VSL NEWS

NUMBER ONE 1994

Editorial

Value – Service – LEADERSHIP

Leadership by a company within an industry has many facets and the values behind these points can vary from company to company and from country to country.

Leadership is usually identified with impressive key figures such as volume of activity, but this is net our understanding of leadership even though in the post-tensioning field, VSL is often considered as being the world leader.

VSL'S leadership is certainly more distinctively measured by the contributions VSL makes to the whole industry; by launching new post-tensioning systems, by improving quality of products and services, and by simplifying site procedures. These contributions have been made in anticipation of the needs of owners, designers and contractors.

Take our Composite System; the anchorage components are smaller and lighter and require shallower block-ruts, the three configurations of STANDARD, PLUS and SUPER allow adaptation to the requirements of the project. Consider also the PT-PLUS plastic duct system ; a tight encapsulation for improved corrosion protection, offering the ability to electrically test and monitor the integrity of the tendon after stressing and throughout the life of a structure. The Composite System and PT-PLUS duct are truly the systems of the future, available to you today. Take also the VSL Stay Gable System 200 SSI. It allows easy Single Strand Installation procedures with light and compact equipment and with its multiple layers of corrosion protection represents a durable product while maintaining the advantage of monitorability and replaceability, strand by strand or the whole system at any stage during the life of the structure. These are a part of VSL'S **Values**.

On the other hand, for us at VSL, leadership also means being local worldwide. With our more than 60 offices in 32 countries we are well prepared to play the rote as your partner in the true meaning of the word. Local VSL staff know the local business environment. They have grown up in the same culture, speak the same language, and are close to you. They are eager to make dialogue between you and VSL both fruitful and effraient and to optimize cooperation for the benefit of you and your project. These are the basis of VSL'S **Services**.

You as our client, our partner : call on us, challenge us, and share our name **Value – Service – Leadership** .

Michel Maître
Chairman of the Board

Front Cover:
Segmental erection Normandy Bridge, France
Photo taken by J.P. BASILE, Le Havre, France

Highlights of this Issue:

Swedish Applications by Spännarmering

In the last few years, Internordisk Spännarmering AR, VSL'S licensee in Scandinavia, has become an experienced and reliable stay Gable contracter both for bridges and building structures. Lately Spànnarmering has been involved in two stayed structures in Sweden.

Conference and Exhibition Centre for the National Road Administration in Borlaenge

Based on an architectural competition the National Road Administration opted for a spectacular roof construction. The concrete roof is suspended from stay cables 6-5 and 6-7 anchored in two steel pylons. The twelve stay cables are composed of 0.6" diameter individually greased and polyethylene sheathed steel strands, encased in a thick walled high density polyethylene stay pipe. For mechanical protection the cables are cement grouted. The stay cables cross the pylon and are anchored at different locations in such a way that there is no twisting effect on the pylon. Two stay Gables encased in steel tubes are arranged diagonally between the pylons to provide additional stability to the suspension structure.

Hallsberg pedestrian bridge, Sweden

Pedestrian Footbridge at Hallsberg Railway Station

In the course of building the new travel centre at Hallsberg in November 1993, one of the most important railway junctions in Sweden, the authorities decided to build the footbridge connecting the parking area and the railway platforms by means of a cable stayed structure. The safety regulations during construction were extremely strict as the steel superstructure had to be launched over temporary supports only 0.7 m above the high voltage lines.

The 18 stay Gables ranged in size from 6-7 to fi-19 and fanned out from the top of an A-shaped pylon. They are protected by high density polyethylene pipes and white Tedlar tape, and are cement grouted. As the bridge is very sensitive to deflections, due to the glass walls, the cross sectional area of the steel strand is governed by stiffness rather than strength criteria.

