Beam me up

Feilden Clegg Bradley Studios overcame space restrictions for a new east London secondary school by constructing its sports facility over an existing council car park

Text by Pamela Buxton **Photos by** Adam Scott

Concepts of gravity and levity informed Feilden Clegg Bradley Studios' steel-framed design for the Isaac Newton Academy in Ilford, east London, a 1,250-pupil school specialising in maths and music.

The narrow site was tightly constrained by a cemetery, terraced housing and a Redbridge Council-owned car park, which had to remain operational during and after construction. The brief specified 11,700sq m of accommodation, but building high to compensate for the small footprint was not an option because of height restrictions owing to the proximity of the housing. An added complication was the organisation of the school into effectively four separate year stages (key stage 3 A and B; key stage 4; key stage 5), each with its own entrance/reception and outdoor play area.

Faced with the prospect of providing a deep block without the quality of natural light and outdoor spaces they wanted, the architects took the risky step of instead proposing a double-height "sports beam", projecting 55.8m out of the main building beyond the school's original site boundaries and over the car park, supported on two-storey steel columns.

"It seemed virtually impossible to fit all the accommodation within the buildable area without seriously compromising the plan," says project architect Akos Juhasz.

"We very much wanted to avoid dark, double-loaded corridors and provide natural light and views for most spaces, including circulation. We could only achieve that by breaching the building line suggested in the guidelines by raising the sports hall above the car park."

This strategy allowed the architects to provide the other school facilities in an interlocking four-storey main block, permeated with outdoor space in the form of courtyards and roof spaces.

According to the practice, the massing of the two elements was also partly a response to the work of Isaac Newton.

"There is the idea of levity versus gravity with the two volumes," explains studio leader/partner Andy Theobald. "One, a heavy brick block with most of the accommodation; and the other, a metal box hovering over the car park providing the levity." These two concepts could also suggest that the academy is both rooted and aspirational, says the design team.

According to engineer Hardip Bansal, a steel structure was chosen for construction speed and because it suited the long spans of the sports beam, as well as the complexities of working over an operational car park. The lack of structural continuity throughout the main building precluded a reinforced concrete flat slab solution.

This primary structure was combined with exposed precast concrete floor slabs and highly insulated SIPS panels clad with buff brick on the elevations. These brick slips were used clearly by the architects as tile-like cladding rather than as a tectonic element, with the width of the brick bond changing across the elevation to create a pattern based on the Fibonacci mathematical sequence. Areas of stack bonding with aligned vertical joints also reference the stacks of bricks that would have been on the site when it housed a brickworks in Victorian times.

The main entrance is positioned under the sports beam to the north of the site, leading to a zone of specialist teaching areas with access from each key stage. These include drama/dinner hall, science, art and music. The dinner hall will have a first-floor gallery to aid its secondary function as a studio theatre.

Key stage 3 A and B are located side by side on the ground and first floors towards the south of the site. Each has classrooms at the perimeter and a common space that opens up onto a central courtyard. Positioned next to each other, these two gathering spaces can be used together for joint assemblies if needed. Key stages 4 and 5 are positioned on the second and third floors respectively, each with its own breakout space to supplement the limited external play areas. These external spaces permeate the plan of the main block and bring in natural daylight to as many rooms as possible. They include a key stage 4 court at second floor level, a central court, and to the north an art and design court and a rooftop science garden. These are supplemented by two large lightwells in key stage 3 inspired by Newton's reflecting telescopes and conceived as translucent light prisms. A further lightwell is introduced over the main entrance through the sports beam.

