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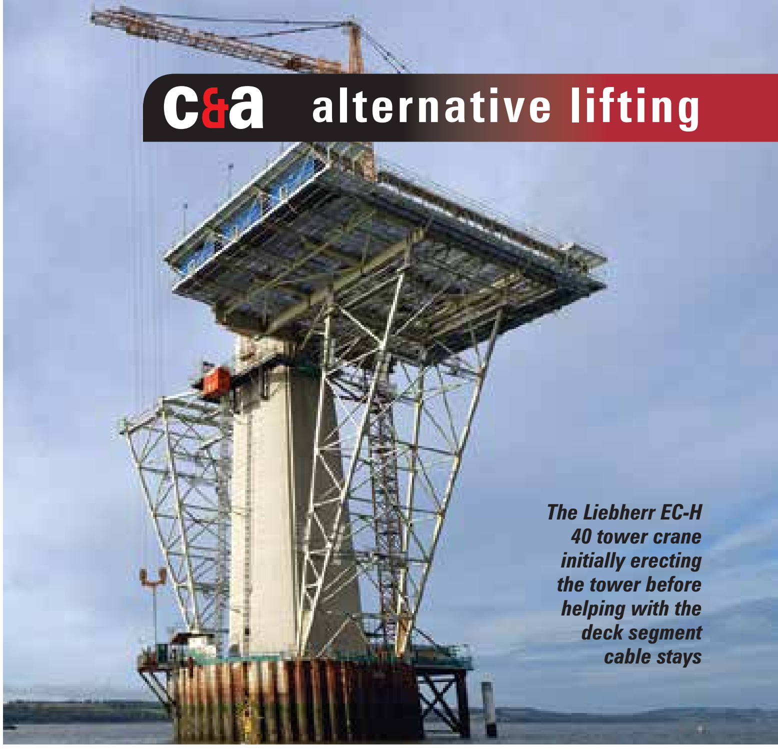
Other ways to lift and shift

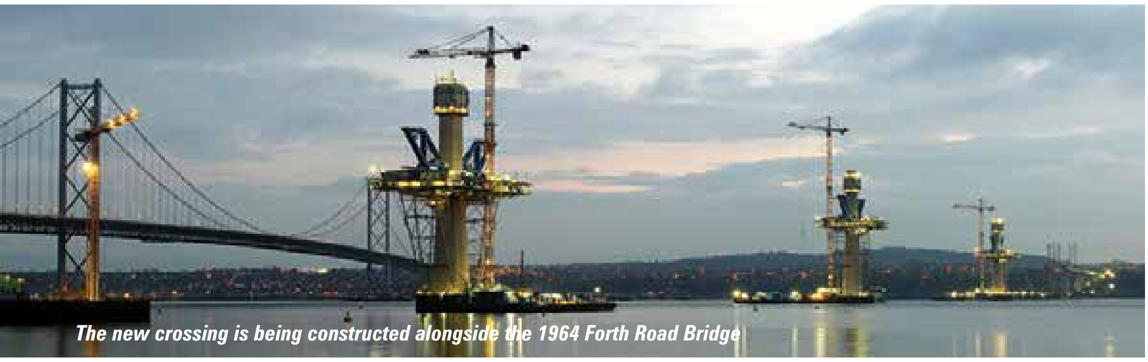
Last month we looked at heavy lifting with mobile cranes, with a focus on developments in the 500 tonne capacity and above sector. However there are numerous occasions when heavy items need to be lifted, when for whatever reason, a mobile crane is impractical or a less efficient method. It may relate to the location of the load, its size or its weight? Or there might be a simpler, safer or more practical method for a particular lift. Large loads also need transporting prior to being lifted into position and this in itself can be a huge challenge. We look at some of the alternatives used in various applications.



The Liebherr EC-H 40 tower crane initially erecting the tower before helping with the deck segment cable stays

New Queensferry Crossing

Perhaps the most high-profile alternative lifting contract currently underway is that of the new bridge across the Firth of Forth - the Queensferry Crossing - in Scotland, being constructed alongside the existing Forth Road Bridge which was built in 1964. The new bridge is intended to safeguard the M90 motorway Forth crossing, following concerns about the long-term viability of the current bridge.



The new crossing is being constructed alongside the 1964 Forth Road Bridge

For those of you not familiar with it, the Firth of Forth is an estuary on the east coast of Scotland and also the mouth of the River Forth to the North Sea. The Queensferry Crossing will therefore be a main transport artery between Edinburgh and the northern regions of Scotland.

