed project will be a dominant feature of the city, with four towers of up to 60 storeys su rmounting a twelve storey podium. The total floor area on completion will exceed 350,000m^2.

David J. Standley
VSL Prestressing (Aust.) Pty. Ltd.
Thornleioh, New South Wales

NASA's Astronauts Memorial readv for construction



VSL Western has completed the structural, mechanical and electrical engineering of the Astronaut's Memorial, soon to be built by VSL at Kennedy Space Center.

The Astronauts Memorial is a major U.S. monument dedicated to the memory of the fourteen American Astronauts who lost their lives in the space effort. The national competition-winning design, by architects Holt Hinshaw Pfau Jones, San Francisco, consists of an exposed steelspace frame structure that supports a 40ft x 50ft (12m x 15m) plane of highly polished granite. The entire structure rotates and tilts to track the sun so that the tablet always faces away from the sun to reflect the sky without glare. The names of the astronauts are etched completely through the granite slabs. A serres of adjustable mirrors are hung from the back of the support structure to reflect and focus the sunlight through the cutout names, making the names glow against the reflected sky.

VSL Western was chosen as the mechanized structure's principal engineering group by NASA'S Astronauts Memorial Foundation and the architect in June 1988. VSL'S Engineering Structures Group is responsible for the structural, mechanical, 'Î and electrical engineering of the memorial, and has completed the design engineering and specifications for all components, fabrication, installation, and construction. The memorial is scheduled for completion in mid-1990.

VSL peoplemover to cross interstate highway in Nevada

The VSL Transit System Group is currently building an 1,800 foot-long (550m) passenger transportation system for the new Primadonna Hotel & Casino at Stateline, Nevada, near Las Vegas. The fully automated, cable-propelled VSL METRO-SHUTTLE will connect an existing hotel/casino located on the west side of Interstate 15 with a new development on the east side of the highway. The shuttle will travel above, four lanes of traffic, making it the first privately-owned transit system to cross a U.S. interstate highway.

Operation of the system is completely automated, requiring no on-board drivers or attendants.

The Primadonna shuttle is the sixth cable propelled METROSHUTTLE system to be built by VSL Corporation. Previously-built VSL systems are performing reliably in Memphis, Las Vegas (two systems) and Reno (two systems).

Model of VSL'S newly-designed transit vehicle and guideway structure, currently under construction in Nevada.

Carlos Banchik
Don McDanie/
David Swanson
Man/y Jackson
VSL Western
Campbell, California

VSL travelling formwork now at work on six major U.S. bridge projects

Westmoreland Bridge under construction in Dallas, Texas.

One of the many ways in which VSL has expanded its scope of services for U.S. bridge projects is through the design and supply of travelling formwork systems. When combined with VSL Multistrand post-tensioning, VSL formwork provides bridge contractors with an efficient, single-source structural package.

The steel travellers are essentially truss structures which support formwork for the cast-in-place method of free cantilevering. The components are pin-connected for fast assembly and dismantling, and are safe and easy to use. Currently, VSL maintains a fleet of nine travellers, all of which are in use across the United States. The projects include the Illinois River Bridge near Jacksonville, Illinois, Jamestown Bridge in Rhode Island, the West Seattle Bridge in Washington State, Bennett Bay Bridge in Idaho, Westmoreland Bridge in Dallas, Texas, and the Hoover Dam Visitors Center Bridge outside Las Vegas, Nevada.

VSL Commercial Structures Group strengthens leadership position in western post-tensioning market

Major airport expansions utilize VSL post-tensioned concrete

Travellers at four western U.S. airports now undergoing major expansions will soon be parking their cars in VSL post-tensioned parking structures. VSL Western's Commercial Structures Group has won contracts for Sky Harbor International Airport in Phoenix, AZ, John Wayne Orange County Airport in Southern California, San Jose International Airport in Northern California, and Salt Lake City International Airport in Utah. The contracts include the design, fabrication, delivery and technical assistance for the post-tensioning of over two million square feet Il 90,000m2) of parking structure deck.

Horizontal and vertical post-tensioning provided the required resistance to bending and overturning forces on the freestanding cantilevered suites.

Increased activity in Arizona building market

VSL'S presence in the busy Arizona building market expanded dramatically in 1989. In Phoenix, the company has completed the following recent projects : Citibank Tower, 2800 N. Central office building and parking structure, Crystal Point Condominiums, Esplanade Office Towers and Merabank Centre.

In Tucson, VSL post-tensioning was utilized in both horizontal and vertical directions to construct the new scholarship suites addition for the University of Arizona's sports stadium. The suites hang above the stadium from cantilevered beams on 185ft (56m) cast-in-place columns.

Georgia dam strengthened with VSL rock anchors

Yonah Dam, owned and operated by the Georgia Power Company is located along the Tugaloo River approximately 85 miles northeast of Atlanta. The dam length at the crest is approximately 975ft. (300m), with a 450ft (140m) centrally located overflow spillway. It has a maximum height of 90ft. (27m). Built between 1923 and 1925, the dam required strengthening to meet current design standards.