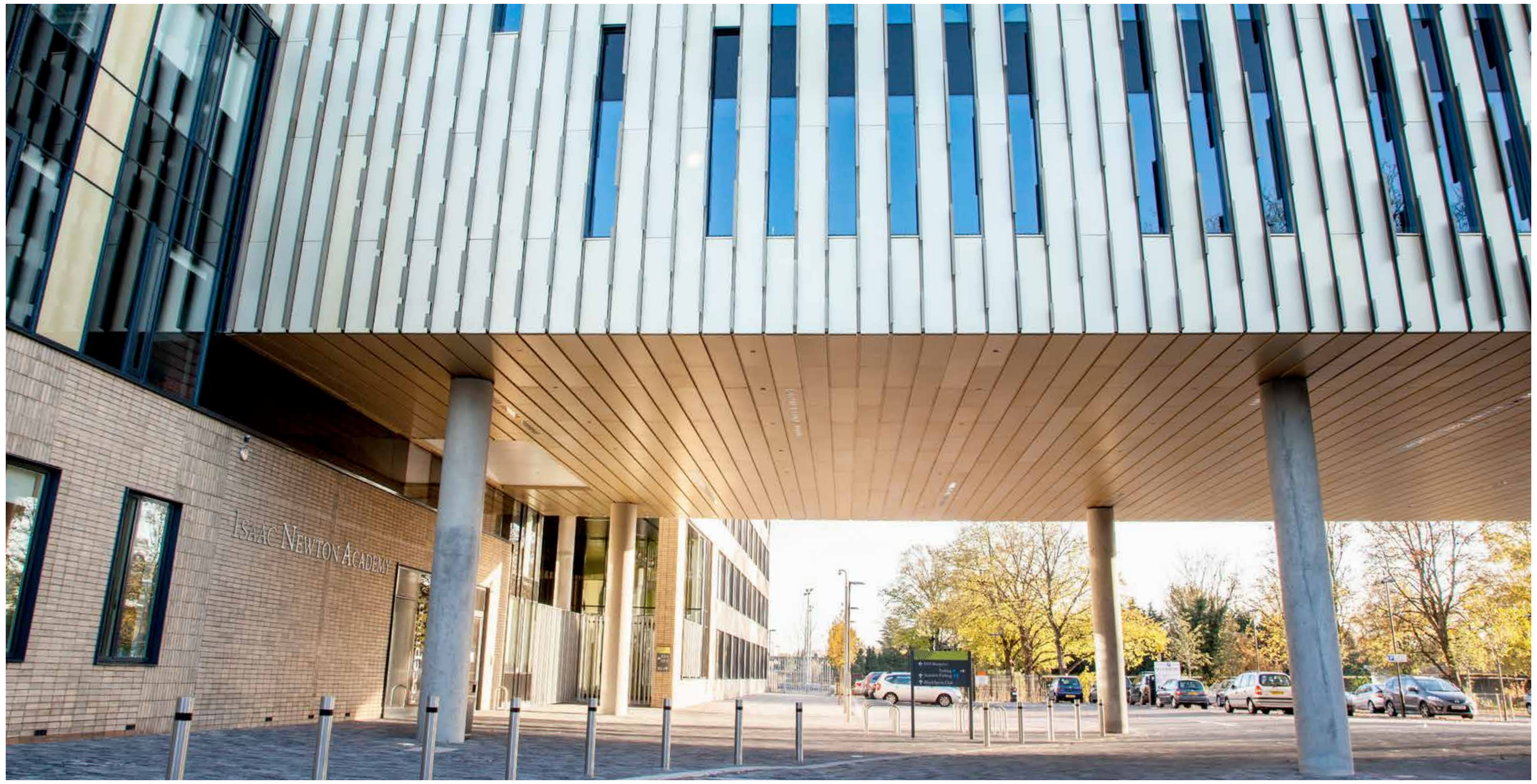
"We're trying to make it as exciting as possible by introducing light in unexpected places," says Theobald.

The new building has a super-insulated, high-performance envelope to reduce energy demands. There is no wet heating system in the teaching spaces. Instead, classroom heating is provided predominantly from the occupants and equipment heat emissions, thanks to the high level of heat reclaim via individual class ventilation "eco-active" units concealed within classroom bulkheads.

Clad in metallic bronze anodised aluminium, the sports beam has a considerable impact on the immediately surrounding area and is the only part of the school visible from the nearby high street. Drawing inspiration from the concentric pattern of Newton's rings, the architects used an overlay of perpendicular aluminium fins on the elevations notched along their length to create ring patterns, which change with different daylight and viewing angles. The underside of the beam is clad so that it appears as a metal box supported 6m above ground level. In all, 1,769sq m of metal cladding was used.

"We're trying to transform a public car park into something with more presence and character, suitable for an important new public building," says Theobald. "It's a potential venue for outdoor activities."

The £30 million school opened in September and is part of the ARK academy group. "The amount of optimism coming out of the classrooms is really inspiring," says Theobald.



The sports beam projects over a public car park.

SITE PLAN OF THE ENTIRE DEVELOPMENT

1 Sports beam
2 Main school building
3 Public car park
4 Cemetery
5 Sports ground

Rear elevation of the main school building, showing the sports beam (left) and the main brick-clad school building.

PROJECT TEAM

Clients
ARK Schools and London Borough of Redbridge
Main contractor
Skanska
M&E engineer
Hulley & Kirkwood
Structural engineer
Skanska Technology
Steelwork contractor
William Hare
Landscape architect
Grant Associates
Project management
Gardiner & Theobald

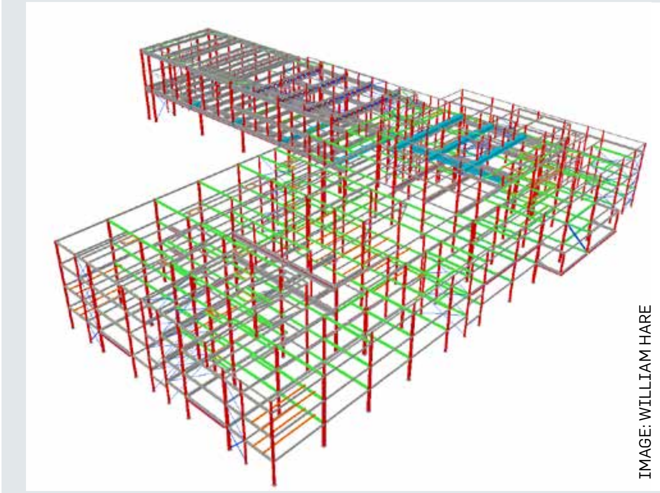


Diagram showing the steel structure, with the sports beam conceived as levity, and the main building as gravity.

THE MAIN SCHOOL STRUCTURE

For steelwork contractor William Hare, one of the challenges was meeting the six-month ordering window for the steel beams, and then dealing with the tight site conditions during the installation – in some places the perimeter fence was just 2m away from the building.

In total, 1,269 tonnes of steel frame is used on the structure, with nearly 2,000 pieces.

On the main school building, asymmetric beams incorporate precast, 200mm-thick concrete floor slabs, which sit on the wider bottom flange of the beam within the 300mm slab depth.

