In association with
The British Constructional Steelwork Association
and Tata Steel

STEEL FOCUS: MEDIA CITY FOOTBRIDGE

A new footbridge designed by Wilkinson Eyre Architects over the Manchester Ship Canal at Salford uses steel to create a structure that is both functional and visually appealing

Text by Graham Bizley

Cable technology gets Salford in the swing

In May a distinctive new swing bridge spanning the Manchester Ship Canal will be completed, as part of the ongoing regeneration of the city's redundant docklands.

Media City Footbridge will expand the Media City UK development — which includes the BBC's northern headquarters — south to Trafford Quays. The £11 million bridge will improve pedestrian connections around Salford Quays, forming a circular route via the existing Lowry Bridge to the Lowry Centre and the Imperial War Museum North.

Beyond its functional role, a bridge has symbolic significance as a gateway, a creator of connections and as a place in itself. Designed by Wilkinson Eyre and engineered by Gifford, the footbridge has an elegant silhouette with eight tapering steel masts that rise above a slender, arching deck. Architecture and engineering have been integrated in a structure that is expressive and contextual. Steelwork is by Rowecord Engineering.

The bridge curves in plan in a radius centred on the drum of the Lowry Centre, a pattern set out in the masterplan to give a focus and coherence to future developments.

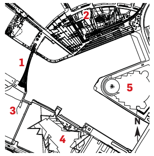
"It's incredibly efficient. Because the whole bridge is on a curve the centre of gravity is on the edge of the deck, which means you can support the deck on one side only," says Wilkinson Eyre associate James Marks.

The deck is supported by a series of stay cables that transfer the load over the steel masts and back down to a wider deck behind that acts as a counterweight. The whole structure can rotate about a pivot below the masts to allow ships to pass.

When it was completed in 1894 the Ship Canal was the largest navigation canal in the world. Although closed to commercial traffic since 1982, a public right of navigation still exists and closing it off with a fixed bridge would have prevented a potentially valuable asset being used in the future.

In its closed position the clearance is the same as that beneath the Lowry Bridge. The biggest design challenge was achieving the necessary height without the gradient becoming too steep or the access ramps too long.

The Highways Agency design criteria demand a maximum gradient of 1:20 for a footbridge but such a shallow slope would result in the approach ramps extending deep into the development site on the north side, impeding pedestrians using the canalside walkway. It was agreed that the navigation envelope could be relaxed slightly, and that a 1:15 gradient would be acceptable. At the north abutment the ramp is only 1.25m above the canalside walkway, maintaining visual continuity.

