Developments erecting wind turbines

Sarens' latest super heavy-lift ring crane - the SGC-140 - is an upgraded version of the 3,200 tonne capacity SGC-120

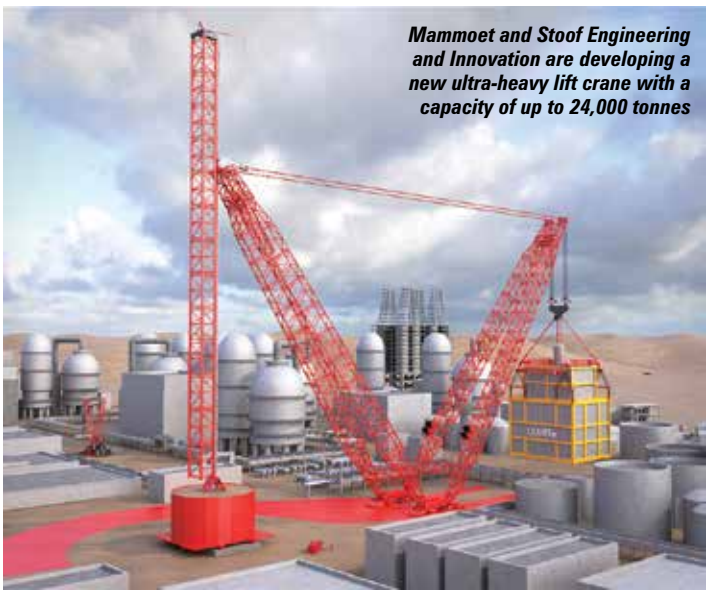
The seemingly never-ending development of larger and heavier modular components continues as well as creating the need for lifting, transport and erection companies to design and produce equipment capable of carrying and raising the heavier loads to higher levels. In the wind sector, product development is racing along with turbines producing ever more power, but at the same time hub heights are increasing while components are becoming heavier. We take a look at some of the latest developments.

Last month we reviewed Sarens' latest super heavy-lift ring crane - the SGC-140 - an upgraded version of the 3,200 tonne capacity SGC-120 - which can lift 2,820 tonnes at 50 metres radius. The crane is just one of a handful of 'super lifters' designed by the heavy lift and transport companies including Mammoet and ALE Heavy Lift, capable of lifting greater capacities than the mainline crane manufacturers and needed for specific contracts around the world.

Following its tests at the Port of Ghent, in Belgium, the SGC-140 will be dismantled and shipped to Kazakhstan to be used on the Tengizchevroil (TCO) project, lifting modules weighing up to 2,500 tonnes at 50 metres. But the trend for increased component size extends much further than just the oil & gas sector.

ALE produces two in-house designed specialist cranes - the 5,000 tonne capacity AL.SK350 and the 4,300 tonne AL.SK190. Since March 2017 the 'smaller' has been working at Earls Court in London removing more than 60 portal beams weighing between 80 and 1,500 tonnes that spanned London Underground railway lines.

Since March last year the ALE AL.SK190 has been working at Earls Court in London



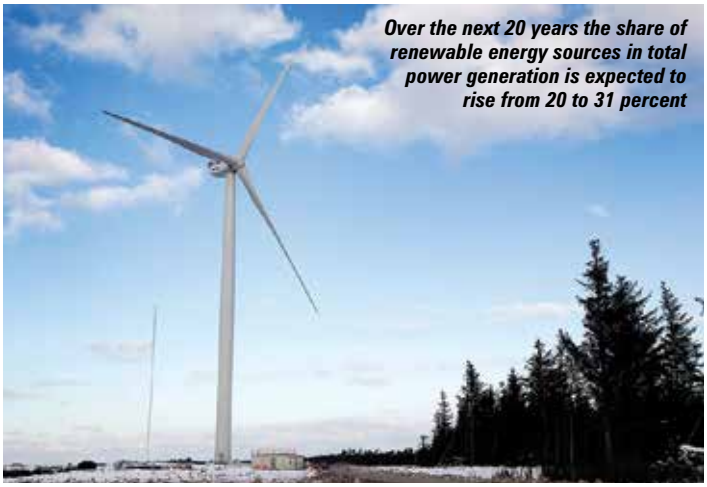
Mammoet and Stoof Engineering and Innovation are developing a new ultra-heavy lift crane with a capacity of up to 24,000 tonnes

