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MARITIME AND PORT DEVELOPMENT: Strong growth momentum for Maritime Singapore

RAILWAY & TRANSPORTATION ENGINEERING: Expanding the rail network and strengthening rail reliability and resilience

CIVIL & STRUCTURAL ENGINEERING: Designing concrete structures using headed reinforcement bars

COVER STORY:

Urgency to strengthen coastal defences





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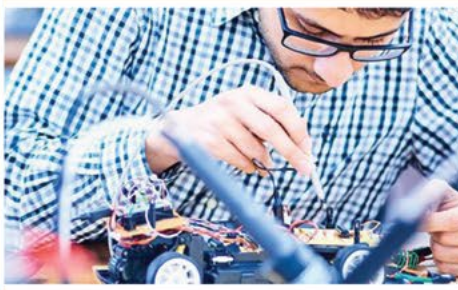


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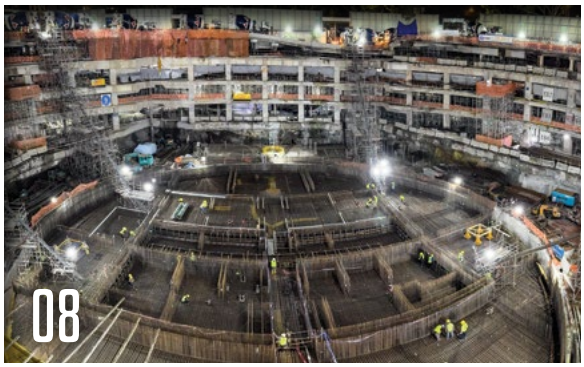
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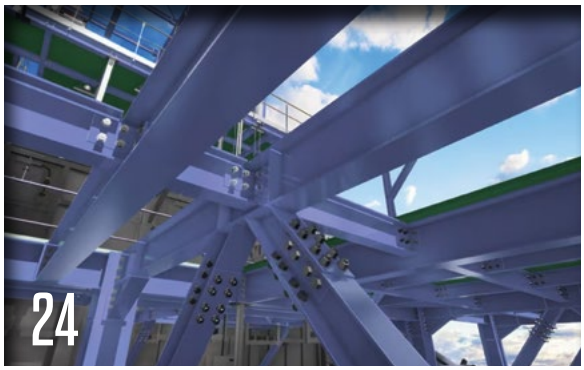
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IES-BuildTech Asia (BTA) Green and Sustainable Built Environment with Innovative Solutions seminar

The IES-BTA Green and Sustainable Built Environment with Innovative Solutions seminar, held on 20 March at BuildTech Asia 2025, was a tremendous success.

Over 160 participants gathered to hear insightful presentations from industry experts, who shared their knowledge on the latest technologies and strategies for advancing sustainability in the built environment.

The topics covered included the latest breakthroughs in green concrete technology, sustainable materials and innovative production methods.

The panel discussion also sparked engaging interactions between the panellists and attendees, fostering meaningful dialogue on the future of sustainable construction.

A big congratulations to IES for organising such a dynamic and impactful seminar!



Over 160 participants attended the IES-BTA Green and Sustainable Built Environment with Innovative Solutions seminar, to hear insightful presentations from industry experts.

Accelerating transformation of the built environment

BuildTech Asia 2025, a leading trade event for the construction and built environment ecosystem, was held from 18 to 20 March 2025 at Singapore EXPO.

Against a backdrop of evolving regulatory demands in building standards including on sustainability and safety, as well as rising costs and rapid technological advancements, the 14th edition addressed the theme 'Building Tomorrow: Innovate, Sustain, Transform', focusing on the following:

- Innovate - Unlocking the Future of Smart Construction
- Sustain - Driving Energy Efficiency & Sustainable Practices
- Transform - Advancing Safety & Resilience in Construction

Attendees were able to connect with over 100 exhibitors and brands from 16 countries demonstrating the latest innovations that advance efficiency, productivity, workplace safety, and resilience.

In partnership with leading industry associations and organisations, BTA 2025 hosted 15 specialised conferences, expert-led forums, and hands-on workshops addressing critical industry challenges and offering actionable insights, while enabling attendees to earn certification points.

The partners included AcePLP; Asia Pacific Assistive Robotics Association (APARA); AtoZero (Accelerate to Zero) ASEAN; buildingSMART International (bSI); Fire Protection Association of Singapore (FPAS); Institution of Engineers, Singapore (IES); International Powered Access Federation (IPAF); SCAL (Singapore Contractors Association Limited) Academy; SGTech; Singapore International Facility Management Association (SIFMA); Society of Project Managers Singapore (SPM); and Workplace Safety and Health Council.

Organised by Constellar, BuildTech Asia is held annually.

Exploring Innovation: IES members visit Cross Island Line CR109 MRT Tunnel Project



Group photo taken during IES members' visit to the CR109 MRT Tunnel Project.

On 21 March 2025, the IES Civil & Structural Technical Committee (Geotechnical & Tunnel Division) organised a visit for 30 IES members to the Cross Island Line CR109 MRT Tunnel Project.

The group was briefed about the project by Dr Sun Jian Ping from China Communications Construction Company (CCCC), the main contractor for the CR109 project.

The visiting IES members were shown the Tunnel Boring Machine (TBM) in operation – a remarkable feat of precision engineering. The TBM is designed to drill through soil and rock while minimising surface disruption. The engineers on-site demonstrated advanced real-time monitoring systems, automated segment installation and efficient slurry removal processes.

The tour underscored the innovation propelling Singapore's metro expansion, with the CR109 project scheduled for completion on 30 December 2029.

IES and Energy Institute forge stronger ties

IES is honoured to have been invited by the Energy Institute (EI), a UK-based Royal Chartered Professional Board for engineers and other professionals in energy-related fields, to attend its event, 'Navigating the Energy Transition Amid Geopolitical Uncertainty in Southeast Asia,' held at Arup Singapore on 24 March 2025.

This event also provided a significant opportunity for IES to sign a Memorandum of Understanding (MoU) with EI, strengthening the collaboration between both associations, particularly in the areas of aerospace, energy and sustainability.

The MoU was signed, on behalf of IES, by Mr Danny Lee, VP for External Relations, IES and witnessed by Mr Syafiq Shahul, Executive Director, IES. On behalf of EI, the MoU was signed by Mr Andy Brown, President of Energy Institute HQ and witnessed by Mr Petery Godfrey, Managing Director, APAC, Energy Institute.

The MoU outlines a focus on supporting the Continuing Professional Development (CPD) of both current and future members, enhancing their contributions to the field of engineering within the community.

IES looks forward to further collaborations with more professional organisations in the future, to advance the interests of members and benefit the broader engineering community.



Mr Danny Lee, VP for External Relations, IES (seated, left) signing the MoU with Mr Andy Brown, President of Energy Institute HQ. The witnesses were Mr Syafiq Shahul (standing, left) Executive Director, IES and Mr Petery Godfrey, Managing Director, APAC, Energy Institute.



The signatories exchanging the MoU documents.

Inaugural Finland Week held to strengthen connections with Singapore

The Embassy of Finland in Singapore and Business Finland held the inaugural Finland Week in Singapore, from 3 to 5 December 2024. Themed 'Connecting Finland to Singapore', the event brought together 16 Finnish innovators and tech companies (including six publicly-listed companies) to showcase the latest in Finnish technology and sustainable solutions, while highlighting opportunities for Singaporean businesses to explore business collaborations and investments.

Held over three days, at Huone Singapore, Finland Week highlighted the country's dynamic ecosystem, where innovation, sustainability and collaboration go hand in hand. Known for its business-friendly environment and forward-thinking solutions, Finland is a leader in digitalisation, quantum computing, green technology and sustainable business practices.

The key objective of the event was to share information about world class solutions, in order to attract global investors and entrepreneurs, and to draw larger international funds to the world's 'happiest innovation ecosystem'.

Visitors to the Finland Week had the opportunity to delve into Finnish know-how, uncover the latest industry trends, and engage with pioneering companies and thought leaders, in areas such as sustainability, technology (e.g. semiconductors and quantum computing), food and healthcare.

The highlights of the three-day event included a keynote address from Professor Antti Vasara, President and CEO of VTT Technical Research Centre of Finland, who spoke on 'Finnish Ecosystem: Driving collaboration and innovation with companies for a sustainable future'.

Prof Vasara is also a member of the Executive Board and Steering Committee of EARTO (European Association of Research and Technology Organisations) which represents 350 such organisations across Europe.

EARTO members make a major contribution to strengthening economic competitiveness and social development in Europe by supporting product, process and service innovation in all branches of industry and services, in both the public and private sectors.

Currently there are more than 200 Finnish companies operating in Singapore. These companies span diverse sectors, including information technology, clean energy and advanced manufacturing.



The Finland Week conference was attended by representatives from Singapore and global organisations.



A panel discussion on innovation was held at Finland Week.

KONE	Finnair
Nightingale Health	Helsinki Partners
Aalto EE	Jääde
Helvar	Kenno
Konecranes	Neste
VTT	Wipak
City of Tampere	Wärtsilä
Bonne Juices	Conduit Group

The Finnish companies that took part in the Finland Week.

Technologies for structural strengthening

Application areas include restoration and refurbishment projects.

A seminar on 'Advanced Solutions for Modern Construction' was held on 21 February 2025, at voco Orchard Singapore Hotel.

The event, which was organised by Mapei Far East and supported by 'The Singapore Engineer' magazine, attracted about 80 registered attendees.

Mr Umberto Rico, APAC Regional Product Manager, Building Line, Mapei, was the main speaker at the seminar.

Mr Christopher Miller, Regional Director, APAC, Mapei Far East and Mr Henson Liong, General Manager, Mapei Far East, also addressed the delegates.

In his first presentation, Mr Rico introduced Mapei's High-Performance Concrete (HPC) and Fibre Wrap systems, highlighting innovative solutions that enhance design efficiency and cost optimisation, with successful project references.

In his second presentation, he introduced the Mapei Structural Design Software, highlighting the industry standards integrated into the platform and its user-friendly operation, and provided a practical case scenario demonstrating its application.

Development of new solutions

For over 20 years, Mapei has been developing new strengthening techniques. Major international seismic events and their disastrous consequences were the impulse for research and development into new technologies to improve the safety of building stock from a structural perspective.

The company's solutions, often precursors of important evolutions to norms and standards, have the capacity to be adapted to deal with any type of problem.

Mapei's strengthening solutions exploit composite materials technology, which enables the properties of each single material to be combined to obtain better overall performance characteristics.

Generally made up of a polymer resin or mortar matrix in which fibre strengthening (in carbon, glass, basalt or steel) is embedded, the composite materials are characterised by high strength, low weight, durability and versatility.



A section of the attendees at the seminar.



Mr Christopher Miller, Regional Director, APAC, Mapei Far East.



Mr Henson Liong, General Manager, Mapei Far East.



Mr Umberto Rico, APAC Regional Product Manager, Building Line, Mapei.

Mass concrete pour completed for casting raft foundation of Singapore's tallest building

Pan-United Concrete, a subsidiary of Pan-United Corporation, successfully concluded a mass pour of 10,250 m³ of concrete for casting the 5 m (16 ft) thick raft foundation of The Skywaters at 8 Shenton Way, in January 2025.

Sitting on a site spanning 10,984 m² (118,229 ft²) and rising to a height of 305 m (1,001 ft), The Skywaters, a 63-storey mixed-use development, will be Singapore's tallest building, upon its completion in 2028.

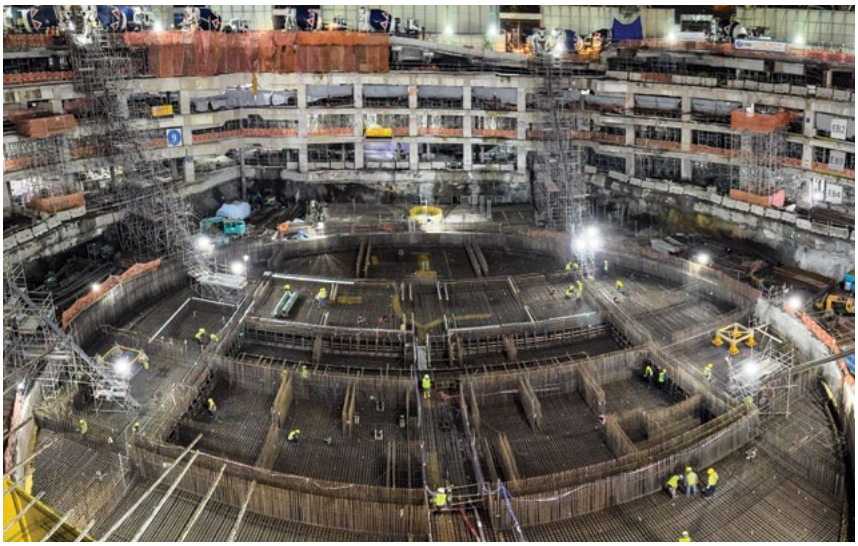
Collaborating closely with the project's main contractor, China Harbour Engineering Company Ltd (Singapore Branch) (China Harbour Engineering Company), the mass pour was executed, non-stop, over 35 hours, with one truckload of concrete delivered to the site every two minutes.

The smooth delivery was made possible by Pan-United's technology arm, AiR Digital. Leveraging its AI-enabled optimisation solution, the AiR Digital system effectively managed the complex logistics of the mass pour.

For instance, its fleet optimisation and auto-replenishment of raw materials ensured that trucks shuttled between the plant and the project site, with zero disruptions. In addition, the mixer trucks could queue seamlessly to deliver concrete without delays.

The Skywaters is Singapore's first project to use the highly durable, Grade 105 PanU Super High-Strength® Concrete which reduces the amount of concrete and reinforcements required for the raft foundation.

To reduce the embodied emissions of the project, The Skywaters is also being built with PanU CMC+ which permanently traps industrial waste carbon dioxide (CO_2) in the concrete, effectively making the building a carbon sink. Additionally, PanU Cool™ concrete was utilised for its temperature control and high flowability.



The mass pour of concrete for casting the raft foundation of The Skywaters, Singapore's tallest building, has been successfully completed. Image: Pan-United.

Mr Lim Han Kwong, Chief Operating Officer of China Harbour Engineering Company Ltd (Singapore Branch), said, "The mass pour would not have been possible without the strong leadership from China Harbour Engineering Company and the seamless collaboration among all stakeholders, including the unwavering support from the entire Pan-United team. This project showcased Pan-United's exceptional coordination skills and their commitment to delivering on their promises."