Torbjörn Lövgren
Internordisk Spänarmering
AB Danderyl, Sweden

National Road Administration Centre Borlaenge, Sweden

CS SUPER: Electrically Isolated Tendons for Post-Tensioning

Picture an engineer inspecting a 30 year old bridge. His task : to report on the bridge's ability to continue to provide safe passage. The post-tensioned concrete bridge was constructed using Electrically Isolated Tendons. The engineer moves to the control panel containing an electrical connection to each tendon and an earth to the structure. He measures the electrical resistance between each tendon and the structure - each tendon has a high resistance - the engineer knows that no break in the corrosion encapsulation has occurred, he knows the tendons will continue to perform their designed task, he turns his attention to other aspects.

In the US, in 1982, the engineers Schupack and Suarez were granted a patent based on the notion of an Electrical Isolated Tendon (EIT), however the notion dia not come with fully detailed components for the multistrand and ground anchor fields, nor did the notion foster the use of electrical measurement to prove and monitor the electrical isolation.

VSL in conjunction with other system suppliers in Switzerland helped in 1988 to formulate a specification for the supply, installation and acceptance of electrically isolated ground anchors. The specification prescribed the electrical resistance acceptance limits and allowable defect rates. While this approach was a great step forward it had limits and never absolutely checked or provided a fully isolated tendon in the anchorage zone in the fully stressed state. Completely isolated ground anchors were first used in 1993 (as reported in VSL NEWS 2 - 1993). New system detailing provided the electrical isolation of the fully stressed soil and rock anchors without changing the established site procedures of drilling and installation.

It was dear that EIT tendons had not reached the end of their development. Based on the increasing demand and the desirable attribute of service life monitoring, VSL adopted an EIT option as one of the development objectives for the CS System, and so made provision for a top

Aderahubel

PT-PLUS duct coupling

of the range option called CS-SUPER (see VSL NEWS 2 - 1992).

CS-SUPER was designed to provide :

- a permanent fully encapsulating moisture barrier that is also electrically isolating,
- the elimination of steel strand to steel duct contact and hence elimination of tendon to duct fretting fatigue,
- components that are small and lightweight which make site work easy and quick,
- continuous life time monitoring using electrical resistance measurements.

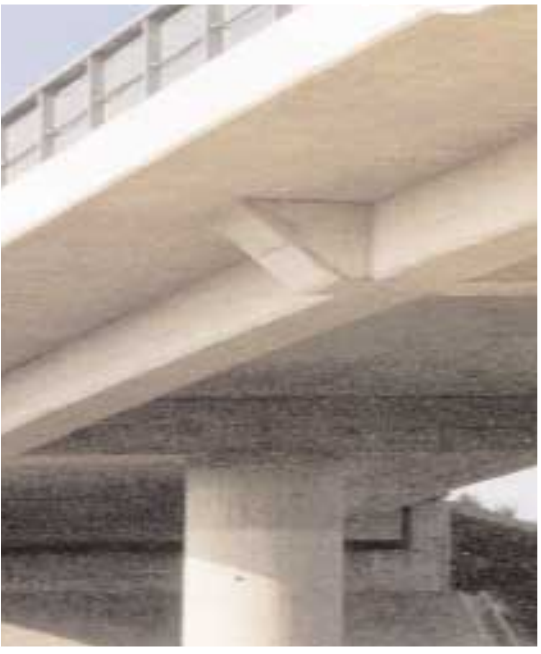
There are three vital requirements that must be fulfilled to achieve an EIT tendon. Firstly, the duct must be able to transfer the lateral strand forces of a multistrand configuration to the structure without loss of isolation. PT-PLUS duct has been designed to transmit such forces without suffering from wear-through. Secondly,

P. S. du Milieu

The new Aare railway bridge, Brugg, Switzerland

CS anchorages installed

electrical isolation of the anchor head from the bearing plate must be provided when subjected to the full tendon load. This is provided by a special high capacity load bearing insulation washer. Finally, positively sealed connections of all duct and anchorage components is a must. CS components are detailed to ensure that field connections are precise, practical and testable.



