Steel for Life would like to thank its sponsors:

HEADLINE

ArcelorMittal, Barrett Steel Limited, British Steel, Jamestown

GOLD

AJN Steelstock Ltd, Ficep UK Ltd, Kingspan Limited, National Tube Stockholders and Cleveland Steel & Tubes, Peddinghaus Corporation, voestalpine Metsec plc, Wedge Group Galvanizing Ltd

SILVER

Hadley Group, Jack Tighe Ltd, Tata Steel, Trimble Solutions (UK) Ltd

● For further information about steel construction and Steel for Life, please visit www.steelconstruction.info or www.steelforlife.org

Edited and written by **Martin Cooper**

Industry Report

STRUCTURAL STEELWORK IN ACTION

STEEL ON SHOW

The London School of Economics is redeveloping its Central Building with an exposed steel frame structure

Situated just south of Lincoln Inn Fields, and just a short walk from the London School of Economics' (LSE's) Academic Building, the Central Building Redevelopment project replaces four previous buildings that were demolished as they were deemed to be no longer fit for purpose.

Once complete, the project will offer a slightly smaller gross internal floor area of 15,507m^2 as the scheme also includes a new landscaped public square.

A modern and stylish environment will be created by leaving much of the new building's steel frame largely exposed, a design that has required a number of bespoke steelwork elements in order to fulfil the project's architectural vision.

Another part of the architectural intent is to provide a slimmed down floor construction, to maximise available space. This design has been achieved by using rectangular hollow section (RHS) or plated floor beams, featuring bottom plates to support the building's long span precast floor units, which sit within the depth of the beams.

As exposed steelwork plays such an important role within the design, the fabrication process had to rise to the challenge accordingly.

"Billington, our steelwork contractor, was tasked with making sure that the majority of the steel connections were hidden from view in accordance with the client's requirements," says Mace project director Frank Connolly.

"Flush connections are the order of the day, or alternatively they have positioned end-plates to help create shadow gaps, which, in turn, are then used as repeating architectural features."

KEY FACT

1,100t
Amount of structural steel used

Shear forces and torsional moments applied to the RHS beams, in conjunction with the desire to avoid site welding, led to the bespoke hidden connection design. The answer was for many of the steel members to have an internal bolted connection, hidden from view and accessed via a hatch.

Having the steel frame and the ductwork exposed creates an aesthetic environment within the completed building, and brings ventilation advantages.

"Exposed steelwork supporting exposed precast flooring planks creates a flat soffit and contributes to the building's MEP strategy via the material's high thermal mass qualities," explains AKT II director Ricardo Baptista.

Overall, the building consists of two conjoined parts; the 13-storey Tower Block and the six-storey Houghton Block. At either end of the blocks, that sit side-by-side for just under half of their lengths, exposed square hollow section (SHS) bracings bookend the project and form another highly visible exposed steelwork element.

This exo-skeleton bracing, which sits approximately 300mm outside of the building envelope, is not just an aesthetic element, as it is a structural requirement, acting with two concrete cores to provide stability.

Above: The steel frame works with the core to give the structure its stability

PROJECT TEAM

Project: London School of Economics Central Building Redevelopment
Main client: London School of Economics
Architect: Rogers Stirk Harbour & Partners
Main contractor: Mace
Structural engineer: AKT II
Steelwork contractor: Billington Structures

Significant forces are transferred within and into the SHS bracing system and so bespoke cruciform node joints were engineered with machined flush plates to ensure the correct standard of finish was achieved.

The structure was only fully stable when the entire frame was erected and all of the precast flooring was installed. Until that point Billington had to install temporary bracing to each floor, which was only removed once each level was fully complete.

According to Billington Structures managing director Mark Smith, the temporary stability system was developed to largely ignore any benefit that the concrete cores may have offered, to allow flexibility in the overall build sequence.

> “Exposed steelwork supporting exposed precast flooring planks creates a flat soffit and contributes to the building’s MEP strategy

“Due to the architecturally sensitive nature of the exposed frame, we had to be mindful of the subsequent impact of any of the connection points for the temporary bracing, and so bolted cleats were used to negate the need for any removal of welded plates,” he says.

The majority of the project’s steelwork begins at ground floor level. But to form a large subterranean auditorium, two large plate girders had to be installed during the basement works programme.

“The basement level is predominantly formed with concrete, although we did use steel plunge columns for the foundations,” explains Connolly.