The dam strengthening involved the installation of 52 VSL rock anchors through the crest of the dam. Design bond lengths range from 39ft to 55ft (12 to 17m) with overall anchor lengths of up to 178ft. (54m). The installed anchor capacity totalled 91,416 kips (407,000 kN). VSL designed and supplied all of the rock anchor materials for the project.

John Crigler
VSL Eastern
Springfield Virginia

Mountainous terrain required that all of the work be done from barges tied to the upstream face of the dam.

Parking expansion for American Airlines continues

VSL's Dallas, TX office is currently involved in the second phase of construction for the American Airlines parking complex that includes approximately 1, 650,000 square feet (153, 000m^2) of elevated concrete deck. The initial phase of construction was completed by VSL in 1986 and included 700,000 square feet (65,000m2). Construction of the second phase began in April 1989. The structural frame was completed in December 1989. The structural framing system consists of post-tensioned beams spanning 60ft (18.3m) and 7in. (180 mm) post-tensioned slabs spanning 27 ft (8.2m). Post-tensioning is also used for slab temperature reinforcing.

American Airlines parking expansion utilizes more than 460 tons of prestressing strand.

Larry Krauser
VSL Eastern
Grand Prairie, Texas

Problem tanks no problem for VSL

The Adolph Coors Company required a 1.5 million gallon (5,500,000l) tank for an expansion of their waste water treatment facility in Golden, Colorado. The process used to treat brewery waste uses gaseous oxygen and requires a gas tight structure. Since existing non-prestressed tanks of similar size and shape had not performed as desired, a fully post-tensioned tank was considered to be the most functional alternative. Post-tensioned tanks are inherently more crack-free than non-prestressed concrete tanks.

VSL provided complete design, supply and installation for the covered tank which measured 200ft. x 50ft. x 21ft. high (61m x 15m x 6.4m). Success was ensured through the careful selection of structural details and construction procedures aimed at reducing shrinkage and restraint cracking. These included designing all members for 200 psi (1,4 MPa) residual compression after all fosses; addition of 1% horizontal non- prestressed reinforcement in lower portion of watts; stressing a portion of the base slab tendons at the same time as those in the watts; early stressing of the base slab; vertical closure strips at corners; and a shear friction joint between the wall and the roof which while initially allowing the roof slab to shorten was finally "locked" by post-tensioning.

VSL's well established ability to provide a complete design and construct package proved to be the key to another successful project.

Vertical closure strips at corners allow unrestrained orthogonal movement of walls and base slab eliminating the accumulation of tensile stresses at these critical locations.

Robert Allen
VSL Eastern
Lakewood, Colorado

Continued growth with Retained Earth

Since its introduction in 1981, VSL has supplied approximately five million square feet (500,000m2) of Retained Earth walls on 180 projects in the U-S.

Contracts have been as large as 220,000 square feet (20,500m2), with wall heights up to 70ft. (21.3m). The job shown here includes 170,000 square feet (15,800m2) of "raised relief" facing panels, 600,000 pounds (272 tonnes) of galvanized reinforcing mesh, and 88,000 cubic yards (67,000m3) of select granular backfill.

Retained Earth walls provide visually interesting access ramps to 1 - 275 south of Tampa, Florida.

Roger Bloomfield
VSL Eastern,
Springfield Virginia

VSL stay cables carry main span of bridge in Finland

VSL International has recently completed the design, fabrication, testing, and installation of the stay cable system which carries the 324m main span of the Kemijoki River bridge in northern Finland.

The 28 VSL stay cables consist of between 32 and 55 15.7mm steel strands which are individually greased and sheathed with high density polyethylene pipe and covered with "TEDLAR" tape. VSL anchorages are located at each end of the stay cables. Additional corrosion protection is provided by filling the anchorages with a corrosion preventative grease and by cement grouting the main length of the stay cables.

The various stay cable components were assembled on site by VSL and subsequently installed and stressed, using equipment specially designed for the project. After all the cables were stressed and the fuit dead load of the deck was carried by the stay cable system, the grease and grout injections were performed, followed by the tapewrapping - again using equipment specially designed by VSL.

Kemijoki River Bridge nearing completion.

Ferdinand Graber/Thomas Schneiter
VSL International Ltd.
Lyssach, Switzerland

Post-tensioning of Aare River bridge now underway in Switzerland

A direct highway connection between the two largest Swiss cities, Zürich and Basel, is now under construction.

The crossing of the Aare valley at Schinznach consists of a twin box girder bridge with 23 spans and a total length of over 1200m. Twenty-one spans of approximately 50m are being constructed on conventional formwork, while the free cantilevering construction method will be used for the two 90m spans.

VSL was the successful bidder for the post-tensioning subcontract. The 19-strand longitudinal tendons are being installed by VSL'S push-through method. The transverse tendons with 3 strands are prefabricated and placed directly into the deck.

