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	Max. lifting capacity	*Main boom*	*Boom extension*	*Max. tip height*	*Max. radius*	*Engine (superstructure)*	*Drive*
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HK 4.070-1	*70 t*	*10.4 m – 41.0 m*	*1.6 m – 15.8 m*	*60.2 m*	*46 m*	*129 kW (175 PS)*	*8 x 4 with steered trailing axle*

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Lifting and moving mega loads

Under one of the bridge sections in the assembly area

Will North takes a look at a few heavy lift and moving jobs that presented particular challenges.

Mega jacking

Mammoet is finding an increasing amount of work for its Mega Jack system, lifting and positioning bridges in Austria and Hong Kong.

The process of connecting people and communities with bridges has always carried its fair share of risks. The very nature of the job, spanning rivers or ravines high above the ground carries all manner of work at height risks, while having to deal with variable conditions.

In recent years heavy lift specialists such as Netherlands based Mammoet have developed a new approach. Rather than building a bridge in situ, why not build it where you can work safely and efficiently, and then move the whole structure?

The Mega Jack modular box jack system was developed by ALE, which Mammoet acquired in January 2020. The system is inspired by a simple technology, which most of us will have used at home or in the workshop for one task or another: raise a load with jacks, slide a support underneath, raise it again, slide in another support. But the ALE/Mammoet system (excuse the pun) raises this concept to another level.

The Mega Jack 5200 is designed for loads measured in the tens of thousands of tonnes, with each jacking tower able to support up to 5,200 tonnes. It is typically used for jobs such as lifting entire offshore modules on top of each other, or on to their foundations. Other systems in the range, the Mega Jack 800 and Mega Jack 300 are designed for smaller, but still significant, loads, with a focus on compact dimensions and speed of work.

As well as being immensely powerful, the systems are designed to be used safely with transport and movement systems. Two recent jobs, in Linz, Austria, and Hong Kong, show how this approach can allow bridges to be installed safely when time is critical and closures around the installation site are limited.

The bridge was moved by the four SPMT sections on to the two double barges

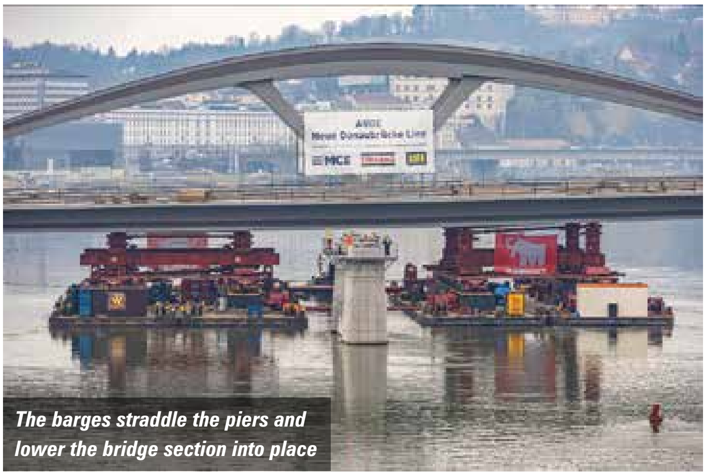
A Danube waltz

The Mega Jack 800 was used for a carefully choreographed bridge installation in Linz, Austria. A 100-year-old railway bridge over the Danube had reached the end of its life, and thus required replacement.

MCE, part of the Habau group, commissioned Mammoet as it had already completed numerous similar waterborne bridge installations and was in a position to provide all of the equipment from its own fleet, avoiding any interfaces that could have delayed the project. The task for Mammoet was to move the two main bridge structures, each weighing around 2,800 tonnes, and measuring 100 metres long by 32 metres wide, from the pre-assembly area on the side of the Danube to low piers in the middle of the river.