“This subterranean level will be used for plant rooms, but it also houses the building’s 200-seater auditorium and associated spaces, such as a bar, and this large column-free area is formed by the two long plate girders.”

Encased in concrete and positioned at ground floor level, the two girders measure 17m long by 1,600mm deep and each one was brought to site in two pieces for ease of transportation. The main steel frame has been erected entirely by tower crane, but these girders had to be installed using a 400t-capacity mobile crane.

The part of the basement containing the auditorium does not lie beneath the new building, but instead it is positioned in front of the structure and below a new public square.

“Creating the square was integral to the overall scheme and having the auditorium below it was the most efficient position,” says Baptista.

“Because of the girder’s position they are working extremely hard as they are designed to carry heavy loads from fire engines, in an emergency, and mobile cranes required to replace rooftop plant.”

Access to the auditorium is via the Tower Building’s atrium, which accommodates a staircase to the lower level and its void is formed with exposed steel columns that start at basement level.

The atrium also offers access to the Tower’s main staircase, known as the meandering stair, as it moves position by one bay at each floor.

Formed with a lightweight prefabricated steel frame, this staircase was lifted into position, piece by piece along with the main steel frame. Its design is said to mimic the movement within the square, as well as allowing better connectivity and collaboration between different departments on different floors.

Summing up, Connolly says this is a complex and challenging project on a confined inner city site, surrounded by businesses and the client’s other facilities. Collaboration, such as having a visual mock-up of the steel frame on site to iron out any snags before the steelwork is delivered, has been the key to our success.

The LSE CBR opens in mid-2019.

FLEXIBLE FRAME

Steel construction was chosen as the most cost-effective solution for a new hospital in Birmingham.

A new flexible private hospital is taking shape, quickly rising up on the site of the now demolished BBC Pebble Mill studios, in Edgbaston, Birmingham.

The £21.5M facility, located in the heart of what has been dubbed Edgbaston's Medical Quarter, is the latest addition to Circle Health's portfolio which includes hospitals in Bath, Nottingham and Reading.

Utilising a steel-framed design sat on a concrete podium containing a car park, the hospital is based on an expandable model which can be adapted and enlarged to meet clinical demand.

The hospital is being constructed over two phases. It will include three operating theatres – expandable to five – an endoscopy procedure room, recovery gym, and in-patient bedrooms.

"This state-of-the-art hospital will bring to Birmingham the high-quality care and excellent hospitality for which Circle Health is well-known, and is an important part of Circle's strategy to add scale to the group," says Circle Health chief executive Paolo Pieri. "The intention is also to add a significant number of beds for physical and neurological rehabilitation, along with the latest rehabilitation technology."

The key aspect of the architect's design approach has been to create a form of "adaptive architecture", giving the client the ability to adapt the building as its needs change.

Bryden Wood director Paul O'Neill explains: "In this instance, we have the ability to double the size of the initial phase, harnessing advanced construction

KEY FACT

925t
Amount of structural steel used

> **"We have the ability to double the size of the initial phase, harnessing advanced construction techniques causing minimal disruption**

techniques causing minimal disruption. This future-proofing makes this hospital highly adaptable and cost effective. This provides our client with a building, which can be adaptable to their business plan as it evolves and responds to local demand throughout its lifetime.

"Our approach has meant that the future incorporation of rehabilitation services into the scheme is made possible. It shows that it is essential to rethink healthcare design, and there is a clear need to provide spaces to be continuously adaptable to the future needs of healthcare requirements and technology. Circle Health successfully responds to these challenges," he says.

Phase one amounted to some 550t of steel and 6,885m² of metal decking, supplied to steelwork contractor Caunton Engineering by Composite Profiles. It was completed at the end March. Phase Two, which will

Above: The steel superstructure has built in flexibility for future expansion

PROJECT TEAM

Project: Circle Health private hospital, Edgbaston, Birmingham
Main client: Circle Health
Architect: Bryden Wood
Main contractor: Simons Group
Structural engineer: Bryden Wood
Steelwork contractor: Caunton Engineering

add another 375t of steel and a further 6,200m² of metal decking began in May.

"A second phase was always on the cards during the initial design, but it only became a reality once the construction programme got under way," explains Simons Group project manager Stuart Partlow. "It's not necessarily ideal to have phase two steelwork being erected above areas that are already erected and occupied by other trades, but we will have a suitable logistical working plan in place."

