VSL

A member of
Bouygues Construction

2024 EDITION

INSIGHT

Committing to sustainable structures

WE MAKE IT POSSIBLE.

Every structure carries loads and is subject to forces on an ongoing basis, and this can lead to material deformation or failure. And in order to build ever-bigger, ever-longer or ever-stronger, it is crucial to strengthen the structure in critical areas and control the behaviour of the ground on which it stands.

This is where VSL comes in. As a specialist in post-tensioned and cable-stayed structures, foundations and ground engineering, VSL contributes to the design and construction of major engineered structures and maintains, repairs and upgrades structural systems, to guarantee performance, safety and durability.

Our strength comes from our 360° approach, which combines engineering and construction methods, structural systems and technologies, and project execution.

Our purpose lies in understanding a structure as a whole, including its environment and use, in order to propose and deliver the best technical solutions to turn even the most complex schemes into reality.

Pushing the boundaries of innovation

DECARBONI-SATION IN MOTION

Climate change is the defining issue of our time, and everyone has a part to play in limiting its impact. At VSL, we are strongly committed to taking real action towards reducing our carbon footprint and that of the structures we build or repair.

01.

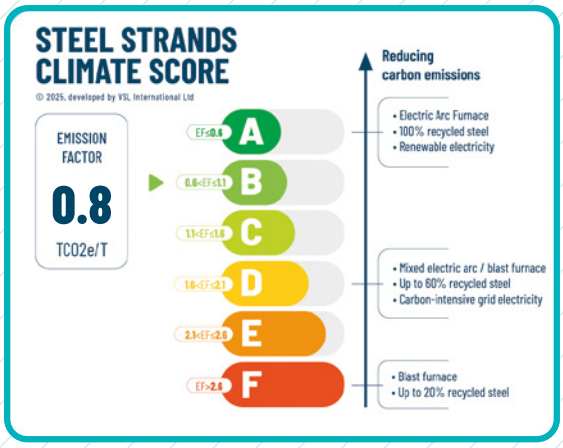
VSL International launches open-source Climate Score to drive global shift towards low-carbon steel strands

VSL International has launched an open-source tool that can be used to assess and compare the carbon impact of steel strand products worldwide. Developed to help customers make informed choices and support suppliers in adopting more sustainable production, the initiative seeks to encourage greater transparency and drive industry-wide improvements.

A new initiative to create a standard scale against which to rank the sustainability of different steel strand products from around the world is set to give asset owners and construction industry professionals the confidence that they are making truly low-carbon choices.

A key challenge for customers and specifiers these days is how to judge manufacturers' claims that their products are more sustainable or have greener credentials than their competitors.

VSL International developed its Climate Score to address this concern, **enabling the carbon cost of steel strand products from all its suppliers across the world to be compared on the same scale**.



Critically, VSL's Climate Score is **an open-source tool**; the entire scoring kit is **publicly available on the VSL website**, to allow anyone in the industry to assess and compare strand products in a transparent and consistent way.

Giving each product a score from A to F against a standard six-point measure offers a simple way of understanding the carbon cost of different products from different manufacturers, and **empowers customers in their choices**. The system works in a similar way to the EU Energy Label, which gives consumers the power to make decisions about household goods by comparing energy use on an agreed scale.

But VSL also wanted **to motivate manufacturers to make changes in their own production processes and material supply chains to improve the sustainability of their products and gain a higher rating**. Hence even suppliers who are not currently able to offer low-carbon strand can demonstrate that they are making efforts to move up the scale.

This approach allows suppliers to:

- Benchmark their performance against industry peers.
- Develop actionable plans for reducing emissions.
- Gain recognition for progress and commitment to sustainability.

VSL's Climate Score initiative marks a fundamental shift in supplier engagement, enabling manufacturers to promote the fact that they are committed to improving their output and are striving for a better ranking.

In 2021, **VSL launched an in-depth analysis of its 28 approved suppliers** across Europe, China, Egypt, and Thailand. Suppliers were asked to provide Environmental Product Declarations – at that time, only five had EPDs, and none offered a 'low-carbon' strand option, which VSL proposes should be identified as a product with an emission factor of 1.1tCO2e/t of strand or lower.

Today 18 suppliers have an EPD, and six now offer low-carbon strand options.

LEADING THE WAY IN LOW-CARBON CONSTRUCTION

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VSL Central Procurement Manager David Forcada explains:

> We have been pioneers in driving this transformation, and it is encouraging to see that many of our suppliers have embraced this challenge. Some were already on this path, while others accelerated their efforts due to our initiative. Notably, the only two suppliers in China who have EPDs are those working with us.

The Climate Score is not simply an internal tool for VSL, it is intended to set a new standard across the construction sector. **VSL Chief Climate Officer Laura Perigaud emphasises:**

> We hope the entire industry will adopt the Climate Score. The more companies value it, the more suppliers will be motivated to reduce their carbon footprint. If we change how steel strands are produced globally, low-carbon strands can become the new standard.

Fasten, one of VSL's suppliers in China agrees:

> VSL's initiative is excellent. As a responsible multinational company, VSL is leading by example in implementing carbon reduction measures. This serves as both encouragement and a push for suppliers. It accelerates our process innovations and contributes to global carbon emission reduction efforts.

02.

Fremantle Bridge project: a sustainability win!

Our teams have achieved a significant milestone in sustainable construction on the Fremantle Bridge project in Australia. They have successfully implemented a lower-carbon solution for the bridge's stay cables, resulting in a reduction in the project's environmental impact.

Connecting North Fremantle and Fremantle in Perth, Western Australia, the Fremantle Traffic Bridge opened in 1939 as a temporary structure. Despite maintenance efforts, it has deteriorated and needs replacement. A new extradosed bridge with cantilevers and cable support is being built on the same alignment, set for completion in 2026.

With our growing focus on minimising embodied carbon, **VSL Australia proactively sought opportunities to reduce the Fremantle Bridge's environmental footprint.** A key objective was identifying **a greener alternative for the stay cables without compromising structural integrity or project timelines**.

The solution: a partnership for sustainability

Our VSL teams identified **a lower-carbon strand option** offered by a leading supplier. This innovative solution presented a compelling opportunity to significantly decrease the project's carbon emissions.

Through close collaboration with the client, VSL effectively demonstrated the advantages of the lower-carbon solution. The client recognised the value of this sustainable approach and agreed to a cost-sharing partnership, **underscoring a mutual commitment to environmental stewardship**.

> For VSL, in 2024, strand emissions represented 48% of the total emissions. There is a huge variation in strand emissions depending on the supplier from 2.9 to 0.6 tCO2e/t of strands. By choosing the right supplier we can reduce the strand emissions by more than 70%.

Laura Perigaud,
VSL International Chief Climate Officer

David O'Donnell,
General Manager at VSL Australia,
points out:

> Our client was really positive when we put this idea to them. They could see that the trade off between dollars versus sustainability benefits that we had presented very much pointed to the greener option being a great option. Getting them on board was made possible because of the strong working relationship we had developed with them, the understanding that we share many values, and the mutual trust that was already established between us. Once their sustainability team had reviewed the carbon reduction calculations they did not hesitate. Going through this process has only strengthen our relationship with this particular client and has given us at VSL Australia renewed confidence that our key clients understand that sustainability isn't just about numbers, but is also about trust and partnership.

The impact: a remarkable 67% reduction in emissions

The transition to lower-carbon strands will result in **a remarkable 67% reduction in emissions associated with the bridge's stay cables strands**. By proactively pursuing lower-carbon alternatives and cultivating strong client relationships, our teams are advancing environmental responsibility within the industry.

SUSTAINABLE INNOVATION LEADERSHIP

Innovation lies at the core of our culture and is pivotal to our achievements at VSL. We are dedicated to leading the way in establishing globally relevant and state-of-the-art technologies, continually pushing the limits to create increasingly sustainable structures. Addressing today's pressing concerns, the longevity, preservation, ease of repair, and ability to upgrade structures are ingrained in our R&D approach for innovative technologies.

01.

Smart PT: the evolution of post-tensioning with real-time monitoring

As a protection standard for post-tensioning (PT) systems, Protection Level 3 (PL3) was established by Fib in 2005, alongside PL1 and PL2, to both validate and monitor long term tendon encapsulation and corrosion protection. Now, VSL is taking PT monitoring to the next level with Smart PT, an innovative solution that enables continuous, real-time tracking—a true game-changer for structural engineering.

Since the 2010s, VSL has implemented PL3 in multiple countries, including Switzerland, the US, Hong Kong, and other parts of Asia. While based on PL3's proven principles, Smart PT is a new concept that **integrates continuous monitoring, enhancing structural integrity and reducing maintenance costs**.
By combining PL3's protective function with real-time tracking of post-tensioned cables, **Smart PT eliminates the need for frequent on-site measurements—making maintenance more efficient and cost-effective**.

Smart PT already in action

Smart PT is available to VSL clients and has already been deployed on the **High-Speed Railway 2 (HS2)** project in the UK in 2025.

ZOOM

Key benefits of Smart PT

The introduction of Smart PT brings several major advantages:

- Continuous monitoring of post-tensioned cables
- Structured and real-time data collection
- Automated alerts and early maintenance actions
- Reduced long-term maintenance costs through data-driven decision-making

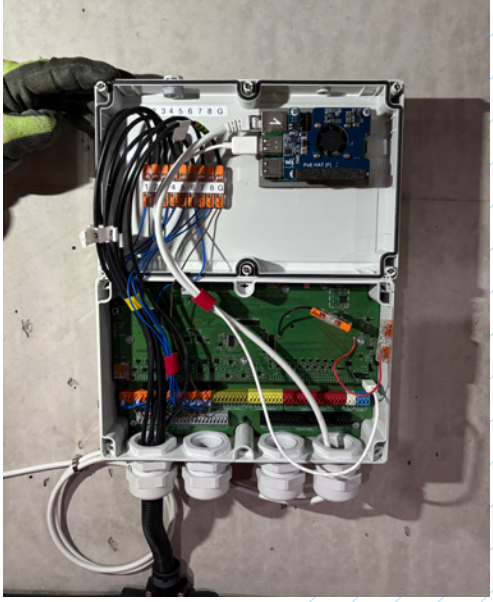
These advances empower engineers with real-time insights, improving structural integrity and long-term maintenance planning.

Marwan El Jamous, Project Director, explains:

> On the HS2 project, we have installed five monitoring Data Acquisition Units along the Colne Valley Viaduct. These units enable both instant and long-term monitoring of 35 post-tensioning cables located in representative and critical sections of the bridge. They were developed jointly by VSL International's VSL Technology Business Line and an independent laboratory, in close coordination with the client, to ensure full integration into the project's global monitoring system.

Easy installation & retrofit capabilities

One of Smart PT's greatest advantages is its easy implementation. **The system can be retrofitted on existing structures that already have a PL3** system, following a technical assessment. Because the tendon itself acts as a sensor in a PL3 system, all that's required is to install the monitoring device and establish an internet connection—making it a straightforward and cost-effective solution.



Monitoring data acquisition unit

Coming soon: an upgraded version combining PT and grout monitoring

A more advanced version of Smart PT is currently under development. This upgrade **will integrate VSL's Void Control (VC) sensors, which are currently used only during grout injection**.

Today, VC sensors operate as a separate system, but the upcoming version will combine PT and grout monitoring into a **single integrated solution—simplifying setup, reducing costs, and enhancing overall reliability**. The expected commercial release for the VC sensor-integrated version is early 2026.

With Smart PT, post-tensioning enters a new era, offering enhanced reliability, reduced intervention needs, and optimised long-term costs—a revolution for the future of structural engineering!

Colne Valley Viaduct, High-Speed 2 (HS2), UK

OVERVIE

/ TWENTYFOUR

NEW STRUCTURES

As a specialist in post-tensioned and cable-stayed structures, foundations and ground engineering, VSL contributes to the design and construction of major engineered structures.

TRANSPORT INFRASTRUCTURE

BUILDINGS

INDUSTRIAL & ENERGY-GENERATING STRUCTURES

LOW-CARBON SOLUTION

LOW-CARBON INFRASTRUCTURE

TRANSFORMING CONNECTIVITY IN GREATER WESTERN SYDNEY WITH A METRO LINE

MORE DETAILS PAGE **69**

WATCH THE FILM

AUSTRALIA

Sydney Metro - Western Sydney Airport - Surface and civil alignment works (SCAW)

The new Sydney Metro – Western Sydney Airport line will serve as a vital transport link for Greater Western Sydney. VSL Australia was entrusted with the contract for deck construction of 3.2 kilometres of elevated viaduct. One key challenge was erecting the viaduct over a major water pipeline, which created scheduling constraints.

- Manufacturing of precast segments and delivery to site
- Design of temporary works
- Deck erection
- Post-tensioning

OFFERING INNOVATIVE SOLUTIONS FOR A COMPLEX PROJECT

MORE DETAILS PAGE **72**

CZECH REPUBLIC

D6 Krupá Highway Bridge

As part of the D6 motorway linking Prague to Germany's western border, the new Krupá highway bridge was key to improving regional traffic. The 830-metre-long concrete structures were built in situ and required extensive post-tensioning. VSL's expertise guaranteed the structural integrity and long-term durability of the twin bridges. Despite tight deadlines, each of the 23 spans was successfully completed within just two weeks as required by the programme.

+ Supply and installation of VSL PT system, protection level PL2

MASTERING POST-TENSIONING FOR AUSTRIA'S MOST SIGNIFICANT HIGHWAY BRIDGE

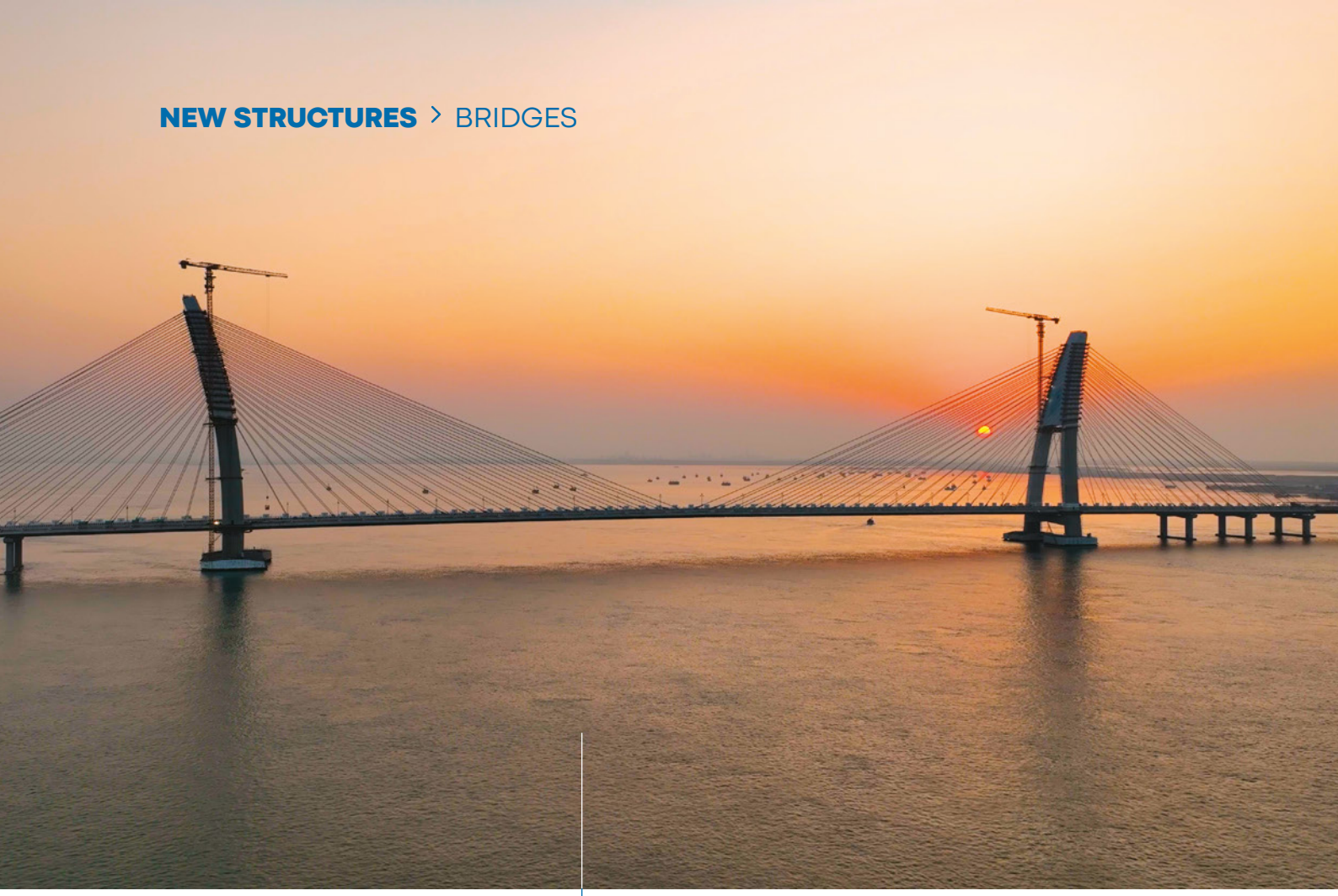
MORE DETAILS PAGE **73**

AUSTRIA

Aurach Bridge

As part of the construction of a new bridge parallel to the one to be demolished, VSL Switzerland supplied and installed the post-tensioning system. VSL's site team focussed on closely following the schedule set by the main contractor, so that there was no delay to the main operations such as pouring concrete and launching form travellers that were on the critical path.

+ Supply & installation of PT system



BUILDING A NATIONAL LANDMARK: THE COUNTRY'S LONGEST CABLE-STAYED BRIDGE

MORE DETAILS PAGE 75

INDIA

Sudarshan Setu Bridge

Inaugurated on 25 February 2024, the Sudarshan Setu is India's longest cable-stayed bridge.
VSL India was responsible for erecting bridge segments, supplying and installing the cable-stayed structure with its sculptural composite pylon, and implementing a structural health monitoring system.

- Supply and installation of the cable-stayed structure
- Implementation of structural health monitoring system
- SLU jack operation for segment lifting

BUILDING A MAJOR CABLE-STAYED BRIDGE ON INDIA'S NEW RAILWAY TO KASHMIR

MORE DETAILS PAGE 77

LOW-CARBON INFRASTRUCTURE

INDIA

Anjikhad Railway Bridge

VSL India supplied and installed the cable-stayed structure, including the pylon, for a major bridge connecting Kashmir to India's national railway network.
With a height of 196 metres, the Anjikhad Railway Bridge connects two tunnels across a deep ravine, and its 290-metre-long main span makes it the longest cable-stayed span on Indian Railways.

- Supply and installation of the cable-stayed structure
- Supply and installation of pylon
- Supply and installation of monostrand load cells
- Natural frequency test and dynamic load test

LOW-CARBON SOLUTION

BUILDING A TECHNICALLY COMPLEX CABLE-STAYED BRIDGE

MORE DETAILS PAGE **79**

INDIA

Santa Cruz-Chembur Link Road's cable-stayed bridge

As part of the Santa Cruz-Chembur Link Road extension in Mumbai, a new cable-stayed bridge was built to ease traffic congestion. VSL India supplied and installed its SSI 2000 stay cable system, overcoming key logistical and technical challenges while reducing the project's carbon footprint.

+ Supply & installation of the cable-stayed structure

PRECASTING AND ERECTING A KEY SEGMENTAL VIADUCT

MORE DETAILS PAGE **81**

INDIA

Ganga Path Expressway Bridge

Ganga Path is a new expressway crossing the Ganges River in Patna, Bihar. VSL India played a key role, designing and supplying segment casting moulds and a launching gantry, while overseeing the erection of a 6.12-kilometre-long precast segmental viaduct.
VSL's scope also included erecting 21 extra spans, post-tensioning, and lifting and lowering 20 spans to facilitate bearing installation.

- Supply, assembly & commissioning of launching gantry and casting cells
- Deck erection
- Supply & installation of post-tensioning
- Assembly and commissioning of launching gantry
- Supply & installation of post-tensioning
- Lifting and lowering of 20 spans for bearing installation
- Supply & installation of permanent plastic grout caps

BRINGING POST-TENSIONING EXPERTISE TO AIRPORT FACILITIES

MORE DETAILS PAGE 83

KUWAIT

Kuwait International Airport

Terminal II will expand the capacity of Kuwait International Airport to 25 million passengers annually. Building on a successful initial project, where VSL Middle East was responsible for the cable-stayed structure and post-tensioning of the terminal's iconic roof, in 2024 VSL provided post-tensioning design, material supply and installation supervision for construction of the bus bay roof structure and eight bridges.

- Engineering for post-tensioning, including design and shop drawings
- Supply of post-tensioning system
- Supervision of post-tensioning works

CONSTRUCTING A MAJOR BRIDGE DECK USING THE FREE CANTILEVER METHOD

MORE DETAILS PAGE **85**

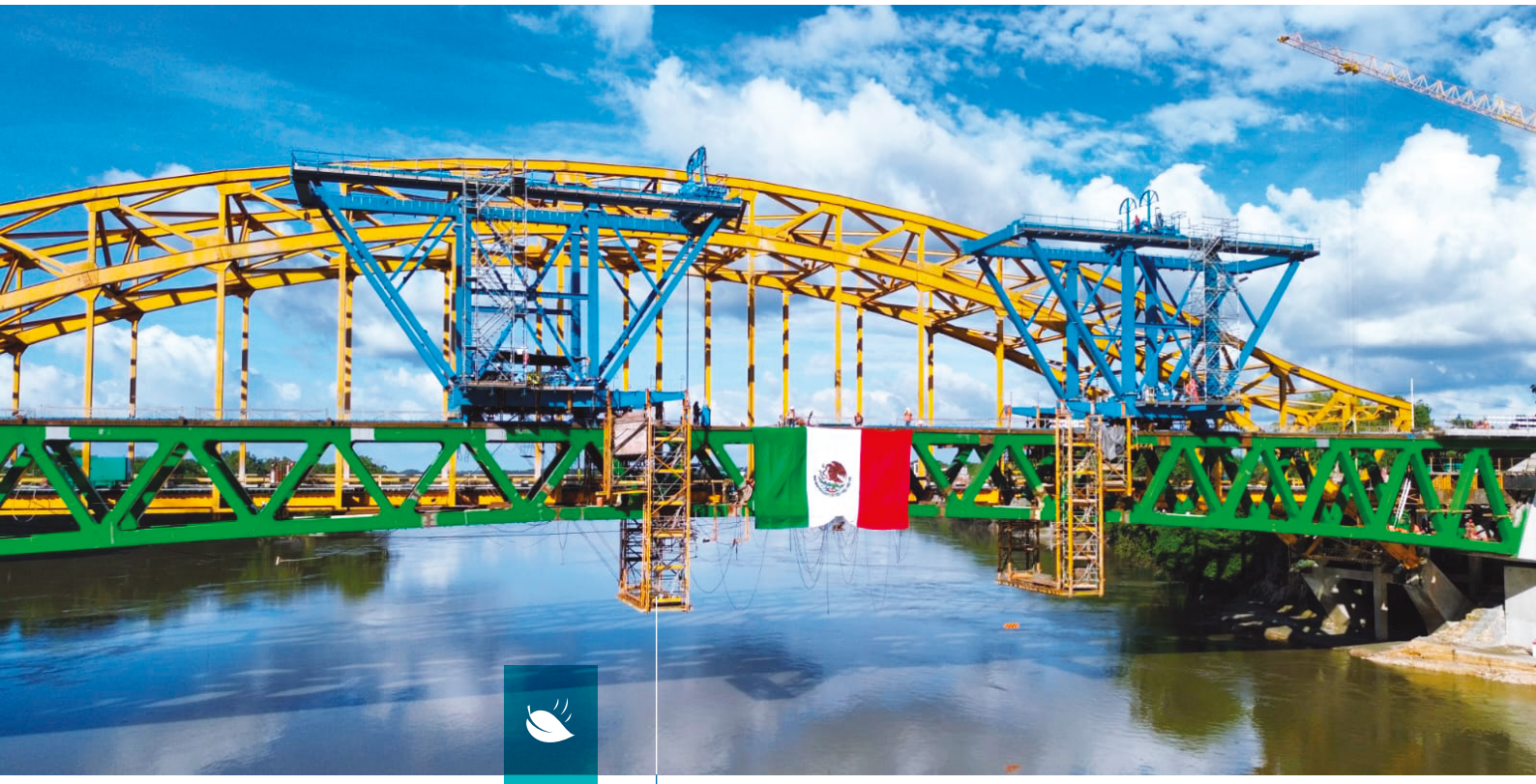
WATCH THE FILM

MEXICO

Las Truchas Bridge

Las Truchas Bridge, part of the Compostela–Las Varas Highway in Nayarit, Mexico, was built to improve regional mobility. VSL Mexico successfully constructed the 433-metre-long bridge deck using the free cantilever method, handling reinforcement installation, concrete pouring, and post-tensioning.

- Supply and operation of form travellers
- Steel reinforcement
- Concrete pouring
- Supply, installation and stressing of post-tensioning



LOW-CARBON SOLUTION

ERECTING A COMPLEX BRIDGE STRUCTURE WITH CUSTOMISED LIFTING SOLUTIONS

MORE DETAILS PAGE **87**

MEXICO

Boca del Cerro Bridge

A key part of Mexico's Tren Maya Project, the Boca del Cerro Bridge spans the 200-metre-wide Usumacinta River.
VSL provided a turnkey solution for the technically challenging project, designing, fabricating, installing, and operating two lifting frames to erect steel bridge segments of up to 100 tonnes in weight, and up to 10 metres in height.
This method proved efficient and was a lower-carbon alternative to using a 500-tonne crawler crane.

- Design, fabrication, transport, installation, and commissioning of two lifting frames
- Operation of lifting frames for steel segment erection
- On-site supervision and technical support for heavy lifting and launching operations

CONTINUING A LEGACY OF EXCELLENCE IN MEXICO'S RAIL INFRASTRUCTURE

MORE DETAILS PAGE **89**

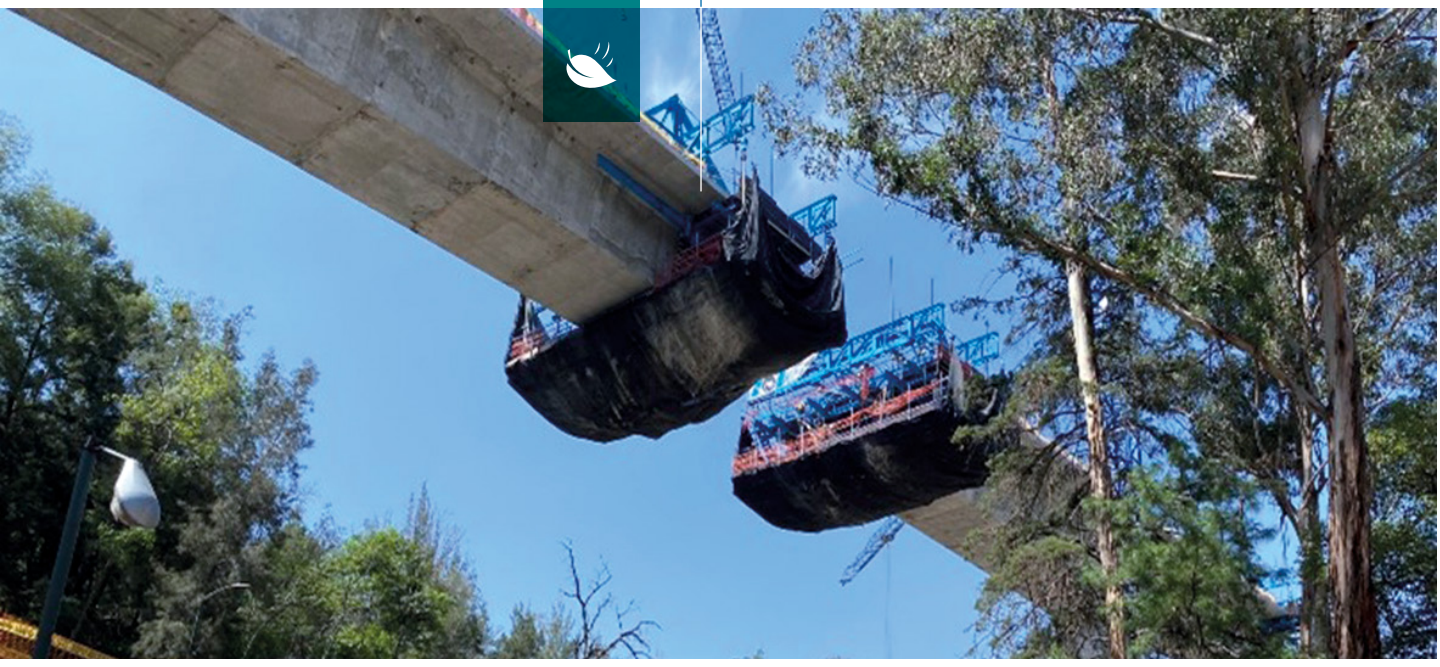
MEXICO

Mexico-Toluca Interurban Railway

After an initial contract to inspect and replace more than 1,000 bearings on the Toluca-Mexico City railway, VSL Mexico was hired for the construction of a critical double cantilever bridge. The technical demands of this project were significant. VSL was responsible for the supply and operation of launching gantries, as well as the supply and installation of post-tensioning.

- Rental of launching gantries
- Supply and installation of the post-tensioning system

LOW-CARBON INFRASTRUCTURE



BUILDING A BRIDGE COMBINING THREE CONSTRUCTION METHODS

MORE DETAILS PAGE **91**

POLAND

S6 Koszalin Bypass

VSL Poland played a key role in building a new bridge over a local road and railway as part of a motorway bypass project, employing specialist construction methods to deliver the most complex parts of the project. VSL used incremental launching and balanced cantilever construction for a 360-metre-long section and a 390-metre-long section, including a 130-metre-long railway span respectively, the rest was built by the main contractor using conventional scaffolding systems. VSL Poland provided and operated lifting equipment, and also supplied temporary bearings, installed the post-tensioning system, and lifted the bridge to replace temporary bearings with permanent ones.