Mammoet - a company that has been designing and building large capacity cranes for more than 20 years - recently joined forces with Stoof Engineering and Innovation to develop a new ultra-heavy lift crane with a claimed capacity of up to 24,000 tonnes and a maximum load moment of 1.5 million tonne/metres. Piet Stoof - the founder of Stoof E&I - is a former technical director of Mammoet and the person who designed the MSG 50 (Mammoet Sliding Gantry) in 1996 which had a maximum load moment of 50,000 tonne/metres. Mammoet claimed that the MSG-50 was the first machine with containerised masts and components, it was the forerunner of the MSG-80 ring crane (80,000 tonne/metres) followed by the containerised PTC ring cranes with load moments up to 200,000 tonne/metres.

One of the main features of the new crane is that it can self-erect without the need for additional cranage, even when the main boom is more than 200 metres long. The crane is said to have a relatively fast erection/dismantling time as well as being manoeuvrable and containerised for easy transport.

The erection process begins by installing a vertical lattice tower with a davit crane on top. Once the tower has reached full height

it hoists up the twin derrick boom/back mast section by section and then repeats the process with the twin boom assembly. The tower then serves as a heavy-duty pendant/link from the top of the back mast to the counterweight. The distance between the foot of the boom and counterweight can be varied during a lift with the load on the hook. This can be done while the crane is slewing, although how it does this - given that the boom back mast pivots appear fixed - is not yet clear. The ballast radius can be increased and because it is suspended vertically from the top of the back mast, it can be positioned over sizeable obstacles, including buildings while carrying out a lift.



Over the next 20 years the share of renewable energy sources in total power generation is expected to rise from 20 to 31 percent

Blowing in the wind

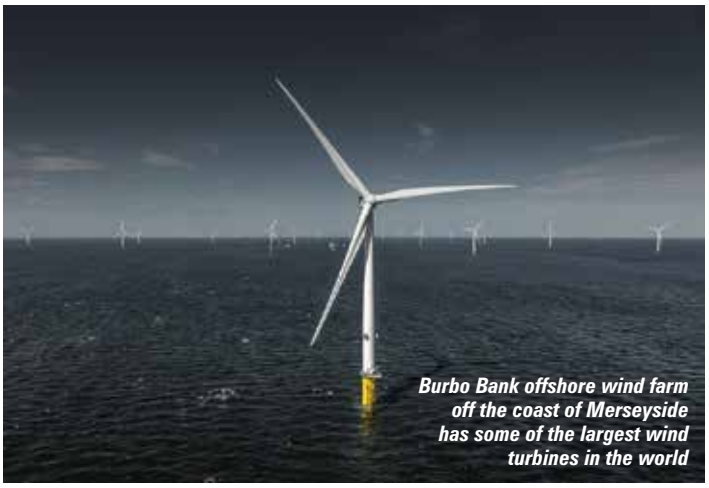
Europe's on and offshore wind market continues to mature at a rapid rate. This includes giant leaps in technology and increasing sophistication in the management and serviceability of the windfarms. However, the European wind industry continues to be tested with challenges including a period of lower than expected energy prices, the reduction or elimination of subsidies and increasingly squeezed margins. In an effort to reduce costs the sector is also pushing the boundaries with larger capacity turbines and higher towers with onshore hub heights now in excess of 140 metres.

To cope with this increase crane manufacturers have launched new and upgraded products, however as the turbine power output continues to increase with the current largest onshore turbine the 8MW Vestas V-164 and offshore turbines of more than 12MW, lifting capacity and reach are deciding factors in the speed of development. Contractors and industrial designers have to work hand in hand and synchronise their development programmes so that planned components are able to be positioned in a cost-effective way.

Over the past 10 years or so the heavy crane sector has concentrated on its most productive sector - wind - making sure that it equipment is available to lift the largest turbines. Wind developer Dong Energy - the company behind the world's largest working wind turbines - has predicted that the size of its giant offshore blades will double again within seven years. This means that crane manufacturers must devise other products or methods to satisfy the lift requirements, sometimes thinking 'outside the box' to develop alternative future-proof solutions.

