Produced in association with TATA STEEL BCSA

Urban hospital build in good health

Whether described as a hospital without beds or a health village, a new community NHS facility in Aberdeen, Scotland, seeks to radically improve the patient experience

PROJECT REPORT
RUBY KITCHING

Project	Aberdeen Community Health and Care Village
Main client	Hub North Scotland
Architect	JM Architects
Main contractor	Miller Construction
Structural engineer	Fairhurst
Steelwork contractor	BHC

When staff, patients and visitors enter the newly built Aberdeen Community Health & Care Village from December this year, they will experience a refreshing change from the drab prison-like layout typically associated with that of ageing general hospitals. This hospital-without-beds is curvy, not boxy; airy not claustrophobic; and attuned to human sensitivities, not just function.

The £29m development will be a community diagnostic and treatment centre providing minor surgery, radiology and physiotherapy among other services. The structure is now complete and the building is currently being fitted out by main contractor Miller Construction.

"We worked closely with the NHS to develop the spaces in terms of their function but also had to focus on the 'feel' of the place," says main contractor Miller Construction senior project manager Jim Hanna.

"It is a village and has open courtyards and bridge. When you walk in, it won't feel like you're walking into a hospital," he says.

To best serve the community, the development is located in the centre of Aberdeen, rather than on a more spacious site in the suburbs. This means that the centre can be more easily accessed using public transport. Client hub North Scotland's aim is to shift the balance of healthcare away from an acute hospital setting to more community-based facilities.

> **"Fortunately, steel lends itself to different layouts"**
> JIM HANNA, MILLER CONSTRUCTION

The Aberdeen Health Village will replace other health centres and local hospitals which currently occupy buildings soon to be disused.

A consequence of choosing an urban location for the Health Village is that the site is in a more built-up area, causing logistic challenges for Miller Construction.

Island site

The three-storey, 9,600 sq m facility is on a tight island site, enclosed by Frederick Street to the north, the A956 to the south, King Street to the west and Park Street to the east.

With little room for site storage, a steel framed solution with just-in-time delivery of members was deemed the easiest way to meet programme requirements to build the facility with minimal disruption to neighbours.

The tight radius of nearby roads limited steel members to 12 m lengths. Steelwork contractor BHC also installed steel-framed lift cores, precast stairs and metal decking for floors.

"Steelwork helps create the shape and the various complex elements," says Graham Miller, JM Architects project architect.

"The concept behind the project is for a village scenario, with the different services arranged around open courtyards and a large main entrance with an atrium."

The building consists of consultation and treatment rooms at ground and first floor and plant, meeting rooms and offices on the second floor.

The building's steel frame gains its stability from braced lift cores and K-bracing located in partition walls and above perimeter windows.

Miller Construction has been on site since spring 2012 when it cleared the site, installed piles and then excavated down 4 m for a new basement car park that occupies half the site.

Due to the many different activities taking place in the centre, room sizes vary across the site. Columns loosely follow a 7.5 m by 10 m grid in the basement car park, changing to 7 m by 6 m above ground.

A number of steel transfer beams accommodate the change in grid. Some members are pre-curved on the building's elevation.

"There were not many standard connections on this job," says BHC project manager Bobby McCormick. "There are very few right angles and lots of curves and skews and lots of different section sizes, although we were limited in beam depths over the car park."

Configuration complexity

Mr McCormick adds that the project's complexity was born out of the many different room configurations in the building. This meant that interfaces between trades and between steelwork and the building envelope had to be carefully co-ordinated.

Due to movement sensitive equipment being used in some rooms, the floors were designed to SCI guide P354 to ensure vibration response levels were acceptable.

Since the building is curved in plan, there is virtually no regular gridline or span. It meant that all contractors on site had to have a greater understanding of how each member worked, particularly when it came to temporary propping as the spans increased.

"We had to understand what was going on in every part of the development," Mr Hanna says.

"Fortunately, steel lends itself to different layouts and BHC's computer model helped us all understand the different geometries involved."

Mr Hanna adds that since there is a demanding schedule of servicing for this building, the three-dimensional model also helped to understand mechanical and electrical requirements.

The steel frame has been designed to accommodate future changes and partitions can be easily dismantled so that two small rooms can easily be converted to one larger room.