- Supply and operation of launching equipment
- Provision of temporary bearings for launching
- Supply and installation of post-tensioning system
- Bridge lifting for bearing exchange

ADAPTING VSL SSI 2000 STAY CABLE SYSTEM TO FIT A SPECIFIC DESIGN

MORE DETAILS PAGE **93**

POLAND

Cable-Stayed Bridge over the Kamienna River

As part of the construction of a new cable-stayed bridge over the Kamienna River, VSL Poland was contracted to carry out a comprehensive scope of work, including supplying and installing the stay cable system, the post-tensioning system and the stressing bars for the pylon connection, as well as anchoring the pylon to the pier foundations.
A key challenge was the installation of forks as dead-end anchorages at the tower, a unique solution required by the bridge's unconventional design. To meet these demands, VSL adapted its SSI 2000 Stay-Cable system, replacing standard anchorages with forks and customising the installation process.

- Supply and installation of the cable-stayed structure
- Supply and installation of the post-tensioning system
- Supply and installation of stressing bars for pylon construction

CONTRIBUTING TO RIYADH'S BRAND-NEW THEME PARK

MORE DETAILS PAGE **94**

KINGDOM OF SAUDI ARABIA

Six Flags Qiddiya Theme Park - Pedestrian Bridge

In the expansive setting of the Six Flags Qiddiya Theme Park, VSL Saudi Arabia played a crucial role in the construction of a pedestrian bridge that will provide direct access for visitors to the new entertainment hub.
In an effort to reduce the project's carbon footprint, VSL implemented measures to minimise material wastage from both ducts and strands.

- Bearing supply
- Post-tensioning

MOVING A BRIDGE BY 30 METRES IN JUST SIX HOURS

MORE DETAILS PAGE **95**

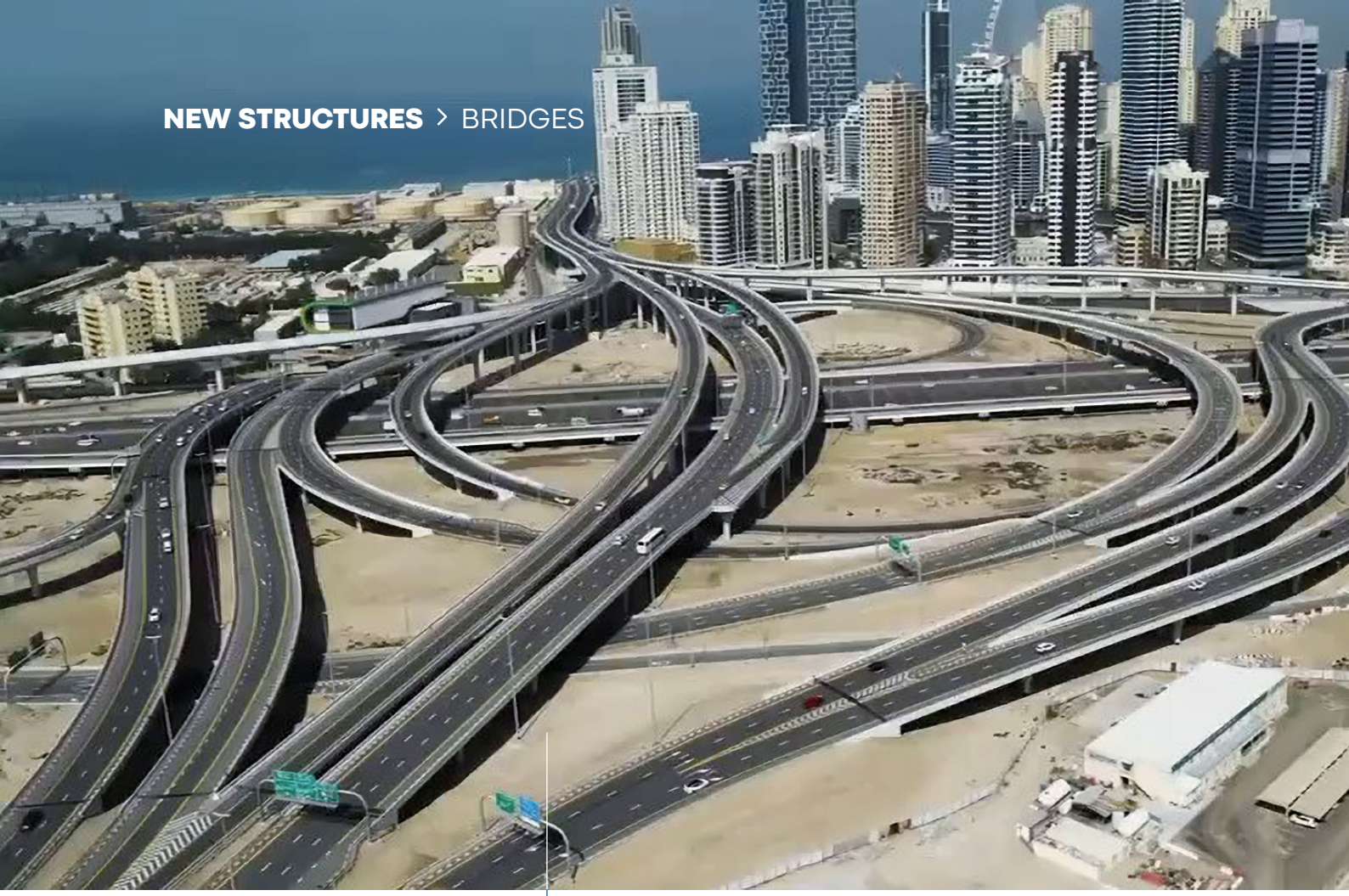
LOW-CARBON SOLUTION

SWITZERLAND

Neuville Underpass

The project to replace a level crossing required the construction of a new railway bridge so that road traffic would be able to pass beneath the railway line.
VSL Switzerland was involved from the tender stage to execute the skidding of the bridge, which was built offline and had to be moved 30 metres into its final position within a six-hour timeframe.

- Dimensioning of the cantilevers
- Skidding operations



PERFORMING THE POST-TENSIONING AND MSE WALLS FOR FOUR BRIDGES

MORE DETAILS PAGE **97**

UNITED ARAB EMIRATES

Garn Al Sabkha – Sheikh Mohammed Bin Zayed Road Intersection

To ease congestion and improve travel times, Dubai's Roads and Transport Authority proposed the Garn Al Sabkha – Sheikh Mohammed Bin Zayed Road Intersection Improvement Project, which includes four new bridges up to 960 metres long, designed to carry as many as 17,600 vehicles per hour. VSL Middle East was selected for its proven expertise in post-tensioning and MSE wall construction. The team delivered these specialised works across four sites - including two remote locations - successfully managing complex logistics and tight coordination.

- Engineering for post-tensioning, including design and shop drawings
- Supply of post-tensioning system
- Supervision of post-tensioning activities
- Engineering of MSE wall
- Supply of equipment
- Erection of the MSE wall panels and barriers

BUILDING TWO DIAPHRAGM WALLS IN A CONGESTED AREA TO CONSTRUCT TWO NEW METRO STATIONS

MORE DETAILS PAGE **99**

AUSTRALIA

Sydney Metro West

As part of its expansion, the City of Sydney is extending its metro train system with underground tunnels and stations. VSL Australia and Keller, as a joint venture, were hired to construct two diaphragm wall shafts that will serve as station boxes.
The two companies together designed the associated production plant for steel cages and concrete panel fabrication, as well as equipment for the works onsite.
KVJV developed a custom concrete mix to reduce carbon emissions by minimising cement use and optimised the cage design for the second shaft, halving the number of delivery trips to 288 because more of the smaller, lighter units could be carried on each truck.

Construction of metro station box shafts

LOW-CARBON SOLUTION

LOW-CARBON INFRASTRUCTURE

CONSTRUCTING DIAPHRAGM WALLS & BARRETTES UP TO 45M FOR MAJOR MELBOURNE INFRASTRUCTURE

MORE DETAILS PAGE **101**

AUSTRALIA

Melbourne North East Link
Bulleen Cut & Cover

The North East Link is Melbourne's largest transport infrastructure investment, featuring a 6.5-kilometre-long tunnel to complete the missing link in the freeway network.
The Keller-VSL Joint Venture was contracted to build a cut-and-cover structure, including a diaphragm wall and barrettes ranging from 20 to 45 metres deep. VSL played a key role as a leading diaphragm wall contractor in Australia.

Construction of diaphragm wall and barrettes

LIFTING TWO BRIDGES FOR A LANDMARK DEVELOPMENT

MORE DETAILS PAGE **104**

MALAYSIA

Oxley Towers

Close to the iconic Petronas Twin Towers in Kuala Lumpur, Oxley Towers KLCC development features three towers linked by a retail podium; two towers with hotel and residential accommodation, and an office tower. Drawing on high-profile references including the Petronas Towers and the Merdeka 118 Tower, VSL erected two link bridges to heights of 250 metres and 190 metres above ground, connecting the towers in this dense and vibrant area.

- Supply and installation of heavy lifting equipment
- Technical support for heavy lifting operation

LIFTING SIX SECTIONS OF A 31-METRE-LONG STRUCTURE TO 110 METRES ELEVATION

MORE DETAILS PAGE 105

THAILAND

Mochit Complex

The Mochit Complex, a landmark project in Bangkok, Thailand, features two high-rise buildings connected by intricate Sky Bridges. Spanning 31.4 metres between the towers, these bridges consist of 3.3-metre-deep steel floor trusses.
With a combined weight of 1,203 tonnes, the structures were lifted from ground level to a height of 110 metres in six separate pieces.
The operation required a precise balance of engineering expertise, meticulous planning, and flawless execution - challenges successfully handled by VSL Thailand.

- Design of temporary works
- Design checks of permanent structures subjected to transient loads during lifting
- Supervision of steel fabrication and installation
- Full-scale load test
- Heavy lifting operation

LIFTING KINGBRIDGE TOWER'S SKY LOUNGE 150 METRES FROM GROUND LEVEL

MORE DETAILS PAGE **107**

THAILAND

KingBridge Tower

The KingBridge Tower, a high-rise landmark in Bangkok, Thailand, required a complex and precise construction process. The cantilevered floor slab for the Sky Lounge demanded specialist expertise in heavy lifting and engineering to overcome several technical hurdles. VSL Thailand's scope included designing temporary structures, supervising steel fabrication and installation, and executing the heavy lifting and sliding operations for the floor truss segments.

- Design of lifting frames and sliding rail beams
- Supervision of steel fabrication and installation
- Heavy lifting

LOW-CARBON SOLUTION

BRINGING EXPERTISE IN DESIGN AND CONSTRUCTION OF A TRANSFER PLATE FOR A 31-STOREY BUILDING

MORE DETAILS PAGE 109

MALAYSIA

Dew Penang Condominium

VSL Malaysia played a key role in providing expertise in the design and construction of the transfer plate on level nine, over an area of 1,680 m². In this multi-storey building, the plate was designed to efficiently redistribute the loads between the walls and columns on adjoining levels that have different floor plans.
The optimised design also reduced the use of rebar, contributing to a lower carbon footprint.

+ Post-tensioning works including design, supply and installation

OPTIMISING UNDERGROUND MATERIAL EXTRACTION WITH SPECIALIST ANCHORING SOLUTIONS

MORE DETAILS PAGE 111

AUSTRALIA

Prominent Hill Mine Winder Building

As part of ongoing developments at the Prominent Hill Mine in South Australia, a winder building was constructed to support a new shaft system that would increase the efficiency of material extraction compared to traditional open-pit mining.
VSL Australia was chosen for its expertise in delivering technical projects in challenging, remote conditions, and was tasked with drilling, installing, and testing deep anchors to ensure the building's structural stability.

- Drilling, supply, installation, and testing of strand anchor system

LOW-CARBON SOLUTION

DESIGNING AND BUILDING A POST-TENSIONING SLAB FOR A MANUFACTURING FACILITY

MORE DETAILS PAGE 113

MALAYSIA

Koa Denko Factory

VSL Malaysia was commissioned to design, supply, and construct post-tensioned slabs across four levels of Koa Denko Corporation's new facility. The team ensured effective load transfer after the slabs were cast and tensioned, while reducing materials, shortening cycle times, and minimising use of resources. Alongside design and consultation, VSL managed the full supply and installation of post-tensioning materials, ensuring efficiency and quality control.
The optimised PT design also reduced rebar use and concrete thickness, lowering the carbon footprint.

+ Design, supply & construction of post-tensioning slabs

BOOSTING PRODUCTIVITY WITH A CUSTOM PT DESIGN FOR VERTICAL POSTTENSIONING ANCHORAGES

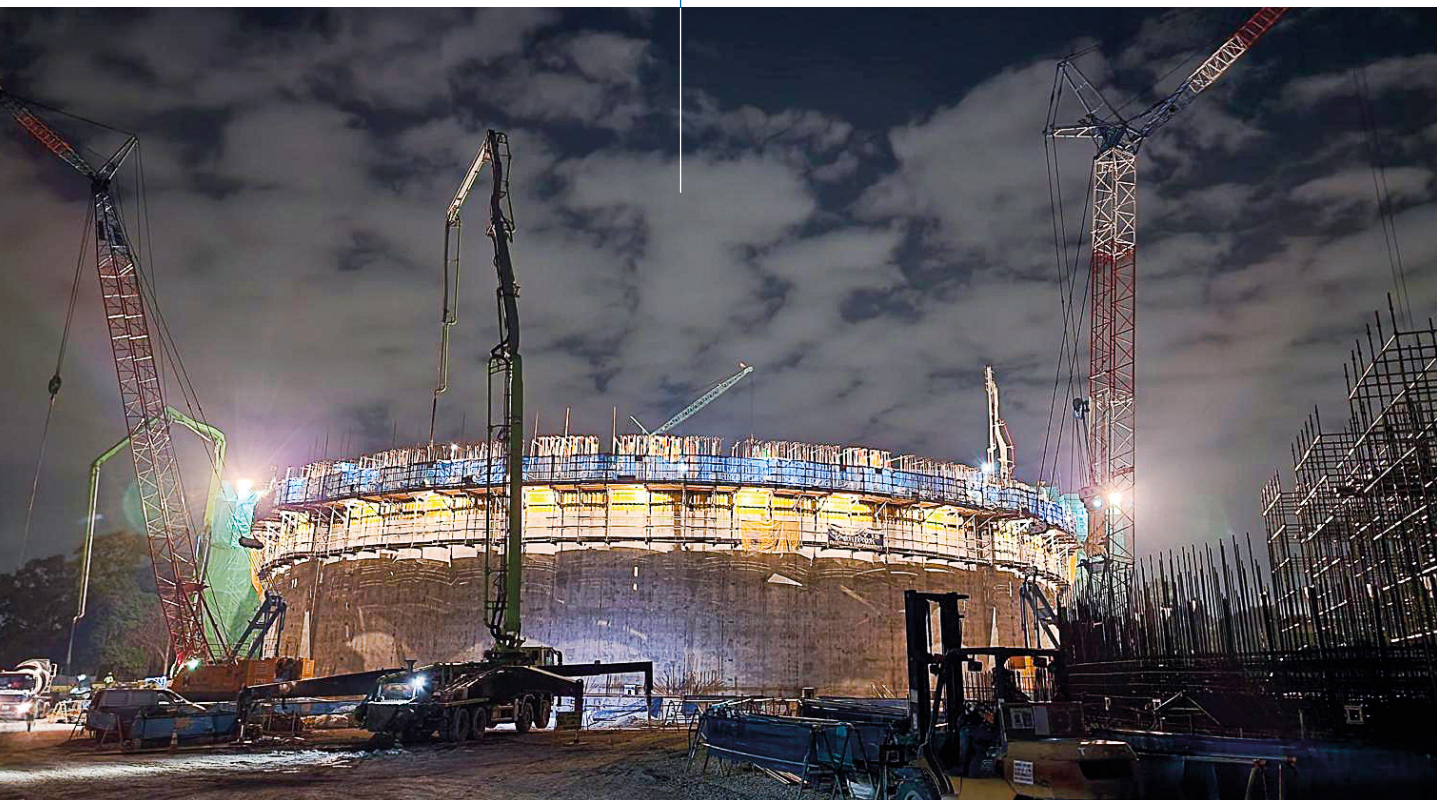
MORE DETAILS PAGE **115**

SINGAPORE

Bukit Batok road's Water Tank

VSL designed, supplied, and installed the post-tensioning system for two new water tanks commissioned by Singapore's Public Utilities Board, to increase storage capacity in the Tengah and Bukit Batok areas.
To address the tanks' complex geometry, VSL developed a customised PT solution featuring an innovative anchorage system that enhanced installation efficiency.
Our experience in large-scale water infrastructure projects, combined with close collaboration with all stakeholders, ensured the structural integrity and long-term durability of these essential assets.

- Design, supply and installation of post-tensioning systems for wall and slab of two water tanks.



LOW-CARBON ENERGY

OVERCOMING CHALLENGES WITH PRECISION ENGINEERING AND INNOVATIVE SOLUTIONS

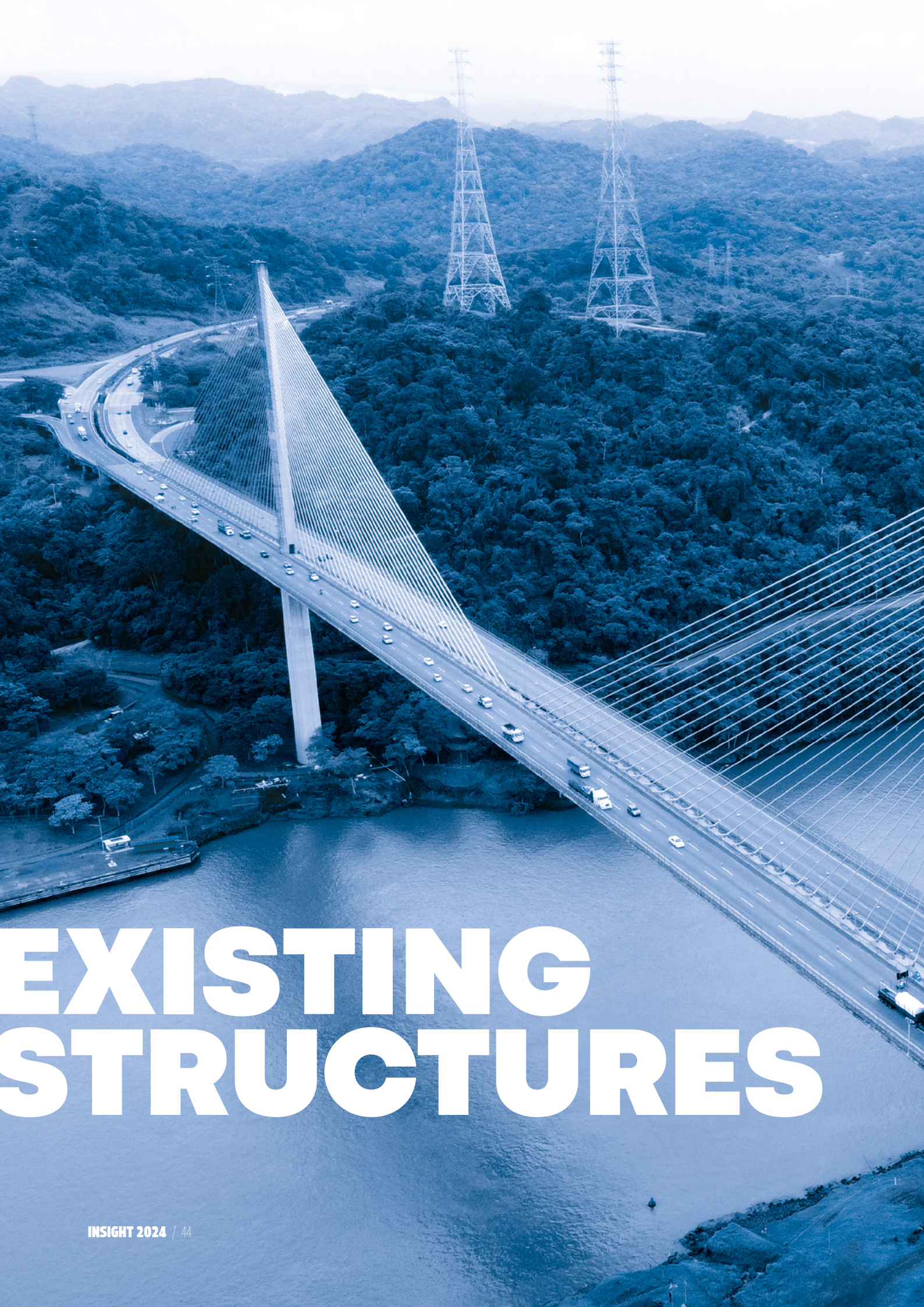
MORE DETAILS PAGE **117**

BRAZIL

Feijao Wind Farm

In 2024, VSL successfully completed a significant project at the remote Feijao Wind Farm in Araripina, Pernambuco, Brazil. The project involved two phases: the manufacturing and supply of 720 tendons for 80 wind turbine towers, along with their installation, stressing, and injection. Despite the remote location and logistical challenges, VSL leveraged its extensive experience and strong partnership with Nordex to deliver the project on time and within budget. By prioritising safety, efficiency, and sustainability, VSL contributed to the growth of Brazil's renewable energy infrastructure.

- Manufacturing and supply of external tendons
- Installation, stressing and injection of tendons



EXISTING STRUCTURES

VSL maintains, repairs and upgrades all the structural systems that guarantee the safety and durability of structures.

TRANSPORT INFRASTRUCTURE

INDUSTRIAL & ENERGY-GENERATING STRUCTURES

STRATEGIC PLANNING FOR A COMPLEX RESTORATION PROJECT

MORE DETAILS PAGE 121

LOW-CARBON SOLUTION

AUSTRALIA

West Gate Bridge Pier 13

VSL Australia was commissioned to carry out critical repair and restoration work on pier 13 of the West Gate Bridge in Melbourne. This project was essential to improve the durability and ensure the safety of the structure.
The work involved removing the existing protective coating, carrying out concrete repairs, and applying an advanced protective coating to prevent environmental and structural deterioration.

- Design and installation of access and working platform
- Concrete repairs and crack injection
- Removal, disposal, and reapplication of the protective coating system

AN INNOVATIVE, SAFE, AND EFFICIENT DE-TENSIONING TECHNIQUE FOR CABLE-STAYED BRIDGE REPLACEMENT

MORE DETAILS PAGE 123

WATCH THE FILM

GERMANY

Duisburg-A40 Rheinbridge Neuenkamp

The 802-metre-long Duisburg-Neuenkamp Bridge, which is Germany's longest span cable-stayed bridge, carries the A40 over the Rhine near Duisburg. As part of the project to replace the aging structure and double its capacity, VSL Switzerland was contracted to supply and install stay cables, including Germany's first friction dampers.
So that the old bridge could be safely dismantled, the loads had to first be removed. VSL Switzerland was responsible for de-tensioning and removing 108 stay cables during 54 operations over six five-day periods. To enhance both safety and performance, VSL introduced an innovative solution and specialist methods.

- Supply & installation of the cable-stayed structure
- Deck erection: incremental launching of the side spans and heavy lifting of main-span's free cantilevered steel segments
- De-tensioning the existing cable-stayed structure

REHABILITATING THE MONITORING SYSTEM FOR THE 9.4 KILOMETRES HONG KONG LINK ROAD VIADUCTS

MORE DETAILS PAGE **125**

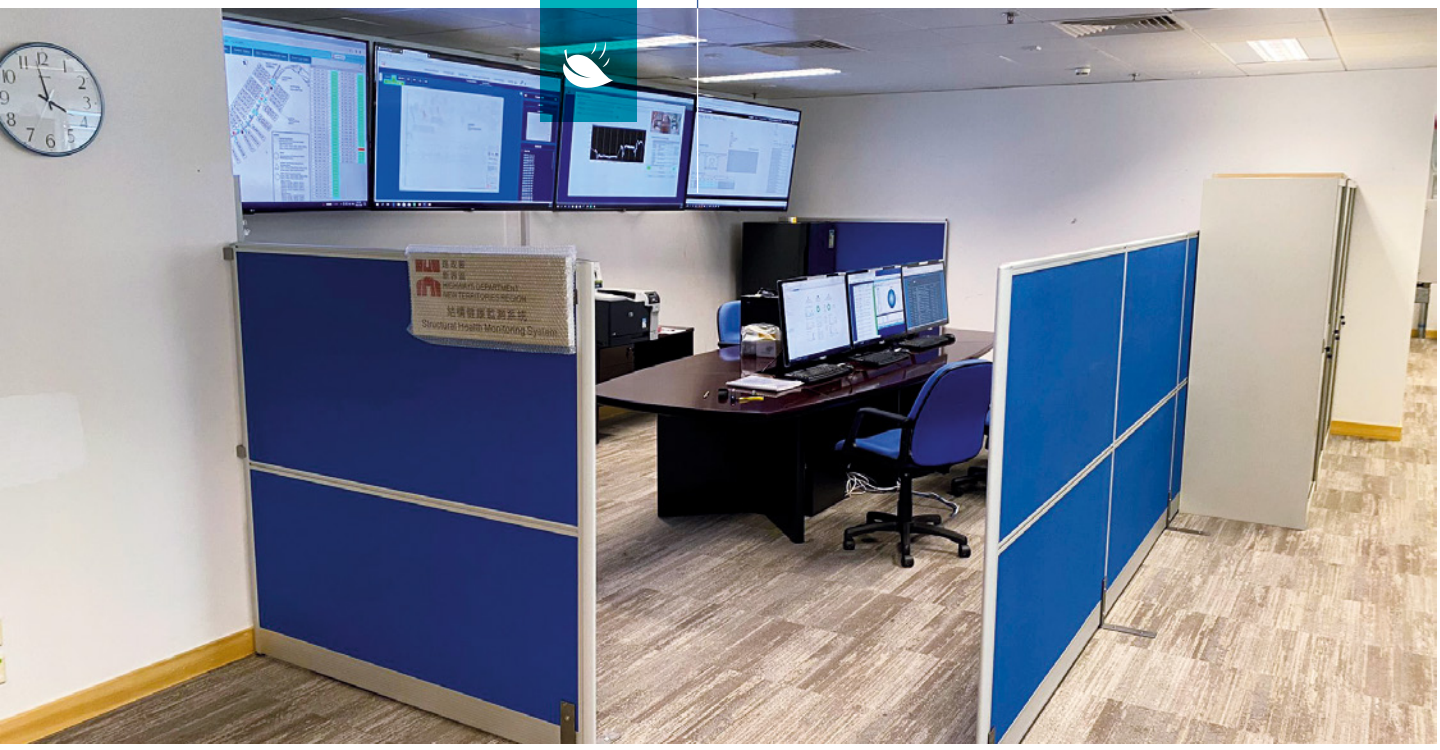
HONG KONG

Hong Kong Link Road

VSL Hong Kong rehabilitated the smart structural health monitoring system on 9.4 kilometres of land and marine viaducts that form part of the Hong Kong Link Road, that has been in operation since 2019. The team implemented a comprehensive rehabilitation strategy to enhance its long-term performance and reliability.

- Condition survey and rectification plan
- Supply and replacement of defective parts & equipment
- Reconfiguration of software
- Rebuilding of database and user interface
- Testing and commissioning

LOW-CARBON SOLUTION



MODERNISING HONG KONG'S BRIDGE MONITORING SYSTEMS WITH INNOVATIVE TECHNOLOGY

MORE DETAILS PAGE **127**

HONG KONG

GPS Monitoring systems of long-span cable-supported bridges in Tsing Ma control area

A comprehensive overhaul of the aging GPS monitoring systems which had been in operation on three of Hong Kong's major bridges since 2000 was carried out to address equipment failures and maintain accurate structural health assessments.
VSL's team of experts was tasked with replacing outdated components, upgrading the communication network and installing advanced monitoring software.

- Supply and installation of GPS equipment
- Communication network upgrade
- Server and workstation setup
- Software development and implementation
- Removal of old equipment

ASSESSING STRUCTURAL INTEGRITY OF A VITAL INFRASTRUCTURE ASSET

MORE DETAILS PAGE **129**

KINGDOM OF SAUDI ARABIA / BAHRAIN

King Fahd Causeway

Completed in 1986, the King Fahd Causeway is a key 25-kilometre-long highway link between Saudi Arabia and Bahrain. To ensure the bridge's continued safety and reliability, a comprehensive inspection of the post-tensioning system was necessary to assess its condition, identify potential problems and take action to address them.

- GPR scanning
- Inspections
- Crossbow testing
- UPE scanning
- Lab testing
- Advanced data processing by Bridgology
- Report

LOW-CARBON SOLUTION

LOW-CARBON INFRASTRUCTURE

PROVIDING EXPERTISE IN STRUCTURAL ASSESSMENT AND AEROTRAIN GUIDEWAY RENOVATION

MORE DETAILS PAGE 131

MALAYSIA

Kuala Lumpur International Airport - Aerotrain Guideway

As part of a project to replace the existing 20-year-old aerotrain at Kuala Lumpur International Airport, VSL Malaysia conducted a thorough structural assessment of the existing guideway structure, which includes 40 spans and bearings. The scope of the work extended to executing repairs of the cracks and spalling that were identified, with a focus on achieving the structural integrity necessary to accommodate the new aerotrain system.
VSL reused as much of the existing structure as possible through strategic repair and replacement. This not only contributed to a reduced carbon footprint but also optimised project timelines.

- Structural design assessment & bearing component checking
- Vibration and ride quality test
- Repairs & strengthening
- Bearing replacement

ASSESSING THE STRUCTURAL INTEGRITY OF A CABLE-STAYED BRIDGE

MORE DETAILS PAGE **133**

MALAYSIA

Sultan Abdul Halim Muadzam Shah Bridge (Penang 2 Bridge)

VSL Malaysia carried out a comprehensive inspection of the cable-stay systems of Malaysia's longest bridge, one of the region's key transport infrastructure links. The inspection was carried out in a challenging environment, requiring strict adherence to safety protocols in a high-security working area, amidst busy traffic and against adverse weather conditions.