In the process of developing CS-SUPER, EIT tendons have been incorporated into two bridge projects in Switzerland to prove the practicality and check performance. P.S. du Milieu bridge is a highway overpass with a length of 100 metres. all 6 longitudinal tendons are electrically isolated and use Type 59 PT-PLUS duct. Aderahubel bridge has two spans of 30 metres and all 6 tendons (22 strands) have used type 100 PT-PLUS duct. The experience gained from these two pilot projects and the extensive in-house testing have conduded that CS-SUPER electrically isolated tendons are ready for full scale use. More recently the Swiss Federal Railways has 8 specified PT-PLUS for the 127 metre long Aare River Bridge, Brugg. This twin track railway bridge with a main span of 60 metres will also include CS-SUPER / EIT tendons.

Electrical Resistance Measurement of EIT tendons, which is a quick and inexpensive procedure, should be viewed as part of a life time structural management detection scheme. A high electrical resistance confirms the complete encapsulation and hence the completeness of the protection. The measurement of resistance is very sensitive to the smallest breach of encapsulation. A failure of the encapsulation will not mean that the tendon has lost its capacity to function , but loss of electrical resistance will indicate the need for the introduction of other more frequent and more involved monitoring techniques.

Brad Rathbone
VSL International Ltd.
Lyssach, Switzeland

Thiong Bahru Plaza, Singapore
Post-Tensioned Foundation Saves Time and Money

VSL was awarded the post-tensioning work for Tiong Bahru Plaza in April 1993. all 3 Basement Levels, 6 storey Podium Block and 20 storey Tower Block are designed as post-tensioned floors with the highlight of the project being the basement raft foundation.

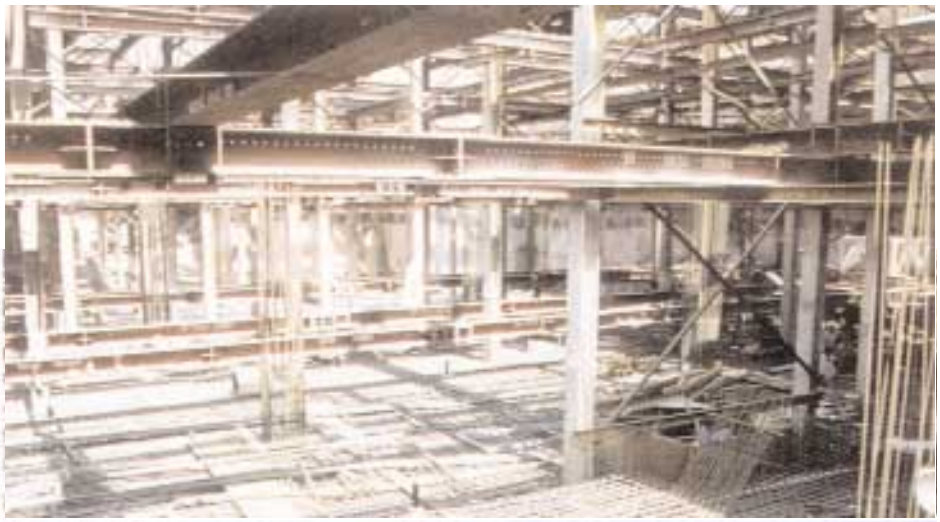
The complexity in the design of the entire structure was made worse by the fact that one third of the Podium Block was to rest on columns provided by the existing underground Mass Rapit Transit (MRI) station. In order to overcome differential settlement problems, four different types of foundation systems were used. The Podium Block was in part supported on a post-tensioned raft foundation, footings, and columns over the MRT station, while the Tower Block was seated independently on bored piles.

The raft is 1250 mm thick and was designed for both the weight of the building as well as the net hydrostatic uplift of approximately 27 kPa due to the possible fluctuation of water level. In the latter case, the raft was to span 40 metres between diaphragm walls. Straight tendons were placed in the top and bottom using 5-12 tendons. With a total area of 5,030 sq.m the raft was cast in five operations with pour sizes ranging from 900 cu.m to 1,500 cu.m.