Construction had to proceed in phases due to site constraints leaving room for only one mobile crane on site for most of the construction period.

"We'd be putting the steel up on one part of the site while working on the new foundations on the other side," recalls Mr Hanna.

At peak, just two mobile cranes could be accommodated on the site, assisted by MEWPs.

£29m
Cost of the development

HOSPITAL WITHOUT BEDS

The Health Village has been designed to create a feeling of wellbeing using light, space and colour, incorporating the atmosphere and scale of a village with all services reached from a central 'village square'.

Four internal courtyards act as large lightwells, allowing natural daylight to penetrate the middle of the building. Transparency within the centre is achieved with an abundant use of glazed partitions and fully glazed footbridges that span the open courtyards.

The main reception, café, sexual health services, outpatient and X-ray facilities are on the ground floor; services such as minor surgery, physiotherapy, cardiac rehabilitation and dentistry are on the first floor and meeting rooms occupy the second floor.

SITE CHALLENGES

The basement comprises a reinforced concrete base slab, retaining wall on one side and a contiguous piled wall on the other three sides. Piling on the site had its own challenges due to the discovery of granite substructures of tenement buildings which previously occupied the site. Since the granite was too difficult to drill through or remove, some piles had to be repositioned.

The contractor also had to build the Health Village around a nineteenth century granary building situated in the north east corner of the site. The building is currently being used as a project office and its future use is yet to be decided.

During construction of the new centre, mobile cranes were prohibited from travelling over the granary building's foundations to prevent the nineteenth century substructure being overloaded.

PROCUREMENT

NHS Grampian, working with hub North Scotland, is building the Health Village using the new Scottish Futures Trust hubCo design, build, finance and maintain 25-year service concession contract. HubCos are procurement vehicles comprised of groupings of public authorities that partner with the private sector to deliver infrastructure.

The Trust seeks to increase the efficiency and effectiveness of infrastructure investment in Scotland. The Health Village is the first project in Scotland which has used this new procurement method. NHS Grampian is contracting with Sub-hubCo Aberdeen Community Health Care Village to create the Health Village.

www.cnplus.co.uk

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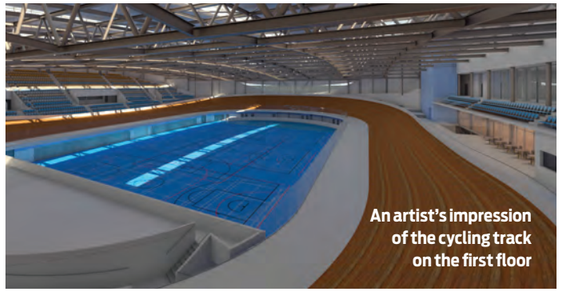
Arena steelworks on the right track

Construction of a steel-framed sports centre in Derby has reached the halfway mark and is already taking bookings for its opening in 2014

PROJECT REPORT
RUBY KITCHING

Project Derby Multi-sports Arena
Client Derby City Council
Main contractor Bowmer and Kirkland
Steelwork contractor Billington Structures
Structural engineer Arup
Architect FaulknerBrowns



An artist's impression of the cycling track on the first floor

The Derby Multi-sports Arena was one of the first Olympics legacy projects to get under way following last year's Games.

Earthworks began in October 2012 on the former car park site, with the erection of the arena's steel frame commencing in June this year.

Funded by Derby City Council and Sport England (which has invested £3m through its Iconic Facilities Olympic and Paralympic legacy fund), the 14,500 sq m arena is being built next to Derby County Football Club's Pride Park Stadium.

The arena is part of Derby Council's £50m investment in leisure facilities for the city.

The three-storey Multi-sports Arena will contain a main sports hall the size of 12 badminton courts at ground floor, a 250 m national standard indoor cycling track on the first floor and fitness studios and offices on the second floor. Plant and meeting rooms occupy the third.

Main attraction

The arena has attracted attention for its cycling facilities and is already taking bookings for when it opens in 2014. It will be the sixth indoor cycling track in the UK – others are located in Manchester, Glasgow, Newport (south Wales), Southampton and London. The Derby site will also include a 1.5 km outdoor closed cycle circuit.