+ Inspection of the cable-stayed structure

SAFEGUARDING AN ICONIC BRIDGE OVER THE PANAMA CANAL WITH A COMPREHENSIVE INSPECTION

MORE DETAILS PAGE 135

PANAMA

Puente Centenario

Spanning the Panama Canal, the Centenario Bridge was subjected to a meticulous inspection and subsequent maintenance project led by VSL, in order to assess the bridge's overall condition and safeguard its longevity. To tackle the complex project, VSL Mexico used state-of-the-art technology and innovative solutions. A sophisticated array of tools and techniques was deployed for a thorough examination of the bridge's intricate components, including anchorages, stay cables, external post-tensioning tendons, bearings, and auxiliary ventilation systems.

- Inspection of anchorages and stay pipes, external PT tendons and bearings
- Cleaning of the stay pipes
- Anti-vandalism protection refurbishment

FROM INITIAL REPAIRS TO THE FINAL STRENGTHENING OF THE VIADUCT

MORE DETAILS PAGE **137**

LOW-CARBON SOLUTION

PORTUGAL

Viaduct EN308

Three years after uncovering significant pier foundation issues during a successful repair contract on viaduct EN308, VSL Portugal was hired to repair and reinforce the piers. VSL's expertise in external post-tensioning was crucial in addressing the severe cracks that were found in the columns and deck piers, as well as treating the visible deterioration and underlying foundation problems.

- Concrete repairs
- Painting
- Abutment drainage repairs
- Waterproofing
- Bearing replacement
- Excavation
- Pier foundation reinforcement and repairs

LOW-CARBON SOLUTION

STRENGTHENING A VITAL CONNECTION USING INNOVATIVE REINFORCEMENT TECHNIQUES

MORE DETAILS PAGE 139

PORTUGAL

Zêzere Bridge

Built in 1993, the Zêzere Bridge, a concrete arch rising 60 metres above the Zêzere River water level, connects the Portuguese municipalities of Ferreira do Zêzere and Vila de Rei. The recent structural repair and reinforcement intervention delivered by VSL, stands out as an example of specialist engineering on a complex structure. The project, which started on June 14, 2023, included strengthening by additional post-tensioning, deck reinforcement by concrete overlay, the replacement of structural components and large-scale concrete repairs as well as improvement to the abutments, paving and drainage works.

- External and internal post-tensioning
- Reinforcement of the deck, carbon fibre and concrete deck overlay
- Replacement of bearings, safety barriers and expansion joints
- Protection and reinforcement of slopes and drainage works
- Crack injection and concrete repairs
- Surface coating
- Deck waterproofing and new pavement

SINGAPORE

Sentosa Express monorail Track

SECURING CONTINUED OPERATION THROUGH TARGETED BEARING REPLACEMENT

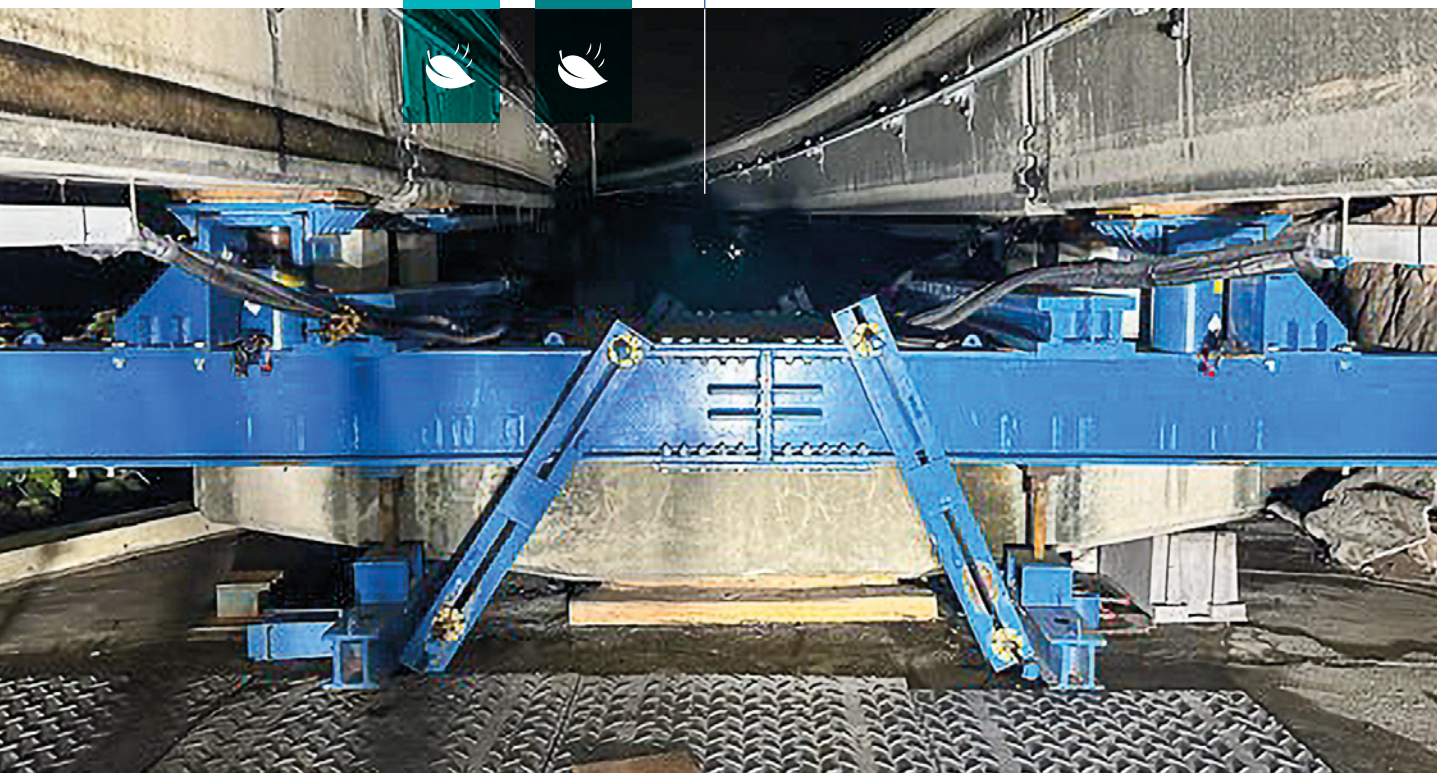
The Sentosa Development Corporation, responsible for the safety and operations of the Sentosa Express monorail, engaged Hwee Wah Engineering Pte Ltd, which partnered with VSL to replace critical guided pot bearings on piers at each end of the railway line. VSL conducted detailed surveys, custom designed and fabricated new bearings, and executed precise replacements under operational constraints, using advanced techniques to minimise disruption and ensure the long-term safety and efficiency of the facility.

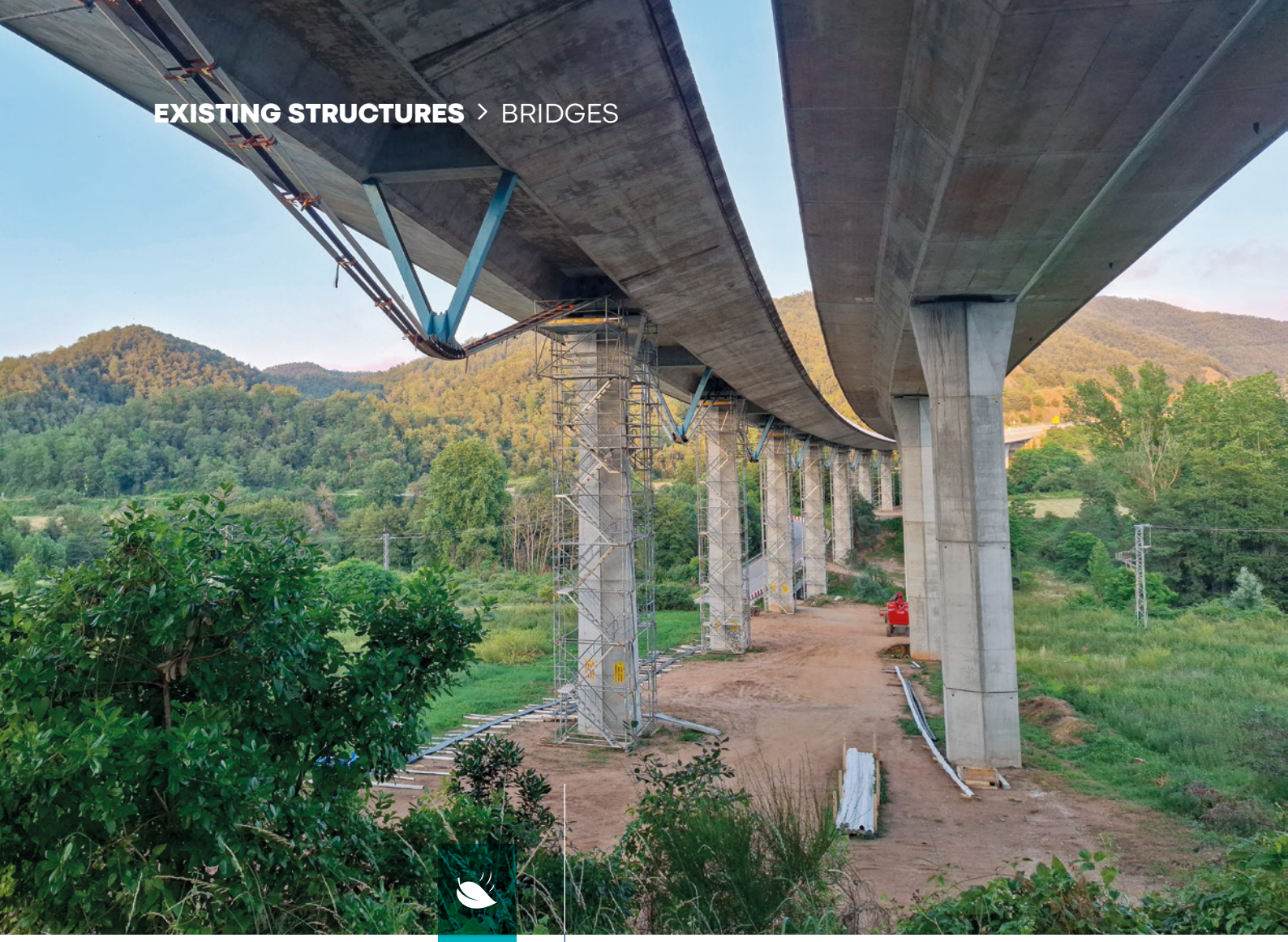
MORE DETAILS PAGE **141**

- Design and execution of pre-condition and post-condition surveys.
- Design and fabrication of guided pot bearings and brackets.
- Replacement of bearings and alignment checks

LOW-CARBON SOLUTION

LOW-CARBON INFRASTRUCTURE





LOW-CARBON SOLUTION

REPLACING EXTRADOSED TENDONS OF AN ICONIC UNDER-DECK CABLE-STAYED BRIDGE

MORE DETAILS PAGE **143**

SPAIN

Road Viaduct over the Osormort River

After conducting a special inspection of the 509-metre-long Osormort Viaduct, which revealed severe tendon corrosion threatening structural safety, VSL Spain was contracted to carry out specialist replacement works. This included installing temporary tendons, de-stressing and dismantling existing tendons, temporary/service monitoring, and installing new tendons and replacing pot bearings on the abutments.

- Replacement of extradosed tendons including de-stressing of damaged tendons

SPAIN

Requejo Viaduct – A52 Motorway

EMERGENCY BRIDGE REPAIR: LEADING THE PROJECT AS THE MAIN CONTRACTOR

After slippage of some of the elastomeric bearings on the Requejo Viaduct, several deck girders were displaced onto the concrete mortar plinths and, ultimately, the bent of the deck slab, creating a 100 millimetre step in the asphalt. In response, the Spanish Ministry of Public Works launched an emergency contract, appointing VSL as the main contractor to inspect and repair the bridge, carry out bearing replacement, and restore it to a safe working condition.

- Strengthening of girder web and pier caps
- Replacement of expansion joints, neoprene bearings, and bridge drainage system

MORE DETAILS PAGE 145

LOW-CARBON SOLUTION

LOW-CARBON SOLUTION

LOW-CARBON INFRASTRUCTURE

DELIVERING SEGMENT COUPLERS AND ELECTRICALLY-INSULATED POSTTENSIONING CABLES FOR A RAILWAY BRIDGE WITHIN A TIGHT TIMELINE

MORE DETAILS PAGE 147

SWITZERLAND

Geissloch Viaduct on the Solothurn–Moutier Railway Line

A 22-kilometre-long railway line in Switzerland had to be upgraded to meet new regulations, with steel bridge decks replaced by modern steel-concrete composites. The project required a six-week service suspension.
VSL Switzerland supplied nearly 400 bridge segment couplers, electrically-insulated prestressing cables and injection grouting, and supervised bridge fabrication, assembly, installation, and grouting on site.

- Supply of bridge segment couplers and insulated prestressing cables
- Injection grouting
- Prefabrication control and support for bridge segments
- Assembly and installation of insulated prestressing cables on site

ENSURING BRIDGE SAFETY AND STRUCTURAL INTEGRITY THROUGH MSE WALL REPAIR

MORE DETAILS PAGE **149**

UNITED ARAB EMIRATES

Marina Marsa Street MSE Wall

The project involved the restoration and repair of existing mechanically stabilised earth (MSE) wall panels to safeguard the structural integrity and safety of a bridge.
VSL Middle East was involved from tender stage to assess and restore the existing MSE wall panels, and implemented innovative solutions tailored to the specific requirements of the project. In particular, micro-concrete allowed the damaged areas to be precisely targeted and repairs executed efficiently.

- Visual inspection
- Replacement of damaged panels
- Crack injection
- Cementitious mortar repair

LOW-CARBON SOLUTION

LOW-CARBON SOLUTION

ENHANCING STRUCTURAL RESILIENCE: VSL'S INNOVATIVE SOLUTIONS FOR THE EXPANSION OF AL JIMI MALL IN AL AIN

MORE DETAILS PAGE 151

UNITED ARAB EMIRATES

Al Jimi Mall North - Al Ain

An ambitious expansion plan to integrate a new IKEA store into the mall added structural loads, particularly on the ground floor slab.
VSL Middle East was first contracted to assess the post-tensioned slab and develop an alternative strengthening solution to guarantee the structural integrity, safety, and stability of the building.
Following a successful assessment, VSL was appointed to execute the work, implementing a tailored strengthening solution using carbon fibre reinforced polymer to enhance the load-bearing capacity of the slab.

+ Design, supply, and installation of post-tensioned slab strengthening

A STRATEGIC INITIATIVE TO ENHANCE INFRASTRUCTURE LONGEVITY

MORE DETAILS PAGE 153

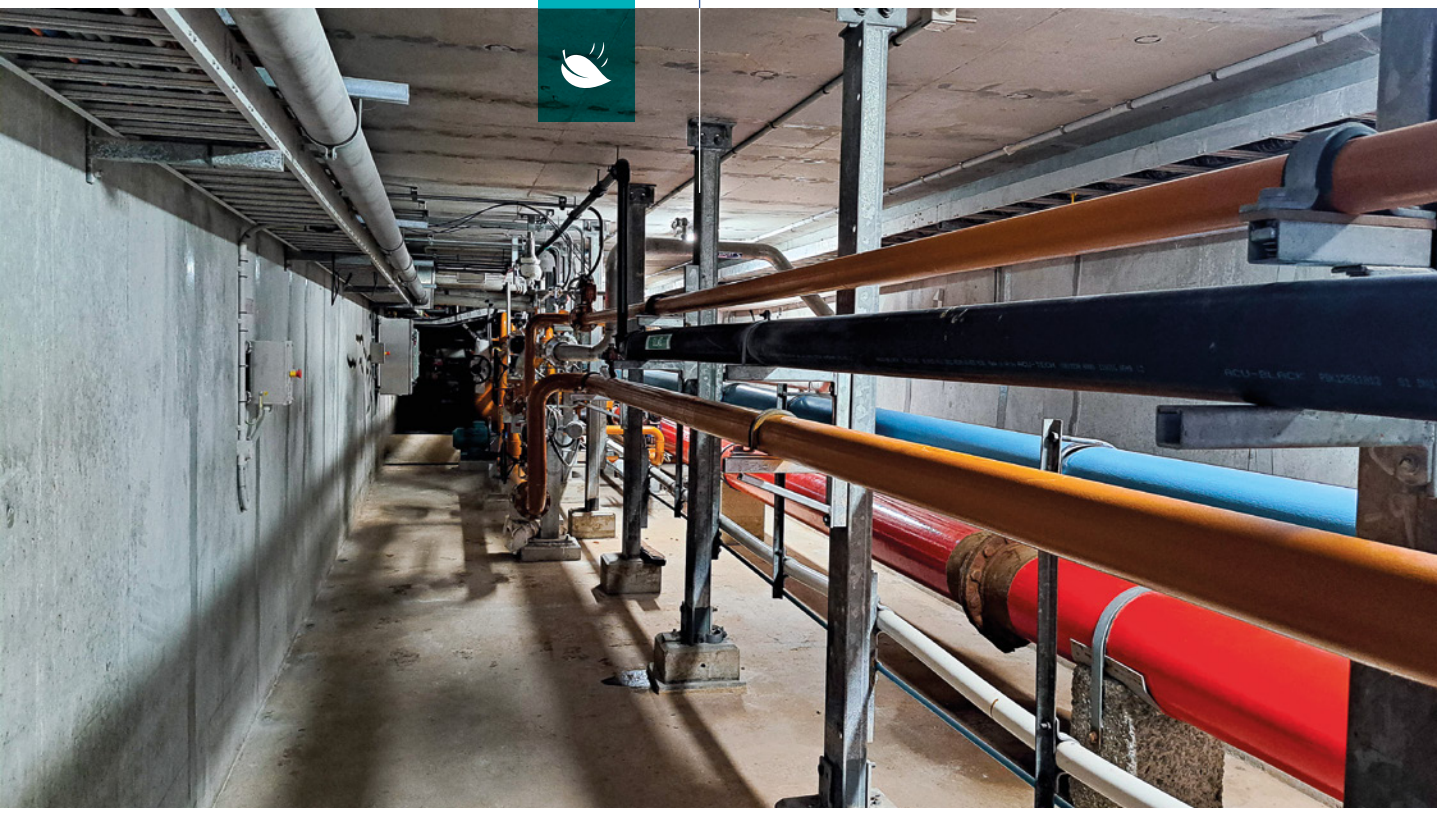
LOW-CARBON SOLUTION

AUSTRALIA

HMAS Stirling Service Utility Tunnel

VSL Australia carried out essential repairs on the service utility tunnel at HMAS Stirling naval base at Garden Island in Rockingham, WA. The tunnel had significant structural issues, including concrete cracks and spalling. VSL Australia's early involvement highlighted the complexity of the work, which required specialist concrete repair expertise.

- Inspection, assessment and recommendations
- Repairs



LOW-CARBON SOLUTION

RACING AGAINST TIME TO SAFEGUARD POZNAŃ'S ENERGY INFRASTRUCTURE

MORE DETAILS PAGE 155

WATCH THE FILM

POLAND

Karolin Pipe Bridge

Built in 1973, the Karolin Pipe Bridge carries four pipes that supply heat to a large population in Poznań. VSL Poland was hired to carry out a comprehensive repair programme, including structural reinforcement, corrosion prevention, concrete surface renovation, anti-corrosion protection for the steel structure, and, most importantly, the replacement of deteriorated collars on the bridge hangers.

- Renovation of the concrete surface of abutments and piers
- Restoration of the corrosion protection of the bridge deck soffit
- Replacement of the hanger collars

2024

INSIGHT

JOB REPORTS

/ TWENTYFOUR

SUMMARY

NEW STRUCTURES

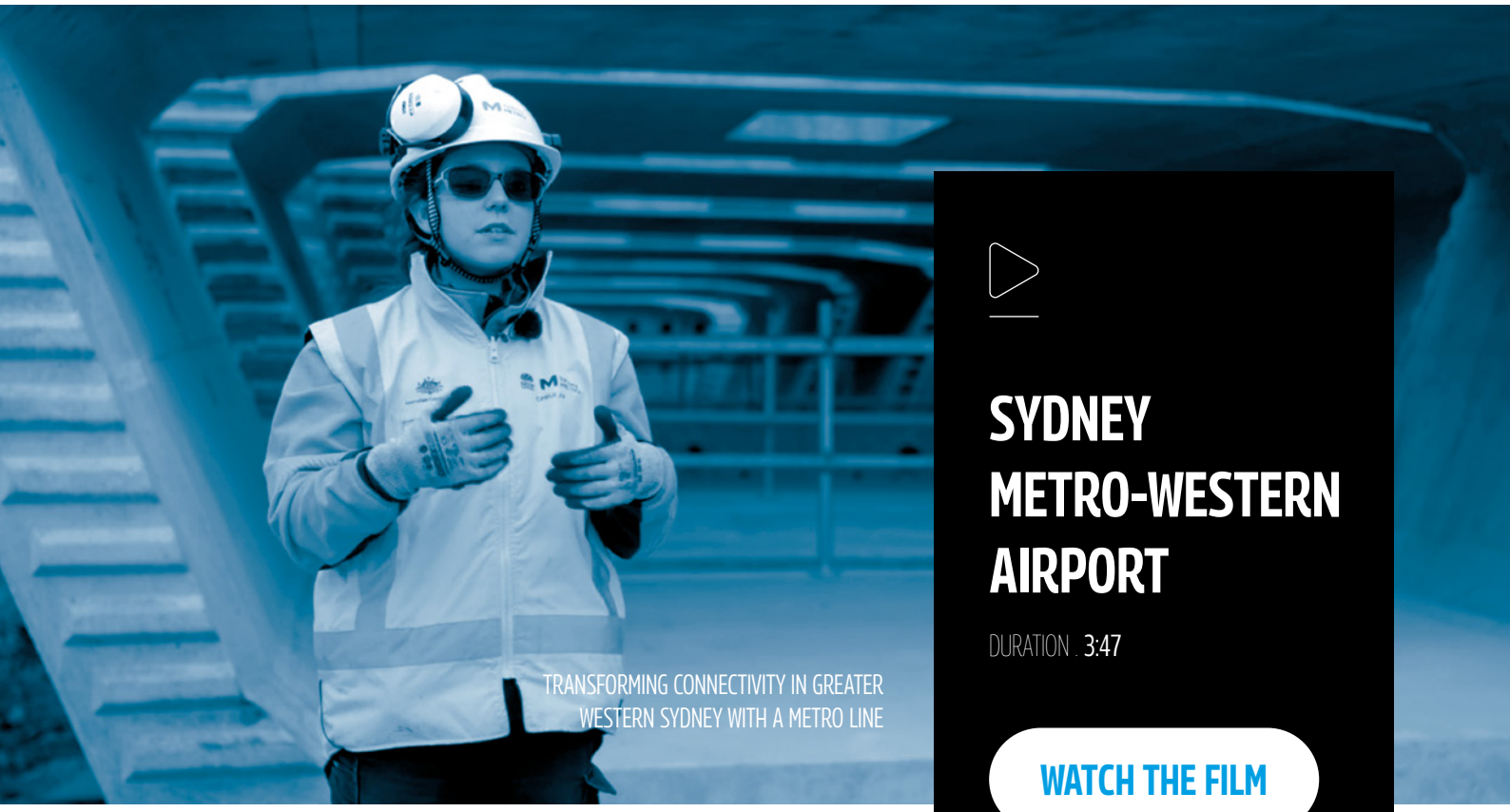
LAS TRUCHAS BRIDGE

DURATION . 4:12

WATCH THE FILM

CONSTRUCTING A MAJOR BRIDGE DECK USING THE FREE CANTILEVER METHOD

MÉXICO



SYDNEY METRO-WESTERN AIRPORT

DURATION . 3:47

WATCH THE FILM

TRANSFORMING CONNECTIVITY IN GREATER WESTERN SYDNEY WITH A METRO LINE

AUSTRALIA

SYDNEY METRO - WESTERN SYDNEY AIRPORT - SURFACE AND CIVIL ALIGNMENT WORKS (SCAW)

TRANSFORMING CONNECTIVITY IN GREATER WESTERN SYDNEY WITH A METRO LINE

The new Sydney Metro – Western Sydney Airport line will serve as a vital transport link for Greater Western Sydney, connecting communities and travellers to the new Western Sydney International (Nancy-Bird Walton) Airport and its rapidly expanding neighbourhood.

The Australian and NSW Governments awarded three significant contracts for the construction of the 23-kilometre-long railway. In March 2022, **CPB Contractors and United Infrastructure Joint Venture were awarded the contract to deliver approximately 10.6 kilometres of elevated viaduct, earthworks for track formation, rail bridges over the M12 motorway and within the airport, and associated works**.

VSL Australia was entrusted with the deck erection contract for 3.2 kilometres of elevated viaduct. The precast segments were prepared at a specialised precast yard established and managed by VSL in an alliance framework with CPB & United Infrastructure. Extensive use of **3D modelling ensured accurate assembly of the 1,101 rebar cages**, to meet the designer's specifications.

SCHEDULING CONSTRAINTS

One key challenge was erecting the viaduct over a major water pipeline, which created scheduling constraints. VSL and its alliance partners collaborated closely with WaterNSW to **programme construction during the low-demand winter months, minimising disruption to Sydney's drinking water supply**.

To address construction needs efficiently and minimise impact at ground level, **VSL employed a combination of**

DATE
2022 - 2024

LOCATION
Sydney, Australia

OWNER
Sydney Metro – Transport for NSW

MAIN CONTRACTOR
CPB Contractors and United Infrastructure Joint Venture.

ENGINEER / DESIGNER / CONSULTANT
Tony Gee & Partners (Superstructure), Aurecon Hatch Joint Venture

SCOPE OF WORKS

Manufacture and delivery to site of precast segments

Design of temporary works

Erection and post-tensioning of the deck superstructure using span-by-span methods

KEY FIGURES

- Number of structures: 3
- Total length of elevated viaduct: 3.2 kilometres
- Number of spans: 87
- Typical span length: 40 metres
- Number of precast segments: 1,101
- Total external post-tensioning: 1,164 tonnes
- Volume of concrete: 20,000 cubic metres
- Total reinforcement: 5,000 tonnes

falsework and an underslung temporary beam (UTB). The UTB was the primary method of erection, offering a faster cycle time of two to three days per span and reducing ground impact by bearing directly on columns.

Several innovative solutions were implemented to enhance safety, quality, and operational efficiency – starting at the precast yard where the 1,101 rebar cages were produced:

Innovations at the precast yard

- One key solution was the use of the **slice table for assembly of the reinforcement for the rebar cages**. Hydraulic jacks were employed to flip the table upward, enabling each rebar layer to be loaded into the jig. This innovation allowed for fast, repetitive assembly of rebar for each slice, with high accuracy; it also enabled the team to build the cages close to ground level instead of working at height in the mould. The precast yard was equipped with three operational slice tables and four master jigs for rebar cage assembly.
- **A new method and equipment was developed for handling the rebar cage into the mould before pouring concrete.** Once a rebar cage was removed from the assembly area, a forklift equipped with a prefabricated frame could easily scoop up the cage, replacing the need for traditional lifting frames.
- Lastly, a **straddle carrier, capable of lifting and moving segments** weighing up to approximately 70 tonnes, provided a safer and more efficient alternative to conventional cranes.

Innovations at the construction site

- **Modular access towers** were used instead of conventional scaffolding, **allowing for quick relocation and improved safety** across the various sites.
- **C-hook segment lifting beam:** At the start of the project, the team developed a C-hook for lifting the standard viaduct segments. This included four vertical jacks to secure the C-hook on the segment via the top slab, preventing the segment from moving out of position. A friction pad was also placed beneath the top slab, and a large hydraulic jack on top allowed for precise horizontal gradient adjustments, accommodating rotations of up to 3.5%. **This method eliminated the need for riggers to work at height to access conventional lifting attachments on top of the segments, as well as eliminating the need to manually handle heavy rigging equipment.** Additionally, inputs in the precast yard have been reduced; there are no inserts to install, nor additional rebar required to accommodate penetrations as would be necessary for a typical lifting arrangement. Further, finishing works on site become simpler with no full depth penetrations to form up and fill.

Sustainability through reuse

VSL Australia is committed to designing for multiple uses, which saves equipment, reduces costs, and lowers the embodied carbon of projects. For this project, the following equipment was reused:

- **Access tower:** This was the second iteration of this equipment, incorporating improvements from its initial design. The towers were reused at each of the 84 piers on the project for access to pier brackets, the UTB and the deck.
- **Underslung temporary beam:** This 250-tonne steel structure has been reused across multiple projects worldwide by VSL for the last 25 years, with minor adjustments made for project-specific needs.
- **Pier brackets:** Originally used on the Sydney Metro – North West project in 2016, these components were modified and reused for this project, resulting in the reuse of

over 100t of temporary steel work.

- **Segment lifting beam (pier segments):** This beam, made of more than 8 tonnes of steel, was reused for its third project to place the heavier pier segments in position.
- **Precast yard:** The same precast yard, previously used for the Hunter Expressway and WestConnex projects, was again repurposed for this project, reducing carbon emissions associated with building a new precast yard and facilitating a smooth and efficient start to construction.

This reuse strategy streamlined project timelines by eliminating the need to refabricate major equipment, delivering both economic and environmental benefits.

A total of 75 staff from VSL were mobilised for this project, working both on site and at the precast yard over the duration of the works. The work began in March 2022, with the first segment cast in March 2023 and the project successfully completed in November 2024.

To address construction needs efficiently and minimise impact at ground level, VSL employed a combination of falsework and an underslung temporary beam (UTB). The UTB was the primary method of erection, offering a faster cycle time and reducing ground impact.

The team developed a C-hook to lift standard viaduct segments, preventing segment movement and eliminating the need for riggers to work at height or handle heavy rigging equipment manually.

D6 KRUPÁ HIGHWAY BRIDGE

OFFERING INNOVATIVE SOLUTIONS FOR A COMPLEX PROJECT

The D6 Krupá highway bridge in the Czech Republic is part of the new D6 motorway, **a major transportation route that connects Prague to the country's western border with Germany** and is intended to provide an alternative route to the existing D5 highway. The bridge's construction was essential for improving regional connectivity and reducing traffic congestion on the D5.