Earlier this year Dong opened the second phase of its giant Burbo Bank offshore wind farm off the Merseyside coast in the UK. The project includes 32, 8MW turbines which stand almost 195 metres high - taller than the Gherkin in London - across an area the size of almost 6,000 football pitches. Each 80 metre blade assembly generates enough electricity from a single rotation to power the average home for 29 hours.

The company is already talking about scaling up its current turbine range to between 12GW to 15GW to reduce costs. Wind turbines have already more than doubled in output from the 3.7MW turbines used in the first phase in 2007. This rapid increase in size has allowed developers to slash costs. As a result wind power is now beginning to undercut gas and oil in terms of return on investment.



Burbo Bank offshore wind farm off the coast of Merseyside has some of the largest wind turbines in the world

Bigger turbines more problems

However bigger, heavier turbines needing to be installed at higher hub-heights causes a problem for the installation contractors - and particularly those supplying the lifting equipment. Once the load exceeds the limit of readily available equipment then erection costs escalate.

Current cranes that are popular for erecting the larger wind turbines include the Demag CC2800 and CC3800 and the Liebherr LR 1600/2, LR 1750 crawler cranes with maximum lifting capacities from 600 to 750 tonnes However these cranes will struggle as the larger turbines come to market. A 6MW Siemens SWT-6.0-154 for example has a three blade rotor with a diameter of 158 metres and a nacelle weight of 360 tonnes. There are also some designs moving towards higher towers but smaller blades - aimed at catching the better air giving greater efficiency.

Boom booster and Power boom

In an effort to increase the capacity and lift height of its large crawler

The Liebherr Power or P boom


The Terex Boom Booster on a CC8800-1

cranes, both Terex and Liebherr have introduced boom booster kits. Six years ago Liebherr unveiled its heavy duty P or Power Boom which significantly increased the long boom and jib capacities while mainly using standard components.

The Power Boom - designed initially as a super lift type device for the 3,000 tonne LR13000 - comprises two main unique components, a butt-section/base boom adaptor that converts the single pivot point into a twin boom configuration and a top adaptor that converts the twin booms back to a single boom for the last few top sections. All the other boom sections are simply standard intermediate boom sections. Liebherr says that in some parts of the load chart improvements exceed 50 percent on both the main boom and on luffing jib, due to the greater torsional stiffness. The boom can also be retrofitted to existing cranes. Another option with this design is that buyers can buy one set of Power Boom adaptors for use over two or more cranes, or they can purchase them later, should a job require the stronger boom. The company says that the Power Boom will play a major role in its future crane developments particularly for sectors such as wind turbine assembly with cranes in the 600 to 750 tonne range.

Two years after Liebherr, Terex released its own Boom Booster upgrade kit. More recently the company has announced an extension to the original kit extending the maximum system length to 183 metres. The kit's new configurations and lengths are the result of removing lighter boom sections at the top of the boom, and adding two more 3.5 metre wide Boom Booster sections at the base, attaching to the boom root or foot section.

Up to nine, 12 metre long boom booster sections can now be used for a total length of 108 metres compared to 84 metres on the original kit. In order to get the long boom configurations off the ground the Superlift mast length extends to 42 metres with an additional 2.5 metre section

Having the additional boom booster sections is said to improve capacities by further 30 percent. The sections come with the Demag fall protection system as standard, while Superlift Split Tray and Flex Frame options are also available. When both systems work together the time required for re-arranging counterweights between raising the boom and working with the crane is substantially shorter while eliminating the need for an assist crane for re-stacking. The Flex Frame also allows flexible setting of the Superlift counterweight radius from 13 to 21 metres with full counterweight on the tray. The new Boom Booster kit is available with new crane purchases or is as a simple retrofit package for existing Terex Superlift 3800 and Demag CC 3800-1 models.