Designed by architect FaulknerBrowns, the arena building is diamond-shaped with chamfered corners. Its main entrance is on the western corner and the oval cycling track sits east-west across opposite diagonals of the building at the first floor.

The centre of the track is open to the main sports hall below. This layout allows the arena the flexibility to be used as a 5,000-seater concert venue as well as for sports.

Steel erection has proceeded from the north side of the site to the south. The building has been spilt into four sections across the site to allow phased handover. Each quarter is completed up to roof level before the next phase gets under way.

Steel erection is currently focusing on hitting key dates for installing the pre-cambered 84 m long trusses at roof level over the main hall area.

Main contractor is Derbyshire-based Bowmer and Kirkland, with steelwork contractor Billington Structures. Billington is also installing precast stairs, terracing and hollowcore floors.

When *Construction News* visited the site in July, half the steelwork had been erected, including the curved steel beams of the inside edge of the cycling track. The impression created by the track is that of a dramatic balcony overlooking the main sports hall.

Two 75-tonne capacity mobile cranes lift most of the 700 tonnes of steelwork, assisted by MEWPs. But when the long roof trusses are being erected, two extra cranes are required.

The trusses are erected in up to four sections, depending on their length. There is usually enough room for cranes to move into the most appropriate position for all lifts, apart from when neighbouring Derby County is playing a home match, when site activity is confined to a much tighter footprint and the site car park is given over to the football club.

Timing is everything

With so much of the building being manufactured offsite – the steelwork, precast floors, stairs and terracing – the quality of finish will be high, but to keep on programme the contractor has had to keep a strong focus on site progress and timing deliveries correctly.

"Our main challenge on this project is to co-ordinate deliveries so that once the steelwork is up, we're not waiting for the precast units to arrive," says Bowmer and Kirkland project manager Scott Millington.

By September, the steelwork will be complete and the roof cladding will go on.

A specialist contractor is installing the cycling track to ensure it is built to the correct specifications and performance standards for competitions.

"The track will be installed next February, when the building will be enclosed and the internal temperature is within the correct range," adds Mr Millington.

As with any design-and-build contract, Bowmer and Kirkland is looking closely at the design to see how details and processes can work more efficiently.

The contractor is currently working on the building's 'eyelid' windows – slithers of glazing – which punch through the cladding. "Apart from sorting out their exact geometry, we're also looking at ways in which we can install the mullions [for the windows] with the cladding and then come back to fit the final glazing panels," Mr Millington explains.

Bowmer and Kirkland will hand over the building to client Derby City Council in October 2014. The arena is due to open the following month.

The sports arena halfway through the steel build showing steelwork to support terracing on the right and long spanning roof trusses

700
The amount of steelwork used in tonnes

> **"Our main challenge is to co-ordinate deliveries"**
> SCOTT MILLINGTON, BOWMER AND KIRKLAND

LANDFILL

Prior to being a car park, the site for the new Derby Multi-sports Arena was a landfill dating back to the 1960s. It was decommissioned and covered with a capping layer by the late 1980s. Pipes continue to release any gases which build up.

Bowmer and Kirkland's contract has involved relocating the 600 parking spaces to a nearby site and drive 1,300 precast piles between 8 m and 12 m deep into the ground for the foundations of the new arena.

Driven piles were considered to be the most suitable, since augured piles would have brought up contaminated soil from the landfill. The piles allow the structure to be supported by ground below the base of the landfill, since the landfill is liable to sink over time.

The contractor has also installed a network of pilecaps and groundbeams to correspond with column locations for the superstructure, so that none of the load from the superstructure or infrastructure is taken by the landfill element of the stratum.

"None of the structure actually sits on the ground [landfill]. The main hall is supported off piles; even manholes and drainage have to be supported off piles," explains Bowmer and Kirkland project manager Scott Millington.

ENVIRONMENTAL IMPACT

The arena will use a combined heat and power plant to generate electricity on site and provide heating and hot water for changing rooms and toilets. The target is for a BREEAM rating of Very Good.

Low environmental impact, durable cladding systems to minimise materials consumption and waste generation are also being used. To minimise materials consumption and road transport to and from site as far as possible, site materials are being reused in situ, or sourced from a local supplier.

The project has also adopted a comprehensive ecological management plan to minimise impact on the adjacent nature reserve and River Trent.