Construction of the raft was completed in less than two months. This was made possible due to the reduction of time and cost of the post-tensioned construction when compared to a conventional 1500 mm thick reinforced concrete raft. The savings were made possible due to :

– Excavation was reduced
– Congestion due to steel reinforcement was eliminated
– Cost of temporary works le-g. strutting system) were reduced due to reduced excavation depth
– Reduction of material handling (concrete and total structural steel)

G. Sean/J. Ng
VSL Singapore Fte. Ltd.
Singapore



The podium block raft foundation

VSL Climbform Baiyoke Tower II, Thailand

The introduction of VSL Climbform into the Thailand construction market was heralded with the award of a contract for one of the tallest buildings ever to be built in the centre of Bangkok. The Baiyoke Tower II, with a height of 289 metres above ground level (84 storeys), will have a core wall area of approximately 72,200 sq.m.

14 VSL (Thailand) Go., Ltd. has been awarded the contract for climbing formwork by Concrete Constructions (Thailand) Co., Ltd. The choice of VSL Climbform for the core wall construction was also made to accelerate the construction sequence of the project.

Work on the project began in 1992 and will take 4 years to complete, with an anticipated total construction cost of around 3,600 M (Thai Baht).

As one of the tallest buildings in Thailand, when completed the structure will be a dominant feature of the City of Bangkok.

S. Boonprecha
VSL (Thailand) Go., Ltd.
Bangkok, Thailand

Thailand's first climbform

The Maribyrnong River Bridge, Australia

A major part of the 29 km Western Rin Road around Melbourne is the Maribyrnong River bridge. A design and construction contract was awarded to Transfield Construction Pty Ltd with structural design by Hardcastle and Richards Pty Ltd in conjunction with VSL Prestressing (Australia) Pty Ltd.

The bridge consists of two parallel structures 520 metres long with 8 spans of 54 metres and end spans of 44 metres. The method of superstructure construction is incremental launch based on a segment length of 27 metres.

Each structure provides three lanes of traffic. A future provision is for a third structure to be built in the gap between the first two and so increase the bridge width to l fanes for future traffic needs.

15 VSL'S scope of works was the supply and installation of transverse, longitudinal construction and continuity post-tensioning. The VSL tendons used are 6-5 and 5-5 transversely, 6-5 in the top and bottom Ranges for straight longitudinal construction post-tensioning and 6-31 longitudinally continuity tendons stressed internally.

Mark Sinclair VSL
Prestressing (Aust.) Fty Ltd
Melbourne, Australia

Western carriageway during launching

Post-Tensioning Towers: VSL Shows the Gateway to Hong Kong's Future

Post-tensioned buildings are setting the scene for Hong Kong's skyline. The recently completed Gateway Development, a twin 37 storey office tower for Wharf Properties, breaks the deadlock on the aviation height limitation for buildings in the northern region of Hong Kong Harbour. In order to maximize net lettable area a post-tensioned Rat slab was required to enable the placement of mechanical and electrical services in the extremely tight ceiling space imposed by the 3.2 m floor to floor height. The 260 mm thick post-tensioned Rat slab spanning 11 .5 m from perimeter columns to central core provided not only an economical floor system, but enabled building construction to proceed on a 4 day cycle.

Robinson Road Development

Hong Kong's trend for high-rise structures with varied occupancy raises the need for a transfer plate to permit a change in column layout between occupancies. In 1993 atone, VSL Hong Kong designed and constructed 3 post-tensioned transfer plates proving it to be an economical and, effective alternative to the conventional reinforced concrete plate. The Robinson Road development for Swire Properties consists of 2 post-tensioned transfer plates 3.2 m thick supporting 47 stories of residential apartments. The transfer plates have been designed to be constructed in 2 layers, the first layer 1.5 m thick, once stressed, will support the construction weight of the remaining 1.7 m of concrete minimizing falsework and construction costs. The post-tensioning enhances the shear capacity of the concrete allowing a thinner and more economic structure.

Gateway Development

Barry Young
VSL Hong Kong Ltd.
Hong Kong

Rapid Construction with Precast Members

Just beside Fukuoka interchange on Kyushu transverse highway route, a large scale distribution warehouse complex is now under construction. Fukuyama Tsu-un Fukuoka Distribution Centre Warehouse, which composes the main part of the complex, was built of precast concrete members. The building has a width of 40 m (10 m x 4 spans), a length of 250 m il 2.5 m x 20 spans), and has three stories.

