STEEL CONSTRUCTION
Education Buildings

Steel for Life and the British Constructional Steelwork Association (BCSA) are working closely together to promote the effective use of structural steelwork. This collaborative effort ensures that advances in the knowledge of the constructional use of steel are shared with construction professionals.

Steel is, by a considerable margin, the most popular framing material for multi-storey buildings in the UK and has a long track record of delivering high quality and cost-effective structures with proven sustainability benefits. Steel can be naturally recycled and re-used continuously, and offers a wide range of additional advantages such as health and safety benefits, speed of construction, quality, efficiency, innovation, offsite manufacture and service and support.

The steel sector is renowned for keeping specifiers abreast of the latest advances in areas such as fire protection of structural steelwork and achieving buildings with the highest sustainability ratings. Recent publications have provided detailed guidance on Fire Protection and CE Marking and what it means for the construction sector. Guidance is provided on all relevant technical developments as quickly as is possible.

The sector's go to resource website – *www.steelconstruction.info* – is a free online encyclopedia for UK construction that shares a wealth of up-to-date, reliable information with the construction industry in one easily accessible place.

This publication has been funded by Steel for Life and would not be possible without the support of our sponsors.

Headline sponsors:

ArcelorMittal | Barrett Steel Limited | Jamestown

Gold sponsors: Ficep UK Ltd | National Tube Stockholders and Cleveland Steel & Tubes | Peddinghaus Corporation | voestalpine Metsec plc | Wedge Group Galvanizing Ltd

Silver sponsors: Jack Tighe Ltd | Kaltenbach Limited | Tata Steel | Trimble Solutions (UK) Ltd

Bronze sponsors: AJN Steelstock Ltd | Barnshaw Section Benders Limited | Hempel | Joseph Ash Galvanizing | Jotun Paints | Sherwin-Williams | Tension Control Bolts Ltd | Voortman Steel Machinery

For further information about steel construction and Steel for Life please visit www.steelconstruction.info or www.steelforlife.org

Steel for Life is a wholly owned subsidiary of BCSA

Introduction
by David Moore, Chief Executive Officer,
British Constructional Steelwork Association

Steel ready for education investment boost

Construction professionals keenly await the details of the promised 'infrastructure revolution' in the March 2020 budget, particularly those involved in the key business of providing schools and other education buildings. Education languished at times during the years of austerity but now that the reins on public sector investment are to be relaxed and resources rebalanced towards previously relatively neglected areas of the UK it is hoped that education will receive a boost.

What could be more crucial for the country's future than having state-of-the-art, modern buildings that have been proven to make an invaluable contribution to the success of a child's education? Further and higher education is also key to the country's future prosperity and stimulating buildings are essential to attract and retain students and academic staff.

The steel construction sector has provided many inspirational buildings in use by educational establishments of all types, from flexible and cost-effective primary and secondary schools and schools for children with special needs, to leading research establishments for universities, involving large student accommodation blocks, sports halls and other leisure facilities like swimming pools.

Steel enjoys a market share of over 60% in education, something that our sector takes pride in. This publication showcases how the use of steel, the most modern method of construction, can help to provide the education buildings the UK's future depends on. We hope you find it informative and useful.

January 2020

Contents

Market overview

Steel construction has proven its superior suitability for providing the education sector with modern, state-of-the-art buildings and extensions for many years, enjoying a market share of over 60% as a result. Nick Barrett reports on a sector looking ahead to growth as a modern method of construction.

Steel has always enjoyed a strong demand from the education sector for schools, sports halls, further and higher education buildings and student accommodation. The sector was very vibrant for a few years before 2010 when England's £55,000M Building Schools for the Future (BSF) programme of secondary school building, overseen by Partnerships for Schools, was cancelled. Also brought to a halt was a parallel £1,900M Primary Capital Programme for primary school building that had envisaged some 675 projects being ordered over three years.

Times have often felt testing ever since. Much of this work was funded under Private Finance Initiative schemes which were gaining in unpopularity with government, and the BSF organisation had been criticised by parliamentary spending watchdogs the National Audit Office. Some 123 Academy school schemes were to be de-prioritised and reviewed on a case-by-case basis.

Today we have the Priority School Building Programme, established in 2011 to organise urgent repairs and refurbishments for primary, secondary and special education needs schools in the worst condition, managed by the Education & Skills Funding Agency. There hasn't been a satisfactory scheme for tapping private sector funding since PFI fell into disfavour; PFI2 and Public Private Partnerships failed to take up all of the resulting slack.

Recent education construction spending peaked at around £11,200M in 2016, driven by investment in both schools and higher education. Demand today is a mixed picture across countries in the UK and among differing types of education buildings.

Building programmes in England's education sector are being led by the Priority School Building Programme (PSBP), the first phase of which to rebuild 260 schools was to be completed in 2019. A second phase, PSBP2, will be worth a further £2,000M.

In Scotland, the £1,800M Schools for the Future Programme was to deliver around 117 schools by March 2020. In Wales, the main investment programme is the 21st Century Schools Building Programme, which aims to upgrade and extend the entire stock of schools in Wales.

In higher education total construction output, including both private and public work, is forecast to rise to around £4,000M between 2018 and 2021, driven by the universities sector.