Construction of the twin box girders of the Aare River bridge is well underway.

Construction of the superstructure began in mid-1989. The completion of the bridge structure is scheduled for 1992.

Dario Cilloni
VSL International Ltd.
Lyssach, Switzerland

Slipforming of the first Dartford Bridge caisson.

Completed caisson being towed across the North Sea.

VSL slipforms two giant caissons

In November of 1988, VSL was awarded a contract for the slipforming of two caissons needed to carry the main piers of the new Dartford cable stayed bridge across the Thames River east of London.

Originally the caissons were to be made in sections in a drydock close to the site, but Dutch contractor Ballast Nedam's solution was to construct complete caissons in a drydock in Rotterdam's Europort.

Each caisson measured 59m by 28m in plan and was divided into 40 cells. The slipformed height was 21m. VSL supplied equipment for one complete caisson which consisted of 1100m of steel formwork and 360 lifting jacks. The equipment transported to Rotterdam totalled 240 tonnes; a new record for VSL's slipform activities.

The slipforming of each caisson was a day and night operation, averaging 3.5m per day. The total wlipformed area was 45,000m2. Upon completion, the dock was flooded and the caissons were towed to the bridge site in Great Britain.

René Ruprecht
VSL International Ltd.
Lyssach, Switzerland

Decking over roadway provides recreation space in Hong Kong

A recreational area was created by decking over an eight lane roadway near Hong Kong's Lam Tin Station. The project covers an area of 261m x 46.5m and was performed without disrupting traffic.

The engineer's design used 3m deep precast prestressed U-beams spanning 46.5m. A 200 mm thick in situ slab was cast over the top to complete the deck. Each of the 87 precast Ubeams weighed 300 tonnes.

VSL was responsible for developing the construction methodology and for carrying out all of the precasting, post-tensioning 1510 tonnes), erection work and bearing supply for the beams.

VSL accomplished this assignment by developing a precasting yard at finished deck level. The beams were lifted from their beds by an overhead rail system. They were then slid horizontally to the end of the casting yard, lowered onto the support structure, and slid horizontally to their final position. All of the lifting and sliding of beams was done with the VSL heavy lifting system.

To accommodate simultaneous construction of the support structure and other constraints, a temporary casting deck was used to build sufficient beams to construct the permanent casting deck. The permanent casting deck being part of the permanent work was reinstated upon completion of the precasting.

Formwork for the beams was designed to be moved with the same equipment as used for the beams. The formwork could be moved from bed to bed, lowered onto a completed reinforcement cage and aligned in one day. An extremely fast turn around time for the formwork was achieved.

Developer: Godfrey Ltd.
Co-ordinating Architects : Ng Chun Man andAssociates
Consulting Engineert: Freeman Fox (Far East).
Project Managers : EHC Project Management Co.
Main Contractor : Kumagai Gumi Co. Ltd.
Post-Tensioning and other services : VSL Engineers (HK) Ltd.

Permanent precasting yard in foreground with beams placed in background.

General view of beams which have been moved into position at the end of the structure.

Andrew Payne
VSL Engineers (HK) Ltd.
Hong Kong

Another major bridge project for Malaysia

The town of Kuala Terengganu, on the eastern coast of the Malayan peninsula is divided by the large Sungai Terengganu River. The transportation link across the river involved the construction of four bridge structures: the 1195m South Channel Approach; the 240m Noah Bridge 1; the 320m Noah Bridge 2; and the 40m Pulau Duyong Interchange. The approach spans of the South Approach Bridge and the three other bridges consist of standardized 40m prestressed beams while the main 65m spans of the South Approach consist of a prestressed concrete box order designed to be constructed segmentally by the cantilever method.

The original design for the approach spans was based on precast I-beams with diaphragms at 10m centres. VSL provided an alternative design using wide top flange T-beams thus eliminating the need for bottom formwork for the deck slab (except for a small gap of 30mm between the top flanges). The diaphragms were also reduced and located at the ends of the beams only. The alternative reduced construction time and produced appreciable material cost savings for the client and main contractor.

VSL involvement included: fabrication and erection of 520-40m T-beams; design and supply of travellers and temporary props; reinforcement placement and concreting of main span cantilever box sections; supply of bearings; supply of all prestressing work; and consultancy services for deflection control of the cantilever construction.

This is the second longest bridge project in Malaysia. It is only exceeded by the Penang Bridge, another notable VSL achievement.

Owner: State Government of Terengganu
Consulting Engineers : Wan Mohamed and Khoo Sdn. Bhd.
Contractor: SPDPK-Shapadu-Shimizu-Marubeni Joint Venture
Post-Tensioning and other services VSL Engineers (M) Sdn. Bhd.

Steven Pong
VSL Engineers (M) Sdn. Bhd.
Kuala Lunopuc Malaysia.

Cantilever segmental construction of the main spans.

Modified T-beams replace the originally designed I-beams.

VSL

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