CONNECT

THE MAGAZINE OF THE GLOBAL BBR NETWORK OF EXPERTS

CONSTRUCTING A DECARBONIZED FUTURE

BBR's decarbonization journey – thinking differently to build better

SMART TECHNOLOGY MINIMIZES MATERIALS AND EMISSIONS

BBR HiAm CONA Pin Connector for bridge construction

BREAKING GROUND WITH GFRP ANCHORS

Glass fiber-reinforced polymer (GFRP) anchors for urban construction

PT SOLUTIONS ARE SHAPING CONSTRUCTION IN SAUDI ARABIA

BBR VT CONA CMF flat for new developments

COMPLETING CRITICAL REPAIRS IN LIVE ENVIRONMENTS WITH EASE

MRR range for wastewater system rehabilitation

BBR Network: Leaders in engineering the future.

80 Years of innovation, excellence, and global impact

Since 1944, the BBR Network has set the global benchmark for post-tensioning, stay cable systems, and specialized construction engineering.
Founded by Swiss pioneers Antonio Brandestini, Max Birkenmaier, and Mirko Robin Roš, BBR thrives today with the same spirit of innovation and technical mastery — proudly marking 80 years of engineering excellence.
From our Technical Headquarters and Business Development Centre in Switzerland, we connect the world's most ambitious projects with outstanding technology and expertise.
BBR is not just about building structures — it is about building the future.

GLOBAL NETWORK, LOCAL POWER

Global know-how meets local strength.
The BBR Network empowers each Network Member with:

- Access to leading-edge technologies and systems
- Collaborative technical platforms and international alliances
- Knowledge-sharing that creates decisive local advantages

From tendering strategies to specialized deployments, BBR Network Members stay ahead — competing smarter and building better.

MORE THAN POST-TENSIONING: A WORLD OF EXPERTISE

Your trusted construction partner.
BBR Network Members offer a wide range of tailored construction services — beyond post-tensioning — adapted to local markets and client needs.
Respected in their regions, connected globally, our Network Members combine deep market understanding with global technical leadership.

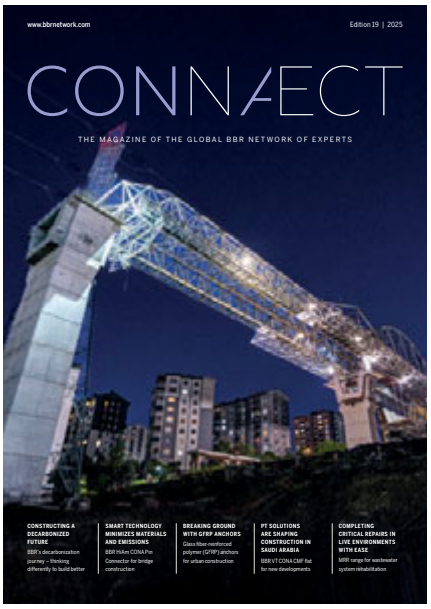
BBR TECHNOLOGIES: TRUSTED WORLDWIDE

Engineering solutions for critical infrastructure.
BBR technologies and systems underpin thousands of essential structures: bridges, towers, LNG tanks, dams, tunnels, wind farms, water infrastructure and nuclear facilities.
Our internationally renowned brands, such as CONA®, BBRV®, HiAm®, DINA®, CONNÆCT®, HiEx, SWIF and BBR E-Trace are synonymous with safety, reliability, and innovation in the built environment.

80 YEARS STRONG: BUILDING THE NEXT 80

At BBR, our legacy inspires our future.
With unrivaled professionalism, constant innovation, and a bold vision for tomorrow, the BBR Network is shaping the next generation of global infrastructure.

Partner with the best. Build with BBR.



Built for the future: efficient, resilient, sustainable

CONNÆCT offers a window into the world of the BBR Network – its technologies, people and Members – and how it is shaping the built environment and can benefit you. The focus is on doing more with less, using BBR's technologies to reduce material use, enhance new builds, and maintain or repurpose existing assets. The result: longer-lasting, higher-value structures with lower carbon footprints.

The 2025 edition opens with CEO Olivier Forget highlighting strategic progress. We showcase the Network's decarbonization journey and how the BBR Build+ and BBR Care+ frameworks create value for Members and their clients. The Talking BBR section features awards and Zurich's anniversary celebration, which brought together leaders from construction, real estate, finance, sustainability, and academia.

Engineering excellence is on display across bridges, buildings, geotechnical projects, tanks, and maintenance, repair, and retrofitting (MRR). BBR Network Members are applying BBR technologies in creative ways, with a growing focus on MRR. A new built health category, in collaboration with Screening Eagle Technologies, Proceq and AQUILA Built Health, showcases advanced technologies and services for asset assessment and inspection, highlighting the shared strengths of our sister companies.

This edition highlights major innovations that are being introduced to market:

- BBR VT CONA CMI Nuclear anchorage system – ETA-approved for the latest generation of nuclear projects, now truly giving clients a choice.
- BBR Intelligence – our AI-powered team member, offering instant access to decades of expertise and best practice.

Collaboration defines the BBR Network. Founded by three pioneering engineers, it has always been greater than the sum of its parts. The synergy between BBR VT International, Network Members and Tectus Group companies ensures that each edition of CONNÆCT tells the real story – driven by innovation, powered by people.

Marcel Poser
Chairman, BBR VT International

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Portfolio section
A novel solution for every challenge:
Hero image courtesy of Alfred Molon, molon.de
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Structural design efficiency reduces concrete to cut embodied carbon:
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Business Review
Evolving our value chain – strategy from BBR VT International's CEO, Olivier Forget

Innovating, adapting, leading

Driving innovation, building a sustainable future

At BBR VT International, we are evolving to meet the challenges of a changing world — innovating faster, collaborating deeper, and delivering smarter, sustainable solutions for asset owners, contractors, and stakeholders everywhere.

For 80 years, BBR has led the post-tensioning and stay cable industry with one clear mission: to build better, longer-lasting, lower-carbon infrastructure.

Today, we are focusing on:

- Accelerating innovation — bringing new technologies to market faster without compromising on quality.
- Strengthening the BBR Network — driving knowledge sharing, partnerships, and local excellence globally.
- Leading sustainable construction — embedding decarbonization, durability, and resilience into everything we design and build.

Agile, reliable, future-proof

Technology leadership:
We refine production and technical collaboration to deliver innovations faster and more effectively to projects around the world.

Network excellence:
Through co-development, field testing, and knowledge exchange, our BBR Network Members deliver cutting-edge solutions tailored to local needs.

Sustainable design:
We build smarter from the start — optimizing material use, reducing carbon footprints, extending asset life, and boosting asset value.

Digital evolution:
Our new AI-powered BBR Intelligence platform preserves expertise, accelerates decision-making, and empowers the next generation of BBR engineers – see p79-80.

BBR Build+ and BBR Care+: full lifecycle support

We expand our services to support clients across the full value chain:

- BBR Build+ provides early design involvement for smarter, more sustainable new builds.
- BBR Care+ delivers long-term maintenance, retrofitting, and upgrading for maximum asset life and performance.

See p12-15.

Engineering with purpose

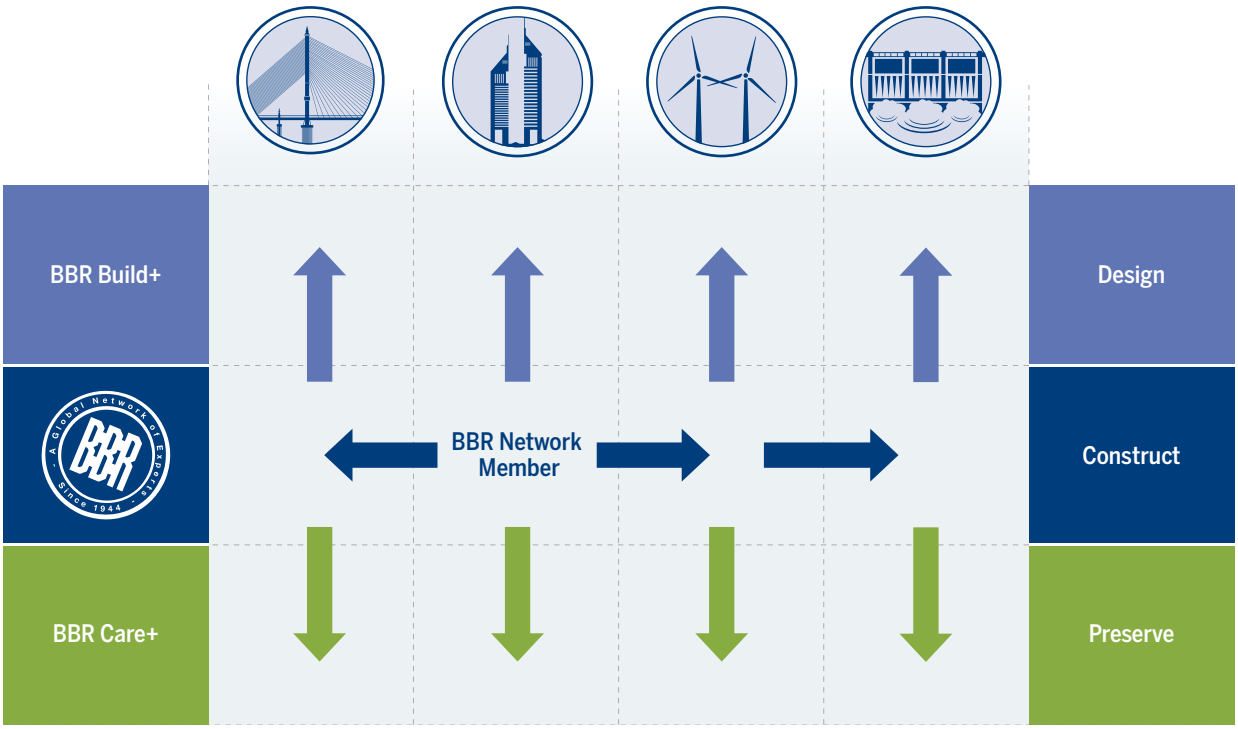
At BBR, innovation is not just about new technologies — it is about building a better built world:

- More durable structures.
- Lower environmental impact.
- Greater resilience against climate challenges.
- Stronger returns for asset owners and contractors.

With every project, we deliver real-world value — for today and for the next 100 years.

BBR VT International:

Driving innovation.
Expanding partnerships.
Building a sustainable built world.



Expanding our services throughout the value chain. Delivering expertise across sectors: bridges, building, energy and ground engineering.

Feature article
BBR's decarbonization journey

Constructing a decarbonized future

Thinking differently to build better

The built world is responsible for nearly 40% of global carbon emissions. While much focus has been on operational carbon, attention is now shifting to embodied carbon — emissions locked into construction materials and processes before a structure is even used. Post-tensioning (PT) technology — doing more with less — is at the heart of the solution. It optimizes material efficiency, cuts embodied carbon and extends the life of structures.

BBR Network Member for Turkey, Kappa Kalıp İnsaat ve Taahhut A.Ş., saved 21,300t of CO_2 by using post-tensioning and movable scaffolding systems technology, when constructing the Sular Valley Viaduct in Istanbul, Turkey.

Embodied carbon: the new frontier

Embodied carbon includes emissions from producing concrete, steel, transportation, and construction itself. With operational emissions declining thanks to clean energy, embodied carbon is expected to account for 50% of the total emissions from global new construction between 2020 and 2050.

Tools like the Whole Life Carbon Assessment (WLCA) standard from the UK's Royal Institution of Chartered Surveyors (RICS), combined with studies by Terrascope for BBR and Synaxis, show that PT slabs can cut embodied carbon by up to 50% compared to traditional reinforced concrete.

BBR: engineering sustainability since day one

BBR's journey toward decarbonization began over 80 years ago. Our founders developed PT technology to maximize material use when resources were scarce — and unknowingly created a low-carbon building solution for future generations.

- Less concrete, more strength.
- Reduced rebar needs.
- Lighter, more efficient structures.
- Extended structural lifespans.

The carbon battle starts before you build

Every slab, beam, and tendon matters.

Post-tensioning slashes embodied carbon, maximizes performance, and future-proofs infrastructure.

BBR is leading the charge — are you ready to build smarter?

Our real-world results include:

Synaxis project, Zurich, Switzerland

55% reduction in upfront carbon emissions using PT beams with reused slabs — reaching 70% with recycled materials.

Sular Valley Viaduct, Istanbul, Turkey

PT combined with advanced construction methods saved 21,300t of CO_2. [To read the full story, see p26-27.]

66 Oxford Terrace, Christchurch, New Zealand

A seismic retrofitting project including BBR PT tendons avoided the demolition of a 13 story building and the embodied carbon of a new build.

66 Oxford Terrace, Christchurch New Zealand: The severely damaged structure was left uninhabitable after a magnitude 6.2 earthquake shattered Christchurch in 2011.

Why PT technology leads the way

- **Material Efficiency:** PT slabs use up to 30% less concrete and 50% less steel.
- **Lifecycle Carbon Savings:** Longer-lasting structures avoid early demolition.
- **Sustainability Certification:** PT systems support LEED and other green building certifications.
- **Independently Validated:** Terrascope and Tectus Group research confirms PT's lower embodied carbon impact.
- Synergies with other embodied carbon reduction methods like low carbon concrete, recycling and material re-use.

A new paradigm for asset owners

Today's asset owners are prioritizing low-carbon solutions for higher property values, stronger investor appeal, and regulatory compliance. Decarbonization is no longer optional — it is a strategic advantage.

BBR Network Members are leading the way by:

- Influencing early-stage design.
- Quantifying and independently verifying project and whole of life carbon impacts.
- Forging partnerships across the supply chain.

Decarbonize the built world

Post-tensioning is not just engineering — it is sustainability in action.

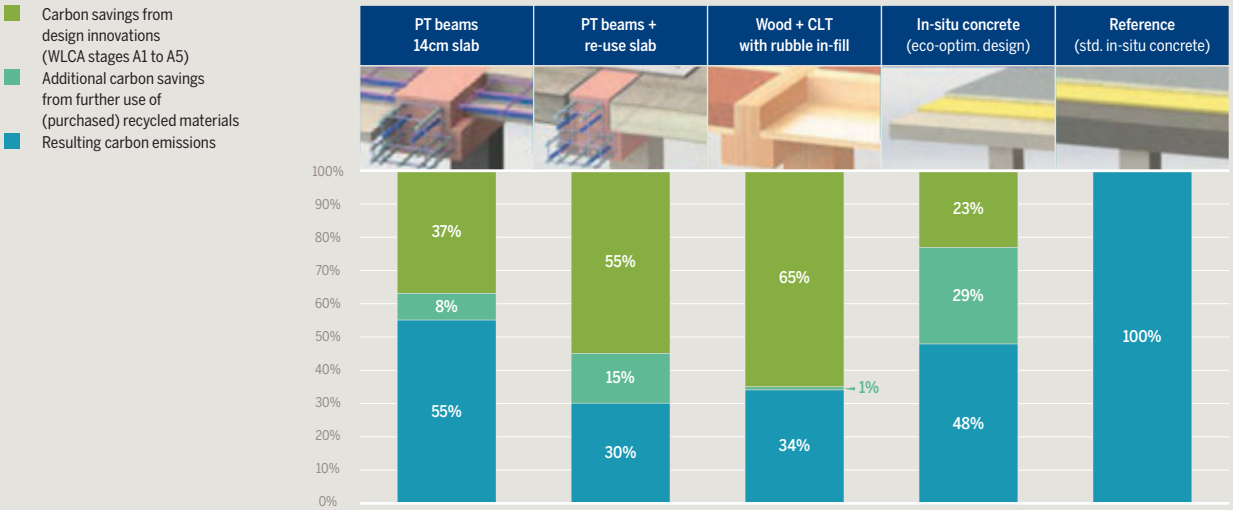
BBR technology cuts embodied carbon by up to 50%, extends asset lifespans, and builds smarter, stronger, greener structures.

Less material. Lower emissions. Longer life.

The future is already here — and BBR is building it.

Comparing carbon: PT v sustainable construction

- New build PT slabs save 37% carbon compared to traditional concrete with rebar.
- Combining the use of PT with re-used slabs and recycled materials increases carbon saving to 70%.
- This is comparable to 65% carbon savings of conventional sustainable slabs using wood and cross laminated timber.



Learn more, download our full reports:

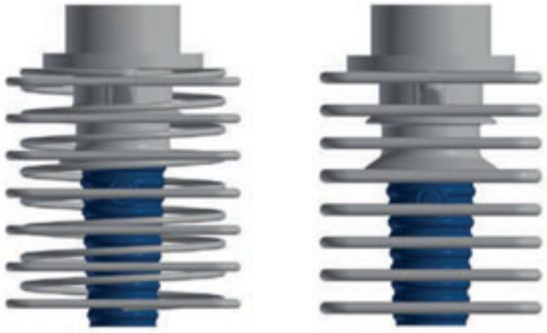
Assessment of the comparative reduction in carbon emissions of innovative building construction methods relating to floor construction and floor support shows how PT technologies can reduce carbon emissions by up to 70%.

The impact of Moderna Homes' technologies on upfront carbon emissions in construction highlights embodied carbon can be estimated and reduced early in the design stage of modular construction projects incorporating steel-hybrid prefabricated prefinished volumetric construction (PPVC) systems.

The impact of BBR technologies on carbon emissions during construction explores how designing-in PT from the outset reduces embodied carbon in new projects.

Redefining structural efficiency and sustainability

Designing reduced materials PT systems was how BBR was born, from the first Stahlton AG plank in the late 1940s (CONNÆCT 2024, p85) to today, and the latest BBR VT CONA CMI/CME systems – as featured below.

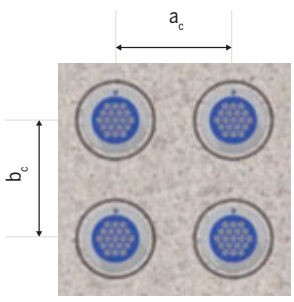


Left: Conventional system with a larger cross section, needs more concrete and embodies more carbon. Right: BBR's optimized design reduces concrete by up to 35% and allows lower concrete strength classes, minimizing materials, curing time and carbon footprint.

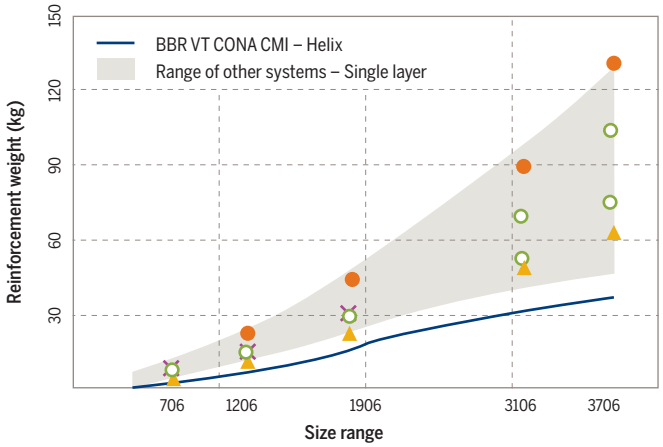
BBR VT CONA CMI/CME PT systems have three features redefining structural efficiency and sustainability:

1. Single-layer anti-bursting reinforcement design cuts reinforcement congestion, speeds up building and reduces weight and embodied carbon, using 25-70% less steel.
2. Compact structural cross section reduces the cross-sectional area thus using up to 35% less concrete. In a 30m beam example, this can reduce CO_2 emissions by as much as 2.5t per element.
3. Adapt to a range of concrete strengths reducing cement demand, shortening curing time, lowering costs and carbon.

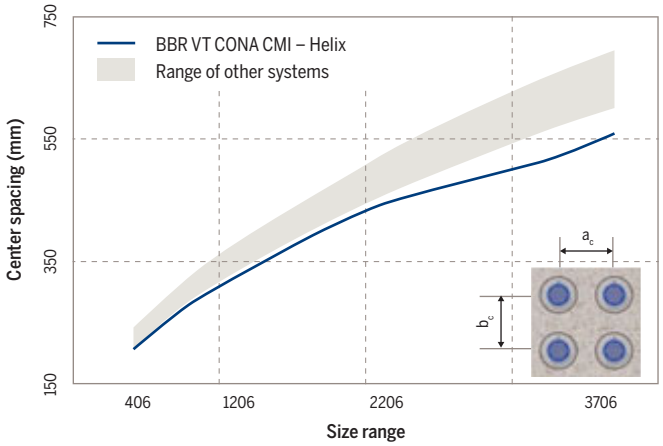
Together, these design innovations make the BBR VT CONA CMI/CME systems a benchmark for sustainable, high-performance PT, delivering measurable carbon savings without compromising structural integrity or construction efficiency.



Optimizing center spacing and edge distance minimizes the element cross section, reducing concrete volumes and embodied carbon.



Reinforcement weight comparison across anchorage sizes. BBR VT CONA CMI/CME (blue line) consistently uses less anti-bursting steel than other single-layer systems, directly saving carbon.



BBR VT CONA CMI/E systems achieve tighter center spacing than conventional systems, enabling more compact structural designs and material and carbon savings.

Decarbonizing with BBR Build+ and BBR Care+

Through our BBR Build+ and BBR Care+ frameworks, we support asset owners from design to retrofitting — helping to embed sustainability at every stage of the infrastructure lifecycle.

- BBR Build+: Early-stage design optimization for new projects.
- BBR Care+: Maintenance, repair, and retrofitting to extend the life of existing assets sustainably.

In the following feature article, we explore how BBR Build+ and BBR Care+ are shaping the future of responsible asset management and lifecycle-based carbon savings.

The future is clear

Post-tensioning is a proven pathway to a decarbonized built world. By building smarter today, we are preserving resources, protecting the planet, and enhancing asset value for tomorrow.

Feature article
BBR Build+ and BBR Care+

Shaping the future with BBR Build+ and BBR Care+

Driving decarbonization and asset longevity

As climate goals tighten and regulations grow stronger, asset owners are rethinking how infrastructure is designed, built, and maintained.

The future demands more than just low-carbon construction — it demands lifecycle thinking. At BBR, we are evolving from pure builders to long-term asset stewards. Through our BBR Build+ and BBR Care+ frameworks, we help asset owners maximize value, extend asset life, and cut carbon — from first pour to future generations.

Stop building for today.
Start building for 100 years.

With BBR Build+ and BBR Care+, your assets are stronger, greener, and future-proof.

Design smarter. Protect longer.
Lead the change.

BBR Build+ in action: The 2011 upgrade to the Wellington Dam, southwest of Perth in Australia, features ground anchors with a design life of 100+ years.

BBR Care+ in action: an existing hotel in Saudi Arabia was transformed into the Khurais Hospital, upgrading structures for the higher loads of hospital beds and equipment, rather than demolish and rebuild.

Building smarter from day one with BBR Build+

BBR Build+ integrates durability, sustainability, and efficiency right from the design stage.
By embedding post-tensioning (PT), geotechnical anchors and stay cable solutions early, we minimize material use, optimize structural performance, and future-proof assets.

Case in point:

- When strengthening the Wellington Dam in Australia, BBR ground anchors were designed with a 100+ year service life — delivering longevity built in from the start.

Protecting and enhancing assets with BBR Care+

Sustainability does not stop at new build construction. BBR Care+ ensures that existing structures are assessed, conserved, and upgraded for long-term performance — avoiding premature demolition and costly rebuilds.

Real-world impact:

- In Saudi Arabia, BBR strengthened an existing building to transform it into a hospital — an exemplary adaptive re-use case avoiding the carbon and cost of full reconstruction (See CONNÆCT Edition 18, p82-83).
- In Poland, BBR Care+ corrosion protection technologies safeguarded a critical bridge, extending its service life and resilience (see p60-61).

Doing more with less

PT by BBR means:

- Up to 30% less concrete.
- Up to 70% less steel.
- Longer asset lifespans.
- Lower embodied carbon.

BBR Build+ and BBR Care+ transform these material savings into long-term environmental and financial gains.

Build smart. Care smart.

BBR Build+ optimizes construction from the outset.
BBR Care+ extends asset life for decades.
Less carbon. Longer life. Greater value.

Future-ready infrastructure starts here.

Lifecycle excellence: from concept to stewardship

The BBR Build+ and BBR Care+ approach gives asset owners a full value chain solution:

Perfect: Optimize construction design for resilience and efficiency.
Assess: Use real-time data and inspections to monitor asset health.
Conserve: Protect structures against deterioration.
Upgrade: Strengthen and adapt assets to meet future demands.

Result:

Stronger performance.
Lower carbon footprint.
Higher asset value.

Localized electrochemical corrosion caused early PT tendon failure on a Vistula River Bridge. BBR Polska Sp. z o.o. applied BBR Care+ technologies to complete the repair and future safeguarding against corrosion.

Tomorrow's infrastructure, today

Across the BBR Network, projects powered by BBR Build+ and BBR Care+ are already reshaping infrastructure:

- Upgrading bridges in Malaysia.
- Strengthening towers in New Zealand.
- Extending the life of transport hubs in Europe.

In a world that demands both resilience and responsibility, BBR is delivering solutions that perform — and endure.