Overcoming schedule challenges in a complex project

The bridge consists of **twin concrete structures built in place** using a movable scaffolding system and extending **830 metres across 23 spans**. Its construction required the installation of a significant amount of **post-tensioning** strands. The project presented a series of challenges, including the need to meet tight deadlines, ensure the highest quality standards and coordinate with other construction activities.

Meeting stringent deadlines while maintaining quality

Each span of the bridge had to be completed in a two-week timeframe, a task that required **meticulous planning** and **efficient execution**. Through careful coordination the project team successfully met these tight deadlines while maintaining the highest quality standards.

Construction of the D6 Krupá highway bridge project began in December 2022 and was completed in February 2024.

DATE
2022 - 2024

LOCATION
Krupá, Czech Republic

OWNER
Ředitelství silnic a dálnic ČR

MAIN CONTRACTOR / DESIGNER
Metrostav Infrastructure a.s.

ENGINEER
Společnost RDS D6 Krupá - M4 Road Design + SUDOP EU

DESIGNER
SUDOP EU a.s.

SCOPE OF WORKS
Supply and installation of VSL PT system, protection level PL2

KEY FIGURES
- Two highway bridges each 830 metres long
- Number of spans in each bridge: 23
- Total PC strands in each bridge: 220 tonnes
- Time taken for installation: 15 months
- Total number of bridge segments: 42
- Total PC strands in each segment: 10.5 tonnes
- Peak installation capacity: 42 tonnes of PC strands per month

AURACH BRIDGE

MASTERING POST-TENSIONING FOR AUSTRIA'S MOST SIGNIFICANT HIGHWAY BRIDGE

Rising to approximately 50 metres in height, the Aurach Bridge is **the highest bridge on Austria's West Autobahn**. At peak periods, it carries 50,000 vehicles daily, and is **the most important highway structure in Austria**, connecting the west and east of the country.

However, decades of use have left their mark on the structure. To ensure safe and smooth traffic flow in the coming decades, **the Aurach Bridge has been thoroughly renewed** by ASFINAG, the Austrian road authority.

In order to keep traffic flowing during construction, **a new bridge was built parallel to the first**, onto which the traffic was diverted. The existing superstructure carrying the Vienna-bound and Salzburg-bound carriageways, along with the piers, was dismantled and rebuilt on the same alignment. Finally, the Salzburg-bound deck was transversely shifted from the parallel bridge onto the new piers using hydraulic jacking systems.

VSL Switzerland was hired by the main contractor, a joint venture of PORR AG/HABAU to **supply and install the post-tensioning system for the bridges**.

The schedule set by the main contractor to carry out the post-tensioning was extremely tight, and **required careful optimisation of operations**.

Equipment and materials were prepared ahead of the start of the shift, with record sheets set up at the same time. VSL ensured that sufficient numbers of tools and sets of equipment were provided for the work, so staff could work to their full capacity.

DATE
2023 - 2025

LOCATION
Aurachkirchen, Austria

OWNER
ASFINAG (Road authorities of Austria)

MAIN CONTRACTOR
Joint Venture PORR AG/HABAU

ENGINEER
KMP

SCOPE OF WORKS

Supply & installation of PT system for internal tendons

Stressing & grouting of PT tendons

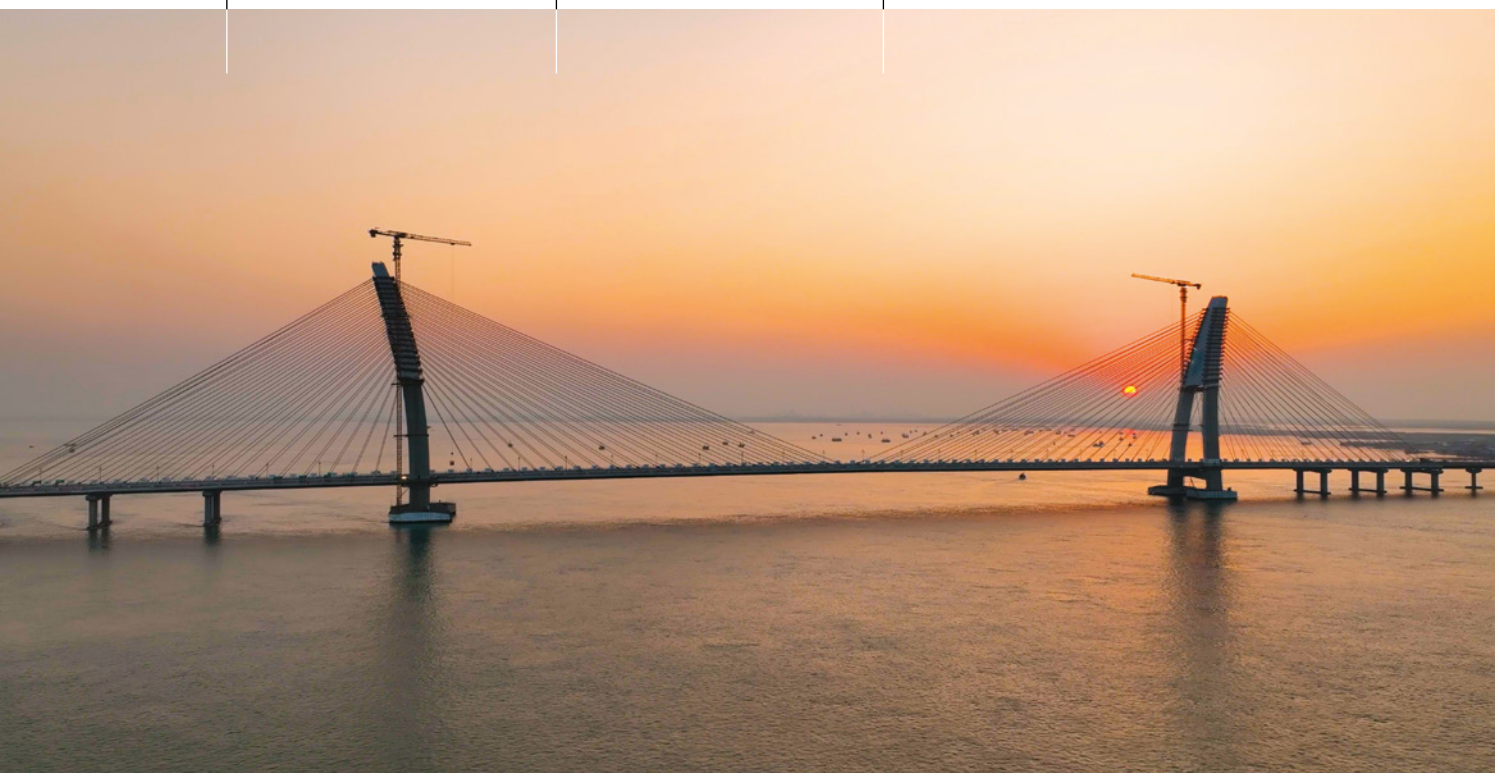
KEY FIGURES

- Number of bridges: 2
- Length of each bridge: 420 metres
- Number of spans: 6
- Length of spans: 66m+4 x 72m+ 66m
- Method of construction: balanced cantilever using form traveller
- Weight of strands supplied: 300 tonnes
- Details of PT system: 452 tendons GC 6-12, 120 tendons GC 6-15
- Total grouting: 110 tonnes

VSL's site team focussed on closely following the rhythm set by the main contractor, so that there was **no delay to the main operations on the critical path - pouring of concrete and launching of form travellers. This was a key factor in reducing project duration**.

Thanks to efficient site preparation and organisation and the use of highly-skilled supervisors, VSL managed to cut four weeks from the 24-month schedule. Work started on January, 31, 2023, the project was completed on January 31, 2025.

VSL Switzerland supplied and installed the post-tensioning system for the bridges.



SUDARSHAN SETU BRIDGE

BUILDING A NATIONAL LANDMARK: THE COUNTRY'S LONGEST CABLE-STAYED BRIDGE

Inaugurated on 25 February 2024, the **Sudarshan Setu is India's longest cable-stayed bridge**; the 2.45-kilometre-long landmark crossing includes a 900-metre-long cable-stayed bridge with a main span of 500 metres and side spans of 200 metres. The bridge connects Beyt Dwarka Island to mainland Okha in Gujarat's Devbhumi Dwarka district.

Beyt Dwarka is nearly 30 kilometres from Dwarka town, home to the famous Dwarkadhish temple of Lord Krishna. Before the bridge was built, devotees could only travel during the day by boat. The construction of the four-lane bridge, which includes pedestrian walkways on both sides, has opened up round-the-clock travel.

The key factors that led to VSL India's participation in this major project were its expertise in cable-stayed structures, its long-standing relationship with the main contractor Singa Construction, and its involvement from the tender stage.

VSL India's scope of works included using **SLU jacks to erect the bridge segments, supplying and installing the cable-stayed structure and implementing a structural health monitoring system**.

Significant investment was made in specialised equipment and technology to enhance productivity and safety. For instance, **specialised stay equipment was procured, rigorously inspected, and deployed**.

DATE
2022 - 2024

LOCATION
Okha-Dwarka, Gujarat, India

OWNER
Ministry Of Road Transport & Highways (MORTH)

MAIN CONTRACTOR
M/S SP Singa Construction PVT LTD

ENGINEER
AARVEE Associate Authority

DESIGNER
WIECON CO. Ltd.

SCOPE OF WORKS

Supply and installation of the cable-stayed structure

Implementation of structural health monitoring system

Operation of the SLU jacks for lifting of the segments

KEY FIGURES

- 152 cables ranging from 62 metres to 283 metres in length
- 1,560 M tonnes of stay strands
- Two pylons

Safety on site

Operating in the marine environment presented some unique challenges, including **unpredictable weather conditions and inherent marine safety hazards. Working at height was another primary challenge**, particularly with pylons rising more than 100 metres above the deck and 128 metres from the pile cap.

To achieve this demanding project, **stringent safety protocols, ongoing training initiatives, proactive hazard identification measures, transparent communication channels, and a zero-tolerance stance against safety infractions were imperative**.

On another note, as a commitment to environmental protection and energy savings, **the VSL teams on-site completely eliminated plastic water bottles and used solar-powered focus lights**.

Smart planning and monitoring of activities and cycle times were crucial in completing the project on schedule. Mobilisation began on February 1st, 2022, and the bridge was completed on 30th April 2024.

Significant investment was made in specialised equipment and technology to enhance productivity and safety.

ANJIKHAD RAILWAY BRIDGE

BUILDING A MAJOR CABLE-STAYED BRIDGE ON INDIA'S NEW RAILWAY TO KASHMIR

With a central cable-stayed span of 290 metres, the Anjikhad Railway Bridge is one of two large bridges being constructed on the new railway line that connects the states of Jammu and Kashmir in the Himalayan foothills of Northwestern India. Once the strategically important Udhampur-Srinagar-Baramulla Rail Link is completed, it will **connect Kashmir, one of the most isolated regions in India, to the rest of the country via the national railway network**.

With a **height of 196 metres** and a **total length of 473 metres**, comprising spans of 290 metres and 183 metres, the new Anjikhad Railway Bridge **carries the railway over a deep ravine between two tunnels. The main span is the longest cable-stayed span on Indian Railways**.

VSL India is recognised for its expertise in cable-stayed bridges and has an impressive portfolio that includes the Basholi Cable Stay Bridge in Jammu and the Arra Chapra bridges, as well as the Bandra-Worli Sea Link Bridge where VSL was hired by the main contractor HCC to supply and build the cable-stayed structure.

VSL India was hence selected to supply and install the cable-stayed structure, including the post-tensioning in the pylon. The Anjikhad Railway Bridge deck is supported by 96 cables ranging in length from 80 metres to 294 metres, supported by a single Y-shaped composite pylon which has 96 friction dampers to mitigate the rain- and wind-induced vibration. Groups of 24 cables are attached to the 195-metre-high pylon on each side of the central and lateral spans, arranged in two rows on the left and right sides.

DATE
2022 - 2024

LOCATION
Jammu, India

OWNER
Northern Railway

MAIN CONTRACTOR
Hindustan Construction Company Ltd. (HCC)

ENGINEER
Konkan Railway Corporation Limited Authority

DESIGNER
Italferr

SCOPE OF WORKS

Supply and installation of the cable-stayed structure

Supply and installation of pylon PT

Supply and installation of 48 monostrand load cells

Natural frequency test and dynamic load test

KEY FIGURES

- Total length 473 metres
- Two spans of 290 metres and 183 metres
- 96 cables ranging from 80 metres to 294 metres long
- 926 tonnes of stay strands
- Two pylons
- 96 friction dampers

The key challenges of this project included handling **extreme weather conditions in the Himalayan Mountains** and ensuring that milestones were reached while working to the necessary safety standards and achieving a high quality of work.

As per the designer's requirements, VSL India was also responsible for carrying out the natural frequency tests and dynamic load tests. To do so, VSL supplied and installed 48 monostrand load cells.

VSL VIBRATEST was carried out twice on the project. It was used to **estimate the stay force in the cable** and to compare it with the lift-off force exerted by the stay cable multi-jack.

It was also used to **check the performance of the 96 friction dampers** to ensure that all stays are within at least 3% logarithmic decrement.

The VSL team worked to **minimise waste arising from the installation of the stay strands and HDPE pipes**; stay strand wastage was 2.29% and HDPE pipe wastage was just 1.77%, compared to the average of around 5%.

Initially scheduled for a 10-month programme, **the cable-stayed spans were completed in 8 months**.

With site mobilisation in March 2022 and the start of work in June the same year, VSL's works were successfully completed in May 2024 and the bridge construction finished at the end of 2024.

The new Anjikhad Railway Bridge carries the railway over a deep ravine between two tunnels. The main span is the longest cable-stayed span on Indian Railways.

SANTA CRUZ–CHEMBUR LINK ROAD'S CABLE-STAYED BRIDGE

BUILDING A TECHNICALLY COMPLEX CABLE-STAYED BRIDGE

The Mumbai Metropolitan Region Development Authority is working to **improve connectivity and sustainability** in the region through investment in projects that enhance traffic flow between Kalina, in the Santacruz East suburb of Mumbai, and Andheri in the west. This route is approximately 5 to 7 kilometres long.

A new cable-stayed bridge forms part of the extension of the Santa Cruz–Chembur Link Road, an elevated corridor that is planned to significantly alleviate traffic congestion on the route. It will boost connectivity from both the Eastern and the Western Express Highways to the bustling commercial Bandra-Kurla Complex.

With a proven track record in landmark cable-stayed structures, VSL India has earned a reputation as an expert in this type of work. VSL teams provide a comprehensive service, actively engaging from the design stage, and collaborating with renowned international bridge design consultants to deliver economically viable and sustainable outcomes.

The main contractor, JKumar Infra Projects Limited, appointed VSL India to **supply and install its SSI 2000 stay cable system on the bridge**. This included 34 tonnes of stay cable, 44 stay-cable anchorages, 22 third-generation VSL patented cables **saddles**, and 824 metres of **HDPE stay pipes, anti-vandalism pipes**, and other essential accessories.

A first cable-stayed bridge of its kind

VSL India successfully navigated three key challenges in this project.
Firstly, the **110-metre radius of curvature** posed a significant challenge, as it is believed to be the first time a cable stay bridge deck has been built on such a sharp curve.

DATE
2023 - 2024

LOCATION
Mumbai, India

OWNER
Mumbai Metropolitan Region Development Authority (MMRDA)

MAIN CONTRACTOR
JKumar Infra Projects Limited

CONSULTANT
PADECO Co. Ltd

DESIGNER
Spectrum Techno Consultants Pvt Limited

ENGINEER
Mario De Miranda (De Miranda Associati)

SCOPE OF WORKS

Supply & installation of the cable-stayed structure and components

KEY FIGURES

- Length of cable stay bridge: 163.2 metres
- Height of bridge: 22 metres above ground level and 9 metres above the existing Vakola Flyover
- Number of orthotropic steel deck spans: 58
- Stay cables: 22 cables with a total weight of 34 Mtonnes

Secondly, the project was located in a **highly congested area**, characterised by constant heavy traffic and proximity to Mumbai International Airport and the busiest commercial centres.

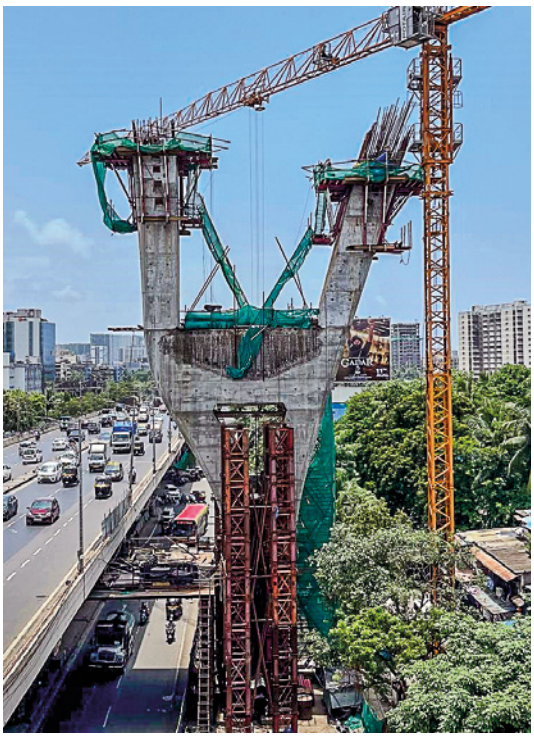
Thirdly, the **orthotropic steel deck demanded precise installation of the guide pipe, as it had to be constructed in the factory at the same time as the steel deck**. VSL India collaborated closely with the designer, main contractor, and deck fabricator, checking coordinates against 3D models to ensure precision.

Reduced carbon footprint

Although the contract did not require such objectives to be met, **VSL India proactively implemented internal measures to minimise the carbon footprint** of the project, by:

- Adopting a lean team and requirement-based mobilisation approach, resulting in a **smaller office space** and minimising utilities demand.
- Ensuring **staff accommodation was within walking distance**, to **reduce vehicle fuel consumption and decrease the need for vehicles**.
- Transitioning **from hardcopy to digital submissions, reducing paper use** and offering environmental benefits.

At its peak, the project employed more than 10 staff and 20 workmen from VSL India, including a dedicated core cable-stay execution team and senior project executives. Work began on January 3, 2023 and was completed on June 30, 2024.



The project was located in a highly congested area, characterised by constant heavy traffic.

GANGA PATH EXPRESSWAY BRIDGE

PRECASTING AND ERECTING A KEY SEGMENTAL VIADUCT

Loknayak Ganga Path, also known as Ganga Path or Patna Marine Drive, is a **new expressway** spanning the Ganges River in Patna, Bihar, India. Jointly constructed by the Housing and Urban Development Corporation and the government of Bihar, this strategic project aimed to **alleviate traffic congestion, connecting east and west Patna** by a 21.5-kilometre-long, four-lane highway and a 7.6-kilometre-long elevated structure along the Ganges.

VSL India, a trusted partner of Navayuga Engineering Company Limited, leveraged its technical expertise and problem-solving capabilities to play a pivotal role in the project's success. This included **taking charge of designing and supplying segment casting moulds and a launching gantry and overseeing the erection of a 6.12-kilometre-long precast segmental viaduct**, which has 121 spans and incorporates 3,252 tonnes of post-tensioning.

Additional scope of works

In December 2022, **VSL India's scope of work was extended to include the erection of 21 extra spans as well as the post-tensioning and the lifting and lowering of 20 spans to enable bearing installation**.

The teams efficiently reassembled the launching gantry, which had been dismantled after finishing the initial task of erecting 121 spans. Once the supplementary spans had been successfully completed the launching gantry was dismantled once more, and handed over to NECL.

Technical innovations for high productivity

Each 50-metre-long span was erected one by one, using the launching gantry over both the land and the River Ganges. The use of an overhead gantry

DATE
2016 - 2024

LOCATION
Patna, India

OWNER
Bihar State Road Development Corporation Limited

MAIN CONTRACTOR
Navayuga Engineering Company Limited

DESIGNER
Precast Bridgetech Co.Ltd.

ENGINEER / CONSULTANT
AECOM - RODIC JV

SCOPE OF WORKS

Original scope:

- Supply, assembly & commissioning of 1 launching gantry and casting cells
- Deck erection (122 spans)
- Supply & installation of post-tensioning

Additional scope:

- Assembly and commissioning of launching gantry
- Deck erection (21 spans)
- Supply & installation of post-tensioning
- Lifting and lowering of 20 spans for bearing installation
- Supply & installation of permanent plastic grout caps

KEY FIGURES

— Tonnage of PT: 3,663 tonnes
— Total bridge length: 7,178 kilometres
— Number of spans: 142
— Number of segments: 2,414

enabled **segments to be delivered behind the truss along the sections of viaduct that were already completed**, and also raised from below for those spans over land. It was not possible to deliver the segments by barge as the water was too shallow.

VSL's innovation in designing and supplying segment pre-casting cells, coupled with the implementation of the GEOCON geometry control software for the short line method, revolutionised the project. This strategic approach led to a substantial enhancement in segment casting methods by effectively **managing potential errors during the casting phase, delivering remarkable improvements in the accuracy of construction**.

Notably, VSL was able to achieve a remarkable **2.5-day cycle time per span** when work fronts were available without interruption, showcasing the company's ability to provide tailored solutions for complex projects.

Coping with weather challenges

The project faced challenges from unpredictable weather conditions, including monsoon floods and winds that might occur any time between July to September and April to May, impacting production and timelines. Measures had to be taken to protect the gantry from wind gusts and VSL used a wind anemometer to monitor wind speed in real time. VSL also used various apps to check the wind forecast for its operations.

Protection against corrosion for enhanced durability

In line with VSL International's latest efforts to improve structural longevity, **permanent plastic grout caps were used on all the bridge's anchorages**. This proactive measure **minimises the risk of corrosion**, especially in a maritime environment.

The project began on January 15, 2016, and was completed in April 2024.

VSL's innovation in designing and supplying segment pre-casting cells, coupled with the implementation of the GEOCON geometry control software for the short line method, revolutionised the project.

KUWAIT INTERNATIONAL AIRPORT

BRINGING POST-TENSIONING EXPERTISE TO AIRPORT FACILITIES

Since 2017, the Kuwaiti Ministry of Public Works has been leading the expansion of the country's airport facilities, **increasing the capacity of Kuwait International Airport with the addition of a new terminal**. Terminal II will enable the airport to accommodate 25 million passengers annually, a figure seven times larger than the country's population.

As part of this significant project, a construction package was developed for the infrastructure necessary to **provide access to the new terminal and to create parking facilities for buses**.

Building on the successful partnership between the main contractor, Limak, and VSL Middle East - responsible for the execution of the cable-stayed structure and post-tensioning of the iconic roof of the new terminal - Limak chose to continue its collaboration with VSL, leveraging the company's expertise in post-tensioning for a second contract. ,.

This collaboration consisted of **two key contracts**:

- **Design and shop drawings for the post-tensioning system of the bus bay's roof structure**, the supply of post-tensioning materials, and the supervision of post-tensioning activities.
- **Design and shop drawings for the post-tensioning system of eight bridges**, including the supply of PT materials and supervision of post-tensioning activities.

One of the most significant challenges for VSL Middle East was the technical design of the **roof structure for the bus bay**. The structure consists of

DATE
2022 - 2023

LOCATION
Subahan, Kuwait

OWNER
Ministry of Public Works

MAIN CONTRACTOR
Limak Insaat Kuwait SPC

ENGINEER
Gulf Consult

DESIGNER
Naco - Arup - Parsons Brinckerhoff

CONSULTANT
Foster & Partners

SCOPE OF WORKS

Engineering for post-tensioning, including design and shop drawings

Supply of post-tensioning system

Supervision of post-tensioning activities

KEY FIGURES

— Number of bridges: 8

five elements, the statical system of each of which is based on heavy panelled post-tensioned beams with spans up to 24 metres long.

VSL's scope covered the design of the post-tensioned beams, **taking account of all gravity and lateral loads including seismic, wind and thermal**.

The design demanded **a unique analytical approach to integrate the PT tendons into the intersecting beams while accommodating the rebar necessary to resist both gravity and lateral loads**.

The project began on March 1, 2022 and was successfully completed on October 24, 2023, with the involvement of a project engineer and three PT supervisors from VSL Middle East.

Initially slated for completion in 2024, the opening of the new terminal has been rescheduled to 2025 or 2026.

The design demanded a unique analytical approach to integrate the PT tendons into the intersecting beams while accommodating the rebar necessary to resist both gravity and lateral loads.

LAS TRUCHAS BRIDGE

CONSTRUCTING A MAJOR BRIDGE DECK USING THE FREE CANTILEVER METHOD

Las Truchas Bridge is part of the Compostela – Las Varas Highway, a construction project launched to tackle regional mobility issues in Mexico's Nayarit region. In 2023, Banobras appointed VSL Mexico to assist with the construction. Our extensive experience and expertise in the successful delivery of large bridges was recognised and led to **VSL Mexico overseeing the successful construction of the bridge deck, including reinforcement installation, concrete pouring and post-tensioning execution**. The bridge has a span of 433 metres and it was constructed using the free cantilever method.

Overcoming communication hurdles and difficult access

VSL Mexico encountered several challenges during the project, including communication difficulties created by the project's **remote location**, limited access to work areas and the need for close coordination between operational and technical staff.

Optimising work cycles to meet tight deadlines

To overcome these challenges, VSL Mexico implemented innovative solutions, including optimising work cycles and resources to meet tight deadlines, enhancing communication strategies and strengthening the technical and operational capabilities of its staff. The implementation of VSL's Be More approach to the continuous improvement of performance, facilitated **proactive identification of critical tasks, enabling timely interventions to eliminate delays and ensure project delivery** met our client's expectations.

DATE
2023 - 2024

LOCATION
Compostela In Nayarit, Mexico

OWNER
Banobras – Banco Nacional De Obras Y Servicios Públicos

MAIN CONTRACTOR
Mota-Engil Mexico

DESIGNER / CONSULTANT
K2.9

SCOPE OF WORKS

Supply and operation of two pairs of form travellers

Reinforcement steel installation

Concrete pouring

Supply, installation and stressing of the VSL prestress system

KEY FIGURES

- Total number of segments: 54
- Volume of concrete: 2,500 cubic metres
- Total weight of reinforcing steel: 406 tonnes
- Total weight of prestressing steel: 309 tonnes

Despite delays caused by external factors, VSL Mexico's strategic approach and technical expertise contributed significantly to the project success. By **delivering the structure one month ahead of the contract schedule**, VSL Mexico demonstrated its commitment to client satisfaction and partnership.

At the peak time, 80 VSL employees worked on the site including engineers, technicians, assistants and drivers. Having started on June 1, 2023, the project was successfully completed on April 30, 2024.

VSL Mexico oversaw the successful construction of the bridge deck, including reinforcement installation, concrete pouring and post-tensioning execution.

BOCA DEL CERRO BRIDGE

ERECTING A COMPLEX BRIDGE STRUCTURE WITH CUSTOMISED LIFTING SOLUTIONS

The Boca del Cerro Bridge carries the railway across the 200-metre-wide Usumacinta River and is **a critical component of the Tren Maya Project**. The bridge deck is of composite construction, combining a concrete slab with a variable-depth steel truss.

Strategic river crossing design and technical challenges

Main contractor Mota Engil Mexico selected VSL for its recognised expertise in heavy lifting and launching systems. **VSL's mission was to provide a turnkey solution, from the design and fabrication of two lifting frames to their installation and operation on site**. The segments to be erected ranged from 55 tonnes up to 100 tonnes in weight, and up to 10 metres in height, creating a technically challenging project.

VSL Spain undertook the design of the lifting frames, with a peer review by TC Singapore and independent verification by K2. Fabrication of the lifting frames was a critical phase, requiring oversight by VSL Spain specialists and collaboration with a local fabricator. Transportation to the site was also challenging due to the dimensions of the main frame, which required special transport arrangements.

Precision engineering and custom fabrication

VSL's innovative solution involved the use of two SMU – 70 HL jacks to lift, launch, and lower the steel segments. The lifting frames were fabricated in three months and transported to the site where they were installed by a 400-tonne crawler crane provided by

DATE
2023

LOCATION
Tenosique, Tabasco, Mexico

OWNER
Secretaría de Comunicaciones y Transportes (SCT)

MAIN CONTRACTOR
Mota Engil Mexico

ENGINEER / DESIGNER / CONSULTANT
Ideam – TY Lin

SCOPE OF WORKS

Design, fabrication, transportation, installation, and commissioning of two lifting frames

Operation of two lifting frames to erect 19 steel segments ranging from 55 tonnes to 100 tonnes, up to 10 metres in height

Provision of on-site supervision and technical assistance for the heavy lifting and launching systems

KEY FIGURES

- 19 steel segments erected
- Two lifting frames designed and fabricated
- Weight of segments: 55 tonnes to 100 tonnes
- Height of segments: up to 10 metres
- Span of the main bridge deck: 210 metres
- Time to erect main span: two months

the main contractor. The commissioning process was meticulously planned, with the VSL Mexico team receiving specialist training from a VSL Switzerland heavy-lifting expert. Load testing the first segment was a coordinated effort involving multiple stakeholders.

The use of the lifting frames was not only efficient but also a **low-carbon alternative compared to using a massive 500-tonne crawler crane, offering significant environmental and cost savings**.

Rapid erection and successful project completion

The project began on 1st January 2023, with the site fully mobilised by mid-2023. The critical phase of erecting the 19 steel segments was completed in a record time of two months, with the entire bridge deck completed by 4th December 2023.

VSL's innovative solution involved the use of two SMU - 70 HL jacks to lift, launch, and lower the steel segments

MEXICO-TOLUCA INTERURBAN RAILWAY

CONTINUING A LEGACY OF EXCELLENCE IN MEXICO'S RAIL INFRASTRUCTURE

VSL's involvement in the Mexico-Toluca Interurban Railway project is not new; having previously undertaken the challenging task of inspecting and replacing more than 1,000 bearings on the Toluca-Mexico City railway, **the company's expertise was called upon for a second time, with a focus on the construction of a critical double cantilever bridge**. This task required not only technical knowledge but also the ability to innovate in the face of tight deadlines and technical complexities.