Mr Ken Loh, Chief Executive Officer of Pan-United, said, "We take great pride in our involvement in this landmark project and are grateful for the confidence and trust that China Harbour Engineering Company has in Pan-United. The successful completion of the casting was very much a combined effort between China Harbour Engineering Company and Pan-United."

"Our teams collaborated closely to carefully plan and execute the pour, round-the-clock. We are glad that Pan-United's years of concrete innovation and use of advanced technology have proven useful in meeting the challenge of setting new records in landmark projects," he added.

The Skywaters, positioned at the intersection of the Central Business District, Marina Bay and the future Greater Southern Waterfront, is being developed by a consortium led by Perennial Holdings. The development features luxury residential units, retail space, offices and a hotel. It is designed by Skidmore, Owings & Merrill, whose portfolio includes the Burj Khalifa in Dubai, One World Trade Center in New York and Jin Mao Tower in Shanghai.

Pan-United Corporation

Singapore-listed Pan-United Corporation is a global leader in low-carbon concrete technologies catalysing change in the concrete space. It is one of the world's top three biggest producers of carbon mineralised ready-mix concrete, the production of which leverages carbon capture and utilisation (CCU) technologies to sequester industrial waste CO_2 within concrete.

Amusement trade expo to feature innovative solutions

International Association of Amusement Parks and Attractions (IAAPA) Expo Asia 2025, the largest amusement industry trade show in the Asia-Pacific region, will be held from 30 June to 3 July at the Shanghai New International Expo Center (SNIEC), Shanghai, China.

The event will showcase the newest technological advancements and innovative solutions in the attractions industry, from more than 300 exhibitors who will present their displays over an area of 10,000 m². Over 10,000 attendees are expected to visit IAAPA Expo Asia 2025.

"The IAAPA Expo Asia is the perfect place to network, expand visibility of your business, enhance your professional development, and connect with manufacturers, buyers and peers," said Mr Jack Chan, Executive Director and Vice President, IAAPA Expo Asia Pacific.

"For both exhibitors and attendees, it is a chance to explore the latest trends, key issues and consumer preferences for the amusement / attractions sector and, by having all the key industry players under the same roof, it is an efficient way to meet in-person with over 10,300 potential clients, partners, suppliers and collaborators, who share your vision," he added.

"Our event embraces the whole attractions landscape, including entertainment centres, location-based attractions, zoos, aquariums, museums and nature attractions, as well as hotels and resorts and event facilities such as stadiums, and food and beverage operators," Mr Chan said.

"It really is a one-stop destination for professionals in the leisure and attractions industry, whether you are part of a multinational corporation or a small family-run operation," he added.

This year's theme 'Find Possible' reflects the event's focus on inspiring creativity and forging meaningful connections to unlock new growth opportunities, explore the future of the leisure and entertainment industry, and discover unexpected partnerships and new market opportunities.

Exhibitors can also gain invaluable insights through the expo's comprehensive education programme which will cover a wide range of topics, from personnel development and business optimisation to F&B trends and revenue diversification.

The expo's EDUTours will offer an exclusive behind-the-scenes look at some of China's peak entertainment venues and the opportunity to obtain insider knowledge directly from their top executives.

'Lunch and Learn' sessions are another opportunity to gain actionable insights that help businesses stay ahead in a rapidly changing market.

"We consistently receive overwhelmingly positive feedback from exhibitors about the value and return-on-investment they have gained by participating in IAAPA Expo Asia," said Mr Chan.



IAAPA Expo Asia 2024, the previous edition of the event, was held in Bangkok, Thailand.

Cutting-edge technologies to be presented at World of Concrete Asia 2025

World of Concrete Asia (WOCA) 2025, Asia's premier exhibition for the concrete, flooring, and mortar industries, organised by Informa Markets, will be held from 13 to 15 August 2025, at the Shanghai New International Expo Center (SNIEC), Shanghai, China.

The event will showcase cutting-edge technologies, innovative solutions and sustainable advancements, shaping the future of the construction sector.

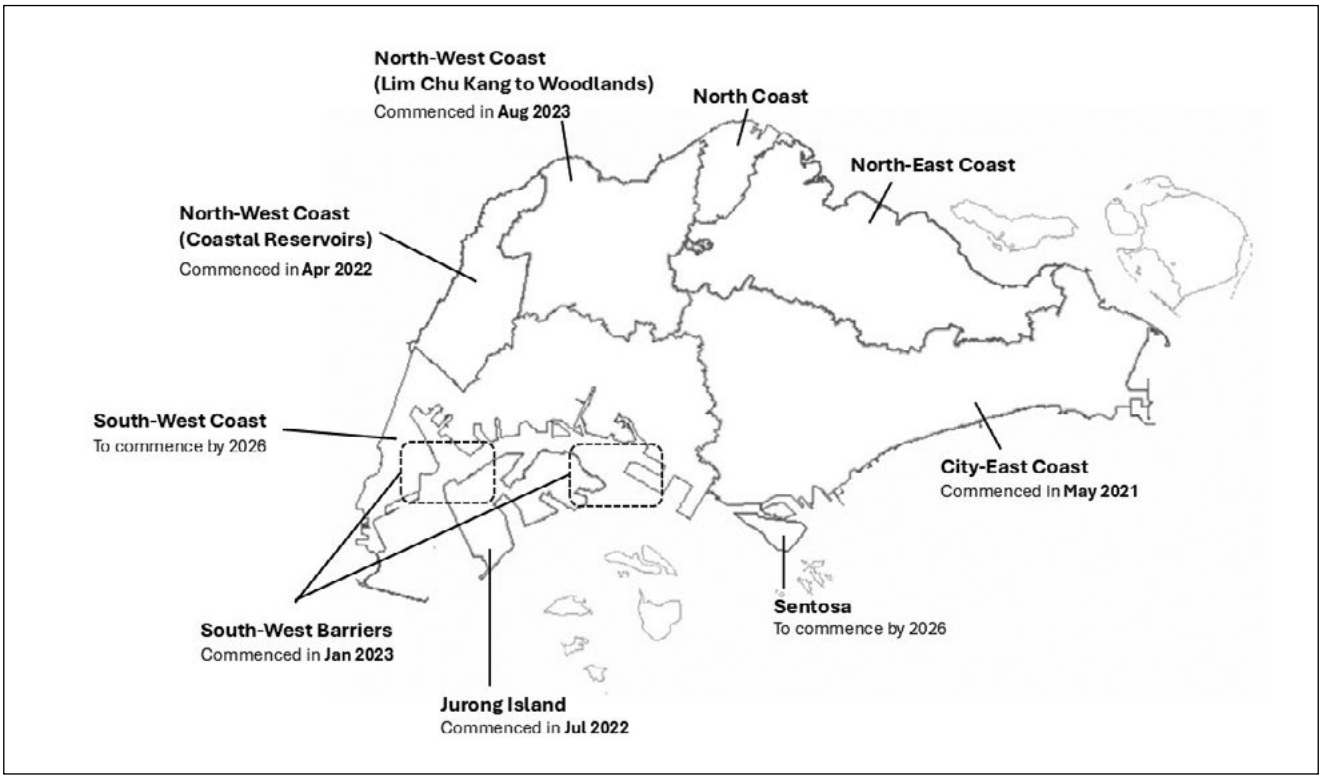
WOCA 2025 will bring together top manufacturers, suppliers and industry experts, from around the world, offering networking opportunities and insights into the latest trends in concrete products, flooring solutions and masonry materials.

With more than 650 exhibitors and 40,000 attendees, from 52 countries, expected to participate, the event will continue to serve as a key meeting point for professionals in construction, real estate and infrastructure development.

The exhibition will feature a diverse range of products and solutions including flooring systems, flooring material processing systems, concrete surface treatment equipment, general concrete and mortars (including concrete equipment), machinery (including loading, crushing and mixing), tools, construction chemicals, decorative flooring and innovative precast technologies.

Urgency to strengthen coastal defences

Several initiatives are being taken to protect against rising sea levels.



Overview of site-specific studies along Singapore's coastline.

As announced by Prime Minister, Mr Lawrence Wong, during his Budget 2025 speech, the Coastal and Flood Protection Fund will be topped up by SGD 5 billion.

In her Committee of Supply speech, Ms Grace Fu, Minister for Sustainability and the Environment and Minister-in-charge of Trade Relations, highlighted the urgency of, and plans to, implement various coastal protection measures progressively over the coming decades.

PUB, Singapore's National Water Agency, leads and coordinates coastal protection efforts across the Government. It will consider a range of solutions for different coastal segments and develop them with reference to the latest climate science.

PUB is undertaking the following initiatives to strengthen the coastal defences against rising sea levels:

- Two more site-specific studies to commence by 2026, for Sentosa Island and the south-west coast (new initiative).
- Coastal protection legislation to be tabled in the second half of 2025 (new initiative).
- Code of Practice for coastal protection and a new Flood-Resilient Developments (FRD) guidebook to be launched in 2026 (new initiative).
- A progress update on the Greater Southern Waterfront and Changi (part of the City-East Coast site-specific study) coastal protection plans, which will be presented in the second half of 2025.

The Third National Climate Change Study, released in January 2024, projected that mean sea levels around Singapore could rise by up to 1.15 m by 2100 and up to around 2 m by 2150. With around 30% of its land less than 5 m above mean sea level, Singapore is vulnerable to the impact of sea level rise. Some locations, such as East Coast Park, already experience sporadic episodes of coastal flooding, when high tide coincides with heavy rainfall.

TWO NEW SITE-SPECIFIC STUDIES

Singapore's coastlines have been divided into different segments for site-specific studies. Since 2021, relevant government agencies have commenced site-specific studies at City-East Coast, Jurong Island and the north-west coast, to develop locally tailored coastal adaptation options and plans. Two new site-specific studies (SSS), at Sentosa Island and at south-west coast, will commence by 2026.

Sentosa Development Corporation (SDC) will lead the SSS for Sentosa Island and dovetail coastal



The site-specific study on the protection of Sentosa's coastline will commence by 2026. Image: Sentosa Development Corporation.



A part of West Coast Park, included in the site-specific study on the south-west coast, which will commence by 2026.

protection measures with its upcoming development plans. The study, covering approximately 16 km of the coastline, will take into account Sentosa Island's function as a leisure and tourism destination.

PUB will commence the SSS for the south-west coast, taking into consideration findings from the ongoing Coastal Barrier Feasibility Study (CBFS) and Jurong Island SSS. The south-west coast study area stretches from Tuas to Pasir Panjang, covering approximately

116 km of coastline.

Key land uses for the area include a blend of waterfront industrial estates, port facilities such as the Tuas Port and Pasir Panjang terminals, and recreational areas like West Coast Park. PUB will consider how to dovetail the coastal protection measures with the development plans for the south-west coast.

Launched in 2023, the CBFS reviews the potential deployment of coastal barriers at the south-western coastlines to protect the area from storm surges.

LEGISLATION AND DESIGN STANDARDS

Coastal Protection Bill

To support the implementation of coastal protection plans, the Ministry of Sustainability and the Environment (MSE) and PUB will be proposing new legislation in the second half of 2025. The intent is to delineate stakeholder responsibilities, safeguard land for coastal protection measures and ensure compliance with coastal protection standards.

PUB will engage stakeholders, including relevant public agencies and private coastal landowners, in formulating the new legislation.

Code of Practice and Guidelines

PUB plans to launch a Code of Practice (COP) for coastal protection by the first half of 2026. Similar to PUB's existing COP for surface water drainage, the coastal protection COP will provide a set of standards for the industry, on the design, construction and operation of various coastal protection structures in Singapore.

PUB is also working on a new Flood-Resilient Developments (FRD) guidebook to complement the COP for coastal protection. This guidebook will contain guidelines and case studies that can help landowners decide how to enhance the flood resilience of their land and premises. PUB will seek inputs from industry experts and relevant stakeholders, that will assist in formulating the contents of the COP and FRD guidebook this year.

UPDATES ON ONGOING SITE-SPECIFIC STUDIES

The Government has adopted a phased approach in carrying out coastal protection site-specific studies (SSS), based on factors such as the vulnerability of the coastline and the need to dovetail them with planned developments. There are four ongoing SSS (at City-East Coast, Jurong Island and both sections of the north-west coast), with the next two planned for Sentosa Island and the south-west coast.

PUB adopts a collaborative approach in developing coastal protection solutions. It has carried out four sessions of Our Coastal Conversation (OCC) thus far, attended by various stakeholders including nature groups, business representatives, community leaders, interest groups, residents and students. The sessions aim to raise awareness and gather feedback on coastal and flood protection, as well as discuss aspirations, potential solutions and trade-offs.

PUB will continue to work closely with key stakeholders on the development of the most appropriate measures for each segment of the coastline, while taking into consideration the development needs and site constraints.

City-East Coast

The study for City-East Coast, which commenced in 2021, covers three areas – East Coast-Marina (covered by Long Island), Changi and Greater Southern Waterfront (GSW).



A second Our Coastal Conversation dialogue was held in October 2023.



Engagement with nature groups for north-west coast, on coastal reservoirs, in October 2024.

PUB will complete the SSS for GSW and Changi this year. The recommended coastal protection measures for GSW and Changi, incorporating feedback from the public, will be shared later this year. Subsequently, design of the recommended measures will be carried out and implementation of the measures is expected to commence from the 2030s.

Long Island, a project that entails reclaiming about 800 hectares of land off the East Coast, will form a continuous line of defence to protect the East Coast area against rising sea levels. Twelve existing outlet drains along the coast will drain water into a new reservoir.

The reservoir will be installed with two barrages and pumping stations, and like the Marina Barrage, the barrages and pumping stations will keep out seawater during high tides and enhance flood protection by discharging stormwater into the sea during heavy rainfall.

Jurong Island

JTC has completed the first phase of the engagement to understand the operational needs and future plans of stakeholders, as part of the development of coastal protection measures for Jurong Island. Some key considerations include maintaining waterfront access for operational purposes and ensuring business continuity in Jurong Island. JTC is currently working with PUB and stakeholders to formulate appropriate coastal adaptation solutions, and the work is on track.

North-west coast

The north-west coast has been divided into two sections. The SSS for the first section, from Tuas Checkpoint to Lim Chu Kang jetty, commenced in 2022. The second study, which covers Lim Chu Kang to Woodlands, was launched in 2023. Both studies are making good progress.

All images by PUB, Singapore's National Water Agency, unless otherwise stated





To enhance flood resilience, new underground MRT stations and developments have elevated entrances.



Another potential flood protection measure is the use of flood barriers.