Perfect

Structural performance from the start

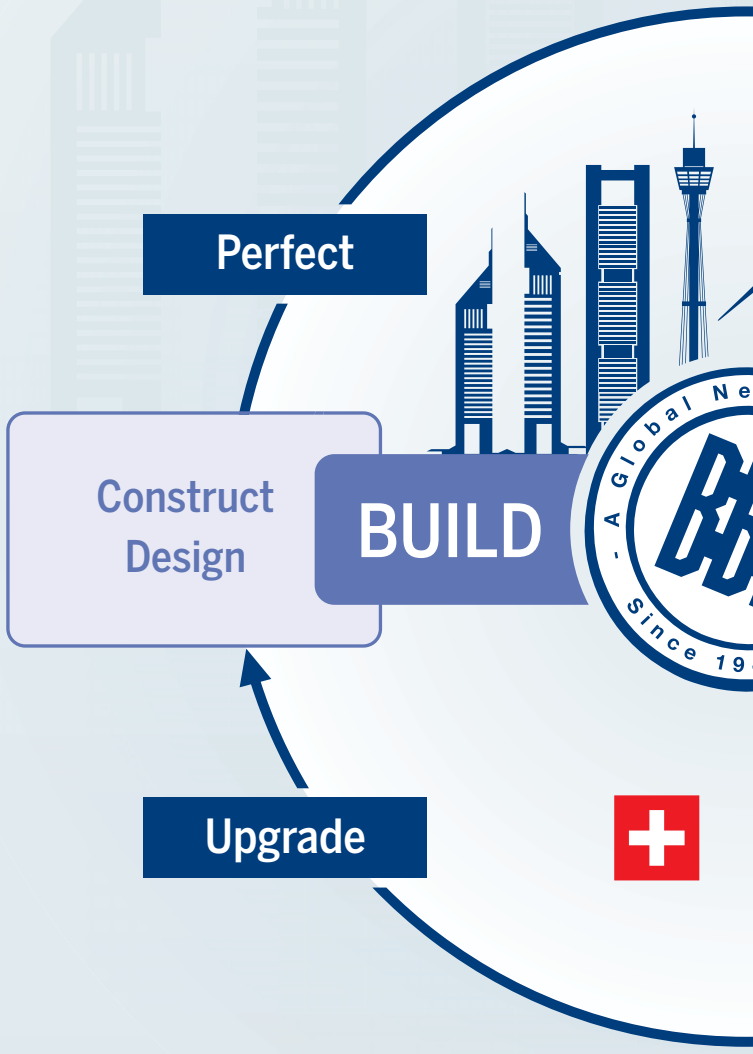
BBR Build+ optimizes structures for long-term durability and adaptability at the design stage. Problems are resolved early, futureproofing and avoiding expensive retrofits.
The Alat project in Saudi Arabia (p62-63) optimized design under pressure mid construction using carbon fiber-reinforced polymer (CFRP) sheets, external PT and concrete jacketing to strengthen the structure. These interventions met the more demanding specifications without needing future retrofits, aligning with the BBR Build+ principle of getting it right first time.

Assess

Data-driven asset management with AQUILA

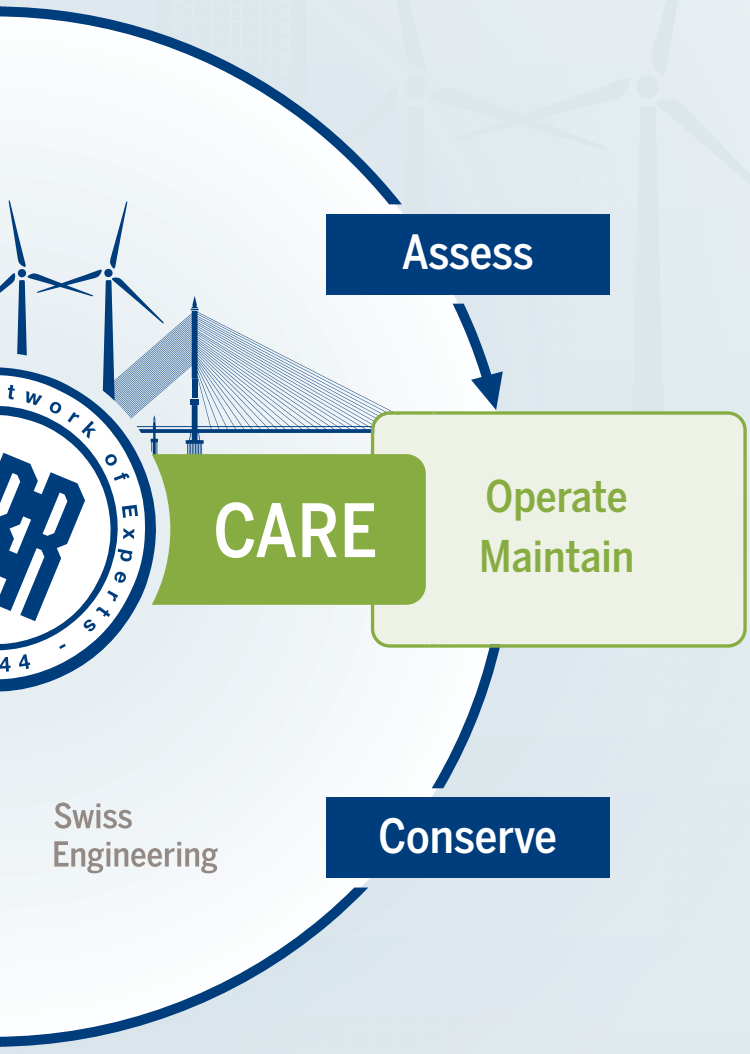
BBR Care+ gives asset owners real-time insight into a structure's condition using non-destructive testing (NDT) inspection and monitoring technologies capturing a building health record at source and accessible online.
AQUILA (learn more about AQUILA Built Health on p64-71) used subsurface mapping, ground-penetrating radar (GPR), and cloud-based asset management platforms to create a digital twin of a multistory car park at one of the UK's international airports (p64-71). By identifying hidden defects and diagnosing issues before deterioration, early intervention enables asset owners to maximize durability and optimize long-term performance, consistent with the BBR Care+ principle.

Building for today. Caring for tomorrow.



BBR BUILD+

Optimizing design and construction with advanced BBR Build+ systems to achieve decarbonization of new structures are enhancing the existing built world.



BBR CARE+

Assessing and conserving built world assets with BBR Care+ solutions to ensure safety, longevity, and resilience for future generations.

BBR Build+ and BBR Care+ integrating design, construction, maintenance and upgrades to optimize asset performance and longevity.

Conserve

Protecting infrastructure from corrosion

Conserving existing structures and ensuring long-term durability with targeted protection strategies.
When a PT tendon failure exposed vulnerabilities in a bridge over Poland's Vistula River (p60-61), BBR Polska Sp. z o.o. implemented a long-term corrosion protection solution, demonstrating how BBR Care+ Conserve strategies extend infrastructure lifespan, reduce maintenance demands and prevent costly structural overhauls.

Upgrade

Strengthening infrastructure for future demands

BBR Care+ upgrades and enhances structural strength and functionality as asset owner and occupiers' needs evolve. BBR Construction Systems (M) Sdn Bhd strengthened the Batang Sadong Bridge (p37-39) in Malaysia. The solution increased load capacity and reduced maintenance needs, extending the bridge's service life while minimizing carbon impact.

BBR: Engineering sustainable lifecycles

From smart design to proactive care, BBR Build+ and BBR Care+ help asset owners protect investments, decarbonize portfolios, and lead the way into a sustainable built future.

One strategy.
One Network.
One step ahead.

News in brief

Overview of events and achievements from around the BBR Network

BBR VT International and BBR Network Members have been even more active on the international scene during 2024, with shared stands at leading seminars and exhibitions, from Christchurch to Costa Rica, passing through several European and Asian locations on the way. Certifications are a major benefit of BBR Network membership and in 2024 we updated the European Technical Assessment (ETA) for two of our leading post-tensioning (PT) solutions, BBR VT CONA CMI and BBR VT CONA CME.

STRATEGY, MARKETING AND TECHNOLOGY ON THE AGENDA AT THIS YEAR'S PM WORKSHOP

The BBR Network's European Project Managers' Workshop was hosted by the new Network Member for the Netherlands, De Vries VSP b.v., on 15-16 October in Gorinchem, Netherlands. The event spanned two days of interactive learning and strategy sessions, covering the full range of BBR technologies and with insightful presentations about BBR Build+ and BBR Care+, AI solutions and the nuclear qualification processes. It wasn't all classroom study, though. At the end of day one, BBR Network Member delegates enjoyed a visit to the De Valk Windmill Museum. To conclude the two-day event, delegates enjoyed a picturesque boat tour through the De Biesbosch National Park, organized by De Vries VSP b.v.

BBR VT International's Baran Kurutepe takes a team photo during the BBR Build+ and BBR Care+ learning session.

On day one, there was a cultural excursion to the De Valk Windmill Museum in Leiden.

BBR'S PT AND AQUILA'S BUILT HEALTH FEATURE AT IABSE CONGRESS IN COSTA RICA

BBR's stay-cable and PT solutions and AQUILA Built Health's structural assessment services and technologies were on show together at the IABSE Congress, 25-27 September 2024, in the Costa Rica Convention Center, San Jose. A member of Screening Eagle Technologies also joined, helping delegates understand the benefits of Proceq's NDT technologies on show (learn more about Proceq's scope and technology on p72-74).
The joint team presented three papers. AQUILA's CEO Gianni Moor spoke about the NDT assessment of pylon foundations of the Swiss power grid, with BBR VT International CEO Olivier Forget and Sales Director Marco Zucconi presenting papers on decarbonization strategies in construction and the replacement of external PT in bridge structures. According to Marco: "From the stage to the booth, the engagement with BBR and AQUILA was outstanding."

AQUILA's CEO Gianni Moor (left) and BBR VT International Sales Director, Marco Zucconi.

BRIDGING THE KNOWLEDGE GAP FOR PT SOLUTIONS

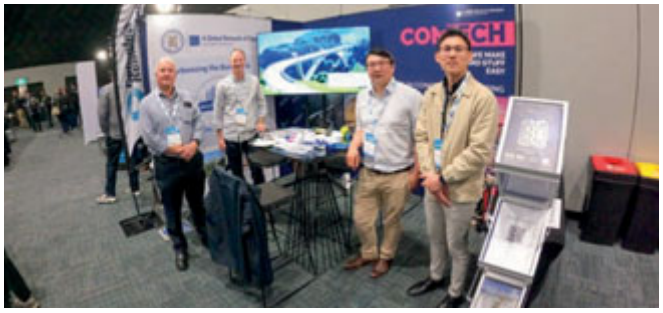
BBR VT International has teamed up with BBR Network Member for Turkey, Kappa Kalıp İnsaat ve Taahhut A.Ş., as silver sponsors of IABSE's 6th Istanbul Bridge Conference. The event, held between 6-8 September 2024, focused on topics ranging from steel-concrete hybrid bridges to digital developments, such as AI's applications to structural condition assessment. BBR VT International's Baran Kurutepe presented a paper on the Çayırhan Bridge project, which is Turkey's first cantilever bridge with inclined piers. You can read the full story about the Çayırhan Bridge in CONNÆCT 2024, p50-51.

BBR VT International's Baran Kurutepe presenting the Çayırhan Bridge project.

The team on the exhibition stand (left to right): Efe Bayram, Yagiz Ardal and Kadir Serden Hekimoğlu from Kappa Kalıp İnsaat ve Taahhut A.Ş. with BBR VT International's Baran Kurutepe.

BBR VT INTERNATIONAL AND CONTECH SHARING HOW TO UNDERSTAND DECARBONIZATION IN MRR

Earthquake resilience, and how to sustainably approach the pre- and post-earthquake phases for structures, was the leading theme at this year's ReConStruct - Resilient Concrete Structures *fib* Symposium 2024. The event was held at the Te Pae Christchurch Convention Centre, Christchurch, New Zealand, and the BBR Network Member for New Zealand, Contech, had a team on hand to talk about BBR Care+, joined by BBR VT International CEO Olivier Forget and Sales Director Marco Zucconi. BBR Care+ and BBR Build+ PT solutions play a key role in earthquake resilience, alongside post-earthquake maintenance, repair and retrofitting (MRR).



Contech's team on the stand at ReConStruct. Left to right: Peter Higgins, Derek Bilby, John Gin, Ken Pang.

ETA UPDATES FOR BBR VT CONA CMI

A key benefit of BBR Network membership is access to world-leading technologies and products that are constantly updated, with globally recognized certifications. In 2024, both the BBR VT CONA CMI internal and BBR VT CONA CME external PT system ETAs were updated. For the BBR VT CONA CMI system, previously we had three assessments. Now, we have rolled them all into one, merging all existing features, such as the full-size range up to 61 strands, both bearing trumplate (BT) and square plate (SP) options, bare strands and monostrands, bonded and unbonded tendons, enhanced corrosion protection up to PL3, and replaceable tendons.
The new CMI ETA also includes some new features like single-layer anti-bursting reinforcement, Coupler K EIT solution, new accessories and BBR VT Plastic ducts and segmental coupler tested according to *fib* Bulletin 75. For the CONA CME system, it includes extensive intermediate sizes, introduces the option to use a square plate (SP), more options for replaceable tendons, as well as new features like single-layer anti-bursting reinforcement and the Coupler K EIT solution.
The ETA charts the process for assessing the performance characteristics of certain specialized construction products, like PT, in Europe. There is international recognition of the benefits of ETA and its CE mark. Learn more about the ETA on p81 and you can find the latest version in the downloads section of our website.

The new version of the ETA CMI and CME approvals, covering sizes of up to 61 strands and all BBR Build+ features.

DE VRIES VSP B.V SAYS TO ITS TEAM, WE'VE GOT YOUR BACK

The BBR Network Member for the Netherlands, De Vries VSP b.v, has introduced health and safety equipment to help mitigate the risks to its workforce from heavy and repetitive tasks. Business Unit Manager, Paul Posthoorn, explains: "The health and long-term employability of our staff is one of our top priorities. We believe that everyone should stay strong and fit – not just today, but well into their retirement. That's why we're introducing a revolutionary solution to drastically reduce physical strain on construction sites."
Paul continues: "After extensive research and practical testing, we have chosen Laevo exoskeletons as the ultimate solution for our construction professionals. One of our personnel is now piloting the exoskeleton, and the feedback has been overwhelmingly positive: less physical strain, more energy, and improved posture." For more information, contact Paul (see the directory on p84-85) or visit laevo-exoskeletons.com.

The Laevo exoskeleton significantly reduces strain when, for example, lifting and handling cement bags, lifting and placing tensioning heads and performing repetitive bending, reaching, and working in a forward-leaning position.

Conference Notes
Global BBR Conference, Zurich, Switzerland 2024

Celebrating 80 years where BBR began

2024 was a special year. We celebrated BBR's 80th anniversary with the BBR Forum and Gala Dinner, and hosted our Global BBR Conference. Held at the Dolder Grand in Zurich, we enjoyed presentations on engineering, innovation and decarbonization alongside a memorable cultural program.

The Global BBR Conference is an opportunity to share and learn from how BBR Network Members and BBR VT International have delivered projects that meet client objectives and overcome engineering challenges. New BBR Network Members De Vries VSP b.v, serving clients in the Netherlands, Belgium and Luxembourg, and Phoenix Specialist Contracting Ltd (PSC), operating in the UK and Republic of Ireland, joined for the first time. We had our first remote presentation at a Global BBR Conference, with Canadian BBR Inc. broadcasting live from Toronto, and a strategy workshop on challenges and opportunities for the global BBR business.

BBR's strategic pillars in action were presented, with BBR Build+ applied to bridges, buildings, geotechnics, special applications, energy and infrastructure, and a glimpse of how BBR Care+ secures asset longevity and saves carbon. Among the novel technologies presented was our AI-powered chatbot, BBR Intelligence (see p79-80). A co-presentation by BBR VT International and decarbonization partner Terrascope explained how carbon emissions along the BBR Network's supply chain have been quantified and how future carbon initiatives are defined. An introduction to AQUILA Built Health (see p64-71) revealed its benefits for BBR Network Members and the role it plays in BBR Care+.

The cultural program began on the Sunday evening with a traditional Swiss meal in the countryside, a short walk through the forest from the venue. After Monday's technical sessions, the team engaged in chocolate making and a tour of the Lindt & Sprüngli factory. The day ended with a dinner and the BBR Awards ceremony. On Tuesday, the partner program featured tours of Brunnen in the Canton of Luzern and, when we came together in the evening, of Sauber Motorsport, where we saw innovation happening in real time inside a state-of-the-art research and fabrication facility. There was even a chance to witness the pressure and excitement of pit stop tire changes, followed by dinner with our hosts.

The Global BBR Conference is an excellent opportunity for BBR VT International and BBR Network Members to discuss developments and network in person.

BBR VT International's Dr. -Ing. Xiaomeng Wang, Senior Manager Knowhow and AI, launches BBR Intelligence

Wearing the correct PPE for the chocolate kitchen, BBR's apprentice chocolatiers are ready for action.

BBR's apprentice chocolatiers work on becoming masters, making chocolate bears and truffles.

An evening with Sauber Group at the Sauber Motorsport facility. Most of the site is off-limits for photography due to the advanced engineering taking place that makes Sauber Group vehicles world-leading, but we got to see behind the scenes.

Day two at the strategy workshop was an opportunity to gather insights from BBR Network Members and engage with core stakeholders to jointly shape the future of BBR.

Conference Notes
BBR Forum and 80th Anniversary Gala Dinner,
Zurich, Switzerland 2024

BBR – 80 years young

The BBR Forum and 80th Anniversary Gala Dinner were held at The Dolder Grand in Zurich, Switzerland, the country where the BBR story began in 1944. The Dolder Grand celebrated its 125th anniversary in 2024.

Proceq CEO Dr Koichi Oba demonstrates the link between real-time non-destructive testing (NDT) data and preventative asset healthcare using Japan's aging infrastructure as a case study.

The BBR Forum's audience comprised delegates from the worlds of construction, engineering and industry, research and academia, finance and asset management, strategy and consultancy, sustainability and decarbonization, and technology.

BBR Chairman Marcel Poser's opening speech engages a captivated audience as he describes a 21st century that is being shaped by innovation and the AI revolution, representing a paradigm shift greater than the industrial revolution.

80 years of engineering excellence is certainly something to celebrate, and we did just that at the BBR Forum and Anniversary Gala Dinner in Zurich on 29 May 2024.

Switzerland is where it all began in 1944, when three entrepreneurial engineers originally from industry and research – Max Birkenmaier, Antonio Brandestini and Mirko Robin Roš – gave their names to the company BBR, or Bureau BBR as it was known from 1945 until 1993.
The BBR Forum was held at The Dolder Grand. Following the Global BBR Conference, we got to hear the fascinating insights of 12 expert speakers, talking to an invited audience of over 150 key opinion leaders from across industry, finance, academia, government and policymaking. Under the theme of Building Tomorrow Together, the speakers' topics were focused around four themes:

1. **Sustainability:** driving value through impactful initiatives.
2. **Celebrating engineering excellence in Switzerland:** a tradition of innovation and precision.
3. **Executing built world innovation:** transforming ideas into reality.
4. **Protecting the built environment:** the critical role of inspection, maintenance, repair and retrofit.

The presentations covered topics as diverse as 3D printing, how reducing carbon can maximize asset values, Japan's aging infrastructure as a case study for proactive built health, and the latest environmental, social and governance (ESG) reporting standards. Three members of the Tectus Group of companies, BBR VT International, AQUILA Built Health and Proceq, showcased their technologies for the delegates at an exhibition in the venue's foyer. It was a fast-paced day, packed with insights and thought leadership, with the Forum's closing summary ending almost exactly on time. Then, we threw BBR a birthday party, with our Anniversary Gala Dinner.

BBR 80th Anniversary Gala guests listen to a saxophonist play as they toast a successful day at a reception ahead of the Gala Dinner.

Gala Dinner guests were treated to an amazing light show to close the evening.

The BBR VT International team.

Above: BBR VT International Honorary Chairman Bruno Valsangiacomo unveiled a video about BBR's history (see BBR's YouTube channel) and spoke about the business he feels privileged to lead, and the reasons behind its enduring success. He highlighted the outstanding people, then and now, who have made the difference.

Left: Andrew Tan, CEO of BBR Construction Systems Pte Ltd in Singapore, presents an artwork to BBR VT International Honorary Chairman Bruno Valsangiacomo as part of the 80th Anniversary celebrations.

The 80th Anniversary Gala dinner was held in the ballroom at The Dolder Grand. Distinguished guests and partners joined attendees from across the Tectus Group, including Proceq, which was celebrating its 70th anniversary.

BBR Awards 2024 Outstanding achievements by BBR Network Members

Awards for Excellence

The annual BBR Awards recognize excellence, creativity, outstanding work and a relentless drive to do more with less. It is always a challenge to pick the winners, as all BBR Network Members push the limits of what is thought possible.

We celebrate outstanding work on projects that utilize BBR technology – projects that have a huge impact on society. As well as being special in so many other ways, 2024 saw the introduction of our Special Awards, celebrating champions who are BBR Network Members, and excel in a specific field.

2024 BBR Award Winners

BBR Network
Project of the Year Award

BBR Saudi Arabia is to be congratulated for winning with its Intensive care for a Riyadh Hospital. This project demonstrates creative engineering excellence and how to do more with less using technology to save carbon. CONNÆCT 2024 p82.

BBR CONNÆCT
Best Article Award

Winner: BBR Polska Sp. z o.o.
Title: From pole to pole by road: BBR Polska connects the country, Expressway S11 and DK-47 National Road Bridge (Poland)

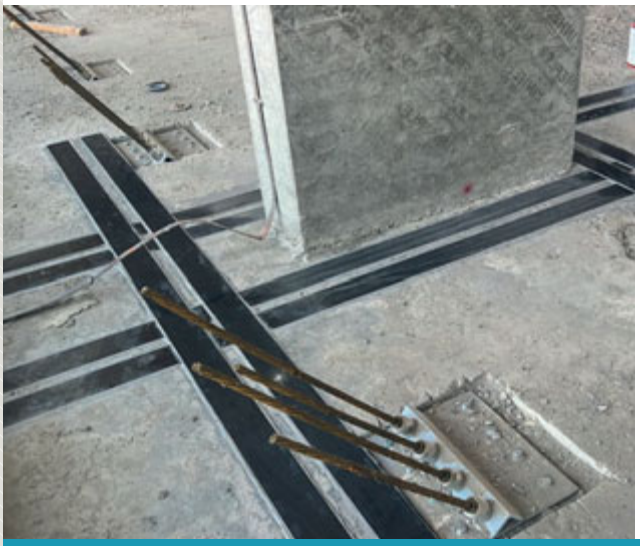
With a focus on BBR's CMI movable coupler, we have the stories of three projects to enjoy, including their work on the Expressway S11, one of the most important road projects in the country. Read it in full in CONNÆCT 2024 on p34.

BBR CONNÆCT
Best Photography Award

Winner: BBR Adria d.o.o.
Title: Heights of achievement, Počitelj bridge (Bosnia & Herzegovina) and a railway viaduct in Slovenia.

Readers get a clear sense of the scale, height, beauty and impact of these structures from the photography in a way that enhances the words and the story being told. See the photography in CONNÆCT 2024 p32.

BBR Network Project of the Year Award 2024



BBR Saudi Arabia's Abdulrahman ElFateh (center) and Mohamed Zaki (right) receive the BBR Network Project of the Year Award 2024 from BBR VT International CEO Olivier Forget (left).

BBR CONNÆCT Best Article Award

BBR VT International CEO Olivier Forget (center) with BBR Polska Sp. z o.o.'s Tomasz Jendernal (left) and Jan Piekarski (right) accepting the Best Article Award.

BBR CONNÆCT Best Photography Award

BBR VT International CEO Olivier Forget (left) presents the Best Photography Award to BBR Adria d.o.o.'s Želimir Bodiroga (center left), Marino Jurišić (center right) and Marko Cvitković (right).

BBR Network Special Awards

BRIDGE CHAMPION 2024

The Bridge Champion focuses on the technical and logistical challenges of bridge construction, repair and maintenance, and the way in which a BBR Network Member has triumphed over these challenges. BBR Construction Systems (M) Sdn Bhd is this year's champion for its creative efforts on the Sungai Bintangor Bridge in Malaysia.

BBR VT International CEO Olivier Forget (left) with BBR Construction Systems (M) Sdn Bhd's Yok Lin Voon.

OUTSTANDING ACHIEVEMENT AWARD 2024

This is awarded to a BBR Network Member that has designed and implemented a post-tensioning engineering solution to the benefit of the local community and wider society. This year's Outstanding Achievement Award goes to Stahlton AG for its work on the Schwamendingen enclosure project in Switzerland.

BBR VT International CEO Olivier Forget (left) and Rainer Zünd (right), who accepts the Outstanding Achievement Award on behalf of Stahlton AG.

SUSTAINABILITY CHAMPION 2024

This award recognizes a BBR Network Member's success in taking a holistic, sustainable approach to projects, such as using less traditional reinforced concrete and prioritizing post-tensioning technology.
As we know, doing this can save on carbon emissions and costs. Our Sustainability Champion is Contech for the twin projects Princes Wharf and Kinleith Mill.