When completed for client Transport Scotland - the Scottish transport authority - by the end of 2016, the 2.7km long bridge will be the world's longest cable stayed bridge with three towers. During its construction there have been a wide variety of lifts using conventional mobile cranes up to 500 tonnes, three of the UKs tallest tower cranes and a barge mounted crane, while skidding techniques have been used for the approach road viaducts and strand jacks employed to lift the bridge segments into place.

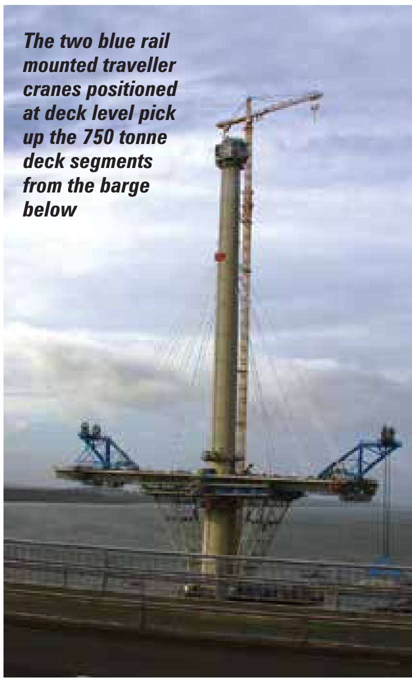
The principal elements of the bridge are the three main towers which have now been constructed, the north and south approach viaducts and the cable stayed bridge decks supported by the towers. In the estuary, work has been concentrating on erecting the three main towers each of which is equipped with its own Liebherr 630 EC-H 40 tower crane. Standing 235 metres high, they are now at full height, having climbed the bridge pylons as work progressed. Each crane stands on a steel foundation (caisson) in the water and were installed using a crawler crane on a barge. A particular challenge of the crossing is the capacity required to handle 30,000 tonnes of steel. The tower cranes can lift up to 180 tonnes and take 40 tonnes out to a radius of 18 metres.

Lifting the deck segments

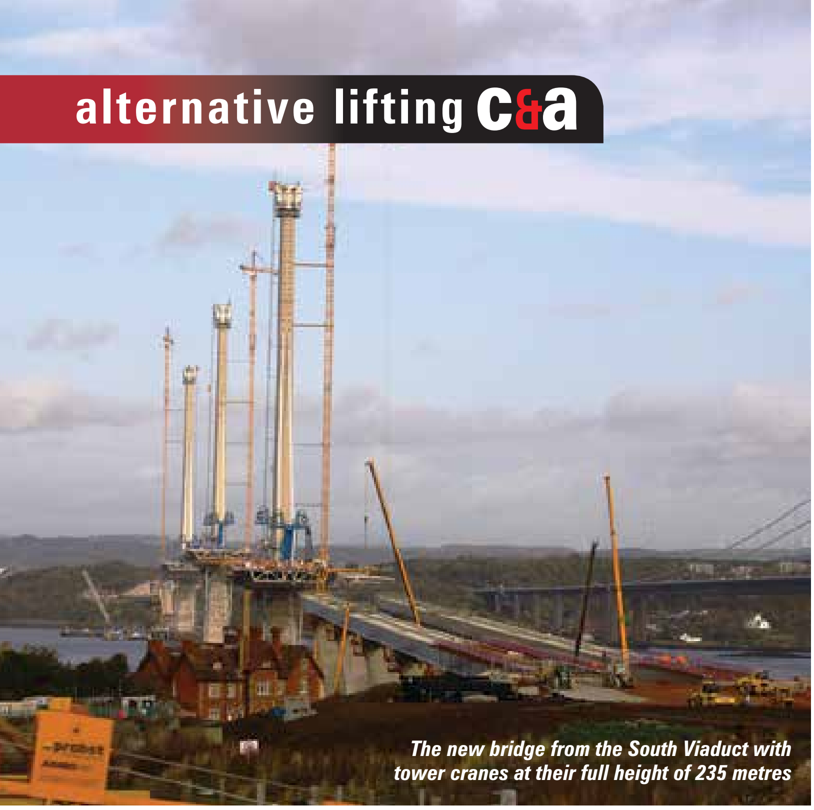
Once the towers were completed the next stage involved the installation of the bridge deck segments and the stay cables - one of the most technically challenging stages. A total of 110 segments have to be lifted into place, filling the gaps and creating the road deck between the towers. Weighing on average of around 750 tonnes, each prefabricated steel segment, topped with reinforced concrete, is transported from the dockside fabrication yard to the tower by a barge, positioned by tugs. The barge is then anchored into position - with a 200mm tolerance - beneath 250 tonne rail mounted traveller cranes positioned at deck level, which complete the 55 metre lifts in around two hours depending on wind, sea and tide conditions. Each segment has to be rotated a few degrees to match the final geometry of the completed bridge deck.