Strong growth momentum for Maritime Singapore

New highs reached.



Singapore continues to be a preferred hub for shipping operations and maritime business. Image: Maritime and Port Authority of Singapore.

Singapore's annual vessel arrival tonnage, total tonnage of ships under the Singapore flag, container throughput, total bunker sales and sales of alternative bunker fuels, reached new highs in 2024. Cargo throughput handled at the Port of Singapore also increased last year.

These were among some of the announcements by Mr Murali Pillai, Minister of State for Law and Transport, at the annual Singapore Maritime Foundation (SMF) New Year Conversations event in January 2025. Mr Murali said that despite strained global supply chains, Maritime Singapore maintained strong growth momentum in 2024 and looks forward to continued steady growth in 2025.

PORT PERFORMANCE

Gross tonnage

The annual vessel arrival tonnage in the Port of Singapore, in 2024, grew by 0.6%, reaching a new record of 3.11 billion gross tonnage (GT), up from 3.09 billion GT in 2023. The key shipping categories – bulk carriers, container ships and tankers – each accounting for close to a third, contributed to over 90% of Singapore's vessel arrival tonnage in 2024.

Arrivals of bulk carriers also hit a record high in 2024. Other categories, such as specialised vessels, ferries and cruise liners account for the remainder. This diverse distribution reinforces Singapore's position as a global hub supporting the diversity of global shipping carrying commodities, containers, energy supplies and various trades.

Cargo

Cargo throughput handled at the Port of Singapore rose to 622.67 million tonnes – an increase of 5.2% from 592.01 million tonnes in 2023.

Containers

The container throughput from both PSA terminals and Jurong Port crossed the 40 million TEU mark for the first time, growing by 5.4% and reaching a new record of 41.12 million TEUs, compared to 39.0 million TEUs in 2023. Around 90% of Singapore's container throughput is for transshipment to other destinations. Singapore remains the largest container transshipment hub in the world.

The majority of container vessels complete their simultaneous cargo handling and bunkering within a day of arrival. Various efforts were undertaken collectively by the Maritime and Port Authority of Singapore (MPA), PSA Singapore and unions, to address the port congestion arising from the Red Sea situation in mid-2024.

These included commissioning new berths at Tuas Port, reactivating berths and yard

spaces at Keppel Terminal, increasing manpower capacity, working with shipping and feeder lines to optimise the operations schedule, and permitting night-tow operations for container barges to and from Pasir Panjang Terminal, for the first time.

Eleven berths at the new Tuas Port are now operational, with seven more berths to be operational by 2027. Reclamation works in Phase 2 of Tuas Port are about 75% completed. A Joint-Venture partnership between Evergreen Marine Corporation (EMC) and PSA Singapore was established in November 2024, offering long-term terminal capacity assurance to EMC's expanding global vessel fleet in Singapore.

Bunker fuels

Total bunker sales registered a new high of 54.92 million tonnes, marking a 6.0% year-on-year increase. The increased uptake was partly due to the extended Asia-Europe shipping routes via the Cape of Good Hope, given the disruptions in the Red Sea. Singapore made steady progress as the world's largest bunkering port, supplying over a sixth of the total fuel used by global shipping.

Sales of alternative bunker fuels exceeded 1 million tonnes, for the first time, to reach 1.34 million tonnes in 2024, which is a year-on-year doubling. Specifically, the sale of biofuel blends grew from 0.52 million tonnes in 2023 to 0.88 million tonnes. Biofuel blends of up to B50 are available commercially, with trials of up to B100 on-going.

LNG increased from 0.11 million tonnes in 2023 to 0.46 million tonnes. An Expression of Interest was launched in December 2024 to explore scalable solutions for sea-based LNG reloading to complement the existing onshore LNG bunkering storage and jetty capacities and support the supply of e-/bio methane as marine fuel in Singapore.

Methanol was available on a commercial scale and registered at 1,626 tonnes, while 9.74 tonnes of ammonia was bunkered for the first time globally in trials in the port.

As part of the pro-enterprise rules review exercise led by Deputy Prime Minister and Minister for Trade and Industry, Mr Gan Kim Yong, to help lower business costs, MPA will reduce the verification frequency of mass flow meters from twice to once a year, starting 1 April 2025. This aligns with the updated SS 648:2024 standards and is expected to save the industry approximately SGD 300,000 a year. Risk-based audits will continue as the industry undertakes the transition.

GROWTH AS AN INTERNATIONAL MARITIME CENTRE AND MARINE TECH START-UP HUB

As a leading International Maritime Centre, Singapore is home to nearly 200 international shipping groups. In addition, more than 30 maritime companies spanning shipping, legal, insurance, shipbroking and marine tech sectors, have established or expanded their operations in Singapore during the year.

Notably, classification society RINA announced the set-up of its Open Innovation Hub in Singapore. Total business spending by key maritime companies overseen by MPA increased to SGD 5.2 billion in 2024, up from SGD 4.8 billion the previous year.

From 1 April 2024, MPA has waived the need for security deposits and bankers' guarantees for companies assessed to have lower credit risks. This initiative, which is also part of the pro-enterprise rules review exercise, will benefit 80% of existing billing parties, improving cashflow for maritime businesses, including small-and-medium enterprises, by over SGD 20 million each year.

The number of start-ups under Port Innovation Ecosystem Reimagined @BLOCK71 (PIER71™) has grown from 17 in 2018 when PIER71™ was launched, to over 140 today. These start-ups have since raised over SGD 80 million in investments, with 10 start-ups raising close to SGD 17 million in 2024.

Singapore retained its position as the world's top maritime centre in the Xinhua-Baltic International Shipping Centre Development Index [1] for the 11th consecutive year. MPA was also recognised by Lloyd's List as one of the top 10 regulators globally. [2]

Singapore Registry of Ships performance

The total tonnage of ships under the Singapore flag exceeded 100 million GT for the first time and reached a new record high of 108 million GT, an increase of 8.5% from 99.6 million GT in 2023. The Singapore Registry of Ships (SRS) remains one of the world's top five ship registries.

Last year, 29 Singapore-flagged ships from 12 companies received Green Ship Certificates under the Green Ship Programme [3]. In April 2024, Eastern Pacific Shipping signed a Memorandum of Understanding (MoU) with MPA, committing several of their ammonia dual-fuel newbuilds to be registered under the SRS, upon delivery. More of such vessels using new fuels are expected to use Singapore as the flag of choice in the coming years.

In the collision involving Singapore-registered tanker, Hafnia Nile, in the South China Sea in July 2024, MPA worked with foreign counterparts and ship managers to coordinate the rescue of 22 crew on board, supported by the Republic of Singapore Navy vessel, RSS Supreme.

In the incident of an allision by Singapore-registered container ship, Dali, with the Francis Scott Key bridge in Baltimore, Maryland, USA, in March 2024, MPA offered its assistance in the US Coast Guard's investigations. MPA also worked with the vessel's classification society to provide the technical assessment and stability calculations to support the salvage operations.

DIGITALISATION, DECARBONISATION, MANPOWER, AND OPERATIONS INITIATIVES

Electronic bunker delivery notes
From 1 April 2025, all bunker suppliers will need to provide digital bunkering services and issue electronic bunker delivery (e-BDN) notes by default. The digital bunkering initiative, which includes an e-BDN record verification service by MPA, aims to streamline operations, enhance security and transparency, and could save up to 40,000 man-days annually.

A standard for digital bunkering supply chain documentation (SS709:2024) was also published in November 2024. Singapore is the first port to implement digital bunkering at scale for bunkering operations, following approval by the International Maritime Organization (IMO) to use eBDN, at the 80th meeting of the Marine Environment Protection Committee in 2023.

New fuels
In March 2024, Fortescue, with support from MPA, successfully conducted the world's first use of ammonia, in combination with diesel, as marine fuel, onboard the Singapore-flagged ammonia-powered vessel, Fortescue Green Pioneer. To support the operationalisation of ammonia bunkering, Enterprise Singapore and MPA will develop the Singapore standards for ammonia bunkering by 2025.

The lead developer for a low- or zero-carbon ammonia power generation and bunkering solution on Jurong Island under the Request for Proposal launched by MPA and the Energy Market Authority of Singapore is expected to be announced in 2025. MPA also worked with counterparts to develop the interim guidelines for the use of ammonia as fuel, which was adopted by the IMO at the Maritime Safety Committee during its 109th session in December 2024.

The first simultaneous methanol bunkering and cargo operations (SIMOPS) was conducted in May 2024 at the Tuas Port. The use of the mass flow metering (MFM) system for methanol, together with the use of digital bunkering, was also trialled during the SIMOPS.

MPA is currently developing the Technical Reference for methanol bunkering, which will cover safety procedures, crew competencies, custody transfer requirements and the framework to govern the use of the MFM and digital documentation records for methanol bunkering. This Technical Reference is expected to be released in 2025.

Electric harbour craft and charging
The first pilot trial for electric harbour craft (e-HC) charging points was launched in April 2024, following a call for proposal to develop and operate e-HC charging points at various locations, under a two-year pilot scheme.

MPA, together with Enterprise Singapore, Singapore Standards Council, industry stakeholders and academia, has developed a Technical Reference for e-HC charging and battery swap systems to support the development of the e-HC charging infrastructure and ecosystem in the Port of Singapore. Details of the Technical Reference will be announced in the coming months.

e-HC designs shortlisted from proposals following MPA's expression of interest launched in July 2023, are undergoing enhancements to improve their performance and cost-effectiveness. These improved reference designs, developed through a collaboration between MPA and various Institutes of Higher Learning, will be marketed by the respective companies, and production demand will be aggregated to achieve economies of scale.

Maritime Energy Training Facility
In April 2024, MPA established the Maritime Energy Training Facility (METF) to train the global maritime workforce in handling and operating vessels using clean marine fuels. The network of industry-supported training establishments is expected to be fully developed by 2026 and will train around 10,000 seafarers and other maritime personnel, by the 2030s.

There are currently 52 METF training partners comprising global marine engine manufacturers, international organisations, classification societies, trade associations, unions and Institutes of Higher Learning. Over 400 seafarers and maritime professionals have undergone training under the METF.

Talent development
In 2024, 56 students from maritime and non-maritime disciplines participated in the 12-week MPA - Global Internship Award programme across 46 maritime organisations and gained valuable internship experience and international exposure in the maritime industry. Twenty-three maritime leaders and professionals also participated in the 4th Maritime Leadership Programme.

The Tripartite Advisory Panel for Future-ready Maritime Workforce report was launched to guide skills development in areas such as digital, and soft skills, to support the transformation of the maritime workforce.

Following the release of the report, the MPA-SMF Joint Office for Talent and Skills was established to facilitate collaboration among the key stakeholders to develop the pool of skilled maritime professionals and to equip the workforce with future-ready skills.

As part of its early efforts, an MoU was signed in August 2024 with the National University of Singapore to pilot an applied data science and analytics course tailored for maritime professionals.

Key developments in Green and Digital Shipping Corridors

In 2024, MPA signed two new MoUs, with Australia and Shandong, China, on Green and Digital Shipping Corridors (GDSCs). These add to the four GDSCs established earlier, with the Port of Rotterdam in Netherlands, the Ports of Los Angeles and Long Beach in the United States of America, Tianjin in China, and Japan.

In October 2024, the Singapore-Rotterdam GDSC successfully completed a pilot for the bunkering of mass-balanced liquefied bio-methane at the Port of Rotterdam. A similar trial is planned in Singapore in 2025.

In addition, the Corridor partners issued a call-for-proposal in April 2024 to develop solutions for efficient and secure data exchange between ship and shore. Seven solution providers have since been shortlisted and trials were scheduled to be conducted with both ports in Q1 2025.

Under the Singapore-Ports of Los Angeles and Long Beach GDSC, discussions are ongoing with industry partners, including Hafnia, K Line and MOL, to support alternative fuels trials and Just-In-Time data-exchange projects for vessels.

As for the Singapore-Tianjin GDSC, the Nanyang Technological University's Maritime Energy and Sustainable Development Centre and the China Classification Society are researching quality and testing standards of green methanol fuels and greenhouse gas intensity of green methanol production from various pathways.

The Singapore-Japan GDSC partners have been conducting information exchanges on port decarbonisation and digitalisation, safety of ammonia-fuelled ships, electric vessels and cyber security.

Operations

MPA, together with various government agencies, supported by oil response experts and contractors responded to several oil spill incidents in 2024, including the Marine Honour oil spill in June and the leakage of oil from facilities in Pulau Bukom in October and December.

The 16th Joint Oil Spill Exercise (JOSE) conducted in October 2024 saw 100 personnel from 18 agencies and companies participate in the table-top exercise and seaward deployment. JOSE, conducted since 1998, has evolved, over the years, incorporating more sophisticated scenarios and new technologies.

Volunteers from the inaugural batch of the Safer Seas Volunteer Programme participated in the annual Ferry Rescue Exercise in August 2024. The exercise integrated and tested the volunteers as experienced craft operators, to complement agencies' efforts in delivering coordinated emergency responses.

STEADY GROWTH AMIDST SHIFTING DYNAMICS IN 2025

The outlook for 2025 is likely to be shaped by geopolitical dynamics and shifting trade patterns. Global GDP growth is forecasted to remain steady this year, with seaborne trade projected to grow 1.9%, with some re-routing of trade routes expected. The major shipping segments – bulk carriers, containerships, tankers and specialised vessels – are expected to continue performing better than pre-pandemic years.

Regional supply chains are adapting to rising demand and increased production within Asia. This has supported the growth of ports in the region, including those in Malaysia, Indonesia and Vietnam.

Notably, Asian ports such as Shanghai and Ningbo-Zhoushan, have experienced robust growth in 2024 and are expected to continue expanding overall container volumes. Shipping alliances are responding to these shifts and reconfiguring in Q1 2025 to optimise their coverage in key markets, including in Asia.

STRENGTHENING SINGAPORE'S MARITIME ECOSYSTEM

Singapore will continue to enhance offerings to serve all shipping segments, while expanding capabilities in emerging domains such as space, aerial drones and cyberspace, to support businesses.

MPA anticipates steady growth for Maritime Singapore in 2025, driven by the strong tripartite cooperation with the industry, unions, government, a strong maritime R&D community and Singapore's continued value offering as a preferred hub for shipping operations and maritime business.

The country will continue to play a constructive role in facilitating international agreements, including at the IMO, and hosted the inaugural General Assembly of the new International Organization for Marine Aids to Navigation in February 2025.