Early in the planning phase, a tight schedule was drawn up in cooperation with the customer to minimise disruption and interruptions due to shipping on the busy waterway. The plan was to use the jacking system to raise the

The barges were rotated 90 degrees and floated to the piers



The barges straddle the piers and lower the bridge section into place

2,800 tonne bridge segments from their pre-assembly height to the load out height and then float them out to the adjacent piers.

During the preparatory engineering phase, Mammoet's team was told that the two steel structures would be heavier than originally planned, due to additional strengthening measures, requiring the original lift plan to be adapted without causing any delays. Other challenges included limited space in the assembly area, and a difference in the centre of gravity between the two bridge structures.

Mammoet's engineers developed a plan to jack up the bridge sections, drive two sets of 120 axles line Self-Propelled Modular Transporters (SPMTs) equipped with jacking units, under the raised bridge. They would then take the weight and transport them onto two sets of two barges, connected with a gap between them wide enough to span the piers. The bridge sections were then floated away from the river bank, with winches rotating the barges 90 degrees to line the bridge up with the piers. The sections were then floated over the piers and lowered into place.

The whole process took place under the full gaze of the public via live streaming. The first bridge section was jacked up with four Mega Jack 800 towers, while the second bridge section - installed a day or two later - required six jacks, due to it being heavier with a different centre of gravity.

The entire installation took 11 days in total. On the day the first bridge section was installed, unforeseen morning fog caused a delay, but Mammoet was able to make up some time allowing the Danube to be reopened after just a short delay. The bridge is expected to be completed in October 2021.

Smooth airport transfer

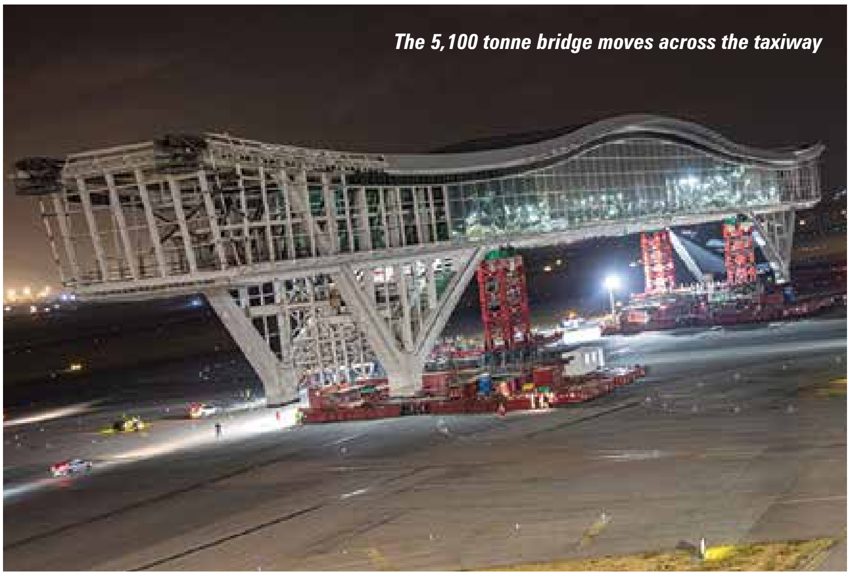
Mammoet faced some similar challenges installing a covered airside bridge/walkway at Hong Kong airport. The distances between the bridge assembly area and the installation point was far greater than for the Linz job, as was the overall weight. Working around airport closure restrictions added a further complication.

Mammoet used its Mega Jack 5200 jacking system, mounted on 264 SPMT trailer lines - the first time it had used them on SPMTs - to move the 5,100 tonne, 200 metre long structure 3.5 kilometres, crossing the taxiway. The team had just five hours to complete the job. Once the bridge reached the airfield apron it was lowered to the point where its legs were taking 10 percent of its weight in order to stabilise it. It was then jacked to a height of 43 metres in order to clear the bridge piers, the bridge was moved over them, with the bridge legs taking 30 percent of the weight, while the jacks held the rest while the bridge was fully welded into place and secured by the client, China State Construction Engineering. This required close monitoring of the jacks hydraulic system while the process was completed. The entire job took seven days.