EDGE PROTECTION DETAILING

Bowmer and Kirkland has worked closely with steelwork contractor Billington Structures to design in temporary edge protection details with the main steelwork design.

"Holes are pre-drilled into the edge-beams for the edge protection fixings and coordinated with the final finish," says Billington project manager Kevin Meers.

The result is that edge protection in the form of metal barriers can be easily installed to a high standard at the same time as the main steelwork is erected.

It can then stay in place until the permanent edge protection – either cladding or railings – is installed.

Crucially, the edge protection's location in relation to the permanent cladding, shuttering or edge detail, has been carefully considered so that it can remain in place until the permanent edge protection can be used.

Produced in association with TATA STEEL BCSA

Walk through the fire protection process

A new guide from Tata Steel and the British Constructional Steelwork Association offers advice for fire-protecting most steel-framed buildings

FIRE SAFETY
RUBY KITCHING

Fire safety engineering involves a specialist designer modelling to understand how a unique building will react in a fire and designing-in fire protection measures to allow occupants to escape safely.

Such a building could be unique due to its height, shape, occupancy or location. However, for the majority of buildings, Approved Documents and British Standards give some pretty straightforward rules for how steel frames should be fire protected – for these cases, fire engineering is not necessary.

Until recently there has been a number of documents on the subject of fire protection that could be referenced.

70%
Market share of steel

Tata Steel and the British Constructional Steelwork Association have produced a single, comprehensive guide for fire protecting steelwork. *Steel Construction: Fire Protection* is a guide aimed at construction professionals rather than fire engineering specialists.

It "walks them through the process," says BCSA manager of fire and sustainability John Dowling, adding: "The guide will appeal to the majority of people working on the majority of building types."

The guide outlines the three-stage process for determining fire protection:

- Determine the 'fire period' through Approved Documents, BS9999 or specific sector requirements;
- Determine the 'section factor' for the structural steelwork;
- Determine the required 'fire protection'.

Fire periods define the length of time during the event of a fire when the load-bearing capacity of a building must function to allow all occupants to escape.

The section factor is governed by the shape of a steel member's cross section and exposure to the effects of a fire on each of its sides.

The section factor describes the time taken for that member to reach its failure or limiting temperature. For example, a heavy, massive section will heat up more slowly than a light, slender section.

The required fire protection, for systems such as intumescent coatings or board, can be determined from published tables.

The guide only outlines how to fire protect steel members and points to which documents to look in order to gain more detailed instructions.

Historically, steel is a material which has undergone more tests to determine its behaviour in a fire than most others, so the new guide also references these results via web links to the actual documents online or via www.steelconstruction.info.

"The guide also looks at the common fire protection systems, techniques and market trends to achieve the required fire period," Mr Dowling says.

Market share

Steel has consistently enjoyed around a 70 per cent market share for 14 years in the commercial, multi-storey sector – a steady rise from 33 per cent in 1980. "In part, this rise is due to the reduction in the cost of fire protection," Mr Dowling says.

The unit cost of fire protection has reduced over time as its demand has increased. The fire protection industry has also invested in research and development to improve the performance of coatings.

This has led to a reduction in basic cost or in the thickness which needs to be applied.

The most popular applied forms of fire protection are intumescent coatings, board or cementitious spray.

"Boards are generally used on columns to create a robust surface – particularly to keep finishes consistent with plasterboarded walls – whereas intumescent coatings are usually applied to beams," Mr Dowling explains. Intumescent coating is the most popular technique for fire protection (see box).

"Applying fire protection is a mainstream activity," he says. "Because of steel's high market share, most contractors are experienced in its installation, so it is very economical."

The guide outlines how specific building types have requirements for additional fire protection measures, such as sprinkler systems.

Sprinklers are an expensive form of fire protection, and are generally used only when they are stated as mandatory in Approved Documents, such as within school buildings.

Single-storey buildings, car parks, hospitals and shopping centres are also highlighted in the guide as building types which require special attention.

For open-sided car parks less than 30 m tall in England and less than 18 m tall in Scotland, for instance, the 15-minute fire period can be achieved using unprotected steel because most steel inherently has a 15-minute fire resistance.

Adequate protection

The unique properties of composite metal deck floors are also detailed in the guide and point to the fact that for this form of construction, fire protecting only the columns and primary members is adequate (see box).