Contech's CEO Derek Bilby (right) accepts the award from BBR VT International CEO Olivier Forget (left).

BUILDING CHAMPION 2024

Our Building Champion award recognizes a franchisee that uses post-tensioning technology in new and creative ways to fulfill the customer's need, reduce cost, save time and save on materials. This year's winner of the Building Champion award is BECOMAR – BBR Maroc for its role in supporting the local community in Tangier by building the Al Jabr International School in just four months.

BBR VT International CEO Olivier Forget (left) with BECOMAR – BBR Maroc's Oussama Kandri (right).

SPIRIT AWARD 2024

The Spirit Award is all about how we collaborate, share best practice, learn from and support other BBR Network Members on projects, in whatever form that may take. As it is this very spirit that unites BBR Network Members, it is always difficult to choose the winner. This year, the winner is BBR Construction Systems Pte Ltd, Malaysia, Singapore and Philippines for their collaboration during the construction of the Talomo Matina Bridge.

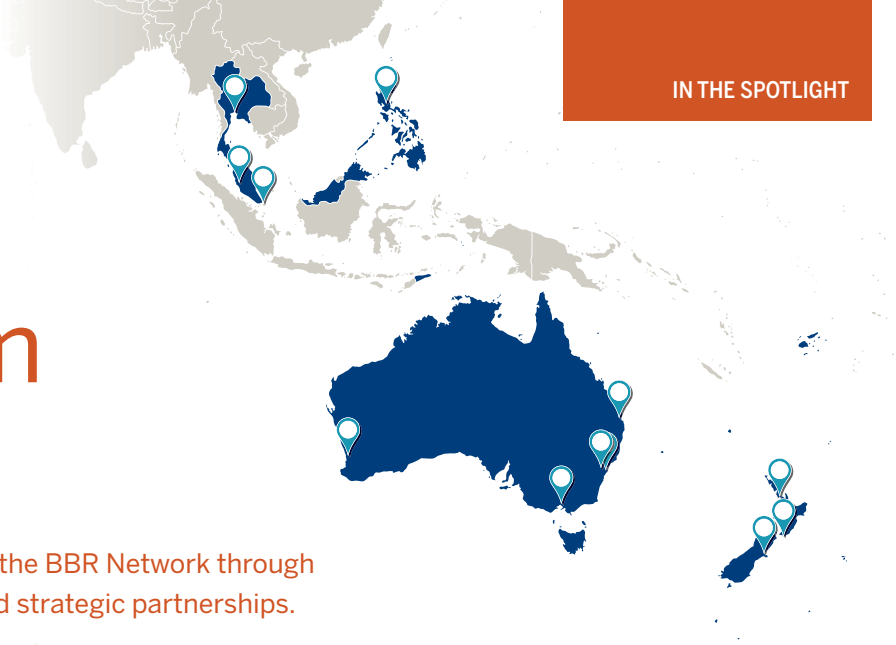
BBR Philippines Corporation's Rey Constantino Singh (center) and John Mo from BBR Construction Systems Pte Ltd in Singapore (right) accept the award from BBR VT International CEO Olivier Forget (left).

GT CHAMPION 2024

A new addition to our awards categories. The GT Champion Award recognizes a BBR Network Member's work on a project that utilized BBR geotechnical construction methods in successful, inventive ways. The winner is Kappa Kalıp İnsaat ve Taahhut A.Ş. for its collaboration with the BBR VT International team in its first use of the BBR VT CONA CMG PL2 strand ground anchors on the Çayırhan Bridge, Turkey's first cantilever bridge with inclined piers.

Kadir Hekimoğlu (left) and Murat Kutay (right) accept the first GT Champion Award from BBR VT International CEO Olivier Forget (center).

Pacific Rim road trip



Knowledge sharing and strengthening the BBR Network through relationship building, collaboration, and strategic partnerships.

In his 2024 Business Review (CONNÆCT 2024, p18-21), and in this year's edition (p6-7), our CEO Olivier Forget highlights the importance of the BBR Network and BBR Network Members, and how we are stronger individually and collectively because we are a global team. After last year's Global BBR Conference, Olivier embarked on a Pacific Rim road trip to visit BBR Construction Systems (M) Sdn Bhd in Malaysia and BBR Construction Systems Pte Ltd in Singapore. Later in the year, Olivier was joined by BBR VT Sales Director Marco Zucconi on visits to SRG Global in Australia and Contech in New Zealand. The purpose? Knowledge sharing and strengthening the BBR Network. BBR Network Members all share engineering expertise, but each develops unique strengths. Olivier discovered this during visits to Malaysia and Singapore, remarking: "I was amazed by the experience of our BBR Network Member for Malaysia, not only in their capabilities for bridge design and construction acting as a specialized contractor, but also in other fields, such as transfer slabs, silos and buildings, both for new construction and upgrades of existing structures."

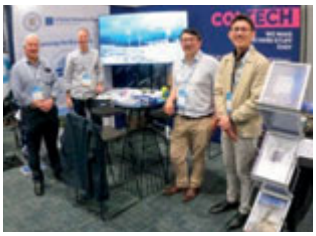
The BBR Network Member in Singapore has a track record in post-tensioning (PT) slab design and installation, from housing to malls and industrial plants. This expertise, Olivier continues, "enables BBR Network Members to work on multi-use projects, combining modular housing construction with commercial car parks that use PT in slabs and transfer beams. This minimizes material use and resources, and the construction site's impact on the surrounding environment, and carbon emissions."

On the second leg through Australia, Marco recalls: "SRG Global took us to two sites in Queensland where BBR's PT technology is making a difference: the Coomera Hospital and Centenary Bridge. We jointly presented BBR's technologies to consultants in the region and updated SRG Global." In New Zealand, the team "visited sites where Contech has applied its methodology to install ultra-thin PT slab-on-grade and presented the latest BBR technologies to Contech and local consultants."

"Every BBR Network Member has developed solutions that can be useful to the whole Network and adapted to local requirements and constraints," concludes Olivier. "By visiting each other, we can ensure the BBR Network becomes stronger together."

BBR VT International and SRG Global teams enjoying downtime. Left to right: Sean Kelly (SRG Global), Marcel Poser (BBR VT), Olivier Forget (BBR VT), Tom Wenzel (SRG Global), Adam O'Dea (SRG Global), Mark Sinclair (SRG Global) and Marco Zucconi (BBR VT).

SRG Global team members on the Coomera Hospital construction site in Coomera, Australia, giving a tour to BBR VT Sales Director Marco Zucconi (who is taking the photograph).



BBR VT International and Contech jointly exhibited at the ReConStruct *fib* Symposium 2024 in Christchurch. Left to right the Contech team: Peter Higgins, Derek Bilby, John Gin, Ken Pang

BBR VT International CEO Olivier Forget (left) with Contech's Southern Regional Manager Peter Higgins (right) at Oxford Apartments, Christchurch, New Zealand (see CONNÆCT 2024, p62-63).

BBR VT International CEO Olivier Forget on site with the BBR Construction Systems Pte Ltd team in Singapore.

BBR VT International CEO Olivier Forget with the BBR Construction Systems (M) Sdn Bhd team.

Kappa Kalıp ve İnşaat Taahhüt A.Ş.
Istanbul, Turkey
PT and MSS technology for viaduct construction

PT and MSS reduce CO_2 in viaduct construction

The Sular Valley Viaduct project is improving Istanbul's expanding ring road's connectivity, using construction technologies that led to a measurable reduction in CO_2.

Using post-tensioning (PT) and movable scaffolding systems (MSS) for deck construction, Kappa Kalıp ve İnşaat Taahhüt A.Ş., in collaboration with Rönesans Holding, is constructing a 90m-span of viaduct while maintaining access to Sular Vadisi Park below.

Progress on the Sular Valley Viaduct continues, with preparations underway for the first segment casting and the first spans completed by June 2025. The viaduct is being built using MSS technology provided by the Portuguese company, BERD. This enables the construction of large, reinforced concrete spans with minimal disruption to the public park below.

By using PT and MSS combined, Kappa Kalıp ve İnşaat Taahhüt A.Ş. can keep construction elevated and allow the deck to be lifted off the ground and moved into place incrementally. This reduces the need for heavy scaffolding and other temporary structures and enables continued access to the park. To complete the full deck width, a cantilever machine will follow behind the MSS, installing the deck's wings and struts. This auxiliary system extends the structure for construction of wider decks.

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1 On this project, the main challenge is to construct a viaduct while maintaining access to a public park below it.
2 PT and MSS technologies allowed the deck to be lifted off the ground and moved into place, limiting heavy scaffolding and allowing the public park below to remain open.
3 The use of MSS and PT technologies on the Sular Valley Viaduct has reduced materials and CO_2, which supports the city's commitment to sustainable development.

Saving 21,300t of CO_2

Sustainability is at the heart of this project, where the use of PT and MSS technology has led to a 46% reduction in concrete compared to the original design, a 51% reduction in rebar, 31% reduction in strands and saved 21,300t of CO_2. Less materials means fewer transport trips, which reduces the carbon footprint further.

With these innovations, the Sular Valley Viaduct sets a new benchmark for sustainable infrastructure development in Istanbul. Kappa Kalıp ve İnşaat Taahhüt A.Ş.'s ongoing work in this project highlights its leadership in decarbonizing construction.

Achieving high structural integrity with PT

The Sular Valley Viaduct's structural integrity is critical. To achieve this, Kappa Kalıp ve İnşaat Taahhüt A.Ş. is incorporating BBR VT CONA CMI and BBR VT CONA CMF PT tendons into the design. This provides the strength necessary to support the viaduct's long span while optimizing materials to meet sustainability goals.

The BBR VT CONA CMI tendons, featuring 31 strands of 15.7mm diameter, 1,860 MPa steel, offer exceptional load-bearing capacity, which is essential for the 90m span. Additionally, BBR VT CMF 306 anchor sets will be deployed to reinforce the deck's wings, with transverse strands strategically placed for added stability. Their compact design minimizes borehole sizes, streamlining installation while reducing costs and materials.

A benchmark for sustainable infrastructure

The Sular Valley Viaduct is a symbol of Istanbul's commitment to sustainable infrastructure development. By integrating PT and MSS technologies, Kappa Kalıp ve İnşaat Taahhüt A.Ş. is demonstrating that large-scale engineering projects can balance urban development with environmental responsibility.

This project is setting a new standard for how cities can grow while preserving their natural surroundings and addressing climate change. Once completed, the Sular Valley Viaduct will improve connectivity in Istanbul and stand as a testament to the potential for construction technologies to shape a more sustainable future.

TEAM & TECHNOLOGY

Owner/developer – Republic of Turkey Ministry of Transport and Infrastructure

Main contractor – Nakkaş Otoyol Yatırım ve İşletme A.Ş.

Technology – BBR VT CONA CMI, BBR VT CONA CMF, MSS90

BBR Network Member – Kappa Kalıp ve İnşaat Taahhüt A.Ş.

Material	Initial BCM design (by client)	Optimized MSS design (by Kappa)	Reduction (%)	CO_2 Savings (tons)
Concrete C60 (m^3)	58,345m^3	31,381m^3	46%	10,786t
Steel rebars B500-C (tons)	12,371t	6,074t	51%	10,075t
Strands (tons)	1,031t	708t	31%	436t
Total CO_2 Savings				**21,297t**

BBR Construction Systems (M) Sdn Bhd
Kuching, Malaysia
BBR HiAm CONA Pin Connector for bridge construction

Smart technology minimizes materials and emissions

The Sungai Bintangor Bridge is currently under construction in Kuching, Malaysia. BBR's stay cable and pin connector technology has enabled sustainable design innovation and met the challenge of rising material costs.

When complete, the bridge, which features a striking three-legged pylon, steel-concrete composite deck and artistic cladding, will provide an additional vehicle and pedestrian crossing for the Bintangor River, linking parts of fast-growing Kuching.

1

For BBR Construction Systems (M) Sdn Bhd, there have been numerous challenges from the outset, including space constraints and a complex geometry. As with any large-scale project, the sequencing of construction is critical, and the temporary works design had to be meticulously planned to accommodate these complexities. The BBR HiAm CONA Pin Connector helped solve these challenges, offering flexibility and precision in the design.

The project involves 32 stay cables, varying in size and length, from 34m to 44m, with fixed pin connectors at the top of the pylon and adjustable pin connectors installed on the deck. These connectors allow for fine-tuned movement, ensuring structural integrity and materials reduction.

Early designs saw ultra-high-performance concrete (UHPC) panels wrapped around the pylon and deck, creating a distinctive visual identity, but designs were adjusted due to subcontractor availability changes and unforeseen material cost increases. This altered the aesthetic but did not diminish overall quality, and the original vision remains intact. Global supply chain disruption caused by geopolitical events and currency fluctuations have led to cost increases, especially for materials. This required a renewed focus on what BBR technology does best: doing more with less.

2

Enabling sustainable construction

Despite these setbacks, BBR Construction Systems (M) Sdn Bhd is reducing the project's carbon footprint. The BBR HiAm CONA Pin Connectors simplify the anchorage design at the pylon and deck, while still allowing the transfer of loads. This has reduced materials, enhanced structural design and made construction more sustainable.

The bridge's stay cables and pin connectors help reduce materials transportation needs, as less are required for installation. This lowers the carbon footprint from transport and machinery. Additionally, the efficiency of these advanced systems supports faster construction, further reducing costs and emissions. Through these innovations, the project supports broader national sustainability efforts.

Skillfully navigating supply disruption

Ongoing disruption to global supply chains has affected the procurement of materials, including the high-strength steel used to manufacture BBR HiAm CONA anchorages, and high-performance concrete. With the contract secured in December 2019 at pre-pandemic prices, the reality has been rising material costs and shipping delays. BBR Construction Systems (M) Sdn Bhd has found solutions to keep the schedule and budget under control.

Supporting regional growth

Through the adoption of advanced technologies and a commitment to sustainability, the Sungai Bintangor Bridge is setting a new standard for modern infrastructure projects in Malaysia. Once complete, it will link key areas across the Sungai Bintangor River, reducing travel times, creating jobs, boosting local commerce and driving regional growth.

3

4

1 The Sungai Bintangor Bridge features a three-legged pylon, steel-composite deck and is suspended by stay cables.
2 BBR Construction Systems (M) Sdn Bhd is optimizing material use while adapting to supply chain challenges, ensuring progress despite rising costs.
3 The BBR HiAm CONA Pin Connectors being assembled and installed.
4 The BBR HiAm CONA Pin Connectors ensure precise load transfer and adaptability to the bridge's complex geometry.

TEAM & TECHNOLOGY

Owner/developer – Public Works Department (PWD) Sarawak
Main contractor – Global Eco BBR Joint Venture Sdn Bhd
Technology – BBR HiAm CONA Pin Connector
BBR Network Member – BBR Construction Systems (M) Sdn Bhd

Contech
Ashhurst to Woodville, New Zealand
BBR VT CONA CMI for bridge construction

PT tendons improve safety and transport connectivity

The need for a new rural state highway – and bridges – in New Zealand has given Contech the opportunity to flex its tendon-stressing muscles.

The 145-year-old Manawatū Gorge, a 6km-long narrow, winding and steep road, once provided the fastest route between the east and west coasts of the lower North Island. But in 2018, following a series of landslips and rockfalls, NZ Transport Agency Waka Kotahi announced plans to build a new 11.5km, $620 million rural state highway that would provide a safe and efficient connection between the towns of Ashhurst in the west and Woodville in the east.

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3

This new highway – known as Te Ahu a Turanga – the Manawatū Tararua Highway, is set for completion in mid-to-late 2025. It will feature two lanes for traffic in both directions, six new bridges, and support walkers and cyclists via a shared-use path. The two longest bridges, both more than 300m long, will cross the Manawatū River and provide smooth transport links for locals and freight transport.

Bridge building for change

For the first time, the Rangitāne o Manawatū, an iwi in the Manawatū region, is heavily involved in the highway's design and implementation, and apprenticeships and other initiatives are being made available to support local communities. For Contech, the project offered an opportunity to apply the team's extensive skills in bridge building and maintenance while contributing to New Zealand's economic future.

Work started in January 2021. By 2023, a three-strong Contech crew joined teams from Fulton Hogan and HEB Construction to work on what would be a major undertaking in replacing the Manawatū River Bridge – then in a state of disrepair – with a new one: Parahaki Bridge.

At 300m long, 26m wide and 19m tall, the Parahaki Bridge is built in four spans using the scaffolding-free balanced cantilever method. Each span was formed in 27 segments, joined with post-tensioning (PT) and then balanced left and right using a form traveler. The bridge itself is hollow, using 320m^3 of concrete, with an internal shaft finishing 2m from the canopy and supported on three concrete piers.

Contech's role was to install and stress, at each of the three piers, four U-shaped tendons comprising 3106 multi-strands (8,091kN UTS). The team's work is part of the installation of a rocking system designed to reduce impact from earthquakes. As the size and shape of the tendons were relatively unusual, and the bridge's design required particularly tight tolerances, the team had to adapt.

The tendons were de-stressed and removed once the installation of the superstructure was complete, a process which involved moving 1.5t of tendons from their location 30m above the ground to a position where they could be removed from site.

Through collaboration and teamwork, this otherwise challenging project was completed smoothly. It stands as another success story for Contech.

1 Parahaki Bridge under construction as part of the Te Ahu a Turanga – Manawatū Tararua Highway project, enhancing connectivity in the region.
2 Contech installing U-shaped PT tendons at the Parahaki Bridge, a key component of the rocking system designed for seismic resilience.
3 Ongoing construction on the Parahaki Bridge using the balanced cantilever method. The project includes the building of six bridges to improve safety and connectivity in the region.

TEAM & TECHNOLOGY

Owner/developer – NZ Transport Agency Waka Kotahi
Main contractor – Fulton Hogan, HEB Construction
Technology – BBR VT CONA CMI
BBR Network Member – Contech

Stahlton AG
Bondo, Switzerland
BBR VT CONA CMI and CMX for bridge reconstruction

BBR's technologies safeguard Bondo community's future

Six years after a rockslide in Switzerland's Val Bondasca, Stahlton AG reconstructed three bridges, stitching the local community back together with durable and safe transport connectivity.

To rebuild the bridges and restore secure transport connections in the Graubünden holiday region, Stahlton AG applied BBR post-tensioning (PT) technology solutions that are designed to withstand future rockfalls.

In 2017, approximately 3 million m³ of rock fell from the Piz Cengalo mountain on the Swiss-Italian Alps border, displacing 1.5 million m³ of mud and glacial ice into the conurbation of Bondo below. This natural disaster destroyed around 99 buildings, roads and other infrastructure, while three bridges – Punt, Bondasca, and Spizarun – were severely damaged.

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1 The Bondo reconstruction plan included three bridges, a roundabout, and large, protective dams.
2 The Bondasca Bridge is one of a trio of bridges that Stahlton AG reconstructed following a rockslide in 2017.
3 Bondasca Bridge's fixed anchorage systems provide stability and long-term durability.
4 Punt Bridge. An important crossing is restored between Bondo and Promontogno.

TEAM & TECHNOLOGY

Owner/developer – Municipality of Bondo
Main contractor – ARGE Castelmur, Censi & Ferrari SA
Civil Engineer – Conzett Bronzini Partner AG
Technology – BBR post-tensioning solutions
BBR Network Member – Stahlton AG

Getting Bondo moving more quickly

A CHF 41 million (USD 41.5 million) budget covered the initial reconstruction efforts. Following the disaster, Bondo residents were left with a weakened and degraded transport infrastructure, including poor access along the Maloja Pass that connects Switzerland to Italy. This corridor is essential for residents, local businesses and tourists, as well as for agriculture and cross-border trade. The reconstruction phase, which included the tripartite bridge project, was executed in a short period of time between June-July 2024. The aim was to restore river crossings, reconnect agricultural land, and provide vital routes for pedestrians and vehicles.

Bondasca bridge: riverway reconnection

Spanning the Bondasca River, this bridge provides access between residential areas, agricultural land and local road networks. One of the key engineering challenges in its construction was the integration of fixed anchorage within the reinforcement structure for stability and durability.

The roadway slab features eight continuous prestressing cables, each 80m long, with an additional 12 cables ranging from 23-28m, all fabricated on-site.

Materials used:

- BBR VT CONA CMX 2406 Kat. b – 930.5m.
- BBR VT CONA CMI FA 3106 Kat. a/b – 12 units.
- BBR VT CONA CMI SA 3106 Kat. a/b – 28 units.

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Punt bridge: arch endurance

The old Punt Bridge between Bondo and Promontogno was destroyed. Its replacement, a flat arch structure, restores connectivity while blending with the landscape, and incorporates some of the fallen rocks in its structure.

The bridge's span was constructed using in situ concrete with a monolithically prestressed frame. Parapets at both ends were widened from 70-90cm to accommodate prestressing anchors and enhance structural resistance.

The bridge complies with flood level requirements and accommodates heavy vehicles up to 40t.

Materials used:

- BBR VT CONA CMX 2206 Kat. b – 194.3m.
- BBR VT CONA CMI FA 2206 Kat. a/b – 4 units.
- BBR VT CONA CMI SA 2206 Kat. a/b – 4 units.
- BBR VT CONA CMX 2706 Kat. b – 194.3m.
- BBR VT CONA CMI FA 2706 Kat. a/b – 4 units.
- BBR VT CONA CMI SA 2706 Kat. a/b – 4 units.
- BBR VT CONA CMX 3106 Kat. b – 194.3m.
- BBR VT CONA CMI FA 3106 Kat. a/b – 4 units.
- BBR VT CONA CMI SA 3106 Kat. a/b – 4 units.

Spizarun bridge: framework for success

Designed as a frame bridge, the Spizarun links local paths and minor roads. This structurally resilient solution features a slanted and curved underside to deflect impact forces and limit vulnerability to damage in future.

The bridge's concrete quality was rigorously monitored, with compression tests verifying strength classifications. Prestressing cables were placed within preinstalled sheathing ducts, allowing for even stress distribution and reducing the risk of cracking.

Materials used:

- BBR VT CONA CMX 3106 Kat. b – 533.4m.
- BBR VT CONA CMI FA 3106 Kat. a/b – 8 units.
- BBR VT CONA CMI SA 3106 Kat. a/b – 20 units.

According to experts, 5 million m³ of unstable rock remains at the mountain's peak, posing an ongoing risk to Bondo. However, more effective early warning systems and the newly reconstructed bridges, strengthened with BBR technology, are built to withstand extreme environmental forces and safeguard against possible future disasters.

FCC Construcción
Amsterdam, The Netherlands
BBR VT CONA CMI for bridge remodeling

Widening horizons on the A9 motorway

One of Europe's busiest transport corridors – the A9 Badhoevedorp-Holendrecht motorway and Schiphol Bridge in The Netherlands that connects the capital Amsterdam to Schiphol Airport – is being upgraded. FCC Construcción has contributed to a project that stands as an extraordinary example of urban integration.

Spanning 11.4km, the A9 project widens the motorway from three to four lanes in each direction, modifying 11 existing structures and adding new junctions, bridges, tunnels, and an underground motorway excavation. A key feature is a 1.7km trench section with three covered subsections to ease congestion.

1

FCC Construcción employed a range of advanced engineering techniques to maximize structural integrity, and staging methods to limit disruption to traffic flows through the corridor during construction. With post-tensioning (PT) and jacking operations progressing, the A9 project remains on schedule for completion by the end of 2027.

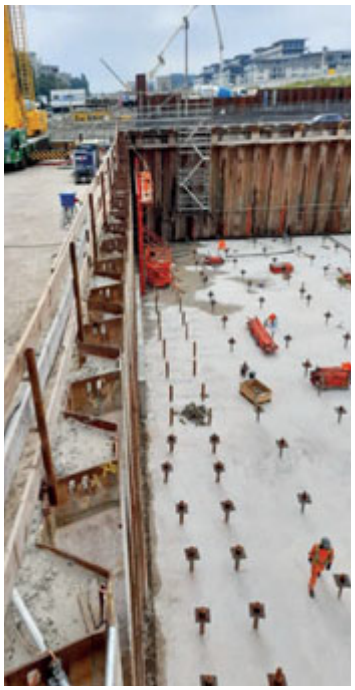
PT technologies optimize infrastructure integrations

The A9 project includes widening bridge decks, PT tunnel slabs, and optimizing canal-roadway connections for better infrastructure integration. FCC Construcción has led PT and jacking operations, such as the remodeling of Schiphol Bridge and the roof structure spanning the underground motorway excavation.

PT was used to reinforce both the Schiphol Bridge and tunnel slabs. Between September 2023 and October 2024, extensive PT works were carried out on four bridge extensions, including two 86m spans and two 65m spans. These efforts involved 240t of active steel and 76 tendons, using BBR VT CONA CMI BT 1906 and 2206 technologies.

The Schiphol Bridge is a bascule bridge, designed to swing upward using a counterweight system to allow ships to pass. As part of the A9 motorway expansion, its bascule chamber, foundations, pillars and decks are being widened and reinforced, alongside upgrades to electrical and mechanical systems.