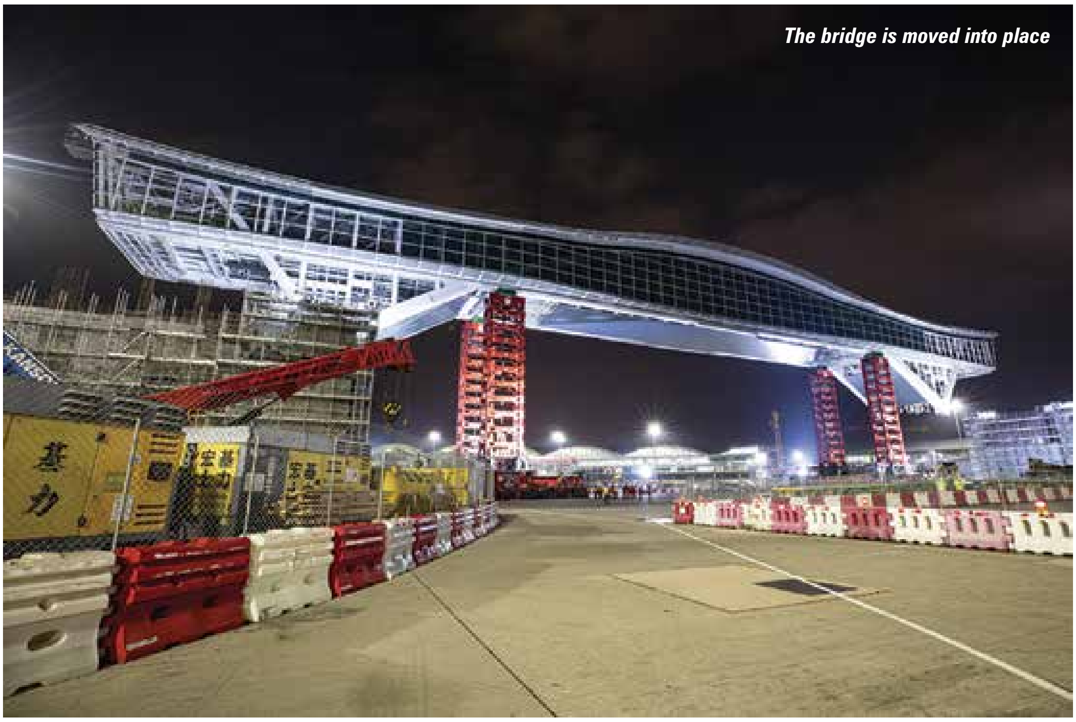
The bridge connects the airport's Terminal 1 with the North Satellite concourse and is high enough for the world's largest passenger aircraft to pass underneath.

Edwin Blösser, project manager for Mammoet, said: "This project required detailed planning, working 24 hours a day throughout the nine day critical time period given to us."

Charles Tse of China State Construction Engineering added: "We are pleased with the work done by the Mammoet team. The project was completed on schedule with minimal disruption to the Hong Kong International Airport's daily activities and this was especially important close to the Lunar New Year period, when we see an increase in traffic flow at this airport hub."



The 5,100 tonne bridge moves across the taxiway



The bridge is moved into place

Precise turbine jacket handling

As offshore wind farm construction surges around the world, improved solutions are required to handle components more efficiently and safely. Netherlands based Q3 Heavy Lift has launched a jacket/foundation handling device. Will North reports.