Although the structure appears simple on plan, according to Skanska senior project leader Hardip Bansal there were several interesting aspects to accommodate. These included bridges linking the north and south blocks, large projecting box structures on the north and south blocks, and hanger supports to the balcony viewing areas in the north block as well as the third floor of the sports beam.

Steelwork is protected with intumescent coating, where needed, to give four hours of fire protection – this was applied off-site.

Bringing as much natural light into the school as possible was a priority.

The main hall can be used as a performance space with an upper tier of seating.

THE SPORTS BEAM

The unusual loads of the 54m-long, projecting sports beam made this a particularly challenging part of the design, with the engineers having to cater for potential rhythmic bouncing taking place in the sports halls while avoiding too many columns protruding into the public space below.

The 18.7m-wide beam is supported by five sets of paired columns, spaced 13.5m apart with the exception of the final pair, which is a double to allow for a fire escape staircase at the end of the sports beam. After initially positioning the columns on the outer edges, the design team decided to bring the first four inwards by 2.35m each side to reduce the span to 14m. This provides greater structural rigidity while preserving the visual effect of levity. Central columns were ruled out as they would have made the space on the ground less flexible.

"We wanted to maintain the architectural vision so opted for moving the columns in," says Skanska senior project leader Hardip Bansal. "Just a short reduction in span makes a big difference to structural dynamic response."

Columns are 305mm x 406mm sections and are encased in concrete. They are spanned by 16 beams, each 914mm deep. Walls are effectively giant two-storey trusses

At the main block end, a mezzanine administration floor is suspended from the four 1,600mm-deep roof trusses spanning 19m.

In order to minimise disruption to access to the sports club beyond the car park, steelwork contractor William Hare had to work quickly on site, using all-bolted connections with no in-situ welding.

By using as simple connections as possible to speed up the erection, the steelwork for the beam was put up over the weekend, thus minimising disruption to the car park beneath.

Left: Perpendicular aluminium fins on the sports beam elevations create a pattern inspired by Newton's rings. Right: The sports beam was erected swiftly, supported by five sets of paired columns.

Spirit of the beehive

Designing a £114m Manchester HQ for the Co-operative Group, 3DReid found inspiration in a traditional symbol of the movement, to produce a building with a real buzz

Text by Pamela Buxton

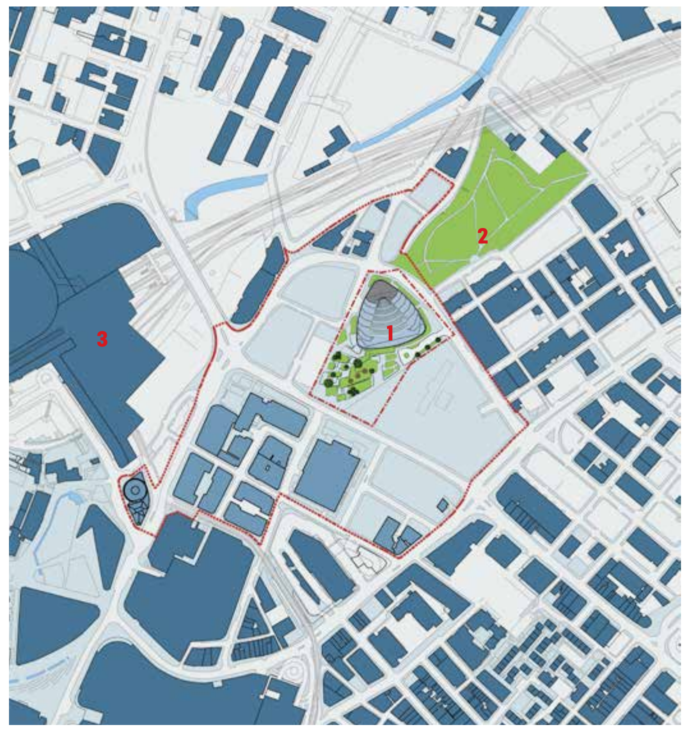
With their emphasis on collaborative industry, co-operative societies have traditionally adopted the beehive as an appropriate symbol for their ethos. It was also a natural inspiration for the architectural form of the Co-operative Group's new £114 million Manchester headquarters, designed by architect 3DReid.

The Co-op decided to invest in a new head office after research indicated that staying put in its current eight offices would require an investment of £180 million over 25 years. Instead, it decided to develop a new building for its own use, but one that would be attractive for sale on the commercial market - for single or multiple occupancy - if desired in the future.

This gave the Co-op the opportunity to consolidate its offices as well as creating a sustainable new office environment for its workers, with a Breeam "outstanding" rating - the highest ever given to an office building.

"The Co-op is an ethical bank and fair-trade supporter," says 3DReid divisional director Mike Hitchmough. "Sustainability is at the very heart of what they are and what they do."

The site, part of the 8ha Noma mixed-use development, is to the north of the city centre and bounded by Corporation Street and Miller Street. 3DReid looked at many configurations for the 46,000sq m building which would fulfil the requirement for floor plates no smaller than 2,300sq m but no wider than 16m, so that no desk would be more than 7m away from a window. Mindful of the client's brief for connectivity within the 16-storey building, the architect avoided a long thin plan. Instead, it wrapped the plan around to form a rounded triangle with cores in each corner providing structural stability, two rising to level 11, one to level 15.