Christ the King Centre for Learning, Knowsley, Merseyside

English universities experienced a 4% funding decline between 2016-17 and 2017-18, with capital funding having declined by over 25% over that period. Some universities have turned to the capital markets to fund infrastructure investments.

Estimates from AMA Research suggest that education capital spending declined by around 12% between 2016-17 and 2017-18, before rising to £6,100M in 2018-19, then falling again in 2019-20.

Going forward, higher education sector workloads are expected to be boosted by long-term capital building programmes as universities invest to provide additional space for teaching, research and accommodation facilities and to attract higher fee-paying overseas students.

The bulk of current education sector projects are due to complete by 2020. The large rise in contract values completing during these years is due to a small number of very high value schemes. The number of projects currently due for completion beyond 2021-22 begins to drop considerably, coinciding with the planned completion of Priority School Building Programme 2.

The construction industry keenly awaits the details of future education investment plans that are expected after a process of spending reviews across the public sector. News is hoped for in the March 2020 budget.

Forecasts from industry researchers Glenigan suggest that over the next couple of years a rise in secondary school building projects will drive education sector activity, despite universities cutting back their capital spending. The number of secondary school age children in England is projected to have risen by 13.6% over the five years to 2022, which means new schools will be required in high growth areas as well as continued expansions of existing schools.

Cash-strapped councils have tried to accommodate the initial rise in pupil numbers through the expansion of existing schools. Where the areas of high growth are exactly could be hard to predict as they might be influenced by Prime Minister Boris Johnson's promise to increase public investment in the north of England.

Glenigan figures from December 2019 suggested that the value of school project starts fell 7% in 2019 after rising strongly in 2018 by 14%. Their forecast is for a rise in the value of school building starts of 8% in 2020, with another 7% growth in 2021.

The value of project starts in higher education rose by an estimated 28% in 2018, mostly as a result of expansion by the Russell Group of universities, but university spending might have fallen back by as much in 2019. The outlook is for a period of settled demand at around current levels.

Glenigan concludes that overall education sector starts will have fallen by 9% in 2019 due to reduced university work and the drop in school building work. Sector starts are forecast to rise 1% in 2020 followed by a 4% rise in 2021, with the lift coming from school buildings.

Building programmes in England's education sector are being led by the Priority School Building Programme (PSBP), the first phase of which is nearing completion. For the second phase, the Government has allocated a further £2,000M.

Wales

In Wales, the main investment programme for the education sector is the 21st Century Schools Building Programme, which aims to upgrade and extend the entire stock of schools in Wales. In its first wave of investment, ending in March 2019, over £1,400M was to have been invested in supporting the rebuild and refurbishment of over 160 schools and colleges across Wales. The second wave of investment for the Programme began in April 2018.

Scotland

In Scotland, the Schools for the Future Programme, worth £1,800M, was expected to deliver around 117 schools by March 2020. The Scottish Government has recently announced that it will contribute extra funding of between £220M and £275M in partnership with local authorities across the country to replace 26 schools, with a further phase of investment to be announced within 12 months. The first projects could open by 2022-23.

Scottish Futures Trust is to manage the programme on behalf of the Scottish government. Several of these projects involve a new type of multi-purpose campus that will bring together nurseries, schools, and colleges, with additional facilities that benefit surrounding communities.

In June 2019 the Department for Education (DfE) said it intends to procure a new offsite construction framework worth £3,000M for the design and build of offsite schools and educational establishments. The DfE says its offsite framework is being established 'to cultivate innovation and modernise the construction industry by increasing the adoption of Modern Methods of Construction (MMC) offsite production in the market, in line with the government's commitment to MMC and its presumption in favour of offsite construction by 2019 across suitable capital programmes, where it represents best value for money.' Steel is the strongest established modern method of construction and will benefit from this approach.

University construction work remains a much smaller market than the schools and colleges sector. Total construction output in higher education, including both private and public work, is forecast to rise to around £4,000M by 2021, as UK universities continue to increase investment in new buildings

The material of choice

What framing material criteria do project teams look at when designing education buildings?

School buildings have a number of particular design requirements and must adhere to a set of requirements in terms of spatial planning, flexible use of space, control of vibrations and acoustics, and robustness.

Criteria such as thermal mass and speed of construction also come into play when choosing a framing material for a project's construction.

Requirements change depending on the type of building, for instance infant, primary and secondary schools will usually have a fairly regular set of classrooms, based around a standard grid pattern. The main difference being that infant and primary schools are usually single storey structures, while secondary schools are predominantly two or three storeys high.

These establishments will also have an assembly hall/sports hall, a structure based around a much larger grid to accommodate the necessary open column-free area.

Meanwhile, in the higher education sector the structures will also have to accommodate offices, lecture theatres and laboratories, and even multi-storey halls of residence with multiple bedrooms.

Catherine Mulley, Director at Pozzoni Architecture says:

"When it comes to education projects, the price and potential of materials are key in meeting the stringent DfE standards. To put it simply, steel is far quicker and more cost-effective to work with than concrete, while providing clients with far greater flexibility for any future adaptations."

Fast construction programmes are vital so that new buildings can be completed within one academic year, or even during the summer vacation in the case of extensions. This will minimise any potential disturbance to the school, college or university, especially if the new building is adjacent to or adjoined to an existing establishment, which is quite often the case.