Mr Dowling says: "It is an up-to-date document that describes how to provide fire protection to steelwork.

"It brings together information held in all other publications by Tata Steel and the BCSA as well as other sources, with more detailed information accessed via weblinks."

Steel Construction: Fire Protection will shortly be available to download freely from www.steelconstruction.info. Hard copies will also be distributed with the 20 September issue of *Construction News*

> **"The guide will appeal to the majority of people working on the majority of building types"**
> JOHN DOWLING, BCSA

COMPOSITE FLOORS

"Because of a phenomenon called 'tensile membrane action', the majority of composite floors in multi-storey construction could be designed to have fire protection only on the columns and primary beams, with secondary beams left unprotected," says BCSA manager of fire and sustainability John Dowling.

This is because a composite steel floor plays a crucial role in providing enhanced fire resistance, something which is not apparent in test results for single, isolated members.

Leaving beams unprotected enables the slab to develop tensile membrane action.

This is where the slab deflects but maintains structural integrity at higher temperatures.

With the composite floor slab developing tensile membrane action, secondary beams can be left unprotected. The guide points to a freely downloadable spreadsheet tool called TSlab from www.tatasteelconstruction.com which aids designers in designing the slab with sufficient reinforcement to bring about this phenomenon in a fire.

"The prime driver for developing composite floors was to save weight in a building and reduce floor depths, but this form of construction also has inherent enhanced fire protection benefits," says Mr Dowling.

INTUMESCENT COATINGS DOMINATE THE MARKET

The use of thin film intumescent coatings on steel-framed buildings has risen from a 20 per cent market share in 1992 to 75 per cent in 2012.

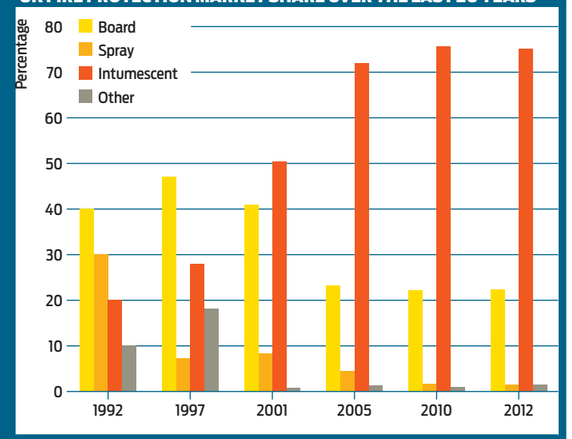
Intumescent coatings continue to develop, but those that are in use today are more efficient and more economic than those available 20 years ago.

Their cost, in real terms, currently stands at a fraction of what it was in the 1990s.

The market share for intumescent coatings has also been assisted by the increasing development of offsite applied systems, which now contribute 20 per cent to intumescent's total current market share of 75 per cent.

Cementitious spray systems that were commonly used on multi-storey buildings in the past are now rarely seen on buildings in the UK.

UK FIRE PROTECTION MARKET SHARE OVER THE LAST 20 YEARS



Other systems in the market include "partial protection", where the beam is cast into the depth of the floor slab that it supports, and also hollow sections, which are filled with concrete.

The information is taken from *Steel Construction: Fire Protection.*

NO EXTRA COST

Steel has dominated the multi-storey, non-domestic building market since the late 1980s and enjoys a market share of nearly 70 per cent.

The cost of fire protection is included in the overall price that has afforded steel its position; it is not an additional extra.

Advances in the science of fire protection systems over the years have further reduced the costs involved, making steel construction increasingly economic.

Produced in association with TATA STEEL BCSA

Steel brings new life to Longbridge

Longbridge in the West Midlands is undergoing radical transformation as a new town centre emerges from the former MG Rover car factory site

PROJECT REPORT
RUBY KITCHING

At the heart of the £1bn regeneration of the former car factory site in Longbridge, West Midlands, is a new park with the River Rea running through it.

When Austin Park – named after the Austin Motor Company which first occupied the site in 1905 (see box) – opens to the public this summer, it will mark a rebirth of the area.

For more than 100 years, this river has been buried and, along with the surrounding ground, suffered extensively from pollution from the car factory which extended across the site.