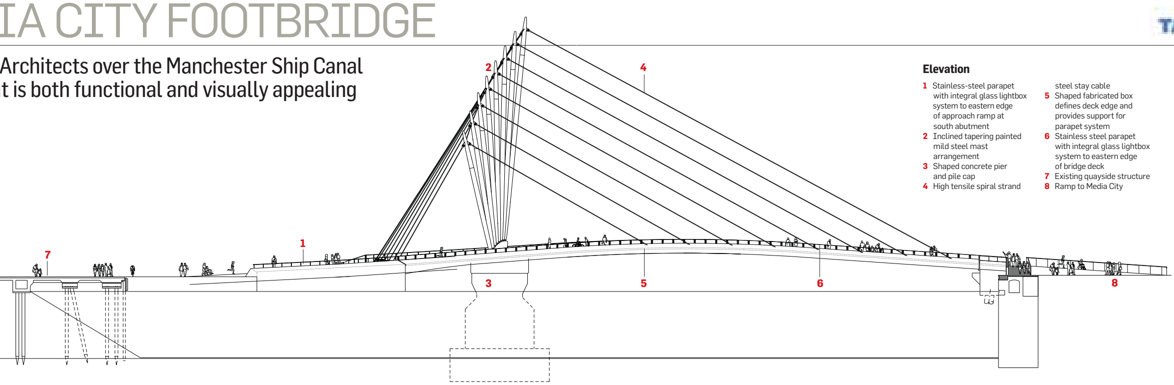


Site plan

1 Footbridge
2 Media City
3 Trafford Wharf
4 Imperial War Museum North
5 The Lowry

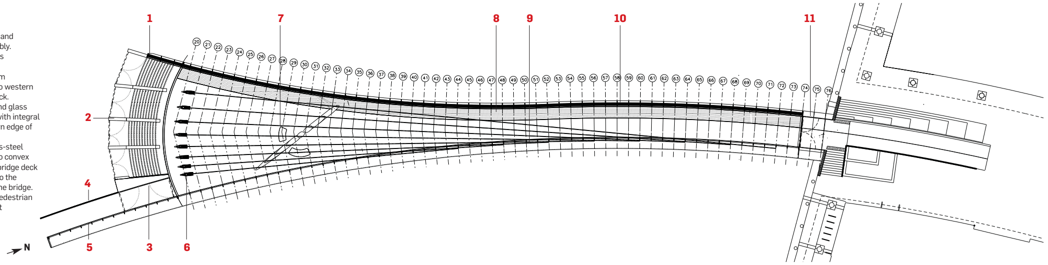
PROJECT TEAM

Client Peel Holdings
Architect Wilkinson Eyre Architects
Structural engineer Gifford
Mechanical engineer Atkins Bennett
Lighting designer Pinniger
Planning consultant S Wright Ltd
Construction management Bovis
Main contractor Balfour Beatty Civil Engineering Ltd
Steelwork contractor Rowecord Engineering



Elevation

1 Stainless-steel parapet with integral glass lightbox system to eastern edge of approach ramp at south abutment
2 Inclined tapering painted mild steel mast arrangement
3 Shaped concrete pier and pile cap
4 High tensile spiral strand steel stay cable
5 Shaped fabricated box defines deck edge and provides support for parapet system
6 Stainless steel parapet with integral glass lightbox system to eastern edge of bridge deck
7 Existing quayside structure
8 Ramp to Media City



Bridge plan

1 Inclined stainless-steel parapet system at concave western edge of stepped approach to bridge at south abutment.
2 Stainless-steel pedestrian barrier housing.
3 Stainless-steel barrier and control pendant housing.
4 Approach ramp: Cantilevered glass balustrade system system. Stainless-steel guardrail and demountable framed stainless-steel wedgewire panel.
5 Stainless-steel and glass parapet system with integral lightbox.
6 Fabricated stainless-steel and timber bench and anchorage assembly.
7 Plant room access hatch assembly.
8 Framed aluminium decking system to western edge of bridge deck.
9 Stainless-steel and glass parapet system with integral lightbox to eastern edge of bridge deck.
10 Inclined stainless-steel parapet system to convex western edge of bridge deck from gridline 52 to the northern end of the bridge.
11 Stainless-steel pedestrian barrier housing at north abutment.

The steel pivot mechanism rotates on a 4m slew ring.

OPENING MECHANISM

Concealed beneath the pedestrian deck is the pivot mechanism on which the bridge rotates.

A 13m-diameter reinforced concrete caisson foundation rests on bedrock 11m below water level. Above the waterline the visible section has a diameter of 7.3m.

The mechanism itself is steel, consisting of a female shoe cast into the concrete base and a cast male pin that rotates within it.

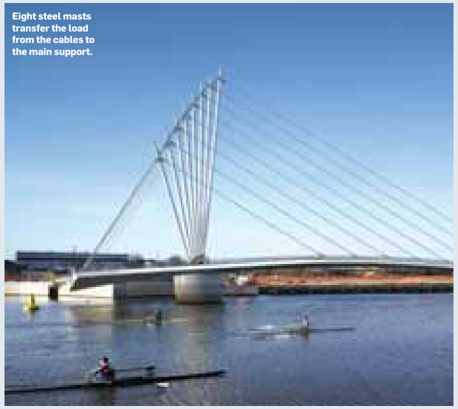
The pin is welded into the deck structure and to the mast base above. Three hydraulic rams fixed horizontally beneath the deck rotate the structure.

The pin rotates on a 4m-diameter slew ring which consists of two precision-made steel rings separated by a captive channel of ball bearings, similar to those used in tower cranes.

The slew ring absorbs all axial and radial forces and the resulting tilting moments.

Initially the design team tried a different approach because the lead-in time of one year for a slew ring was too long. When the economic downturn started, however, lead-in times reduced so that the manufacturers were able to supply the bearings within programme.

The deck opening mechanism sits on foundations 11m below water level.



Eight steel masts transfer the load from the cables to the main support.

PHOTO: DANIEL HOPKINSON

CABLE-STAYED BRIDGE

Media City Footbridge is an asymmetric cable-stayed swing bridge with a 65m main span. A cable-stayed design minimises the thickness of the deck and maximises clearance beneath.

The bridge was fabricated on land adjacent to the canal, from sections brought to site by road on low-loaders.