Steel construction has achieved a strong market position for all types of education buildings, not just for its speed of construction – helped by the fact that

The sports hall at the Inverness Royal Academy was economically constructed with steel

steel can be prefabricated into modular elements - but also for shallow floor construction which can aid vibration and acoustic performance.

The majority of teaching spaces tend to have a 3m clear headroom and exposed concrete soffits, either precast planks or exposed in situ reinforced concrete.

Flexibility is also a major consideration in the design stage. Long span steel construction creates column-free space and allows rooms to be configured on the floor plan to meet the current and future education needs. Light steel internal walls can be relocated in the future if requirements change, leading to fully adaptable buildings.

Atriums and long linking streets for larger education buildings are parts of a construction project that are invariably framed with steel. Both of these features rely on long open areas where steel construction is the obvious choice.

Another area that relies on steelwork's long span qualities are sports halls, which always require a clear column-free space.

An example of this is the recently completed Inverness Royal Academy, which has two games halls housed within a 50m-long steel-framed braced structure.

The steel structure also houses changing rooms, a dance studio and a gymnasium, with the majority of these facilities also open to the local community.

"Steelwork was chosen for this part of the project because it provided the most economical way of forming the hall's 19m-long spans," says Morrison Construction Senior Project Manager Finlay Black.

Designers usually say that steel is more expressive for the construction of big feature elements such as curving and undulating covered streets and amphitheatres.

This was the case at the West Calder High School project in West Lothian. This facility has an amphitheatre, a swimming pool, games hall and dining area, all of which are contained within large column-free spaces.

Consequently, their buildability was one of the main reasons for choosing a steel framing solution for the project.

"Early in the design process we looked at all framing options, weighing up their pros and cons. Ultimately, to build the required long spans efficiently and quickly, we went with a steel-framed solution," says Arup Lead Project Engineer Ian Miller.

A steelwork design provided a more cost-effective solution for Rhyl New School

Cost-effective steel design

The BREEAM 'Excellent' Rhyl New School in Denbighshire underwent a complete redesign during an enforced hiatus when it became entangled in the Welsh 21st Century Schools Building spending review.

During the period leading up to construction actually getting under way the project's design was changed from a concrete frame to a more cost-efficient steel solution.

"The school was completely redesigned and a totally different building was finally built," explains Ramboll Associate John Whitfield. "The old design included a sports hall on the ground floor and this was omitted as a nearby leisure centre was refurbished as part of the project."

Structural steelwork was deemed to be the ideal framing material for the three-storey school, which is rectangular in shape and divided in two by a covered street. Steel footbridges span the void and link the building above ground floor level.

AKT II Director Riccardo Baptista says:

"Steel buildings offer a safer, faster and leaner 'blueprint' for education buildings that responds to the multiple challenges that this typology, perhaps more than any other, faces whenever looking to produce new built assets. As the majority tend to be campus-based, any construction works associated with the long-term betterment of the institutions can have a negative short-term impact as works are executed. Access to development plots is often restricted, timetabling conflicts inevitably impact on permissible working hours, and in live environments like this, health and safety is paramount. These logistical constraints sit alongside the core benefits of steel fabrication in enhancing quality control, limiting waste and reducing programme, resulting in an approach to development that can be considered on most education projects."

Cost-effectiveness: Steel tops the class

Steel has been proven to be the most cost-effective solution for education buildings over many years, providing aesthetically pleasing, flexible, modern environments in which pupils and students thrive. There is a wide range of cost related benefits that flow from selecting steel as the framing solution, whether it is for a primary or secondary school, college or university building or student accommodation.

A wide range of factors can have a significant influence on the cost of education buildings. Aside from the considerations that would apply to any building like logistics, building form, fire protection, and erection, education building costings have to consider a range of specific cost drivers

For example, there will be a need for a wider range of specialist areas like studios, laboratories, workshops and lecture theatres and this will vary between the different education sectors. The growing need for specialist information and computer technology (ICT) systems and for 'future proofing' them might demand additional services distribution and penetrations through structural elements.