Precast building elements become continuous with a second stage of post-tensioning

Precast concrete members are used for the 2nd and 3rd floors.

Simultaneously with site construction work, girders prestressed with VSL post-tensioning tendons were fabricated in the precast shop in nearby Kurume city, transported to the site by large trucks, and positioned by a large capacity movable crane. Alter placing precast sortit slabs, column-girder joints and slabs were concreted. When the concrete had attained the designated strength, a second stage of post-tensioning was applied to transform the columns, girders and slabs into a continuous structure.

Compared with the conventional cast-in-situ method, this system has various advantages in terms of construction duration, constructability, quality, and labour environment. The resultant structure, with its long clear spans, has not only superb performance for utilization and operation of the warehouse but also excellent durability and anti-seismic characteristics.

Shusuke Sakata
VSL Japan Corporation
Tokyo, Japan

A Viaduct to Kansai International Airport

In order to cope with the future increase of international passengers and freight to Japan, the construction of a new airport is now in full swing. The new Kansai International Airport will be located 5 km offshore in Osaka Ray due to the lack of available Rat areas and as a means of avoiding noise pollution.

Nagataki viaduct is part of the trunk highway which connects Osaka city and the redaimed man-made island for the airport. The viaduct has two parallel decks with spans of approximatively 29 metres. The decks are of post-tensioned concrete voided slabs 11.5 metres wide and 1.4 metres in depth. 307 tonnes of prestressing strand together with 820 tonnes of reinforcing bar were consumed for the decks. Taisei Corporation, one of the sublicensees of VSL Japan, started with the deck work in January 1991 and completed the work in December 1993. The airport is expected to open in summer 1994.

Shusuke Sakata
VSL Japan Corporation
Tokyo, Japan

Bonded Beam and Slab Parking Garage

Installation of PT-PLUS flat duct

Overall View – Hahnemann parking garage under construction

The construction of the Hahnemann University Parking Garage in Philadelphia, Pennsylvania, marks the introduction into the US of the VSL Bonded Slab PT System for commercial structures. Additionally, PT-PLUS Plastic Duct was utilized for state of the art corrosion protection. The VSL Bonded Post-Tensioning System has an excellent record of durability in the harshest environments, and has been extensively used in bridge construction over the past 30 years, here in America and around the world. In 1992, VSL introduced the PT-PLUS duct system, featuring smaller and lighter components, enhanced corrosion protection, improved duct friction values, and easier installation.

The project engineer agreed that bonded post-tensioning was superior to the unbonded system, but was concerned about initial costs. Bidders were allowed to submit bids on both bonded and unbonded alternatives. The bids were competitive, allowing the owner to follow the engineers recommendation and construct the project using the bonded system.

The impact of the bonded system on the constructability of the project was positive. The 6 inch slabs span 22 feet, and the 16 inch x 28 inch beams span 52 feet. The slabs employ VSL SA anchorages with 1" x 3" PT-PLUS plastic duct, encapsulating up to 4 strands. The typical beam employs one EC 5-12 tendon. This represents a 42 % reduction of end bearing area, when compared to individual monostrand anchorages. The use of the bonded components reduced congestion (when compared to the unbonded system) and helped the contractor achieve an aggressive construction schedule.

Dan Falconer
VSL Corporation
Philadelphia, FA

Parrotts Ferry Bridge Retrofit

The Parrotts Ferry Bridge constructed between 1976 and 1978 over the New Molonos Lakes in Northern California, is a 3 span, single cell, lightweight concrete post-tensioned box girder. The bridge is 1290 feet long with a 640 feet main span built by the cast-in-place cantilever segmental method.

The original design mortel dia not account for the relatively high creep and shrinkage rates of the lightweight concrete used in

Erecting work platforms under bridge

construction. As a result, a 25 inch downward deflection at the centre of the main span occurred over a ten-year period. It was determined by the Onwer's consultant that without a retrofit scheme, it would be likely the bridge would deflect 12 more inches over the next 50 years.