Precision and speed: VSL's winning formula

The technical demands of this project were significant. **VSL was responsible for the rental and operation of form travellers, as well as the supply and installation of a total of 81 tonnes of prestressing steel in a 19-unit multistrand system**.

The bridge, spanning 191.7 metres with three spans of 58.7, 85, and 48 metres, required precise execution to meet the project's tight deadlines.

Drawing on previous experience with the Mexico-Toluca project, VSL Mexico was able to anticipate and overcome the challenges associated with such a complex structure, by mobilising resources quickly and effectively ensuring that the project stayed on track. **VSL successfully reduced the construction cycle for each segment from eleven days to just six.**

VSL's approach to the double cantilever bridge was both innovative and strategic. **By using pairs of form travellers for each column, VSL Mexico was able to carry out simultaneous operations that cut two weeks from the original programme.**

DATE
2022 - 2023

LOCATION
Mexico City, Mexico

OWNER
Secretaria de Infraestructura Comunicaciones y Transportes

MAIN CONTRACTOR
Constructora de Proyectos Viales de México (CPVM)

ENGINEER
Ing. Sergio Souza Tettamanti Junior (Project Superintendent, CPVM)

DESIGNER
SENERMEX Ingeniería y Sistemas S.A. de C.V.

CONSULTANT
IDEAM Ingenieros Estructurales

SCOPE OF WORKS

Rental of form travellers

Supply (excluding strands) and installation of the post-tensioning system

KEY FIGURES

- Total amount of prestressing steel installed: 81 tonnes of strand in 19-unit multistrand system
- Bridge length: 191.70 metres
- Number of spans: 3
- Depth: Ranging from 5.5 metres at pier 1 to 3.45 metres at the centre of the main span
- Bridge width: 11.5 metres

VSL Mexico delivered its contribution to the Mexico-Toluca Interurban Railway project between June 3, 2022, and December 30, 2023, completing on time while ensuring quality and safety. This project supports Mexico's expanding transportation network.

By using pairs of form travellers for each column,VSL Mexico was able to carry out simultaneous operations that cut two weeks from the original programme.

S6 KOSZALIN BYPASS

BUILDING A BRIDGE COMBINING THREE CONSTRUCTION METHODS

VSL Poland played a crucial role in **building a new bridge over a local road and railway line** as part of the construction of the Koszalin Bypass on the main S6 motorway connecting Gdańsk with Szczecin.

Main contractor Polbud-Pomorze used three different construction methods to build the twin 760-metre-long bridges, in order to address poor ground conditions that were identified at the design stage and handle the complex geometry of the concrete box girder deck. These were the incremental launching method (ILM), the balanced cantilever method, and conventional scaffolding support.

As a specialist in deck erection, VSL Poland was contracted to provide and operate ILM equipment, supply temporary bearings for launching the bridge segments, provide the post-tensioning system, perform all post-tensioning work, and lift the bridge onto supports to enable the temporary bearings to be exchanged for permanent ones.

Smart construction methods for the ILM

A **360-metre-long section of each bridge was built using the incremental launching method** with the necessary equipment designed for the second set of piers. **The dimensions of the concrete box girder posed significant challenges**: the typical span length was 58.5 metres and the launching had to be performed without the use of any intermediate supports. The total bridge weight during launching reached 13,000 tonnes, and it was launched on a gradient of 3.95%.

The launched part of the bridge was divided into 13 segments. VSL proposed **launching the first three segments from the abutment to the first pier**

DATE
2022 - 2024

LOCATION
Koszalin, Poland

OWNER
General Directorate for National Roads and Highways (GDDKiA)

MAIN CONTRACTOR
Polbud-Pomorze

DESIGNER
Transprojekt Gdański

CONSULTANT
Lafrentz Polska

SCOPE OF WORKS

Supply and operation of launching equipment

Supply of temporary bearings for launching

Supply of PT system and all post-tensioning works

Lifting of the bridge on supports for bearing exchange

KEY FIGURES

- Total bridge length: twin bridges each 760 metres
- Number of spans: 10 in each bridge
- PT cables: 949 tonnes
- Length built by incremental launching: 360 metres
- Length built by balanced cantilever: 390 metres

using strands pulled by hydraulic jacks, as it was difficult to install the conventional launching equipment at the abutments. **The remaining ten segments were launched using ILM equipment.** This combination of methods **made it possible to launch this heavy structure using just one set of equipment**.

Construction of the twin bridges took place simultaneously, with the launching operation taking six months. This allowed the main contractor to stay on schedule.

Balanced cantilever method

The balanced cantilever method was used to build a 390-metre-long section of each bridge, including a maximum span of 130 metres across a railway line.

VSL expanded its scope of work by supplying and installing prestressing bars in temporary supports and **assembling one of the 12 form travellers that was required for the balanced cantilever deck construction**.

The VSL team consisted of two engineers, eight operatives and two experienced supervisors. The project began on June 30, 2022 and was successfully completed on April 30, 2024.

The balanced cantilever method was used to build a 390-metre-long section of each bridge, including a maximum span of 130 metres across a railway line.

CABLE-STAYED BRIDGE OVER THE KAMIENNA RIVER

ADAPTING VSL SSI 2000 STAY CABLE SYSTEM TO FIT A SPECIFIC DESIGN

Ostrowiec Świętokrzyski is a city in south-eastern Poland. As part of a project to expand a 2-kilometre-long section of the city's Provincial Road 754, **a new cable-stayed bridge was built to replace the existing structure over the Kamienna River**.

VSL Poland was contracted to deliver **a comprehensive scope of work**, which included:

- **Supplying and installing the stay cable system**, including 22 stay cables.
- **Supplying and installing the post-tensioning system** for the concrete deck.
- **Supplying and installing the stressing bars for the pylon connection** between the concrete deck and the steel pylon, as well as anchoring the pylon to the piers' foundations.

What made **this project particularly notable for VSL Poland was the installation of forks as dead-end anchorages at the tower - a unique solution demanded by the unconventional design of the cable-stayed bridge, which featured an asymmetrical arrangement of stay cables on either side of the steel tower**. To meet these specific design requirements, **VSL adapted its SSI 2000 Stay-Cable system by incorporating forks instead of the standard anchorages and customised the installation procedure**, demonstrating the team's capability in developing tailored solutions for atypical structures.

Additionally, the VSL team proposed an alternative for the dead-end anchorages in the deck. This involved using single strands embedded in the concrete without anchorages, reducing the space required in the deck structure and simplifying stressing operations.

The project began on October 1, 2023, and was successfully completed on June 6, 2024.

DATE
2023 - 2024

LOCATION
Ostrowiec Świętokrzyski, Poland

OWNER
Świętokrzyski Zarząd Dróg Wojewódzkich w Kielcach

MAIN CONTRACTOR
Mota-Engil Central Europe S.A.

ENGINEER
Sweco Polska Sp. z o.o.

DESIGNER
Contek Projekt

SCOPE OF WORKS

Supply and installation of the cable-stays

Supply and installation of the post-tensioning system

Supply and installation of stressing bars for pylon construction

KEY FIGURES

- Total bridge length: 65 metres
- Number of spans: 1
- 22 stay cables for a total of 33.600 metres of strands used
- Total amount of post-tensioning: 30 tonnes
- Length of stressing bars: 324 metres

SIX FLAGS QIDDIYA THEME PARK - PEDESTRIAN BRIDGE

CONTRIBUTING TO RIYADH'S BRAND-NEW THEME PARK

In the expansive setting of the Six Flags Qiddiya Theme Park, VSL Saudi Arabia was involved in the **construction of a pedestrian bridge that will provide direct access for visitors to the new entertainment hub**.

VSL was positioned as an ideal partner for the project, having the necessary expertise in post-tensioning, coupled with competitive pricing and a strong relationship with Bouygues Batiment International. With the support of VSL's manufacturing facility in Spain, VSL ensured that bearings were supplied in a timely fashion, delivering ahead of schedule.

A reduced carbon footprint: VSL's dedication to sustainability

In an effort to reduce the project's carbon footprint, VSL implemented measures to **minimise material wastage from both ducts and strands**. This eco-conscious approach enhanced the sustainability of the scheme without compromising its quality.

Navigating timelines: Overcoming challenges to deliver the project on time

The team's commitment to innovation and efficiency allowed the scheduled timeline to be compressed, so that **post-tensioning work was completed in just one month – half the time that had been planned**.

VSL's contribution to this project ran from January 5, 2024, to May 1, 2024.

DATE
2024

LOCATION
Riyadh – Qiddiya, Kingdom of Saudi Arabia

OWNER
Qiddiya Investment Company

MAIN CONTRACTOR
BBI-AGC JV

ENGINEER / CONSULTANT
Atkins

DESIGNER
Jacobs

SCOPE OF WORKS

Bearing supply

Post tensioning

KEY FIGURES

- Length: 47 metres
- Total tonnage: 95 tonnes
- Strand type: 15.24 millimetres
- Anchorage type: GC 6-31
- Bearing type: Spherical bearings with coefficient of friction test & proof load test

NEUVILLE UNDERPASS

MOVING A BRIDGE BY 30 METRES IN JUST SIX HOURS

The project to replace a level crossing in Martigny, in the Swiss canton of Valais, required the construction of a new railway bridge so that **road traffic would be able to pass beneath the railway line**. This would eliminate a potentially hazardous level crossing that was used by 11,000 vehicles every day.

VSL was commissioned to perform the skidding of the box, which was built offline and had to be slid by 30 metres into its final position. VSL's heavy lifting division is recognised for its expertise in skidding operations, a capability that few Swiss companies can offer.

VSL Switzerland was involved from the tender stage in planning what was referred to as the 'Operation Coup de Poing', a rapid and decisive intervention. The expertise of the technical centre of VSL Switzerland was also called on early in the project, to **design the cantilever section where the jacks were installed**.

A tight six-hour window

VSL had **just six hours to skid the bridge over a distance of 30 metres and also dismantle the equipment**. Our approach was to propose a method rarely used in Switzerland, which allowed the entire skidding operation to be completed in just a few hours, **using equipment compact enough to fit on a truck and eliminating the need for large cranes or other heavy machinery**.

In total, over four days and in collaboration with TMR (Transports de Martigny et Régions), the site teams successfully prepared and completed **a spectacular operation to install the 1,340-tonne concrete structure, which incorporated both the underpass and the TMR bridge**. As a result, the construc-

DATE
2024

LOCATION
Martigny, Switzerland

OWNER
City of Martigny

MAIN CONTRACTOR
Implenia

ENGINEER
Moret et Associés SA

SCOPE OF WORKS

Dimensioning of the cantilevers

Skidding operation during the line closure

KEY FIGURES

— Weight of bridge: 1,340 tonnes
— Distance moved: 30 metres
— Number of jacks: four groups of vertical jacks, four groups of push/pull jacks with pumps

tion scheme was able to continue to the planned schedule.

In addition to the tight timeline, the VSL team overcame several critical challenges:

- First, the **skid tracks were at risk of shifting laterally**, which could have created problems with alignment. To address this, **VSL devised skidding tracks equipped with push-pull jacks and vertical jacks**. This solution was far simpler than using a crane to lift the 1,340 tonnes structure
- The **need to correctly align the track when the bridge was in its final position**, accounting for the predicted settlement, and the limited margin for the vertical jacks posed another significant challenge during the operation.
- The **width of the bridge** made it impossible for VSL to accommodate a horizontal jack for each skidshoe, which would be the conventional solution. Instead, **a single horizontal jack was used for two skidshoes**, representing just half of the standard pushing force. Hence there was a **need to closely monitor each lifting point to ensure that they remained within an allowable range of movement according to the available pushing force**.

In line with **VSL's commitment to sustainability and pursuit of low-carbon initiatives, all components used in this project were repurposed from previous projects, minimising waste and resource consumption**.

The team responsible for successfully completing the 'Operation Coup de Poing' was led by two experts from VSL's heavy lifting division highly trained in skidding operations, with three on-site personnel.

Following the installation of the underpass and the TMR bridge, the new Neuville Road to Martigny city centre, opened to traffic at the end of 2024.

Project planning began in 2023, and on-site execution commenced on June 24, 2024, marked by the installation of equipment. The bridge slide was successfully completed on July 5.

VSL performed the skidding of the box, which was built offline and had to be slid by 30 metres into its final position.

GARN AL SABKHA – SHEIKH MOHAMMED BIN ZAYED ROAD INTERSECTION

PERFORMING THE POST-TENSIONING AND MSE WALLS FOR FOUR BRIDGES

In order to **reduce congestion and improve transit times in Dubai**, the Roads and Transport Authority of the United Arab Emirates is pursuing the Garn Al Sabkha – Sheikh Mohammed Bin Zayed Road Intersection Improvement Project.

This scheme features the **construction of four bridges**, each capable of accommodating up to 17,600 vehicles per hour and with lengths ranging from 960 metres to 660 metres.

The project is designed to optimise traffic flow, reducing the distance and travel time between Garn Al Sabkha Street and Sheikh Mohammed Bin Zayed Road, as well as between Sheikh Mohammed Bin Zayed Road and Al Yalayis Road, to improve access to Jebel Ali Port.

Due to its expertise in **post-tensioning and MSE wall construction** in Dubai, VSL Middle East was selected to carry out these specialised scopes of work on all four bridges.

The VSL team had to **work across four separate locations, with two of the bridges much further away**. Initially, work was carried out on two of the bridges then it transitioned to parallel operations. During the deck erection phase, the main contractor and VSL teams worked concurrently. VSL Middle East collaborated closely with the international team in charge of **VSL's global approach for continuous improvement of performance, to streamline operations** and minimise any overlap of staff and equipment while performing tasks simultaneously at each location.

DATE
2023 - 2024

LOCATION
Dubai, United Arab Emirates

OWNER
Roads and Transport Authority

MAIN CONTRACTOR
CCECC

ENGINEER / DESIGNER / CONSULTANT
Khatib & Alami

SCOPE OF WORKS

Engineering for post-tensioning, including design and shop drawings

Supply of post-tensioning system

Supervision of post-tensioning activities

Engineering of MSE wall

Supply of equipment

Erection of the MSE wall panels and barriers

KEY FIGURES

- Number of bridges: 4
- Number of MSE wall panels: 2,886
- Number of barriers: 898
- Amount of post-tensioning: 837 tonnes

Another key innovation on the project was VSL's first use of Building Information Modelling for the design of the MSE walls on all eight ramps of the four bridges. The BIM model provided a **detailed and comprehensive visualisation of the installation process for each structure and the 2,886 panels, enabling precise technical planning and sequencing during the design phase**. This meant that drawings were produced with accurate detailing allowing the site team to interpret friction tie details correctly, ensuring precise execution of the works. The successful completion of the post-tensioning and MSE walls resulted in the main contractor **entrusting VSL's team with the subsequent installation of 898 bridge barriers**.

Almost 45 VSL staff were involved, including a project manager, project engineer, and supervisors for the precast yard and erection works, with an additional supervisor for night-time erection operations, and 40 operatives at the peak of the work. The project began in April 2023, and was completed in October 2024.

Following the successful PT and MSE wall works, VSL was entrusted with installing 898 bridge barriers.

SYDNEY METRO WEST

BUILDING TWO DIAPHRAGM WALLS IN A CONGESTED AREA TO CONSTRUCT TWO NEW METRO STATIONS

As part of the City of Sydney's expansion, the city authority intends to decentralise activities, away from the historical centre and towards western Sydney. This has led the state government to **extend its metro train system with underground tunnels and stations**.

This programme of works required a specialist contractor with expertise in construction of diaphragm walls, including those with a design life of 120 years. The main contractor, Gamuda - Laing O'Rourke Consortium, hired specialists VSL Australia and Keller as a joint venture, to **construct two diaphragm wall shafts that will serve as station boxes**. VSL Australia and Keller together designed the associated production plant for steel cages and concrete panel fabrication, as well as equipment for the works onsite.

Coping with a challenging jobsite location

Significant challenges were posed by the location of the works, which are in the middle of the **highly congested Central Business District** including:

- complicated **delivery logistics**;
- stringent **planning and noise reduction**: 24-hour working shifts were necessary to meet the tight execution schedule, and specific measures were implemented to allow this to proceed in a mix area of commercial and residential buildings;

DATE
2022 - 2024

LOCATION
Sydney, Australia

OWNER
Transport for New South Wales

MAIN CONTRACTOR
Gamuda - Laing O'Rourke Consortium

ENGINEER
Sydney Metro

DESIGNER
GHD-SMEC-Aurecon

SCOPE OF WORKS

Construction of two station box shafts

KEY FIGURES

Facility and maintenance shaft for TBM launch at Rosehill

- 52 no 1-metre-thick panels approximately 30 metres deep
- Plan area 130 metres by 20 metres
- 2,900 tonnes of reinforcement
- 10,000 m^3 of concrete
- 30 tonnes of GFRP

Parramatta Station shaft

- 72 no 1-metre-thick panels approximately 30 metres deep.
- Plan area 195 metres by 27 metres
- 4,900 tonnes of reinforcement
- 13,300 m^3 of concrete
- 30 tonnes of GFRP

- **proximity to heritage buildings**: the project was within a metre of an existing heritage building at its closest point.

However, the use of extensive preparation and planning ensured a smooth construction process.

VSL's technical centre also carried out **specific calculations to confirm trench stability** and provided an **alternative guide wall design to minimise the risk of building settlement during wall excavation**, due to the proximity of structures.

Improving design and constructability

In some sections of the project, the design was refined, and **standard solutions were adopted where possible**. VSL provided **constructability advice during this process**, which led to **time savings in the procurement and manufacturing phases**.

In addition, 3D **modelling of reinforcement cages was used to detect potential clashes before the cages were fabricated**, helping to identify and resolve cage congestion during installation.

Reducing carbon footprint

KVJV sought a **custom concrete mix design aimed at reducing carbon emissions**, minimising the quantity of cement that was used to meet CO_2 emission requirements.

The joint venture also **refined the design of the cages for the second shaft, making units smaller and lighter and cutting the delivery trips by half**. Instead of the planned 576 trips, **only 288 trucks travelled to the site, as two of the smaller units could be stacked on each truck**.

Maximising performance and productivity

VSL's **bespoke digital application TIO was employed to meticulously monitor progress and excavation productivity, with the aim of maximising performance, simplifying work, and enhancing productivity**. Installed on tablets used by excavation machine operators, the app allows them to log their activities in real time. The system records the time taken to carry out each activity, and this data is stored for analysis by project engineers and managers. The technical centre can subsequently use this data to derive accurate excavation rates, ensuring precise tracking and optimisation of the excavation process.

The team consisted of 39 staff at its peak, including a highly skilled engineering team. The coordination and experience of each individual was key to the project's success. The project started on May 6, 2022, and was completed on March 25, 2024.

MELBOURNE NORTH EAST LINK - BULLEEN CUT & COVER

CONSTRUCTING DIAPHRAGM WALLS & BARRETTES UP TO 45M FOR MAJOR MELBOURNE INFRASTRUCTURE

The North East Link represents **the largest transport infrastructure investment ever made in Melbourne's north east**, and is set to transform how people move around the city. The project features a **6.5-kilometre-long tunnel** stretching from Watsonia to Bulleen, intended to complete the missing link in Melbourne's freeway network. This will **remove 15,000 trucks from local roads every day and reduce commute times by up to 35 minutes**. Additionally, upgrades to the Eastern Freeway and M80 Ring Road will include new lanes, smart technology, and seamless connections to the North East Link tunnels. An extensive programme of works has been planned to ensure the project's components are ready for opening in 2028, effectively bringing all elements of the North East Link together.

As part of this ambitious project, the Keller-VSL Joint Venture (KVJV) was contracted to **construct a cut-and-cover structure**. This involved **building a diaphragm wall and barettes from 20 metres to 45 metres deep**, including excavation, the placement and splicing of prefabricated steel cages, and the casting of concrete. VSL played a crucial role in this venture as a **leading diaphragm wall contractor in Australia**.

The head contractor SPARK CJV and KVJV entered an **Incentivised Target Cost Contract**, agreeing to perform the work in a spirit of cooperation and openness to achieve the project objectives.

The contract ran smoothly, with both parties actively engaging in regular board meetings to discuss and address project challenges early on, ensuring

DATE
2022 - 2025

LOCATION
Melbourne, Australia

OWNER
Major Transport Infrastructure Authority

MAIN CONTRACTOR
SPARK CJV (WeBuild, CPB, GS E&C and China Construction Oceania)

ENGINEER
IREA / Nominated Authority

DESIGNER
Arcadis WSP Joint Venture (AWJV)

SCOPE OF WORKS

Construction of one diaphragm wall and barrettes

KEY FIGURES

- Number of diaphragm wall panels: 326
- Length of diaphragm wall panels: from 20 metres to 45 metres
- Volume of concrete: 68,000 cubic metres

timely resolutions and preventing future consequences.

The teams had to cope with four main challenges:

- Coping with a **large volume of rock** excavation;
- Addressing **flooding risks**;
- **Minimising bentonite disposal**;
- Managing interfaces with various follow-on works within a restricted site corridor.

Coping with large volume of rock excavation

One of the significant challenges of the project was the extensive **presence of rock; it constituted some 45% of the total excavation volume**, and it also **impacted the procedure to insert the stopend into the deep rock socket**. Several mitigation measures were implemented to **minimise the risk of stop ends becoming trapped in the rock socket**:

- Increasing tolerance on the verticality of diaphragm wall panel excavation to minimise relative displacement between adjacent panels;
- Use of polyfoam/plywood backing and PVC pipes on the ends of stop ends;
- Enhancing existing tools for removing stop ends after the panels are cast.

Preventing flooding risks

Another critical area was executing works in the **floodplain** of the Yarra River, which is prone to seasonal flooding. This posed several **challenges for the design and constructability of the diaphragm wall panels**, particularly at the northern end of the cut-and-cover structure where the panels are the deepest.

KVJV collaborated with main contractor SPARK CJV to safeguard resources and operations during flooding. For key items of plant, this included:

- Installing items of plant permanently in elevated positions;
- Moving large items of plant to designated refuge areas;
- Uncoupling and lifting various pumps in the bentonite plant to elevated positions using davit arms with chain blocks.

Minimising bentonite disposal

Managing the use of bentonite was another critical aspect due to the geological conditions, with sandstone that is apt to break down into very fine particles and affect the bentonite performance, increasing the quantity that had to be disposed of. This was mitigated by **implementing a centrifuge and doubling the reuse of bentonite, thus reducing disposal volumes by 75%**.

Maximising performance and productivity

VSL's **bespoke digital applications were employed to maximise performance, simplify work, and enhance productivity, saving significant time** in editing and reconciling data.

The TIO app was deployed to **monitor progress and excavation productivity**. Installed on tablets used by excavation machine operators, the app allows operators to log their activities in real-time. The system records the timing of each activity, and this data is stored for comprehensive analysis by project engineers and managers. Later, the technical centre can also access this data to **derive accurate excavation rates**, ensuring precise tracking and **optimisation** of the excavation process.

QuickConnect was used to **streamline QA documentation related to diaphragm wall reinforcing cage inspections and the concrete record for casting panels**. Specifically, a digital checklist facilitates **efficient and quick inspections**

of each specially designed cage. This process includes online validation and client signatures, **ensuring transparency and accountability**.

The North East Link project also served as a pilot for implementing QuickConnect **on the bentonite test records**. The aim of this initiative was to enhance the **understanding and documentation of the bentonite quality process**. By recording and visualising the entire process on graphs, **the project team achieved significant improvements in bentonite quality and reduced waste on site**.

The project started on 11 February 2022 and was completed on 3 April 2025.

VSL's bespoke digital applications were employed to maximise performance, simplify work, and enhance productivity, saving significant time in editing and reconciling data.

OXLEY TOWERS

LIFTING TWO BRIDGES FOR A LANDMARK DEVELOPMENT

Located in the heart of Kuala Lumpur's Golden Triangle and close to the iconic Petronas Twin Towers, Oxley Towers KLCC is a freehold development featuring **three towers linked by a retail podium**; two towers with hotel and residential accommodation, and an office tower.

VSL Malaysia drew on its **expertise in heavy lifting** to play a crucial role in the construction of Oxley Towers. Drawing on high-profile references such as the Petronas Towers and the Merdeka 118 Tower, **VSL erected two link bridges to heights of 250 metres and 190 metres above ground, connecting the towers in this dense and vibrant area**.

Collaborating with the main contractors BUCG and Eversendai Engineering, VSL provided **key input to the design and methods necessary for the heavy lifting operations**. This included selection of specialist equipment to suit the structure's design. **VSL supplied both the machinery and expertise**, leveraging resources from its equipment workshop in Switzerland, alongside its local team in Malaysia.

The heavy lifting operations employed a strand jacking system, allowing for **precise lifting and orientation of the bridges**. This method not only enhanced **safety but also minimised the use of cranes**, freeing them up to support the ongoing tower construction.

The project began on December 14, 2023 and the design and heavy lifting operations were successfully completed on June 11, 2024.

DATE
2023 - 2024

LOCATION
Kuala Lumpur, Malaysia

OWNER
Oxley Holdings

MAIN CONTRACTOR
BUCG (M) Sdn. Bhd. / Eversendai Engineering Sdn. Bhd.

ENGINEER
Mohamad Firdaus

DESIGNER
Eversendai Engineering Sdn. Bhd.

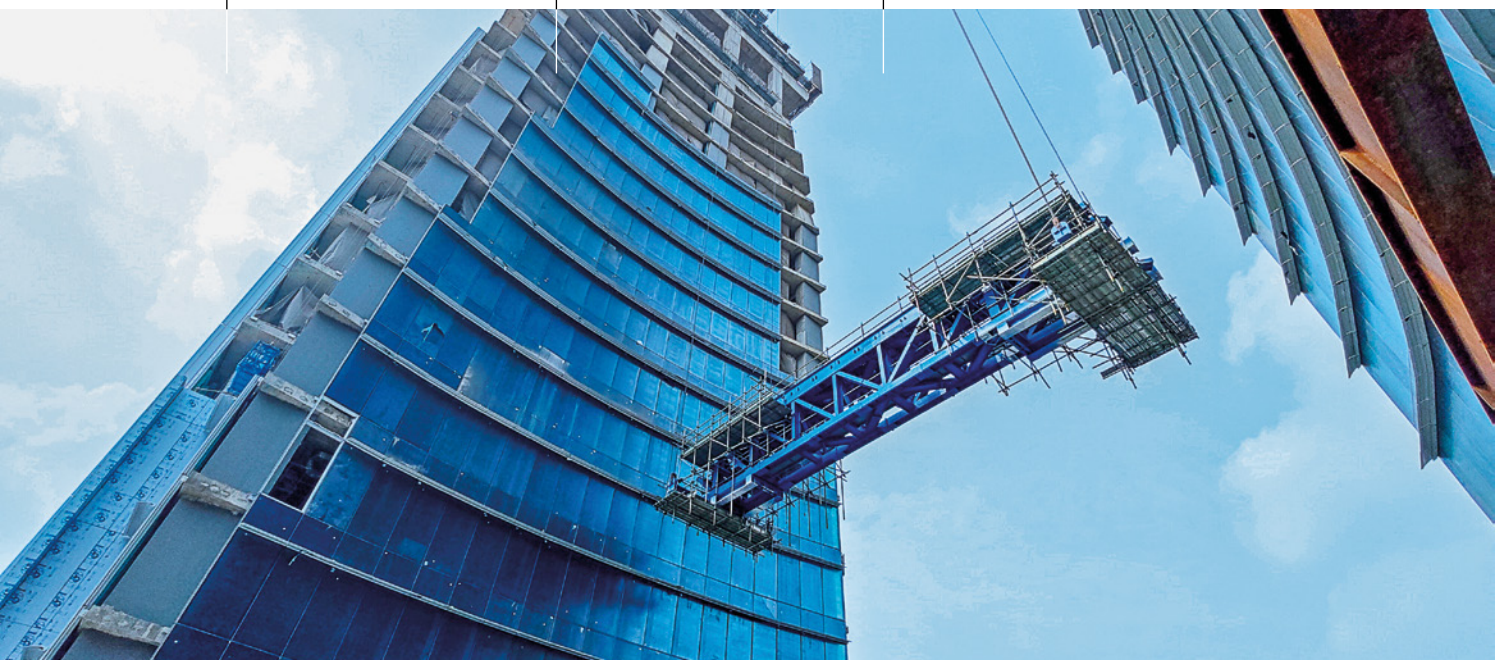
CONSULTANT
T.Y Lin International Sdn. Bhd.

SCOPE OF WORKS

Supply and installation of heavy lifting equipment

Technical support for heavy lifting work

KEY FIGURES
- Weight of upper bridge: 65.6 tonnes
- Weight of lower bridge: 330 tonnes



MOCHIT COMPLEX

LIFTING SIX SECTIONS OF A 31-METRE-LONG STRUCTURE TO 110 METRES ELEVATION

The Mochit Complex, a landmark undertaking in the bustling metropolis of Bangkok, Thailand, involved the **construction of two high-rise buildings connected by intricate Sky Bridge structures**. This ambitious project, situated in the vibrant Chatuchak district, will provide a modern, mixed-use development.

A balancing act of engineering and precision

The Sky Bridge structures span 31.4 metres between the towers and consist of 3.3-metre-deep steel floor trusses. These colossal structures with a combined total weight of 1,203 tonnes, were lifted from the ground level to a height of 110 metres in six separate pieces. The operation demanded a delicate balance of engineering expertise, precision execution and meticulous planning.

VSL Thailand was the ideal choice to tackle this formidable challenge; our expertise in designing temporary structures, supervising steel fabrication, and executing complex lifting operations proved central to the project's success.

Key challenges and innovative solutions

The project presented several significant challenges, including:

- **Design iterations:** multiple design revisions were necessary to accommodate evolving client requirements.
- **Fabrication delays:** issues with connection tolerances led to delays in the steel fabrication process.
- **Equipment maintenance:** the operations employed **16 lifting and sliding jacks of varying capacities**, which required meticulous and consistent maintenance.