Once in position the new segment is fixed permanently into place by welding around the entire steel box structure and the internal beams within. Finally a reinforced concrete 'stich' is poured on top of the structure along the weld lines, securing the segment to its neighbour.

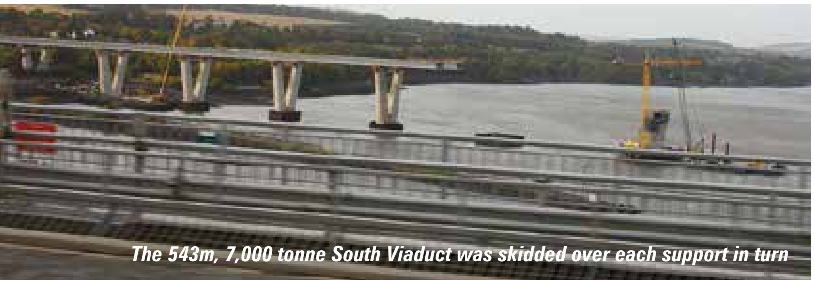
The cantilevered segments are then supported by the stay cables with segments erected one side of the tower and then the other to maintain a balanced weight distribution on the tower. The stay cables which comprise up to 109 strands - each made up of seven high tensile galvanised wires 5.2mm in diameter - are installed using the tower crane. Once the segment is fully secured the hydraulically powered, traveller crane moves forward on its rails to the leading edge of the newly installed segment ready to lift the next segment into place.



The two blue rail mounted traveller cranes positioned at deck level pick up the 750 tonne deck segments from the barge below



The new bridge from the South Viaduct with tower cranes at their full height of 235 metres



The 543m, 7,000 tonne South Viaduct was skidded over each support in turn

Skidding the viaducts

The cable stayed bridge is just one element of the new Queensferry Crossing. To gain access to the bridge there has been an enormous amount of work connecting the crossing to the existing road network. Both North and South Approach Viaducts - connecting the land to the bridge - are now well underway, with the south side further advanced. At 543 metres in length and weighing over 7,000 tonnes, installing the Approach Viaduct South was a major civil engineering project in its own right. Consisting of steel sections welded together on land, the structure is launched using hydraulic strand jacks to pull them out over the newly installed concrete piers. Cables attached to the king posts - rising at right angles to the steel sections - lift the front edge of the structure to counteract the effects of gravity and ensure the end is kept at the correct height to meet the lateral guides positioned on top of each pier. This also ensures the steel sections remain in alignment as they head towards the main bridge. This is thought to be a first time that this method has been used in the UK.

In total 12 such launches are needed to complete the South Viaduct, with one being carried out each month. In June the completion of Pier S3 on the south-side triggered the last launch completing the south viaduct.

On the north side, works are on schedule for a launch of the 5,600 tonne viaduct over two piers in a single operation. The north will employ a very different operation to the south in that it will involve 'pivoting' the structure as it moves along, so that the trailing edge is lowered by about two metres to create the correct profile to allow the structure to pass over the pier N1 and be at the correct angle to meet the main crossing deck segments suspended from the North Tower.

When completed there will be three bridges over the Forth, spanning three centuries - the iconic Forth Bridge, now a World Heritage Site - opened to rail traffic in 1890, the Forth Road Bridge - the UK's first long-span suspension bridge - opened in 1964 and now the Queensferry Crossing, due for completion in 2016.

40m jack-up and skid for Malikai platform

UK-based international lifting and heavy transport group ALE was challenged with lifting and placing the 13,800 tonne fully assembled topside structure onto the 40 metre high legs which form the upper part of the hull of the Malikai Tension Leg Platform, in Johor Darul Takzim, Malaysia.