After an extensive clean-up operation where soil was removed and bio-remediated offsite and 20,000 plants, 550 trees along with grass and paths added, this much-needed green space for the area will demonstrate that Longbridge can move on from its industrial past.

Surrounding Austin Park will be the buildings which make up Longbridge's new £70m town centre: a college, hotel, residential blocks, a supermarket, restaurants, offices and shops.

The common theme of all these buildings, except for the college, is that they have all used steel-framed construction.

In fact, developer St Modwen has specified in its contract documents that steel construction is a "requirement".

Material of choice

"I've been here for 14 years and nearly all the buildings are steel," says St Modwen construction manager Mark Batchelor.

"We like it because of its speed of construction. You can still put it up in bad weather, it doesn't require much back-propping and you can span large distances and build in future flexibility."

Even the recently opened footbridge that crosses the River Rea in Austin Park is of steel construction (see box).

Phase one of the town centre development began with Bournville College, which was completed in 2011. But the main bulk of town centre construction has taken place since February this year and includes a 7,900 sq m Sainsbury's supermarket with offices and retail units (see box) which is due to open this month.

A four-storey "island block" of retail units, office blocks and a 75-bed hotel is also under construction. Here, restaurants and shops occupy the ground floor, and either the hotel or offices occupy the upper levels. Most of these units will be open by the end of this year.

St Modwen is submitting planning applications for phase two of the development, which will include an 11,150 sq m major retail unit, and 1,200-space multi-storey steel-framed car park as well as other retail units.

Phases three and four of Longbridge's regeneration will include more residential units and leisure facilities.

"Sustainability is high on our agenda and we aim to recycle as much as we can," says Mr Batchelor. "We like using steel because we know it can be reused in its later life."

He says that since contracts are signed with retailers before most units are built, all parties are keen to get construction under way as quickly as possible so that the businesses can gain returns on their investment as quickly as possible.

This is where steel holds court as St Modwen's construction material of choice. Steel-framed buildings are known to be quick to erect, he says, adding: "Offsite fabrication also means that the buildings are of a consistently high standard, which is reassuring for tenants.

"We also know from experience that a steel-framed building is easily adapted [to suit different tenants], which means that a design can be futureproofed, to some extent."

Mr Batchelor explains that on the Sainsbury's store project, the retailer wanted to have the option of adding a mezzanine floor at a later date, so the steelwork has been detailed, designed and erected accordingly. Using a steel frame also means that the space can be divided up in many different ways on the fly.

Adaptability for clients

"We frequently find, as we talk to end-users for the units, that they want a restaurant unit and a half, say, or something different to what we had planned. Having a steel frame which is designed for long spans means we can take out or put in partitions and we can accommodate these requests."

St Modwen expects to be building on the site for the next five years to complete the regeneration of Longbridge.

It has a government-approved master-plan, known as the Longbridge Area Action Plan, which was developed in conjunction with Birmingham City Council and Bromsgrove District Council as well as major landowners and transport bodies.

Mr Batchelor says that the timescale for development very much depends on the time taken to process planning applications, as well as the demand for new units. Regeneration of Longbridge is expected to create up to 10,000 jobs and 2,000 homes.

> **"We like steel because of its speed of construction. You can span large distances and build in future flexibility"**
> MARK BATCHELOR, ST MODWEN

> **"Sustainability is high on our agenda. We like using steel because we know it can be reused in its later life"**
> MARK BATCHELOR, ST MODWEN

LONGBRIDGE'S PAST

Longbridge is a 189 ha site located to the south-west of Birmingham city centre. Since 1905, the area has been dominated by the Longbridge car plant, which was established by Herbert Austin.

It has been home to the iconic Mini, along with a number of other famous brands including Austin and British Leyland.

Developer St Modwen acquired the site in 2003 and work to prepare the site for regeneration began in 2007 after the most recent owner, MG Rover, went bust in 2005. MG now has Chinese owners and retains a small research and development presence at Longbridge.

The first building to emerge on the site was the £100m Longbridge Technology Park in June 2007, followed by the 4,180 sq m Innovation Centre (a building made up of units used by high-tech starter businesses). Both are steel-framed buildings.