2



3

Minimizing impact during excavation

Extensive excavation is ongoing to construct the underground motorway in Amstelveen on the outskirts of Amsterdam. A deep trench will house the motorway below ground level, minimizing its impact on the surrounding urban landscape and enabling the development of a new park on, and alongside, the tunnel roof.

PT work on 42 tunnel slabs (21 each on the north and south sides) is being done entirely at floor level, forming the roof structure that spans the excavation area. This roof, constructed using slabs ranging from 24m to 42m in length, will eventually bear the weight of the road above. This work involved:

- 832t of active steel.
- 317 tendons with BBR VT CONA CMI BT 2206 technology and 142 couplers.
- 416 tendons with BBR VT CONA CMI BT 2706 technology and 208 couplers.
- 142 tendons with BBR VT CONA CMI BT 3706 technology and 71 couplers.

The precise application of these tendons provided essential support for the slab structures, ensuring their longevity and resilience under heavy loads. PT reduces the concrete height of the slabs – a critical factor given the high forces and weight the structure must support. This allowed for thinner, lighter slabs without compromising strength.

The couplers support alignment within the tendons, which was necessary given the strong force exerted by heavy loads and the complex geometry of the bridge. Unlike in traditional applications, where couplers are used to join long tendons, here they were employed to accommodate curvature and connect the slabs with transverse tendons. This enabled seamless integration of the bridge deck's structural elements for stability and flexibility. Scheduled for completion in September 2027, this project showcases FCC Construcción's technical expertise and effective project management.

4

Precision jacking for greater structural integrity

A significant technical achievement in the A9 project was the synchronized jacking of the new southwest and northwest decks of the Schiphol Bridge. These decks, each spanning 86m and weighing 1,600t and 3,000t respectively, were lowered by 1.5m as part of the bridge remodeling.

The synchronized jacking operation utilized a hydraulic powerpack system with up to 34 lifting points, enabling precise load and displacement control. This ensured a smooth descent of the entire deck with differences between lifting points kept to less than 0.3mm to maintain structural integrity.

Two additional jacking operations reduced the load on the bearing blocks of the existing north and south bridges, which continued to carry traffic during construction. Polytetrafluoroethylene (PTFE) stainless steel sliding pads allowed for controlled movement of the deck. By using synchronized jacking equipment, FCC Construcción achieved accurate deck positioning and uninterrupted traffic flow.

Smoother access between major transport hubs

FCC Construcción, in collaboration with Rijkswaterstaat, the project's owner and developer, ensured the A9 motorway could remain open. Maintaining access to Schiphol Airport – a busy international hub – was a priority. Synchronized jacking precisely positioned the bridge decks, ensuring uninterrupted traffic flow for commuters and airport travelers beneath the construction zone.

Congestion and journey times have already been reduced, with smoother access between Amsterdam and Schiphol Airport. The project sets a new benchmark for sustainable urban integration, enhancing mobility for residents and commuters.

For FCC Construcción, the A9 motorway project stands as a shining example of what can be achieved when precision engineering, planning and vision come together.

1 On the Schiphol Bridge, preparing to install PT tendons for structural strength and durability.
2 The BBR team crew installing a PT anchor with BBR VT CONA CMI technology.
3 Construction on the underground motorway, where 832t of active steel is being used for structural integrity.
4 Reinforcement and PT preparation, ensuring structural integrity and load-bearing capacity.
5 Synchronized jacking using a hydraulic powerpack with 34 lifting points and flat jacks (220t to 350t) for precise deck positioning on the A9 motorway.
6 Synchronized jacking operation lowering the new southwest (1,600t) and northwest (3,000t) bridge decks by 1.5m.
7 The synchronized hydraulic powerpack system ensured seamless jacking operations for the Schiphol Bridge decks.

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TEAM & TECHNOLOGY

Owner/developer – Rijkswaterstaat
Designer/architect – FCC Construcción
Main contractor – FCC Construcción
Technology – Post-tensioning, synchronized hydraulic jacking
BBR Network Member – FCC Construcción

BBR Construction Systems (M) Sdn Bhd
Sarawak, Malaysia
BBR CONA external post-tensioning for bridge

A novel solution for every challenge

Malaysia's Batang Sadong Bridge required structural strengthening to support two new 600mm water pipes as part of Sarawak's Water Supply Grid Programme and ensure its continued role in the region's infrastructure.

BBR Construction Systems (M) Sdn Bhd adapted original design proposals to overcome safety and engineering challenges, and successfully deploy BBR VT CONA CME external post-tensioning (PT) for the water pipe installation.

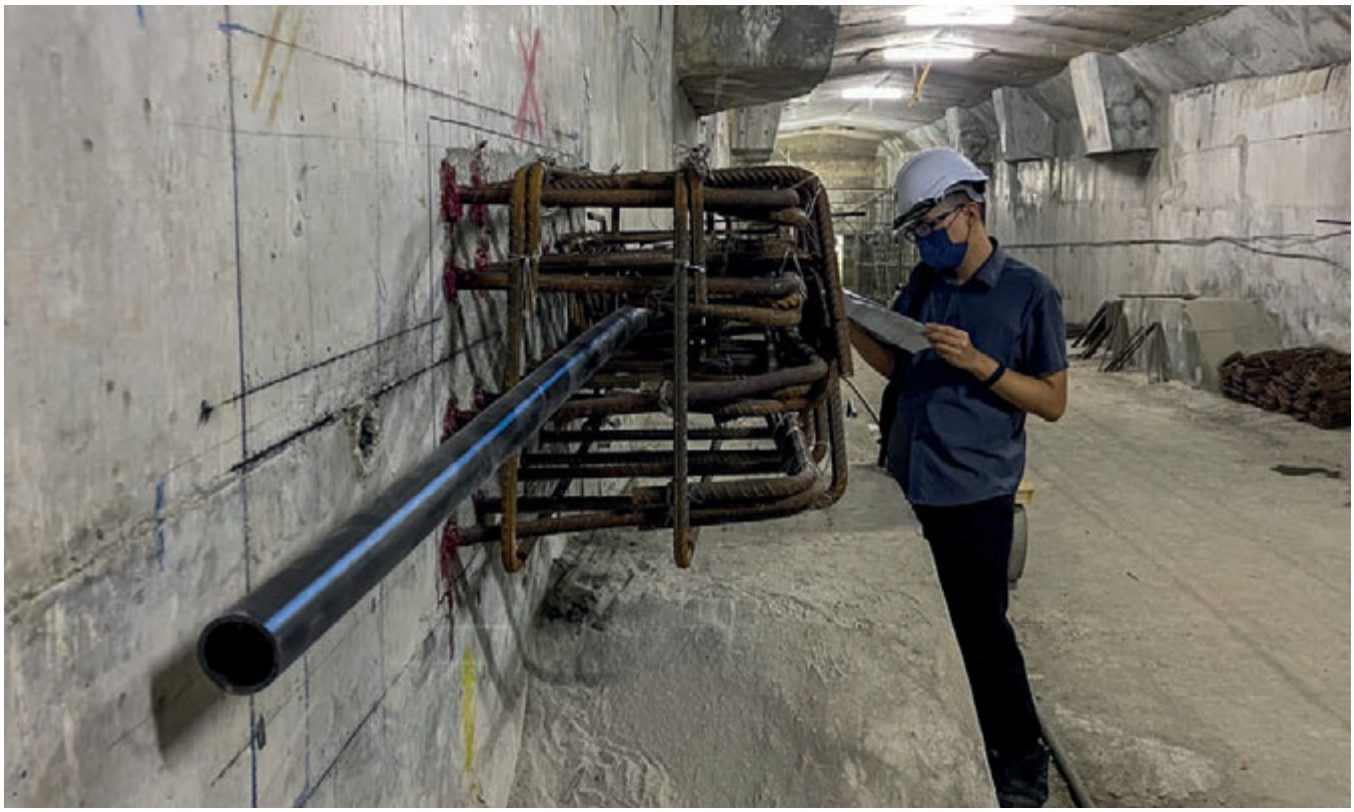
1

In the original designs, the location of the external PT tendons were placed outside the box girder at the piers. These tendons would require temporary works that would encroach onto the live carriageway, obstructing traffic flow. Given the constant use of the bridge by heavy vehicles, closure was not possible. Additionally, the external tendons had to be protected by a composite grill, which affected the bridge's aesthetic and created maintenance challenges.

It was also proposed that the external tendons were anchored using steel blisters bolted through the box girder web. A gondola platform would have to be erected outside the box girder, which posed a safety risk. The external tendons featured adjustable nut heads and polyethylene-coated strands, similar to stay cables, adding another layer of complexity to the design.

Improving safety and reducing disruption

In response to these challenges, BBR Construction Systems (M) Sdn Bhd proposed using BBR VT CONA CME external PT tendons and relocating the tendons from outside the box girder to inside it. Placing the tendons inside the girder while maintaining them as an external PT system protects them from the elements and enhances their durability. This eliminated the need for workers to operate outside the box girder, improving safety.



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Another advantage was limited traffic disruption. Shifting to BBR VT CONA CME external PT within the box girder allowed work to proceed without the need for bridge closure. The revised design concealed the previously exposed tendons and composite grill from view. This enhanced the bridge's aesthetic and removed maintenance challenges related to the grill.

Buggies facilitate movement in confined spaces

Working within a confined space is always challenging, and the 1.5km bridge with its two entry points posed logistical difficulties for material transport. The BBR Network Member for Malaysia used electric-powered buggies to transport materials within the box girder. These buggies, and the installation of mini ramps, facilitated movement across the pier openings. Temporary power, water and ventilation systems ensured efficient operations within the confined space.

The Screening Eagle Technologies' Proceq GP8100 ground-penetrating radar (GPR) device, which scanned existing rebar and tendon positions before drilling or coring, ensured the new PT system was installed without interfering with existing infrastructure.

GPR technology streamlines installation

A key component of the project was the use of advanced construction technologies, including Proceq's GP8100 GPR device. Using GPR helped identify tendon and rebar positions before any modifications were made and ensured the BBR VT CONA CME external PT streamlined installation.

The team's synergy with Screening Eagle Technologies' equipment further optimized the construction process. Mapping out the bridge's internal structure before modification reduced the risk of costly mistakes and delays, enhancing safety and efficiency.

Cost and time savings for the client

The alternative solution proposed by the team not only improved safety and aesthetics but resulted in significant cost and time savings for the client. The use of more commonly available materials, such as anchorage, strand, grout, concrete, rebar and HDPE pipe, reduced overall project costs, while the removal of external platforms and the composite grill allowed for more efficient construction.

The project stands as an example of how leading-edge technologies and collaboration can address complex engineering challenges and the value of collaboration in overcoming these challenges, while demonstrating the effectiveness of external PT systems in bridge strengthening.

1 The Batang Sadong Bridge, a vital Malaysian transport link, strengthened for longevity and resilience.
2 Relocating external PT tendons inside the box girder simplified the design and enabled faster, more efficient work.
3 The Proceq GP8100 GPR device accurately scanned rebar and tendon positions, ensuring correct installation of the new PT system.
4 Electric-powered buggies and temporary power, water and ventilation systems supported material transport in the confined environment of the box girder.

TEAM & TECHNOLOGY

Owner/developer – Public Works Department (PWD) Sarawak
Main contractor – BBR Construction Systems (M) Sdn Bhd
Technology – BBR VT CONA CME external
BBR Network Member – BBR Construction Systems (M) Sdn Bhd

4

SRG Global
Brisbane, Australia
BBR VT CONA CMI internal for pontoon construction

PT sets new standards for pontoon construction

SRG Global has collaborated with marina design expert Bellingham Marine to assist in finalizing the design and construction of a pre-cast, post-tensioned rowing pontoon for a prestigious school in Brisbane, Australia.

Utilizing advanced tendon technology, the structure was assembled, stressed and transported upstream, setting new standards for pontoon construction.

1

In May 2024, Bellingham Marine chose SRG Global to assist with finalizing the design of the post-tensioning (PT) required in the pontoon for the Anglican Church Grammar School (Churchie), which would replace the decommissioned pontoon. Measuring 62.3m in length and 3.73m in width, SRG Global leveraged specialized tendon configurations, customized ducting for corrosion protection and advanced PT techniques.

The final design incorporated BBR VT CONA CMI internal technology, with six tendons providing primary structural integrity. Temporary tendons were utilized to ensure initial structural stabilization before permanent PT installation.

The end modules of the pontoon housed anchor blocks for the BBR VT CONA CMI internal anchors for a reliable connection. The match-cast pre-cast modules were assembled downstream, with temporary tendons sealing the structure before the final ducts and tendons were installed. This staged approach minimized movement during construction and meant all components could be integrated easily.

Preparing the pontoon for harsh conditions

The Brisbane River is a harsh environment with significant flood events, vessel wake and salt water. The pontoon was designed to AS3962 and followed the AS5100 Bridge Design Code. A double polyethylene (PE) duct system was implemented to enhance durability and protect the tendons from corrosion. The outer PE duct was incorporated during the match-casting process, providing an initial protective layer. Once the temporary tendons were in place, the inner PE duct was installed for secure enclosure.

To accommodate the oversized PE in the anchorage zone, a larger anchorage casting was adopted. This multi-layered system provided superior protection, ensuring the pontoon's structural integrity against the constant exposure to water and external forces.

Skilled assembly

The pontoon's total weight exceeded 400t, requiring the pontoon to be assembled and post-tensioned in the Brisbane River. This introduced challenges such as restricted access, fluctuating tides and complex anchoring requirements. A downstream location was carefully selected by Bellingham Marine, where cranes and erection equipment could be utilized efficiently.

Once fully stressed and grouted, the pontoon was carefully transported upstream using a tugboat, guided into position, and secured to piles before being connected to the land via gangways. The entire PT operation, including multistrand stressing using 4800kN front-pulling jacks, was completed within an impressive 11-day window.

PT innovation delivers high performance

Following the success of this project, SRG Global and Bellingham Marine are exploring additional pontoon construction projects. This collaboration has also extended internationally, with Bellingham Marine engaging Contech in New Zealand to replicate similar pre-cast PT pontoon designs.

SRG Global's PT expertise continues to drive innovation in marine construction and was on full display during this project. Through successfully implementing BBR VT CONA CMI internal technology, the team delivered a robust, high-performance floating structure that will meet the needs of the school's rowing program for years to come.

1 A crane positioning pontoon sections for assembly on the Brisbane River.
2 SRG Global and Bellingham Marine used BBR VT CONA CMI technology for Churchie's precision-engineered floating pontoon.

TEAM & TECHNOLOGY

Owner/developer – Anglican Church Grammar School (Churchie)
Main contractor – Bellingham Marine
Designer – Burbury Consulting
Technology – BBR VT CONA CMI internal
BBR Network Member – SRG Global

2

FCC Construcción
Madrid, Spain
Heavy lifting for football stadium roof

Raising the roof on a sporting triumph

The $1 billion transformation of Santiago Bernabéu Stadium, home to Real Madrid CF, reimagines a sporting icon as an architectural marvel and social hub.

Key to the revitalized stadium's look and atmosphere is the new retractable roof, which BBR Network Member FCC Construcción remodeled with very little workspace.

With the curving, organic shape of the stadium, the roof creates a 'cauldron' effect, ringing to the chants of up to 85,000 fans when games are in play. When needed, for example during rainfall, the roof retracts in just 15 minutes.

A rolling program of works

The structure, comprising over 10,000t of steel, was raised to accommodate an extra tier and 4,000 spectators. For work to continue even while games were in session, a compression beam was placed onto two new towers and two columns to form an outer ring. The stadium's inner-city location meant the team faced challenges due to limited workspace, especially in lifting the four longitudinal trusses, each 140m long and weighing approximately 800t.

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Beyond the retractable roof

The roof isn't the only moving part. As the pitch is retractable, the stadium can quickly accommodate other functions. Grass is installed on 12 single track units and embedded in a concrete stab.

In addition to the roof, a new plaza and metro station are being developed to create a social space for events and festivals, and to better integrate the stadium into the city's urban fabric.

Real Madrid visitors will be welcomed into a revitalized space in one of the stadium's notable structures: the museum beam. This mega truss supports four levels of the building between its towers, and visitors enter by means of tilting slabs. It was assembled at the foot of the building and hoisted into place underneath 16.5m-high lattice work crown by the same lifting system of roof trusses in June 2022.

FCC Construcción solved these challenges by using two primary transverse trusses as rails for carts, moving loads across the stadium from west to east. These trusses were assembled from ten segments and anchored to the new towers built on 26 deep piles and the new columns. To facilitate the operation, the transverse trusses extended 176m outside the stadium. After completion, they were 'trimmed'.

Seven hours of tension

From April 2021, FCC Construcción lifted the four longitudinal roof trusses. This was done by four special heavy lifting strand-jacks with 500t capacity to fit 42 steel strand tendons. On the end, strand anchor heads were used to lock the tendons to the trusses. With each strand-jack containing up to 42 steel strands, the focus was on robustness and safety. The strand-jacks were mounted on transverse adjustment frames on translation trolleys, which allowed precise positioning in two axes. The hooking system for attaching the structure involved a fork-shaped, load-bearing connector with a bolt to attach it to the auxiliary lifting structure, complemented by an anchorage with wedges for securing the steel lifting strands. The lifting process was conducted using two translation trolleys, each housing two of the heavy lifting cylinders. These slid over the transverse trusses at both ends of the stadium. The trusses were lifted to the level of the main trusses on the jacks. The load was then transferred to the main cylinders of the translation trolleys so assembly could be moved to the roof assembly area.

Once the two parts of the roof structure were assembled, each had a total weight of 2000t.

To put both parts of the roof structure in their final position, the translation operations ran west to east along the transverse trusses at both ends of the stadium. For both operations, eight special heavy lifting strand-jacks with 85t capacity were used. The process alternated between pulling and retaining movements during the translation to compensate for the positive and negative slope of the transverse trusses. The equipment used both for lifting the four longitudinal roof trusses and translating the roof parts was managed by a PLC (programmable logic computer) system that was controlled by software developed by FCC Construcción specifically for this application. Every lifting and translation operation was a success. In September 2023, the retractable roof was put through its paces when Real Madrid played its first home game of the season against near neighbors, Getafe CF. Rain was forecast. The hosts won 1-0.

1 The new Santiago Bernabéu Stadium features a retractable roof and pitch. This aerial picture shows the two primary transverse trusses used as rails for the yellow carts and for the heavy lift of the roof trusses and structure. What is incredible is that matches were still playing during the renovations.
2 This external picture of the stadium clearly shows all the heavy lifting features, the transverse trusses extending outside of the stadium. The yellow translation trolleys can be seen lifting and guiding two of the longitudinal roof trusses into position. ©Real Madrid.
3 The translation trolleys, housing the heavy lifting cylinders, were integral to both the lift and moving the longitudinal roof trusses into position.

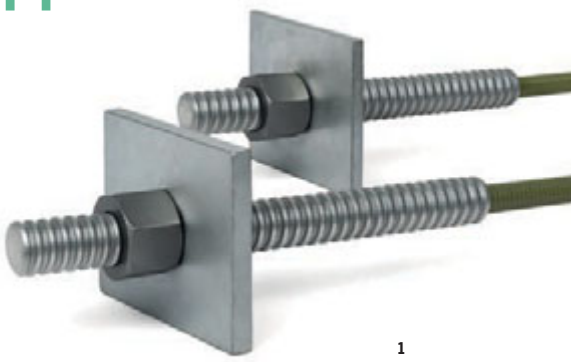
TEAM & TECHNOLOGY

Owner/developer – Real Madrid FC
Designer/architect – L35, GMB and Ribas & Ribas, FCC Construcción
Main contractor – FCC Construcción
Technology – Heavy lifting
BBR Network Member – FCC Construcción

3

Canadian BBR Inc.
Toronto, Canada
Glass fiber-reinforced polymer (GFRP) anchors for urban construction

Breaking ground with GFRP anchors



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Toronto's construction landscape is evolving as high-density urban development expands and sustainability takes priority. Canadian BBR Inc. is driving a major shift in deep excavation and foundation design with glass fiber-reinforced polymer (GFRP) anchors, a corrosion-resistant, high-performance alternative to traditional steel tiebacks.

On three projects – two deep excavation developments and one critical water infrastructure upgrade – Canadian BBR Inc. is proving that GFRP anchors are not just an alternative, but the future of foundation engineering. You can read more about the development of this new tieback and ground anchoring technology in our Technology section, on p75-78.

Bringing GFRP anchors into active construction required a strategic and measured approach. While Canadian BBR Inc. is known for foundation construction, introducing a new material to the market meant demonstrating its reliability in the field. By collaborating with industry leaders, the BBR Network Member for Eastern Canada has provided the confidence and technical validation necessary for widespread adoption.

1 Proving GFRP anchors are a sustainable alternative

On Dundas and Kipling, an early shoring project, Canadian BBR Inc. worked with Zancon Group to replace traditional steel tiebacks with GFRP anchors, but with a deliberately cautious approach. Rather than immediately stressing anchors to full capacity, each steel anchor was replaced with two GFRP anchors, using only a third of their documented strength.

To prove the material's long-term viability, Canadian BBR Inc. pushed one test anchor to its design limit, successfully demonstrating that GFRP anchors could outperform steel tiebacks. With proof of performance established, the project laid the groundwork for broader industry acceptance, reinforcing GFRP anchors as a viable, sustainable alternative on future projects.

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2 Advancing GFRP anchors adoption in Toronto's urban core

Following the success of the initial collaboration with Zancon Group, Canadian BBR Inc. took GFRP anchors to the next level with Rise&Rose, a high-rise development in Richmond Hill, a suburb of Toronto. This dense, urban setting required a shoring solution that balanced strength, efficiency and sustainability. Canadian BBR Inc. decided to replace steel tiebacks with GFRP anchors.

The excavation site was surrounded by existing infrastructure and roads. GFRP anchors offered an alternative to steel anchors, being lighter, easier to install and corrosion resistant, they streamlined the shoring process without compromising performance. GFRP anchors were seamlessly incorporated into the shoring system, with hydraulic jack testing and inspections confirming their stability and long-term viability.

Their lightweight nature also simplified handling and installation, improving efficiency on-site and reducing transport emissions.

Beyond their technical performance, the project quantified significant CO_2 reductions, reinforcing GFRP anchors as a sustainable alternative for deep excavation in carbon-conscious developments. By reducing raw material use and eliminating the risk of corrosion, GFRP anchors provide both environmental benefits and superior structural reliability over traditional steel tiebacks.

Through achieving a one-to-one replacement at scale, this project marked a turning point in the acceptance of GFRP anchors as a superior solution, proving they are a viable alternative for strength, durability, and sustainability in urban construction.

3 Successfully deploying GFRP anchors in complex applications

Beyond deep excavation, Canadian BBR Inc. is demonstrating how GFRP anchors can solve complex structural challenges in infrastructure and water management projects. At Lakeview Water Treatment Plant, just outside of Mississauga, the challenge was preventing uplift in a reinforced concrete raft slab under constant hydrostatic pressure. Traditional steel anchors would have introduced corrosion risks and costly ongoing maintenance, making them less than ideal for a high-moisture environment.

This project involved securing a raft slab of approximately 975mm with GFRP anchors acting as groundwater pressure pins, preventing the slab from shifting under hydrostatic pressure. Nearly 300 GFRP anchors were installed, stressed and tested. Every anchor passed testing. Unlike steel anchors, which for this type of application require protective coatings and monitoring, GFRP anchors offer corrosion-free durability, guaranteeing a 50+ year lifespan with no degradation. This made them the ideal long-term solution for a structure exposed to water.

The installation process was efficient, minimizing disruption to the operational treatment plant. This project reinforced Canadian BBR Inc.'s expertise in using GFRP anchors for complex engineering applications, proving their versatility beyond excavation into water infrastructure.

The successful deployment of GFRP anchors across excavation and infrastructure projects underscores their strength, durability and sustainability. As adoption grows, they are no longer just an alternative to steel tiebacks, but a solution for corrosion-free, high-performance foundation engineering and low-carbon construction.

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1 Canadian BBR Inc.'s ultra anchor GFRP rock bolts have been developed in partnership with MST.
2 Richmond Hill, Toronto, about to be graced with the Rise&Rose apartment blocks along Yonge Street.
3 GFRP anchors securing the excavation shoring wall, reinforcing structural stability.
4 Iron shoring system securing the deep excavation site.
5 A GFRP anchor installed as a corrosion-resistant tieback.
6 Lakeview Water Treatment Plant, Mississauga, where GFRP anchors provide long-term, corrosion-free stability.

TEAM & TECHNOLOGY

1 SHORING PROJECT

Owner/developer – CentreCourt Developments
Main contractor – Zancon Group
Technology – Glass fiber-reinforced polymer (GFRP) anchors
BBR Network Member – Canadian BBR Inc.

2 RICHMOND HILL DEVELOPMENT

Architect – Graziani + Corazza Architects
Owner/developer – Greenpark Group
Main contractor – Zancon Group
Technology – Glass fiber-reinforced polymer (GFRP) anchors
BBR Network Member – Canadian BBR Inc.

3 LAKEVIEW WATER TREATMENT PLANT

Owner/developer – Lakeview Water Treatment Plant
Main contractor – Canadian BBR Inc.
Technology – Glass fiber-reinforced polymer (GFRP) anchors
BBR Network Member – Canadian BBR Inc.