"Modeling the geometry was a major challenge and then we had to break it down into manageable loads that could be transported and welded together on site," says Gareth Summerhayes, contract manager at Rowecord Engineering.

To avoid the health and safety risks of working over water, as much work as possible was done on land before the entire structure was slid across on rollers and dropped on to its permanent concrete support in the canal.

At its narrowest the deck is 4m wide, flaring out to form a 16m-wide public space at the south end that counterbalances the weight of the main span.

Mast bases rest on steel joints.

Eight high-tensile spiral strand steel cables are attached to the concave eastern edge of the deck. These are parallel but are set out tangential to the curve so the support plane warps in the air, forming a dramatic sculptural canopy overhead.

Each cable is tied to its own steel compression mast that transfers the load down through the deck to the main support beneath the bridge. The masts are tied together at their tips to keep them in alignment.

At the bottom, each mast rests on a stainless-steel ball and socket joint that expresses the transfer of point load down into a welded steel base.

Uplighters are housed in bolt-on stainless-steel sheaths.

At the south abutment, pedestrians pass through a gateway formed by the eight cable-stay anchorages. A bench cantilevered from each anchorage prevents people walking into the cables and encourages gathering in the space beneath the cables.

The tapered shape of the masts was made by cutting out a section from a standard CHS steel tube and welding it back together so the resulting section is eye-shaped rather than circular at the ends.

Live loads on the structure will vary with pedestrian numbers and wind uplift. The bridge therefore has to maintain an equilibrium to ensure the cables always remain in tension.

In its closed position the nose and tail of the bridge engage with the abutments to provide support and limit deflection. The deck is lifted off these supports by a jacking mechanism when it opens.

STEEL DECK STRUCTURE

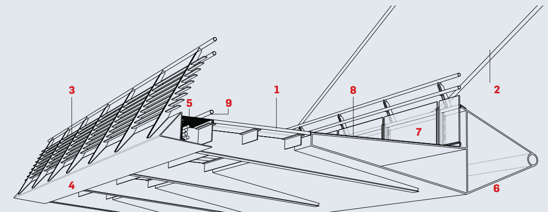
The deck is an orthotropic steel box, which means that the structural top plate forms the actual surface of the bridge, with stiffening plates beneath to transfer the loads back to the primary structure.

An orthotropic steel deck is considerably lighter than an equivalent concrete structure — an important factor for a swing bridge — and it allows the deck to be very thin, which helps reduce the gradient of the approach ramps. The deck surface is finished with a non-slip epoxy aggregate.

The box is trapezoidal in section, its faces angled to accentuate the form of the bridge and reduce its visual weight. Rather than bringing the plates to a point with an awkward weld, the leading concave edge is made from a CHS tube that blurs the transition from top surface to soffit.

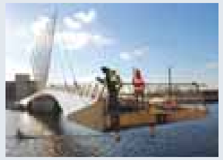
On top the box has a vertical face that incorporates a lightbox to illuminate the walkway. On the western edge the deck surface changes to perforated aluminium through which the water can be seen below.

The aluminium decking sits on transverse steel beams cantilevered off the main box beam, expressing the relative thinness of the western side.



Deck detail

1 Continuous perforated, non-slip aluminium decking system. Nominal width 1.5m
2 High tensile, spiral strand steel stay cable
3 Inclined stainless-steel parapet system to western edge of bridge deck
4 Shaped fabricated box defines deck edge and provides support for parapet system
5 Demountable, framed stainless-steel wedgewire panel system at floor level to western edge of brick deck
6 Fabricated steel deck box
7 Stainless-steel and glass parapet system with integral lightbox to eastern edge of bridge deck
8 Non-slip epoxy aggregate surface finish in silver-grey
9 Continuous stainless-steel guardrail at low level



The steel construction means the deck can be very thin.

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STEEL FOCUS: RST AUDITORIUM

TATA STEEL BCSA In association with The British Constructional Steelwork Association and Tata Steel

Taking the lead role in Stratford's revival

A versatile steel structure was at the heart of Bennetts Associates' Royal Shakespeare Theatre

Text by Pamela Buxton

After a three-year construction programme, the Royal Shakespeare Company's reworked theatre complex in Stratford-upon-Avon was officially opened last month and stage productions have begun in the main auditorium.

This was the most complex space in the entire project, and the last to be completed. One of the priorities of Bennetts Associates' design was to create a greater intimacy between the 1,040-strong audience and the actors by halving the maximum distance from seat to stage. This was achieved with a thrust stage and also through the use of a steel structure that plays both a functional and aesthetic role in the design of the auditorium.