SITE PLAN OF THE NOMA DEVELOPMENT

1 Co-operative Group headquarters 2 Angel Meadows 3 Victoria Station

Open balconies overlook the triangular atrium. This central social space, which is glass-topped at roof level, is in effect the "glue" that binds the headquarters and its occupants together, says Hitchmough, as well as acting as an extraction duct for stale air passing up towards the vents.

"The buzz of the building will bleed into the central atrium," he says. "Wherever you sit on the floor plate you can either look out of the window or across through the atrium to see either the Pennines, the Peak District or the city centre."

The building is tilted due south to optimise natural light, stepping down from the 15th to the 8th level. This last full floor plate includes the staff restaurant and terrace looking across the city.

The design provides 2,800 desk spaces for 3,500 staff, in response to the client's desire to introduce new ways of working, including an element of hot-desking. In so doing, 3DReid has avoided the need for three extra floor levels, thus saving approximately £20 million. The building provides 30,000sq m of office space as well as other facilities such as a 275-seat auditorium in the upper basement. The atrium functions as a temporary exhibition area with a business lounge for visitors, a café, and a meeting space for up to 500 people.

Initially, the design team considered a fully concrete frame but this would have made it difficult to achieve such wide, column-free spans. Instead, it opted for steel with precast concrete floor slabs for thermal mass. In total the building uses 3,200 tonnes of steel.

"The programme we were working to led us down the steel route," says Hitchmough. "The structure is fully exposed so that the building is clear and honest and legible in how the concrete and steel come together.

"The client was insistent there should be no internal columns so we had to span 16.5m from the atrium to the external wall. This meant the steelwork had to work harder, and there were cost implications. But the client was willing to buy that for the flexibility it gives it down the line."

Hitchmough adds that "longevity and resilience of use was a key aspect of the brief - that's sustainable design as well," making the point that this effectively future-proofs the building so that it will be able to perform to the same standards in a simulated hotter climate of 2050.

The hope is that the new building will operate with at least an 80% reduction in carbon emission and a 50% reduction in energy consumption compared to the current head office complex.

The new offices have exposed concrete soffits, which act as a thermal sponge, and a double-skin facade which, says Hitchmough, acts as a big thermal duvet. A natural ventilation system draws through 50,000 litres of air per second using 150m of underground concrete earth tube, which passively heats or cools the incoming air.

The Category A office building is the largest commercial office in Manchester, cost £2,200/sq m, rising to £2,500/sq m after fit-out, which is currently underway. According to Buro Happold principal engineer Mark Phillip, it has surprised those who expected a more overtly bespoke solution.

"Anyone financial or legal could move in," he says. "It's a fantastic office building rather than a Co-op building."

According to Hitchmough, the new building will be a tool for the transformation of the Co-op's business and the wider regeneration of the Noma site.

The building was designed using bim, which will also be used for a post-occupancy research project into the building.

For a video case study of this building, go to www.steelconstruction.info/Video_case_studies

PHOTO: PAULRHOADES

Each office floor overlooks the central atrium, which is topped with a lattice roof.

The plectrum-shaped HQ encloses a central atrium surrounded by three office floorplates.

PHOTOS: LEN GRANT

DOUBLE-SKIN FACADE

The Co-op building has a double-skin facade to improve its thermal performance. The thermal line is on the inside of the fully glazed building with the outer skin acting as a weather-tight thermal buffer to trap solar gain. This void swells from 800mm at the top and bottom to 2.5m in the middle, giving a fluid, dynamic outward form in contrast to the rational, inner skin.

"We wanted to create something with a real fluidity, mindful that as soon as you have curved glass the cost goes through the roof," says Hitchmough.

Instead, 99% of the glass is in flat, triangular panels, cold bent with a very slight elasticity to them, which gives a 10mm distortion over a distance of 4m. This outer skin is attached to the inner using secondary brackets fixed to the primary steelwork. These cantilevering arms follow the line of the outer skin.

A robust, anodised finish to the outer skin was specified at an extra cost to a standard, powder-coated finish to reduce maintenance costs over the life of the building.

A double-facade creates a thermal buffer to improve environmental performance.

ROOF

Taking inspiration from the Great Court at the British Museum (which engineer Buro Happold also worked on), five huge steel Vierendeel trusses span the atrium, tied together with a steel framed lattice. Each piece is framed by a pair of 300mm-diameter circular hollow sections, which meet at the ends of the lattice. This lattice was welded on site and installed by the facade contractor.

The atrium glass has a 60% solid frit pattern to control light but preserve views out for those working in the offices.

"We wanted to create a roof that provided a window on to the city for the staff," says Hitchmough.

The atrium roof steps down in response to the irregular form of the building.

