This supplement showcases the best uses of structural steel in building bridges and energy projects across the UK.
Movement control

The Place
By Martin Cooper

How do you construct a modern office block in the midst of a busy station forecourt and with a myriad of subterranean services immediately beneath the site’s footprint? Use structural steelwork was the answer.

Designed by renowned architect Renzo Piano, The Place is an innovative steel framed London headquarters building which will provide 40,000m² of efficient office space within a 17-storey structure. The building has plant levels on floors 18 and 19.

It forms part of the South Bank development known as the London Bridge Quarter (LBQ), which also incorporates The Shard, improvements to London Bridge railway and bus stations, and a new landscaped public realm developer. Located in the heart of the UEA and spanning three lanes of the new bus station, The Place’s structure has posed the construction team a number of unique challenges.

“Steelwork was the ideal material for constructing this project,” says developer Sellar managing director Flan McNamara. “It has given us the required efficient structure with long cantilevers, erected on a constrained site with minimal disruption to pedestrians and traffic. Below ground steel and concrete columns allowed us to conduct a top-down programme, while an on site archaeological dig was ongoing.”

Below ground, the building’s foundations are constrained by a host of London Underground assets. This has demanded some innovative engineering techniques as pile locations are limited. Meanwhile above ground, the building’s steel framed floorplates expand outwards at level 3, with the aid of cantilevering spans of up to 15m.

The spans are not equal; they are longer on the east elevation than on the west, and this means the building is out of balance. In the north south direction it is again out of balance, because of the limited columns. To stop the structure from tipping, the cores provide the lateral stability, taking the gravity loads imposed by the cantilevers.

“Where we couldn’t pile we have installed non-load bearing columns, more architectural than structural to give the building a symmetrical look,” says Mace senior project manager Matt Massey. “In these areas the steelwork is all hung from the concrete cores.”

During the early part of the steelwork programme the site was rather busy and congested. After the majority of the footprint was cleared and the basement was being excavated, a team of archaeologists from the Museum of London came on site. The investigation unearthed a host of interesting finds including medieval remains and the walls of two Roman villas. Construction work had to continue around the dig and the installation of a total of 56 prefabricated steel plenum columns allowed main contractor Mace to progress the project.

The re-forming of the two cores was completed on time and they are supported on forty of the plunge columns. A number of large diameter bored piles have also been installed, including what is believed to be the UK’s biggest. “This pile is 2.7m diameter and 58m long; it was installed during one 20 hour long operation,” explains Massey. “It supports one of the main and most loaded columns in the building and it has to deal with loads of up to 32MN.”

With the cores complete, steelwork erection was able to commence and one of the first tasks was to form the slab of level 0, which effectively made a bridge or crash deck above the archaeological, allowing them to continue working safely while the Place’s structure began to rise up in earnest.

Another early part of the steelwork programme was the erection of a temporary safety canopy around the elevations spanning the bus station. Safety is paramount, and this heavy duty support structure consists of 6t of steel and could withstand drop loads of up to 8t.

A phased steel erection programme was used, due to the complexity and the long cantilevers.

Steelwork was initially erected up to level 3 using temporary props, as very few of the columns are load bearing. Above this, up to level 12 a temporary support system of Macalloy bars was used, holding the floors in place and allowing the props below level 3 to be removed.

The erection sequence involved Severfield-Reeve partially erecting the cantilever columns up to level 8 and then the Macalloy bars were suspended, holding each floor as it was completed.

“If each floor was completed we had to monitor and adjust the temporary Macalloy system,” says Richard Tarren, Severfield-Reeve Project Manager. “We had to keep to some extremely tight tolerances, otherwise the cladding programme would have been affected.”

The eastern side was initially erected to level 12 and then the western side followed. The remaining eight levels were then erected in a more traditional manner with the topping out taking place last June.

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“Only when level 12 was complete with the permanent hangers in place, giving us the permanent load paths, could the temporary props be released,” explains WSP technical director Jack Adams. “The loads from level 12 and from the permanent hangers are applied to the core through steel beams which are fixed to the core with embedded plates.”

One of the final steel elements to be erected were winter gardens which stretch from level 13 to level 15 on the western elevation. These were simply bolted onto the already completed framework in stages. The winter gardens are supported on one Y-shaped column, positioned at ground level and brought to site in three pieces.

“The Place is scheduled for completion in mid 2013.”

The Place

Steel solution: In many areas steelwork is hung from concrete cores

Steelwork was the ideal material for constructing this project. It has given us the required efficient structure

Flan McNamara, Sellar

Project: The Place, London
Main client: Sellar Property Group
Architect: Renzo Piano
Main contractor: Mace
Structural engineer: WSP
Steelwork contractor: Severfield-Reeve Structures
Steel tonnage: 6,700t

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Organic household waste solution

Bolton IVC plant
By Martin Cooper

The Greater Manchester Waste PFI scheme is the largest of its kind in Europe and steel framed buildings are crucial to the programme.

Worth £38m, the Greater Manchester Waste scheme includes the construction of 42 recycling plants for household and industrial waste in and around the UK’s third largest conurbation.