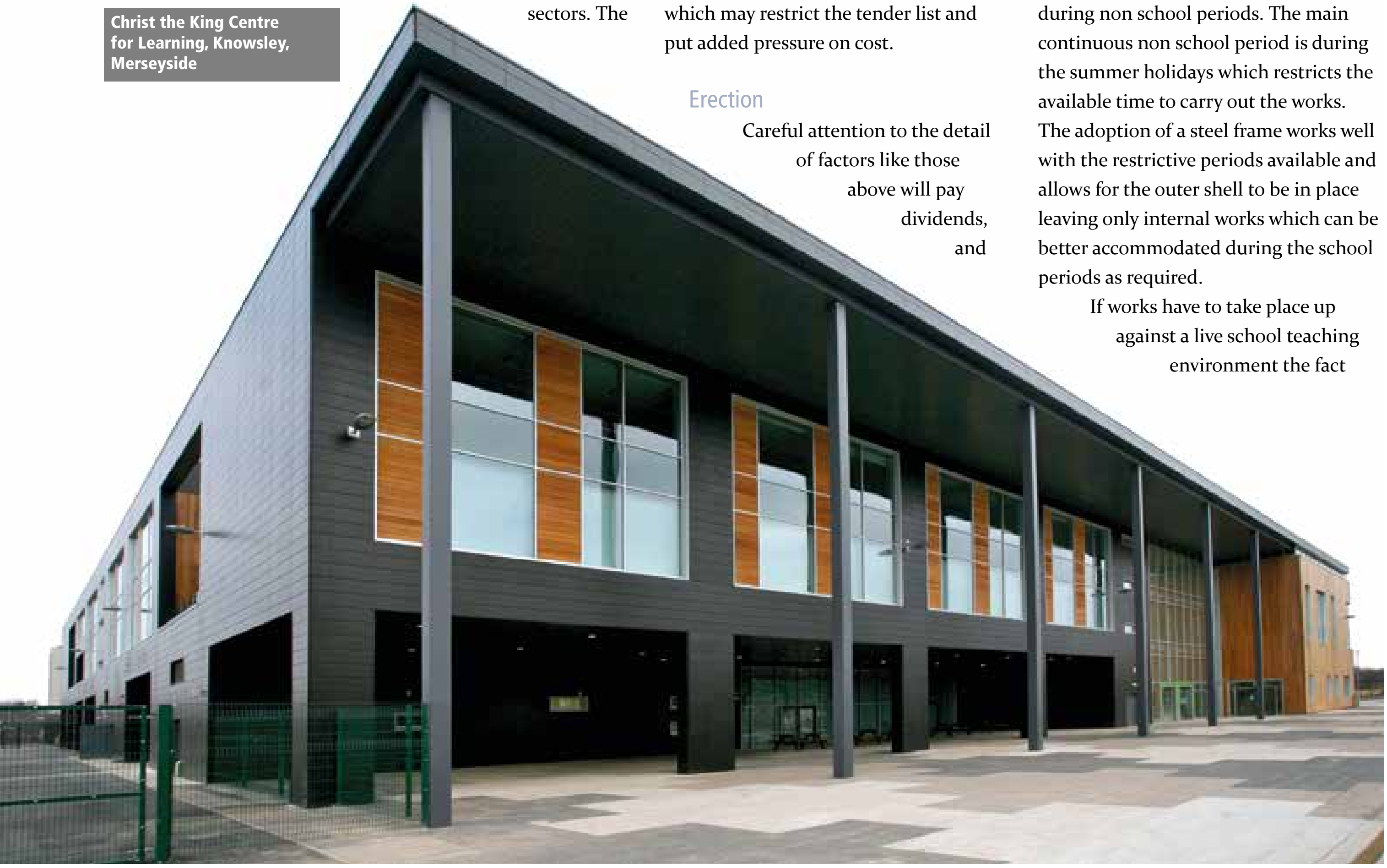
Programming is a key cost driver for school buildings in particular due to the constraints of the academic calendar and the frequent demand for new space to be available for the start of the academic year. The Employer's Requirements set out comparatively high liquidated damages to act as a deterrent to non-completion within the set timescales, which may restrict the tender list and put added pressure on cost.

Erection

Careful attention to the detail of factors like those above will pay dividends, and there are substantial cost benefits to be gained from selecting a steel framed solution. A key cost benefit derives from the quicker erection time that is inherent with using an offsite prefabricated modern method of construction. On site erection time is significantly less with a steel frame that can be brought to site as and when required, eliminating the need for storage of equipment like shuttering or accommodation of concrete batching plant and pumps.

Speed of construction is particularly important as work - particularly extensions - is often undertaken during non school periods. The main continuous non school period is during the summer holidays which restricts the available time to carry out the works. The adoption of a steel frame works well with the restrictive periods available and allows for the outer shell to be in place leaving only internal works which can be better accommodated during the school periods as required.

If works have to take place up against a live school teaching environment the fact



Christ the King Centre for Learning, Knowsley, Merseyside that the fabrication of the steel frame takes place in a factory controlled environment remote from the school has been appreciated by generations of teachers.

Flexibility
Education buildings, in common with other buildings, increasingly have to be designed to allow for future uses, and to accommodate demographic changes that impact on class sizes. Steel's designed-in flexibility can mean that a building's life is extended for many years, when changing requirements might have otherwise led to its demolition. Steel-framed buildings are easily adapted in comparison to buildings constructed with loadbearing masonry. The flexibility of the framing allows horizontal adaptation where rooms can be altered in size to accommodate changing requirements.

Adopting a steel frame allows the design to accommodate a variety of functions, not all of which may suit a rigid layout. For example, workshops have differing sizes to classrooms. Column-free spaces for sports halls can only be cost-effectively achieved with steel-framed solutions.

Offsite manufacture
As steel components are manufactured offsite the main site activity is assembly. This minimises impacts on building users and on local communities and reduces the requirement for on-site labour, which as a consequence reduces health and safety risks. Particularly in large buildings or programmes of works, there is likely to be a drive towards standardisation which allows for the adoption of modern methods of construction. These are made more viable with the volume of repetition and are well suited to a steel-framed building.