BBR Adria d.o.o.
Belgrade, Serbia
BBR VT CONA CMM for building

Green building certification success enabled using PT solutions

Since 2005, a city-within-a-city has grown on 14ha (35 acres) between Belgrade Nikola Tesla Airport and the city center. Here, a new business park development continues to expand. BBR Adria d.o.o. provided post-tensioning (PT) solutions for the East Gate Building, the 13th structure.

The new addition has a total above-ground area of 25,451m² and comprises two underground levels beneath a 15-story above-ground section, each featuring a 1,630m² floorplate designed for modern workspace flexibility.

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The first 11 floors were constructed with 25cm-thick PT slabs spanning 11.2m, while 22cm-thick slabs covered spans of 8.4m, ensuring an efficient open space concept. On the top four floors, there is a receding internal structure. This required a combination of PT slabs ranging from 22-30cm thick, along with transfer beams between 60-80cm high.

The variations in design posed both architectural and structural challenges, particularly in force distribution. To ensure stability, BBR Adria d.o.o. executed prestressing in phases, tensioning as additional floors increased the load.

Green credentials for the East Gate Building were important to reduce CO_2 emissions. It was recognized for this and awarded a LEED Gold certification, just like the previous 12 blocks.

With completion scheduled for 2025, commercial activity will soon be cleared for takeoff.

1 A new business district emerges in Belgrade, transforming a former airfield into a modern commercial hub.
2 Variable floorplates on the highest four floors comprise PT slabs from 22-30cm in thickness.

TEAM & TECHNOLOGY

Owner/developer – Afi Europe Serbia
Main contractor – Exing b&p d.o.o.
PT Design – Mašinoprojekt Kopring, BBR Adria d.o.o.
Technology – BBR VT CONA CMM
BBR Network Member – BBR Adria d.o.o.

BBR Adria d.o.o.
Varaždin, Croatia
BBR VT CONA CMM for commercial space

Minimalist PT slabs transform and future proof a new technology hub

The BBR Network Member for Croatia has helped bring to life NTH Mobile's new technology hub in the Croatian city of Varaždin, using post-tensioning (PT) slabs that enable column-free spaces and spans that foster collaboration and networking.

NTH Mobile has long anchored Varaždin's technology scene. Now the business is embracing a new role in creating a space where the country's technology community can congregate, collaborate and innovate. Featuring soaring spans and minimalist PT slabs, BBR Adria d.o.o. has constructed a future-proofed workspace based on designs by architect Davor Bušnja.

This architectural gem now connects schools, universities and startup offices. It features a vast, column-free open interior with 12.6m spans and a 3.8m cantilever, structured to maximize interaction and adaptability. The space is achieved using a 27cm-thick PT slab, ensuring structural efficiency while maintaining a sleek aesthetic.

The roof slab, at 20cm in thickness, is reinforced with shallow-wide beams (160/35cm) where no cantilever is present, optimizing load distribution. This minimalist ceiling solution enhances the elegance of the space while maximizing usable interior volume, creating an environment where professionals, students and entrepreneurs can collaborate.

By optimizing form and function, Bušnja's design creates a setting where Croatia's future technology talent can come together and thrive.

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1 Tech entrepreneurs, academics and students will be able to exchange ideas and build businesses in NTH Mobile's new building.
2 Collaborative space is made possible with minimalist PT slabs and shallow-wide roof beams.

TEAM & TECHNOLOGY

Owner/developer – NTH Mobile
Main contractor – Izgradnja d.o.o Domašinec
PT Design – Radionica statike d.o.o.
Architect/designer – Davor Bušnja
Technology – BBR VT CONA CMM
BBR Network Member – BBR Adria d.o.o.

Phoenix Specialist Contracting Ltd (PSC)
London, UK
BBR VT CONA CMF flat anchorage post-tensioning for multi-use development

High-performance structures to power net zero

Elephant Park, a new development in London's Elephant and Castle neighborhood, is setting new standards for sustainable urban living in the city through a focus on green infrastructure. Phoenix Specialist Contracting Ltd (PSC) has lent its post-tensioning (PT) expertise to this project.

Centered around a new two-acre park, the mixed-use development boasts fountains, waterfalls and recreational areas alongside an energy hub, with sustainable homes and spaces for residents and retailers.

In March 2024, PSC began work on the PT structural elements of Plot H11B, which consists of two residential blocks ranging from 11 to 25 floors, covering an area of approximately 19,425m^2. The blocks will provide 298 new homes, as well as spaces for retail, bike storage and waste management facilities at ground level.

The team was able to minimize concrete, reducing the project's embodied carbon while maintaining strength and durability. The result is a high-performance structure that supports Elephant Park's broader net zero ambitions.

TEAM & TECHNOLOGY

Owner/developer – Lendlease
Project consultant – Robert Bird Group
Architect – HOK
Main contractor – Modebest
Technology – BBR VT CONA CMF flat anchorage post-tensioning system
BBR Network Member – Phoenix Specialist Contracting Ltd (PSC)

PT installation underway at Elephant Park, a sustainable high-rise development in London.

Phoenix Specialist Contracting Ltd (PSC)
Limerick, Ireland
BBR VT CONA CMF flat strands for new development

Structural design efficiency reduces concrete to cut embodied carbon

A new sustainable-first development is taking shape in the Irish city of Limerick, where Phoenix Specialist Contracting Ltd (PSC) is managing the post-tensioned (PT) structural works to enhance sustainability.

A landmark mixed use development due to its sustainability-first focus, Project Opera spans 15,000m^2 of land in Limerick. Set for completion in mid-2025, it will comprise multistorey office spaces, entertainment and retail outlets and a new public square, creating a vibrant hub for business and community life.

Designed to meet Nearly Zero Energy Building (nZEB) standards, the development integrates energy efficient construction techniques, with the aim to reduce energy consumption by 60% compared to conventional buildings.

Structural efficiency was key to achieving both performance and sustainability goals. To optimize materials and durability, the team engineered a PT basement raft slab with integral waterproofing, covering 10,000m². Above this, a 9,450m² podium slab and 12,100m² of upper-level PT slabs were designed to support diverse building function. The substructure PT slabs range in thickness from 350mm to 650mm, while the upper-level slabs vary from 215mm to 300mm, ensuring efficiency without compromising performance. Overall, 180t of PT were used.

BBR VT CONA CMF strand anchorages with two, three, and four configurations were deployed, balancing structural demands with material efficiency. This enhances load-bearing capacity and minimizes concrete use, aligning with the project's sustainability targets.

TEAM & TECHNOLOGY

Owner/developer – Limerick Twenty Thirty, Ireland Strategic Investment Fund
Project consultant – PUNCH Consulting Engineers
Architect – COADY Architects
Main contractor – Sisk Group
Technology – BBR VT CONA CMF flat strands
BBR Network Member – Phoenix Specialist Contracting Ltd (PSC)

Opera Square: Limerick's sustainable mixed-use development and urban hub. Credit: Model Works.

BECOMAR – BBR Maroc
Rabat, Morocco
BBR VT CONA CMF flat for building strengthening

Successfully balancing modern design with Moroccan heritage

The reconstruction of The Court of Cassation in Rabat, Morocco, is a landmark project that will modernize Morocco's judicial system. BBR technology is being integrated by BECOMAR – BBR Maroc to enhance efficiency and structural integrity.

Situated in the heart of the country's capital, The Court of Cassation is being architecturally upgraded to expand its space and improve how it functions, with the new designs honoring traditional heritage while embracing modernity.
Courtrooms, dedicated workspaces for judges and legal professionals, and public access areas are being expanded, redesigned or modified to support the judicial process and its transparency.

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A defining feature of this ambitious project is its extensive use of post-tensioning (PT) technology. BECOMAR – BBR Maroc is using over 56,000m² of PT slabs to ensure structural performance and long-term sustainability. To date, over 8,000m² of PT slabs are in position. The BBR Network Member for Morocco has utilized BBR VT CONA CMF anchors, specifically S406 and S206, to enable the team to optimize materials use, reduce overall construction weight and increase structural capacity. Advanced tendon configurations provide precise deflection control, ensuring stability and durability while meeting seismic and load bearing requirements.

Designed for longevity, the courthouse's structure meets the highest international standards in judicial infrastructure.

Stronger foundations support meaningful judicial reform

The country's judicial reforms aim to improve access to justice and strengthen the legal system. By turning an existing building into a state-of-the-art facility and well-designed space for legal professionals and the public, this will streamline case handling and legal proceedings.

The Court of Cassation reconstruction project symbolizes institutional renewal. Its advanced modern design elements and integration of PT solutions will support the evolving needs of the country's judicial system long into the future. As construction progresses, this project strengthens BECOMAR – BBR Maroc's role in shaping the sustainable development of Morocco's infrastructure.

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1 Foundation works underway at The Court of Cassation in Rabat, preparing for large-scale post-tensioned slabs.
2 BECOMAR – BBR Maroc engineers oversee PT works at the construction site.
3 Architectural rendering of the Court of Cassation in Rabat, which is being reconstructed to blend modern design with Moroccan heritage.

TEAM & TECHNOLOGY

Owner – Ministry of Justice (Morocco)
Delegated Project Owner – Rabat Région Aménagement
Main contractor – Tramco
PT Design – BECOMAR – BBR Maroc
Architect/designer – Archi Team & Partners
Technology – BBR VT CONA CMF flat
BBR Network Member – BECOMAR – BBR Maroc

BBR Saudi Arabia
Riyadh, Saudi Arabia
BBR VT CONA CMF flat for new developments

PT solutions are shaping construction in Saudi Arabia

Riyadh's changing skyline reflects its growing influence as a global center for business, commerce and innovation. In this, BBR Saudi Arabia is the great enabler, with its application of post-tensioning (PT) technologies to solve engineering challenges.

The city's rapid expansion demands a bold architectural vision and the technical expertise to bring it to life. BBR Saudi Arabia's PT expertise is currently being utilized across six landmark projects spanning residential, commercial and retail developments in Riyadh and beyond.

1 Streamlining construction at Capital Avenue

Capital Avenue is a 33,000m² mixed-use development that will accommodate commercial and residential space. For First Avenue Real Estate Development, the main design requirement was for open-plan internal layouts, flexible-use areas and minimal support columns.

With 8-9m wide PT slab spans and 3m cantilevered sections, a conventional reinforced concrete approach would have led to excessive slab thickness, more construction materials and deflection risks.

BBR Saudi Arabia's solution was to implement 125t of PT tendons and 2,500 BBR VT CONA CMF S2 anchorages, reducing overall slab depth to 250mm. This method controlled deflection, enhanced load-bearing capacity, and allowed for greater adaptability inside the development's internal layout, streamlining construction.

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2 Optimizing materials at Norville Business Complex

At 124,000m², the Norville Business Complex is redefining Riyadh's retail and hospitality landscape. Designed as a four-story hub for shopping, dining and entertainment, the project required a column-free internal layout. However, the design presented unique engineering challenges, including high-load landscaped areas at ground level and large cantilevers that required enhanced load distribution.

For stability, BBR Saudi Arabia used 370t of PT tendons and 9,000 BBR VT CONA CMF flat S2 anchorages. This optimized materials, reduced the need for excessive reinforcement and ensured structural integrity under demanding load conditions.

3 Architectural ambitions achieved at Skyline Tower

Skyline Tower, one of Riyadh's most striking high-rise developments, rises 35 storeys over the city. Its design is structurally complex, and includes vertical irregularities, large cantilevers, and wide-span floor slabs, all of which required precise engineering to maintain stability while maximizing internal floor space.

BBR Saudi Arabia introduced a PT flat slab system with drop panels, integrating 155t of PT tendons and 3,200 BBR VT CONA CMF S2 anchorages. This approach allowed for thinner slabs, efficient load transfer and greater spatial flexibility, ensuring structural strength and durability without compromising architectural ambition.

1 Skyline Tower construction in progress, where PT slab work is shaping one of Riyadh's most iconic high rises.
2 Capital Avenue is a dynamic mixed-use development that is redefining urban living.
3 A visionary look at the Norville Business Complex, a planned retail and hospitality hub.
4 Skyline Tower is a high-rise development, soaring 35 storeys above Riyadh.
5 Ramz Al Ihsa Mall is a landmark retail destination in Al-Ahsa.
6 The Bellevue, Riyadh's largest mixed-use project, offers diverse shopping, residential, and leisure spaces.
7 Sedra Valley is a mixed-use development currently under construction.

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4 Accelerating construction schedules in Sedra Valley

Sedra Valley is among Riyadh's most ambitious residential and mixed-use projects, covering over 300,000m². With exceptionally large spans and significant structural loads, particularly at podium levels and tower foundations, the project required an innovative approach to post-tensioning.

BBR Saudi Arabia developed a full PT design, incorporating 1,200t of tendons and over 36,000 BBR VT CONA CMF S2 anchorages. Despite a tight 90-day schedule, the structural, procurement and construction teams collaborated effectively, and the schedule was met. The use of PT minimized material consumption and accelerated construction, ensuring both long-term resilience and operational efficiency.

5 Cost and material savings at the Ramz Al Ihsa Mall

Situated in Al-Ahsa, the Ramz Al Ihsa Mall required a structural system capable of balancing efficiency, speed and cost-effectiveness. BBR Saudi Arabia provided a PT raft foundation, reducing steel use by 30% and cutting concrete thickness by 30cm, delivering cost savings and lowering environmental impact.

The structural system extended beyond the foundation to include PT slabs and vertical supports. With 500t of PT tendons and 20,000 BBR VT CONA CMF S2 anchorages, the system allowed for larger spans, fewer support columns and improved load distribution.

Despite the remote location, BBR Saudi Arabia executed the project efficiently, demonstrating expertise in delivering high-performance PT solutions for a large-scale commercial development.

6 Sustainability wins at The Bellevue

The Bellevue exemplifies Riyadh's vision for integrated urban developments. Designed as a vibrant suburban hub, this 100,000m² area integrates residential, commercial and leisure spaces.

As part of this project, BBR Saudi Arabia constructed 50,000m² of PT slabs across three floors, using 300t of PT strands and 6,000 BBR VT CONA CMF S1 anchorages. With spans ranging from 10-14m and specific zones exceeding 60kPa in load requirements, the PT system ensured structural resilience, reduced material costs and enhanced durability, aligning with Riyadh's vision for sustainable urban expansion.

BBR Saudi Arabia continues to shape Riyadh's skyline – and future – one project at a time.

TEAM & TECHNOLOGY

1 CAPITAL AVENUE

Owner/developer – First Avenue Real Estate Development
Designer/architect – Sawaed for Engineering Consultancy
Main contractor – Experience Castle Contracting Co.
PT designer – BBR Saudi Arabia
Technology – BBR VT CONA CMF flat anchorage post-tensioning system
BBR Network Member – BBR Saudi Arabia

2 NORVILLE BUSINESS COMPLEX

Owner/developer – Rafen Real Estate
Designer/architect – ERGA
Main contractor – Elm & Memar Construction
PT designer – BBR Saudi Arabia
Technology – BBR VT CONA CMF flat anchorage post-tensioning system
BBR Network Member – BBR Saudi Arabia

3 SKYLINE TOWER

Owner/developer – Heyazah Real Estate Development
Designer/architect – Abdulelah Al-mohanna
Main contractor – Bait Almward Contracting Co
PT designer – BBR Saudi Arabia
Technology – BBR VT CONA CMF flat anchorage post-tensioning system
BBR Network Member – BBR Saudi Arabia

4 SEDRA VALLEY

Owner/developer – Mohammad Al Habib and Partners Real Estate Company
Designer/architect – ATA Architects - Abdulmohsin Altheyab & Partners
Main contractor – Asala Residence
PT designer – BBR Saudi Arabia
Technology – BBR VT CONA CMF flat anchorage post-tensioning system
BBR Network Member – BBR Saudi Arabia

5 RAMZ AL IHSA MALL

Owner/developer – Al Ramz
Designer/architect – Arabesque for Engineering Consultancy
Main contractor – Al Jalal Contracting Co
PT designer – BBR Saudi Arabia
Technology – BBR VT CONA CMF flat anchorage post-tensioning system
BBR Network Member – BBR Saudi Arabia

6 THE BELLEVUE

Owner/developer – Unified Real Estate Development
Designer/architect – ERGA
Main contractor – Experience Castle Contracting Co.
PT designer – BBR Saudi Arabia
Technology – BBR VT CONA CMF flat anchorage post-tensioning system
BBR Network Member – BBR Saudi Arabia

BBR Construction Systems (M) Sdn Bhd
Kuala Lumpur, Malaysia
BBR VT CONA CMF S2 for social housing

Saving costs and accelerating construction deadlines for much-needed homes

In Sungai Besi, a suburb of Kuala Lumpur, a large-scale social housing project is providing homes for Malaysian Armed Forces personnel. BBR Construction Systems (M) Sdn Bhd is deploying BBR technology to save costs and deliver the sustainable, affordable homes for Malaysia's 'One Member One House' (SASaR) initiative.

BBR Construction Systems (M) Sdn Bhd applied post-tensioning (PT) for a large car park and transfer floor structure to accompany the project's 3,500 homes built across five residential blocks.

Post-tensioning for a large car park and transfer floor structure is managed by BBR Construction Systems (M) Sdn Bhd as part of a large-scale housing project in Malaysia.

The original structural design was revised through value engineering to optimize material use without compromising performance. BBR VT CONA CMF flat anchorage post-tensioning is helping to reduce concrete volumes by 1,240m³ and reinforcement steel by 778t, leading to significant cost and carbon savings. In addition, some 286t of PT tendons allowed for thinner slabs while maintaining high load-bearing capacity. The PT-enabled efficiency gains extend beyond construction speed, however. Revised designs resulted in an estimated 1,717t reduction in CO_2 emissions – every kilogram of steel saved translates to approximately 2kg of CO_2 saved.

The SASaR initiative aims to provide secure, affordable and sustainable housing for military personnel in the country's capital. The use of PT has supported affordability and accelerated the construction deadline and delivery of much-needed homes.

With the team's work completed in July 2024, the project demonstrates how advanced construction technology can drive the building of efficient, sustainable housing developments at scale. By integrating BBR VT CONA CMF flat anchorage post-tensioning, the team has been able to deliver time and cost savings and support the sustainability agenda.

TEAM & TECHNOLOGY

Owner/developer – Platinum Victory Development Sdn Bhd
Main contractor – Binastra Builders Sdn Bhd
Technology – BBR VT CONA CMF S2
BBR Network Member – BBR Construction Systems (M) Sdn Bhd

Stahlton AG
Basel, Switzerland
BBR VT CONA CMI for wastewater treatment plant

Improving efficiency at the wastewater treatment plant

Stahlton AG played a key role in the CHF 300 million (USD 330 million) upgrade of The Basel Wastewater Treatment Facility (ARA). New prestressed tanks are important to meeting domestic and industrial waste needs and processing more pollutants.

Originally commissioned in 1982, ARA treats approximately 86,000m³ of wastewater daily. Approximately 40% of this wastewater is produced by the city's 270,000 residents, with the remaining 60% coming from industry and businesses. But the plant was aging and reaching its capacity limits.

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As well as reaching age and capacity limits, the plant was at risk of non-compliance penalties by the Canton of Basel-City. It was struggling to comply with new government regulations that required 80% of contaminants, including pharmaceutical residues and microplastics, to be removed.

To address this, operator ProRheno AG initiated an upgrade in 2008, testing an advanced treatment stage for micropollutant removal. The process introduces ozone (O_3) to oxidize complex organic pollutants, followed by powder-activated carbon (PAC) to absorb remaining byproducts and dissolved contaminants.

Expansion and modernization work began in 2018 and continues at the time of writing. As well as the new processes outlined here, Stahlton AG's work made possible several other important steps. Into its nine sequencing batch reactors (SBRs), wastewater is fed from a central reservoir, then oxygenated and manipulated to allow microorganisms to break down carbon, nitrogen and phosphorus compounds. Stahlton AG also helped build the primary clarifiers, which settle solids, and the digesters, which produce biogas for energy.

Reducing the need for future upgrades

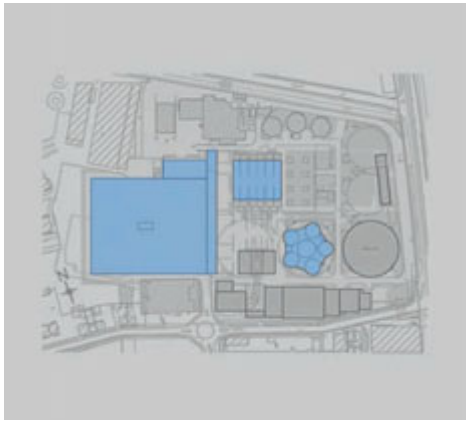
Stahlton AG completed its work in two phases. In phase 1 (January-June 2020), nine SBR tanks were constructed in 16 stages. Each tank was around 34m x 37m with a height of 10m and built on a 100m x 110m foundation slab.

Tanks and foundations were prestressed longitudinally and transversely using the BBR VT CONA CMI 0706 system, arranged in a 1.75m grid. Additional strand cables were used in the tank walls and interconnected for continuous prestressing. Special concrete enabled prestressing within three or four days of each stage.

Six primary clarifiers, approximately 50m in length and width, were also built during this phase. Their foundation slabs and walls were prestressed both longitudinally and transversely, with a 1.6m spacing grid on the longitudinal side and a 1m grid on the transverse side. The 5m-high walls incorporated five strand cables, utilizing the BBR VT CONA CMI 0406 system.

Phase 2 (June 2023-February 2024) saw the construction of five 26m digester towers. They were built in nine rings to a diameter of 16m. Four were prestressed with 14 BBR VT CONA CMI 0406 and 30 CMI 0706 strand cables, installed at varying levels.

With the micropollutant treatment and digestion process expected to be completed during 2025, ARA should ensure clean and efficient wastewater management for the region through 2040, requiring no further major upgrades.



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1 Five new digester towers will produce biogas from waste at The Basel Wastewater Treatment Facility.
2 Laying firm foundations for the digesters.
3 The new treatment plant upgrades a 1982 facility.

TEAM & TECHNOLOGY

Owner/developer – ProRheno AG
Main contractor – Erne Bauunternehmung AG
Structural Engineer – Holinger AG
Technology – BBR VT CONA CMI 0406 Category B, BBR VT CONA CMI 0706 Category B
BBR Network Member – Stahlton AG

Contech
Auckland, New Zealand
MRR range for wastewater system rehabilitation

Completing critical repairs in live environments with ease

When wastewater infrastructure fails, quick and strategic intervention is key. Contech worked in extreme conditions to restore operations on two major sewer rehabilitation projects in Auckland.

From the sudden collapse of the Ōrākei Main Sewer to the planned relining of the aging Eastern Interceptor, Contech deployed advanced techniques to stabilize and future proof Auckland's wastewater systems.

In September 2023, the old Ōrākei Main Sewer, a 13km-long, 2.1m diameter brick arch sewer located about 13m underground, collapsed. This created a 13m-deep sinkhole which blocked the sewer and caused overflows.
For Watercare, Auckland's wastewater provider, an all-hands-on-deck emergency response was required. At the time, approximately 150l of sewage was draining every second into the nearby Waitematā Harbor – about 8 million liters daily. Contech helped restore the sewer pipe to its full function.

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A new product was approved for use on the Ōrākei Main Sewer by Watercare. This was a glass-reinforced plastic (GRP) liner to restore large and irregularly shaped sewers and aging brick and concrete manholes. GRP is light-weight but high strength, resistant to impact, slip and fire, durable and easy to install. It can extend the life of a sewer or manhole by up to 100 years.
The slip lining process was used, and the annulus formed between the liner and the host pipe was filled with a cement grout to fill the void. The liner thickness varies depending on the specification but is typically between 10-50mm.

New solutions restore structural integrity

Emergency repairs were carried out by main contractor March Cato, while Contech was chosen for its specialist grouting expertise and familiarity with working in live sewer environments. To confirm the grout could flow between ports and mitigate the impact of static water in the annulus, Contech under-took a full-scale trial grouting of a section of the pipe off-site.
Given the time pressure to complete the proj-ect and the pipe's variable flow patterns during the day, the 11-strong Contech team worked night shifts for nearly four months. Working in waist-deep sewage and having to leave and reenter the pipeline several times a night to allow backed-up flows to be released proved challenging.
Simon Sun, Contech's Project Manager on-site, acknowledges the challenges for everyone involved: "The team was working in a contam-inated sewage zone, so we had to be alert to the risks posed by the water levels around us and by the 100t of sewage behind us."

"We also had to comply with the rules and regulations of working in this type of environment, using personal protective equipment and gas detectors," Sun continued. "We even received training in how to rescue people from confined spaces. It was difficult work, but the team's camaraderie kept us in good spirits."

Extending expertise below the surface

In 2022, Contech was called to work on another critical project: relining a 200m section of Auckland's Eastern Interceptor, a major pipeline transferring waste from the eastern suburbs to the Mangere Wastewater Treatment Plant.

Originally constructed in the 1950s, the interceptor is now surrounded by urban infrastructure, complicating maintenance and repairs. The section that required work had suffered significant biogenic corrosion, and the best solution was to reline using SewperCoat sprayed mortar.