Singapore will continue to review rules and regulations to reduce business costs and enhance port efficiency and readiness to meet the evolving needs of international shipping.

References

[1]: https://www.balticexchange.com/en/news-and-events/news/press-releases-/2024/singapore-announced-top-maritime-centre-for-11th-consecutive-year.html

[2]: Lloyd's List, 6 December 2024 'Top 10 in regulation 2024': https://www.lloydslist.com/LL1151743/Top-10-in-regulation-2024

[3]: Launched in 2011, the Green Ship Programme (GSP) under the Maritime Singapore Green Initiative (MSGI) aims to reward ship owners who voluntarily adopt solutions that enable ships to exceed environmental regulatory standards set by the International Maritime Organization.

The GSP has been enhanced with revisions made to the MSGI from 1 January 2025 until 31 December 2027. Refer to MPA Shipping Circular No 12 of 2024.

Designing concrete structures using headed reinforcement bars

Facilitating the construction industry's adoption of this beneficial and innovative technology.

INTRODUCTION

Traditional ways of anchoring steel reinforcement bars in concrete structures often result in bar congestions when the joints need to be heavily reinforced and/or when the joints are complex and restrictive due to tight dimensions.

Headed bars (also known as headed reinforcement anchors) can contribute to the tension anchorage of reinforcement bars in concrete. Under certain qualifying design situations, they can even provide the full tension anchorage.

They provide anchorage via the direct bearing of the head on to the concrete. They depart from the traditional reinforcement anchorage which relies mainly on the bond along the length of the bar. In this manner, headed bars can provide straight anchorage with a reduced anchorage length.

Headed bars have proven to be effective methods for load transfer and particularly advantageous in design situations where it is not practical to rely on bar bond alone to provide the anchorage length.

By reducing the bar anchorage lengths, the heads can achieve the following:

- Reduce bar congestion at the joints.
- Improve concrete compaction and quality.
- Lead to simpler and quicker installation.
- Improve productivity.
- Reduce overall bar tonnage.
- Potentially lead to net cost savings.

There are different ways of connecting the heads to the bars. Generally, they can be classified as welding, hot forging, threading, swaging or bolting type. They are supplied by specialist trade manufacturers and are product-specific, using their own proprietary systems to connect the heads to the bars, details of which can be obtained directly from the manufacturers themselves.



At the launch of the 'Design Guide for Use of Headed Bars to Eurocode 2', at the 2024 CTIL Seminar, held in July 2024, are, from left, Er. Yong Fen Leong, Chair of the C&S Practice, Association of Consulting Engineers Singapore; Er. Ng Kee Nam, Senior Group Director, LTA; Er. Prof Chiew Sing Ping, Head of CTIL; Prof Chua Kee Chaing, SIT President; and Mr Kelvin Wong, CEO, BCA.

DESIGN GUIDE FOR USE OF HEADED BARS TO EUROCODE 2

However, there were no clear design rules to help engineers design concrete structures using headed bars safely and effectively. A working group comprising representatives from the Singapore Institute of Technology (SIT), Association of Consulting Engineers Singapore (ACES), Land Transport Authority (LTA) and Building and Construction Authority (BCA) was set up quickly to drive the research and development of a new design guide for the construction industry.

The outcome of this applied research collaboration is the 'Design Guide for Use of Headed Bars to Eurocode 2', authored by Er. Prof Chiew Sing Ping, Head of the Construction Technology Innovation Laboratory (CTIL) at SIT, and published by ACES in collaboration with SIT, LTA and BCA.

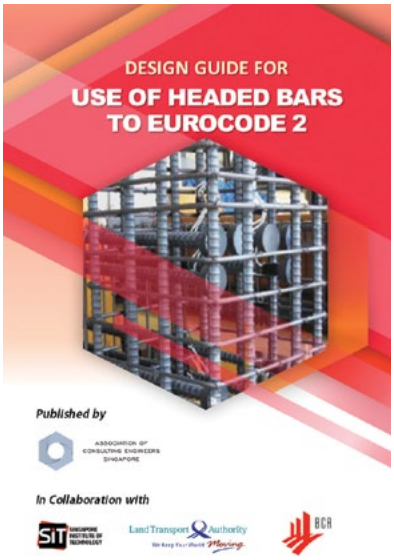
This design guide on headed bars is consistent with the design recommendations given in the 2nd Generation Eurocode 2 (EC2) BS EN1992-1-1: 2023.

The 2nd Generation BS EN1992-1-1: 2023, published by the British Standards Institution (BSI), in October 2023, has an entire new Section 4.8, covering anchorages of headed bars.

At the time of writing the design guide, BS EN1992-1-1: 2023 had not yet been adopted for use in Singapore, and it would take several years for the current 1st Generation SS EN1992-1-1: 2008 to be replaced with the new 2nd Generation EN1992-1-1: 2023.

The current 1st Generation SS EN1992-1-1: 2008 does not provide any design guidance on how to use headed bars, hence there is an urgent need to develop this guide to bridge the gap, as the industry is keen to adopt headed bars in construction to improve concrete quality and productivity.

The main objective of this guide



The new guide is expected to help engineers design concrete structures using headed bars, safely and effectively.

is to set out clear design rules on how to use anchor heads on main longitudinal reinforcement bars in tension. Its focus is on the contribution provided by the head to anchor the bar, so that the anchorage length can be reduced, and its design model and rules are in line with BS EN1992-1-1: 2023.

In this way, this guide will be aligned to the 2nd Generation EN 1992-1-1: 2023, when it is fully implemented in Singapore, in the future. In addition, this guide also provides typical applications where headed bars can be used efficiently, as well as additional rules for good practice.

As a guide, it only provides guidance and recommendations, and it should not be construed as presenting mandatory requirements by the Building and Construction Authority. The Qualified Persons should ensure that the ensuing design and execution of their projects are in accordance with BCA's requirements. Additional references could be made to the appropriate sections in BS EN1992-1-1: 2023, if necessary.

Applications

This design guide provides some typical design situations where headed bars can be applied efficiently, along with additional rules for good practice.

The use of headed bars is also permitted in other design codes and it is useful to see where this design guide stands in comparison with the other design codes.

Headed bars are most effective in joint regions with high congestion and interlinking bent bars. Their use will lead to lesser rebar congestion and better concrete consolidation in these regions.

Product conformance requirements

There are many proprietary headed bar systems that are commercially available in the market.

They are construction products which need to be manufactured under stringent factory-controlled processes and certified by independent assessment bodies, to ensure that the headed bar products meet certain performance requirements, for example, the strength of the steel material for the head and its connection to the bar, and to determine whether they are adequate and safe to be used in construction.

At the time of writing the guide, a harmonised European Product Standard does not exist for headed bars, hence it is not possible for any independent notified body to carry out product conformity assessment and issue a CE mark to any headed bar product. As a result, manufacturers could only opt to apply for approval based on a European Technical Assessment (ETA) issued by national technical assessment bodies under the European Organisation for Technical Assessment (EOTA), using the European Assessment Document (EAD) No 160012-00-0301 for which the base reference standard is ISO 15698.

Approval for use in Singapore

Only headed bar products with the

Winner of the IStructE (Singapore) Book Prize 2024



Mr Seah Wang Zhe, fourth from left, was one of the recipients of the IStructE (Singapore) Book Prize 2024. Image: IStructE Singapore Regional Group.

Mr Seah Wang Zhe, a recent graduate of the Singapore Institute of Technology (SIT) & University of Glasgow (UOG) Joint Civil Engineering Bachelor of Engineering degree programme, was one of recipients of the IStructE (Singapore) Book Prize 2024.

The award was presented by the IES-IStructE Joint Committee, for the assistance provided by Wang Zhe to his academic supervisor at SIT, Er. Prof Dr Chiew Sing Ping, in writing and compiling the recently published 'Design Guide for Use of Headed Bars to Eurocode 2'.

The book prize was presented at the IStructE Members' Appreciation Night 2024.

following technical approvals which have been evaluated independently can be used with this design guide in Singapore:

- ETAs issued by EOTA's technical assessment bodies based on EAD No 160012-00-0301 and ISO 15698.
- Technical Approvals based on EAD No 160012-00-0301 and ISO 15698 issued by assessment bodies accredited by Singapore Accreditation Council (SAC) or assessment bodies accredited by other national accreditation councils having mutual recognition arrangements (MRAs) with SAC.
- ETA-equivalent Technical Approvals, subject to independent evaluation and approval by BCA. Examples of such equivalent approvals include those issued by assessment bodies accredited by national accreditation councils such as United Kingdom Accreditation Service (UKAS) and Ministry of Land, Infrastructure, Transport and Tourism of Japan (MLIT).

Summary

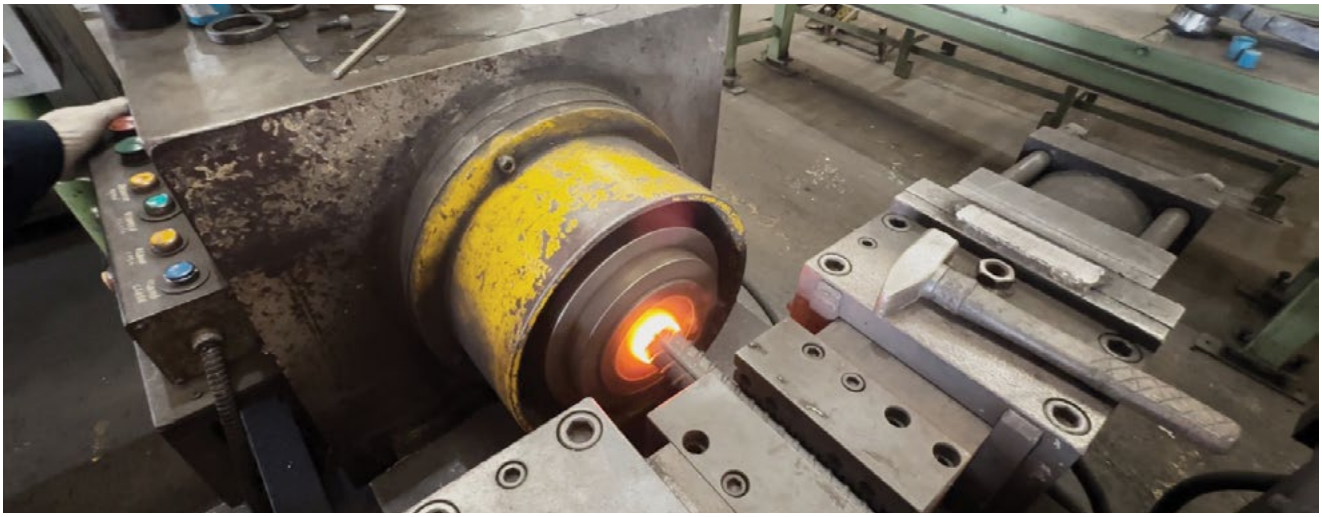
This design guide on headed bars is intended for use as a non-conflicting complementary supplement to the existing SS EN1992-1-1: 2008 and it deals primarily with the anchorage of headed bars in accordance with the provisions of BS EN1992-1-1:2023. The guide bridges a current design gap, and it will allow the industry to adopt headed bars to facilitate construction where applicable. It will also pave the way for design engineers to transit to the new 2nd generation EN 1992-1-1: 2023 easily, in the future.



Headed bars can reduce overall bar tonnage. Image: Mr Saravanan Natarajan, NatSteel Holdings Pte Ltd.



Headed bars can reduce bar congestion at the joints.



Local production of headed bars using the friction welding process. Image: Mr Saravanan Natarajan, NatSteel Holdings Pte Ltd.

Fit for the future through sustainable construction

Approaches to save resources, avoid emissions and reduce noise.

The construction industry uses significant amounts of resources and is one of the largest producers of greenhouse gases. For that reason alone, social development aimed at sustainability is inconceivable without essential contributions from the construction industry.

bauma 2025 will provide an overview of the diverse approaches in the construction machinery world for sustainable construction. The world's leading trade fair for construction machinery, building material machines, mining machines, construction vehicles and construction equipment will be held from 7 to 13 April 2025, at Trade Fair Center Messe München.



Sustainable construction is one of the key topics at bauma 2025. Image: Messe München GmbH.

Serial construction

When it comes to saving resources, serial construction is one of the most promising levers.

"It uses raw and other materials more efficiently than with conventional construction methods, as prefabrication can be carried out in a controlled industrial environment," explains Stephan Oehme, Consultant Mining & Minerals, Construction Equipment and Plant Engineering at the German Engineering Federation (VDMA).

According to him, material waste can thus be reduced in several ways. Production waste and scrap materials generated at the factory can be better recycled. It is also easier to dismantle the buildings at the end of their useful life and to reuse their materials.

3D printing with recycled and biobased materials

As a further opportunity to protect natural resources, greater use can be made of recycled materials for 3D printing of buildings. The industry is also carrying out research on biobased materials for additive manufacturing.

In any case, there seems to be the demand. According to a study by the market research company, Exactitude Consultancy, the global market for 3D printing mortar is expected to grow from around USD 3.5 billion in 2024 to around USD 13.8 billion in 2034.

Recycling of mineral construction waste

Of the around 208 million tons of mineral construction waste generated in Germany, in 2022, over 90% was recycled, according to the Kreislaufwirtschaft Bau initiative.

For example, asphalt pavements can be prepared on site using the cold recyclers from the Wirtgen Group. The existing pavement is granulated with a milling and mixing rotor and prepared by adding binding agents, cement and water. The result is a homogeneous material that can be directly reapplied.

Electric drives

Sustainable construction also includes the goal of decarbonisation to the maximum possible extent. Contributing to that are the alternative drives for mobile construction machinery, which will also be a separate key topic at bauma 2025.

In addition, electric solutions also prevent exhaust fumes and noise from construction equipment, such as vibratory plates and tamping rammers. The range of products is now so wide that, according to the manufacturer Wacker Neuson, a completely emission-free construction site is already possible today.

Low-emission asphalt mixing

Other market players also supporting climate-friendly construction are construction material manufacturers. For example, an asphalt mixing company in Nentershausen in the German state of Hesse, is now successfully using the Revoc system, from manufacturer, Benninghoven, which was presented as a world premiere at bauma 2022.

The retrofitted 'catalytic converter' enables total carbon emissions to be reduced by up to 50%, while the share of recycling material in the asphalt can be increased to up to 60%. Benninghoven also recently launched the world's first asphalt burner that can be powered by 100% green hydrogen.

Expanding the rail network and strengthening rail reliability and resilience

Initiatives announced for the public transport system.