New SX boom systems

Liebherr has recently increased the length and capacity on the SX boom systems for its 750 tonne LR 1750/2 crawler crane and LG 1750 lattice boom truck crane. The SX system, with its 3.5 metre wide lattice boom sections, can be extended and strengthened with the new SX2 and SX3 kits which comprise two or three 14 metre long by six metre wide sections fitted directly to the boom base or butt section significantly improving long boom capacities sufficient to install wind turbine components weighing up to 127 tonnes to a height of 166 metres, with many capacities improved by up 30 percent. The six metre wide SX sections fold down to an overall width of 3.5 metres for transport.

While these new boom kits help cope with current turbine demands there will be a point in the not too distant future when a mobile crane will not be the most cost effective method of turbine installation.

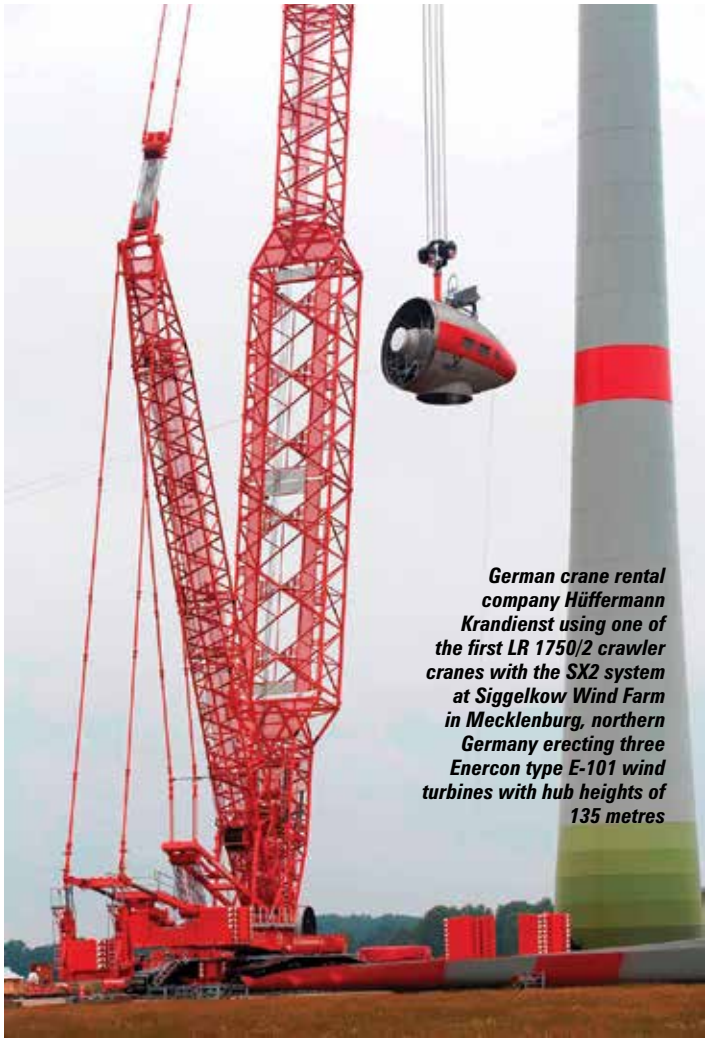

Wolffkran tower crane turbine erection

Tower crane option

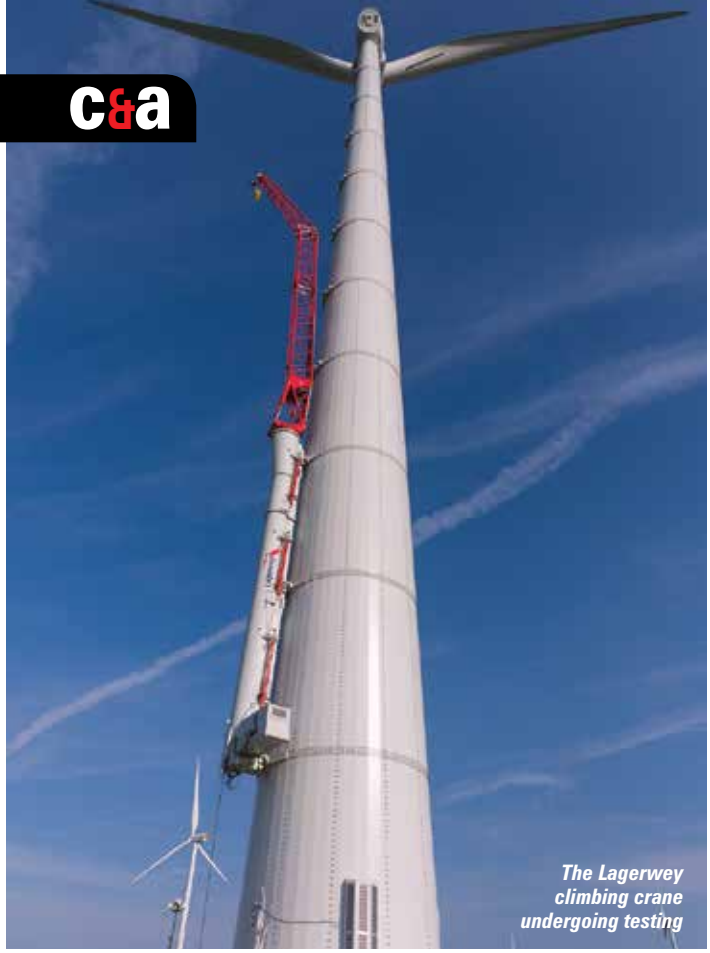
A few tower crane manufacturers such as Liebherr and Wolffkran have been working on modify their tower cranes for installing the larger hub height turbines. Wolffkran has used its 700B luffing jib tower crane to install turbines with a hub height of 145 metres without any tower ties.

Liebherr has used its largest tower crane - the 125 tonne capacity 1000 EC-B 125 Litronic with a hook height of 155.5 metres - to complete the installation of a pre-assembled 113 metre diameter rotor weighing almost 70 tonnes, lifting it to a height of 142.5 metres at a wind farm in Deining, Bavaria.

The 1000 EC-B 125 Litronic has been designed specifically for the erection of wind turbines with its variable crane drive and Micromove function, allowing precise positioning of a heavy load. The crane's foundation was integrated into the wind turbine foundation using just half the space of conventional cranes and requiring less forest area to be cleared. To achieve the required


German crane rental company Hüffermann Krandienst using one of the first LR 1750/2 crawler cranes with the SX2 system at Siggelkow Wind Farm in Mecklenburg, northern Germany erecting three Enercon type E-101 wind turbines with hub heights of 135 metres