This steel-framed supermarket combines column-free space and flexibility for the future

£70m
Value of the Longbridge project

FOCAL POINT

In June this year, the 35 m-long footbridge across the River Rea in Austin Park Longbridge was opened officially. It is the main pedestrian link between the newly created town centre, Bournville College and future development phases.

With its single support, the steel structure aims to be a focal point for the park. St. Modwen senior development surveyor Mike Murray says: "The bridge's minimalist design is in keeping with our aim to create a high-quality green space, featuring footpaths, dramatic views and public art reflecting the site's automotive history."

SAINSBURY'S STORE, LONGBRIDGE TOWN CENTRE

Project Sainsbury's Longbridge
Main client St Modwen
Architect Holder Mathias
Main contractor Morgan Sindall
Structural engineer Rodgers Leask
Steelwork contractor James Killelea

The 7,900 sq m Sainsbury's store in Longbridge town centre also includes an underground car park.

Car parks can accommodate regular column arrangements to suit standard parking bay sizes – here a 16.5 m x 7.5 m grid has been adopted – but supermarkets generally prefer long spanning structures so that there is more flexibility in the way the space is divided up.

"Steel was the only material that could efficiently provide these requirements," says project engineer Kully Toor for structural engineer Rodgers Leask. "This is a typical car park grid, but above we've omitted alternate columns to get a much larger 16.5 m x 15 m open plan area for the store," he adds.

Approximately half the 475-space car park is positioned beneath the retail structure. Headroom in the car park is a standard 2.4 m, but above ground, the steelwork has been designed for a double-height space and to accommodate a future mezzanine level. This means columns are designed to account for this future load and are of larger section size, as are the foundations beneath.

The structural form of the store is a braced frame, with cross-bracing located in the perimeter walls. The 1,000 tonnes of steelwork consists of 1,630 individual pieces of hot rolled steel that need more than 20,000 bolts.

Produced in association with TATA STEEL BCSA

Power plant walks with dinosaurs

A new energy-from-waste facility in Oxfordshire follows the path of the three-toed Megalosaurus, which roamed the site 168 million years ago

PROJECT REPORT
RUBY KITCHING

Project	Ardley EfW plant
Client	Viridor
EPC contractor	CNIM Clugston Oxfordshire
Civils contractor	Clugston Construction
Process contractor	CNIM
Steelwork subcontractor	Bourne Steel
Architect and structural engineer	Tata Steel Projects

To divert municipal waste from landfills in Oxfordshire, recycling and waste management company Viridor is building a new energy-from-waste facility on a plot of land adjacent to its existing landfill at Ardley.

Construction of Ardley EfW began on the former limestone quarry site in 2011 after it had been meticulously cleared of Megalosaurus dinosaur footprints (see box). These three-toed carnivorous beasts inspired the shape of the sculptural, steel-framed building, which will process 300,000 tonnes of non-hazardous post-recycling residual waste from 2014.

Working on behalf of Clugston, Bourne Steel is erecting steelwork up to 35 m above ground level. Clugston's contract also includes design, installation and commissioning of building services as well as design and construction of a new access road, highway junction and reservoir.

To understand how the building works requires some understanding of the energy-from-waste process. Refuse lorries enter the building and tip waste down shoots in the 'tipping hall' and into a 7,200 cu m waste bunker. Overhead cranes with mechanical grabs then move the waste in batches from the bunker into a burning area, above which flue gases are filtered before they are released into the air.

Steam-driven

The burning waste heats water in pipes in the boiler hall and create steam that drives turbines in the turbine hall to create electricity, which is fed into the National Grid. The ash by-product is cooled and stored in open-air screened compounds, ready for disposal off site. The building also has plant and store areas and a four -storey administration block.

Clugston and Bourne's contract is to build the structure and roof of the waste-tipping area, waste bunker, turbine hall and office block as well as a roof over the boiler area and the ash storage and processing enclosures.

The Ardley facility is being built on the site of a former quarry

MEWP ACCESS TEST

Working around the huge pieces of plant that make up this facility has been one of Clugston and Bourne's biggest challenges.

Roof steelwork over the waste bunker was only accessible from one side so just half could be built using MEWPs at ground level. "We built a track over the hoppers for a MEWP to allow us safe access to the other half of the roof steelwork," says Bourne Steel's Mr Springett.

Complicating the project is the fact that the structure is curved in elevation and in plan.