The modular Mega Jack system lifted the topside to a height of 40 metres

The new fully-manned platform is operated by Shell which co-owns it along with ConocoPhilips Sabah and Petronas Carigal, and is part of the Malikai Deepwater Oilfield Project, 100km offshore from Sabah. The platform has the facilities to process 60,000 barrels of oil and 1.4 million cubic metres of gas a day.

ALE started to mobilise the equipment required, including its computer controlled skidding system, its mast and Mega Jack systems, weighing cells and strand jacks, around four months prior to starting the move and lift.

It began by skidding the 13,800 tonne topside 85 metres over the top of the base of its Mega Jack system set up alongside the legs. The modular Mega Jack system then lifted the topside to a height of 40 metres. The combined weight at this point was 17,300 tonnes. The topside was then skidded on rails at this height, a distance of 90 metres until it was directly above the four legs of the Hull. The topside was then lowered and the two parts connected. ALE also removed all equipment using its 900 tonne strand jacks which were pre-installed onto the main deck of the topside.

Edwin Blösser, ALE project manager from the Netherlands branch said: "We are always willing to push the boundaries in order to offer a bespoke solution for the client. This lift would not have been possible without a great crew and the Mega Jack system. With its capacity to easily lift the topside to the desired height, the Mega Jack enabled the client to work on both the topside and the hull at ground level therefore optimising the logistics needed for such a build. As both the Mega Jack and skidding systems are operated remotely via fail-safe computerised controls in a control room it provides a very safe way of working."

The Malikai TLP site in Malaysia

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Country: The Netherlands

YOM: 2009

Price starts at € 14,500.00

JLG-M3369LE

Country: Denmark

YOM: 2005

Price starts at € 12,500.00

JLG-460SJ

Country: Benelux

YOM: 2004

Price starts at € 15,500.00

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Skidding an aircraft carrier

ALE has also skidded its heaviest item ever, the forward section of the aircraft carrier HMS Prince of Wales weighing 26,500 tonnes in Rosyth Dockyard, Scotland.

Working for Babcock International on behalf of the Aircraft Carrier Alliance, the operation involved jacking-up and then skidding two sections weighing 13,050 tonnes and 26,500 tonnes respectively, skidding the lighter section about 94 metres and the heavier section 18 metres.

The skid-shoes used a built-in jacking system that could be easily installed under the specially designed supports, placed on five rows of dock blocks to prevent sagging and provide easy access under the sections. A total of 35 skid-shoes were used for the lighter module and 58 skid-shoes for the heavier, with a minimum capacity of 500 tonnes. 800 metres of skid track was then required to skid the lighter section and 650 metres for the heavier section. 1,000 tonnes of spreader plates were fabricated to suit the skid shoes, with the ability of the wings on the bow to be taken off in an earlier stage to speed up the lead time of the project.

The largest hull section is attached during the skidding to three other sections of HMS Prince of Wales at Rosyth Naval Dockyard

Songdo Bridge solution

Enerpac used four HSL8500 strand jacks to simultaneously lift and position the two 2,000 tonne sections of the each of the two main pylons on the Songdo Bridge in South Korea.

The 12.3 kilometre long bridge - also known as The Incheon Bridge - is the fifth longest bridge of its kind in the world, and provides a vital link between Incheon International Airport and New Songdo City. Construction was made more difficult because it is located in a seismically-active region and the cable-stayed section runs 74 metres above the main shipping route into Incheon Port,

The cable-stayed section of the bridge was the most challenging, with two main 230.5 metres high pylons/towers, supporting the 800 metre centre span and side spans of 260 metres and 80 metres. The two 2,000 tonne upper parts of the inverted Y pylons were cast on either side of the pylon base, which supports the road deck and then had to be lifted upright to join above the deck.

In order to prevent counter-balance problems while lifting, both pylon sections had to be raised simultaneously, even the slightest loss of balance would have created intolerable stress levels on the center pillar which is built on flexible expansion joints to cope with earthquakes. The lack of a good footprint and a lifting height of 100 metres made it impossible to use two cranes or other alternative heavy lift solutions.

The Enerpac HSL8500 strand jack

Enerpac therefore proposed using a four legged temporary steel tower and four HSL8500 strand jacks, driven by high pressure hydraulic power-packs, incorporating its SCC software programme which synchronised the strand jacks, precisely adjusting the load at each of the four lifting points. Each strand jack - lifting 850 tonnes - was installed at the top of the temporary tower while the base of the each pylon section pivoted on the pylon base. The whole process went without a hitch and was completed in just two days.