Singapore's rail network is set to expand, as announced at the Ministry of Transport's Committee of Supply debate. LTA plans to proceed with the West Coast Extension which extends the Jurong Region Line to connect with the Circle Line and Cross Island Line.

Feasibility studies are also ongoing for new rail lines to further improve access to public transport. Concurrent with these expansion efforts, additional investments will be made to support tripartite efforts to maintain the reliability of the existing rail network.

ONGOING RAIL PROJECTS

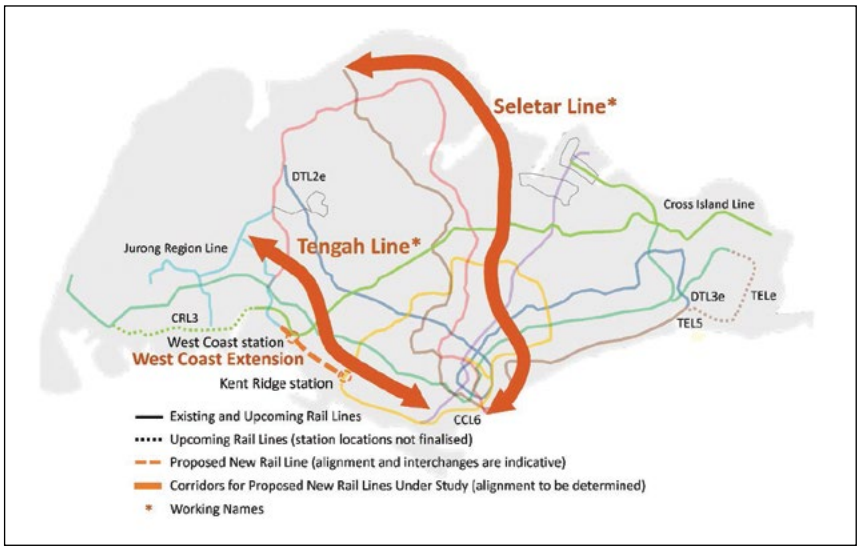
Rail projects across the island continue to make steady progress.

Hume station on the Downtown Line (DTL) opened for passenger service on 28 February 2025, while phase 2 of the Cross Island Line (CRL) is expected to break ground in the first half of 2025.

Circle Line (CCL) stage 6, which closes the circle between HarbourFront and Marina Bay stations via three new stations, is due to be completed in the first half of 2026. Another three new stations, as part of Thomson-East Coast Line Stage 5 (TEL5) and Downtown Line 3 extension (DTL3e), are on track to open in the second half of 2026.

Electrical, mechanical and track works have also commenced for Jurong Region Line Stage 1 (JRL1), which is on track to open in 2027, followed by the next two stages of the JRL in 2028 and 2029. From 2030, the eighth MRT Line, the Cross Island Line, will be progressively opened.

As the ongoing rail projects move forward, the Government remains committed to the long-term vision, under the Land Transport Master Plan, to have 8 in 10 households within a 10-minute walk from a train station, by the 2030s. The rail network will continue to be expanded, to better serve residents, especially in areas with new and growing developments.



Schematic of Singapore's existing and upcoming rail lines (not drawn to scale).

West Coast Extension

LTA has been studying a West Coast Extension (WCE) to further improve rail connectivity in the West. The plan is to implement the WCE in two phases:

- The first phase will extend the JRL from Pandan Reservoir station to connect with the CRL at West Coast station by the late 2030s.
- In the second phase, the current plan is to further extend the JRL from West Coast station to connect with the CCL at Kent Ridge station by the early 2040s.

The WCE will provide residents in the west time savings of up to 20 minutes for journeys towards the city centre. It will also strengthen the resilience of the rail network by providing alternative travel options to the city centre via the Circle Line, as well as to other parts of the island via the Cross Island Line. More details on the alignment of the line and station locations will be announced at a later date.

FEASIBILITY STUDIES FOR NEW RAIL LINES

In the Land Transport Master Plan 2040, the Government had identified a proposed new line for feasibility studies. This rail line, tentatively called the Seletar Line, could serve areas such as Woodlands, Sembawang, Sengkang West, Serangoon North, Whampoa, Kallang and the Greater Southern Waterfront. Feasibility studies are currently ongoing.

In addition, another corridor has also been identified, with the potential for a new rail line, tentatively called the Tengah Line. Feasibility studies are ongoing to assess how such a line could supplement the transport network in the west and northwest regions, to serve areas such as Tengah, Bukit Batok, Queensway and Bukit Merah.

Preliminary assessment has also indicated that these two potential rail lines could meet at the Greater Southern Waterfront. LTA's feasibility studies will therefore take into consideration the possibility of linking both lines into a single line. If studies confirm that these lines are feasible, they could be completed in phases, from the 2040s. The lines are estimated to serve more than 400,000 households. More details will be provided, as progress is made on the feasibility studies.

STRENGTHENING RAIL RELIABILITY

As planning goes ahead on expanding the rail network, the aim is also to ensure that the rail network remains safe, reliable and resilient. Through strong tripartite efforts, the target figure of at least 1 million mean kilometres between failure (MKBF) for the rail network has been consistently achieved since 2019. However, maintaining high reliability standards will become more challenging as the network expands and it becomes necessary to maintain both newer and older systems and assets.

To support tripartite efforts to strengthen rail reliability, the Government intends to invest up to an additional SGD 1 billion, over the next five years, to enhance the management of rail assets and improve the capabilities of the rail workforce. This investment reinforces the strong collaboration between LTA and the tripartite partners to develop a reliable public transport system and ensure smoother and more efficient journeys for commuters.

The management of rail operating assets will be strengthened, by investing in condition monitoring capabilities that allow for more proactive and targeted maintenance. This will complement investments to carry out targeted pre-emptive replacements of subsystems and components to better sustain the assets. Investments will also be made in new technologies that enhance maintenance efficiency and effectiveness across the sector.

Investments will also be made to transform and level up the rail workforce, who play a crucial role in the maintenance and smooth operations of the MRT system. Training programmes will be strengthened and more opportunities will be provided for rail workers to upgrade their skills, while supporting public transport operators, as they drive workforce and operations transformation to be more future-ready.

More opportunities will also be created for the rail workforce and leaders to learn from the best overseas metro systems and international experts.

Together, these efforts to expand the rail network, enhance the management of rail assets and upskill the rail workforce, will allow the continued delivery of convenient, reliable and resilient public transport for commuters.

Hume station opened

The new Hume MRT station on the Downtown Line (DTL) opened for passenger service on 28 February 2025.

Hume station is located along Upper Bukit Timah Road, between Hillview and Beauty World stations. It will serve existing residential developments along Hume Avenue and provide Singaporeans with even more convenient access to the Rail Corridor (Central) and Former Ford Factory.

Residents staying near Hume station will enjoy time savings when travelling on the DTL. For instance, residents travelling from Hume will be able to reach Downtown in around 30 minutes on DTL, saving up to 15 minutes of travel time.

The station box for Hume station was completed as part of the second phase of the DTL. Works to fit it out as an operational station commenced in January 2021.

Hume station has two entrances – one entrance facing Upper Bukit Timah Road and the other facing Hume Avenue. To enhance first-and-last mile connectivity to the station, covered linkways have been constructed to provide sheltered access to nearby bus stops and pick-up/drop-off points.

The station will also accommodate 60 bicycle parking lots near the entrances for active mobility users.

Hume station has achieved the BCA Green Mark Gold certification for its green features including a rooftop with solar panels, energy-efficient lighting and a hybrid cooling system.

With the completion of Hume station, DTL has a total of 35 operational stations. Extensions to connect the DTL with the Thomson-East Coast Line and the North-South Line are under construction, and are scheduled for completion in the second half of 2026 and in 2035, respectively.



The platforms at the new Hume station.

Common pain points in steel fabrication and how to solve them

by Dr Thomas Phang, Vice President, Trimble Asia Pacific region



Dr Thomas Phang

The application of digital solutions is the answer.

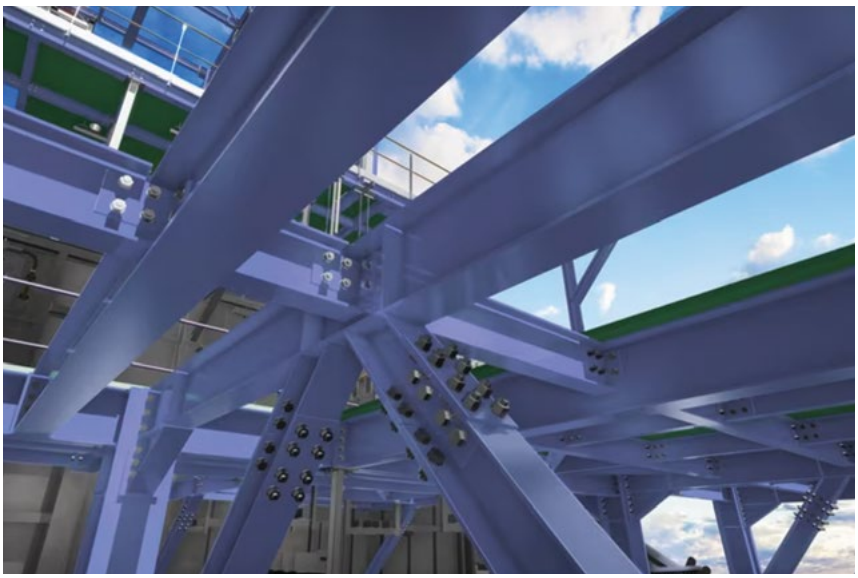
Steel fabrication is an essential process in construction, encompassing the cutting, shaping and assembling of steel components to create structures. While critical in many industries, the fabrication process has long been challenging.

Traditionally, steel fabrication involved manual measurements, reliance on two-dimensional drawings and limited coordination among stakeholders, which often led to costly errors, delays and rework. However, modern technologies, such as digital fabrication, are revolutionising the industry, solving these problems and making steel fabrication more efficient, accurate and collaborative, for construction business owners in Southeast Asia.

The technological advancements provided by digital fabrication have reshaped how steel industry professionals and company owners approach projects. In Southeast Asia, where the demand for steel structures is rapidly growing, digital fabrication is proving to be a game-changer, offering a host of benefits that those in the industry now count as essential.

Digital fabrication refers to the process of using digital technologies to design, model and manufacture components, from materials such as copper, thermoplastics, wood and steel. This includes using computer-aided design (CAD) software, automated machinery and cloud-based collaboration tools.

The keen uptake of this new technology by the steel industry is due to its ability to significantly enhance accuracy, efficiency and cost savings. It is not just a trend but a critical component of modern steel fabrication that helps companies stay competitive in an increasingly complex and demanding market.



Digital fabrication is transforming how steel industry professionals approach their work, from the initial design phase to the final construction and assembly.

Challenges and digital solutions

• Cost and resource overruns: One of the most compelling benefits of digital fabrication is its ability to deliver significant cost savings and optimise resource usage.

Steel detailing produces highly accurate shop drawings, fabrication documents and bills of materials. These documents are essential for ensuring that all components are manufactured to the correct specifications, reducing the likelihood of costly rework.

Precise cutting and shaping of steel components minimises waste and leads to more efficient use of materials. This optimisation is particularly important in regions like Southeast Asia, where the cost of raw materials can be a significant factor in project budgets.

Digital fabrication reduces reliance on manual labour by automating many of the tasks traditionally performed by workers. This automation lowers labour costs and reduces the risk of human error, further enhancing profitability.

• Inaccurate measurements and errors: Even minor measurement errors can result in components not fitting together correctly, leading to rework, delays and increased project costs. Digital fabrication offers unparalleled precision and accuracy, both of which are crucial in the steel industry.

Computer-Aided Design (CAD) software capabilities are essential in projects like high-rise buildings and bridges, where precise modelling of structural elements and connections is critical. Southeast Asia is witnessing rapid

urbanisation, driving large-scale infrastructure construction. The use of CAD in digital fabrication is helping to reduce errors and inconsistencies, leading to safer and more reliable structures.

Detailing automation is a hallmark of digital fabrication. It uses intelligent parametric components that can be customised and reused, making detailing steel faster and easier. This automation maximises productivity by reducing the time and effort needed, as well as the waste produced, to create detailed designs. It also minimises human error by ensuring that all components are consistent and accurate.

Repeatability is one of the key advantages of this technology, as it ensures that every component produced meets the required standards. This is particularly important in projects that require uniformity, such as mass-produced steel components for modular construction. The ability to replicate designs with high precision helps maintain quality across multiple production runs.

- Poor coordination and communication: Steel fabrication projects often involve multiple stakeholders, including architects, engineers, fabricators and contractors. Without proper coordination and communication, there can be misalignments between the design and the fabrication process, leading to delays and errors in the final structure.

Construction software solutions on the market today offer seamless collaboration through integrated communication tools. Contractors should seek a software that allows all stakeholders to access a centralised 3D model which serves as a single source of truth for the project – meaning everyone works from the same real-time information, reducing the chances of miscommunication and misalignments.

- Complex design changes and revisions: Design changes are inevitable in construction projects, but these changes can be particularly challenging in steel fabrication. Managing revisions to shop drawings, fabrication documents and bills of materials can be time-consuming and is prone to error, especially when using traditional methods.



Using software solutions for the steel fabrication process can significantly enhance design accuracy and facilitate error detection.

Streamlined digital workflows enable more efficient integration of the various stages of steel manufacturing and assembly, as well as overall project design. This integration reduces the time spent on each stage of the process, allowing projects to be completed more quickly. The construction industry is no stranger to pressure to meet tight deadlines, so this efficiency is a critical advantage.

The capability for rapid prototyping using digital fabrication technologies results in faster testing and shorter lead times. This is particularly beneficial in large-scale projects, where delays can be costly. For example, in the development of new industrial complexes in countries like Vietnam, rapid prototyping allows for quicker iterations and refinements, ensuring that the final product meets all specifications and sustainability standards.

Embracing technology for a smoother steel fabrication process

Steel fabrication is a complex process with many potential pitfalls, from measurement errors to communication breakdowns. However, the right technology can help minimise or eliminate these challenges. Contractors should look for a comprehensive digital solution that addresses the most common pain points in steel fabrication, from ensuring accurate measurements to facilitating collaboration and simplifying design revisions.

Digital fabrication offers substantial benefits for steel industry professionals as they work to meet the rising demand for efficient, sustainable and cost-effective construction solutions. The enhanced precision and accuracy provided by digital tools, combined with the increased efficiency and speed of automated processes, result in significant cost savings and resource optimisation.