Steel was a natural choice for the framework because it allowed a slimmer structure than concrete or wood. This assists sightlines and helps the architects to bring the audience closer to the stage.

Bennetts was also keen to take a different approach in the main auditorium to the timber structure of the far smaller Swan Theatre at the RSC. Instead, a "scaffold" of exposed architectural steelwork columns and beams was used to support faceted balconies of seating around the auditorium. Above this are two further steel structures unseen by the audience: three levels of lightweight technical bridges suspended from giant roof trusses which span over the new flytower and rest on the concrete frame of the building.

"Steel achieves a delicacy of construction. Every millimetre counts in this space — it really does make a difference. The slimmest construction is absolutely essential," says Bennetts Associates director Simon Erridge.

The emphasis was on as lightweight a steel construction as possible in order to minimise the load and piling requirements, especially in a difficult waterside location. In total, the auditorium contains approximately 650 tonnes of steel.

Overall, the theatre complex is expected to have a 20% smaller carbon footprint than the original theatre, assisted by the use of cross-laminated timber floor panels instead of precast concrete.

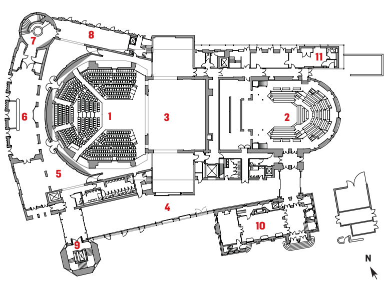
Although the auditorium has been designed as a permanent structure, the steel structure could be dismantled to allow the whole space to be reconfigured.

"It's a steel armature that can be changed, and the expression of the steel elements supports that," says Erridge. "If you really wanted to, you could unbolt it in 30 years' time and redo the auditorium."

Above: Aerial view of the theatre's construction.

Right: The slim steel structure is both aesthetically appealing and allows the audience to sit closer to the stage.

PROJECT TEAM
Architect Bennetts Associates
Engineer and transport consultant Buro Happold
Theatre consultant Charcoalblue
Construction management Mace
Acoustic consultant Acoustic Dimensions
Project management & strategic planning Drivers Jonas Deloitte
QS and planning supervisor Gardiner & Theobald
Steelwork contractors Billington Structures (primary steelwork); CMF (auditorium steelwork)



Ground floor plan
1 Royal Shakespeare Theatre
2 Swan Theatre
3 Stage and wing spaces
4 Colonnade
5 Foyer void
6 Scott foyer
7 Fountain staircase
8 Café
9 Theatre tower
10 Library and reading room
11 Stage door

AUDITORIUM STRUCTURE

The auditorium seating is arranged on three levels around a 7.2m-wide, 10.25m-deep thrust stage that protrudes from the proscenium. The stalls seating rests on a concrete slab supported on a steel sub-frame.

Ten exposed cruciform columns support the lightweight steel structure that holds the circle and upper circle seating. The ring beam structure is fixed back to concrete cores behind the timber-clad walls of the auditorium.

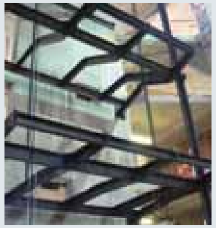
The slender columns measure 10m high, including 1m concealed below auditorium floor level, and are set approximately 4.5m apart, breaking up the large audience into small pockets of approximately 30 seats. In all, there are 24 types of seats, including five width variants from 450-555cm. The steel structure is left exposed, including the ribs of the underside of the circle balconies, which have painted plywood soffits.

To ensure the columns aren't too prominent and don't interfere with sightlines, they are positioned one row back from the front of the balcony and this front row is bolted on to the structure and cantilevered out.

An extra stipulation was that the two seating bays closest to the proscenium had to be demountable at circle, upper circle and technical area level to give production designers the flexibility to use large pieces of scenery near the proscenium. These wedge-shaped blocks can be unbolted from the rest of the structure if required.

In all, more than 500 components were manufactured for the auditorium, according to Paul Tierney, associate director of CMF, the steelwork contractor responsible for the exposed steelwork in the auditorium, which had a team of more than 40 working on the job. All welding was done off site, thus limiting the time spent constructing the structure in the auditorium where it was bolted together.