New SL400 gantry

Enerpac has launched the SL400 hydraulic gantry its highest capacity bare cylinder gantry to date. Equipped with three stage lifting cylinders, the SL400 lifts up to 9.1 metres and can take to 400 tonnes to the top of the second stage.

Featuring an Intellilift wireless control system, the SL400 allows for unobstructed views of the load and allows users to operate the lift locally at each leg or via remote control. The system ensures automatic lift synchronisation to within an accuracy of 25mm and automatic travel synchronisation to within a tolerance of 15mm.The SL400 can also be equipped with a powered side shift for easy operation.

Peter Crisci of Enerpac said: "The SL400 hydraulic gantry offers many new features such as a wireless control system and integrated self-propelled drive system. Allowing our customers to satisfy their complicated lifting applications safely and reliably.

The Enerpac SL400 hydraulic gantry features wireless control and integrated self-propelled drive systems.

New All Terrain Transporters

ALE has introduced an All-Terrain Transporter - a cross between a trailer and SPMT - which allows the fast transportation of large and heavy loads on minimally prepared roads. The company's R&D department has worked with a third party manufacturer to develop the new transporter.

Ronald Hoefmans, ALE's technical director said: "Currently, a lot of road preparation has to be done to bring large loads into newly developed areas on deep inland locations when using conventional trucks and trailers. We looked for a solution that would solve the problem more effectively and came up with the All-Terrain Transporters which can perform the task at higher levels of safety and save clients a huge amount of money on road preparation."

"These transporters are almost as quick as conventional trucks, but have the flexibility of an SPMT. In addition, their large wheels and the number of drive axles enable cross country operations. They will also be able to travel longer distances, climb steep slopes and traverse minimally prepared roads. We think they will revolutionise the way we transport heavy loads, offering a more time and cost effective solution for clients in many locations."

What the new All Terrain Transporter may look like

Fold-away trailer

The Highway Giant has an integrated folding mechanism

Sterett Crane & Rigging of Owensboro, Kentucky has successfully transported a 127 tonne vessel from Tennessee to Michigan using a combination of a 6+8 axle Scheuerle Highway Giant with 136 tonne capacity bolsters. A special feature on the Highway Giant is the integrated folding mechanism which allows the modules to be loaded on standard trailers for the unloaded return. The approval-free empty runs will provide substantial cost-savings.

Tres Sterett, owner of Sterett Crane & Rigging, said: "This concept has put us ahead of the competition. We can react faster to customer requests and pass on our savings to the customer."

The Highway Giant Dual Lane Trailer has been approved for use in most US states and not only accommodates the variable vehicle widths 16, 18 and 20 feet /4.8, 5.4, and six metres, but it can be safely widened while under load. A PowerBooster also allows the trailer to be used as a self-propelled vehicle, ideal for moving into final positions in confined spaces.

Halfway through folding

Collett delivered two 200 tonne transformers using its girder bridge trailer. Here a 14 axle modular flat top trailer moves one transformer to its holding location

Big transformers

UK specialist haulage company Collett has used its girder bridge trailer to deliver two 200 tonne transformers measuring 11.4 metres long by 4.4 metres wide and 4.75 metres high, from the port to the onshore substation at Burbo Bank. Once constructed, the substation will connect the 32 turbine offshore wind farm to the national grid, generating power for over 180,000 homes.

The transformers were unloaded from the delivery ship at the Port of Mostyn with a 1,200 tonne crane and placed onto a 14 axle modular hydraulic flat top trailer and moved to a holding position at the port until required.

To exit the port the load had to travel over a level crossing. However due to the weight and the size Collett had to obtain official track possession before travelling over the level crossing with a 12 axle modular trailer. They then stopped at a layby about a mile from the Port, before being transferred to the 550 tonne capacity Girder Bridge trailer for onward transportation. This was not a simple task of lifting from one to the other. The transformer had to be unloaded onto stools and the modular Girder Bridge then built up around the load.

The route planning highlighted a weak bridge, too fragile to accommodate the Girder Bridge and transformer. The team therefore managed to obtain a temporary traffic restriction order to contraflow the A55 dual carriageway thus avoiding the bridge.

Once on site the team unloaded the transformer using its own jacking and hydraulic skidding system and manoeuvred it into position on a plinth and aligned onto anti vibration pads. Five days later the exact same procedure was used for the second transformer.

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