A number of retrofit schemes were considered by the Army Corps of Engineers, as proposed by T.Y. Lin International. The chosen method for retrofitting the structure utilized external tendons within the box girder that protruded up to 3 feet below the sortit for 80 feet each direction of midspan. The tendons in the box are sheathed in 4 inch polyethylene duct. Once below the sortit, the tendons are encased in curved concrete ribs.

Twelve 27-0.5 inch strand tendons passed through a series of deviation blocks to introduce the desired stresses from the post-tensioning into the structure to remedy the deflection problem. Upon stressing all twelve tendons, 7 inches of deflection was immediately recovered. It is anticipated that 85 % of the deflection will be recovered due to longterm concrete creep.

VSL was awarded the project in September 1992 and the retrofit work took approximately 12 months to complete.

Steve Ruel
VSL Corporation
Campbell, California

VSL's Transit System Group Delivers Mirage Tram Project

Placement of precast guideway segment

VSL'S Transit Systems Group has designed and built nineteen passenger transportation systems since the Group's inception in 1974. Since 1980, the Transit Systems Group has installed, as turnkey supplier, eight Automated Guideway Transit (AGIj systems; two monorail and six cable-propelled.

In August of 1992, the Transit Systems Group contracted to install its latest AGT system with the Mirage Corporation in Las Vegas, Nevada. On October 20, 1993, the Mirage system was placed into service. In the first fourteen hours of operation, the vehicle successfully carried in excess of 10,000 passengers between the Mirage Casino/Hotel and the new Treasure Island Hotel/Casino complex. The system consists of a cable-propelled AGT system with one 60 passenger vehicle (expandable to a two car 120 passenger capacity system) travelling on an elevated guideway between two terminals. The horizontal guideway length is approximately 1,200 feet.

Mirage vehicule in service

The Transit Systems Group is currently under contract for the supply of a second vehicle for this system which, when installed, will provide the owner with a system capacity of nearly 2,000 passengers per hour per direction.

Jeremery B. Kimmel
VSL Corporation
Campbell, California

VSL Lifts Aircraft Hangar Roof in Brunei

The Royal Pavilion aircraft hangar at Brunei International Airport serves for the maintenance of the fleet of His Royal Highness, the Sultan of Brunei.

The hangar roof structure, a space truss 235 by 100 metres weighing 3500 tonnes, was assembled early last year on short temporary supports close to ground level. The roof was then lifted by means of 6 groups of VSL strand lifting units featuring central computer control of levels and loads.

To support the lifting equipment, the 6 circular steel columns were extended by 9 metres high temporary structures. These were designed by VSL Singapore and fabricated by Singapore based structural steel main contractor Yong Nam.

The 25 metres lin was carried out in 2 stages. It was engineered and executed jointly by VSL Singapore Pte. Ltd. and VSL (Switzerland) Ltd.

Walter Althaus
VSL (Switzerland) Ltd.
Lyssach, Switzerland

The hangar roof during lifting and a close-up of a column with 4 srand lifting units

Bar Anchors with Electrically Isolated Tendons

Electrically isolated passive bar anchor

The electrically isolated tendon (EIT) recently introduced by VSL (Switzerland) Ltd. (see VSL News II/(1993), continues to be in demand. It is a reliable system to allow the owner to use efficient quality control methods to check the corrosion protection of soi(and rock anchors. Special attention is always required in areas where stray currents from railways and the like coula lead to conditions favourable for corrosion.

Recently, VSL (Switzerland) Ltd. negotiated two contracts that required short high strength bar anchors to be electrically isolated. The first was a refurbishment of a tunnel of the famous Bernina railway near St. Moritz where pre-injected VSL 26 mm diameter Stressbar with a length of 10.5 qnmetres were needed. The second contract was in Regrouillon, near Sion. This project involved an extensive excavation for a railway and motorway that needed 1200 electrically isolated passive bar anchors to secure the near vertical face. The bar anchors were 40 mm diameter and varied in length from 3 to 11 metres and were detailed to meet the demands of harsh winter conditions.