One of the biggest challenges was incorporating all the ventilation, fire, IT and electrical servicing within the slim auditorium, especially the need to bring large amounts of cabling to lighting bars at the front of the balconies.



The lightweight steel structure that holds the circle and upper seating is supported by 10m high columns.

AUDITORIUM INTERIOR PHOTOS: PETER COOK; CONSTRUCTION PHOTOS: RSC/STEWART HEMLEY AND BENNETTS ASSOCIATES

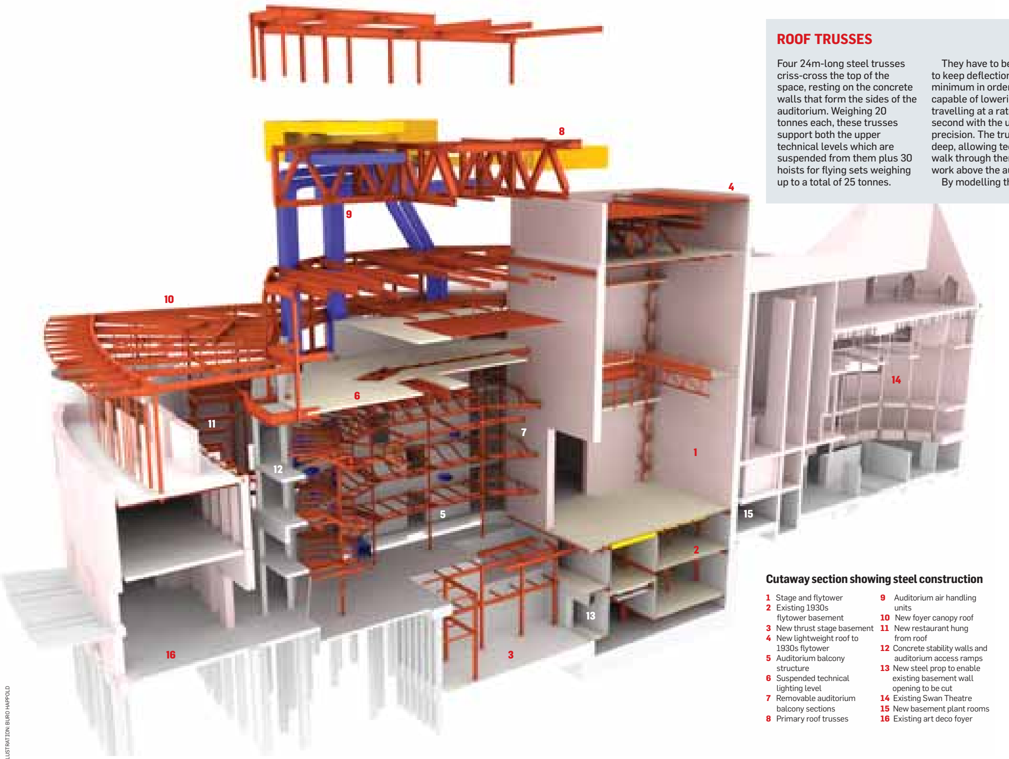


ILLUSTRATION: BURO HAPPOLD

Cutaway section showing steel construction
1 Stage and flytower
2 Existing 1930s flytower basement
3 New thrust stage basement
4 New lightweight roof to 1930s flytower
5 Auditorium balcony structure
6 Suspended technical lighting level
7 Removable auditorium balcony sections
8 Primary roof trusses
9 Auditorium air handling units
10 New foyer canopy roof
11 New restaurant hung from roof
12 Concrete stability walls and auditorium access ramps
13 New steel prop to enable existing basement wall opening to be cut
14 Existing Swan Theatre
15 New basement plant rooms
16 Existing art deco foyer

ROOF TRUSSES

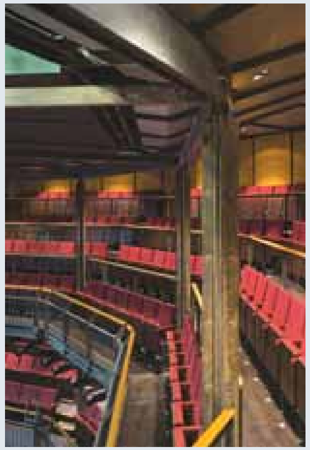
Four 24m-long steel trusses criss-cross the top of the space, resting on the concrete walls that form the sides of the auditorium. Weighing 20 tonnes each, these trusses support both the upper technical levels which are suspended from them plus 30 hoists for flying sets weighing up to a total of 25 tonnes.