As far as the project's phase one steelwork is concerned it has been designed to accept further phases. As well as having slightly larger members than would ordinarily be needed, Caunton has pre-welded a series of stubs to the top of the uppermost columns and beams. This will allow the easy installation of phase two steelwork members.

> "There is a clear need to provide spaces to be continuously adaptable to the future needs of healthcare requirements and technology

The hospital consists of three blocks, with the main building known as block C measuring 75m long by 32m wide. Sat entirely on the concrete podium, this structure's steel grid pattern has been dictated by concrete columns forming the car park below.

Its ground floor will accommodate the operating theatres, recovery rooms and X-ray department. Also included in the initial steelwork phase is a first-floor plant area which has been erected and which covers just under half of block C's footprint.

To accommodate phase two, a number of transfer beams have been included along the ground floor ceiling to support the column grid change for a first-floor rehabilitation gym that will cover the area adjacent to the plant area.

Because of the need to have a larger column spacing for the exercise equipment, the grid changes from a 7m by 15m pattern to a 15m by 15m formation.

Phase two will also include a second floor for block C, where the grid pattern will change yet again to accommodate 60 patient bedrooms.

Attached to one end of block C, block B is 40m by 20m and will accommodate the hospital's main public areas, such as the main entrance and a ground floor café/restaurant, with the first floor used entirely for administrative offices. Also included in the first phase is block B's second floor, which will contain 24 patient bedrooms.

"There were a number of reasons for choosing a steel frame for the project," says O'Neill. "The speed and ease of construction were two, as well as flexibility and the ability to secrete bracing around the structure. We also have a 7.2m long cantilever along one of block B's main elevations and this would have been difficult to build in anything other than steel."

As well as being a highly architectural part of block B's design, the cantilever also increases the floorplate for the second-floor bedrooms. It will also carry on up to include a further floor to be added in phase two, while another – fourth level – could even be added in the future.

"We had to work collaboratively with the engineer and the contractor to design and then work out the best position for the temporary works, needed to support the cantilever during both phases of the construction programme," explains Caunton Engineering contracts manager Michael Firth.

Adjoining block B is block A, which measures 30m by 15m. Used entirely for consulting rooms, this block will remain as a single-storey structure, although it has been designed to be extended to the rear to add up to 10 additional consultation rooms, again exemplifying steel construction's flexibility.

Phase one of the project is due to complete by early 2019.

COME IN NUMBER 3

The third of three steel-framed office blocks in Snowhill, Birmingham is rapidly taking shape. **Martin Cooper** reports.

Sat next to its sister buildings, Three Snowhill is a 19-storey office tower that forms a stunning gateway to Birmingham's business district, completing the final phase of Ballymore's Snowhill Estate development.

Offering nearly 38,000m^2 of Breeam "Excellent"-rated Grade A office floor space, together with retail and leisure units at podium and ground floor levels, the building sits above four levels of concrete basement and podium substructure. Three Snowhill, like its sister buildings, has a composite design comprising a steel frame with cellular beams supporting metal decking.

As well as accommodating the office block's services within the structural void, the Fabsec cellular beams have proved to be a cost-efficient option to create 10.5m-long internal spans.

This final plot of the Snowhill development has a long and varied history. Initially twin residential and hotel towers, both constructed with reinforced concrete frames, were envisaged. In 2007 work began on this scheme and all of the basement and substructure works had been completed when the job was halted a year later.

Due to market conditions, a redesign was undertaken and the project was resurrected as a solitary commercial block, which in turn led the team to choose a steel framing solution.

"A single tower on the site necessitated some substantial alterations to the substructure, most notably a much thicker raft to accommodate the different loads," says WSP associate director James Bodicoat. "This meant the five-storey basement became four storeys as the lowest level was in-filled."

KEY FACT

4,500t
Amount of structural steel used

Instead of two main cores, one for each tower, the new scheme now has three concrete cores, which provide the stability for the single tower.

Two of the cores, situated along the north elevation have the functionality of one core but are structurally independent. They are, however, linked together by steelwork that forms a frame for scenic lifts and a large glazed façade.

Working on behalf of main contractor Bam Construction, Severfield has fabricated, supplied and erected 4,500t of steel for this project. All of the steelwork has been erected via the site's three tower cranes, as none of the elements exceeds 13t in weight.

Although the project sits on a busy inner-city area, it is well served with two material laydown areas running along two main elevations, which have allowed steelwork to be delivered on a regular daily basis.