The PTC200-DS lifting a jacket with the Jacket Lifting Tool

A view over the factory and dock

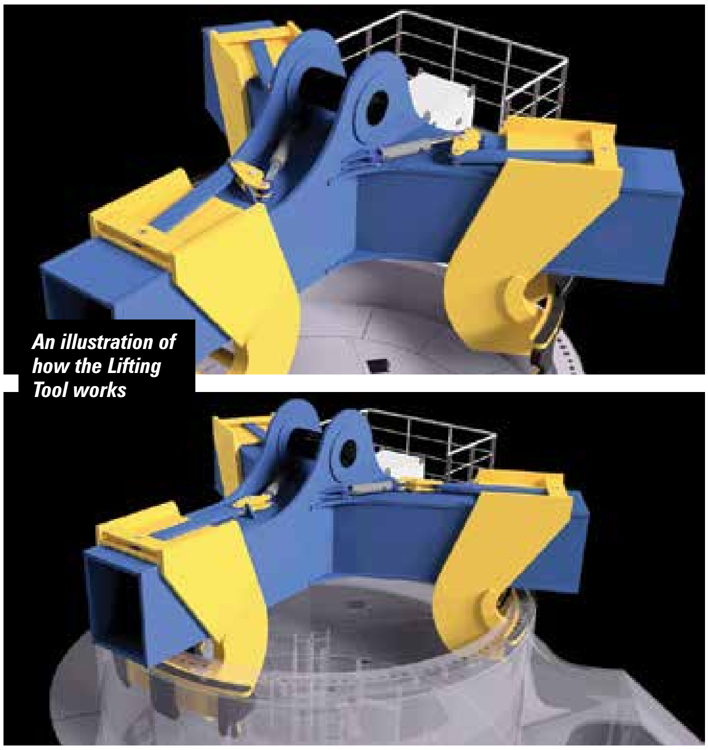
Q3 is a Dutch heavy lift and logistics specialist, with offices in the Netherlands and Taiwan. In 2019 it was approached by the company building Taiwan's first specialist facility for offshore wind structure fabrication in order to supply systems and services to handle the large foundation jackets used to support wind turbines. The Jacket Lifting Tool formed a key component of Q3's logistics plan, with the company designing and developing the device rapidly in the Netherlands to Lloyd's Register certification standards with structural components built by local fabricators Rometal. The device has three legs or 'C-Hooks' which are expanded hydraulically under the tower connection flange/ring on the jackets. It can also be used for any structure with a similar flange connection with a diameter of between 5.5 and 6.8 metres.

The first job took place earlier this month with a 3,000 tonne PTC200-DS heavy lift crane, configured specifically to lift wind turbine jacket foundations weighing around 1,250 tonnes.

The client's decision to work with Q3 was influenced by its ability to provide a turnkey package, including in-house design, engineering, production and commissioning as well as its years of on-site, hands-on experience in the sector.

The Jacket Lifting Tool weighs 37 tonnes and can handle loads of up to 2,000 tonnes. The device features nine cameras, giving feedback to the crane cab, helping operators work safely, swiftly, and efficiently. The remote controlled attachment is equipped with a small diesel engine, driving a hydraulic power unit. A fully electric powered alternative is also available. Q3 Asia also provided all of the local training required for the safe use of the product.

Positioning the Jacket Lifting Tool ready to connect with a jacket flange



An illustration of how the Lifting Tool works

The Jacket Lifting Tool in place

Compact hydraulic power

When the Koudiet Eddraouch power station in El Tarf, Algeria, needed to carry out maintenance on its 470 tonne generator it commissioned Algerian company Global Freight Transit (GFT) and its Enerpac SBL1100 hydraulic telescopic mast gantry to carry out the lift.

With a capacity of almost 1,100 tonnes, the SBL1100 tops Enerpac's eight model range of hydraulic gantries. Its three stage hydraulic octagonal profile masts can lift loads to a height of 12 metres. The system is also designed for easy and compact transport, with each mast folding down to offer an overall height of 2.25 metres, a length of 4.3 metres and a width of 1.4 metres.

The Intellilift wireless remote controller

GFT used the gantry to raise the generator 4.1 metres and move it onto a support structure in order for the maintenance work to be carried out. Once completed it reversed the process, returning the generator to its working position.