They have to be stiff enough to keep deflections to a minimum in order to be capable of lowering scenery travelling at a rate of 2.5m per second with the utmost precision. The trusses are 3.4m deep, allowing technicians to walk through them as they work above the auditorium.

By modelling the effect of a fire on stage, Buro Happold was able to show that the trusses and other technical steelwork did not need a fire protective coating — which would have been problematic given that they are constantly handled and clamped when in use. In this way the need for a safety curtain between the proscenium and thrust stage was avoided. Large smoke extract fans are installed in the roof.

The original flytower has been refurbished and the old concrete roof replaced with a lighter weight steel and timber roof. This allows more of the structural load capacity to be given to supporting theatre services.

Steel beams fan out from the concrete walls.



Steelwork in the auditorium was left untreated for a raw finish.

UNTREATED STEELWORK

The architect's initial instinct was to paint the exposed auditorium steelwork, or to shot-blast it. Eventually, it was decided to leave it untreated, except for a clear lacquer to preserve the finish.

CMF similarly left the raised welding on the auditorium structure intact rather than grinding it off, as would be more usual, putting more pressure on the welders to make sure their welds all matched and lined up perfectly.

"Not to clean up the welds goes against the grain," says CMF's Paul Tierney. "We had to relay a few welds where the guys had naturally cleared them up."

Project architect Alasdair McKenzie adds: "You get a sense of it being handmade and that's deliberate. All the columns are very different — some are orangey, some blue."

This ties in with the broader design decision to have rawer material finishes in the auditorium — rough sawn oak timber panels are visible on the rear walls and exposed brick around the proscenium — in contrast with the more highly finished foyer areas.

Mock-up of auditorium steelwork showing exposed welds.

In association with The British Constructional Steelwork Association and Tata Steel

New research will help architects maximise low-carbon design

Target Zero guidance on achieving low-carbon buildings has been launched by the BCSA and Tata Steel. Here are three steel-framed projects featured in the research

Text by Pamela Buxton

What is Target Zero?

Target Zero is a £1 million research programme set up to provide free guidance on the design and construction of sustainable, low- and zero-carbon buildings in the UK. It is funded by Tata Steel and the British Constructional Steelwork Association (BCSA) and has been carried out by a consortium of sustainable construction organisations including AECOM and Cyril Sweett.

The guidance analyses five non-domestic building types — a school (Christ the King Centre for Learning, Knowsley), a distribution warehouse (DC3, Prologis Park, Stoke), a supermarket (ASDA food store, Stockton-on-Tees), a medium-to-high-rise office (One Kingdom Street, Paddington) and a mixed-use building (Holiday Inn, Salford Quays).

In each case, the designs are modified to a base level compliant with 2006 Part L before introducing the latest Building Regulation changes.

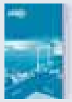
The research focuses on how Very Good, Excellent and Outstanding Breeam ratings can be achieved and at what cost; quantification of the embodied carbon in buildings with different structural forms; and how operational carbon can be reduced by incorporating energy-efficiency measures and low- and zero-carbon technologies.

Want to know more?

The first three guidance reports — Schools, Warehouses and Supermarkets — can be downloaded now from the Target Zero website with the final two — Offices and Mixed-Use — to follow soon. **www.targetzero.info**

SCHOOLS
This first Target Zero report was based on Christ the King Centre for Learning in Knowsley, Liverpool, built by Balfour Beatty and opened in January 2009. Occupied by 900 pupils and 50 staff the 9,637sq m steel-framed building is based on a 9m x 9m structural grid and requires mechanical ventilation.

WAREHOUSES
This study is based on the 34,000sq m DC3 warehouse at ProLogis Park, Stoke, which was completed in December 2007. The report was written before the government introduced its feed-in tariffs for renewable energy sources in April 2010. A revised report will be published shortly.



SUPERMARKETS
The supermarket report is based on Asda's food store at Stockton-on-Tees in Cleveland, completed in May 2008. The building has a floor area of 9,393sq m over two levels. The retail floor area, including a 1,910sq m mezzanine level, is 5,731sq m.

One Kingdom Street is designed around two central atriums, which help reduce solar gain.

ONE KINGDOM STREET PADDINGTON CENTRAL, LONDON

ARCHITECT
SHEPPARD ROBSON
STRUCTURAL ENGINEER
RAMBOLL
M&E ENGINEER
AECOM

Rated Breeam Excellent, Sheppard Robson's One Kingdom Street offices for Development Securities was one of the first UK office schemes to incorporate carbon footprinting of the construction process throughout the supply chain.