PROJECT TEAM

Architect 3DReid
Client Co-operative Group
Structural engineer
Buro Happold
Contractor
BAM Construction
Steelwork contractor
Fisher Engineering

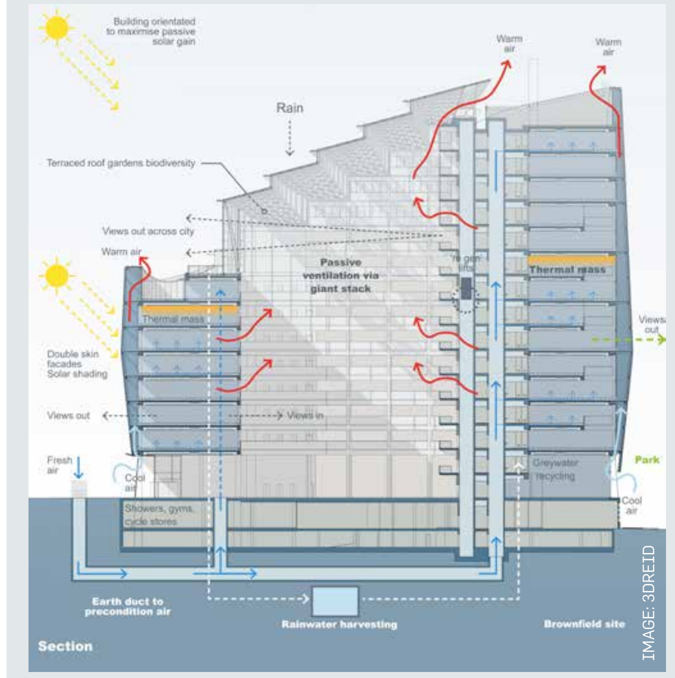


IMAGE: 3DREID

MAIN OFFICE STRUCTURE

Use of steel enabled the required large, column-free floors. The steel frame is spliced at every third level and is tied to the concrete cores on every level via connecting plates welded by steelwork contractor Fisher Engineering on to plates cast in to the cores.

Fisher used 2,000 tonnes of cellular beams, chosen because of their service holes and also their ability to achieve a shallow floor depth. These fabricated steel I- sections are 590mm deep and spaced 3m apart. They span a maximum of 16.5m. These were combined with precast concrete coffer units for thermal mass. These are notched to sit on the bottom flanges of the beams. There is a 110mm concrete topping and a 400mm-deep lightweight raised floor for any additional services.

In total, there are 18 types of fabricated beams with varying flange and web thicknesses but a constant depth – the exception being the corners, where the rounded Fabsec steel beams are deeper at 900mm for extra stiffness.

"The main challenge," says Fisher senior project manager Barry Craig, "was that because the steelwork members have the bottom flange exposed in their final state, we had to erect them to very tight tolerances and had to have a high decorative paint finish."

Logistically, the steel frame erection needed careful coordination between the trades, with Fisher erecting three levels on one side at a time and then moving on to the next side while the precast coffer units were installed and the concrete topping cast. This was finished in time for Fisher to start on the next three levels using a lightweight cherry picker on the completed slab.

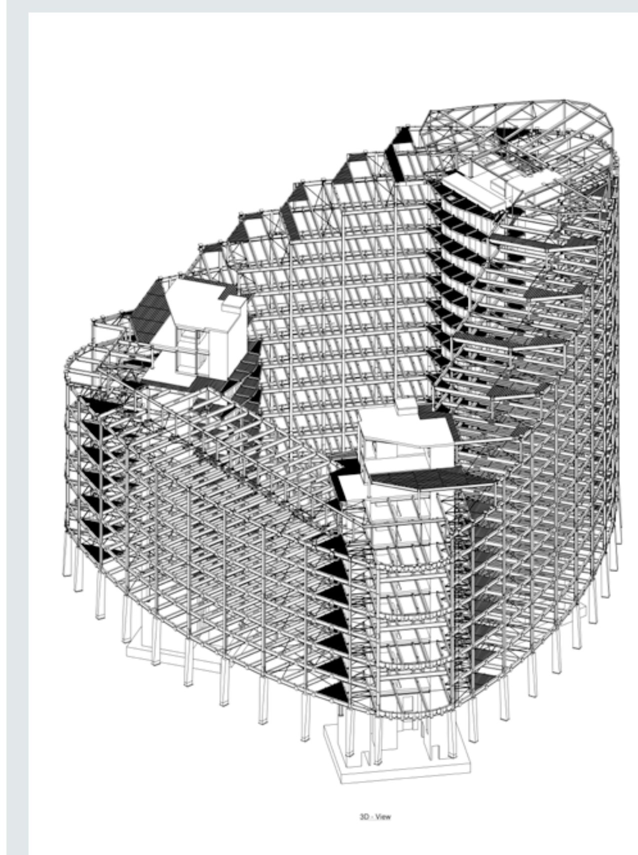


IMAGE: FISHER ENGINEERING

The steel structure enabled the design team to meet the tight programme and achieve the desired spans.

How to win the top green ratings

Breeam ratings are more important than ever. We look at the most cost-effective ways of achieving the highest three standards in five common sectors

Total floor area certified under Breeam has doubled in the last two years, as the sustainability rating system becomes an increasingly powerful planning and marketing tool.

According to statistics released last month, Breeam has now certified a total of 44 million sq m of floor space – nearly four times the amount in 2008. Project registrations have also increased from 20,000 to 44,000 since 2008 with a sharper upward trend from 2010.

"Breeam is increasingly used by owners and developers to help drive sustainability, says Simon Guy, head of sustainability marketing at the Building Research Establishment (BRE), which administers the scheme. "It is also attracting a lot of interest from the investment community as a means of protecting and enhancing the value of a property portfolio."

Breeam standards are also being increasingly linked to planning, with a growing number of local authorities writing Breeam into planning policy.

"If you just meet Building Regs you've done the worst possible you can get away with," says Ant Wilson, director of Building Engineering at Aecom and project director of the recent Target Zero research into sustainable design. "It's often now a requirement of planning to attain certain levels of Breeam."