VSL (Switzerland) Ltd. is convinced that the recent achievements with Electrically Isolated Tendons will encourage specifiers to freely call for this type of quality product.

André Gabus
VSL (Switzerland) Ltd.
Lyssach, Switzerland

Slipforming speeds up Construction of Concrete Towers

VSL has been active in slipforming for more than 25 years. The main advantages of this construction method include cost savings, short construction time and high dimensional accuracy.

The VSL Slipform has a height of 1.25 m and it consists of standardized steel panels and structural components. The slipform is raised by hydraulic jacks, at a speed of 2 to 6 m per 24 hours. Continuous working produces a monolithic structure without construction joints.

VSL engineers the slopform and provides the equipment on a hire basis to the client. Assembly and operation are taken care of by our specialists. The main contractor places rebars, post-tensioning and block-outs and pours the concrete.

A recent accomplishment of VSL Slipforming includes 11 building cores up to 65 m high for the Espace Léopold office complex in Brussels, executed for the AMCEL Group. Together with 6 cores slipformed previously by VSL in the same location for the OIC complex, this presumably represents the largest building core site in Europe.

Another recent accomplishment was the +j m high furnace tower for a cement dctory near Bar(, ltaly, with a slipformed surface of 13,700 sq.m. The horizontal concrete beams were also cast using the slipform, with no interruption to the continuous work.

Erich Möschler
VSL (Switzerland) Ltd.
Lyssach, Switzerland

Karl Hirsch
N.V. PROCEDES VSL S.A.
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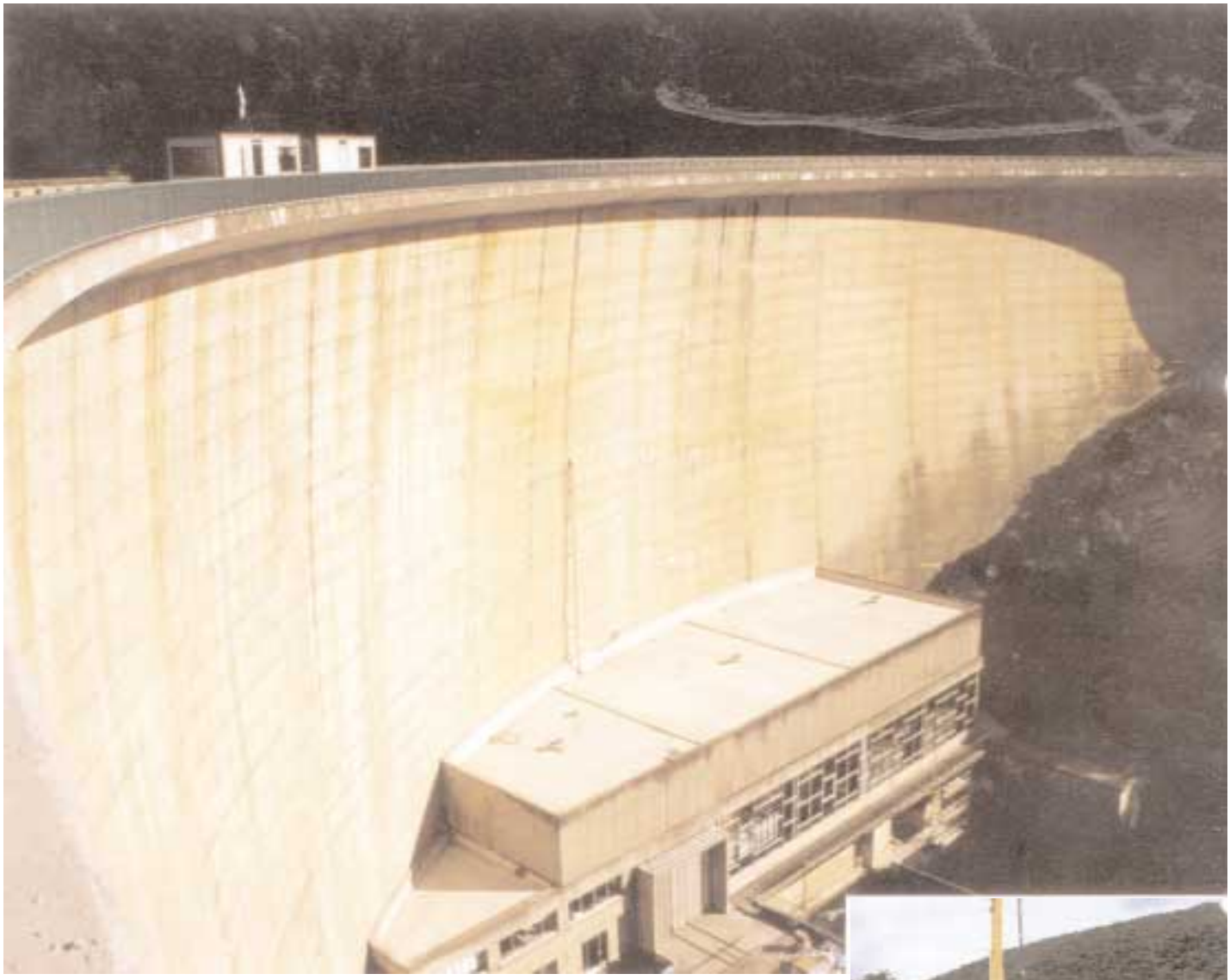
General view of the Espace Léopold construction site