Liebherr's 125 tonne capacity 1000 EC-B 125



The Lagerwey climbing crane undergoing testing

The Lagerwey crane can operate in winds up to 15m/s

maximum lifting height of 155.5 metres, the crane has to be tied to the tower. The installed foundation can also be used for future service and maintenance work by smaller cranes.

Lagerwey climbing crane

In an effort to make turbine erection even simpler, several manufacturers are developing custom climbing cranes. The Netherlands' only wind turbine designer and manufacturer Lagerwey, claims to have developed the world's first wind turbine mast climbing crane to enable faster and cheaper construction of wind turbines. The Lagerwey crane does not require a large base allowing wind turbines to be erected in places previously impossible to access. The crane can also operate under wind conditions of up to 15 metres a second.

The crane consists of a heavy-duty climbing base, turntable and boom. It is fully self-contained with its own integral power pack, arrives on site on three standard trucks and according to the company can be fully rigged and ready to work in about half a day. The turbine construction begins with a relatively small All Terrain crane - between 130 and 200 tonnes - installing the first ring/base of Lagerway's modular steel tower.

The All Terrain then installs the climbing crane's base onto the tower base section followed by the hydraulic luffing boom and it is then ready to start work and the All Terrain can leave site. The climbing crane installs the next few tower rings before using its climbing cylinders to raise itself to the top of the new level before clamping in place on the tower connection bands. The process is repeated to the tower's full height. The crane then installs the nacelle/generator and blades before climbing back down for removal. The crane can also be used for maintenance. The crane only requires a small base - about 350 square metres - compared to about 3,000 square metres for a conventional crane. As a result, the costs involved are significantly lower.