As the steel industry continues to evolve, embracing digital fabrication will be essential for staying competitive and meeting the growing demands of the construction sector. By leveraging these technologies, business owners can ensure they deliver high-quality, reliable structures that meet the needs of today and tomorrow.

Future-proofing Singapore's construction industry

by Avtandil Mekudishvili, ASEAN Regional Lead at PlanRadar



Mr Avtandil Mekudishvili

Embracing technology with the 2025 budget.

Singapore's construction industry is poised for steady growth through 2025, driven by both public and private sector demand, technological advancements and a shift towards sustainability.

In 2025, the industry is expected to expand by 4.1% in real terms, supported by a rise in the total value of construction contracts and significant investments in critical infrastructure such as transport, housing and clean energy projects. This projection is underpinned by a robust pipeline of public sector projects, including significant infrastructure developments such as Changi Airport Terminal 5 and the Cross Island MRT Line.

The sector is also navigating the effects of global economic shifts, including tariffs and disruptions in supply chains that have led to increased material costs. Domestically, the construction industry is addressing challenges such as workforce shortages and the urgent need to meet sustainability goals.

Singapore's push for a digitised construction industry

In Singapore's Budget 2025, the government has reaffirmed its commitment to accelerating the digital transformation of the built environment. This marks a pivotal shift away from manual, paper-based project management towards more streamlined, tech-driven solutions. With an increasing focus on smart infrastructure, digital tools are becoming essential for construction firms looking to reduce inefficiencies, improve safety and meet the rapidly evolving demands of the market.

Government-backed AI and cloud initiatives will play a crucial role in helping construction firms overcome traditional barriers to tech adoption, such as high costs and limited expertise. These efforts are part of Singapore's broader push to modernise the construction sector and ensure that it is prepared for the future.

Why construction firms need to act now

With government funding and AI integration initiatives on the rise, construction firms can no longer afford to delay tech adoption. In particular, AI-powered project management tools, alongside innovative construction tech, will be key to staying competitive. As Singapore moves towards smarter, tech-driven infrastructure, early adopters will gain a significant edge in securing high-value projects, reducing project delivery times and enhancing the overall efficiency of their operations.

Digital solutions are no longer optional, they are becoming a necessity for construction firms. The industry must act swiftly to capitalise on these emerging technologies, in order to thrive in a highly competitive market.

How can construction firms make best use of the funding?

To make the most of the funding opportunities available under Budget 2025, construction firms should focus on adopting AI-powered solutions, investing in workforce training and streamlining their digital infrastructure. The government's ongoing support for digital transformation provides an excellent opportunity for firms to integrate advanced technologies that can improve project outcomes, boost productivity and reduce costs.

Additionally, firms should look at how cloud-based systems, AI and Building Information Modelling (BIM) can optimise project planning, increase collaboration and provide real-time data insights, to improve decision-making and efficiency.

Why timely action is needed in 2025

The construction sector is at a critical juncture. Strategic support, particularly from the government, will help to position the sector to meet emerging challenges and seize new opportunities. With global factors, such as supply chain disruptions and domestic issues, including manpower shortages, continuing to impact the industry, it is essential that firms take advantage of available funding and technological advancements to build resilience.

In particular, firms that invest in AI-powered technologies now will be better equipped to meet the demands of high-profile infrastructure projects like Changi Airport Terminal 5 and the Cross Island MRT Line, while also advancing sustainability goals, in line with the nation's 2030 Green Plan.

Ensuring growth and innovation

As Singapore's construction industry moves forward with the 2025 budget, several key areas of focus are critical for ensuring growth and innovation. These include:

- Increased funding to support digital infrastructure and technological innovation.

• Tax incentives or subsidies for the adoption of sustainable materials and processes.

• Expanded workforce training programmes focused on advanced construction technologies to address the skills gap.

Additionally, the government is expected to allocate resources to strengthen supply chain resilience, thereby providing critical support in the face of global disruptions. For small and medium-sized enterprises (SMEs) that make up 90% of Singapore's businesses, financial incentives may be introduced to help them adopt new technologies, particularly those that support green construction practices.

Utilising technology to change the game

Technology is playing a crucial role in solving some of the most pressing challenges facing the construction industry, such as workforce shortages, rising costs and supply chain disruptions.

• Addressing workforce shortages: Tools, like BIM, streamline the design, planning and coordination processes, reducing manual intervention and increasing productivity. AI-powered automation can also handle routine tasks, allowing skilled workers to focus on more complex, high-value activities.

• Reducing costs: BIM's ability to simulate project scenarios and visualise potential cost-saving opportunities early can help reduce expensive design errors and optimise material usage. AI can also improve budget forecasting and resource allocation, reducing the risk of unexpected cost overruns.

• Managing supply chain disruptions: BIM's detailed material tracking capabilities improve procurement planning, while AI-driven predictive analytics allow firms to proactively adjust schedules or source alternatives. This technology ensures that construction firms can maintain smooth operations despite global supply chain challenges.

A smarter and more resilient construction sector

Embracing transformative technologies is now a pressing necessity for Singapore's construction industry. With the government's commitment to driving digital transformation through Budget 2025, construction firms must act quickly to integrate AI and other innovative technologies. This will enable them to remain competitive, meet the demands of the future and contribute to building a smarter, more resilient infrastructure for Singapore in 2025 and beyond.

(PlanRadar is a leading platform for digital documentation, communication and reporting, in construction, facility management and real estate projects. https://www.planradar.com/)

Graphisoft strengthens presence in Southeast Asia

Graphisoft, a global leader in Building Information Modelling (BIM) software for the architecture, engineering, and construction (AEC) industry, is set to deepen its impact in Southeast Asia, driven by surging demand for advanced digital tools amidst the region's rapid development and growing focus on sustainable construction practices.

"Southeast Asia is a growth powerhouse for the construction industry and is poised to be one of the most dynamic regions in the next 20 years. While Japan is experiencing rapid growth, Southeast Asia remains a key focus for us, with its significant potential and opportunities. We are excited about the opportunities here and remain committed to strengthen our presence," said Mr Daniel Csillag, Chief Executive Officer, Graphisoft.

Established in 1982 by Hungarian architects and mathematicians, Graphisoft has grown globally. Often called the ancestor of BIM, it has over 200,000 users worldwide and 25 offices across 14 countries.

At the heart of Graphisoft's success is its flagship product, Archicad, a leading 3D architectural design software. Archicad was honoured as BIM Product of the Year 2024, at the prestigious Construction Computing Awards (The Hammers), marking its 14th consecutive win in the category.

Archicad offers an intuitive interface and powerful tools that streamline design documentation, one-click publishing, photo-realistic rendering, and advanced analysis, allowing architects to focus on creativity.

Graphisoft's confidence in Southeast Asia is bolstered by its strong positioning and recent success stories, including its role in the iconic Merdeka 118 skyscraper – the world's second-tallest building – standing as a testament to Archicad's capabilities.

The project exemplifies how Graphisoft's innovative solutions empower architects and engineers to deliver groundbreaking designs while preserving cultural significance and meeting stringent sustainability goals.

Graphisoft's growth plan in Southeast Asia is supported by a robust network of partnerships designed to meet the unique needs of the local markets.

Unlocking the potential of digitalisation with networked construction

Making the industry more efficient, more transparent and more sustainable.

Digitalisation and networking are seen as effective measures that help get a grip on the major challenges facing the construction industry.

In view of this significance, bauma 2025 has added 'Networked Construction' to its key topics.

bauma 2025, the World's Leading Trade Fair for Construction Machinery, Building Material Machines, Mining Machines, Construction Vehicles and Construction Equipment will be held from 7 to 13 April 2025, at Trade Fair Center Messe München.

Smart attachments with standardised digital language

In networked construction, digital technologies and communication systems are integrated into the construction process, which improves collaboration and efficiency.

For example, attachments supply process data and communicate with the respective carrier machines. A standardised digital language is required for this communication, that will also work regardless of the manufacturer. The foundation for this was laid by the MiC 4.0 BUS protocol which won the Innovation Award in the field of digitalisation, at bauma 2022, the previous edition of the event.

Version 1.0 of the protocol is now freely available with full functional security. Thanks to the common universal protocol, the carrier machine recognises which attachment is to be used, which parameters it needs, to function, and whether the attachment is suitable for use on the machine.

"Accidents caused by incorrectly closed quick hitches, unsuitable hydraulic pressure or incorrectly dimensioned attachments can thus be reliably avoided," reports Dr Darius Soßdorf, Managing Director of the MiC 4.0 working group at the German Mechanical Engineering Industry Association (VDMA). The working group includes manufacturers of construction machinery and sensors, software companies and construction firms.

Bidirectional information flow between construction machine and user

Through the advancing digitalisation of construction machinery, users receive increasing amounts of data which not only show them the condition of the machines, but also provide valuable information on their performance and work quality.

For example, more efficient fuel routes can be developed on the basis of current consumption data, while machine deployment can be optimised by accurately recording the respective capacity utilisation.

A new function of the telematics system from the manufacturer, Bobcat, shows that the information flow does not have to be a one-way street – just from the machine to the operator. The engine of wheel loaders, mini excavators etc can be remotely deactivated and also reactivated, by the owner, with just a few clicks. This prevents unauthorised use and theft, which can result in lower insurance premiums, among other things.

Valuable support for machine operators

On the basis of digital information, and given the shortage of skilled workers, even less experienced machine operators can avoid slight errors and accidents, and achieve good work results.

For example, the construction machinery manufacturer, Develon, formerly known as Doosan Construction Equipment, together with surveying specialist, Leica Geosystems, recently started offering 3D machine control as a retrofit option for one of its crawler excavator models. Design information and real-time cut/fill indications are displayed on the control panel in the cab, so that the driver can carry out the excavator work exactly according to the reference model.



Networked Construction is one of the key topics of bauma 2025. Image: Messe München GmbH.

Sensors connect the physical and virtual world

Sensors are a prerequisite for the digitalisation of construction machinery, including developing assistance and autonomy systems.

For example, they register the boom and bucket position, are used for fluid management, or help detect structural loads and damage. One of the biggest challenges for using sensor technologies in the construction machinery industry is often the harsh working environment, which is why manufacturers like Baumer are developing extremely robust sensors specifically for use in mobile machines.

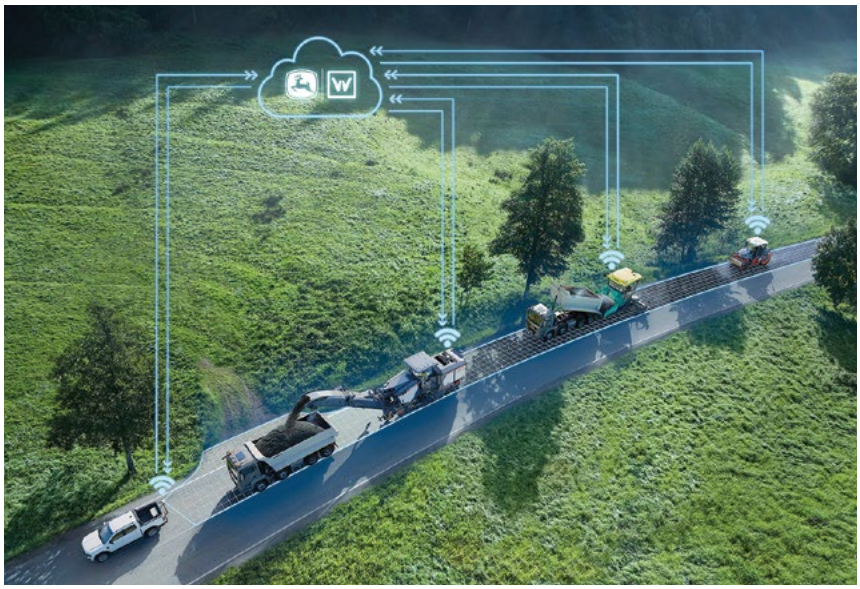
Special material, design and test concepts ensure that the data required for digitalisation flows even under the toughest operating conditions.

Smart automation in roadbuilding

More precise asphalt reclamation and paving.

Digital terrain models used for controlling machines are characterised by accuracy, predictability and precise compliance with target values.

They simultaneously present a number of challenges, in practice, such as additional outlay for the registration and provision of data, the need for planning and skilled personnel for operating machines with 2D/3D machine control systems and for the installation of surveying/measuring equipment on the construction site. Also, the low data transparency leads to reservation on the part of machine operators, when faced with complex technologies.



The Wirtgen Group solution 'Smart Automation in Roadbuilding' has been nominated for the bauma Innovation Award 2025 in the category 'Digitalisaton'.

All from a single source

With Smart Automation in Roadbuilding, the Wirtgen Group provides new digitalisation and automation solutions for asphalt rehabilitation, that enable easier utilisation of the advantages of digital terrain models and the solution of challenges in practice.

The key components are the Work Planner as a digital tool in the John Deere Operations Center, Smart LEVEL PRO for automation of the milling depth and cross slope on Wirtgen F-series large milling machines and Smart Pave for automatic control of the screed position – i.e. steering and screed width adjustment – in the case of the Vögele Dash 5 compact class tracked pavers.

Milling process

Planning data that can be generated by all commonly used surveying and planning software solutions is made available in the Work Planner via an open interface. A model of the existing area and a model of the area to be milled are required for the automatic control of the milling machines.

The Work Planner analyses and checks whether the data is usable for the automation process. Parameters such as the milling area, milling volume as well as minimum, maximum and average milling depths are displayed directly on the screen. The distribution of the different milling depths in the course of the project is also visualised.

Asphalt paving

For automated asphalt paving, three lines, defining the steering line and the two outer edges of the project area, are provided to the Vögele pavers. This enables the realisation of considerably tighter tolerances in the paving process. The Work Planner shows users a clear overview of the area, length and orientation of the paving project.

A map-view option enables personnel without a background in surveying to easily localise and check the project. Site managers, surveyors and resource planners benefit from the transparency of the data, its practicability and the expected final result, prior to the start of the paving project.

Connectivity

For the realisation of a project, the data can be shared with other contractors or transmitted to freely selectable machines from the operator's own connected fleet, via cellular communication. The machine control systems are already fully integrated in both road pavers and cold milling machines and require no installation of additional components. Localisation of the machines with the necessary accuracy is enabled by a GNSS receiver with an RTK correction signal.

Ease of operation

The operating concept is simple. All the machine operator has to do is choose the desired control mode on the familiar control screen. The Live-View of project data enables the operator to know which mode the machine is in and what actions and control commands can be expected.