Completed in 2008, the 24,000sq m building provides typical floor plates of 2,500sq m with floor-to-ceiling glazing on all facades. Accommodation is arranged over 10 storeys and around two central atriums. It has a 12m x 10.5m steel grid comprising fabricated cellular steel beams supporting a lightweight concrete slab on a profiled steel deck. The £65 million building sits on a podium over the route for Crossrail and steel was the only structure able to span the gaps between the beams in the substructure.

Carbon reduction was considered from the onset of the project's design, right from the orientation of the building through to the facade design and the specification of the building systems.

"The design originally had a large atrium on the north but we changed it to the south because it offered a better buffer to solar gain," says Sheppard Robson partner Mark Kowal.

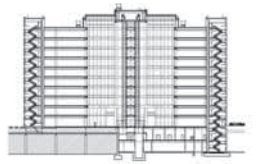
The main vertical escape and service cores are at the east and west ends to minimise sun penetration. On the south side, the main circulation core and atrium act as a buffer between the external environment and occupied floors. Offices that do engage with the south facade are protected by external horizontal deep louvres.

The building achieved its Breeam Excellent rating with the help of geothermal piles to provide ground source cooling and the use of renewable energies such as solar roof panels. An active chilled beam air-conditioning system was considered but at the time this wasn't widely accepted by clients and investors and so was not used. However, perceptions of this technology are now changing.

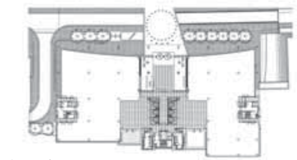
"The ethos of One Kingdom Street is about trying to reduce carbon in the whole delivery process. It's not just about sticking in clever gizmos," says Neil Burns, director of operations in Europe at Aecom. "It has done well to optimise the balance between lighting levels and energy consumption."

Kowal has noticed an increase in emphasis on low-carbon design since the creation of One Kingdom Street. "It's genuinely being driven right through the design process, even by the clients," he says.

Burns adds that it is important the quality of the environment isn't neglected. "It's no use having a low-carbon solution that no one wants to occupy," he says.



Long section



Ground floor plan

What the Target Zero report says: The Target Zero report is on an amended version of the building stripped back to just satisfy the requirements of 2006 Part L. Measures are then re-added and measured for efficiency and cost.

A package of the most cost effective energy efficiency measures costs 0.3% and yields a 42% saving in regulated emissions, which well exceeds 2010 Part L requirements. To achieve Breeam Outstanding would require 9.8% more capital cost compared with 0.2% and 0.8% respectively for Very Good and Excellent.

Lighting accounted for 27% of carbon emissions. The impact of the structure on operational emissions was small — varying 0.5% between post-tensioned concrete and a steel frame composite.

HOLIDAY INN MEDIA CITY UK, SALFORD

ARCHITECT
FAIRHURSTS DESIGN GROUP
STRUCTURAL ENGINEER
JACOBS
BUILDING SERVICES CONSULTANT AECOM

The hotel is next to the studios.

Completed in late 2010 for client Peel Holdings, the Holiday Inn building is attached to the main studio building in the Media City UK complex in Salford. Chosen as the mixed-use case study in the Target Zero guidance, this north block consists of two levels of hotel reception facilities, plus five floors of studio offices and eight floors of hotel rooms above that.

The entire building is rated Breeam Very Good, assisted by the Trigen Combined Heat & Power system that provides heating, cooling and hot water for the whole of the complex.

Architect Fairhursts had to contend with changing uses — the south tower was initially residential before changing to office use, and in the north tower, Fairhursts is looking at fitting out the office floors as hotel bedroom floors.

Building services consultant Aecom looked initially at passive methods of reducing energy needs such as beefing up the thermal performance of the building fabric and glazing systems that went into it. But Aecom concluded that utilising heat recovery and CHP systems was far more effective, especially on a site with diverse uses.

"With building regulations getting tighter anyway, extra investment in the fabric wasn't giving the same measure of reduction as something more active," says Graham Millard, regional director of Aecom.

"If you had a single use building, increasing its thermal fabric requirements might have been more effective. The more diverse the uses, the more advantageous CHP is."