GFT logistics coordinator, Sofiane Issiakhem, said: "The Enerpac SBL1100 is invaluable for this kind of work, where we need to lift heavy loads in a limited space. Ease of deployment and operation has also allowed us to safely conduct similar generator lift projects in another power plant nearby."

A key component for completing applications such as this is Enerpac's Intellilift wireless remote control system that transmits and receives verified and encrypted signals to and from receivers on each jacking mast. The system monitors and synchronises the lift across the four masts to within a 25.4mm tolerance, while travel is synchronised to within 15mm. A wired controller can also be used, but the wireless controller allows the operator to stand in the best position for an unobstructed view of the lift progress.

GFT's Enerpac SBL1100 hydraulic gantry lifts the 470 tonne generator at the Koudiet Eddraouch power station

A 450t reverse pick & carry


With the load attached, an auxiliary crane added 320 tonnes of suspended ballast

In late 2020, Austrian crane rental company Felbermayr used its latest 1,000 tonne Liebherr LR 11000 crawler crane to unload and travel with a 450 tonne generator, reversing 20 metres before placing it.

The lift was carried out alongside the 45.6 kilometre Rhine-Herne Canal in Germany's Rhine-Ruhr region, which connects Duisburg with the Dortmund-Ems Canal and remains a vital commercial artery for industrial plants in the region.

The 450 tonne generator was delivered by barge from Mülheim an der Ruhr and had to travel the last two kilometres overland to its final destination, an expansion project at a nearby gas and steam turbine power plant. The crane simply had to unload the generator from the barge and place it on to a waiting Self Propelled Modular Transporters (SPMTs).

As is often the case, getting the crane to site and setting up was the longest part of the job. The new crane was delivered directly to site on 19 low loaders and 30 curtain side trailers. It was set up with a 48 metre main boom, 36 metre derrick boom, 260 tonnes of superstructure counterweight and a suspended ballast pallet with a 20 metre radius.

When the barge arrived, the LR 11000 was ready to go, the load was attached to the hook, and an auxiliary crane added 320 tonnes of suspended ballast pallet. The operator then lifted the generator and reversed 20 metres away from the canal, to make room for two linked SPMTs, with 18 axle lines each, to be positioned beneath the load.

The barge tied up at the dock at noon and by 14:30 the SPMTs were ready to set off on the last leg of the generator's journey to the power plant.


The LR 11000 raises the generator from the barge…


...and tracks in reverse to create space for the SPMTs to drive in below the load


The SPMTs head off on the two kilometre trip to the power station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Big crane shallow lake


The Demag PC6800-1 ready for work

As demand for wind power grows, developers are driven to search for new locations for turbines. In the Netherlands, 89 Siemens Gamesa's 4.3MW turbines are being installed in the shallow waters of the IJsselmeer lake. As with the installation of turbines in forest clearings, the Fryslan Wind Farm posed new challenges for contractors.

A critical first step was the installation of the 39 metre long monopile foundations for the turbines, which weigh up to 250 tonnes. Sarens was contracted by Van Oord Offshore Wind to lift and install them. The requirement for a big lattice crane went without saying but getting to the installation locations and lifting heavy loads in a lake with an average depth of around five metres, was another challenge altogether.

Sarens chose its 1,250 tonne Demag PC 6800-1 pedestal crane for the job, due to its high capacity, and ability to work with up to two degrees of inclination. A vessel was created from four barges, linked together, to create a surface area of 62 by 53 metres - large enough for the crane and equipment needed for the job, while maintaining a draft of less than 2.5 metres. A heavy raised sub frame was added to accommodate the crane. Once in position the platform was stabilised by 'spuds' - legs lowered into the lake floor.