Strengthening a historic Victorian-era landmark in Canada

Composite systems and carbon fibre cords for the work carried out on McGill University's Strathcona Music Building.



An exterior view of the Strathcona Music Building.

To the casual observer, the Strathcona Music Building is a sturdy landmark anchoring the eastern flank of McGill University's Montreal campus. Like the grim-faced statue of Queen Victoria peering out from the entrance's front steps, the building has kept calm and carried on over 120 years of Montreal winters, its façade routinely adorned with large icicles hanging from its many ledges.

Built in 1896, the imposing gray limestone edifice – originally named the Royal Victoria College for girls by Lord Strathcona – was last renovated in 1971, when it was given to McGill University. The building was then rechristened with its present name and became home to the university's Schulich School of Music and Pollack Hall. Today, it stands as one of the busiest cultural venues in the city, holding some 700 concerts and other events annually.

"Masonry was sometimes used as structural elements," explained Hamza Ouziame, Engineering and Architectural sales representative, Mapei Canada Inc.

Upon surveying the Strathcona's interior walls in the spring of 2022, Ouziame and Luca Albertario, Regional Product Line Manager for the Building line, Mapei Group, found that the walls were composed of terracotta bricks dating from the 19th century.

These walls would certainly require extra strengthening to maintain their structural integrity.

"The engineers were looking for a fibre-reinforced polymer (FRP) solution and were happily surprised to find Mapei has a fibre-reinforced cementitious matrix (FRCM) option designed for masonry," Ouziame said.

This option was a perfect fit for the job at hand.

A complete structural strengthening system

The FRCM system for structural strengthening is centred on MAPEGRID G 220, an alkali-resistant, glass fibre mesh that is applied with PLANITOP HDM MAXI pozzolan-reaction, fibre-reinforced mortar.

When applied on masonry structures, MAPEGRID G 220 makes up for the structure's lack of shear and tensile strength and increases the structures overall ductility, so that stresses are distributed more evenly. In this project, the system was used to enhance the masonry walls' wind and seismic loads.

"MAPEGRID G 220 is the main product, but it requires a matrix. PLANITOP HDM MAXI mortar is compatible with masonry. Unlike an epoxy mortar, it allows breathability. It has a low modulus of elasticity and together with its moderate compressive strength, the products combine to work better with masonry than a FRP system. MAPEWRAP C FIOCCO carbon fibre cord is added to assist the long-term bond of the system for the interior," Ouziame explained.



The FRCM-based system used in this project is centred on MAPEGRID G 220 alkali-resistant, glass fibre mesh that is applied with PLANITOP HDM MAXI fibre-reinforced mortar.

Preparing the substrates

Following the engineering team's assessment, damaged bricks were identified that had to be replaced and repointed, after which MAPEI STEEL DRY 316 helical stainless-steel bars were inserted for local reinforcement.

"Repointing can speak to replacement of a brick or a joint and changing out parts of the substrate that were at the point of failure," Ouziame said.

Workers also cleaned the bricks to remove efflorescence and dirt. PLANITOP 23 fibre reinforced cementitious repair mortar, which is manufactured and distributed on the Canadian market by Mapei Canada Inc, was then used to smooth the wall surface in specified areas.

Applying the FRCM system

ELASTOCOLOR PRIMER WB, a water-based acrylic primer distributed on the Canadian market by Mapei Canada Inc, was applied to saturate the masonry in preparation for the FRCM application.

Once the first layer of PLANITOP HDM MAXI was applied, the MAPEGRID G 220 structural mesh was added with a 15 cm overlap between the bands, followed by a second layer of PLANITOP HDM MAXI. Then, a second and final layer of MAPEGRID G 220 mesh was added with the same overlap, followed by a third and final layer of PLANITOP HDM MAXI. Each layer of PLANITOP HDM MAXI was at 5 mm to 6 mm thickness.

A few products for buildings, again distributed by Mapei Canada Inc on the Canadian market (MAPECEM 100, MAPECEM QUICKPATCH and PLANITOP 25), were also used to level and patch the floor slab where required.

Using the same FRCM system, the strengthened walls were then connected to levelled slabs for structural continuity.

The final stage of the strengthening started by marking insertion points for 10 mm MAPEWRAP C FIOCCO





The structural strengthening system chosen for the project involved applying MAPEWRAP C FIOCCO carbon fibre cords spread out in a 360° star formation.

carbon fibre cords as anchoring rope, about 1 m apart. Holes were drilled at each of these spots and filled with MAPEWRAP 12 moisture-tolerant, structural epoxy putty. The anchoring ropes were impregnated with MAPEWRAP 21 epoxy resin and broadcast with MAPESAND COARSE sand, 24 hours before insertion. MAPEWRAP 12 was also applied around the inserted MAPEWRAP C FIOCCO carbon fibre cords as they were spread out in a 360° star formation.

Finally, MAPEWRAP 21 was used to encapsulate the system fabrics by incorporating the wet-layup technique to saturate and encapsulate the fibre fabrics by way of mechanical saturation and to cure to a high-performance laminate. Once cured, the laminate provided additional strength to the structural elements, thereby completing rehabilitation of the building envelope.

The Strathcona Music Building has seen the waning days of Queen Victoria's reign and made it all the way through the 70-year reign of Queen Elizabeth II. It is certainly a tribute to history that this landmark institution is now poised to carry on its own legacy well into the future.

This editorial feature is based on an article from Realtà MAPEI INTERNATIONAL ISSUE 104. Images by Mapei.

PROJECT DATA

Project
McGill University's Strathcona Music Building, Montreal, Quebec, Canada

Year of construction
1896

Owner
McGill University

Main contractor
Atwill-Morin

INTERVENTION BY MAPEI

Year of the Mapei intervention
2022

Structural engineer
Elizabeth Darveau, WSP

Contribution by Mapei
Supplying products for structural strengthening and concrete repair.

Application of Mapei products
Preparing substrates – ELASTOCOLOR PRIMER WB**, MAPEI STEEL DRY 316

Repairing concrete – MAPECEM 100**, MAPECEM QUICKPATCH**, PLANITOP 23**

Structural strengthening – MAPEGRID G 220, MAPESAND COARSE**, MAPEWRAP 12, MAPEWRAP 21, MAPEWRAP C FIOCCO, PLANITOP 25**, PLANITOP HDM MAXI

(**These products are manufactured and distributed on the Canadian market by Mapei Canada Inc)

Website for further information
www.mapei.com
www.mapei.com/sg

(Some products are available in Singapore. Please contact customer service at Mapei Far East for the available products.)

CO_2 reduction in waste management

The deployment of an all-electric material handler contributes to sustainability.

The Vanheede Environment Group in Belgium is engaged in the pursuit of sustainable innovation in waste management.

The company is more than just a waste disposal service provider. With a progressive approach to waste management, material recovery and green energy, Vanheede makes an important contribution to the circular economy – 98.4% of the waste collected is already recycled or diverted for useful applications. This is a proportion that Vanheede is constantly increasing through continuous investment.

In line with this sustainability strategy, the company relies on the all-electric SENNEBOGEN 825 E material handler at its Rumbeke site.

Vanheede is setting the course for even more efficient recycling with a state-of-the-art sorting plant at the Rumbeke site. The plant processes up to 100,000 tons of residual waste annually and can separate eight waste streams.

Operations Manager, Tom Maroy, explains, "The new Vlarema guidelines require precise sorting – simple handling is no longer enough."

The precise separation of the waste streams produces purer material fractions that can be fed directly back into the circular economy. These high-quality secondary raw materials open up new applications for Vanheede and external processors.

Advanced sorting technology for raw material recovery

Since February 2023, the SENNEBOGEN 825 E electric material handler, with its 14 m reach and 32.8 t operating weight has been supporting the new sorting plant and is a prime example of sustainable technology. The electric material handler not only contributes to CO_2 reduction, but also saves up to 40% of operating costs compared to diesel-powered models.

"With its long service life and low maintenance costs, the 825 E is ideal for us," says Lucas Ossieur, Fleet Manager at Vanheede.

The decision to opt for an electric appliance fits in seamlessly with Vanheede's goal of reducing its CO_2 emissions in all areas of operation. If 100% of the electricity used to operate the electric machine comes from renewable energy sources, the machine can save around 106 t of CO_2 per year in a two-shift operation.

Another advantage is that the environmentally friendly operation in the production hall protects the health of the employees who enjoy emission-free air quality in the workplace.

A partner with experience and reliability

The cooperation with SMT Belgium, which supplied the SENNEBOGEN 825 E, guarantees reliable service and fast response times – essential for the smooth operation of plants with critical goods.

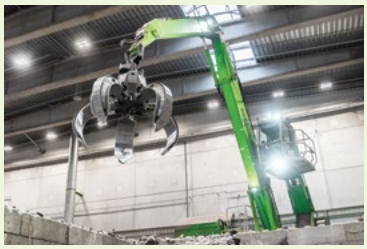
"We know that the service is right when quick help is needed. SMT gives us the assurance that our excavator will always be ready for use," emphasises Ossieur.

Safety of employees

The SENNEBOGEN 825 E is not only efficient, but also safe. The elevated cab position offers the operator an optimum view of the filling line, making work particularly precise and safe. The cab itself is pressurised and equipped with a Hepa filter to protect the driver from harmful particles in the air.

A pane of bulletproof glass protects against potential hazards from gas cylinders and ensures a safe working environment – a point that is crucial for Vanheede.

Since its commissioning in February, the SENNEBOGEN 825 E has already completed over 1,000 operating hours and is now preparing to switch to two-shift and later even three-shift operation.





The electrically powered 825 E material handler ensures emission-free operation.

Crawler crane lifts bridge components weighing up to 280 t

The machine is a key appliance in a complicated bridge demolition process.

After many years of preparation, experts at the construction company Max Wild in Berkheim bei Memmingen in Germany, the crane hire company Emil Egger from the Swiss city of St Gallen, the building authority of the City of Hanau in Germany, Deutsche Bahn and other stakeholders completed the concept for the demolition of the Eisenstrassenbrücke, which had been built in 1959, at the western end of the main railway station in Hanau. In the week before Christmas, work commenced and the first section of the bridge was demolished.

The complicated demolition process was being carried out by Max Wild, in two stages, with its crane partner, Emil Egger, from Switzerland. Railway tracks had to be closed and overhead lines dismantled. A temporary bridge was installed, diversions set up and hundreds of other trades, institutions and specialists prepared for the major demolition job.

The demolition began in early December 2024. Visible proof of the efforts was the assembly of the LR 1700-1.0 from Liebherr, with a weight of 900 tonnes and a 60 m long main boom, as well as a 36 m long derrick boom. It arrived on 38 trucks and was erected and calibrated by three experienced Egger crane professionals and a 120 t telescopic crane, in just three days.

Ensuring stability were the 50 tonnes of central ballast, 150 tonnes of revolving platform ballast and the large suspended ballast.

The first dismantling phase was scheduled for completion by 31 December 2024 and consisted of 15 lifts totalling 4,000 tonnes of material. Demolition by means blasting or hydraulic hammers was ruled out due to the surroundings and the sensitive railway structure.



Egger's LR 1700 in the dismantling of the road bridge at Hanau's main railway station. The 78 t bridge section is already lashed and is being dismantled using a band saw.

Max Wild decided to saw out the individual segments, each weighing between 70 t and 280 t. After the installation of the LR 1700-1.0, the work really began.

The team laboured round-the-clock. During sawing, the bridge section to be cut out was attached to the LR 1700-1.0 with lifting straps and chains. The lifting gear was under tension, as the load was only released and suspended from the crane's hook when the last saw cut had been completed.

The LR 1700-1.0 is characterised by high sensitivity. Further, assembly and dismantling can be completed in just a few days, with a 130-tonne auxiliary crane, thanks to the accuracy of fit, the simple plug-in connections and the clear erection guidelines.

There were and still are plenty of unpredictable aspects to the job, as the 38 trucks carrying the components of the Liebherr LR 1700-1.0 crawler crane had to travel backwards under the bridge structure to the assembly site.



Lifting straps and sling chains are carefully prepared for lifting the 78 t bridge section.

The crane has been there since mid-December, with the second



Night working: the sawn-free bridge element floats on the hook and is moved with a 180° slew to the dismantling site.

part of the assembly, involving a further 16 lifts, scheduled to begin in the second half of February. Equipped with 60 m of main boom and 36 m of derrick boom with 2 x 8-fold reeved rope (winch 1 and 2), the LR 1700 is suitable for this sensitive bridge demolition.

In the first dismantled section, the heaviest part weighed 280 t. To handle this, an additional 375 t of suspended ballast had to be added on. The challenge with this was that the boom had to be luffed as soon as the component was released and hung on the hook. The crane then had to move back a few metres and then slew through about 180°, to gently place the bridge component on the dismantling site.

The LR 1700-1.0 from Liebherr is the second-largest crane in Switzerland and also the second-largest in the Egger fleet, after the LR 11000.

Construction work and assembly work, especially on bridges, buildings and industrial structures, as well as loading in harbours, are the bread and butter business for the LR 1700.

EMIL EGGER Group

The EMIL EGGER Group has 11 locations and 800 employees across Switzerland, and boasts many years of experience in the logistics industry as well as a strong focus on customer service. The company specialises in complex general logistics services, from warehousing to heavy-duty assembly.

The crane fleet, which has 50 machines, spans all types of telescopic and crawler cranes, as well as specialist cranes and jacking systems. The LR 11000 is the most powerful crane in Switzerland. The family-run company has been relying on products from the Liebherr Group since 1981.

Liebherr-Werk Ehingen GmbH

Liebherr-Werk Ehingen GmbH is a leading manufacturer of mobile and crawler cranes. Its range of mobile cranes extends from 2-axle, 35 t cranes to heavy duty cranes with a lifting capacity of 1,200 t and a 9-axle chassis. Its lattice boom cranes, on mobile or crawler travel gear, deliver lifting capacities of up to 3,000 t. With universal boom systems and extensive auxiliary equipment, they can be seen in action on construction sites throughout the world.

The Ehingen site has a workforce of 5,000. An extensive, global service network guarantees the high availability of Liebherr mobile and crawler cranes.

Liebherr Group

The Liebherr Group is a family-run technology company with a highly diversified product portfolio. The company is one of the largest construction equipment manufacturers in the world. It also provides high-quality, user-oriented products and services in a wide range of other areas. The Liebherr Group includes over 150 companies across all continents. In 2023, it employed more than 50,000 staff.

Liebherr was founded by Hans Liebherr in 1949 in the southern German town of Kirchdorf an der Iller. Since then, the employees have been pursuing the goal of achieving continuous technological innovation, and bringing industry-leading solutions to its customers.