DATE
2022 - 2024

LOCATION
Bangkok, Thailand

OWNER
Mochit Land Company Limited

MAIN CONTRACTOR
Sino-Thai Engineering and Construction PLC

CONSULTANT
CEL Engineers Company Limited

ENGINEER / DESIGNER
VSL Thailand Co., Ltd.

SCOPE OF WORKS

Design of temporary works for the lifting operations

Design checks of permanent structures subjected to transient loads during lifting

Supervision of steel fabrication and installation including full-scale load test

Heavy lifting operation

KEY FIGURES

- Maximum lifting height: 110 metres (from floor 10 to floor 36)
- Number of steel trusses lifted: 6 truss elements which were lifted separately then assembled to form the floors of the Sky Bridge.
- Total weight: Floor trusses of 676 tonnes and 527 tonnes, total 1,203 tonnes
- Total Sky Bridge floor area: 880 m^2 (floor 33); 1,030 m^2 (floor 36)
- Number of strand jacks: 12 VSL SLU jacks with capacities varying from 40 tonnes to 120 tonnes
- Span length of lifting trusses: 38.7 metres
- Lifting operation period: 3 months

To overcome these hurdles, VSL employed a range of solutions:

- **Temporary lifting trusses:** the use of temporary lifting trusses spanning over the towers provided flexibility and efficiency.
- **Collaborative approach:** close collaboration between VSL, the client and technical support teams ensured effective problem-solving and project management.
- **Equipment monitoring:** rigorous procedures were implemented to monitor the behaviour of lifting trusses and maintain equipment performance. **All units could be operated either manually** or **remotely with millimetre-accurate precision-control**. This precise coordination was achieved by **the use of specially designed computer-based multi-point monitoring systems**.

VSL Thailand successfully navigated the project, delivering exceptional results. The project began on September 21, 2022, and was completed on October 21, 2024.

The 1,203-tonne Sky Bridge, spanning 31.4m, was lifted in six pieces to 110m, requiring precise engineering and planning.

KINGBRIDGE TOWER

LIFTING KINGBRIDGE TOWER'S SKY LOUNGE 150 METRES FROM GROUND LEVEL

The KingBridge Tower, a high-rise landmark in Bangkok, Thailand, required a complex and delicate construction process. **One of the most challenging aspects was the installation of the cantilevered floor slab for the Sky Lounge** - a task that demanded specialist expertise in heavy lifting and precise engineering. VSL Thailand was entrusted with this critical operation, based on its extensive experience and innovative solutions.

VSL's scope of work encompassed the **design of temporary structures, supervision of steel fabrication and installation, and the execution of the heavy lifting and sliding operations for the floor truss segments**. VSL's involvement was pivotal in ensuring the successful completion of this complex project.

Overcoming engineering challenges

The project presented several technical hurdles. **One major challenge was the large cantilever of the floor slab**, which required innovative solutions to optimise the temporary works. VSL addressed this by **installing two sets of stay cables to reduce the cantilever effects**.

Another complex procedure was the operation to slide the lifting frame and suspended floor truss transversely into position, a distance of 21 metres parallel to the building and 13 metres towards it. This required precise coordination and synchronisation of all operations to ensure success.

DATE
2023 - 2024

LOCATION
Bangkok, Thailand

OWNER
Saha Capital Tower Co., Ltd.

MAIN CONTRACTOR
Thai Obayashi Corporation Limited

ENGINEER / DESIGNER
VSL (Thailand) Co., Ltd.

CONSULTANT
Stonehenge Inter Public Company Limited

SCOPE OF WORKS

Design of lifting frames and sliding rail beams to carry out the heavy lifting operations

Supervision of steel fabrication and installation

Heavy lifting operations

KEY FIGURES

- Total weight of floor trusses: 226 tonnes
- Maximum lifting height: 151 metres
- Number of steel trusses lifted: 3
- Maximum cantilevering distance of lift load: 13 metres
- Maximum transverse sliding distance: 25 metres
- Number of stay cables at the end of lifting frame: 2 (7 strands each)
- Number of strand jacks: 2 VSL SLU jacks (120 tonne capacity)
- Lifting operation period: 1.5 months

151 metres from ground level

Combining a sophisticated heavy lifting system, levelling control units, temporary cable-stayed systems and expert personnel, VSL Thailand's involvement was crucial in overcoming these challenges. It enabled precise control of the lifting operations, **stabilising the trusses as they were raised all the way from ground level to the 39th floor at a height of 151 metres**.

Ten highly-trained professionals were involved, with expertise in heavy lifting, working at height and safety rigging.

Despite initial delays in the design and fabrication of steelwork, VSL's efficient problem-solving and collaborative approach allowed the project to stay on track by resolving issues promptly and involving all parties in discussions to agree the proposed solution.

The KingBridge Tower Heavy Lifting project began on March 23, 2023, and was completed on October 22, 2024.

Precise coordination was required to slide the lifting frame and suspended floor truss 21m parallel to the building and 13m towards it.

DEW PENANG CONDOMINIUM

BRINGING EXPERTISE IN DESIGN AND CONSTRUCTION OF A TRANSFER PLATE FOR A 31-STOREY BUILDING

The state of Penang on the northwest coast of Peninsular Malaysia includes Penang Island - home to the historic tourist destination of George Town - and Seberang Perai on the mainland. With a population of 1.74 million, it is one of the country's most densely populated and urbanised states.

VSL's project was part of the Dew Penang housing development, an affordable housing project initiated by PLB Land. This **31-storey building** includes 281 residential units and four retail units, and is intended to address the housing needs of Penang's growing population.

VSL Malaysia played a key role in supporting the main contractor, PLB Bina Sdn Bhd, by providing expertise in the **design and construction of the transfer plate on level nine, in a 1,680 m² area**. A transfer plate **helps redistribute loads from one structural system to another** and in this multi-storey building, it was designed to **efficiently transfer the loads between the walls and columns on adjoining levels that have different floor plans**.

VSL Malaysia's involvement included **managing the construction sequence, detailing the design**, and ensuring that all key considerations were addressed to avoid construction delays and ensure safety. **The proper sequence of work proposed by the VSL team was crucial in eliminating rebar clashes and ensuring that the tendons achieved the correct profiles**, resulting in faster and more efficient execution.

DATE
2024

LOCATION
Penang, Malaysia

OWNER
PLB Land Sdn Bhd

MAIN CONTRACTOR
PLB Bina Sdn Bhd

ENGINEER
Michael Tang

DESIGNER
VSL Engineers (M) Sdn Bhd

CONSULTANT
Sri & Sri's Associates Sdn

SCOPE OF WORKS

Post-tensioning works including design, supply and installation

KEY FIGURES

- Area of transfer plate; 1,680 square metres
- Total weight of post-tensioning: 50 tonnes

Additionally, VSL Malaysia recommended the **use of wood formwork** instead of the conventional Hy-rib mesh formwork at construction joints. This **ensured that the tendons could be fully stressed without bursting, reducing the risk of honeycombing** behind the tendons during concreting, especially if concrete compaction had not been fully executed. **The optimised design also reduced the use of rebar**, contributing to **cost savings and a lower carbon footprint**.

The project was completed by a single team of one supervisor and six workers. It began on April 1st, 2024, and was successfully completed on August 30th, 2024.

PROMINENT HILL MINE WINDER BUILDING

OPTIMISING UNDERGROUND MATERIAL EXTRACTION WITH SPECIALIST ANCHORING SOLUTIONS

As part of ongoing developments at the Prominent Hill Mine in South Australia, owner Oz Minerals and its contractor BHP initiated the **construction of a winder building to support a new shaft system**. This system is **designed to enhance the extraction of materials from deep underground, optimising operations compared to the traditional open-pit mining approach**. Located in a remote and demanding environment, the project required careful planning and precise execution.

VSL Australia was selected for its proven expertise in delivering high-quality technical projects, particularly in challenging and isolated conditions, **the task being to drill, install, and test deep anchors to ensure the structural stability of the winder building**. The mine is situated in the **remote and arid northern Woomera region of South Australia**. It is 800 kilometres north of Adelaide and can only be accessed by gravel all-weather road and by air. The fact that it **sits within a sensitive military area** added the need to **coordinate onboarding security procedures**, and **temperatures on site exceeded 50 degrees Celsius**. VSL successfully addressed the remote location and additional logistical challenges, and completed stage one of the project ahead of schedule.

Innovative anchoring solutions in a challenging environment

VSL employed its permanent strand anchor system, a proven solution for providing robust support in demanding

DATE
2024

LOCATION
Prominent Hill, South Australia

OWNER / MAIN CONTRACTOR
Oz Minerals/BHP

DESIGNER / CONSULTANT
AECOM

SCOPE OF WORKS

Drilling, installation, and testing of two 20 metre-deep, 20-strand test anchors

Supply and installation of VSL's permanent strand anchor system

KEY FIGURES

- Total weight of strand supplied: 1.8 tonnes
- Total amount of cement: 6 tonnes
- Total length of 19 millimetre-diameter poly pipe: 300 metres
- Total length of 130-150-millimetre-thick corrugated sheathing: 40 metres

conditions. The anchors, **drilled to a depth of 20 metres**, were tested rigorously to ensure they met the high safety and performance standards required by the project. The system was **particularly suited to the remote site, where reliability and ease of installation are paramount**. The efficient execution of these works was crucial in preventing delays and ensuring mining operations could continue without interruption.

Ahead-of-schedule delivery with high standards

The success of the project was largely due to VSL's detailed planning and on-site expertise. The **ground anchors were fabricated off site to minimise the extent to which operatives were exposed to the extreme heat on site**. Plant and materials were brought to site on twin trailer trucks to **reduce the number of truck movements** that were necessary, with site supervisor and project engineers mobilised three days ahead of the plant, materials, equipment, and remainder of the crew. With these staff members in place early, all necessary permits and access issues could be resolved before the full mobilisation. The crew was able to offload, set up and start drilling within 16 hours of the plant arriving on site.

Despite the project's remote location and environmental challenges, stage one of the work was completed ahead of the scheduled date. This timely delivery not only provided immediate value to the client but also laid a solid foundation for the second phase of the work.

Started in April 2024, the project was successfully completed in December 2024.

KOA DENKO FACTORY

DESIGNING AND BUILDING A POST-TENSIONING SLAB FOR A MANUFACTURING FACILITY

Japan-based microchip component manufacturer Koa Denko Corporation has undertaken a significant investment in **building a new facility for its Malaysian subsidiary**, Koa Denko (Malaysia). The new 84,000 square metre factory in Malacca on the site of the previous facility, is intended to boost productivity, improve profitability, and ensure a stable supply chain.

The new complex consists of a **two-storey production building and a five-storey office building and incorporates eco-friendly features** such as solar panels on the roof of the production facility and the car park.

Being an established leader in PT slab design and construction, and noted for adhering to strict safety and quality standards, VSL Malaysia was commissioned **to design, supply, and construct post-tensioning slabs on four levels of the new facility**.

Working alongside the main contractor Kajima (M) Sdn Bhd, VSL Malaysia provided its technical expertise, particularly in **ensuring effective load transfer after the slabs were cast and tensioned**. This precision allowed materials, equipment, and machinery to be safely installed on the slabs, even before the post-tensioning tendons were fully stressed.

During the conceptual design stage, VSL assisted with selection of the most efficient flooring system while providing preliminary sizing and material estimates. VSL Malaysia also proposed

DATE
2024

LOCATION
Malacca, Malaysia

OWNER
KOA Denko Sdn Bhd

MAIN CONTRACTOR / CONSULTANT
Kajima (M) Sdn Bhd

ENGINEER
Yan Shang Qian

DESIGNER
VSL Engineers (M) Sdn Bhd

SCOPE OF WORKS

Design, supply & construction of post-tensioning slabs

KEY FIGURES

— Total weight of post-tensioning: 221 tonnes

slab zoning to mitigate the risk of construction delays, ensuring the PT slabs could be cast without obstruction from non-PT areas.

Our involvement continued through the detailed design stages, **contributing to a sustainable construction process by reducing the need for materials, shortening cycle times, and minimising resource consumption**.

In addition to design and consultation, **VSL Malaysia oversaw the full supply and installation of the post-tensioning materials**, ensuring efficient installation and thorough quality control. One innovation that we implemented was to use colour-coded bar chairs for tendon profiles, simplifying the inspection process and reducing the chance of errors during construction.

A low-carbon solution

The embodied carbon in a structure account for a significant portion of its lifetime carbon footprint, particularly from the construction of floor slabs. **The PT design employed at the new Koa Denko factory reduces the amount of rebar that is used and decreases concrete thickness, leading to material savings and a reduced carbon footprint** - a key benefit in today's efforts to seek sustainable construction solutions.

A dedicated team of two supervisors and 12 operatives began work on the PT slab in March 2024, and the project was completed in September 2024.

BUKIT BATOK ROAD'S WATER TANKS

BOOSTING PRODUCTIVITY WITH A CUSTOM PT DESIGN FOR VERTICAL POST-TENSIONING ANCHORAGES

Singapore's Public Utilities Board (PUB) needed to **build two new water tanks** in Bukit Batok Road **to expand water storage capacity and support the growing needs of the Tengah and Bukit Batok areas**. The scheme will ensure long-term water security in the western part of Singapore.

Engaged by main contractor Chye Joo Construction, **VSL designed, supplied, and installed the post-tensioning systems for both the walls and roof slabs of the tanks, contributing to enhanced water storage capacity** for the Tengah and Bukit Batok areas.

VSL provided a complete package, encompassing design, supply, and installation of PT (PL2) system. PL2 corresponds to a moderate-to-high level of corrosion protection, suitable for most structures in aggressive environments, such as water tanks.

Overcoming design and coordination challenges

To address the complex geometry of the tanks, VSL developed a customised post-tensioning system for the tanks' walls. This included a new, innovative AF anchorage for vertical tendons. Replacing the conventional U-loop design, it also allowed for optimisation of the installation process, which involved 160 vertical tendons per tank.

Additionally, effective coordination with

DATE
2023 - 2024

LOCATION
Bukit Batok Road, Singapore

OWNER
Public Utilities Board (Pub)

MAIN CONTRACTOR
Chye Joo Construction Pte Ltd

CONSULTANT
Bosons Consulting Group Pte Ltd

SCOPE OF WORKS

Design, supply and installation of post-tensioning systems for wall and slab of two tanks.

KEY FIGURES

- PT tonnage: 217.83 tonnes
- Number of tanks: 2
- Number of vertical tendons per tank: 160
- Number of horizontal tendons per tank: 34
- Number of roof slab tendons per tank: 126

multiple stakeholders, including the main contractor and consultant, was essential for smooth project execution.

The project began on November 8, 2023, and was successfully completed on May 31, 2024, demonstrating VSL's expertise in providing comprehensive PT solutions for large-scale water infrastructure.

The innovative AF PT Anchorage for vertical tendons was created to replace the conventional U-loop design, greatly enhancing installation productivity.

FEIJAO WIND FARM

OVERCOMING CHALLENGES WITH PRECISION ENGINEERING AND INNOVATIVE SOLUTIONS

The Feijao Wind Farm is situated in a remote region of Brazil and its construction presented **particular logistical challenges**. The site is 40 minutes' drive from Araripina, the region's largest town, and a further five hours' drive from Petrolina, the largest city in the state of Pernambuco. **This remoteness demanded meticulous planning and execution to ensure timely delivery of materials and equipment**, the main challenge being to bring spare parts and materials to the area. All air transport arrives in Sao Paulo which is three days' travel away by truck, so it was essential to plan with spare equipment for any unforeseen eventuality. VSL was able to draw on its extensive experience in similar projects to successfully navigate these obstacles.

A focus on safety, efficiency and sustainability

Throughout the project, VSL prioritised safety, efficiency and sustainability. **Rigorous training programmes were implemented to ensure adherence to industry best practices and minimise risks when working at height or in confined spaces on wind towers.** The company also explored opportunities to optimise processes and reduce its environmental footprint.

The Feijao Wind Farm project is a testament to VSL's engineering expertise. With a manufacturing and supply phase from July 14, 2023, to March 14, 2024, and the installation phase wrapping up in September 2024, VSL played a pivotal role in bringing this renewable energy project to fruition.

DATE
2023 - 2024

LOCATION
Araripina, State of Pernambuco, Brazil

OWNER
ENEL

MAIN CONTRACTOR / DESIGNER
NORDEX

SCOPE OF WORKS

Tendon manufacturing and supply

Installation, stressing and injection of tendons

KEY FIGURES

- Number of wind turbine towers: 80
- Number of tendons manufactured and supplied: 720
- Weight per tendon: 2.5 tonnes
- Total weight of tendons: 1,800 tonnes
- Number of tendons installed, stressed and injected: 720

EXISTING STRUCTURES

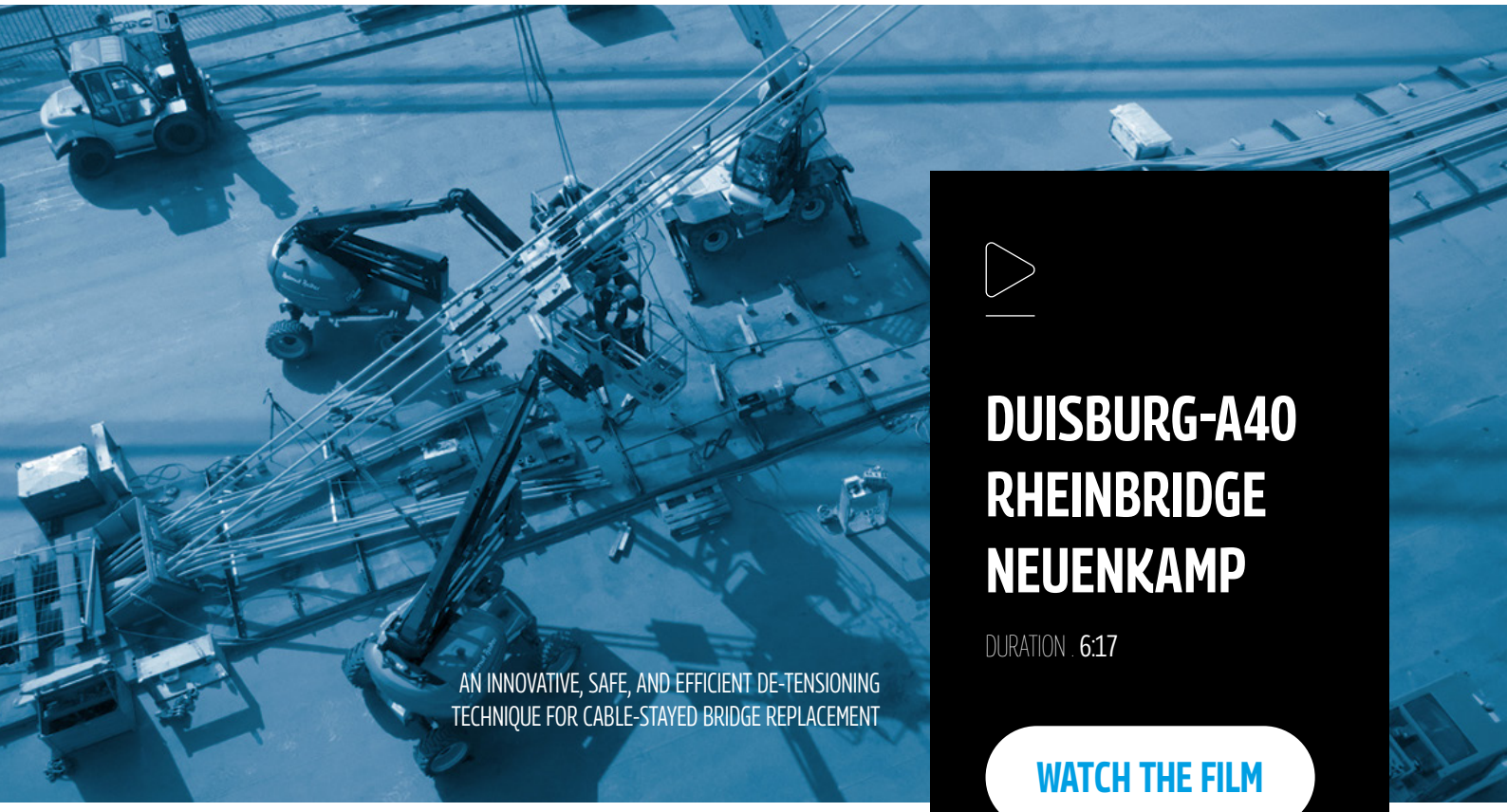
KAROLIN PIPE BRIDGE

DURATION . 4:02

WATCH THE FILM

RACING AGAINST TIME TO SAFEGUARD POZNAŃ'S ENERGY INFRASTRUCTURE

POLAND



DUISBURG-A40 RHEINBRIDGE NEUENKAMP

DURATION . 6:17

WATCH THE FILM

AN INNOVATIVE, SAFE, AND EFFICIENT DE-TENSIONING TECHNIQUE FOR CABLE-STAYED BRIDGE REPLACEMENT

GERMANY

WEST GATE BRIDGE PIER 13

STRATEGIC PLANNING FOR A COMPLEX RESTORATION PROJECT

In 2024, VSL Australia was commissioned by Victoria's Department of Transport & Planning to **carry out critical repair and restoration work on pier 13** of the West Gate Bridge in Melbourne. This project was essential to **improve the durability and ensure the safety of the structure**.

The bridge is a key part of the city's transport infrastructure, connecting Melbourne with its western suburbs, and it requires regular maintenance to ensure its durability and the safety of its users. This repair work was intended to **address signs of aging and to apply a new protective coating system** to extend the life of the iconic structure.

At 48 metres tall, pier 13 is exposed to harsh weather conditions, including strong winds and temperature fluctuations, which accelerate the deterioration of concrete and protective materials.

VSL Australia's scope of work included the **removal of the existing protective coating, execution of concrete repairs and the application of a new, advanced protective coating system** to safeguard the pier against environmental and structural deterioration.

Planning and designing safe access to a challenging structure

The first critical phase of the project involved **designing and installing a safe access and working platform for VSL's staff**. Given the height of the pier, an **enclosed scaffolding system and a working platform were erected**, along with a material hoist for transport of equipment and materials. This arrangement was essential in ensuring the safety of the workers while optimising the efficiency of the operation.

DATE
2024

LOCATION
Melbourne, Australia

OWNER
Department of Transport and Planning - Victoria

MAIN CONTRACTOR
VSL Australia

SCOPE OF WORKS

Design and installation of access and working platform

Protection of services, assets, accessories and fixtures of pier 13

Removal and disposal of the existing protective coating system

Concrete repairs and crack injection on the pier column and pile cap

Supply and application of the new protective coating system on the external faces of pier 13

KEY FIGURES

- Total surface area treated with fairing coating system: 2,200 square metres
- Total surface area treated with six separate coats of protective system: 13,200 square metres
- Number of concrete repairs: 91
- Number of areas requiring cathodic protection: 38
- Total length of epoxy crack injections: 12 metres

An environmentally-conscious removal method

The existing protective coating, which showed significant signs of degradation, was **removed by chemical stripping**. A solvent was applied over a total surface area of 2,200 m², allowed to cure for 48 hours, and then removed with pressure washers. **Runoff water** that was contaminated with the solvent and paint residues, was **carefully managed** using bunding at the base of the pier and treated offsite at a licensed facility, minimising the environmental impact of the operation.

Following the removal of the old coating, repairs were carried out on the damaged concrete areas. **Epoxy injections were used to fill cracks, and galvanic anodes were installed to provide cathodic protection to corroded areas**, enhancing the long-term durability of the structure.

A meticulous application for a long-lasting protection

Once the repairs were completed, **VSL applied a fairing coat to smooth the concrete surface and prepare it for the new protective system**, which was meticulously **applied in six distinct layers** to ensure maximum protection against corrosion and aging. **Two layers of corrosion inhibitor were followed by two layers of anti-carbonation coating, and finally, two layers of UV protection and sealer**, achieving a total thickness of 300 microns.

Managing time and budget constraints

The project presented several challenges, including a tight budget and demanding schedule, which required careful planning and execution. VSL optimised the work programme by **carrying out activities concurrently and scheduling tasks according to weather conditions**, hence minimising delays by high winds at such heights. This approach ensured that deadlines were met without compromising the quality of the work.

VSL's expertise, combined with effective coordination with subcontractors, was crucial to the project's success. Through efficient resource management and continuous monitoring of on-site conditions, VSL delivered high-quality work while adhering to strict safety standards.

By overcoming significant technical and environmental challenges, VSL not only extended the lifespan of this essential structure but also reinforced its reputation as a leader in infrastructure rehabilitation in Australia.

DUISBURG-A40 RHEINBRIDGE NEUENKAMP

AN INNOVATIVE, SAFE, AND EFFICIENT DE-TENSIONING TECHNIQUE FOR CABLE-STAYED BRIDGE REPLACEMENT

The 802-metre-long cable-stayed Duisburg-Neuenkamp Bridge is Germany's longest span cable-stayed bridge, and carries the A40 over the Rhine River near Duisburg. In 2018, Germany's motorway authority announced plans **to replace the aging bridge and double its capacity**. The replacement project is being carried out in a series of phases: construction of a new bridge on temporary piers to the south of the existing structure; demolition of the existing bridge; construction of a northern bridge parallel to the first and finally the displacement of the whole southern bridge by 14 metres towards the northern bridge, into its final position.

Friction dampers: a first in Germany

VSL Switzerland was initially contracted to supply and install stay cables for the new bridge, including friction dampers — the first time they have been used on a cable-stayed bridge in Germany. For this mission, **VSL needed approval from the Deutsches Institut für Bautechnik (DIBt) to use its patented stay-cable system**. This process involved large-scale testing and close collaboration with the Civil Engineering Materials Testing Institute (MPA BS) in Braunschweig, the end client and engineers to ensure they could be confident in the performance of the technology.

VSL was subsequently awarded the heavy-lifting contract which included incremental launching of the steel side span segments for the new stay cable bridge and the operation to lift the large steel deck segments for the main span which was built using the free cantilever construction method.

Cutting-edge innovation for de-tensioning stay cables

To dismantle the old bridge safely, it was essential to relieve the forces in the

DATE
2021 - 2024

LOCATION
Duisburg, Germany

OWNER
DEGES

MAIN CONTRACTOR
Hochtief & MCE

ENGINEER FOR NEW BRIDGE
Leonhardt, Andrä und Partner
Beratende Ingenieure VBI AG

ENGINEER FOR REMOVAL OF OLD BRIDGE
Ingenieurbüro Grassl GmbH

SCOPE OF WORKS

Supply & installation of a new cable-stayed structure

Incremental launching of the side spans

Heavy lifting of main-span's free cantilevered steel segments

De-tensioning the existing cable-stayed structure on the old stay cable bridge

KEY FIGURES

- Length of bridge: 802 metres
- Total number of friction dampers: 160
- 108 cables required de-tensioning, achieved through 54 separate operations, nine of which had to be finished in five-day periods

existing stay cables in a controlled and staged manner as they continued to carry the self-weight of the bridge deck during its reverse-cantilever de-construction. The de-tensioning operation focuses on carefully removing this load from the stay cables so that they can be safely taken off.

A total of 108 cables had to go through the de-tensioning process, and this was achieved through 54 separate operations over six periods, each of which lasted five days. This task was critical for safety, and required the strict implementation of engineered risk control measures in the field to minimise the residual risks for both site staff and the structure.

Conventional procedures for de-tensioning cables rely on friction clamps. **However, VSL introduced an innovative solution that uses a wedge clamp instead, creating a solid confining block around the cable within the de-tensioning assembly. No human intervention is needed to create the clamping force, not only improving safety but also enhancing performance, as the wedge secures the hundreds of wires in each cable.**

Comprehensive testing before on-site implementation

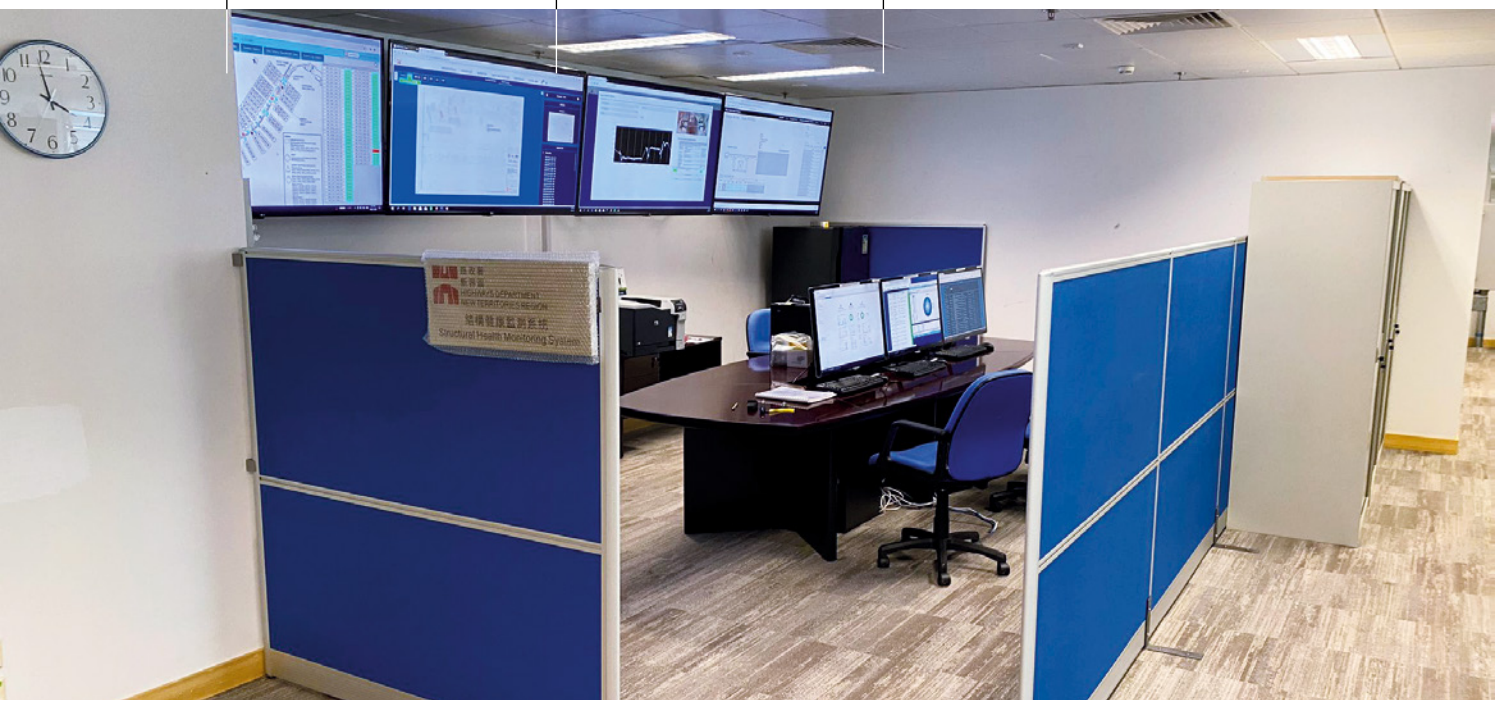
Before implementing the de-tensioning method on site, VSL carried out **comprehensive full-scale testing of the system and the method at the company's testing facility in Switzerland. The operational team was also involved at an early stage, allowing workers and supervisors to familiarise themselves with the entire sequence, and ensuring they were well trained and prepared for the on-site tasks**.