But while Breeam's relevance and profile have undoubtedly increased, finding the most economic way of achieving these standards can be a complex and opaque issue. Research carried out by Aecom and costed by Sweett Group as part of Target Zero tackles this by setting out the most cost-effective ways of achieving the Breeam ratings of "very good", "excellent" and "outstanding" for five standard case study buildings from five different sectors (see diagrams below). While the base case buildings are steel-framed, Breeam does not include the direct impacts from the frame, so the results are relevant irrespective of framing material chosen.

It also identifies the costs of achieving these ratings compared with a base case version of the buildings that, in terms of operational carbon, met the minimum requirements under Building Regulations Part L (2006).

In all five building types – distribution warehouse, supermarket, office, secondary school, mixed-use development – relatively small uplifts of between 0.04 and 0.2% were needed to achieve "very good", with slightly more – between 0.4 and 1.8% – to achieve "excellent". As might be expected, the big difference comes when achieving the top rating of "outstanding". The distribution warehouse was the cheapest, requiring a cost uplift of 4.8%, followed by mixed use (5%) and secondary school (5.8%). The office and supermarket were the most costly to attain "outstanding", requiring a 9.8% and 10.1% uplift respectively.

Involving a Breeam assessor early is another way of achieving Breeam credits and is a good way to start, according to Wilson.

"If you have a good Breeam assessor on your job they'll have an idea of the cost of what's required, and can tell you the cheapest way of achieving the right credits to get certain ratings," he says.

"One of the things that came out of Target Zero is the cost differences that get the same outcome in Breeam." To score well on Breeam, it's vital to get the energy performance right.

"Do all you can with the fabric of the building," he says. "First get the building to consume far less energy in the first place to get the loads down, and then control its systems efficiency.

'Get the building to consume far less energy in the first place'

"Try to get the energy balance right. It's not just about insulation and low U-values – sometimes you have to let the heat out to limit solar and internal gains. Comfort issues – health and wellbeing – are also vitally important."

Breeam "outstanding" is a tough challenge, representing the top 1% in terms of building performance, says experienced Breeam assessor Clare Lowe, who is associate director of environmental consultancy Southfacing.

"With all types of buildings, 'outstanding' is a big ask, particularly for speculative buildings," she says. "You need to have a lot in your favour in terms of location credits, including public transport and a brownfield site in the first place, to give you a good basis."

A frequent stumbling block is achieving the compulsory 10 out of 15 energy performance credits needed to attain "outstanding". Gaining sufficient water credits can also be a challenge, she adds, since they sometimes push clients towards unfamiliar products or technologies that they may not be comfortable with. This can be a particular issue with hotels. For retail, the key issues are lighting and in the case of supermarkets, refrigeration.

Since they tend to require lighter floor structures, says Lowe, steel-framed buildings generally benefit under Breeam from using less material, while the often prefabricated nature of steel structures can also count towards a better rating, tending to generate less waste on site. But steel's potential for recyclability is not yet rewarded, although this might change if future versions of Breeam give more weight to end-of-life issues.

"Steel is more sustainable in a whole-life argument because of its re-use capability," says Wilson. "Recycling a building asset might be better than ripping it down and starting again."

Breeam's growing relevance to planning was noted in the last year's Good Practice Guidance: Sustainable Design & Construction, produced by the TCPA, BRE and a number of other industry bodies. This referred to several examples of planning authorities using Breeam as a reference for required sustainable standards.

The importance of the Breeam rating scheme is likely to grow as it expands from new construction and in-use assessment schemes into refurbishment. Breeam for domestic refurbishment was launched last year and a standalone version of Breeam for non-domestic refurbishment is being developed. Pilot projects include university buildings, two London office schemes and a department store, and Hanover House on the Co-operative Group's Noma site in central Manchester. BRE is currently seeking further pilot projects to test out the criteria and identify opportunities and barriers for sustainable refurbishment. The scheme is expected to launch this autumn with the next general update to Breeam due in 2014. ■

Research into the comparative costs of achieving Breeam ratings for different building types can be found at www.steelconstruction.info/Target_Zero#Breeam_results

Building	Capital construction cost (£m)	Capital cost uplift (%) to achieve Breeam		
		VERY GOOD	EXCELLENT	OUTSTANDING
DISTRIBUTION WAREHOUSE	19.4	0.04	0.4	4.8
SUPERMARKET	16.4	0.2	1.8	10.1
SECONDARY SCHOOL	22.5	0.2	0.7	5.8
OFFICE	61.7	0.2	0.8	9.8
MIXED USE	36.7	0.1	1.6	5.0

Target Zero research showing the average cost increase required to secure the top Breeam ratings.

PHOTO: EDMUND SUMNER

Wilkinson Eyre's Crystal building for Siemens in London's Royal Victoria Dock is rated Breeam "outstanding" and LEED Platinum.