The overall programme is the largest such PFI in Europe and part of it includes the building of four In Vessel Composting (IVC) plants, designed by TEG Environmental, a specialist technology provider that designs, builds and operates sites that treat organic waste.

Many local authorities are now investing in IVC plants as they offer an environmentally friendly solution for recycling food and green household waste.

The completely natural composting process generally takes approximately two weeks, with a further six to eight weeks for the product to stabilise before being dispatched as fertilizer.

The programme started in May and this progress steadily. "It was important to get the steelwork up to allow the job to progress steadily," says Thomas Jagger. "We had to achieve a clear span and the correct design was important, as the waste intake area will have numerous vehicles manoeuvring. Internal columns, which could hinder vehicle movement, were out of the question, so a clear span 30m portal frame has been erected.

Interestingly, this part of the structure has been sawn off 90° from the rest of the steel frame in order to get the long clear spans. The building is 48m wide in the opposite direction and this was deemed too long for a single span. The zone directly behind the waste intake area, which houses the composting technology, is facing in the other direction and the 48m width is accommodated with a propped portal frame.

The three columns measure 18m, 12m and 18m, and accommodate the three silo cage composting lines. "We erected the steelwork for the area to house the composting lines first, followed by the waste intake area, to enable TEG’s specialist suppliers to proceed as quickly as possible," says Airey. "It was important to get the steelwork up to allow the job to progress steadily."

While steelwork erection was ongoing in one phase, bunkers and plinths for the silo cages were being cast simultaneously in adjacent zones. As Border was responsible for the entire package, it could organise all trades around one common roster.

Immediately after the steel frame was erected the cladding and roofing construction followed on behind, ensuring the structure was watertight as quickly as possible.

For the steel erection programme, Border used a 50t capacity mobile crane, while a mobile tower crane was utilised to install the cladding.

The building’s cladding consists of a traditional composite panel with a 200 micron thick external paint coating, which is applied internally as well as externally to protect it from the humid composting environment. Prior to erection the Bolton IVC is due for completion in March 2013 and the plant will start receiving waste in April 2013. TEG will remain on site during the commissioning phase, to oversee the operation and train the Viridor staff, who will eventually be running the site.

In Vessel Composting Process

1. Waste is delivered, put into bunkers and then shredded
2. Three lines of composting equipment process the waste
3. Waste is then stored in bunkers for up to eight weeks while it stabilizes
4. The final product is then sold as fertilizer

Column free: Long spans were important
Workington’s Northside Bridge reopened last month, three years after the original structure collapsed. Steelwork played a pivotal role in re-spanning the River Derwent.

The devastating floods of 2009 will not be forgotten in the north west of England for a long while. Human casualties aside, the effects are only now being completely rectified and the casualties aside, the effects are only

Some of which were recovered from the original bridge.

“Steel offers us a number of benefits, one of which was speed of construction,” says Capita Symonds project manager Alan Webb.

Main contractor Birse Civils started on site during August 2011 and completed the project in little over 14 months, achieving one of the client’s main objectives – namely having the new bridge open within three years of the old original structure’s demise.

Early works for Birse included the removal of the original bridge’s foundations and locating the service diversions. For the foundations a total of 72 bored piles were installed to a depth of 26m.

The structure’s two piers are positioned on both river bank. This negated a lot of potentially hazardous working near and in water and also resulted in a quicker construction programme.

But it was not the only reason for this design as Cumbria County Council project manager Jason Dixey explains: “During public consultations about the construction of the bridge, local people made it clear they wanted something that looked robust, and bearing in mind what happened to the old bridge, piers in the river did not seem appealing.”

Mabey Bridge fabricated, supplied and erected the steelwork package in three phases.

The structure was split into three segments for the construction programme.

The northern side of the bridge was erected over one weekend in February, followed a month later by the installation of the southern part. The northern side of the bridge comprised of six pairs of braced girders, three 30m long pairs and three 25m long pairs all incorporating the bridge’s haunch.

Sparing from river bank abutment, onto a pier and then over the river, the installation of the steelwork in the river so we had to weld the six pairs of girders into three long sections and lift them into place with a much bigger crane,” says Dilworth.

Mabey Bridge brought eight pairs of small girder sections to the riverside site to make the 46m long central span girders. Over a period of four weeks they were welded into the required longer lengths.

The cantilevering formwork – used to form the deck – was also installed on the steelwork before the lifting process, minimising even further the amount of work that would have had to be done over the river.

To do this work a Demag cc2800-1 crawler crane was needed. This unit has a lifting capacity of 800t, a 60m long boom, a 180t counterweight and took two days to assemble on site.

“During public consultations about the construction of the bridge, local people made it clear they wanted something that looked robust,” says Jason Dixey, Cumbria County Council project manager.

The original bridge collapsed and was swept away on 20 November 2009. Within weeks a temporary bridge was erected but last month, after three years, a new permanent crossing spanning the River Derwent and the A596 was opened.