With the concept for the job planned, Sarens turned to offshore engineering specialists Waves group to confirm the feasibility. Waves built a hydrostatic model to assess the stability specific to inland waterways. The monopiles are driven into the lakebed with a hydraulic hammer, so a detailed hydrodynamic analysis was required to calculate the rigging loads and the height required for the hammer. This involved investigating a range of factors, including soil properties and specific wave and wind profiles for each location.

The wind conditions on the lake posed another challenge. Hendrik Sanders, who worked with his R&D department and Demag engineers to overcome this, said: "We needed Demag to look at the specific conditions of this job and adjust the permissible wind conditions for the crane. We also needed new charts for the maximum lifting capacities at up to two degrees inclination."

Demag conducted a 'failure modes and effects' analysis to identify crane components subject to particularly large loadings and describe the effects of a potential failure, in order to be able to respond quickly in the event of a failure, minimising downtime. Last, but not least, new software had to be loaded into the crane's control system, with Demag engineers coming to site specifically for the task.

With the plan for the barge complete, and the feasibility of the approach confirmed, the PC 6800-1 was transported directly from its previous job in Hungary to the Dutch coast. Due to the limited space on the barge, the rigging and set up had to be planned meticulously. "We pre-assembled the crane on the shore and then put together and tested the larger components on the barge, minimising the risks of assembly on water and at height," said Sarens project manager Mart van Hoorn.

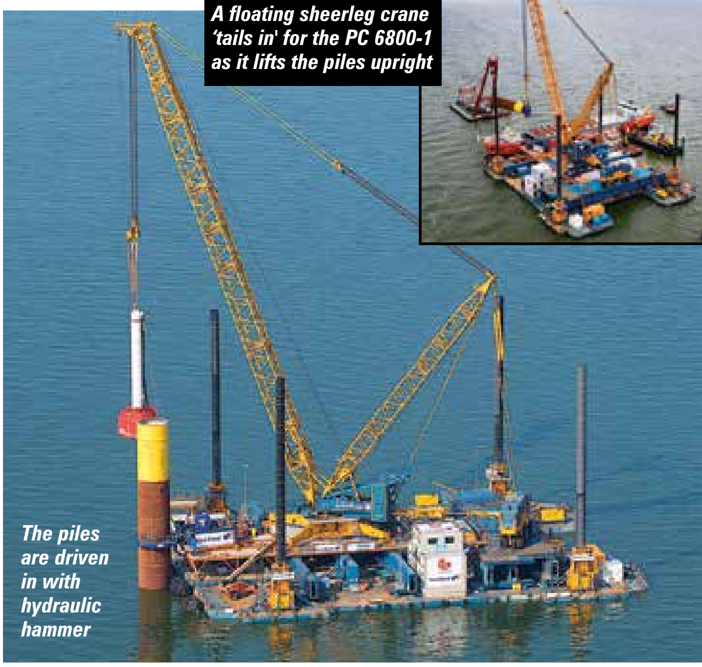
It took the six person assembly crew a week and a half to set up the crane, including the application of a protective coating against saltwater corrosion. The PC 6800-1 was rigged in SSL/LSL S1 configuration, with a 72 metre main boom, and a 40.5 metre Superlift/derrick mast. The superstructure counterweight was 250 tonnes, while the Superlift ballast on a wheeled carrier was 360 tonnes.

With the piles stowed horizontally on the delivery boat, a Wagenborg floating sheerleg crane 'tailed in' the load. The crane vessel then repositioned if required, before the pile is lowered into place. "The fact that these operations have to be carried out in a sort of floating arrangement between other vessels makes the operation particularly challenging," says Van Hoorn. "Which is why at least 10 experienced employees are on board for each lift. The lifting and positioning of a pile takes between 30 and 90 minutes, our plan is to drive two piles a day depending on the weather."

The project is due to take three months.

A floating sheerleg crane 'tails in' for the PC 6800-1 as it lifts the piles upright


The monopile delivery


The piles are driven in with hydraulic hammer

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