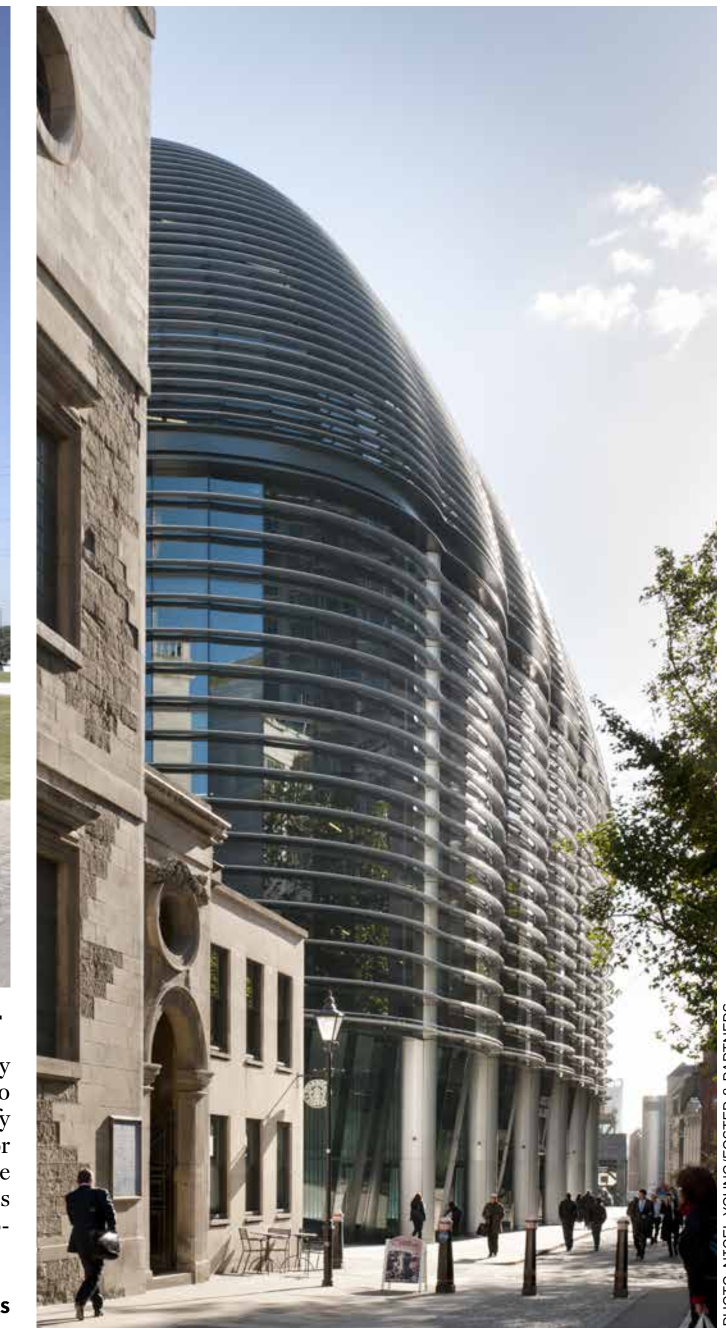


PHOTO: NIGEL YOUNG/FOSTER & PARTNERS

Foster's Breeam "excellent"-rated Walbrook House in the City of London is one of the increasing number of buildings being assessed under Breeam.

MAKE EVERY PENNY COUNT

These diagrams summarise the most cost effective routes for achieving each Breeam rating. For a "very good" rating, designers should consider the credits in the white boxes; for an "excellent" rating, they should consider the credits in both the white and orange boxes; while for an "outstanding" they need to consider all credits.

Guidance for the education sector and further information is available at www.steelconstruction.info/Target_Zero#Breeam_results

OFFICE

ENERGY
Submetering of substantial energy uses, efficient external lighting, sub-metering of areas and/or departments

WATER
Water meter, low flow sanitary fittings, major leak detection

WATER
Grey water harvesting

MANAGEMENT
Seasonal commissioning

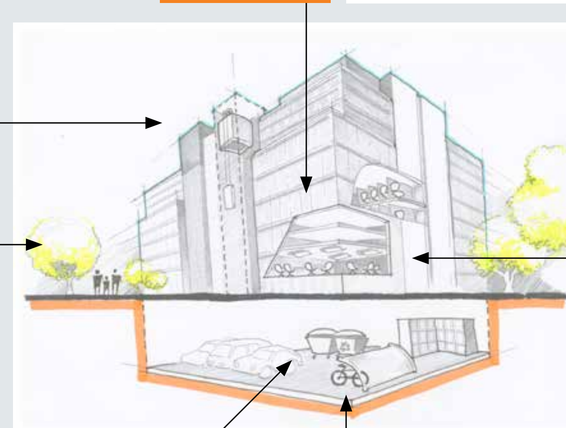
MANAGEMENT
Commissioning, considerate constructors, construction site impacts, security, building user guide

HEALTH AND WELLBEING
High-frequency lighting, internal and external lighting levels, preventing microbial contamination, reducing the use of VOCs, thermal comfort, lighting zones and controls, acoustic performance

ENERGY
Reduction of CO2 emissions

WATER
Sanitary supply shut-off

ENERGY
Efficient lifts



HEALTH AND WELLBEING
Potential for natural ventilation, glare control

ECOLOGY
Enhancing site ecology

HEALTH AND WELLBEING
Indoor air quality

POLLUTION
Low GWP refrigerant, refrigerant leak detection and pumpdown

MATERIALS
Material specification, responsible sourcing of materials and insulation, robust details, A-rated hard landscaping

POLLUTION
Low flood risk zone, minimising watercourse pollution, reduction of light pollution, noise attenuation

WASTE
Construction site waste management, storage of recyclable waste, use of recycled aggregates, floor finishes

TRANSPORT
Public transport links, proximity to amenities, travel plan, maximum car parking, cyclist facilities – racks, showers, lockers and changing