Gaining access to the pipeline was simplified by an adjacent open space, allowing for the installation of a new entry point and site setup. A gantry crane was positioned for worker entry and to lift equipment into the pipeline, and a ventilation system was installed downstream to improve air quality and improve safety.

Work was controlled through isolation permits, pump station shutdowns and strict entry procedures. Contech collaborated with hydro-demolition contractor Aquamax to develop a trolley-mounted cleaning rig. This increased efficiency compared to traditional hand-cleaning methods. The extent of reinforcing degradation was discovered to be worse than first thought, however. Every reinforcing bar in the top section of the interceptor had to be replaced before applying the SewperCoat sprayed mortar.

Work was disrupted by storms that hit Auckland in February 2023, causing widespread damage. As a result, the site was closed for several weeks, and only 70m of the planned 200m relining was completed.

Aging critical infrastructure and unexpected failures present constant challenges for city networks. But whether tackling emergency repairs or planned rehabilitations, Contech was able to respond with expertise and perseverance to deliver solutions that mean Auckland's wastewater system will remain operational and reliable.

1 Emergency response underway at the Ōrākei Main Sewer site, where a 13m-deep sinkhole disrupted Auckland's wastewater network.
2 Contech working in live sewer conditions, navigating waist-deep water and confined spaces to complete critical repairs.
3 Reinforcing bars installed inside the interceptor, restoring structural strength before relining.
4 GRP liners ready for installation. These are an easy-to-install, durable solution to restore the sewer's structural integrity.
5 Contech applying SewperCoat to protect and extend the life of the sewer.

TEAM & TECHNOLOGY

Owner/developer – Watercare
Main contractor – March Cato
Technology – MRR range
BBR Network Member – Contech


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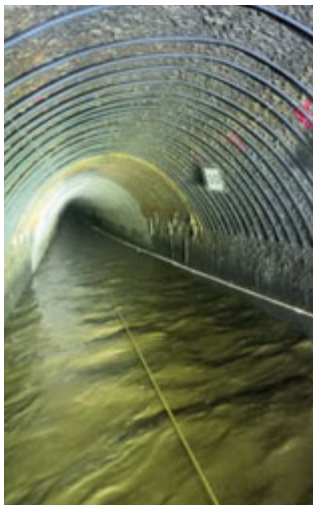
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BBR Polska Sp. z o.o.
Vistula, Poland
BBR VT CONA CMM monostrand for bridge repair

Monostrand technology rehabilitates failed bridge tendons

When a post-tensioning (PT) tendon failed on a bridge over Poland's Vistula River due to electrochemical corrosion, BBR Polska Sp. z o.o. was called in to carry out the repairs.

After just 10 years of service, one external PT tendon on the four-span, pre-stressed concrete bridge required immediate attention, and BBR VT CONA CMM monostrand technology was the solution.

In November 2023, BBR Polska Sp. z o.o. was engaged to assess the corrosion and propose a suitable repair strategy. The failed tendon, embedded in plastic sheathing, had suffered localized corrosion, leading to strand failure. As this was the second tendon failure on the bridge, local authorities sought a long-term, reliable solution.

Monostrand corrosion protection technology guarantees optimal performance

BBR Polska Sp. z o.o. deployed BBR VT CONA CME monostrand technology for its corrosion protection. Unlike conventional PT systems, this technology features fully encapsulated strands with individual PE sheathing to create a robust corrosion barrier, while a hermetically sealed duct system prevents moisture ingress. Additionally, its load monitoring capabilities allow for periodic force measurement throughout the bridge's lifecycle.

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Each tendon contained 25 strands, with each strand comprising seven high-strength steel wires. With a load-bearing capacity of 27t per strand, optimal performance is guaranteed. This project marks the first time this technology is used as a tendon replacement on a structure in Poland.

Fast, efficient tendon replacement minimizes traffic disruption

The tendon's replacement was completed in just three weeks, despite challenging working conditions. Specialized safety measures, ventilation systems and planning were required to move equipment and materials efficiently within the tight confines of the box girder. At first, local authorities were unfamiliar with this type of BBR technology, but BBR Polska Sp. z o.o. successfully demonstrated its long-term benefits to the extent that it will be considered for use on future bridge maintenance projects in Poland.

The tendons were not originally designed for easy exchange, making the replacement process highly complex. BBR Polska Sp. z o.o. implemented a multi-step approach to remove the damaged tendon and install the new monostrands efficiently.

A model for future bridge repairs

Due to BBR VT CONA CMM monostrand technology, the bridge now benefits from superior corrosion protection, with multi-layer encapsulation to help prevent electrochemical corrosion in future. The tendons are not bonded to each other or the structure, allowing for easy maintenance and precise load monitoring throughout the bridge's service life. This project showcases this technology as an effective option for MRR applications. As infrastructure ages and repair needs grow, these types of PT solutions will play a greater role in ensuring the safety and longevity of bridges worldwide.

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1 Along much of its 1047km length, the Vistula River varies in width from 80m to 610m.
2 Visible corrosion damage to tendon anchor and individual strands.
3 A new tendon is installed, with corrosion protection applied.

TEAM & TECHNOLOGY

Owner/developer – General Directorate for National Roads and Motorways in Gdańsk (GDDKiA o/Gdańsk)

Main contractor – BBR Polska Sp. z o.o.

Technology – BBR VT CONA CME monostrand with Grout Infill

BBR Network Member – BBR Polska Sp. z o.o.

Tendon replacement

STEP 1

Removing the failed tendon

The existing tendon was carefully segmented into one and two sections and extracted from the bridge's deviators and anchorages using a 3t chain winch. Remaining components, including debris and deteriorated grout, were cleaned.

STEP 2

Installing the new monostrand

Due to the tendon's 133m length, individual strands were pulled through one by one, similar to cable-stayed installation techniques. The PE duct was suspended at 3m intervals to maintain a straight tendon profile for optimal alignment before final encapsulation.

Positioning the tendon with the anchoring device during installation.

STEP 3

Grouting and sealing

Once the strands were in place, the tendon was sealed at both anchorages and grouted using EN 447 standard cement grout. This step further enhanced corrosion resistance and structural stability.

Applying grease to seal the tendon and to enhance corrosion protection.

STEP 4

Stressing and anchorage adaptation

BBR Polska Sp. z o.o. designed custom transition rings to fit the BBR anchor head to the pre-existing bearing trumplate from a different system. Stressing was executed using a multistrand 680t jack for optimal force distribution across the new tendon.

Post-tensioning using jacking equipment to apply precise tension to the tendon.

STEP 5

Final corrosion protection

Additional corrosion protection measures were implemented in the anchorage zones. All voids were filled with special grease, and protruding strands were enclosed with protective caps to prevent deterioration.

BBR Saudi Arabia
Riyadh, Saudi Arabia
MRR range for structural reinforcement

BBR's new MRR solutions strengthen structures to allow changes of use

Modifying a structure mid-construction presents unique challenges. On two projects in Riyadh, BBR Saudi Arabia's expertise in retrofitting and strengthening enabled it to adapt and strengthen structures for new building elements and increased loads.

The two structures – Alat, a manufacturing hub, and The 25 Mall, a commercial center – each underwent alterations and changes of use that needed major structural change.

For the Alat, structural strengthening was required after late-stage design changes introduced new staircases and elevators and extended floors. In the case of The 25 Mall, evolving commercial use had unsustainably increased demands on the building's columns and foundations. BBR Saudi Arabia was tasked with delivering reinforcement solutions, ensuring both projects met performance and safety standards.

❶ The Alat was originally completed with a standard design, but substantial modifications were requested by the client to increase floor space and accessibility. These were not cosmetic; they would fundamentally alter the structural demands of the building. The challenge was ensuring the building could support new stresses without compromising its long-term performance.

BBR Saudi Arabia undertook a meticulous structural reassessment, evaluating every foundation, column and slab. To meet the revised design, they implemented a suite of advanced strengthening techniques. Carbon fiber reinforced-polymer (CFRP) sheets were applied to slabs, enhancing their load-bearing capacity and addressing the impact of new openings for staircases and elevators.

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To manage the additional stresses and increased floor loads, external post-tensioning (PT) was employed to control deflection in critical slab areas. Certain structural beams were strengthened using concrete jacketing, which increased their cross-sectional area and overall load capacity. Additionally, selected columns were reinforced with CFRP wrapping and jacketing to boost their compressive strength and ductility for greater stability under the new load conditions.

Every layer of reinforcement brought the Alat project closer to completion, exemplifying BBR Saudi Arabia's ability to merge innovative materials with traditional techniques to build strong, high-performing structures.

2 Reinforcing structure and elevating design

The 25 Mall, a 68,000m² retail, entertainment and workspace hub, was envisioned to become a shining example of modern commercial design. However, as construction progressed, evolving architectural plans introduced heavier loads and new structural demands, threatening to outpace the building's original design.

BBR Saudi Arabia was tasked with executing a PT solution and reinforcing the structure. The project incorporated an impressive 222t of PT and 4,450 anchorages with BBR VT CONA CMF S2 to bring stability and durability.

To meet increased load demands, a combination of CFRP wrapping and concrete jacketing was implemented. Columns were discreetly strengthened with CFRP wraps, enhancing load-bearing capacity without disrupting the building's sleek design. In areas that required greater reinforcement, concrete jacketing was applied to both columns and foundations, enhancing structural strength and aesthetic. With this approach, the foundation could absorb and distribute any additional stresses introduced by the design changes.

BBR Saudi Arabia's interventions not only safeguarded The 25 Mall's structural integrity but ensured the project could proceed without compromising the design or timeline.

Constructing the future with confidence

Both projects demonstrate BBR Saudi Arabia's ability to set a high benchmark in construction engineering, showcasing the team's expertise in integrating advanced materials like CFRP with time-tested techniques, such as concrete jacketing.

These projects reflect BBR VT International's commitment to creating high-performing, extraordinary structures that will endure for generations to come.

1 Concept rendering of The 25 Mall, a vibrant retail and commercial destination in Riyadh.
2 Alat project: CFRP sheets applied to slabs to enhance load-bearing capacity and reinforce structural integrity following late-stage design modifications.
3 The 25 Mall project: the team reinforcing a column with concrete jacketing, enhancing its load-bearing capacity to support evolving demands.

TEAM & TECHNOLOGY

1 ALAT

Owner/developer – Alat
Designer/architect – Savills
PT designer – BBR Saudi Arabia
Technology – BBR CFRP wraps and jacketing
BBR Network Member – BBR Saudi Arabia

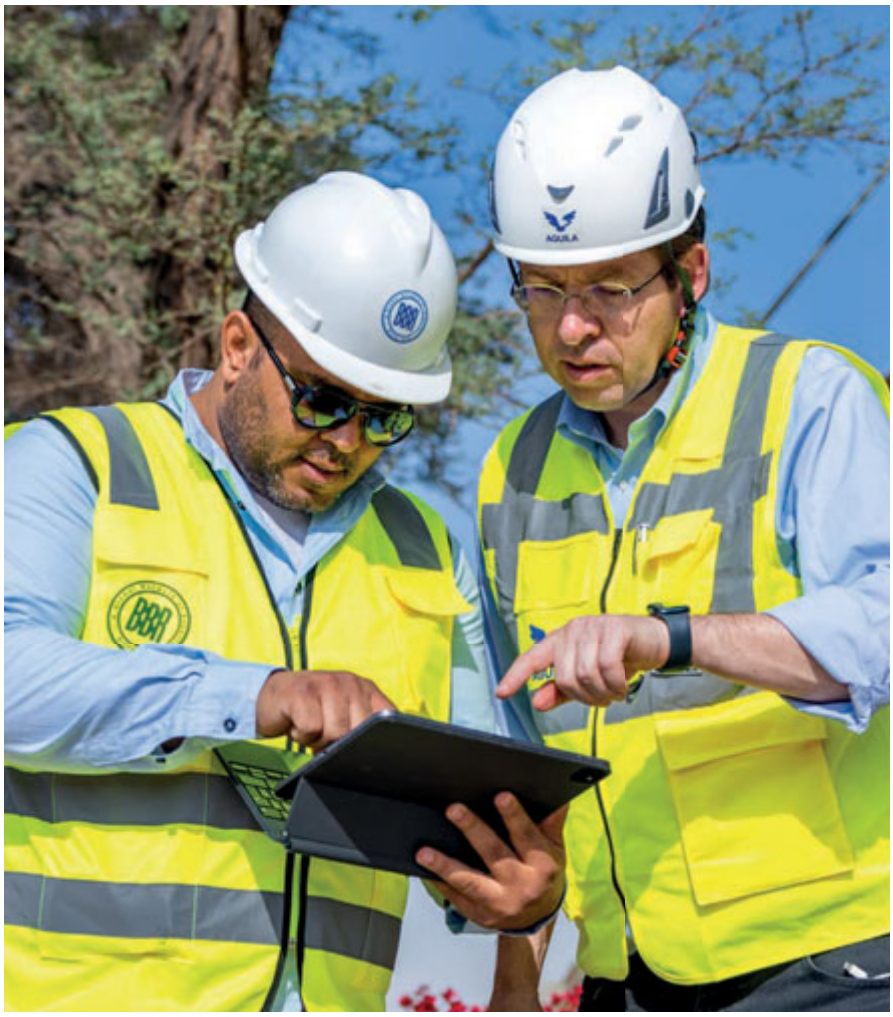
2 THE 25 MALL

Owner/developer – Osus Real Estate
Main contractor – Construction & Planning Co. Ltd. (C&P)
Architect/designer – Architectural Art Engineering Consultants
PT designer – BBR Saudi Arabia
Technology – BBR VT CONA CMF S2
BBR Network Member – BBR Saudi Arabia

Welcome to Built Health, a new CONNÆCT category focused on how we can maintain a built asset's health and increase its value while committing to a decarbonized future. It represents the intersect between members of the Tectus Group family of companies: BBR and Network Members' engineering expertise, and from Screening Eagle, Proceq Switzerland's advanced sensor technology and Dreamlab Singapore's software.

AQUILA

AQUILA Built Health: A BBR* company powering digital health records for structures



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AQUILA Built Health is a specialized inspection and digital asset-health brand of the BBR franchise, consolidating decades of knowledge and expertise from the global BBR Network. It is structured as a dedicated knowledge-management and certified service module for BBR Network members. Assessments, inspections, and related services under the AQUILA brand are performed exclusively by experienced BBR Network members, now unified under this new brand, explicitly meeting the latest compliance standards for inspection objectivity.

1 AQUILA CEO, Gianni Moor (right), training a BBR Network Member colleague on using the advanced asset management software in the field.

Proven expertise from the BBR Network applied to infrastructure inspection and digitalization

As infrastructure ages and expectations around safety, resilience, and sustainability rise, structural asset owners are looking for more proactive ways to manage their investments. To support this shift—and help BBR Network Members expand their service offerings—BBR has created AQUILA Built Health® (AQUILA), a dedicated entity focused on visual and non-destructive inspection, digital asset records, and real-time condition monitoring.

AQUILA harnesses extensive experience and proven methodologies built over decades by BBR Network members globally. It aims to offer clients a more comprehensive value proposition—combining structural solutions with ongoing asset insight and support. Asset owners benefit directly from the reliability, quality, and trust established through countless successful inspections and assessments.

Smart sensors detecting and monitoring structural vital signs

Aging bridges and buildings need health check-ups. AQUILA is answering this call with advanced smart sensors that are diagnostic tools for structures. High-performance non-destructive testing (NDT) tools like ground-penetrating radar (GPR) and ultrasound devices from sister company Proceq Switzerland, look inside concrete and steel to evaluate structural vital signs. Crucially, all data is visualized in real time. Thanks to software developed by Screening Eagle Dreamlab Singapore, inspection results appear instantly on rugged mobile tablets—no more waiting for post-processing. Inspectors can scan a structure and view 3D and augmented reality (AR) visualizations, dashboards, and annotated defect maps on the spot.

Photos, sensor data, and notes are automatically uploaded into the Inspect Built Health record. It's a digital health record for the structure, capturing everything from as-built condition to ongoing degradation. An engineer can roll a GPR device over a concrete slab and immediately view the rebars and cables beneath the surface on an AR 3D map. Or an engineer can fly a drone to inspect a façade, watching high-resolution footage in real-time. Whether inspecting a bridge deck, or a wind turbine foundation, engineers leave each site with a complete, structured record—ready for analysis, compliance, or planning future works.

AI-Enhanced inspection for smarter decisions

Defect classification made efficient. Skilled labor made scalable.

Collecting data is just the beginning. AQUILA's platform uses AI-powered applications to detect, classify, and characterize structural defects, for example from photos taken by anyone on site. These models reduce reliance on skilled inspectors who are in short supply, empowering a wider range of BBR field technicians to collect usable data and make faster decisions.

From cataloging surface cracks to helping identify severe safety risks in concrete structures, AI supports structured and rapid evaluation. This not only boosts efficiency but also standardizes approaches across global teams—a major advantage when managing infrastructure across borders or networks.

The result is a richly detailed virtual representation of the structure as it exists. Crucially, this digital record is continuously updated with each new inspection or test, creating a historical timeline of the asset's condition. The health record grows over time, enabling engineers to track changes like crack propagation, corrosion progression, or subtle settling. Future inspectors can easily review this living digital twin, a powerful knowledge base that travels with the structure, to leverage past findings.

Transforming real-time insight to real-life value

This technology serves a business purpose: creating value for asset owners and stakeholders. Real-time, data-rich insights mean maintenance can shift from reactive fixes to proactive care. AQUILA's technology gives owners and operators the information they need to identify issues early, prevent costly repairs and failures, and extend the service life of their assets. If a scan reveals moisture ingress starting to corrode rebar, targeted repairs can be done now rather than a far more expensive beam replacement down the line.

Built assets deserve health records too.

AQUILA makes every scan, inspection, and insight part of a living digital twin — because knowing is key to preservation and longevity.

Smart sensors. Instant insights. Real results.

From aging bridges to new towers, AQUILA's real-time data transforms uncertainty into opportunity.

*BBR Holding AG, a Tectus Group company, holding shares in BBR VT International Ltd and BBR Holdings (S) Ltd.

Beyond the financial benefit, having a comprehensive digital record enables more accurate structural health assessments. With the right data, engineers can make confident decisions, whether that is verifying a repaired bridge meets safety standards or confirming a building's structural capacity before a change of use. The detailed digital record also helps reveal any discrepancies between a structure's as-built versus as-specified state. It is not uncommon for on-site investigations to find that what was constructed differs from the original plans or specifications. Maybe rebar spacing is off specification, a concrete member was poured thinner than designed, or an undocumented retrofit was done decades ago.

AQUILA's digital health records show these hidden variances. Identifying such gaps is critical as it prevents false assumptions and enables owners to address issues or hold contractors accountable. What you see is what you have – no more guessing about a structure's true condition. With real-time insight and an archived history of the asset, owners can plan with certainty and avoid unpleasant and expensive surprises.

Integrating engineering expertise and digital intelligence

From BBR's engineering legacy to AQUILA's digital edge

The AQUILA brand represents global expertise delivered locally through BBR Network members. Clients benefit from extensive international collaboration, shared technological innovation, and consistent quality in service delivery. AQUILA equips BBR Network members with digitally enabled ready-to-deploy NDT tools, AI-powered software, and training programs that allow for quality, precision and responsiveness to client needs.

AQUILA recognizes that technology alone cannot solve global infrastructure challenges; people and skills are equally important. There are skills shortages just at the time when infrastructure is aging and needs greater attention. AQUILA tackles this gap through BBR's global franchise network and training programs. Engineers in local markets receive standardized training and verification in use of the platform's tools. They benefit from continuous knowledge sharing via webinars, updates, and a centralized knowledge base to ensure know-how is spread worldwide. Through AQUILA's connected network, an engineer in Asia can tap into best practices developed in Europe, and vice versa. By empowering local teams with world-class technology and training, AQUILA raises structural inspection standards.

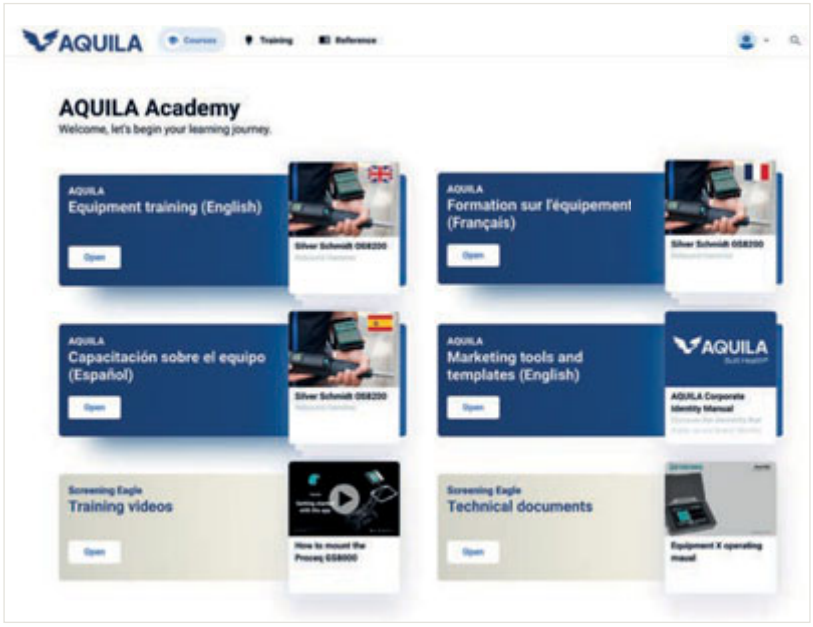
Proactive care for a sustainable future

AQUILA's focus is to make infrastructure last longer and perform better, sustainably. This is a timely mission responding to the global megatrends of aging assets, climate change and decarbonization. An estimated 80% of the buildings that will be standing in 2050 have already been built. This fact highlights that we cannot rely on building new structures to meet these challenges; we must extend the life of existing ones. AQUILA's digital health records enable healthy life extension. Through early detection of issues and condition-based maintenance, built asset service lives are extended by many years. Every extra year an existing structure remains safely in service is an extra year that the carbon cost of demolishing it, and constructing a replacement, is avoided. Delaying and avoiding new build by using AQUILA's asset management approach helps reduce the 50% of construction-related emissions that come from embodied carbon in materials like cement and steel.

Hosting the digital health record with its inspection data in a cloud environment enables stakeholders to collaborate remotely in real time, reducing the need for multiple site visits, and their associated travel emissions. It also ensures renovations or retrofits are surgically targeted, since engineers know exactly which beams or columns need attention, and which are still healthy. This level of precision minimizes waste and unnecessary work, aligning maintenance efforts and efficiency gains with sustainability goals. AQUILA's NDT solutions reduce the need for destructive testing, like coring or chipping concrete, preserving structural integrity and preventing additional repairs down the line. This creates a virtuous cycle: proactive care saves money, avoids disruptions, extends asset life, and shrinks the infrastructure carbon footprint. For asset owners, and governments, balancing tight budgets and climate commitments, this approach provides a much-needed win-win.

Stop managing problems. Start managing performance.

With AQUILA, real-time asset health drives proactive action — not reactive repairs.



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Asset value, supercharged.

Less guesswork. More resilience. Higher returns.

Built health is built wealth.

A strategic addition to the BBR toolbox

Not just inspection—an opportunity to support the full asset lifecycle

AQUILA Built Health offers trusted, expert inspection and digital asset-health management under a unified brand delivered by skilled BBR Network members. More than a set of tools; it's a way to help BBR Network Members add long-term value to their client relationships. By offering services that go beyond construction and into the operational phase of infrastructure, members can play a longer-term advisory role—supporting owners through the full lifecycle of their assets.

For BBR, AQUILA facilitates the growth beyond the existing core of structural design and post-tensioning systems. For clients, it offers peace of mind. And for infrastructure itself, it means more informed care, longer life, and reduced uncertainty.

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2 The AQUILA Academy is an exclusive resource that includes training and knowledge sharing programs.
3 Use of Proceq Pundit PD8050 to detect voids or delamination.
4 Schmidt Hammer test to assess the concrete strength and homogeneity.
5 The AQUILA Academy contains case studies that demonstrate built-health assessments, processes, analysis and reporting, and which also serve as learning tools.

AQUILA IN ACTION

Use cases demonstrate the benefits for clients and franchisee opportunities

The following case studies showcase AQUILA's approach and highlight a range of typical revenue generating opportunities for its franchisees.