Rapid de-tensioning method with easy-to-deploy equipment

VSL's equipment was designed to be user-friendly, combining standard elements that were easy to operate with specialised tools to improve efficiency. For example, a custom frame was developed by VSL Switzerland's Technical Center and equipment hub to assist with installing the heavy plates of the confining block on the cables. Another tool was designed to help operatives to thread nuts onto bars.

Overall, VSL developed **a safe and rapid dismantling method that was easy to coordinate and could be efficiently performed**. The construction of the southern bridge began in 2021 and was completed in 2023. De-tensioning operations on the old bridge started on July 1, 2024, and were fully completed by October 11, 2024.

VSL replaced friction clamps with an innovative wedge clamp, forming a solid confining block within the de-tensioning assembly. This eliminates manual intervention, enhancing both safety and performance.



HONG KONG LINK ROAD

REHABILITATING THE MONITORING SYSTEM FOR THE 9.4 KILOMETRES HONG KONG LINK ROAD VIADUCTS

The structural health monitoring (SHM) system operating over 9.4 kilometres of land and marine viaducts on the Hong Kong Link Road, which had been in place since 2019, began experiencing equipment failures. A thorough assessment of the third-party-supplied system revealed a range of issues, including:

- **Sensor failures:** a significant number of sensors were malfunctioning or providing inaccurate data.
- **Data logger malfunctions:** data loggers were not recording data reliably, leading to data gaps.
- **Software issues:** software bugs and outdated components were hindering the system's performance.

To address these issues, VSL's team of experts **developed a comprehensive rehabilitation strategy that involved the following key steps:**

- **Condition assessment and repair strategy:** a detailed assessment of the system's components was conducted to identify defective parts and equipment.
- **Equipment replacement:** faulty sensors, data loggers and other components were replaced with high-quality substitutes.
- **Software reconfiguration and database rebuilding:** the system's software was updated and reconfigured to optimise performance and data analysis.
- **Rigorous testing and commissioning:** extensive testing and commissioning were conducted to ensure the system's reliability and accuracy.

DATE
2023 - 2024

LOCATION
Hong Kong

OWNER
Highways department of the Hong Kong Government

MAIN CONTRACTOR
Gammon Construction Limited

SCOPE OF WORKS

Condition survey and rectification plan

Supply and replacement of defective parts & equipment

Reconfiguration of software

Rebuilding of database and user interface

Testing and commissioning

KEY FIGURES

- 1260 sensors
- 56 dataloggers
- 2 servers
- 3 workstations
- 3 major software systems
- Quantity of defective equipment
  - 73 sensors
  - 15 dataloggers
  - One major software system

Overcoming challenges and delivering results

VSL's experienced team successfully navigated challenges such as coordinating with traffic management and accessing the bridge infrastructure to examine the equipment. **Using its knowledge of the SHM data flow in the individual sensor systems, VSL provided a software-based intervention rather than having to reinstall the entire system. This action reduced the amount of data that was lost and the time taken to rehabilitate the monitoring system.**

VSL delivered a comprehensive system upgrade that significantly enhanced the SHM system's performance and reliability, **increasing the monthly data collection rate from 75% to 98% and reducing the need for site inspections from twice a week to twice a month**.

VSL's commitment to infrastructure safety and reliability

VSL successfully carried out the rehabilitation of the Hong Kong Link Road's SHM system between July 27, 2023, to 18 April 2024.

GPS MONITORING SYSTEMS OF LONG-SPAN CABLE-SUPPORTED BRIDGES IN TSING MA CONTROL AREA

MODERNISING HONG KONG'S BRIDGE MONITORING SYSTEMS WITH INNOVATIVE TECHNOLOGY

VSL has successfully completed a significant project to **rehabilitate the GPS monitoring systems for several critical bridges in Hong Kong: Tsing Ma Bridge, Kap Shui Mun Bridge and Ting Kau Bridge**. The project, undertaken in two phases, aimed to modernise the existing systems and ensure the continued safety and reliability of these critical infrastructure assets.

Addressing aging infrastructure with advanced technology

The aging GPS monitoring systems, which had been in operation since 2000, **required a comprehensive overhaul to address equipment failures and maintain accurate structural health assessments**. VSL's team of experts was tasked with **replacing outdated components, upgrading the communication network and installing advanced monitoring software**.

Overcoming technical challenges and ensuring seamless integration

A **key challenge in this project was the integration of the new system with the existing infrastructure**. VSL engineers carefully planned and executed the installation process to **minimise disruption and maintain seamless operation**. Additionally, the team addressed complex technical issues, such as **data conversion and calibration, to guarantee accurate and reliable data collection**.

DATE
2023

LOCATION
Hong Kong

OWNER
Highways Department of the Hong Kong Government

MAIN CONTRACTOR
TIML MOM Limited

SCOPE OF WORKS

Supply and installation of GPS equipment: new GPS reference station, receivers and antennae

Communication network upgrade: installation of new communication network infrastructure

Server and workstation setup: rack-mounted application server, 42U computer server racks and operator workstations

Software development and implementation: customised software for data display and management

Removal of old equipment: removal of temporary brackets and existing GPS antennae

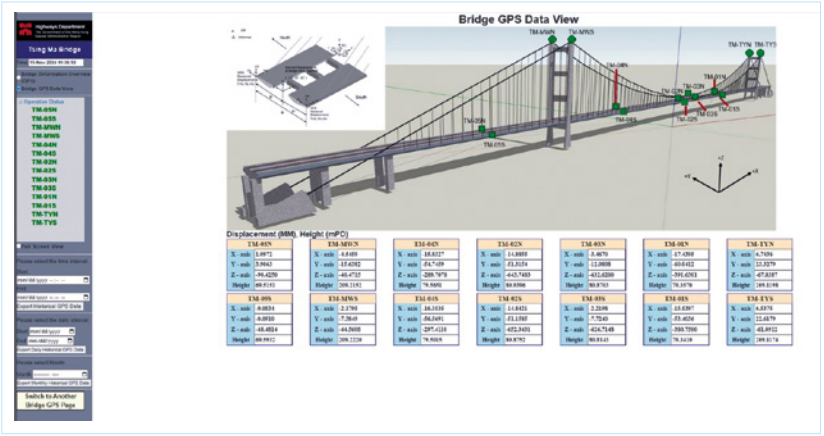
KEY FIGURES

- 29 GPS rover
- 2 GPS reference
- 1 GPS server
- 1 GPS workstation
- 1 GPS software system

Ensuring infrastructure safety and reliability

The upgraded GPS monitoring systems will provide valuable insights into the structural behaviour of the bridges, enabling timely maintenance and preventative measures.

VSL's successful rehabilitation of the GPS monitoring systems for Hong Kong's long-span cable-supported bridges from February 1, 2023, to September 30, 2024, underscores the company's expertise in structural health monitoring and its dedication to ensuring the safety and reliability of critical infrastructure.



The upgraded GPS monitoring systems will provide valuable insights into the structural behaviour of the bridges, enabling timely maintenance and preventative measures.

KING FAHD CAUSEWAY

ASSESSING STRUCTURAL INTEGRITY IN A VITAL INFRASTRUCTURE ASSET

Completed in 1986, the King Fahd Causeway is a 25-kilometre-long transportation link between Saudi Arabia and Bahrain. As such, it plays a key role in promoting economic and social development between the two countries, facilitating trade, tourism and cultural exchange.

To ensure the bridge's continued safety and reliability, a comprehensive inspection of the post-tensioning system was necessary to assess its condition, identify potential problems and take action to address them.

Advanced inspection techniques for a comprehensive evaluation

The inspection team employed **a combination of advanced techniques to gather comprehensive data on the bridge's condition**:

- **Ground-penetrating radar (GPR):** GPR was used to scan the carriageway and VSL partnered with specialist consultant Bridgology to post-process the radargrams to identify potential hot spots of deterioration.
- **Crossbow testing:** Crossbow tests were conducted to **measure the tension in the post-tensioning tendons**.
- **Inspection windows:** Access points were created to allow a more **detailed examination** of specific areas of the bridge.
- **Ultrasonic pulse velocity (UPV) scanning:** UPV scanning was used to **evaluate the condition of the concrete around the post-tensioning tendons** and identify the presence of any voids in the duct.
- **Laboratory testing:** Samples of **concrete and steel** were taken for laboratory analysis to identify any signs of contamination.

DATE
2024

LOCATION
Al Khobar and Bahrain, Jasra, KSA

OWNER
King Fahd Causeway Authority

CONSULTANT
Egis Middle East

SCOPE OF WORKS

Carrying out GPR scanning activities

Advanced data processing by Bridgology to detect hotspots

Preparation of in-depth inspection plans

Carrying out in-depth inspections at site:

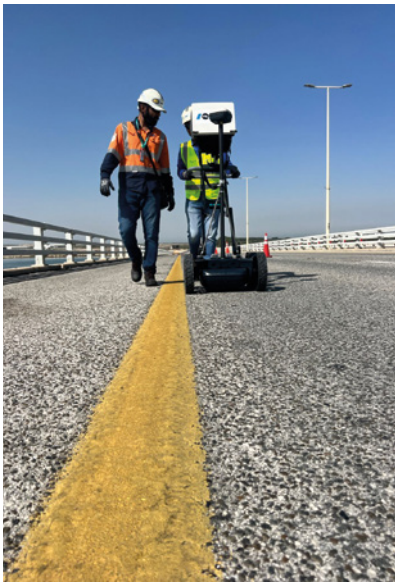
- Crossbow testing
- Inspection windows
- UPE scanning
- Lab testing

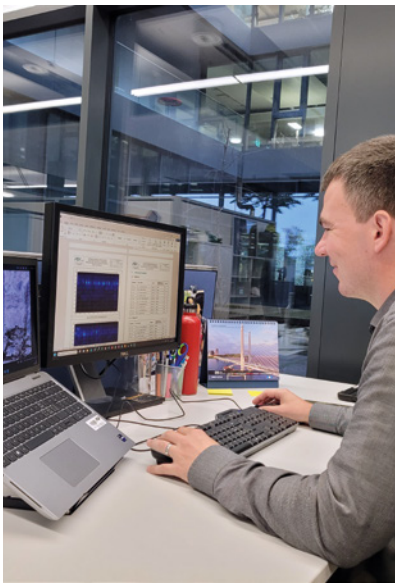
Preparation of a summary and comprehensive report detailing the condition of the bridge post-tensioning system

KEY FIGURES

— Number of bridges: 5
— Number of flyovers: 2
— Total bridge deck GPR scanning length: 125 kilometres
— Total length of web GPR scanning: 8 kilometres
— Number of crossbow tests: 10
— Working in two countries

The inspection began on January 1, 2024, and was successfully completed on October 30, 2024, providing valuable insights into the bridge's structural health and remaining lifespan. The data gathered will **inform future maintenance and repair plans**.





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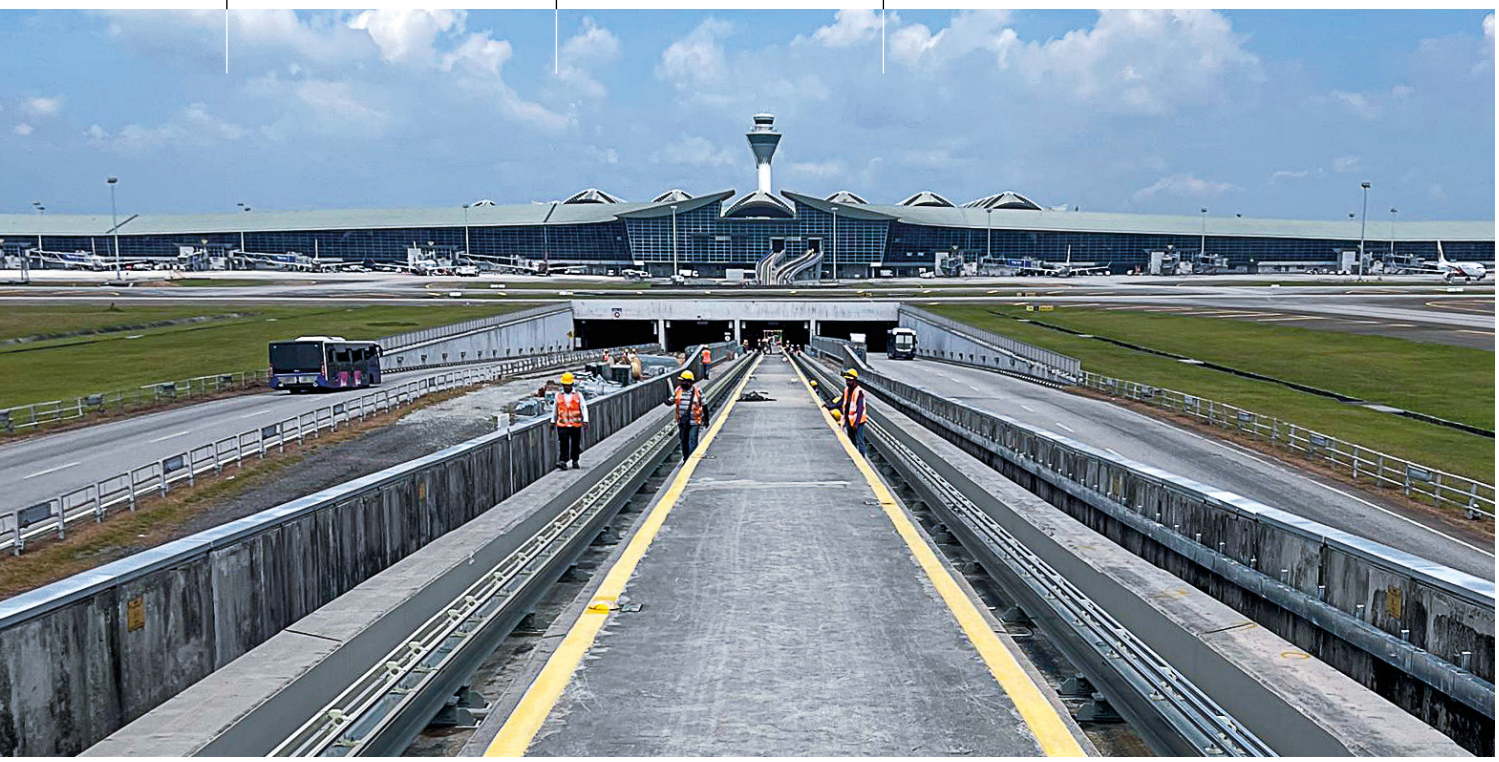


KUALA LUMPUR INTERNATIONAL AIRPORT - AEROTRAIN GUIDEWAY

PROVIDING EXPERTISE IN STRUCTURAL ASSESSMENT AND AEROTRAIN GUIDEWAY RENOVATION

The Kuala Lumpur International Airport Aerotrain Guideway project, initiated by Malaysia Airport Holdings Berhad, aimed to enhance passenger ride comfort by **replacing the existing 20-year-old aerotrain**. This comprehensive scheme by main contractor IJMC-Pestech JV made use of the structural assessment and repair expertise of VSL, particularly in the complex domain of bridge infrastructure.

VSL Malaysia played a key role in the project, conducting **a thorough structural design assessment of the existing guideway structure, which includes 40 spans and bearings**. The team's proficiency extended to **executing repairs of the cracks and spalling that were identified**, with a focus on **achieving the structural integrity** necessary to accommodate the new aerotrain system. **Finite element analysis was used to carry out the structural assessment, evaluate the guideway's capacity** and identify deficiencies. Additionally, the team conducted **vibration and ride quality tests before the work was carried out, to establish a benchmark against which the final quality of the ride could be measured**. This was done to ensure optimal performance.

The repair phase involved addressing identified defects, **installing 58 replacement pot bearings and 18 replacement elastomeric bearings, and strengthening the existing elevated guideway structure**.

DATE
2022 - 2024

LOCATION
Sepang, Malaysia

OWNER
Malaysia Airport Holdings Berhad (MAHB)

MAIN CONTRACTOR
IJMC-Pestech JV

ENGINEER
Jacobs Engineering Malaysia Sdn Bhd

CONSULTANT
KL Prima Consult Snd Bhd

SCOPE OF WORKS

Structural design assessment of existing guideway structure

Repairs to structural members of existing guideway

Strengthening existing elevated guideway structure

Vibration and ride quality test

Bearing component checking and bearing replacement

KEY FIGURES

- 1 kilometre length of 20-year-old aerotrain guideway
- 40 spans
- 58 nos of pot type bearing, 18 nos of laminated elastomeric bearing

Engineering for structural longevity

The workforce on the project included one VSL engineer, two supervisors, a safety officer, and nine skilled labourers, all specially trained in retrofitting and repair techniques.

The work began on March 12, 2022, and was successfully completed on February 29, 2024. VSL's combination of specialist know-how, and efficient project management was central to the successful delivery of the work.

Noise testing inside aerotrain.

SULTAN ABDUL HALIM MUADZAM SHAH BRIDGE (PENANG 2 BRIDGE)

ASSESSING THE STRUCTURAL INTEGRITY OF A CABLE-STAYED BRIDGE

The Sultan Abdul Halim Muadzam Shah Bridge, more commonly known as the Penang Second Bridge, is a dual carriageway toll bridge that connects mainland Peninsular Malaysia to Penang Island. As only the second bridge built to the island, it is considered **one of the region's key infrastructure links**.

With a total length of 24 kilometres of which 16.9 kilometres is over water, it is **Malaysia's longest bridge and the second longest in Southeast Asia**, surpassed only by the Saifuddien Bridge in Brunei.

The bridge features a three-span cable-stayed structure, with a 240-metre-long main span and two side spans each 117.5 metres long. Multi-strand cables ranging from 22 metres to 131 metres long support the deck. The bridge has four pylons, each rising to a height of 60.9 metres, which provide structural stability.

Bridge concessionaire Jambatan Kedua Sdn Bhd **commissioned a comprehensive inspection of the cable-stay systems and selected VSL Malaysia for the task**, leveraging the company's knowledge as the original designer, developer, and installer of the cable-stayed structure, which was opened in 2014.

With the support of the VSL Technical Centre in Singapore, VSL Malaysia conducted a detailed inspection of the bridge's cable-stay systems. The

DATE
2023 - 2024

LOCATION
Pulau Pinang, Malaysia

OWNER
Jambatan Kedua Sdn Bhd (JKSB)

MAIN CONTRACTOR
VSL Engineers (M) Sdn Bhd

CONSULTANT
Evenfit Consult Sdn Bhd

SCOPE OF WORKS

Inspection of the cable-stayed structure

KEY FIGURES

— Number of cable-stayed spans: three
— Number of towers: four
— Height of towers: 60.9 metres
— Length of cables: from 22 metres to 131 metres

inspection covered key components including:

- **Deck:** cable profiles, deformations, AVP (anti-vandalism pipe), and dampers.
- **Below deck:** anchorage, bearing plate, anchorage protection cap, strands, and wedges.
- **Pylon:** cable attachments to pylons and the tension ring.

The inspection was carried out in a challenging environment, requiring **strict adherence to safety protocols in a high-security working area, amidst busy traffic and against adverse weather conditions including strong winds and heavy rain**. To cope with these conditions, **the VSL team designed and deployed a tripod lifting frame to facilitate the lifting activities that were required for on-deck damper inspections**.

The inspection findings allowed the current condition and structural integrity of the cable-stay systems to be assessed.

Five supervisors and five operatives were mobilised to carry out the inspection, which began on October 28, 2023. The project was successfully finished on June 25, 2024, after the EOT approval.

PUENTE CENTENARIO

SAFEGUARDING AN ICONIC BRIDGE OVER THE PANAMA CANAL WITH A COMPREHENSIVE INSPECTION

The Centenario Bridge, a **vital artery connecting Panama City to Arraijan and spanning the Panama Canal**, has undergone a **meticulous inspection and maintenance project led by VSL**. Commissioned by the Ministry of Public Works (MOP), this ambitious endeavour aimed to **assess the overall condition of the bridge and ensure its longevity**.

State-of-the-art technology and innovation to overcome the complexity of the project

VSL **deployed a sophisticated array of tools and technologies** to conduct a thorough examination of the bridge's intricate components, including anchorages, stay cables, external post-tensioning tendons, bearings and auxiliary ventilation systems. Advanced equipment such as **stay cable cleaning machines, inspection robots and electromagnetic conductivity testing provided unprecedented levels of precision and detail, allowing for a detailed understanding of the bridge's health**.

One of the most critical challenges encountered was the large amount of data to be recorded and processed. To address this complexity, VSL implemented a robust digital data management system. This system facilitated efficient data collection, analysis and interpretation, empowering the team to make informed decisions throughout the project.

A flawless assessment: the results of rigorous inspection

The findings of the inspection were comprehensive. **VSL's team successfully removed 17 tonnes of wax, inspected 256 anchorages, cleaned and**

DATE
2024

LOCATION
Over the Panama Canal, between Panama City and Arraijan, Panama

OWNER
MOP (Public Works Ministry)

MAIN CONTRACTOR
Centroequipos

SCOPE OF WORKS

Detailed inspection of all anchorages

Cleaning and inspection of the stay pipes

External PT tendons inspection

Bearings inspection

AVP refurbishment

KEY FIGURES

- 17 tonnes of wax removed
- 256 anchorages inspected
- 16 kilometres of stay pipes cleaned and inspected
- 128 AVP refurbished
- 43 external PT tendons inspected

inspected 16 kilometres of stay cables, refurbished 128 auxiliary ventilation systems, and assessed 43 external post-tensioning tendons. This meticulous evaluation provided a detailed snapshot of the bridge's condition, highlighting areas requiring attention.

Ensuring a sustainable future: the importance of preventative maintenance

This project marked the third detailed inspection of the Centenario Bridge since its inauguration in 2004. By proactively identifying potential issues and recommending timely maintenance, VSL has played a pivotal role in ensuring the long-term viability of this critical infrastructure.

The successful delivery of the Centenario Bridge project took place between May 1 and December 20 2024.

VSL Mexico implemented a digital system for efficient data collection, analysis and interpretation, enabling informed decision-making throughout the project.

VIADUCT EN308

FROM INITIAL REPAIRS TO THE FINAL STRENGTHENING OF THE VIADUCT

VSL Portugal was appointed in 2020 to repair the concrete on the piers and deck of Viaduct EN308 near Braga in the north of Portugal, to replace bearings, and reinforce the piers with external post-tensioning. The initial contract included excavating the pier bases to carry out waterproofing - a task that **revealed significant issues with the pier foundations**.

In 2023, the motorway concessionaire, BRISA, recognising the critical nature of the deficiencies, issued a second tender to **repair and reinforce the foundations of the piers**. VSL Portugal was again selected, securing a contract with a 14-month duration. This phase presented numerous challenges, including **severe weather conditions** during the winter of 2023, which hampered the **excavation and earthmoving efforts that were critical for accessing and repairing the pier foundations**.

External post-tensioning

Throughout both project phases, VSL's expertise in post-tensioning proved invaluable for **strengthening the top of the columns** using Y1050 bars and steel elements. The technical know-how and precise execution of this method ensured the structural integrity of the viaduct, **addressing severe cracks at the top of the columns and deck piers, visible deterioration and underlying foundation issues**.

The second phase work involved using **post-tensioning bars to repair, restore and strengthen the concrete founda-**

DATE
2020 - 2024

LOCATION
Braga (North of Portugal)

OWNER
BRISA

MAIN CONTRACTOR
VSL Portugal

ENGINEER / DESIGNER / CONSULTANT
Perry da Camara

SCOPE OF WORKS

Concrete repairs

Painting

Abutment drainage repairs

Waterproofing

Bearing replacement

Excavation

Pier foundation reinforcement and repairs

KEY FIGURES

— Number of piers repaired and strengthened: 36
— Viaduct length: 635 metres

tions that had suffered damage from alkali-silica reaction.

The first phase of the project was completed within the stipulated time frame in 2021, despite the challenges posed by the Covid-19 pandemic. The second phase, which began in early 2023, was completed in 2024.

After excavating the pier bases for waterproofing—revealing major foundation issues—VSL repaired the concrete, replaced bearings, and reinforced the piers with external post-tensioning.

ZÊZERE BRIDGE

STRENGTHENING A VITAL CONNECTION USING INNOVATIVE REINFORCEMENT TECHNIQUES

Built in 1993, this bridge in central Portugal rises 100 metres above the Zêzere River, linking the municipalities of Ferreira do Zêzere and Vila de Rei. It spans 385 metres across the Castelo de Bode dam reservoir and includes a 224-metre central concrete arch. The bridge plays an important role in regional mobility and connectivity.

After more than three decades in service, structural wear made intervention necessary. The project restored the bridge's structural integrity and extended its operational lifespan.

A key link in central Portugal's transport network

The Zêzere Bridge connects the districts of Santarém and Castelo Branco, serving local communities and regional logistics. With 19 spans, 18 pier alignments, and a 10.5-metre-wide deck supporting two traffic lanes and pedestrian walkways, the bridge plays a key role in local transportation. Its location above the reservoir adds to the technical complexity of the project.

Engineering solutions and access strategy

The project required careful coordination among the teams involved. One major challenge was providing underdeck access without disrupting traffic or river navigation. A multidirectional scaffolding system, cantilevered from both the arch and the deck, enabled safe and efficient access. Material deliveries were aligned with work cycles, and scaffolding was installed at a rate of one span per week.

DATE
2023 - 2024

LOCATION
Ferreira do Zêzere and Vila de Rei, Portugal

OWNER
Infraestructuras de Portugal

MAIN CONTRACTOR
VSL

CONSULTANT
LCW

SCOPE OF WORKS

External and internal post-tensioning (cables and bars)

Reinforcement of the deck, carbon fibre and concrete deck overlay

Protection and reinforcement of slopes (soil nails), and drainage works

Crack injection and concrete repairs

Replacement of bearings, safety barriers and expansion joints

Surface coating for enhanced durability

Deck waterproofing and new pavement

New sidewalks and handrails

KEY FIGURES

- Bridge height above riverbed: 100 metres (water level 60 metres)
- Total length: 385 metres
- Central arch span: 224 metres
- Spans ranging from 14 to 21 metres

To access the arch, a suspended structure was designed to travel along its length, ensuring continuous and protected access for the workers.

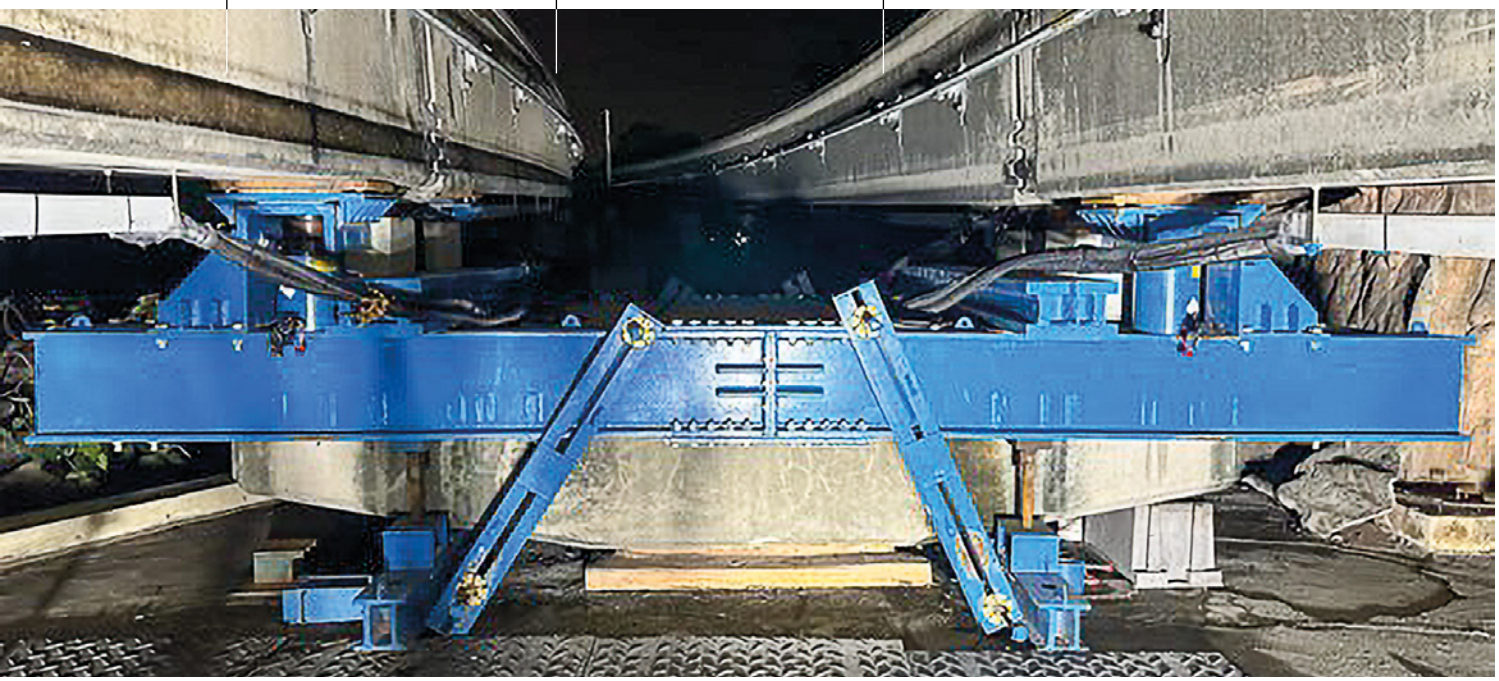
Post-tensioning, crack injection and structural work

The works included installing and tensioning 16.5 tonnes of external longitudinal post-tensioning cables and over 11 tonnes of conventional reinforcement steel. More than 15,000 linear metres of cracks were sealed or injected. Sixteen elastomeric bearings were replaced, the deck was reinforced with a new concrete overlay, and 17,000 square metres of protective coating were applied to the exposed surfaces. Anchor blocks and deviators for the post-tensioning system were cast using specific methods to support installation and structural performance.