Tata Steel Projects designed the complex curved steel superstructure with a high architectural specification, which needed to be integrated with the process steelwork.

Many of the major pieces of plant will be housed within a structure inside Bourne's steel frame. Erection and completion of the boiler is on the critical path.

"This [project] is essentially a piece of process equipment with a building around it," says Clugston senior project manager Anthony Warder. "The boilers and turbine are supported by a separate structure."

Work on site is currently proceeding on at least four fronts using two mobile cranes and a host of MEWPs. The whole building is up to 224 m long and 73 m wide.

300k
Tonnes of waste to be recycled at Ardley plant

The roof undulates between 15 m and 35 m above ground level (the highest point is made up of 17 m tall steelwork on an 18 m deep concrete bunker), so some of the highest reaching MEWPs in the country are being used.

Steelwork for the waste tipping area and bunker are being erected and involve installing 1,016 mm deep I-section beams, 828 mm deep I-section columns and 36 m long trusses made up of 203 mm deep column sections.

"The trusses arrive on site in three pieces and have to be erected using two mobile cranes," says Bourne project manager Kevin Springett.

The building is intended to be used 24 hours a day, every day, so the crane grab over the waste bunker will be in permanent motion and all of the structure connecting to it has to be designed to be exceptionally robust.

Tata Steel Projects' engineers provided the fatigue characteristics based on the weight, frequency and speed of travel of the crane and Bourne's designers identified critical areas that would require further testing, inspection and higher quality detailing, including increased weld runs. Main steelwork in the facility is galvanised to offer extra protection against corrosion.

Bespoke connections

With bespoke connections and curved beams, welding and cutting had to be right first time.

"Where a simple fillet weld uses one or two runs of welding and simple bolts, here we have up to 30 runs of welds and tension-control bolts," Mr Springett says.

The specified fabrication tolerances and geometrical accuracy on this project are higher than the industry standard (National Structural Steelwork Specification 5th edition) to prevent the movement of the crane inducing any out of plane stresses in the structure. Providing lateral stiffness to the beam-crane-bracket detail is a "surge girder" – a truss laid on its side made up of 203 mm-deep column sections – and a 1,016 mm deep I-section beam.

Rafters up to 24 m long made up of 828 mm-deep I-sections are also being erected over the covered ash storage area up to 20 m above ground. "When we design members, we consider how they will be lifted and erected," says its operation director Nick Hatton. "By carefully designing in lifting hooks, we can ensure they will be perfectly balanced when they are lifted by crane."

This is also standard practice for Bourne and means that, at any time in the future, the building can be easily dismantled. On visiting the site, it is easy to appreciate how essential these systems of work are as high winds frequently build up due to the low-lying surrounding area.

"It can often be too windy to erect light sections of steelwork high up. When this happens, we revert to erecting heavier sections lower down the building – we're often planning by the hour on site," explains Bourne site manager David Loan.

"It can get too windy to erect light steelwork. We often plan work by the hour on site"
DAVID LOAN, BOURNE

The roof over the boiler area will be built using long-reach cranes lifting complete prefabricated cassettes of cladding and structure, including 2.5 m deep trusses. Operatives in MEWPs on high level temporary platforms will fix the cassettes in jigsaw-fashion to complete the structure.

The £200m facility will be complete in 2014 and will divert at least 95 per cent of Oxfordshire's residual municipal waste from landfill, while generating enough electricity for about 38,000 homes.

Mudstone under the new building preserved footprints of the Megalosaurus

T-REX'S RELATIVE STOPS WORK IN ITS TRACKS

Oxfordshire is a known hotspot for dinosaur remains, and when footprints were found in the mudstone at the base of the former quarry at Ardley in 1997, construction of Viridor's energy facility had to follow a "dinosaur footprint protocol".

On discovering a footprint, earthworks had to stop, the print would be surveyed, photographed and recorded.

Related to Tyrannosaurus Rex, the three-toed Megalosaurus, which created the footprints at Ardley, would have been up to 7 m long and weighed about 1 tonne. Footprints were up to 800 mm long and 650 mm wide. It left them in mudflats that existed for a short time under a shallow sea. The imprints were preserved as layers of material built up on the sea bed.

IMAGES: ENGLISH HERITAGE