TRANSPORT
Pedestrian and cyclist safety

MIXED USE

ENERGY
Submetering of substantial energy uses, efficient external lighting, reduction of CO2 emissions

MANAGEMENT
Seasonal commissioning. life cycle costing

MANAGEMENT
Commissioning, considerate constructors, construction site impacts, security, publication of building information, consultation, building user guide

HEALTH AND WELLBEING
High-frequency lighting, internal and external lighting levels, preventing microbial contamination, Reducing the use of VOCs, thermal comfort lighting zones and controls, acoustic performance, view out, daylighting

ENERGY
Sub-metering of areas and/or departments

ENERGY
Efficient lifts, building fabric performance

HEALTH AND WELLBEING
Indoor air quality

ECOLOGY
Enhancing site ecology

MATERIALS
Material specification, responsible sourcing of materials and insulation, robust details, A-rated hard landscaping.

POLLUTION
Low GWP refrigerant

POLLUTION
Refrigerant leak detection and pumpdown

TRANSPORT
Cyclist facilities – racks, showers, lockers and changing space.

POLLUTION
Low flood risk zone, minimising watercourse pollution, reduction of light pollution, noise attenuation

WATER
Sanitary supply shut off. grey water harvesting

WASTE
Construction site waste management, storage of recyclable waste, use of recycled aggregates, composting

TRANSPORT
Public transport links, proximity to amenities, travel plan, maximum car parking capacity

WATER
Major leak detection

WATER
Water meter, low-flow sanitary fittings

TRANSPORT
Travel information point, pedestrian and cyclist safety

SUPERMARKET

ENERGY
Efficient lifts, improved efficiency cold storage, efficient escalators, building fabric performance and avoidance of air infiltration, renewable energy solutions

WATER
Water meter, low-flow sanitary fittings, major leak detection, sanitary supply shut-off, vehicle wash

WATER
Water recycling

WASTE
Use of recycled aggregates

HEALTH AND WELLBEING
High-frequency lighting, internal and external lighting levels, preventing microbial contamination

WASTE
Construction site waste management, storage of recyclable waste, compactor, composting

ENERGY
Efficient cold storage

WATER
Grey water system

HEALTH AND WELLBEING
Reducing the use of VOCs, improving indoor air quality

ENERGY
Submetering of substantial energy uses, efficient external lighting, submetering of areas and/or departments

POLLUTION
Refrigerant leak detection and low GWP cold storage

POLLUTION
Low flood risk zone, minimising watercourse pollution, reduction of light pollution

MATERIALS
Material specification, responsible sourcing of materials and insulation, robust details, A-rated hard landscaping

MANAGEMENT
Commissioning, considerate constructors, security, building user guide, construction site impacts

TRANSPORT
Public transport links and local amenities, pedestrian and cyclist safety, deliveries and manoeuvring, travel plan

TRANSPORT
Travel information point

MANAGEMENT
Seasonal commissioning

TRANSPORT
Cyclist facilities – showers, lockers and changing space

WAREHOUSE

ENERGY
Submetering of substantial energy uses, efficient external lighting

POLLUTION
Noise attenuation

MANAGEMENT
Building user guide, construction site impacts

HEALTH AND WELLBEING
High-frequency lighting, internal and external lighting levels, preventing microbial contamination, reducing the use of VOCs, views out, thermal comfort and zoning

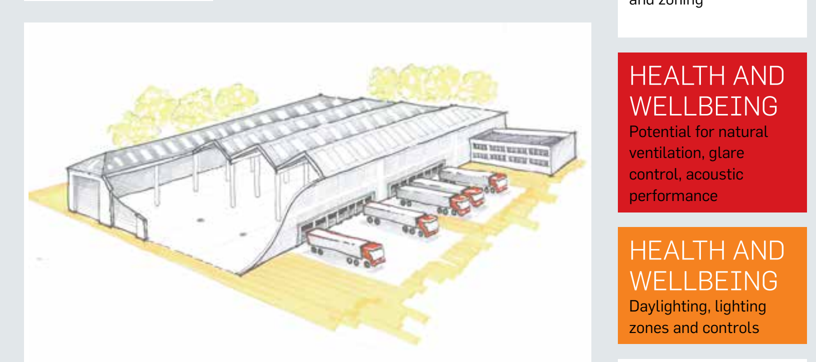
POLLUTION
Low flood risk zone, minimising watercourse pollution, reduction of light pollution

MANAGEMENT
Commissioning, considerate constructors

ENERGY
Submetering of areas/ departments, efficient lifts, reduction of CO2 emissions

MANAGEMENT
Security

ENERGY
Building fabric performance and avoidance of air infiltration, renewable energy solutions



HEALTH AND WELLBEING
Potential for natural ventilation, glare control, acoustic performance

WATER
Water meter, low-flow sanitary fittings, major leak detection

HEALTH AND WELLBEING
Daylighting, lighting zones and controls

WATER
Sanitary supply shut-off

MATERIALS
Material specification, responsible sourcing of materials and insulation, robust details, A-rated hard landscaping

TRANSPORT
Public transport links, deliveries and manoeuvring

WASTE
Construction site waste management, storage of recyclable waste, compactor, use of recycled aggregates

WATER
Rainwater harvesting

TRANSPORT
Pedestrian and cyclist safety, travel plan

TRANSPORT
Cyclist facilities – racks, showers, lockers and changing space