The new 152m long, three span composite steel bridge has been erected in the same position as the former structure. It is supported on concrete piers with bored pile foundations and clad in sandstone some of which was recovered from the original bridge.

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Sparing from river bank abutment, onto a pier and then over the river, temporary trestles supported the structure between the pier and the abutments during the erection process.

“Once all of the girders were installed and the cross beams had been welded into place the trestles were removed as the steelwork was then stable,” says Birse Civils site manager Phil Dilworth.

Two mobile cranes were utilized for this operation, one 700t capacity unit to do the three gider lifts, and a smaller 60t crane to install the cross beams.

The northern section spans the A596 road, and, in order to install the steelwork, the project team had a weekend possession in place from a Friday night until the following Monday morning.

So successfully and quickly was the steelwork erected that the road was able to reopen on the Sunday lunchtime, – earlier than anticipated.

In a similar procedure the southern section, which is identical to the north, was then erected last April, leaving the middle 46m long mid span to be installed during May.

In order to avoid working in and over the river, the installation of the middle section was done slightly differently.

“We couldn’t put temporary trestles in the river so we had to weld the six pairs of girders into three long sections and lift them into place with a much bigger crane,” says Dilworth.

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“Installing the final sections of the bridge girders was a key moment in the delivery of the project.

“It was also significant in this case as it re-established the connection between the north and south banks of the River Derwent,” says Dilworth.
Economy with thermal mass

Thermal mass

Utilising thermal mass within a steel frame can reduce a structure’s CO₂ emissions while contributing to overall cost savings.

Many designers and engineers are looking to achieve the optimum thermal mass of a building to help minimise the energy required for cooling. This can ultimately save the client a lot of money otherwise spent on powering air conditioning units.

Rising energy costs and a possible increase in temperature over the next 100 years, due to climate change, have both prioritised the need to construct buildings in the most energy efficient way. Designers need to make use of thermal mass in buildings to address this issue.

Structural steelwork offers a number of benefits, such as cost efficiency and speed of construction, but using a structural steel frame can also offer the design team the perfect solution for an economic and cost effective method for achieving peak thermal mass.

It has been thought that large, heavy buildings can mobilise greater amounts of thermal mass than lightweight alternatives, sometimes resulting in specification of reinforced concrete frames. Thermal mass is, however, independent of frame material.

“It’s a common misconception that a building needs to have large volumes of concrete to achieve thermal mass,” says Mott MacDonald technical director Edward Murphy.

Thermal mass is the ability of a material to absorb excess heat. The element with the most thermal mass is the concrete in the floor slab and for this to work efficiently it requires the floor soffit to be exposed.

During the day, solar gain, electrical equipment and human activity generate heat, which warms the air in a building. Most structures would use air conditioning to artificially cool the internal environment, but if the concrete slab is exposed it can absorb and store heat during times of peak temperature, then release it later as internal temperatures fall at night.

Designing to effectively use thermal mass can remove the need for air conditioning. As mechanical cooling is energy intensive, this can have a huge impact on running costs, and will significantly reduce CO₂ emissions.

The steel framed solution, comprising steel decking and composite concrete floor slabs was decided on as the best solution to incorporate natural ventilation and thermal mass to control building temperatures.

Durham County Council design engineer Alasdair Cameron, says: “We wanted a naturally ventilated building with a design that would help cut-down running costs and lower emissions. We also wanted to increase the thermal mass by exposing the floors to allow them to absorb heat during the day and dissipate it at night.”

The building has achieved a BREEAM “Very good” rating.

“Thermal mass can, if designed correctly, be just as effective within an exposed hollow floor deck steel frame building as it can within a concrete frame.”

“In this instance we chose to use steel with hollow floor deck because of the cost and time efficiencies that it offered.”

As a result of using a steel frame, approximately 5% was saved on the cost of the frame and the job was completed four weeks earlier than would otherwise have been expected.
The steel sector’s new website – www.steelconstruction.info – has been hailed as one of the most significant developments in making steel related advice available to engineers and architects since the internet started, and is already proving popular since its launch on 1 October.

The new site brings together for the first time all the technical and cost information previously available across a variety of steel sector sources into one place. It is a Wikipedia based site that has been described as the free encyclopedia for UK steel construction, designed to be as easy to use and as comprehensive as possible - a first stop for technical guidance on steel construction.

The site is the result of a two-year development programme by Tata Steel, the British Constructional Steelwork Association and the Steel Construction Institute. Chris Dolling, BCSA Manager, Technical Development, said: “A survey confirmed that the internet has become the first port of call for architects and engineers looking for design guidance and other information, so the steel sector decided to provide a class-leading online resource to external sources of information. These core articles act as a roadmap to each topic, using links to more detailed information available from the sector and other external sources.

A number of online CPD presentations are also included, which enable users to take tests and download certificates for their records.

The steel sector has an ongoing pipeline of research and development, continuously updating its guidance in line with changes in legislation, standards and industry practice, and the already comprehensive site will be continuously updated as new information and guidance becomes available.

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At your fingertips

Website www.steelconstruction.info

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