The crane's designer Henk Lagerweij said: "Wind turbines are continually getting bigger, heavier and taller. On the one hand, this enables us to create more energy with fewer turbines but it also means the price of building tall masts is constantly rising. The cranes capable of erecting large turbines are scarce and expensive and they take up a great deal of space on the site."

Wind turbines possible in more locations

The Lagerwey crane clearly makes more sites suitable to host wind turbines. At the moment, locations are deemed unsuitable if the ground is unable to support large, heavy machinery or access roads are unsuitable preventing the use of large cranes.

At the moment, the crane only fits the Lagerwey modular steel masts used for its own L100-2.5MW and the new L136-4.0MW wind turbines. The mast consists of steel plates that can be joined together on-site using bolts in prefabricated recesses. The crane climbs the mast using the same recesses.

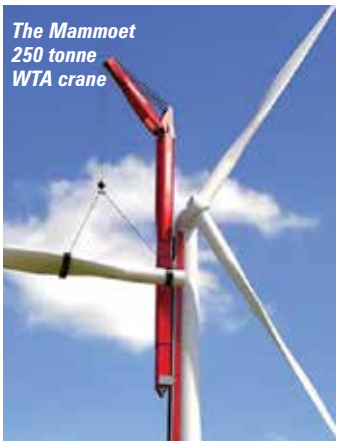
Lagerwey says that using a steel mast saves substantially on costs and makes smaller sites accessible, as no special transportation or large storage facilities are required and the mast is recyclable.

Mammoet version

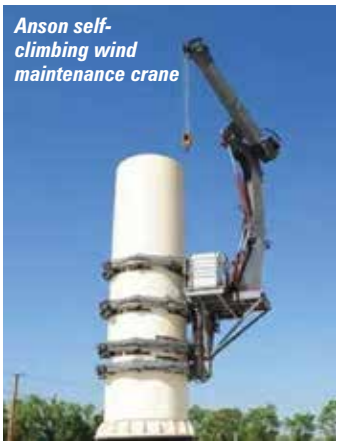
Mammoet is also working to develop specialist wind turbine climbing cranes, with the unveiling of two new turbine erection and service cranes, the WTM 100 (Wind Turbine Maintenance) and WTA 250 (Wind Turbine Assembly) earlier this year. Both cranes use the turbine's tower as its main support or structure - the WTA 250 attaches to a guide rail on the tower sections allowing them to lift and lower components to greater heights. With a maximum capacity of 250 tonnes the WTA 250 has been developed in cooperation with engineering company Mecal, which provides the wind turbine tower design.

First an assist crane lifts the base section with the WTA attached into place on the turbine's foundation. The WTA then lifts the second section into place and climbs the tower, installing subsequent sections as it goes. When at full height it can lift and position the

The Mammoet 100 tonne capacity WTM 100 attaches to two pre-installed hoisting eyes on the tower sections which it uses to pull itself up the turbine mast/tower



The Mammoet 250 tonne WTA crane



Anson self-climbing wind maintenance crane

nacelle and blades, before climbing down the tower. Once construction has been completed, the guide rail can either be removed, or remain in place for use on future maintenance operations.

The 100 tonne capacity WTM 100 attaches to two pre-installed hoisting eyes on the tower sections which it uses to pull itself and the load up the turbine mast/tower. The crane is equipped with claws that wrap around the tower to hold itself in place while lifting loads. The WTM 100 requires minimal modification to the tower and can be used on existing turbine towers as well as those with pre-installed lifting eyes.

Innovations director Wessel Helmens said: "Both cranes are compact - the WTM can fit into two standard containers and the WTA only needs two trailers to be delivered to site - making them easy to mobilise and relocate and much more efficient than conventional alternatives. More importantly, both cranes eliminate the height restrictions for turbines and make both assembly and replacement faster and more cost effective. Also because the cranes are attached to the tower, they have no footprint, virtually eliminating the need for additional ground reinforcement. The tower based design also puts the crane and the operator closer to the positioning of the loads, making assembly and maintenance safer and easier. We may introduce more additions to the WT series, depending on customer input."