Restrictive/existing sites
Prefabrication also means that steel is particularly relevant to projects requiring an extension to existing buildings and/or the development of additional buildings within a campus. Steel arrives on-site prefabricated which in conjunction with the speed of erection limits the amount of disruptive time to the adjacent buildings. Storage issues on restricted sites are routinely overcome by construction teams using steel-framed solutions.

Key costs £/m² (GIFA), for Merseyside secondary school

Elements	Steel and precast hollowcore planks	In situ concrete flat slab	Steel composite
Frame and upper floors	293	253	266
Total building	3200	3169	3143

Cost Comparison

Above we provide the results of a cost comparison exercise to show the cost model for a secondary school building on Merseyside.

The building used for the cost model is the Christ the King Centre for Learning, a secondary school in Knowsley.

The building's key features are:

- Three storeys, with no basement levels
- Typical clear spans of 9m × 9m
- 591m² sports hall (with glulam frame), 770 m² activity area and atrium
- Plant at roof level.

This building was originally part of the Target Zero study conducted by a consortium of organisations including Tata Steel, Aecom, SCI, Cyril Sweett and BCSA in 2010 to provide guidance on the design and construction of sustainable, low and zero-carbon buildings in the UK.

This cost comparison updates the cost models developed for the Target Zero project and provides up-to-date costs at Q4 2019 for the three alternative framing solutions considered.

About the building
Christ the King Centre for Learning secondary school in Knowsley, Merseyside, was part of the Building Schools of the Future programme (BSF), it was completed in December 2008 and constructed to be occupied by 900 pupils and 50 staff. The gross internal floor area of the school is 9,637m². The building is based on a 9m × 9m structural grid with many classrooms 9m deep.

The main architectural features of the building are: a standardised 9m × 9m structural grid, a 591m² sports hall, a winter garden covered by an ETFE roof, a three-storey high atrium and some external terraces at upper floors. The school has a structural steel frame supporting precast concrete floor slabs and is clad in a combination of timber cladding, aluminium curtain walling and terracotta rainscreen.

Cost comparison
Three structural options for the building were assessed as shown in the table above which include;

Base case: Steel frame; 250mm hollowcore precast concrete planks; 75mm structural screed

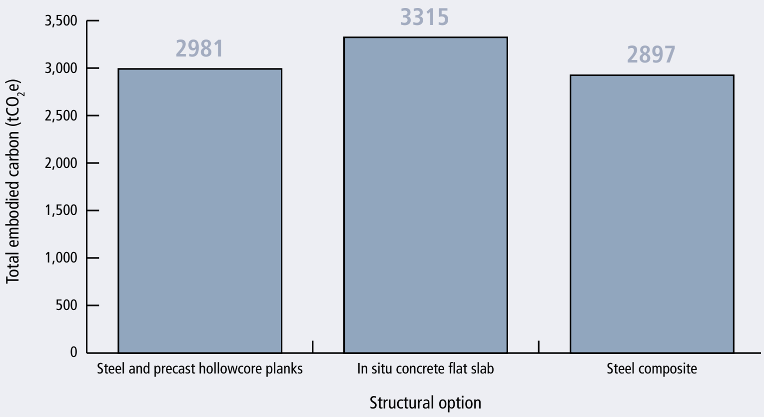
Option 1: In situ 350mm reinforced concrete flat slab with 400 × 400mm columns

Option 2: Steel frame; 130mm concrete topping on structural metal deck.

The comparative costs highlight the importance of considering total building cost when selecting the structural frame material during design. The concrete flat slab option has a marginally lower frame and floor cost compared with the steel composite option, but on a total building basis, the steel composite option has a lower overall cost (£3,143/m² compared with £3,169/m²). This is because of lower substructure and roof costs and lower preliminaries resulting from the shorter programme.

Embodied carbon comparison
The original Target Zero project also included a comparison of the embodied carbon of the three framing solutions. This was on a "cradle-to-cradle" basis that included the manufacture and transport of construction materials, the construction process and the demolition and disposal of the building materials at the end-of-life. The results, which are presented in the chart below showed that the embodied carbon of the steel frame solution with precast hollowcore floor slab was 11% lower than the in situ concrete flat slab alternative while the steel frame solution with decking and in situ concrete topping was a further 3% lower.

Embodied carbon comparison



SDM Fabrication erected the steel for the Silsoe Church of England Lower School

Sustainability: Steel is a priority

Making sure schools offer a high quality and positive environment is a key part of the government's long-term vision for education.

The sustainability of all types of educational buildings is important throughout all stages of their design, construction and operation. There is a general belief that better schools help build a fairer society and ultimately a better economy.

To this end, the UK government has in recent times launched a number of initiatives which have not only produced better educational establishments, but also more cost-effective and sustainable buildings.

Many schools and universities are keen to promote environmental awareness and so sustainability is manifested in the design of highly sustainable buildings, which are often very energy efficient in operation and frequently contain a high proportion of renewable energy provision.

As part of the Government's previous 'Building Schools for the Future' programme there was a significant drive to make schools more sustainable and for new school buildings to be examples of best practice in sustainable construction.

A sustainable school was defined as one which prepares its pupils for a lifetime of sustainable living through its teaching, fabric and day-to-day practices.

The intention of the Priority Schools Building Programme was to undertake school rebuilding and refurbishment projects to improve the overall standard of school buildings by creating classrooms which were conducive to learning and providing access to world-class facilities for pupils and teachers.