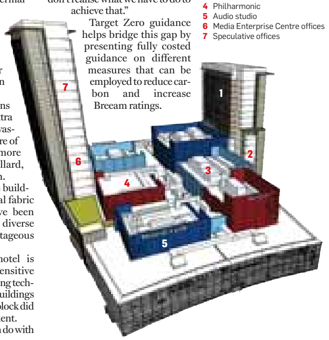
Energy use in the hotel is reduced by occupation-sensitive lighting and air-conditioning technology. Unlike the other buildings on the site, the mixed-use block did not achieve Breeam Excellent.

"There's not a lot you can do with studios — they use a lot of energy. It's the nature of the beast. It's not easy to achieve any more than Very Good," adds Fairhursts associate director Trevor Cousins.

He says architects and clients are still learning about how to achieve low-carbon buildings. "Clients want Breeam Excellent but they don't realise what we have to do to achieve that."

Target Zero guidance helps bridge this gap by presenting fully costed guidance on different measures that can be employed to reduce carbon and increase Breeam ratings.

Plan strategy
1 Hotel
2 Production offices
3 Studios
4 Philharmonic
5 Audio studio
6 Media Enterprise Centre offices
7 Speculative offices



CHRIST THE KING CENTRE FOR LEARNING KNOWSLEY, LIVERPOOL

ARCHITECT AEDAS
STRUCTURAL ENGINEER / M&E ENGINEER AECOM

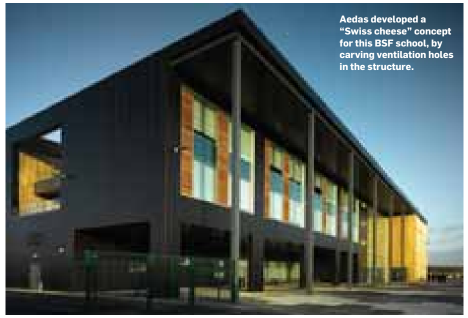
Balancing educational needs with environmental performance was a key challenge for architect Aedas in its design for Christ the King Centre, one of seven BSF schools designed by the firm in Knowsley.

Completed in 2008, the 9,637sq m building accommodates 900 students, although it is now threatened with closure owing to falling pupil numbers. It is based on a 9m x 9m structural grid and has a Breeam Very Good rating.

One of the biggest issues was the client's stipulation for 80sq m classrooms grouped around a centralised learning zone for each key stage. This led to a deep plan for the three-storey building, with Key Stage 3 accommodated on the top floor, Key Stage 4 on the middle, and specialist-teaching accommodation on the ground floor.

Unfortunately, says Aedas associate director Rob Hopkins, environment and educational priorities were "almost at opposite ends of the spectrum".

"As soon as you have a school where classes are deeper than 7.5m, being able to use natural ventilation and daylight becomes challenging," he says. "So we developed a 'Swiss cheese' concept where we carved holes into the building that swept down so you could naturally ventilate." He adds that M&E engineers in the end went for mechanical ventilation after it was decided to use a steel frame rather than post-tensioned concrete.



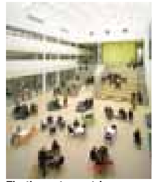
Aedas developed a "Swiss cheese" concept for this BSF school, by carving ventilation holes in the structure.

Section

Very low sill levels in classrooms made the most of the daylight. "Wherever you were, you had a nice view," says Hopkins.

Where the school did score well in carbon reduction was the use of ground source heat pumps and heat-recovery technologies installed by Balfour Beatty across all the Knowsley BSF schools. "That really helped us to reduce the carbon footprint," he says.

In the years since the Knowsley BSF, low-carbon has become a higher priority in Aedas's school designs, which now gain Excellent or Outstanding Breeam ratings.



The three-storey atrium.

"Knowledge is improving very quickly," says Hopkins. "In 2007, [low-carbon] conversations rarely took place unless it was a specifically low-carbon school design. Now, these conversations take place on every school we design."

Hopkins welcomes new guidance on designing low-carbon buildings: "Any information that is easy to digest is vital, as is being able to look at a number of different sources for that information."

What the Target Zero report says: For a version of the school stripped back to "typical practice" (e.g. just compliant with 2006 Regs etc.), the capital cost uplift needed to achieve Breeam Very Good was 0.2% compared with 0.7% for Excellent and 5.8% for Outstanding.

Cancelling out regulated carbon emissions with on-site low carbon technologies would cost 12% more. The guidance found a significant proportion of embodied carbon was in the substructure, and that the best results were obtained using steel piles. The structure had virtually no impact on operational carbon emissions — with less than 1% variation between steel and concrete.

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