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 UK 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 plunge 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 14m. The spans are not regular; 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 escape stairs as well as the main London Bridge Underground ticket hall, are all within the building’s footprint, sometimes only a matter of metres away from the basement walls.

With so many subterranean obstructions, column and pile locations were extremely limited and had to be carefully planned.

“Steelwork was the ideal material for constructing this project. It has given us the required efficient structure” Flan McNamara, Sellar

Project TEAM
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

Use structural steelwork was the answer.

The spans are not regular, 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.

“We had to keep to some extremely tight tolerances, otherwise the cladding programme would have been affected” Richard Tarren, Severfield-Reeve

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

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

Small footprint: The basement has to fight for space with the Underground
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 £3.8bn, 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 Bolton plant is the fourth IVC facility to be constructed by TEG in the PFI scheme, following on from similar builds in Rochdale, Bredbury and Taffs Well. “Together the plants will recycle 170,000t of organic waste per annum, Bolton IVC will deliver 50,000t of this material every year,” says TEG contract manager Nicola Rafferty.

All of the IVC facilities are housed within steel framed structures and Border Steelwork Structures has erected three of these projects on behalf of TEG.

“Cost, efficiency and the need for large clear spans were the main reasons why the IVC plants are all steel framed structures,” explains Thomas Jagger, a director at project architect TD Jagger.

“For the Bolton plant, Border has erected 340t of structural steelwork as part of its overall contract as envelope provider,” he says. “We are responsible for all internal civil works,” says Border Steelwork Structures senior contracts manager Stuart Airey. “It is the steelwork fabricator, supplier and erector; it has been beneficial for us to also take responsibility for the civil and building elements as well as the cladding and roofing of the plant, as all of these trades interweave around the completion of the steel frame.”

Border started on this former British Coal site, located on the outskirts of Bolton, last February. Previously Costain had completed a thorough ground improvement programme as a result of the steel frame.

“Border started on this former British Coal site, located on the outskirts of Bolton, last February. Previously Costain had completed a thorough ground improvement programme as a result of the steel frame. “Border started on this former British Coal site, located on the outskirts of Bolton, last February. Previously Costain had completed a thorough ground improvement programme as a result of the steel frame. “The requirement for three distinct zones dictated the structural design of the plant,” says Jagger. “We had to devise a way these could all be accommodated within a structure with no strange shapes; a steel portal frame was the best option.”

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 stabilises.
4. The final product is then sold as fertilizer.

IN VESSEL COMPOSTING PROCESS
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 opening of Workington’s Northside Bridge represents the last major hurdle to the county’s infrastructure recovery.

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 of which was recovered from the original bridge.

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

Main contractor Birs Civils started on site during August 2011 and completed the programme 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 Birs 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 25.5m long pairs all incorporating the bridge’s haunch.

Spanning from river bank abutment, onto a pier and then over the river, the installation of the bridge’s haunch. Spanning from river bank abutment, onto a pier and then over the river, the installation of the bridge’s haunch.

Once all of the girders were positioned on both river bank, 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.

“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.

Steel tonnage: 980t

Project value: £17.2m

Completed: The finished structure also spans a busy road

In place: A crane positioned on the river bank erected the bridge’s steelwork, negating the need for any potentially dangerous work in or over the water

“Local people made it clear that they wanted something that looked robust”

Jason Dixey, Cumbria County Council

Project team

Project: Northside Bridge, Workington
Main client: Cumbria County Council
Main contractor: Birs Civils
Structural engineer: Capita Symonds
Steelwork contractor: Mabey Bridge
Steel tonnage: 980t
Project value: £17.2m

‘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.

Mabey Bridge brought six pairs of small girder sections to the riverside site to make the 46m long centre 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.

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.

Mabey Bridge brought six pairs of small girder sections to the riverside site to make the 46m long centre 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.

“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. In fact the first 50mm to 75mm of an exposed concrete slab is the bit that does all the work – the thickness of material exceeding this is thermally neutral in its beneficial effects on 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.