While the city centre location has provided logistical challenges, Severfield worked very closely with the site team to co-ordinate deliveries. Using its offload system has been particularly useful, allowing two steel deliveries to be unloaded at once despite the tight conditions on site.

The building wraps around a large central atrium, which allows plenty of natural light to penetrate the inner areas, as it is topped with a glazed roof. This glazing also spans the double-height upper floor, creating a large light-filled breakout space.

A series of steel circular hollow section (CHS) trees, each with two or three branches, along with CHS rafters support the glazed roof on this upper level.

Large parts of the building's roof support plant areas,

Left: Cladding is installed as the structure rises
Right: Successive floorplates increase in size with each storey

PROJECT TEAM

Project: Three Snowhill, Birmingham
Main client: Ballymore Properties
Architect: Weedon Architects
Main contractor: Bam Construction
Structural engineer: WSP
Steelwork contractor: Severfield

and in order to create a visual screen to hide the equipment, two elevations have a 5m over sail. This high-level element is formed by a series of cantilevering trusses.

Possibly the most standout features of the scheme are the raking façades, which, as well as providing the building with some architectural highlights, also help the project to maximise the available floor space as the building's floorplates gradually increase in size with each successive storey.

The building's north west and north east corners both feature raking façades, formed by a series of CHS columns, founded at basement level on large 5m-high steel nodes.

The nodes have bolted connections to raking columns, which merge at the ground floor level, and to perpendicular perimeter columns. Weighing approximately 9t each, the nodes are connected to two or three columns, depending on their location.

Another sloping façade is located on the south east corner, where a portion of the building, extending from level three to eight, is suspended from three large raking columns.

> **"Severfield's design department has been key in developing solutions to issues such as the hung steelwork on the south east elevation**

"Severfield's design department has been key in developing solutions to issues such as the hung steelwork on the south east elevation, which had to be temporarily propped before it was fully suspended," says Bam senior site manager Charlotte Owen.

Summing up the benefits of the steel-framed design, Owen adds: "The steelwork frame installation sequence has allowed us to maximise programme benefits for following trades. For example, the floorplates being split in to four areas allows us to concrete the floors in two halves and then start installing the curtain walling, while still ensuring exclusion zones are maintained for the steelwork erectors.

"By using steelwork, we have been able to monitor progress closely and forecast key milestone completion dates as the piece count is easy to measure on a weekly basis."

Three Snowhill is due for completion by Spring 2019.

SPORTS REPORT

A highly efficient and value-engineered steel-framed sports hub will help the University of Warwick achieve its ambitious physical activity targets.

Due for completion in March 2019, the University of Warwick's new sports hub will create one of the foremost sports facilities at a UK university – including what is claimed to be the country's largest higher education gym facility. The project aligns with the university's ambition to be the "most physically active campus community in the UK by 2020".

Replacing the current sports centre on the campus, the hub will feature a 16-court sports hall, a 25m-long swimming pool with a moveable floor, fitness suites, climbing and bouldering walls and flexible studio spaces, as well as squash courts, outdoor 3G sports pitches and netball courts. It will also be the official training ground for Coventry's Wasps Netball Superleague team.

Cost is always a major factor in any construction scheme and this project is no different. Early in the design phase Willmott Dixon engaged with the steelwork contractor Hambleton Steel to help with a value engineering exercise.

The project's original design envisaged a steel frame supporting precast planks to form the building's upper floors. Hambleton suggested changing this to a more cost-effective metal decking solution.

"We changed all the floors to metal decking with the exception of the wet changing rooms and areas near to the pool because of chlorine corrosion concerns," says Willmott Dixon construction manager Nick Preedy.

"This meant we had to add extra beams to support the decking as it couldn't span as far as the planks, but overall we used less steel tonnage, as a lighter frame was needed, which ultimately saved the client money."

Another benefit resulting from this design change was a quicker steel erection programme. Including the metal decking installation and the remaining precast planks, the work was completed in 13 weeks instead of the previously estimated 18 weeks.

KEY FACT

900t
Amount of structural steel used

Overall the sports hub is one large steel frame, which gains its stability from strategically-placed cross bracing, and offers 14,000m^2 of floor space.

Two large open-plan areas dominate the building and are placed at either end of the 200m-long structure. At the northern end of the structure the 16-court sports hall is a large column-free space reaching the full height of the building. The hall is formed with a series of 11 spliced 40m-long by 2m-deep trusses, weighing 8t each.

The trusses are supported at one end by tubular raking columns, that form the architectural feature façade for a viewing gallery.