Breakthrough for one of the 'Seven Engineering Wonders of the Modern World'

Executing a project with a high level of complexity.

The Chesapeake Bay Bridge-Tunnel is a 37 km long structure of bridges and tunnels for motor traffic. Near the city of Norfolk and the adjacent naval base in the US state of Virginia, it connects the Hampton Roads region with the Delmarva Peninsula (part of Delaware, Maryland, Virginia).

A previous bottleneck is now to be eliminated. At the end of January, a tunnel boring machine (TBM) from Herrenknecht achieved a breakthrough for a tunnel that will contribute to this in the future.

The Chesapeake Bay Bridge-Tunnel (officially known as the Lucius J. Kellam Jr. Bridge-Tunnel) has been one of the largest structures of its kind since it opened in 1964. Bridges and tunnels alternate between four artificially raised islands, over a length of 37 km.

Four million vehicles a year pass through the bridge-tunnel in a northerly or southerly direction. Following its opening in 1964, it was named one of the 'Seven Engineering Wonders of the Modern World'. In 1965, it was awarded the 'Outstanding Civil Engineering Achievement', by the American Society of Civil Engineers.

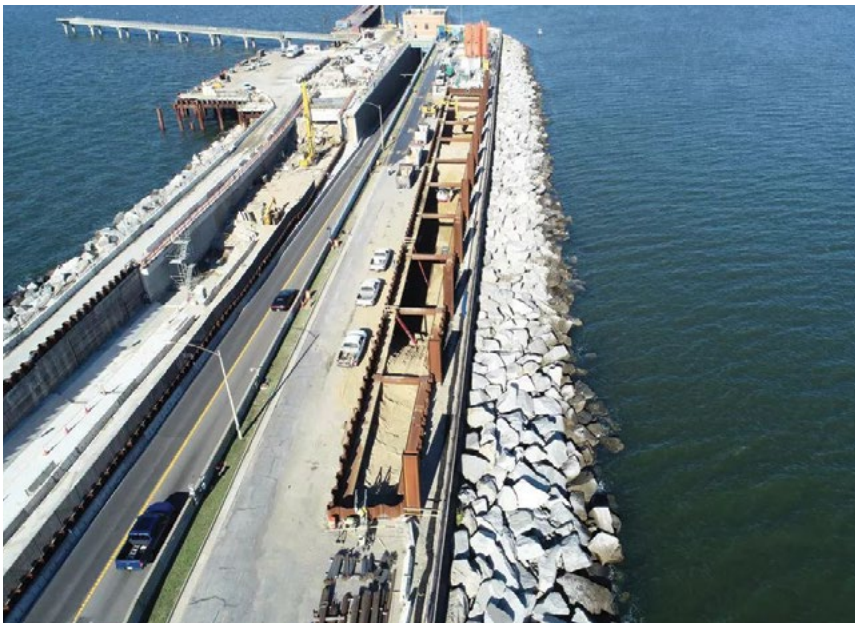
Since 1999, large sections have been widened from two to four lanes – there is a separate bridge with two lanes for each direction of travel.

The Thimble Shoal Tunnel, which passes under a shipping channel, has been a bottleneck. For a distance of around 2 km, traffic is reduced to two lanes, one in each direction, to pass through the tunnel. This is set to change from 2028.

A major milestone for the expansion has now been reached. The new parallel Thimble Shoal Tunnel has been fully excavated using a TBM. The next step is to line the road in the new tunnel.



The big moment: breakthrough for the Parallel Thimble Shoal Tunnel.



Bridges and tunnels merge in the area of the islands. One of the islands was also the starting point for the Thimble Shoal Tunnel.

TBM 'Chessie'

The construction company, a joint venture between Dragados USA and Schiavove Construction Company LLC, relied on a TBM from Herrenknecht to build the approximately 2 km long tunnel.

A so-called Earth Pressure Balance (EPB) shield, with a diameter of 13,210 mm, a drive power of 7,000 kW and 46,183 kNm of torque, was used. The EPB

technology, with its earth pressure support, is designed for comparatively soft, fine-grained soils and medium earth and water pressures, such as those found when crossing sea floors and rivers at shallow depths.

The TBM for the Chesapeake project was given its fitting nickname in a naming competition in the Hampton Roads region. Since then, it has been called 'Chessie'.

Special demands were placed on Chessie. It had to be designed to be particularly robust, especially in the area of the excavation tools, in order to minimise the need for compressed air entries, as much as possible. One challenge, at the start and end of the advance, was the low overburden in the area of the man-made islands where large boulders can also be found.



TBM 'Chessie' at the Herrenknecht plant in Schwanau, Germany.

Joint project success

All in all, Chessie was nine months in charge of tunnelling the almost 2 km long route. There was a delay at the beginning. An old, ship's anchor, 3 m high and weighing several tons, near the starting shaft in the area of the first island, was stuck in the ground. Since this had to be recovered, it held up the advance.

But the highly experienced joint venture, supported by the Herrenknecht service team, found a solution, by cuting and removing the anchor directly in front of the cutting wheel, while the TBM was standing in a special seal block construction.

The spoil from the tunnel construction site was loaded onto ships via a belt conveyor from the Herrenknecht subsidiary, H+E Logistics, and transported away by water.

Before the TBM was handed over to the customer for assembly, with the support of Herrenknecht Service in the US, two project managers from Herrenknecht worked on it simultaneously.

Michael Kimmeskamp, Member of the Management Board of the Traffic Tunnelling division, Herrenknecht, said, "The project was very challenging for us and required a high degree of problem-solving expertise, but together with the customer we overcame all the challenges. The efficiency achieved as a result and the very positive feedback from the customer show once again that service starts with project management."

Steffen Dubé, President and General Manager of the Herrenknecht subsidiary in the US, said, "Not every project is the same. With the Chesapeake Bay Bridge Tunnel, we unavoidably had to deal with a high level of complexity. We made up for it through the customer's trust and an extra level of service."

On the day of the breakthrough, John Hellman, Project Executive of the joint venture, said in a statement, "Today was a monumental day for the Chesapeake Tunnel JV team, a Dragados and Schiavone joint venture. Our TBM 'Chessie,' a Herrenknecht TBM, broke through the headwall to complete the tunnel drive for the Parallel Thimble Shoal Tunnel for the Chesapeake Bay Bridge-Tunnel."

"This new tunnel will help ensure that commuters travelling between Virginia Beach and coastal eastern Virginia experience less congestion and a safer trip," he added.

PROJECT DATA

Project
Chesapeake Bay Bridge-Tunnel – Thimble Shoal Tunnel

Client
Chesapeake Bay Bridge-Tunnel (CBBT)

Contractors
Chesapeake Tunnel Joint Venture – Dragados and Schiavone

Application
Road

Drive length
1,936 m

Geology
Sandy shelly clay, fine to coarse sand, silt

MACHINE DATA

Machine type
EPB Shield

Diameter
13,210 mm

Cutterhead drive power
7,000 kW

Torque
46,183 kNm

The new generation of MAXIMO Panel Formwork

PERI, one of the largest manufacturers and suppliers of formwork and scaffolding systems, has introduced the new generation of MAXIMO Panel Formwork which has been well-known, for decades, for its efficient handling and minimal manpower requirements.

The new generation of MAXIMO combines proven strengths with new, innovative features that make work on the construction site even more user-friendly, safer and more sustainable.

The single-sided wall formwork combines familiar selling points, such as the Alignment Coupler BFD that can be used with one hand, the fast MX Tie Technology without spacer tubes and cones, and a concrete surface in architectural concrete quality, along with sophisticated new functions.

The new generation of MAXIMO Panel Formwork redefines durability and sustainability standards. The innovative coating PERIskin provides comprehensive corrosion protection for the steel frame. Additionally, the polypropylene-coated ROBU B Formlining is designed for increased reuses, significantly reducing maintenance costs and optimising upkeep.

Ergonomic handles and RFID Tags simplify handling and the comprehensive recording of product information. In addition, the new components are 100% compatible within the existing MAXIMO System.

Sustainable corrosion protection and sophisticated design

The PERIskin Corrosion Prevention System completely encases the MAXIMO Elements, including hard-to-reach cavities, providing comprehensive protection. The electroless coating is applied at room temperature and significantly reduces the CO_2 footprint in production, compared to conventional processes. Combined with the new, optimised frame profile in an innovative design, MAXIMO offers increased durability and ease of cleaning.

User-friendliness

With the new bone strut, new as well as existing accessories can be flexibly attached, as well as components from the PERI UP Scaffolding Kit. The new ergonomic positioning handles ensure easier handling for every project.

Thanks to their user-friendly arrangement, the MAXIMO Panels can be positioned precisely and effortlessly. This optimisation is complemented by the enlarged area of the levering corner, which makes deshuttering with the lifting bar even easier and more efficient.

Optimum concrete appearance and digital efficiency

Customers can choose between the proven FinPly Formlining and the new ROBU B Hybrid Formlining which combines the advantages of wood and polypropylene panels.

In addition, the MAXIMO Panels are equipped with integrated RFID Tags as standard, which enable quick access to all relevant product information using the appropriate PERI App.



The new generation of MAXIMO combines proven strengths with new, innovative features. Images: PERI SE.

Caterpillar introduces the Cat MH3032 Material Handler

Caterpillar is strengthening its line-up of material handlers with the launch of the Cat Next Generation MH3032 Material Handler.

Positioned to plug the gap between the MH3026 and MH3040, both already on the next generation platform, the new MH3032 calls on the same criteria to deliver performance, durability and reliability, in a 30 MT technology-driven design.

With a near-15 m reach, the MH3032 is available with both drop-nose and straight-stick options, for maximum configurability. Typical scrap materials are no challenge for the standard Cat orange-peel grapple with its 1 m³ capacity, while a 20 kW generator option puts magnet attachments into play for even greater on-site versatility.

Ease of operation and optimum productivity are provided by Cat Payload, the built-in technology that allows operators to see how much they are lifting in each load and to constantly monitor tonnage output.

Also fitted as standard on the MH3032 is Cat 2D E-fence, which keeps the arm within a predefined work area, away from the elevated cab, providing greater operator confidence while protecting the machine from damage and helping improve site safety. This is combined with a new Swing Assist feature which automatically stops the swing motion at an operator-defined preset point.

Technologies like these not only help reduce the operator fatigue associated with repetitive tasks but also help improve site safety. Optimised movements also mean incremental improvements to time and fuel consumption.

The safety theme continues into the dedicated Material Handler cab, where an in-cab monitor displays dual external camera views to maximise visibility and hazard awareness.



The Cat MH3032 Material Handler is said to deliver performance, durability and reliability.

Although the MH3032 joins the material handler line-up as a completely new model, it uses proven components common to the rest of the MH3000 Next Generation range. This ensures tried-and-tested performance, reliability and easy parts availability, without operators having to compromise on class or versatility.

Power for the MH3032 follows the same principle. Its Cat C7.1 engine is one of Caterpillar's most modular and most compact power units, meeting US EPA Tier 4 Final, EU Stage V and Japan 2014 emission standards, or emitting equivalent to US EPA Tier 3 and EU Stage IIIA, based on regional availability. Deployed in the MH3032, it is coupled with long-life filters, fewer hoses and fewer check points, to allow extended maintenance intervals for further operational savings.

"By meeting the demands of the 30 MT size class head-on, the MH3032 should prove a popular selection in the all-important material handling sector. It is a fine machine, totally at ease with its next gen credentials, and we are delighted to see it launch in 2025," said Vincent Migeotte, Caterpillar Senior Product and Sales Consultant.

Caterpillar began manufacturing material handlers in 1998, starting with the M318 MH followed by the M320 MH, later that year. The first models produced featured the MH Boom and MH Drop Nose Stick, 4-point stabiliser undercarriage, hydraulic or fixed cab riser, a magnet generator and solid tyres. Today, Caterpillar designs and manufactures eight models of material handlers in facilities around the world.

Small machines for small construction sites

For small project sites, the Wirtgen Group product portfolio offers a range of machines that are suitable and cost-efficient.

In addition to the small milling machines from Wirtgen, it includes MINI class pavers from Vögele and compact rollers from Hamm.

The portfolio of small milling machines from Wirtgen ranges from the smallest milling machine, from the W 35 Ri and the half-metre class W 50 Ri to the 1 m class models. Despite their compact dimensions, their daily productivity is high. They can rapidly remove surface layers or mill out several layers at a time. Small rear loaders such as the W 120 Ri can even remove complete asphalt packages up to a depth of 30 cm and a maximum width of 1.2 m.

The rapid completion of construction projects with small milling machines is enabled by single-handed operating and high travel speeds of up to 12 km/h. A further advantage here is the FCS quick-change system for milling drums. It allows the fast and simple exchange of milling drums with a variety of working widths and tool spacings.

Wherever space is severely restricted, such as on construction sites with narrow or tight situations or low headroom, or when small paving widths are required, the smallest Vögele pavers, the MINI 500 and MINI 502, or the compact SUPER 700i and SUPER 800i pavers, can be deployed. They offer paving widths as low as 0.25 m to 3.5 m and can eliminate the need for manual work. The MINI class pavers enable contractors to achieve even the smallest projects more conveniently and with higher efficiency and quality, with a machine.



A production system, with zero operating emissions, comprising a Wirtgen small milling machine, a Vögele MINI class paver and a compact roller from Hamm deployed on a small construction site.

Vögele Compact Class pavers are suitable for small- to medium-scale construction projects. Depending on the model, the SUPER 1000i, SUPER 1003i, SUPER 1300-3i and SUPER 1303-3i machines offer paving widths from 0.75 m to a maximum of 5.00 m.

With operating weights of between 1.5 t and 4.5 t, the HD 8 - HD 14(i) articulation steered tandem rollers, from Hamm, are all-rounders, not only in the construction of roads and paths, but also in gardening and landscaping projects. Not only crushed stone, frost protection and base layers, but also water-bound road surfaces and asphalt layers can be ideally compacted with the tandem rollers of the HD CompactLine series.

Depending on the construction material and the required compaction depth, the best results are achieved with vibration, oscillation or combination rollers. With eight electrically powered rollers, Hamm also offers a range of solutions for compaction with zero operating emissions. The HD 10e / HD 12e models (drum width of 1 m to 1.20 m, operating weight of 2.5 t to 2.7 t) offer exactly the same compaction performance as their combustion-engined counterparts, but with zero operating emissions. The operating system of the e-rollers is almost identical to that of the other models in the HD CompactLine series.

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