The programme covered primary, secondary and special education needs (SEN) schools, which were spread across England and grouped together in batches by taking consideration of condition, need, commercial viability and geography.

The current Priority School Building Programme Phase Two, which will conclude in 2021, has a greater emphasis on standardisation, cost reduction and energy efficiency.

The majority of the schools in this latest programme, along with many higher education and student accommodation schemes, are steel-framed projects as the material is chosen as it comfortably meets clients and project teams' numerous requirements.

Along with speed of construction and cost-effectiveness, sustainability features highly in those requirements. With its lightweight nature, future flexibility and recyclability, steel construction is the ultimate sustainable framing material and facilitates the highly rated BREEAM projects shown in this publication.

The lightweight nature of steel and optimum use of thermal mass helps to minimize both embodied carbon and operational energy. Low and zero carbon buildings are readily achievable using steel construction, as demonstrated by the BCSA and Steel for Life's Target Zero programme, which included a study of a real secondary school building where steel construction out-performed other framing materials.

"We've designed a number of schools and they always have a steel frame for ease and speed of construction," says David Turnock Architects' Leon Delegate.

Turnock Architects worked on the design of Silsoe Church of England Lower School in Bedfordshire.

This school's layout needed to provide a compact building plan, to keep construction costs to a minimum, while a fabric first approach to the building design, led to energy-efficiencies in all aspects of the design.

In order to tick all of these boxes a structural solution based on the use of a steel frame with lightweight steel in-fill panels was the chosen method of construction.

"The extensive use of insulation and using materials with less embodied energy also helps to keep the U-values as low as possible," explains Central Bedfordshire Council Principal Project Manager Helen Konstantinidi.

Other reasons for using a steel solution include the fact that the material can be multicycled endlessly with no detrimental effect on its properties.

When a steel-framed building is demolished, its components can be reused or returned to the steelmaking process to create brand new components, thereby adding to a project's sustainability credentials.

In the UK, 96% of steel construction components are recovered in this way. Globally, recycled steel accounts for 50% of new steel production.

Because steel structures are significantly lighter than concrete equivalents, they require less extensive foundations, which reduces the environmental impact of the build. If steel pile foundations are used, these can be extracted and recycled or reused at the end of a building's life, leaving no waste material on site.

Long-span steel solutions, such sports halls or atriums, provide flexible clear span spaces that future-proof a building, offering an increased lifetime. Steel structures are also durable and can be readily adapted, improving their economic viability as they can easily be updated or modernised. Educational clients like steel's flexibility, as a steel-framed school can be more easily reconfigured than a concrete alternative.

Thermal Mass

As energy costs have risen in the past decade, schools as well as other construction schemes have increasingly become interested in creating buildings that save money through utilising their own thermal mass to reduce energy use.

Also, known as fabric energy storage, thermal mass is the ability of a building's fabric – particularly the exposed soffit of a concrete floor slab – to soak up excess heat. This helps to keep the internal environment comfortable while reducing the need for air conditioning.

A common misconception is that concrete building frames create better thermal mass than steel frames. This is incorrect, as steel-framed structures are just as effective, as it is the concrete floor that ultimately provides the mass.

In buildings such as schools, which are intensively used during the day, temperatures can build up to uncomfortable levels due to solar gain and internal heat gains from the occupants, computers and other equipment. If the soffit of the floor slab is left exposed, the warm air rises and some of the heat is soaked up by the concrete.

One of the seven schools: The Kings Langley School, where Leach Structural Steelwork erected steel that supports pre-cast blanks

In-built sustainability for Home Counties schools

As part of the Government's Priority School Building Programme a total of seven steel-framed secondary schools spread across Hertfordshire, Luton and Reading were constructed as one of the first batches of the Education Funding Agency's Priority School Building Programme, PF2 private finance model.

To create a cost-effective and efficient construction programme, the team developed a solution that standardised the classroom design and allowed for similar corridor layouts.

Predominately three storeys high, each school benefits from a large centrally positioned atrium, which acts as a conduit between separate teaching blocks.

A steel frame supporting precast planks was chosen as the most cost effective design for all of the main school buildings, while long span areas such as sports halls and assembly halls were formed with cellular steel beams.

The chosen structural solution also helped the school buildings benefit from heating and cooling gains. These were achieved through taking advantage of the high thermal mass qualities of the composite design, which is able to absorb and store heat. This in-turn reduces the requirements for mechanical ventilation and cooling, which contributes to an overall saving in running costs of each school.

Senior Engineer at Arup Mike Wood says: "To mobilise the thermal mass effectively, the precast plank soffits are left exposed in all of the classrooms."

On parade with steel

Structural steelwork is forming a signature school building for the new community of Mindenhurst, which is being built on former Army land in Surrey. Martin Cooper reports.

The new community of Mindenhurst is quickly taking shape at the Princess Royal Barracks at Deepcut in Surrey. As the Army undergoes a phased withdrawal of its personnel to Worthy Down near Winchester, it is vacating land for 1,200 new homes, 69 hectares of public green space and village amenities.

The site, which has been the home of an Army training centre since the Nineteenth Century, is steeped in history. Once Deepcut is entirely vacated, the remaining Army buildings will be demolished, with the exception of three listed structures, making way for further phases of the redevelopment scheme.