"These raking columns are the middle portion of a longer spliced column," explains Hambleton Steel design engineer Andrew Dobson. "At basement level, the column is vertical universal column section, it then changes to a raking section for the ground floor and then reverts back to a vertical member higher up."

Another design innovation from Hambleton is a series of beams that cantilever out from the top of the sports hall's roof and over the lower roof of the adjoining areas. Willmott Dixon supported the scaffold for the cladding installation onto these sacrificial beams, which will be removed when the cladding is complete.

"This helped speed up the installation of the scaffolding as it would have ordinarily been supported from ground level. By using the beams the scaffold was erected more rapidly, which allowed us to get started on the cladding earlier, and meant we got the sports hall

PROJECT TEAM

Project: University of Warwick sports hub
Main client: University of Warwick
Architect: Space & Place
Main contractor: Willmott Dixon
Structural engineer: Arup
Steelwork contractor: Hambleton Steel

Left: A feature cantilever forms a sheltered terrace for the café
Right: Raking columns form a feature façade overlooking the sports hall

watertight earlier," says Preedy.

At the southern end of the hub there is an 8m-high swimming pool hall, which is another large open column-free space. This zone is formed by a series of 30m-long glulam beams supported on steel columns.

The columns in the pool area will be left exposed in the completed building, as will most of the sports hub's steel frame. To this end, all of the project's steelwork has been painted with a high-spec protective coating system to prevent corrosion from the potentially humid and chlorinated conditions.

The sports hub's other facilities occupy the large area between these two column-free zones, as well as running along the entire eastern elevation. In these parts the hub has three floors, a basement – mainly accommodating changing rooms and offices – a ground floor with the main entrance, climbing wall and squash courts, wet changing facilities and a café, and a first floor containing a 330-station gym and multi-purpose studios.

Steel starts at basement level, where a large concrete retaining wall forms this partially subterranean level.

> **"By using the beams the scaffold was erected more rapidly, which allowed us to get started on the cladding earlier**

Early in the construction programme Willmott Dixon completed a cut and fill operation, removing 20,000m³ of overburden to level the previously sloping site.

As well as internal exposed steelwork, some of the hub's exterior steel will also be remain visible as architectural features.

Adjacent to the pool, a large cantilevering canopy, partially supported by raking circular hollow section columns, creates an outdoor terrace for the hub's café.

At the opposite end of the hub, a similar canopy forms the roof for the facility's main entrance, again supported by raking columns. These 273mm diameter columns also extend along the exterior of the eastern elevation, joining the two canopies with a series of large W's, evoking the name of the university.

Most of the raking columns are not structurally integral, but purely architectural. They are attached to the elevation's cantilevering roof and will be installed when the cladding is complete.

Summing up, Willmott Dixon managing director for the Midlands Peter Owen says: "This is a fantastic project to be part of, creating cutting edge sporting facilities for the community at University of Warwick, which will really benefit its users."

ROAD RIVER AND RAIL

A steelwork contractor's expertise has enabled challenging crossings to be erected safely, accurately and on time for the A14 improvement scheme.

Highways England's £1.5bn A14 improvement scheme between Cambridge and Huntingdon aims to relieve congestion, unlock economic growth, improve safety and enhance the local environment.

The existing road is notoriously congested and suffers from numerous delays as it is used by almost 85,000 vehicles every day, far more than it was originally designed to accommodate.

The improvements include a new bypass to the south of Huntingdon, widening sections of the existing A14 and A1 trunk roads, new local access roads, and improved junctions. A total of 34 bridge structures will be required for the scheme, crossing roads, railways and waterways. Working on behalf of the A14 Integrated Delivery Team, six of these structures are being fabricated, supplied and installed by Cleveland Bridge.

Steelwork for two of these bridges – the A14 Brampton Interchange Bridge and the East Coast Main Line Bridge – has been completed, while the viaduct over the River Great Ouse is currently ongoing and due for completion by early August. The final three bridges will all be completed by early 2019 (*see box*).

Commenting on the use of steel, A14 Integrated Delivery Team construction director Jim McNicholas says: "Prior to coming to site we carried out a value engineering exercise, and from this we decided that any structure that was 40m or longer would be built with steel."

Completed in January, the A1 Brampton Interchange Bridge is an 80m-long curved structure spanning the A1. The bridge was constructed from 30 curved and cambered girders, each up to 34m long and weighing a total of 1,400t.