Digital monitoring and productivity gains

Real-time monitoring tools were used to track productivity and adjust work cycles. With a data-driven approach, construction methods were refined and resources optimised weekly. Initially, each span required 325 man-hours over six days. By introducing preassembled cable kits and adapting formwork strategies, this was reduced to 232 man-hours over five days, contributing to timely and cost-efficient delivery.

Works began on June 14, 2023, starting with the northern half of the bridge. In February 2024, work shifted to the southern section. The project was completed on November 12, 2024.



SENTOSA EXPRESS MONORAIL TRACK

SECURING CONTINUED OPERATION THROUGH TARGETED BEARING REPLACEMENT

The Sentosa Express is **a vital transportation artery in Singapore** that relies heavily on the structural integrity of its **monorail track**. To proactively guard against issues as the infrastructure ages and ensure continuous, safe service for customers, **the Sentosa Development Corporation initiated a targeted bearing replacement project**. Lead contractor Hwee Wah Engineering Pte Ltd selected VSL due to its specialist expertise in this complex and critical work.

Addressing structural needs on four key piers of the bridge

The primary objective was the replacement of critical guided pot bearings along the Sentosa Express track, specifically focusing on the first three piers on Sentosa Island and on the final pier at VivoCity Station—the northern terminus of the line, located at the VivoCity mall in Singapore. This targeted intervention was judged essential to maintain the structural integrity and operational safety of the monorail system. Hwee Wah Engineering Pte Ltd's decision to partner with VSL stemmed from VSL's proven track record in delivering high-precision structural solutions to stringent deadlines.

From detailed surveys to precise bearing installation under operational constraints

VSL's comprehensive mission encompassed:

- **Detailed pre- and post-condition surveys:** assessing existing bearings to determine precise replacement needs and verifying successful installation.
- **Custom design and fabrication:** de-

DATE
2023 - 2024

LOCATION
Sentosa and Vivo City, Singapore

OWNER
Sentosa Development Corporation

MAIN CONTRACTOR
Hwee Wah Engineering Pte Ltd

CONSULTANT
H&T Consulting

SCOPE OF WORKS

Design and carry out pre-condition and post-condition surveys.

Design and fabricate guided pot bearings and brackets.

Replace bearings and ensure their proper alignment

KEY FIGURES

— Total number of bearings replaced: 8
— Location: Sentosa (3 piers) & Vivo City (one pier)

signing and manufacturing new guided pot bearings and supporting brackets tailored to the specific requirements of the Sentosa Express track.
- **Safe and precise bearing replacement:** planning and carrying out the replacement of bearings with minimal disruption to the daily operation of the Sentosa Express service.

The project presented formidable challenges, including **operating within a high-traffic transportation environment and adhering to tight timelines to minimise service disruptions**. VSL's ability to ensure safety and precision during the bearing replacement was paramount.

Enhancing long-term safety and efficiency through expert execution

VSL's expertise ensured minimal disruption to the Sentosa Express operations, delivering high-quality, durable bearings that enhanced the track's long-term safety and functionality. The focused solutions were instrumental in achieving accurate and efficient bearing replacements, minimising downtime and maintaining Sentosa Express services.

The contract, which began in April 2023, was successfully completed on May 12, 2024.

ROAD VIADUCT OVER THE OSORMORT RIVER

REPLACING EXTRADOSED TENDONS OF AN ICONIC UNDER-DECK CABLE-STAYED BRIDGE

The 509-metre-long Osormort Viaduct near the Spanish town of Sant Sadurní d'Osormort was **the first bridge in the world to feature under-deck cable stays when it was completed in 1995**. The structure, which has 13 spans and was designed by the world-famous Spanish bridge engineer Javier Manterola is located on the Eix Transversal de Catalunya C-25 road that links the cities of Vic and Girona in the north east of the country.

Each span of the viaduct is supported below the deck by a pair of tendons anchored to the piers, and deflected by a single compression strut that introduces the upward deviation forces from the cables into the deck, achieving an extraordinary slenderness.

In December 2023, VSL Spain carried out a special inspection of the bridge, revealing **severe corrosion in some tendons that could compromise structural safety due to a low degree of structural redundancy**. The affected tendons, that were bare strand grouted, showed significant deterioration. A week later, **the bridge was closed to traffic, to enable tendon destressing and replacement operations**.

VSL Spain was contracted to **carry out the specialist replacement works, including installation of temporary tendons, destressing and dismantling of existing tendons, temporary/service monitoring and installation of the new tendons and replacement of the pot bearings on the abutments**.

A temporary post-tensioning tendon was installed through the diaphragm of the piers using the reserve guide tube specified in the initial design, installed only in alternate spans.

Stressing was carried out simultaneously from both ends using a multi-strand jack to symmetrically introduce the load into the structure and prevent destabalisation of the strut.

The existing tendons were secured to the temporary tendon.

DATE
2024

LOCATION
Sant Sadurní d'Osormort, Spain

OWNER
Generalitat de Cataluña

MAIN CONTRACTOR
VSL Spain

ENGINEER
Enginyeria Reventós, S.L.

DESIGNER
Javier Manterola Armisén y Leonardo Fernández Troyano, Carlos Fernández Casado, S.L

CONSULTANT
BEWS Barcelona Engineering Workshop

SCOPE OF WORKS

Replacement of extradosed tendons including de-stressing of damaged tendons

KEY FIGURES

- Viaduct length: 500.1 metres
- Average height: 25 metres
- Length of spans: 31.7 metres + 11x39.7 metres + 31.7 metres
- 13 temporary tendons of 6-22
- 26 extradosed tendons VSL XT-M PLUS 6-22

The objective was to prevent tendons from whipping out of control if they were to rupture, and avoid lateral buckling of the tendons, though longitudinal movement was not restricted.

Removal of the existing tendons

The nature of the tendon connections, both in the anchorage zone and the deflectors, **was a critical consideration** when planning the detensioning procedure.

To minimise the risk of sudden energy release, 'windows' were created to expose the steel strands in the tendons by carefully removing the sheathing and cement grout. These allowed the elastic energy of the tendon to dissipate gradually as the strands were cut one by one. This approach was validated by high-speed dynamic simulation before the works were carried out.

The goal was to achieve gradual de-tensioning right down to the last strand, avoiding sudden rupture of the remaining strands. Additionally, cutting was carried out from the midpoint to ensure the load was released as symmetrically as possible with respect to the strut axis.

All 26 tendons were successfully cut without incident, and the behaviour accurately matched the simulated models.

Selection of the new prestressing system

VSL's most advanced post-tensioning system was used to replace the external tendons. **The new tendons feature multiple corrosion barriers along their entire free length and are specifically designed to allow eventual re-tensioning or individual strand replacement.** The new tendons are designed as a bundle of individual unbonded strands in order to enhance structural redundancy by preventing force transfer between strands in the event of failure.

The new tendon system features:

- VSL XT-M PLUS anchorage block
- 22 galvanised, greased, and individually sheathed 0.62" strands
- Length: 45.6 metres
- Continuous HDPE sheath (140 x 8.3 mm)
- PEHD electrofusion reducer elements
- Flexible filler injection in caps
- VSL HPI grout injection
- Strand bundle within HDPE sheath injected with grout

Monitoring

Due to the nature of the work, **comprehensive monitoring was carried out on the first span**, including full control of the stresses, rotations, deflections of the deck and displacements in the strut.

Throughout all execution phases, strict control of all parameters was maintained, and the structure's behaviour was verified against the calculation models. The tensioning of the temporary tendon and subsequent de-tensioning of the existing tendons, as well as the tensioning of the new tendons, were especially critical.

The results obtained during construction were fundamental in designing the monitoring system for the service phase.

Replacement of pot bearings

The pot bearings on both abutments had to be replaced due to severe corrosion, which in some cases had resulted in the extrusion of the PTFE sheet. Two unidirectional units and two free units were supplied and installed, both designed for a vertical load of 5,700kN and a displacement of ±120 mm.

The repair works commenced on 19 March 2024 and were successfully completed on 11 October 2024.

REQUEJO VIADUCT – A52 MOTORWAY

EMERGENCY BRIDGE REPAIR: LEADING THE PROJECT AS THE MAIN CONTRACTOR

The Requejo Viaduct on the A-52 Highway is located in the province of Zamora, Spain close to the small village of Requejo. The village, which has approximately 200 residents, sits between the Segundera and La Parada mountain ranges.

The twin deck, concrete I-girder viaduct was built in 1997 as part of the A52 highway construction and it has six spans ranging from 25 metres to 36 metres long. Each span is formed of four concrete I-girders that are 1.85 metres deep, and rest on pairs of concrete piers rising up to 60 metres in height. The bridge is subject to high chloride loading during winter maintenance periods.

In August 2023, some of the elastomeric bearings on the bridge slipped, causing several deck girders to come to rest on the concrete plinths. As a result, the deck slab dropped, creating a step of up to 100 millimetres in the asphalt.

The Spanish Ministry of Public Works (owner of the A-52 highway) immediately ordered **an emergency project to inspect and repair the bridge, including replacement of the bearings, to restore it to a safe working condition**.

VSL's role as the main contractor

The owner appointed **VSL as main contractor to carry out the works**, on the basis of its proven capabilities, extensive experience with similar projects, and immediate availability of trained personnel and specialist equipment.

VSL organised all site activities to meet contractual requirements, including safety, quality, deadlines, scheduling, and budget. VSL also evaluated and coordinated all its subcontractors to ensure they delivered site activities safely and effectively.

To keep the road open during the

DATE
2024

LOCATION
Requejo, Zamora Province, Spain

OWNER
Zamora Province State Highways Department

MAIN CONTRACTOR
VSL Spain

ENGINEER / DESIGNER / CONSULTANT
IDEAM-TYLIN

SCOPE OF WORKS

Strengthening of girder webs

Strengthening of pier caps

Replacement of expansion joints

Replacement of neoprene bearings

Replacement of bridge drainage system

KEY FIGURES

- Number of elastomeric bearings: 104
- Weight of steel rebar: 16 tonnes
- Length of expansion joints: 78 metres
- Volume of R4 repair mortar: 44 cubic metres
- Number of drains replaced: 18
- Number of girders repaired: 96
- Depth of girder edges: 1.85 metres
- Area of waterproofing: 270 square metres

repair works, VSL implemented a traffic management plan with a 24/7 supervision and maintenance system to prevent accidents. Strict control of access to the scaffolding was also implemented to prevent unauthorised entry into the working area.

VSL coordinated and carried out a wide range of operations, including:

- Provision and replacement of 104 elastomeric bearings.
- Repair of 96 girder edges of 1.85 metre depth, including breaking out damaged concrete, sandblasting to remove steel corrosion, and recasting with R4 repair mortar.
- Girder strengthening through section enlargement.
- Synchronised jacking system to lift the bridge, allowing for independent control of pressure, load, and displacement. This work included the installation of new corbels for jacking.
- Strengthening of the slab that was damaged by the bearing failure.
- Pouring 44 m^3 of R4 repair mortar to restore various bridge elements.
- Replacement of 78 metres of expansion joints.
- Replacement of 18 drains to divert de-icing salts away from the pier caps.
- Application of 270 m^2 of waterproofing to prevent further corrosion and damage to concrete girders, steel reinforcement, and active tendons.

Site-specific construction methods

VSL developed site-specific construction methods and proposed innovative solutions to repair different parts of the bridge. One notable example was the **use of friction corbels for bridge jacking**.

Another example was **the design and engineering of hanging scaffolding to provide access to pier caps and the deck soffit**. This approach was chosen over conventional underbridge inspection units, which run off diesel engines. Although the main reason for the choice was operational, it also reduced the carbon footprint of the project.

Coping with harsh weather conditions

With the Requejo site at an altitude of 1,009 metres above sea level, receiving 1,400 millimetres of rainfall each year and experiencing winter temperatures that are often below 0°C, **executing a concrete bridge repair project in such environmental conditions presented significant challenges**. **To address these weather constraints:**

- **Heaters were used to control temperatures** during concrete pouring in low ambient temperatures.
- **Wind speed measurements** were taken on top of the bridge deck using an anemometer to ensure safe working conditions on the scaffolding.
- **High quality shelters** with heating and rest areas were provided for the operatives.
- Workers were equipped with appropriate clothing and personal protective equipment for the harsh environment.

The VSL team comprised an engineer acting as the project manager, one technician in the role of site superintendent, and another in charge of equipment lifting operations. At the peak of the project up to 20 additional personnel, mainly subcontractors, were involved.

Work was carried out in three stages to suit the management of traffic and winter closure periods: the first took place over two months in 2023, the second over seven months in 2024 and the final stage is scheduled to take place in 2025.

GEISSLOCH VIADUCT ON THE SOLOTHURN–MOUTIER RAILWAY LINE

DELIVERING SEGMENT COUPLERS AND ELECTRICALLY-INSULATED POST-TENSIONING CABLES FOR A RAILWAY BRIDGE WITHIN A TIGHT TIMELINE

To meet new regulatory standards, the 22-kilometre-long Solothurn-Moutier railway line in Switzerland is undergoing a **significant upgrade**, including the **replacement of steel bridge decks with modern steel-concrete composite structures**. This extensive project demanded **a six-week suspension of services on the line** to accommodate the work.

As part of the renovation, operating company BLS took the opportunity to refurbish the 120-year-old Geissloch Viaduct in the city of Bellach, so that it could continue to be in service for another 25 years. The viaduct was completely overhauled; its natural stone masonry was repaired and a new ballast trough installed.

VSL Switzerland was selected by the main contractor, Frutiger, to participate in this project due to its track record of successful collaborations and shared ambition for high-quality work as well as a recent reference from a similar project. VSL also has a reputation as **one of Switzerland's leading suppliers of electrically-insulated post-tensioning cables (Category C, EIT), which are widely used in both railway and national road bridge construction**.

VSL Switzerland's responsibilities included:

- **Supplying almost 400 bridge segment couplers**, all the **electrically-insulated post-tensioning cable** material and injection grouting.
- Overseeing and supervising the **fab-**

DATE
2023 - 2024

LOCATION
Bellach, Switzerland

OWNER
BLS Netz AG

MAIN CONTRACTOR
Frutiger AG

ENGINEER / DESIGNER
Furst Laffranchi Bauingenieure GmbH

SCOPE OF WORKS

Supply of the bridge segment couplers and electrically insulated prestressing cables

Injection grouting

Control and support of prefabrication of bridge segments

Assembly and installation of the electrically insulated prestressing cables on the construction site

KEY FIGURES

— Total bridge length strengthened: 193 metres (in four phases)
— Total weight of 0.6" steel strands: 11 tonnes
— Length of time of railway closure: 6 weeks
— Total installation time for VSL: 2 weeks (in four phases)

rication of the bridge segments at the precasting facility in Giswil, as well as **the assembly, installation and grouting of the electrically-insulated post-tensioning cables on site**. One of the most critical tasks was to **ensure that the segmental couplings were completely leak-proof during the cable grouting process**.

- Delivering the documentation and electrical resistance measurements to the client.

Segment couplers

Post-tensioning tendons are used to connect pre-cast segments to provide tensile capacity across the segmental joints and to achieve a monolithic behaviour of the structure. Where they cross the joints, segmental couplers are used to ensure a completely leak-tight envelope. They consist of a sealing assembly embedded in the segment faces which is compressed and activated during segment fitting and pre-stressing. This is particularly important when electrical testing is used to verify the integrity of the leak-tight corrosion protection barrier of each tendon. They must be carefully designed and installed by specialists to ensure robust behaviour.

The assembly and installation had to adhere to a strict timeline, agreed with the main contractor and other supply-chain partners, to ensure the entire renovation could be completed within the planned six-week window and that the bridge would be ready for reopening.

The project was completed without any hold-ups and met all the client's requirements, particularly for the installation of the electrically-insulated prestressing cables and the demand for leak-tightness of the grouting injections. The railway line reopened at the end of June 2024, following the completion of all construction work between October 2023 and June 2024.


#1


#2


#3

#1 — Fabrication of the bridge segments in a facility offsite.
#2 — Assembly, installation and grouting of the electrically insulated pre-stressing cables on site.
#3 — Segment coupler

MARINA MARSA STREET MSE WALL

ENSURING BRIDGE SAFETY AND STRUCTURAL INTEGRITY THROUGH MSE WALL REPAIR

The project involved **the restoration and repair of existing mechanically stabilised earth (MSE) wall panels along Marsa Street in Dubai Marina**. This critical maintenance project was necessary to **safeguard the structural integrity and safety of a bridge** and required a specialist with expertise in this type of work.

VSL was involved from tender stage, being entrusted with the project due to its experience of MSE wall repair. The challenges included **time constraints and navigating a challenging environment where existing utilities were present**, requiring meticulous planning and execution.

VSL's mission was to assess, repair, and restore the existing MSE wall panels based on its detailed assessment report.

To address the challenges posed by the project, VSL implemented innovative solutions tailored to the specific requirements of the project. This included the use of micro-concrete as a replacement for ready-mix concrete. Micro-concrete was considered the ideal solution for this project as many areas needing repair had limited access and conventional concrete delivery methods, such as mixer trucks, were not feasible. **Micro-concrete, with its pumpable nature and ability to be applied in small quantities, allowed the damaged areas to be precisely targeted and repairs executed efficiently.**

The material can be easily pumped into confined spaces and applied to vertical surfaces, and it offers high strength and durability compared to ready-mix concrete.

DATE
2023

LOCATION
Dubai, UAE

OWNER
RTA

MAIN CONTRACTOR
WBB – (Waagner Biro Bridge)

ENGINEER / CONSULTANT
Parsons

DESIGNER
VSL

SCOPE OF WORKS

Visual inspection to identify affected panels

Removal of existing damaged panels and replacement with new ones

Use of crack injection to repair cracked panels

Cementitious repair mortar

KEY FIGURES

— 1 post-tensioned slab
— 1 post-tensioned concrete top thickening at top slab
— 8 concrete pedestals at top slab
— 5 CFRP laminates at slab soffit and top

Micro-concrete sets quickly, reducing project timelines, and it has a **lower shrinkage rate** compared to traditional concrete, **minimising the risk of cracking and other defects**.

It **can be applied in thin layers**, resulting in a smooth and dense surface finish that is particularly **beneficial for aesthetic applications** and where a high-quality finish is essential.

To navigate the challenging environment, including high traffic volumes and the presence of existing utilities, VSL implemented a strategic approach using a mobile detour strategy. A limited-time traffic permit to close the outer shoulder of the road was secured, allowing the team on site to set up a mobile detour in order to expedite the repair works. **By working efficiently within a four-hour timeframe from 1am to 5am, the repairs were successfully completed without major disruption to traffic.**

The project, which began on February 6, 2023, was successfully completed on October 9 the same year.

Micro-concrete allowed the damaged areas to be precisely targeted and repairs executed efficiently.

AL JIMI MALL NORTH – AL AIN

ENHANCING STRUCTURAL RESILIENCE: VSL'S INNOVATIVE SOLUTIONS FOR THE EXPANSION OF AL JIMI MALL IN AL AIN

An ambitious expansion project to integrate a new IKEA store into Al Jimi Mall, a prominent retail destination in Al Ain, UAE, posed challenges as **it imposed additional structural loads on the existing structure, particularly the ground floor slab**. Ensuring the safety and stability of the building under these new conditions was paramount. In response to this challenge, the main contractor ATS engaged VSL, a leading specialist in post-tensioning and structural strengthening, **to address the structural integrity, safety, and stability of the building**.

VSL was initially contracted to assess the post-tensioned slab, in order to develop an alternative strengthening solution that could be applied, even with the dense MEP services that were present under the slab. The client appreciated the savings that VSL was able to leverage by optimising the solution: VSL designed a cost-effective solution as compared to conventional strengthening methods, and the efficient execution minimised operational disruption, ensuring timely completion of the project. This successful outcome led to VSL being **appointed to execute the work**.

VSL Middle East **developed a tailored strengthening solution using carbon fibre reinforced polymer (CFRP) technology** for the ground floor slab, offering enhanced load-bearing capacity.

To further reinforce the structure, **concrete pedestals were installed** on the **top slab, providing additional support and stability. VSL also used**

DATE
2023

LOCATION
Abu Dhabi – Al Ain City, UAE

OWNER
AL DAR

MAIN CONTRACTOR
ATS – (AL Tayer Stocks L.L.C.)

ENGINEER
PMK Consult

DESIGNER
GHALI Consultant

SCOPE OF WORKS

Design, supply and execution of post-tensioned slab strengthening, using:

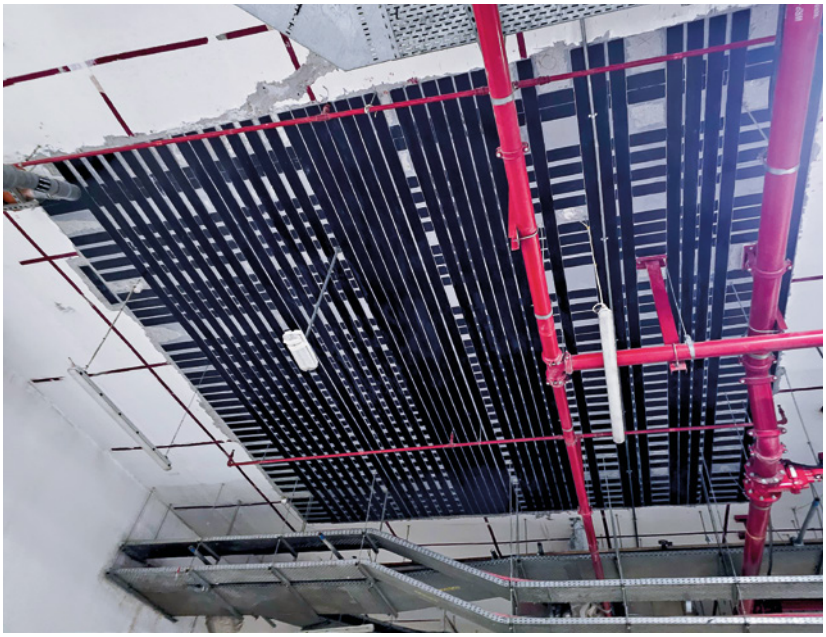
- Post-tensioned top thickening
- Installation of concrete pedestals on top slab
- Installation of CFRP laminates on slab soffit and top slab

KEY FIGURES

— 1 post-tensioned slab
— 1 post-tensioned concrete top thickening at top slab
— 8 concrete pedestals at top slab
— 5 CFRP laminates at slab soffit and top

CFRP laminates to strengthen the slab top and soffit, distributing the additional loads effectively and improving its structural resilience. An **additional thickness of post-tensioned concrete was applied to enhance the top slab's load-bearing capacity** and structural integrity.

This comprehensive strengthening solution ensured the building's safety, stability, and long-term resilience, reinforcing Al Jimi Mall's position as a premier shopping destination in Al Ain, UAE. The work began in September 2023 and was completed in November 2023.



VSL also used CFRP laminates to strengthen the slab top and soffit, distributing the additional loads effectively and improving its structural resilience.

HMAS STIRLING SERVICE UTILITY TUNNEL

A STRATEGIC INITIATIVE TO ENHANCE INFRASTRUCTURE LONGEVITY

VSL Australia was contracted in August 2024 by PCB Contractors Pty Ltd to undertake **essential repairs** on the service utility tunnel at HMAS Stirling, located on Garden Island, Rockingham, Western Australia. The tunnel had exhibited significant structural concerns, including **cracks and spalling in the concrete**. These issues, if unaddressed, could have compromised the tunnel's structural integrity.

The Australian Navy initiated this project with the primary aim of restoring the tunnel's structural integrity, thereby **ensuring the continued reliability and safety of the infrastructure**. VSL Australia's involvement from the early stages underscored the complex nature of the project, requiring specialist expertise in concrete repair.

Navigating complex technical and environmental challenges

The project presented several challenges due to the tunnel's environment and its role. One of the primary obstacles was the **infiltration of rainwater into the tunnel, which exacerbated the existing damage**. In particular, areas where spalling and hollow concrete were submerged or obscured by utilities posed significant difficulties. VSL Australia had to **meticulously plan and coordinate** with the main contractor, PCB Contractors Pty Ltd, to ensure that these challenges were effectively managed.

To address the issue of water intrusion, **VSL deployed submersible pumps to drain the tunnel, maintaining dry conditions necessary for effective concrete repair**.

DATE
2024

LOCATION
Garden Island, Rockingham, Western Australia

OWNER
Australian Navy Base

MAIN CONTRACTOR
PCB Contractors Pty Ltd

ENGINEER / DESIGNER / CONSULTANT
Aurecon

SCOPE OF WORKS

Survey and inspection

Repair recommendation

Concrete repair

Project management, documentation and reporting

KEY FIGURES

- Tunnel dimensions: 1,000 metres long, 3 metres high, 3 metres wide
- Concrete repair areas:
  - cracks: 403 metres
  - spalling: 21 square metres
- Materials used:
  - epoxy injection: 100 litres of low-viscosity repair epoxy
  - spalling/hollow concrete repair: 2,000kg of repair materials
- Team size: 5 skilled professionals

High-quality repair solutions and sustainable practices

VSL Australia's approach to the project was marked by the use of **high-quality repair techniques and sustainable materials**. For the concrete repairs, VSL employed **low-viscosity epoxy injections to address cracks and high-performance repair mortars for spalling areas**. These materials were selected not only for their **durability but also for their reduced environmental impact**, reflecting VSL's commitment to sustainability in infrastructure projects.

The repair process was carefully executed to ensure long-term durability. By implementing comprehensive safety protocols and utilizing advanced materials, VSL Australia ensured that the tunnel's structural integrity was restored without compromising the environment or the project's tight timeline.

The project started in August 2024 and was successfully completed in November of the same year.

For the concrete repairs, VSL employed low-viscosity epoxy injections to address cracks and high-performance repair mortars for spalling areas.

KAROLIN PIPE BRIDGE

RACING AGAINST TIME TO SAFEGUARD POZNAŃ'S ENERGY INFRASTRUCTURE

The Karolin Pipe Bridge is a single-span suspension bridge that dates from 1973 and carries four district heating pipes, making it a crucial element of Poznań city's infrastructure, supplying heat to a large population. The bridge was rehabilitated in 2003, when its load-bearing cables were replaced. However, a recent inspection revealed to Veolia, the owner of the bridge, the **need for further repairs**. This included **the renovation of concrete surfaces, the renewal of anti-corrosion protection for the steel structure, and most importantly, the replacement of deteriorated hanger collars**.

VSL Poland was entrusted with the task of revitalising the Karolin Bridge. The project required **a comprehensive approach that encompassed both structural repairs and corrosion prevention**.

Protecting Karolin Bridge for the future

The concrete abutments required repair in order to ensure their durability and structural integrity. VSL's team performed crack injections, general concrete repairs and applied anti-carbonation coatings to ensure that the structure lasts for many more years to come and safely resists the forces from the suspension cables.

Combatting corrosion: protecting the bridge for the long-term

To protect the bridge's steel components from further deterioration, VSL implemented **a rigorous corrosion prevention programme**. This involved the removal of old coatings, the treatment of any underlying corrosion that was

DATE
2024

LOCATION
Poznań, Poland

OWNER
Veolia (Powerplant & Heating)

MAIN CONTRACTOR
Vsl Poland

ENGINEER / CONSULTANT
Pmr Paweł Bocheński

DESIGNER
Vsl International, Top Projekt (Poland)

SCOPE OF WORKS

Renovation of the concrete surface of the abutments and piers of the bridge (including pressurised concrete injection)

Restoration of the corrosion protection of the bridge deck soffit

Full replacement of the collars of the main hangers

KEY FIGURES

- Number of replaced collars: 30
- Area of repainted steel deck structure: 1,300 square metres
- Area of refurbished concrete on the abutments: 640 square metres

uncovered, and the application of high-performance protective coatings.

One of the most challenging aspects of the project was **the replacement of the main hangers of the bridge, which had suffered significant damage over time**, compromising the functioning of the structure. **VSL engineers designed and fabricated new custom-made hangers that were tailored to the unique requirements of the Karolin Bridge.**

Overcoming obstacles and meeting tight deadlines

The renovation project presented numerous challenges, including **tight deadlines, logistical constraints, and the need to work on the bridge while it was still in operation**. VSL overcame these obstacles through meticulous planning, innovative engineering solutions, and the dedication of its team.

From replacing the hangers to protecting the steel skeleton from corrosion, every aspect of the restoration project was executed with precision and care.

The development of custom-designed temporary hangers enabled the team to remove two collars at a time, temporarily accommodating the loads which were released from the hangers when collars were removed. **This solution was developed by VSL's expert structural engineers, making use of their expertise in cable-supported structures and relying on detailed knowledge of the operations necessary to complete the renovation works.**

VSL combined advanced engineering techniques, innovative materials, and a thorough knowledge of bridge mechanics to successfully complete the work between June 10, 2024, and September 30, 2024, ensuring that this historic structure will continue to serve the community for generations to come.

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