Currently, work is all being undertaken 'outside of the wire' on land adjacent to the functioning military facility. So far, two parcels of land have been awarded to housebuilders with more to follow in the near future, on a scheme that Skanska expects to run until 2025.

Mindenhurst, will boast village-style retail outlets, business premises, a pub, a community hall adjoining the site's historic garrison church of St Barbara at Deepcut and a new primary school. The latter is already under construction and is due to take-in its first pupils in September.

Steel was considered to be the only viable material for this project

"The first homes are nearing completion and there will shortly be a need for the 420-capacity primary school," explains Skanska Development Manager Peter Cater.

The T-shaped steel-framed primary school building has a distinctive design, as its main two-storey classroom block forming the T's upright section is topped with a four-peaked saw-tooth roof.

"As a key piece of infrastructure, we wanted the school to be a signature building for the site, acting as a signpost to the development as it has a prominent position near to a main road," adds Mr Cater.

The saw-tooth feature, not only creates a stand-out building, it also means the upper level of classrooms will have a higher floor-to-ceiling height and will be flooded with natural light as the vertical sections of the roof will have large glazed windows.

The roof is formed with a series of cranked south-facing rafters, with a bolted knuckle joint, that forms an inclined section from two separate steel members. Completing each saw-tooth

FACT FILE
Mindenhurst Primary School, Surrey
Main client:
Defence Infrastructure Organisation
Architect: AWW
Main contractor: Skanska
Structural engineer: Skanska
Steelwork contractor:
William Haley Engineering
Steel tonnage: 220t

Visualisation of how the school will look

ridge, the north side is formed with a single rafter that slopes outward and downwards to its supporting column.

Overall, the school will include two nursery classrooms with associated spaces that can be operated independently on the ground floor. Elsewhere, two reception and 12 more classrooms will be available to accommodate year one and two pupils on both the ground and first floors.

The ground floor is 2m wider than the upper level along the western elevation, allowing these classes to have more room.

Because of this longer span on the ground floor, the column line for this elevation's first floor does not align with lower level.

The first-floor columns are consequently supported on a series of box section members, acting as a transfer structure.

The 500mm × 300mm box sections each measured 8m-long and weighed 2.5t. These were the heaviest steel elements steelwork contractor William Haley Engineering had to erect on the project.

The top portion of the T-shaped structure accommodates a large double-height space for two halls. These column-free spaces are both 12m-wide and will be separated by a moveable partition, allowing them to be used as one or two separate areas.

Adjacent to the hall is another two-storey zone, accommodating the school's kitchen on the lower floor and a plant deck above.

Stability for the steel frame, which supports precast planks to form the upper level, is provided by bracing, located in corridors and partition walls.

"The decision to use precast flooring was all about speed of installation," sums up Skanska Construction Director George Taylor. "William Haley erected the steel and all of the project's precast units, which included a lift shaft, in just five weeks.

"Also the overall design for this eye-catching structure could not have been done in any material other than steel, because of the shape and length of spans."

Steel supporting precast planks was chosen for its speed of construction

The distinctive saw-tooth roof is formed with cranked rafters

An amphitheatre sits in the middle of the school

School spearheads new town

Scotland's first brand new secondary school in more than 25 years has opened with the aid of steel construction's efficiency and speed of delivery. Martin Cooper reports.

The new Bertha Park High School is a £32.5M project led by hub East Central Scotland on behalf of Perth & Kinross Council with Robertson serving as main contractor.

The school will serve the new 800-acre village, known as Bertha Park, which is starting to take shape on the outskirts of Perth.

Spearheaded by Springfield Properties, which secured planning consent for its masterplan in 2016, the construction of the village's proposed 3,000 homes will continue for the next 30 years, creating about 450 building jobs.

It is estimated Bertha Park, featuring 60 acres of commercial land accommodating shops, offices and restaurants, will generate work for 2,000 people.

The school is said to be unique in that it is an entirely new school and not a replacement of an existing one. Part of the Scottish Government's Schools for the Future programme, Bertha Park will eventually accommodate up to 1,100 pupils.

Commenting on the completed project, Robertson Tayside Managing Director Kevin Dickson says: "Bertha Park is set to be one of the most advanced schools not only in Scotland but across the UK and beyond. Partnership working has been crucial to delivering this state-of-the-art facility and Robertson has been privileged to serve as the main contractor.

"The built environment can have an enormous impact on the education experience and while our work is now complete, we are genuinely excited to see how the story of the school unfolds."

Having a blank canvas with no old school to replicate in any way, as well as building on a greenfield site, has allowed the design team to produce a highly distinctive school building.

The school is accommodated within one large wedge-shaped structure that measures 70m-long and is 40m-wide at the northern end. Both of the main elevations taper inwards and so the southern end is slightly narrower at 20m-wide.

Topping the building is a sloping roof with a five degree pitch, which slopes downwards from the north facing main façade. This means the structure has three floors with a large enclosed plant deck above at one end, sloping down to only two floors at the southern elevation. The uppermost third floor consequently only extends over five bays at the north end.

This 40m-wide north façade contains the school's main entrance and, similar to the slightly narrower southern elevation, will feature large glazed areas in contrast to the two side elevations of the school that will be clad with brick.