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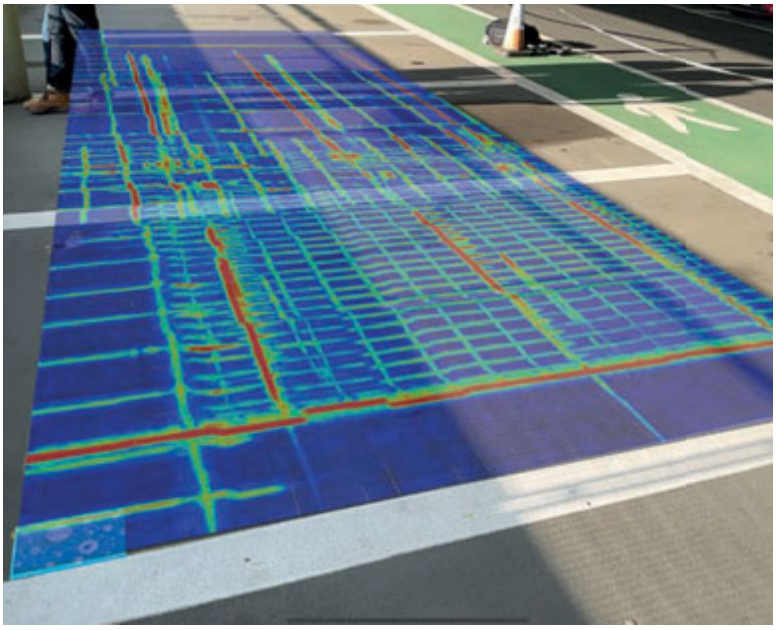

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Parking garage condition surveys to create digital twin for lifecycle management

Condition visibility is a challenge for property portfolio operators with multiple, geographically dispersed assets, especially if the portfolio has grown through the acquisition of existing properties. An added challenge for assets like multi-story car parks (MSCPs) is how the demands on the structures are evolving beyond the original design – for example, due to the additional loading from the increased proportion of sports utility vehicles (SUVs) and electric vehicles (EVs) in national vehicle fleets, and the additional fire safety considerations from newly installed EV charging infrastructure.

AQUILA was tasked by an asset maintenance contractor of an MSCP at one of the UK's international airports to conduct a structural assessment using comprehensive NDT, an evaluation of corrosion and delamination and to generate a digital twin for real-time updates and lifecycle management of the structure. A two-day inspection was carried out by a team of AQUILA and client personnel, and a detailed report was delivered to the client within two days of the site inspection. This clearly demonstrated AQUILA's ultra-efficient and result-oriented approach. The findings in the report highlighted repair, maintenance and upgrade considerations. Using the advanced asset-management software, AQUILA created a digital twin for the client to use as a lifecycle management tool.

Typical benefits for engineer and asset owner clients

This case study demonstrates several differentiated benefits to clients. For example:

- High-value inspection services – offering NDT and advanced diagnostics for large-scale infrastructure projects.
- 'Digital twin' integration – creating digital twins for clients to use as proactive asset monitoring and predictive maintenance tools.
- Repair and maintenance planning – supporting the client with developing repair strategies based on data-driven insights, increasing client trust and revenue.

Efficiently completing multi-asset portfolio assessment, evaluation and remediation for utility network

Swissgrid operates, plans and maintains the extra-high voltage transmission grid within Switzerland, and to and from other countries. The infrastructure under management includes 12,000 pylons, 147 substations and 41 cross-border power lines. Many of its assets are in difficult-to-reach locations, subject to climate extremes such as storms, and over 60% of the pylons are over 50 years old. Each pylon has four foundations, meaning there are 48,000 across the network. They are all assessed regularly, with some structures in key locations undergoing continuous monitoring. Since 2023 AQUILA has been supporting an ongoing inspection program of the foundations of 260 pylons in some of the country's most remote locations. A variety of assessment devices are used to investigate cracks, debonding, corrosion, structural weaknesses and other defects that require repair and maintenance. A cloud-based platform for paperless data collection, storage and collaboration is used from which tailored repair strategies are proposed based on problem severity, ensuring cost-effective remediation. With so many built assets, this project demonstrates the advantages of workflow templates and predefined inspection criteria to streamline and standardize inspections, alongside the paperless data acquisition and immediate centralized storage.

Multi-faceted offering for engineer and asset owner clients

This is an example of a long-term multi-asset assessment and management project that enables improved asset care such as:

- Inspection services: planning and implementing long-term and multi-site visual and NDT inspections for large infrastructure projects.
- Data-management solutions: capturing, analyzing and reporting on high-volume and extensive condition datasets.
- Asset-management solutions and training for clients – using advanced software to enable client operatives to extract maximum value from the asset data.
- Maintenance, repair and retrofit planning – developing and implementing cost-effective maintenance strategies for structural upgrades.

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6 An ultra-compact GPR device was used to scan smaller and difficult-to-access areas. The tablet shows the scan results in real time on screen. This data is uploaded to the digital asset management solution, feeding into the digital twin and the inspection report.
7 Augmented-reality view of the GPR results. The survey revealed unexpected rebar within a parking deck PT slab.
8 AQUILA operative using a Pundit UPE device to identify cracks or debonding within a pylon foundation.
9 Heavy rain was no obstacle to AQUILA's structural investigation work on site.
10 Clarification of as-built layout of steel reinforcement using a Proceq GP8100 GPR device (augmented-reality view).
11 Visualization of areas at risk of active ongoing corrosion using a Proceq PM8500 device (augmented-reality view).

Quality assessment of new-build MSCP constructed using PT solutions

High-volume construction is likely in fast-growing economies, with infrastructure erected quickly. When constructing at speed, the inevitable defects are often not apparent until the building is occupied. AQUILA's assessment technologies can identify defects during the construction, commissioning and preoccupation phases. In this project, the new MSCP was constructed to the highest standards, so AQUILA's objective was to show the client's team how new structures can be inspected using its high-tech solutions.

The assessment included high-precision scanning with various GPR devices, one of which features 50 sensors for unmatched structural imaging. The use of these devices saved time and reduced errors, with the results visualized in real time. Efficiency was greatly increased, with scanning work roughly eight times faster than would be achieved using standard subsurface mapping equipment. Investigation data was fed seamlessly into the 'digital twin' created by AQUILA, supporting the client's lifecycle management efforts.

Typical benefits for engineer and asset owner clients

This case study shows how AQUILA's services can be used in real time during the construction phase to identify defects and support quality control. Benefits include:

- Rapid large-scale inspections – these provide efficient and high-resolution scanning for extensive areas like parking structures, warehousing and logistics centers or airport runways.
- Premium data analysis services – these deliver a fast turnaround and detailed, georeferenced reports for advanced structural diagnostics.
- Diverse applications for utility and infrastructure projects – some GPR devices are particularly effective at utility mapping, bridge deck inspections and structural assessments.

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Duct inspection to assess tendon corrosion risks in bonded PT systems

Bridges over 20-30 years old are especially vulnerable to wear, corrosion and material degradation, potentially compromising their structural integrity and safety. There are many bonded PT bridges worldwide and a significant percentage of these are structurally deficient. Built assets constructed using PT typically require less maintenance compared to reinforced concrete, but high-profile bridge collapses caused by tendon failure demonstrate that it can be difficult to complete accurate structural health assessments of bonded PT systems.

Corrosion is a common cause of tendon failure, which can result from the voids in tendon ducts caused by grouting defects, such as the soft grout phenomenon (see the project by BBR Polska Sp. z o.o. on p60-61). Voids in the grouting can occur anywhere in the tendon duct, so inspecting its entire length is required to identify all defects.

AQUILA's bonded PT inspection process uses high-tech NDT, including GPR and ultrasonic pulse echo (UPE), for void detection. A typical assessment maps tendon ducts and rebar, identifying locations at which minimally invasive further investigations should be carried out, with the results stored in the asset's digital twin.

Just like the BBR Care+ approach to asset management, this extends the asset's lifecycle and enhances safety while also reducing carbon.

Building on BBR's technical leadership and track record in post-tensioning

Duct void detection is a logical service offering extension to care for PT structures, with various benefits for clients. These include:

- Specialized inspection services – providing advanced NDT solutions to assess corrosion risks and structural conditions for critical infrastructure like bridges.
- Proactive maintenance planning – this helps asset owners to mitigate costly failures by identifying vulnerabilities early and offering a remediation strategy.
- Digital asset management – this uses 'digital twins' to manage inspection data, enabling ongoing client engagement and value-added services.

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12 AQUILA senior engineer Colm O'Suilleabhain using a GS9000 device, with the scans showing in real time on his tablet.
13 An AQUILA operative using a handheld GPR device to scan a wall, assessing concrete cover and rebar spacing, with the results displayed on a tablet device in real time.
14 An AR view of a parking deck showing the PT and reinforcement within the concrete.
15 Use of a Proceq Pundit PD8050 UPE device to detect voids, with the scan results displayed in real time on the operator's tablet.
16 Comparing the UPE scans identifies anomalies. The left-hand image shows voids, the right-hand image shows no voids. This imaging can be viewed in real time.

SCREENING EAGLE | proceq

NDT solutions are a game changer for built health assessments

Proceq has provided leading-edge, non-destructive testing (NDT) solutions for over 70 years. Its extensive portfolio of powerful NDT sensors and equipment, and the real-time results they deliver, forms an essential element of predictive built world healthcare that extends asset life and increases long-term value for owners.

As a part of technology and software company Screening Eagle Technologies, Proceq also supports Tectus Group family brands such as AQUILA Built Health (see p64-71) and BBR Build+ and BBR Care+ (see p12-15). You'll see Proceq's equipment in photographs across our project articles in this and other issues of CONNÆCT. In fact, our global headquarters are all in the same office complex just outside Zurich, Switzerland.
Leading Proceq Switzerland is CEO Dr Koichi Oba. We wanted to help CONNÆCT readers better understand the challenges that built world engineers, operators and asset owners face and how NDT can help meet them. So, we asked Koichi for his insights.

1 Dr Koichi Oba, CEO of Proceq.
2 Proceq's Pundit Ultrasonic PD8050 used for structural imaging, object and defect detection.
3 The GM8000 detecting potential underground voids with full resolution 3D imaging in real time.
4 Completing a bridge deck assessment in the Italian Alps with the pushcart GS9000.
5 The Pundit PD8050 ultrasonic imaging system assessing PT ducts in the bridge deck of the Roosevelt Bridge, Florida.

What are the biggest obstacles in road and bridge inspections, and how does Proceq address them?

The major obstacle is the high volume of aging infrastructure being used for heavy traffic, as this constrains investigations. An aging workforce means certain markets lack experienced inspectors. This is compounded by the need for simpler methods of identifying structural defects and failures that do not require time-consuming engineering works and expert judgment. In the past year, we have many use cases demonstrating how Proceq's technologies identified sinkholes, road cavities, bridge deck rebar corrosion and pavement cracks.

How do Proceq's solutions improve efficiency in infrastructure assessments?

Proceq's connected solutions enable users to see the results of inspections in augmented reality in real time. You can interpret the results throughout the inspection without discovering afterwards that you have missing data and need to go back to the site. That's efficiency. We have developed technologies that enable users to gather the depth and breadth of high precision, post-processed data analytics needed in a single scan and site visit. We are currently using parallel processing technology to make data analyses even more efficient, and we plan to add Artificial Intelligence (AI) in future.

Can you share a success story where Proceq's technology significantly impacted a project's outcome?

We consistently see a big impact in utility mapping for roads and bridges. For example, a recent project in Germany saw our customer save their client tens of thousands of euros in less than an hour. With our subsurface ground penetrating radar (GPR) they could pinpoint the exact location of a missing gas pipe without costly digging and provide accurate 3D data for planning a new pipe installation. Learn more about this on our Tech Hub – see the QR code overleaf.

How does Proceq align with global infrastructure sustainability goals?

We can efficiently detect the structural defects and failures and/or aging phenomena of concrete structures such as rebar corrosion and concrete cracking. That leads to the cost-efficient refurbishment and restoration of structures. It means a structure's operating life is extended without demolishing and rebuilding. This is one of the most effective ways to reduce embodied carbon. Proceq solutions limit the need for invasive investigations, such as excavation, coring and cutting, which improves efficiency and reduces emissions.

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What motivates Proceq's R&D strategy, and how do you foresee evolving client needs driving future innovations?

In the construction industry, the average annual research and development (R&D) investment as a percentage of sales is roughly 3-4%. We invest double digits. We do this to accelerate the innovation cycle, especially in the field of data processing and AI in cooperation with our sister company, Screening Eagle Dreamlab.

Real-time data supports effective decision-making

Proceq's solutions provide engineers, asset operators and owners with accurate, real-time data via a digital asset management solution, delivered online to devices in the field. Access to data in real time leads to more effective decision-making. The ease of use and portability of the equipment also means built asset owner and operator customers save time, reduce cost and minimize disruption. This improves infrastructure safety, efficiency and longevity. For road and bridge inspection specifically, Proceq's assessments address challenges such as defect and cavity detection, PT duct inspection, concrete strength estimation, corrosion potential detection, and road marking and sign visibility testing.

The case studies explored in the AQUILA article (p64-71) showcase the immediate positive impact of having real-time data, as well as equipment that is intuitive and can be used by built world professionals across different disciplines. Access to data in real time means findings can be confirmed immediately on site, without further visits. Many minor defects can evolve into costly failures if not identified early or left untreated. Real-time data enables defects to be fixed quickly, reducing the need for repair or rebuild. This proactive approach increases asset life and reduces carbon, a core aim of BBR Care+. The Swissgrid use case highlights the power of Proceq's and Screening Eagle Technologies' combined software and AQUILA's engineers when assessing sizable estates with thousands of dispersed infrastructure assets.

Transformational technologies from Proceq

Subsurface mapping, site investigations and structural inspections were different before multichannel GPR and ultrasonic imaging with real-time 3D visualization. Building and infrastructure health assessments have been transformed with the ability to see survey results in 3D in real time. An added dimension is speed, with the 2025 release of Proceq GM8000, a vehicle mounted solution. Mapping large areas like major road systems, airfields and large facilities like chemical plants, factories and logistics hubs have become as efficient as they are effective. Here are some of Proceq's leading structural health assessment tools.

Enabling high-speed, wide-area subsurface mapping

The GM8000 multichannel GPR is Proceq's most recent product release for 2025 which captures large amounts of high-resolution 3D data in a fraction of the time. A newly constructed highway required urgent assessment to check for hidden subsurface voids caused by soil erosion after severe flooding. To ensure the pavement was safe before opening the highway to the public, the GM8000 multichannel GPR system was deployed for a 80 km/h inspection. Its 23 channel-array-configured, with a tight 7.5cm spacing, delivered real-time visualization of full-resolution tomographic images, with a sensor array that maintained data integrity at speed, confirming the safety and durability of the highway.

Subsurface assessments are a stroll in the park

Proceq's GS9000 is a pushcart multichannel GPR that generates a 3D subsurface map as the operator walks. Applications include utility mapping, damage prevention, road and bridge inspection, sinkhole prevention, cavity detection and structural monitoring. The GS9000 was recently used for a detailed bridge deck assessment in the Italian Alps. With up to 50 channels at 2.5cm spacing, the GS9000 delivers exceptional data quality for bridge and road applications where small details matter. In just one scan, the team identified and verified the shoulder reinforcement and checked for weaknesses in the entire bridge deck.

Rapid void detection in PT structures

Using ultrasonic imaging technology rather than GPR, Proceq's Pundit PD8050 is a non-destructive concrete assessment solution commonly used for inspecting PT ducts and grouting where early detection of issues is crucial for safety. It is often used by AQUILA in PT inspections to identify defects before they cause bigger issues. The Pundit PD8050 was used to inspect potential damage to PT ducts on the Roosevelt Bridge in Stuart County, Florida. The team rapidly identified and assessed the potential PT duct failures and verified the integrity of the defect-free sections.

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If you are new to Proceq and its technologies or want to learn more about the solutions and case studies in this article, scan the QR code to visit our Tech Hub.

GFRP anchors: a low carbon option for shoring, tiebacks and stabilization

Canadian BBR Inc. and technology partner MST Rebar Inc. develop creep and corrosion-resistant glass fiber-reinforced polymer (GFRP) ground anchors – a solution that leads to lower carbon.

A new era for ground anchors

Traditional steel tiebacks have been the industry standard for shoring, soil stabilization, tunneling and mining. However, the disadvantages of leaving buried steel strands from ground anchors post-construction or when additional works are commissioned were evident when a tunnel boring machine became entangled with steel strands during an infrastructure project in Toronto. The event led to significant delays and a $25 million taxpayer expense.

Recognizing the urgent need for a safer, more efficient alternative, MST Rebar Inc. and Canadian BBR Inc. collaborated to develop GFRP ground anchors, a revolutionary solution made from high-strength glass fiber-reinforced polymer. These anchors offer superior corrosion resistance, reduced weight and enhanced cuttability when compared to existing steel strand anchors, ensuring they integrate seamlessly into modern construction environments. Following extensive testing, including third party evaluation, these GFRP bars are fully certified by ASTM, CSA and ICC safety codes. Being lighter than steel rock bolts, GFRP anchors offer another benefit: lower emissions. The combination of lower emissions generated and less material used in the anchor manufacturing process, alongside significant weight savings that reduce supply chain emissions, helps reduce overall carbon generated during the construction phase, and locked into the built assets when completed.

1

Turning innovation into a reality

While MST Rebar Inc., led by Borna Hajimiragha, had the vision to develop a high-performance fiberglass anchor, proving its real-world viability required expertise and rigorous testing. That's where Canadian BBR Inc. came in. With extensive experience in post-tensioning (PT) and structural engineering, Rick Dozzi and his team were instrumental in validating GFRP anchor technology, demonstrating its strength, durability, cuttability and long-term performance.

Through a structured five-year development program, these collaborators pushed GFRP anchors from concept to industry-ready solution, overcoming industry skepticism and proving their value through extensive laboratory and field testing and project deployment. Today, having demonstrated their efficacy, GFRP anchors are gaining widespread acceptance, offering a smarter, safer and more sustainable alternative to traditional tiebacks in many project settings. You can read about three projects where the GFRP anchors have been used on p44-45.

Optimizing shoring and tiebacks

One of the first applications of GFRP anchor technology was in partnership with Zancon Group, a contractor specializing in deep excavations and shoring systems. The challenge was to replace conventional steel tiebacks with a solution that offered comparable performance but eliminated interference risks. Using GFRP anchors, Zancon Group was able to:

- Reduce material consumption, using two GFRP anchors for every steel anchor while maintaining structural integrity.
- Enhance installation efficiency, as GFRP anchors are 75% lighter than steel, simplifying handling and reducing labor costs.
- Ensure long-term durability, as GFRP anchors are corrosion resistant, eliminating ongoing maintenance concerns.
- Validate performance through rigorous testing, with one anchor stressed to its full design capacity to confirm strength, though the project team remained conservative in applying load levels across all anchors.

While initial trials used only a fraction of the GFRP anchors' documented strength, performance testing proved that GFRP anchors could meet or exceed project requirements. This conservative approach helped ease industry uncertainty and paved the way for broader adoption on future projects.

GFRP anchor applications

Playing to GFRP strengths

GFRP is not a new material and its applications across wider industry are considerable and well understood. Now that MST Rebar Inc. and Canadian BBR Inc. have gained certification for the GFRP anchors, specific applications can benefit. GFRP has several intrinsic features that differentiate it from steel and other materials:

- Typically, 75% lighter than equivalent steel rods.
- Up to three times stronger than steel anchors.
- Do not corrode, so GFRP endures exposure to salt water, coastal winds, road salt or soils with harsh alkaline or acid conditions with no effect.
- The manufacturing process of the MST Rebar Inc. and Canadian BBR Inc. GFRP anchor has a smaller carbon footprint than manufacturing the equivalent steel product.
- Being a quarter of the weight of steel, the weight savings during GFRP transportation and handling mean the product further contributes to reducing carbon footprint.

When coupled with the high tensile strength, low relaxation, high stiffness and high anchoring force, GFRP anchors can outperform steel anchors in many applications.

Shoring and soil stabilization for general construction

As shown in the Rise&Rose project in the Toronto suburbs (p45), under certain urban site conditions, replacing the steel tiebacks with GFRP anchors is the logical choice. Ground anchors can penetrate up to 32m in an urban shoring application, which poses a threat to adjacent foundation and tunneling works. Alongside the lighter weight and corrosion resistance, should any of the GFRP anchors remain in the soil, they will not damage plant and drilling machinery, or tunnel boring machines.

Raft and foundation stabilization in wet and corrosive environments

Corrosion resistance becomes a significant advantage in wet, acidic or alkali soils. GFRP anchors were used to stabilize the raft foundations at the Lakeview Water Treatment Plant, Mississauga (p45), against the hydrostatic pressure of the high-water table.

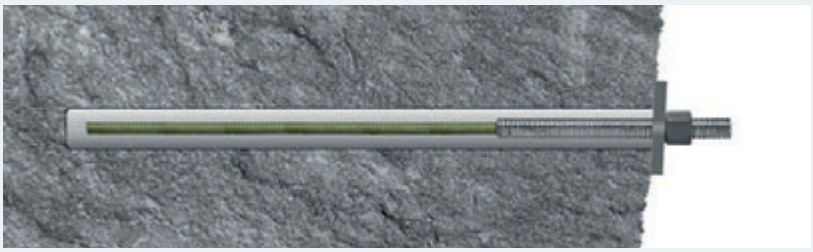
Soils resulting from the erosion of many types of igneous and metamorphic rocks can result in highly acidic or alkali soil conditions.

Depending on the nature of the geotechnical challenge, the corrosion resistance of GFRP anchors means they are an ideal substitute for steel strand ground anchors. The steel collar is subject to corrosion, but at a rate that's unlikely to cause performance degradation.

Less damage when using GFRP anchors for tunnels and mining

GFRP anchors are effective replacements for steel anchors when mining for specific minerals and metals to avoid the steel contaminating the ore body. In tunneling, where subsurface excavations require shoring, the stabilization anchors can remain in place as the tunnel boring machine can cut through the GFRP anchors without damage. This is also true of tunnel face stabilization, when further excavations and tunneling are planned, as most excavation plant easily cut through GFRP strands without damaging equipment.

Canadian BBR Inc. and MST Rebar Inc.'s work to secure certifications enables engineers to consider GFRP anchors in many more applications.



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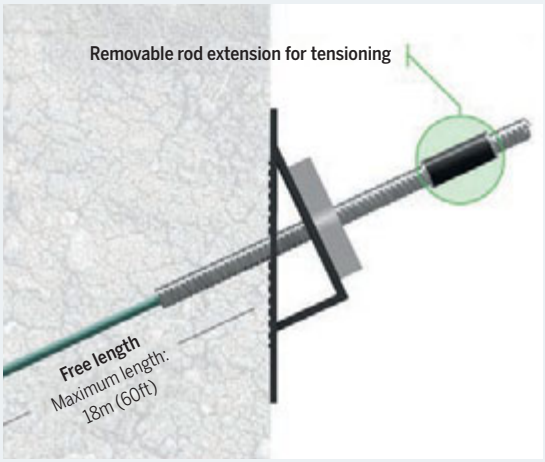

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GFRP anchor performance has been measured and verified

The challenges preventing wider adoption of GFRP anchors during the 2010s were related to certifications and codes and a perception that GFRP lacked sufficiently robust performance characteristics when compared to steel bar anchors. Lower quality imported GFRP bars performed poorly, so GFRP bars were unfairly considered to be less reliable than steel in all applications. As a result, the performance requirements in the American Society for Testing and Materials (ASTM) and Canadian Standards Association (CSA) codes have been set low.

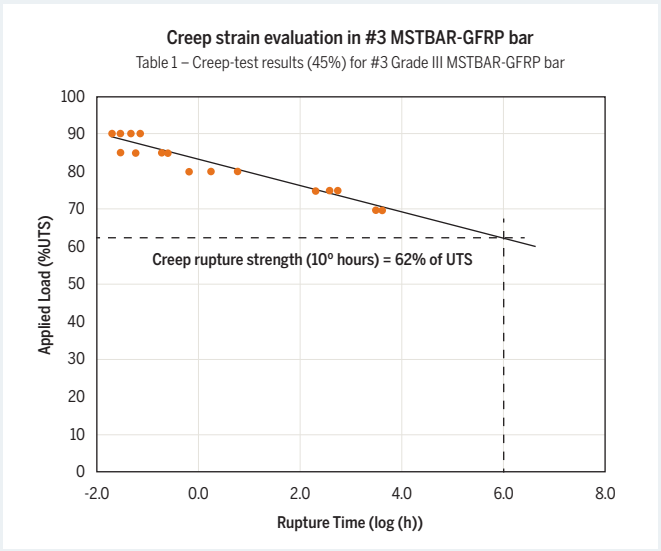
Independent third party tests by the Université de Sherbrooke, completed during the development of the GFRP anchors, included creep and longitudinal tensile properties of the GFRP bars. The tests, which were all conducted to ASTM D7205/D7205M-06 Standard Test Method for Tensile Properties of Fiber Reinforced Polymer Matrix Composite Bars, provided robust data that MST Rebar Inc. and Canadian BBR Inc. needed to demonstrate the high performance of GFRP bars and anchors to both construction industry designers and specifiers, and to the certification bodies.