Final word

The world demand for energy is expected to grow by more than two thirds over a 25 year period to 2035. During this time the share of renewable energy sources in total power generation is expected to rise from 20 to 31 percent, with renewables expected to eventually surpass gas and coal and become the primary energy source in the world. With manufacturers already planning and developing bigger and more powerful turbines, it will be interesting to see how the lifting developments needed are able to keep up with this growth.

The AL.SK190 assembled at Earls Court, London

Offering the full package

A recent entrant into the heavy lift sector is UK-based Osprey Heavy Lift, a 50/50 joint venture between heavy transport company Allelys Heavy Haulage and port and marine company Osprey Maritime.

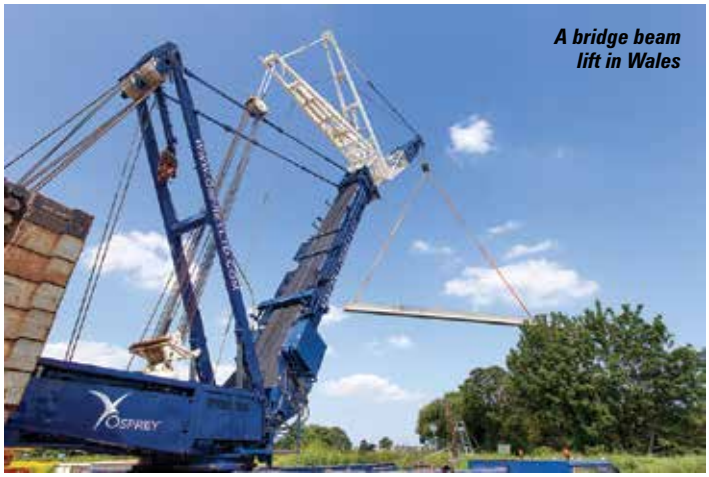
With similar revenues - £16 million and £15 million respectively - the two joined in 2016 to offer a combined heavy lift and transport solution. Osprey has depots in Bristol and Newcastle, while Allelys has a massive head office/yard in Studley, Warwickshire.

"The companies have worked together for the past 20 years or so on an informal basis but we thought it would be beneficial to form a company that offered clients the full package of both heavy lift and heavy transport," said David Allelys.

The large cranes and SPMTs are owned by Osprey Heavy Lift, with other equipment provided by each of the companies when needed for a project. "The key fact here is that we can supply all the equipment in-house rather than having to use third parties particularly for the large capacity cranes."

The new company has three large capacity cranes - a 750 tonne Liebherr LG 1750, a 550 tonne LG 1550 and an LTM 1800D. The LTM 1800D is a cable suspended telescopic crane originally owned by Baldwins' US subsidiary Phillips

Crane & Rigging and converted to D spec . It dates back to 1997 and has a capacity of 800 tonnes or 1,000 tonnes with back mast and Super Lift. The crane was fully refurbished last year and has helped the company to branch out from doing port side work to heavy lift projects and working with smaller regional crane companies and main contractors. The LG 1550 is a more recent purchase from Poland.



A bridge beam lift in Wales

"Our initial thoughts revolved around adding a 1,000 tonne capacity crane but as one was not available and a 10 year old LG 1750 appeared we purchased that for the projects", says Allelys. "The LTM 180D is used to carry out our regular 100 to 200 tonne lifts and the 2006/7 LG 1550 will be a good back-up crane after being checked over and repainted."

The company also claims to have the largest UK-based SPMT fleet as well as jacking/skating systems, and on the heavy haulage side has wide load/ heavy lift transport and 200, 350 and 500 tonne capacity girder frames. Osprey Heavy Lift also offers contract lift services cross-hiring smaller cranes when needed and can carry out route surveys. Osprey Maritime adds ships, barges, marine and port logistics which it offers as an integrated service.

The new JV is a stand alone company with its own staff - some from the two companies and some new - with reinforcements of personnel and equipment from either company.

Investment to date is around £10 million, although this is set to increase when additional large capacity cranes are added to the fleet - possibly a Terex CC or PC crawler crane although the purchase will be driven by a specific project.

"We are all hoping for the major infrastructure projects to be brought forward but in the meantime we are getting ready. By investing in our own large capacity cranes we can offer clients the full package knowing we have total control."

The large cranes and SPMTs are owned by Osprey Heavy Lift