KEY FACT

7,825t
Amount of structural steel used

> **"We decided that any structure that was 40m or longer would be built with steel**

Cleveland Bridge says the major challenge on this bridge was the curved and cambered nature of the structure. It had to use advanced modelling software to enable the manufacture of the girders for the deck, which had a high skew and tight radius.

The complex geometry meant the girders had to be transported singly and then spliced and braced together on site. To achieve the total bridge length of 80m, 10 lines of three girders, weighing up to 55t each, were used to span between abutments and piers.

Cleveland Bridge says it developed a jacking system on top of the piers, which allowed the girders to cantilever out beyond the central pier. This enabled a whole line of supporting trestles to be removed from the scheme, saving time for the client.

All of this work had to be completed to a very tight deadline around live A1 traffic management. Switching the traffic from one carriageway to another was precisely scheduled, so bridge construction had to be completed on time so diverted traffic could run safely beneath the new structure. The bridge over the A1 was completed on schedule within the tight programme timetable, ensuring traffic could continue to flow throughout the works. The

Above: The River Great Ouse Viaduct will be 750m long when complete

PROJECT TEAM

Project: A14 Cambridge to Huntingdon improvement scheme
Main client: Highways England
Delivery organisation: A14 Integrated Delivery Team
Main contractor: Costain Skanska, Balfour Beatty joint venture
Designer: Atkins and CH2M joint venture
Steelwork contractor: Cleveland Bridge

THREE MORE BRIDGES

Cleveland Bridge is fabricating and supplying three more bridges for the A14 scheme. These are the BN20 and BN21 Bar Hill Junction bridges and the BN27 structure, which is also known as the A14/A1 link overbridge.

The Bar Hill Junction comprises two identical 47.5m-long bridges, to be constructed from six main girders each weighing 55t. These are to be assembled on site, before being manoeuvred into their final positions by self-propelled mobile transporters over two successive weekends in September. Measuring 102.5m-long, BN27 will be last of Cleveland Bridge's six bridges to be erected in early 2019. Curved in plan and elevation, it will consist of nine pairs of girders measuring 29m, 34m and 39.5m long.

> "The biggest challenge for the bridge was the short possession periods during which the bridge could be constructed

entire construction of this complex bridge was completed in just nine weeks.

A different set of challenges was negotiated for the 40m-long bridge spanning the East Coast Main Line.

"The biggest challenge for the bridge was the short possession periods during which the bridge could be constructed," says Cleveland Bridge project manager Michael Whinn. "As one of the UK's busiest rail arteries, all construction work had to take place when no services were running, and all work had to be programmed in close partnership with Network Rail."

The bridge comprised five pairs of 40m-long girders, with each pair weighing 85t.

Initially the girders were to be installed over five weekends. However, Cleveland Bridge says it was able to complete the work in just three weekends, within 2am to 6am possession windows.

There was no room for error since any delay could have seriously disrupted rail services for thousands of passengers. Cleveland Bridge says it planned all works in meticulous detail to ensure that the steel girders were positioned well before the end of each possession window.

"This bridge was an exception and would have been built with steel even if it was less than 40m-long," explains McNicholas. "Only by using steelwork with a slim profile could we achieve the required headroom for the railway, while keeping the road at the necessary level."

The project's longest bridge structure is the 750m-long River Great Ouse Viaduct, which is considered to be a showpiece element of the A14 project. The bridge spans the river, plus a large area of floodplain on either side. This viaduct will require 6,000t of steel, comprising 76 separate main girders and 800 cross girders.

A time-saving construction method has been devised, which involves another subcontractor lifting prefabricated concrete slabs onto the steelwork erected by Cleveland Bridge, at the same time as steelwork installation continues ahead of this activity.

A key feature of this method is the close tolerances required between the deck slabs and supporting steelwork. These require precise steelwork fabrication and installation, to ensure clashes between the slabs, projecting reinforcement and the steel are avoided.

Supported on 16 pairs of piers, most of the main girders required for the bridge are up 40m long, 2m deep and weigh 50t. The section of bridge that crosses the river has a longer 70m span, requiring more complex girders, with larger, deeper haunches to carry the greater load.

Cleveland Bridge says it suggested a different steel grade for these haunch girders, making them simpler to fabricate. It is using a 600t capacity crawler crane, which can lift all components for each bay from one position on both sides the river. This meant fewer crane movements were required, with no need to move the crane across the bridge footprint – reducing site congestion and saving time and money.

The A14 improvement is due to be completed in 2021.