Creep rupture strength withstands long term loading

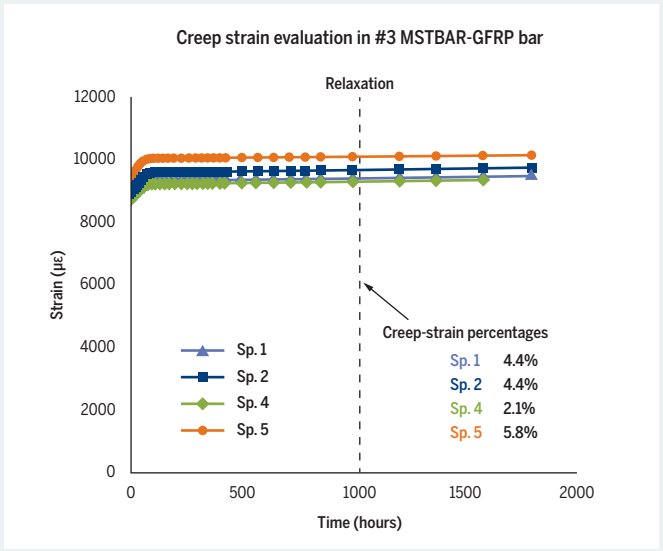
Extrapolation of test data on GFRP bars for 10,000 hours under sustained loads, confirmed that GFRP anchors have creep rupture strength of 62% of their ultimate tensile strength (UTS) even after 1,000,000 hours, proving their ability to withstand long-term loading conditions without significant loss of performance. This durability is a critical factor in ensuring the structural integrity of ground anchors over extended periods.

GFRP anchors have been tested for a 113-year service life at 62% of UTS, significantly surpassing the requirements for temporary tiebacks, which are typically stressed at 50% UTS for just 2-10 years, making current applications highly conservative.

Unlike lower-quality fiberglass bars from overseas, which often fail to meet long-term creep performance benchmarks, MST Rebar Inc. and Canadian BBR Inc.'s GFRP anchors set a new industry standard, exceeding CSA's requirements by nearly double. While CSA standards are designed to accommodate the weakest fiberglass products on the market to encourage broader adoption, MST Rebar Inc. and Canadian BBR Inc.'s GFRP anchors go far beyond these minimums, demonstrating exceptional long-term reliability and superior resistance to creep rupture.



This chart demonstrates that GFRP anchors maintain 62% of UTS after 1,000,000 hours.



The results for the four specimens shown (Sp.1 to Sp.4) demonstrate that GFRP anchors exhibit minimal creep strain, ensuring long-term stability. The low creep-strain percentages indicate that the bars have a high degree of stability over time.

1 GFRP anchors. The strands are GFRP with a steel collar, anchor plate and, in this configuration, nuts.
2 Cross section cutaway of the GFRP anchor used as a tieback.
3 Steel ground anchors left in the ground after a project is completed can ruin a tunnel boring machine's day and a construction budget.
4 A typical installation of GFRP anchors used as tiebacks for shoring on site. The steel collar has a thread that reduces the risk of shearing.
5 A GFRP anchor being prepared for installation on site as a tieback. The light green GFRP contrasts with the gray steel collar.
6 Installing GFRP anchors as tiebacks on site using a standard drilling rig for micropiles and ground anchors.
7 A high-strength bonding agent ensures adhesion between the ribbed GFRP bar and the steel collar, providing a strong hold throughout the product's lifetime.
8 For greater loads, GFRP anchors are available in bundled multi-stand variants.

These findings reinforce MST's leadership in fiberglass reinforcement technology, ensuring that GFRP anchors provide not only immediate benefits in installation and sustainability but also long-term performance that meets or exceeds industry expectations.

Minimal relaxation shown by creep strain evaluation

Further analysis demonstrated minimal relaxation over time, with creep strain percentages ranging from 2.1% to 5.8% across different samples, significantly lower than many steel alternatives. The testing involved a 10mm GFRP bar under sustained stress, simulating real-world conditions.

Most relaxation occurs within the first 24 hours, after which strain levels plateau, ensuring long-term stability. Engineers confirmed that by initially stressing the bars to 105% of the target load, they naturally settle at 100% after the first day, effectively mitigating long-term relaxation effects. Even under higher stress conditions, GFRP anchors remained well within CSA standards, which set a 35% limit, while MST Rebar Inc. and Canadian BBR Inc.'s outperformed expectations, demonstrating 45%, surpassing industry benchmarks for durability and performance.

These findings confirm that GFRP anchors provide stable, predictable performance over time, reinforcing their viability as a high-performance alternative to steel tiebacks.

90% tensile strength retained after alkali resistance testing

Additional structural performance tests have been conducted under severe chemical stresses to simulate highly corrosive environments. After 120 days exposure to a pH level of 12.7 at 60°C, the GFRP rods maintained 90% of their residual tensile strength. This performance in an accelerated aging test of this kind highlights the viability of GFRP anchors for permanent installation.

Are GFRP codes still fit for purpose?

Existing GFRP codes need updating for new higher-performing products

The research and development of the GFRP anchors highlighted that the existing construction codes from both the ASTM and CSA, require upgrading to account for the greater performance of products like those developed by MST Rebar Inc. and Canadian BBR Inc. Borna and Rick are both on relevant CSA codes committees. They are urging these committees to consider the new test evidence and field data, accepting that not all GFRP bars are created equal, and to update the codes.

For example, the data in the creep strain evaluation chart on p77, based on MST Rebar Inc. and Canadian BBR Inc. research by the Université de Sherbrooke, shows the GFRP bar retains 63% of the load after 113 years (note the x-axis time uses a log six base). The current CSA code requires 35% of the load to be retained. This low percentage is due to low-quality imports in the 2010s that performed poorly and gave GFRP a correspondingly negative reputation.

The second chart on p77, measuring relaxation of the GFRP bar when under load, shows that a 10,000ms results in only a 5% relaxation in the first 24 hours.

There is scope for more demanding codes that will give greater confidence to designers and specifiers that, in many applications, GFRP anchors are a superior option to steel.

No codes for temporary tieback installations

A similar opportunity to update codes is related to temporary GFRP structures. Tiebacks shoring retaining walls on sites like Rise&Rose (p45) are temporary structures, typically lasting up to 10 years, depending on the nature of the project. The ASTM and CSA structural engineering standards frameworks have no codes for temporary structures of this kind.

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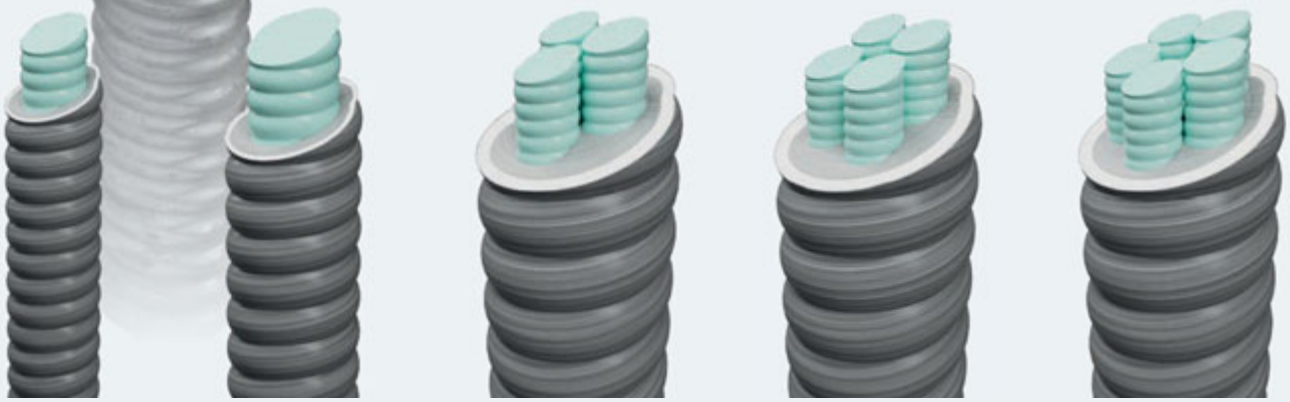
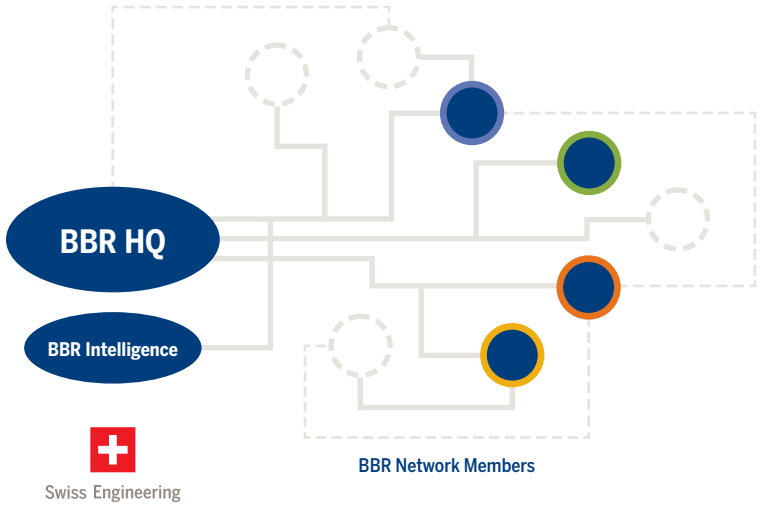


8

Leveraging AI to benefit the BBR Network

Artificial Intelligence (AI) is transforming how industries work. As adoption accelerates, how can we harness it to drive efficiency and accuracy and facilitate collaboration? At BBR, AI is already being utilized to enhance decision-making, streamline knowledge sharing and optimize processes. Now, AI tools like chatbots are shaping our everyday operations and strengthening the BBR Network.

BBR Intelligence is our AI-powered toolset that goes beyond generic AI applications. It provides instant access to 80 years of BBR's technical expertise, project information and best practice, ensuring that BBR Network Members get real-time support tailored to their needs.



Strong network:
- Strong market influence + brand
- Global references + credibility
- Continuous R&D + advanced technology
- Approvals + certification
- Digital supply chain
- Digital CE certification
- Knowledge management

Customer service:
- An attitude – not a department

Collective intelligence:
- Experience sharing
- Network thinking to create value
- Harness the power of AI

1

2

1 BBR VT International is harnessing AI to improve knowledge sharing, optimize engineering processes and strengthen the BBR Network.
2 BBR Intelligence retrieving reference projects for the BBR VT CONA CMI technology system for silo constructions.

BBR Intelligence is the first AI tool to be introduced to BBR Network Members globally. BBR is training BBR Network Members in how to use it, meaning we are not only promoting new technologies but safeguarding sustainable human development. Today, BBR Intelligence directly supports BBR Network Members in their daily operations, as they can access BBR's comprehensive knowledge base, case studies and technical specifications.

Built on the world-leading OpenAI platform and utilizing OpenAI's most advanced large language model (LLM), the chatbot analyzes user enquiries, retrieves relevant information from BBR's internal archives and delivers professional-level responses. Retrieval-augmented generation (RAG) allows queries to be processed in seconds, eliminating the need for extensive manual searches or direct consultations with experts.

Currently supporting over 30 active conversations per week, BBR Intelligence is already assisting with market research, technical enquiries and knowledge sharing.

It is also serving as an 'agent' by automatically managing multiple tasks as part of a process. For example, at the project tendering phrase, BBR Network Members usually submit a technical specification of a certain system and reference of application. Now, BBR Intelligence can provide the following documents through a list of download links within seconds:

- Key specification documents, including materials, dimensions and performance data.
- Case studies of BBR technologies used in similar projects.
- Downloadable documentation, including certifications, datasheets and brochures.

By delivering structured, accurate responses in seconds, research time is reduced for BBR Network Members, allowing them to focus on design and execution rather than information retrieval. At time of writing, BBR Intelligence continues to evolve.

Evolving network and scaling innovation

BBR's strategic investment in AI, realized through a broader AI initiative, BBR Intelligence, is intended to make the BBR Network more connected and agile. As engineering challenges grow more complex, projects carried out by BBR Network Members will increasingly benefit from easy access to historical data and case studies. By utilizing AI, BBR Network Members can work faster.

BBR Network Members' engineers and business development teams can also take full advantage of BBR's range of post-tensioning (PT) systems, corrosion protection solutions and geotechnical applications. Best practice case studies are now accessible across the entire network, enabling franchisees to apply proven techniques in new markets.

AI is also addressing a limitation faced by growing organizations: scalability. Traditionally, a BBR Network Member's ability to expand has been constrained by two factors: Sales-force capacity on the one side and technical support bandwidth on the other. A small team can only manage so many projects at once, capping revenue and growth potential. By integrating AI into knowledge distribution and technical support, BBR is removing these barriers, enabling BBR Network Members to scale more efficiently while focusing on engineering innovation and market expansion.

With AI managing the flow of knowledge and optimizing processes, BBR is supporting BBR Network Members to be more efficient today and better equipped to grow, compete and lead in the future.

BBR's AI-powered future

As technology advances, AI-driven solutions will further enhance capabilities in automated design, intelligent tendering and real-time project monitoring. AI-powered structural analysis will optimize PT design, while predictive analytics will refine risk management and maintenance planning.

By embedding AI into BBR's core operations and training BBR Network Members on how to use AI-powered tools, we ensure every franchisee can innovate, optimize and deliver engineering excellence.

AI is transforming how BBR operates – and this is just the beginning.

Latest BBR VT CONA CMI ETA offers asset owners new and expanded low-carbon PT technology

European Technical Assessment 06/0147 consolidates BBR's existing ETAs on BBR VT CONA CMI Systems into a single document, incorporating new technologies including nuclear anchorage.

What are ETAs and why are they important?

European Technical Assessments (ETAs) provide independent verification that construction products meet European performance standards. Issued by accredited Technical Assessment Bodies, they are especially important for innovative or non-standard products not covered by harmonized standards. Our Technical Assessment Body is the Austrian Institute of Construction Engineering (Österreichisches Institut für Bautechnik, or OIB), headquartered in Vienna, Austria.

For post-tensioning systems (PT) like BBR's, ETAs give Network Members, asset owners and contractors confidence in quality, safety and compliance worldwide. As regulatory frameworks evolve, achieving and maintaining ETAs ensures that BBR's systems continue to meet the highest levels of technical rigor — supporting global competitiveness and unlocking project opportunities for our Network.

Merging three ETAs into one – clarity and convenience

Released in July 2025, ETA 06/0147 applies to the PT system *BBR VT CONA CMI – Internal Post-tensioning System with 01 to 61 Strands.* It consolidates three existing ETAs into a 133-page document with 91 Annexes that feature many additional components and accessories. Specifically, the document includes:

- Size range from 01 to 61 including intermediate sizes.
- Both Bearing Trumplate (BT) and Square Plate (SP) as load transfer elements.
- Bonded and unbonded.
- Encapsulated (PL2) tendon.
- Electrical Isolated Tendon (EIT/PL3) with both Coupler K and H options.
- Exchangeable/removable tendons with bare or monostrands.
- Plastic ducts and segmental couplers fully complying to *fib* Bulletin 75/113.

New features – nuclear, one-layer reinforcement and EIT

The very latest inclusions to BBR's ETA are the option of one layer of reinforcement, either helix or stirrup, up to size 55 and an extension of the EIT tendons to size 3706. Significantly, a newly approved nuclear anchorage system has been added to the ETA. This is one system of an emerging suite of technologies to support the global nuclear renaissance we highlight on the next page.

BBR's nuclear energy expertise is prepared to support asset owners during the global atomic power resurgence

With global net zero targets in place, both energy security and decarbonization are increasingly prioritized. But as electricity demand surges and renewables like wind and solar face intermittency challenges, many nations are expanding and reactivating nuclear power programs to ensure a stable, low-carbon energy supply.
This shift is growing demand for the PT technologies suitable for nuclear facilities that BBR has delivered for decades.

As China and Russia continue to lead in new reactor construction, advanced economies are addressing aging nuclear fleets, balancing life extension programs with new-build replacements to maintain grid stability. European nations with existing fleets are advancing reactor upgrades and next generation technologies, while emerging nuclear markets like Poland, Saudi Arabia and Egypt are making their first investments in nuclear power, leveraging advanced reactor designs to strengthen energy independence. At the same time, small modular reactors (SMRs) and advanced nuclear containment technologies are reshaping the industry. These innovations offer greater flexibility, enhanced safety and faster construction timelines, supporting the modernization of the global nuclear fleet.

Sweden's largest nuclear power facility, the Ringhals Nuclear Power Plant, in 2007. Nuclear technology has advanced significantly in the years since, and this facility now features BBR PT solutions throughout the installation.

BBR's legacy in nuclear containment

BBR has been a pioneer in nuclear PT since the 1960s, playing a critical role in ensuring the structural integrity of nuclear containment vessels and installing PT solutions throughout nuclear estates. Between 1969 and 2021 alone, BBR's PT solutions were installed in 65 nuclear facilities in 13 countries. The 2008 edition of CONNÆCT (p45-47) detailed BBR's contributions to nuclear infrastructure, reinforcing the importance of high-performance containment systems in safeguarding reactors against external forces and catastrophic failure.
As the nuclear industry enters a new era, BBR is once again at the forefront. With a proven track record in engineering and technical innovation, we continue to set the standard for nuclear safety and efficiency, and we are evolving our PT solutions to meet the demands of modern reactor designs.

New PT solutions for nuclear

BBR is advancing its nuclear PT technology offering with the BBR CONA CMI Nuclear anchorage system, designed specifically for nuclear plant containment. This solution integrates specialized components, including the anchorage type N, bearing trumplate N, protection cap type N, trumpet type N and soaped steel strip sheath for greater durability and ease of installation. These advances reinforce BBR's position as a leader in PT technology for nuclear infrastructure, ensuring compliance with the industry's most demanding safety and performance standards. As regulatory frameworks evolve and new-build projects accelerate, BBR's continued innovation will inform the next generation of safer, more efficient and long-lasting nuclear infrastructure.

Powering the future of infrastructure

A strategy for global decarbonization, PT technologies in general and nuclear projects specifically are accelerating worldwide. From pioneering PT techniques in the 1960s to developing next generation anchorage systems today, BBR remains at the leading edge of nuclear engineering excellence and will continue play a role in the future of nuclear energy infrastructure.

Our expanding global network
India

Aergon Prestressing Systems

Headquartered in Pune, Maharashtra and operating throughout India, Aergon Prestressing Systems Private Limited (Aergon) was founded in 2017 by Sameer Setiya and Neeta Setiya. It has delivered over 200 post-tensioning (PT) and pre-tensioning projects throughout India, across the residential, commercial, public utility and infrastructure sectors, including building India's largest single span bridge of 100m.

"Our vision is perfectly aligned with BBR Build+ as we carefully select projects where we can focus on quality and reliability and not volumes," explains Sameer. "Like BBR Build+, our goal is to educate designers and asset owners about the benefits of higher standards and sustainability."

This includes promoting the use of European Technical Assessments (ETA) in buildings to ensure system approvals and component reliability, and electrically-isolated tendons (EIT) PL3 for railway and metro projects.

"Our dedication to value engineering, customer service, and optimizing performance has helped us to retain 100% of our clients. As a BBR Network Member, leveraging BBR's unique selling points and design advantages will enable our clients to benefit from more resilient, durable, lower carbon and economical structures," adds Sameer.

Aergon's Director Sameer Setiya has been working with PT technologies for over a decade, completing more than 300 projects across India, the Middle East and globally.

BBR VT CEO Olivier Forget (center) and Aergon's Director Sameer Setiya (right), with Sameer's father Ajit Setiya (left), at Aergon's headquarters in Pune, India.

Sameer describes some recent PT projects completed by Aergon:

Maha Trade Mart, Pune, India
Maha Trade Mart (MTM), Pune, is a mixed-use development of 290,000m² designed by Spanish architects L35. Situated in the heart of the city, MTM includes two basements, six floors of retail and two upper-level parking floors, with a 15-story hotel tower and a 27-floor office tower above the parking decks.

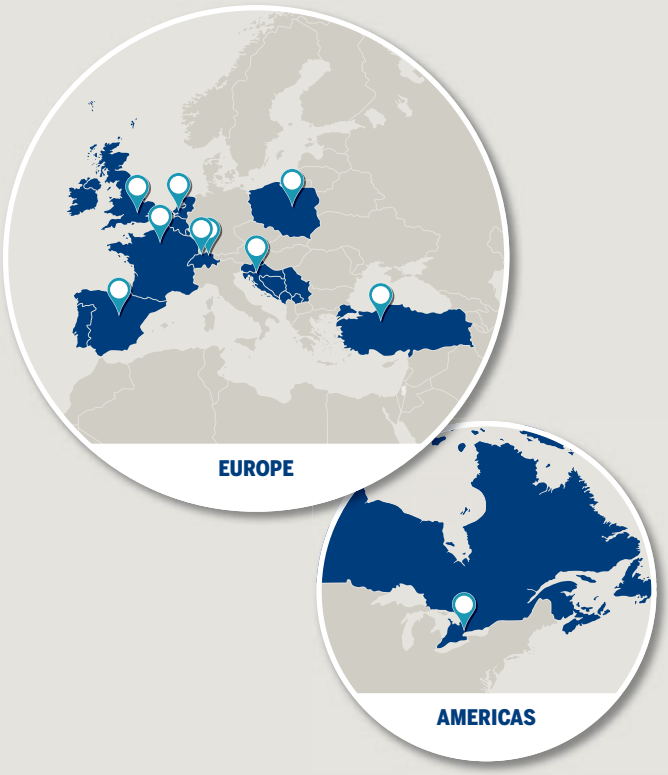
Aergon designed and installed PT slabs in the complete structure. PT in the beams and slabs optimizes floor space utilization by providing more column-free space, while also increasing the floor-to-floor height through optimized depths of PT beams.

Godrej Koregaon Park, Pune, India
The 186,000m² Godrej Koregaon Park commercial development presented an interesting challenge to the Aergon team. The structure's floor plate of 170x80m required a design without any expansion joints and, if that wasn't demanding enough, there was a three-week construction window. Aergon created a unique design solution to accommodate creep and shrinkage, enabling the team to achieve an expansion joint-free structure and a slab cycle of just 21 days

Our global presence

Our clients are active in over 50 countries – so our global presence is a vital asset.

We can share our international experience locally, provide solutions adapted to specific conditions and be on hand to offer a personalized service.



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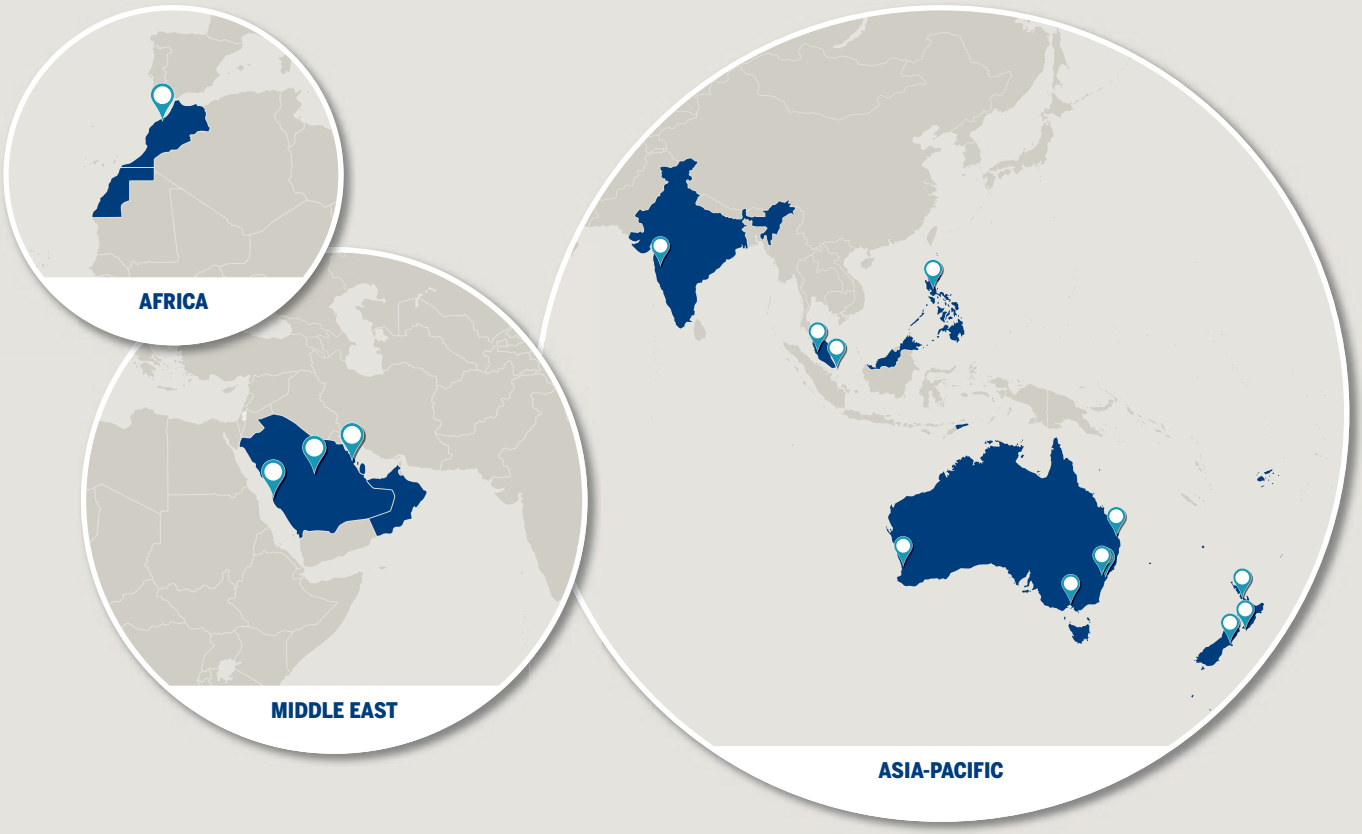

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