The Unicem furnace tower near Bari, Italy

VSL Rock Anchors for Esch sur Sure Dam, Luxembourg



To increase the overall stability of the Esch sur Sure dam, located in the northern part of the Grand Dutchy of Luxembourg, the utilisation of permanent rock anchors was proposed.

VSL was called to install 15 rock anchors 45 metres long in the counterforts of the dam. The anchors, type 6-36, have an ultimate capacity of 9500 kN and were stressed to 4310 kN. The anchors consist of individually greased and sheathed monostrands for the free length and the whole anchor is encased in a smooth and corrugated plastic encapsulation. To allow restressing and load adjustment each anchor head is threaded.

The installation was made by means of a mobile crane which lifted the completed anchor into the vertical position where the 15 metre internai bond length was grouted. Alter this internai grouting and following visual inspection the whole anchor was lowered into the bore hole where the remaining grouting was performed.

Roland Mathys
VSL France S.A.
Egly, France

The dam and is new stabilising partner

Erection of the main span segments of the Normandy stay cable bridge

The central 624 m of the world's largest cable stayed bridge (main span 856 mi is made up of prefabricated steel segments. SDEM (the erection contractor) commissioned VSL France, because of its proven experience in the field of bridge segment lifting, to carry out the lifting work.

The 32 steel box girder segments are : 19.65 m long, 21 m wide, and the streamlined profile has a depth of 3 m. Each of the 220 tonne segments is lifted with two fi-12 Dylorm cables at a rate of 30 m/hr.

Planning and equipment had to take account of : a maximum wind speed of 50 km/h, a variation of barge draught of 0.5 m, and a maximum lin induced deck deflection of 2.8 m.

The cantilever construction method was used and required each new segment to be lifted dear of the navigation channel as quickly as possible and to be accurately aligned to the previous section and held in position until field welding and stay cable installation and stressing were completed.

Lucien Boutonnet
VSL France S.A.
Eg/y, France

Segment erection Normandy Bridge

Retained Earth in France

VSL has for many years been amassing world-wide experience with the VSL Retained Earth System. VSL France has recently added to this now popular civil engineering solution when it completed a serres of retaining walls associated with a new freeway at Besançon in eastern France.

Designed by VSL France, with support from Technical Centre Europe (Lyssach), the project consisted of 7 separate walls that were composed of 88 different panel types with a total area of 1700 sq.m. The walls which were up to 5.9 metres high were an alternative to cantilever retaining walls and provided significant cost and time savings for the general contractor.

Raphael Lu
VSL France S.A.
Egly, France

Attractive retained earth walls, France

PUBLISHED BY VSL International Ltd., Bernstrasse 9, 3421 LYSSACH, Switzerland • Editor: Therese Wenger

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