“How thermal mass works

1. Human activity and solar gain generate heat during the day
2. Structure allows the free flow of air across exposed surfaces
3. Heat is stored in the structure by day and expelled at night by the flow of cool air across the exposed surfaces

“During the day, solar gain, equipment use and human activity generate heat, which warms the air in a building. The warmed air rises, flows across exposed surfaces and is absorbed into the building’s floor slab.

At night, cool air is allowed into the building and flows across surfaces which have been used to absorb heat during the day. These surfaces are then ready to absorb heat during the following day.”

St John’s Square

St John’s Square is a multi-use, four-storey council office block that formed part of a £19M redevelopment of Seaham town centre. The building houses a public library and cafe as well as offices for Durham County Council and Seaham Town Council.

The project team’s aim from the outset was to reduce running costs and strengthen the scheme’s sustainable credentials. The building needed to be kept cool in summer and warm in winter, sustainably.

A 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.
At your fingertips

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 internet based source for steel construction. It has already proven to be a great success with designers, which is no surprise as all the guidance they need can be found there and it couldn’t be more straightforward and simple to use.”

At the heart of the site is a series of over 100 interlinked technical articles written by steel sector experts and external consultants covering best practice in the use of steel. Topics covered include fire engineering, costs, sustainability and health and safety. These are all downloadable as pdfs and contain multiple links to other information sources. These care 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.

“IT IS A WIKIPEDIA BASED SITE
THAT HAS BEEN DESCRIBED AS
THE FREE ENCYCLOPEDIA FOR
UK STEEL CONSTRUCTION,
DESIGNED TO BE EASY TO USE
AND AS COMPREHENSIVE AS
POSSIBLE”

SteelConstruction.info
The free encyclopedia for UK steel construction information

Sectors
Multi-storey office buildings
Single storey industrial buildings
Retail buildings
Healthcare buildings
Education buildings
Leisure buildings
Residential and mixed-use buildings
Bridges

Key Resources
The Blue Book
The Green Books
Eurocode Design Guides
Target Zero Guides
Design software and tools
Continuous Professional Development

Topics
Cost of structural steelwork
Sustainability
Design
Fire and steel construction
Corrosion protection
Acoustics
Floor vibrations
Health and safety
Fabrication
Construction

CPD Events and Training
Continuous Professional Development
SCI Training Courses
Structural Steel Design Awards (SSDA)
Tata Steel / BCSA Student Awards 2012-13

Quick Links
Tata Steel Construction
Find a Steelwork Contractor
Find a Product Supplier
BCSA Publications and Online Shop
SCI Publications and Online Shop
New Steel Construction Magazine

1 SECTORS
Here you will find links to other parts of the site for information relating to various building types such as multi-storey offices, single storey industrial buildings, education and healthcare buildings as well as bridges. Links to external sources of information are also provided.

2 KEY RESOURCES
This section leads you to all the steel sector produced basic resources such as the Blue and Green books, Eurocode design guides, Target Zero (the steel sector low carbon buildings research initiative), design software and tools and online Continuous Professional Development presentations.

3 TOPICS
A vast amount of detailed advice produced after extensive research by the steel sector in areas like the costs of structural steelwork, sustainability, design, fire engineering, acoustics, floor vibrations is linked from here, including links to external sources. The cost of structural steelwork link, for example, leads to the results of a relatively new steel sector initiative to explain the key costs drivers for steel frames for different types of buildings, written by Gardiner & Theobald.

4 HOT TOPICS
Advice on life cycle assessment and embodied carbon can be located from here, as can the various sources of news provided by the sector like “New Steel Construction” magazine and regular steel special sections produced with magazines such as “New Civil Engineer”. From here can be found a section devoted to explaining what the site is all about, how it works and an overview of what it contains.

5 CPD EVENTS AND TRAINING
All training courses and Continuous Professional Development initiatives provided by the steel sector can be learned about here, as well as information on the Structural Steel Design Awards, the Tata Steel/BCSA Student Awards and SCI Training Courses.

6 QUICK LINKS
From here you can quickly access the Tata Steel construction website, information about finding and selecting a steelwork contractor (for which there is now a free searchable app listing BCSA members available for smartphones), the BCSA and SCI online shops where their publications are listed. “New Steel Construction” magazine, to which free subscriptions are available, can be accessed from here.