"It's a very efficient shape, suited to a steel-framed design," explains NORR Director Kevin Cooper. "The teaching spaces are located around the exterior of the structure with a large column-free centrally positioned amphitheatre acting as the school's main focal point."

The steel frame is based around a nominally standard gird for its classrooms of 7.5m × 7.5m, although there are some slightly larger teaching spaces with a grid of 7.5m × 9m.

Steelwork supports metal decking throughout creating a composite design. Stability for the steelwork is derived entirely from braced bays, located throughout the structure, but mostly in partition walls.

Ground floor of the project contains


The glazed north façade contains the main entrance

the aforementioned classrooms around much of the perimeter, with the western elevation also accommodating a sports hall, a smaller games hall and a gym. The sports hall is a double-height braced box with spans of 20m.

The middle of the ground floor features the amphitheatre, breakout spaces and dining areas, all of which form the central open-plan spine of the school. These zones are spanned by bridges, giving access across the void, and are topped with a roof featuring rooflights allowing plenty of natural daylight to penetrate the building's interior.

The northern end of the amphitheater features an audience terrace, formed by steel rakers supporting precast planks. Behind the terracing the school's three-storey part extends for five bays.

According to the design team, the intention is that the school provides well-designed spaces, both internally and externally, that produce and encourage opportunities for positive social interaction for all age groups, both within the formal school setting and in the public environment.

The design addresses the access needs of disabled children and adults, pupils, staff, and visitors. The new school is said to be a 'barrier-free' environment, providing full access for the integration of students and other users who have special needs.

This requirement goes beyond simply providing access and toilets for wheelchair users, but also addresses for example, the needs of the hearing and visually impaired, and the provision of accommodation for teaching areas appropriately sized to accommodate students with special mobility and equipment needs.

Summing up, Robertson Operations Manager Robbie Kerr says: "There were a number of factors as to why this job was always going to be a steel project, speed of construction was one but also the location was important. We were located on a greenfield site with little or no paved access roads, but steel was transported to site in erectable loads. We would have struggled with any other material.

"The long 16m spans over the amphitheatre and the 20m spans over the sports hall would also have been difficult to form in any other framing solution."

Bertha Park High School opened at the start of the Autumn term 2019.

FACT FILE
Bertha Park High School, Perth
Main client: Perth & Kinross Council
Architect: NORR
Main contractor: Robertson
Structural engineer: Goodsons Associates
Steelwork contractor: Walter Watson
Steel tonnage: 720t


The steel frame creates the school's distinctive wedge shape

Innovation Centre set to drive industrial strategy

Exposed steelwork is the order of the day for a £35M teaching and research facility which engages directly with industry and provides students with real-world experience on live, engineering-related projects.

Forming one of the initial elements of the University of Central Lancashire's (UCLan) ambitious £230M campus masterplan, the Engineering Innovation Centre (EIC) is a unique facility.

Based at the University's Preston campus, the steel-framed EIC will act as one of the driving forces behind the Lancashire Industrial Strategy as well as the national industrial strategy, addressing the need for innovation and producing the next generation of world-class engineers.

Cutting-edge research and teaching facilities include an additive manufacturing lab (3D printing), an advanced manufacturing workshop, an intelligent systems facility, a motorsports and air vehicles lab, a high-performance computing lab, a flight simulator suite as well as a fire, oil and gas facility.

The exposed steelwork is a highlight of the building's interior

To date, the EIC is the largest single investment in Lancashire's educational infrastructure establishing UCLan as one of the UK's leading universities for engineering innovation.

Commenting on the construction of the EIC, Simon Atkinson, Construction Manager for main contractor BAM says: "The project was a big success with the client, and the steelwork was an important part of the finished building.

"Often a building will cloak its services. But being a centre of engineering excellence, this building makes a virtue of the frame and the connections. This makes them an integral part of the design and tone of the building, and an incidental teaching tool which is also naturally elegant."

Work on the site, which had previously been used as a car park, started during 2017. Prior to the structure's steel frame being erected, BAM had to install piled foundations along with a retaining wall along three of the elevations.

Preliminary work then included erecting the building's two precast concrete cores, which are positioned at either end of the structure. Once these were up, the steelwork programme was able to commence, as the cores provide the frame's overall stability.

The six-storey steel frame is approximately 70m-long x 20m-wide and 30m-high. It has been designed around a regular grid which incorporates two spans, one of 13.5m and another at

6.5m. The longer span accommodates the building's workshops and teaching spaces, while the shorter span houses circulation routes, a main staircase and some smaller ancillary classrooms.

Within the frame a series of steel box sections support 450mm-deep precast flooring planks within their depth via a welded plate on the bottom flange. These sections work in conjunction with T-section members spanning in the opposite direction, which also sit within the plank depth to create the flat soffit.

"This framing solution was chosen as it creates a flat soffit from which the services are suspended," explains BDP Project Engineer Chris Goodwin.

"The client had an aspiration for a clean soffit as it helps – along with the building's exposed steelwork – to create an industrial-feel to the structure."

According to project architect Simpson Haugh, a key concept from early inception was the expression of the

FACT FILE
University of Central Lancashire [UCLan] Engineering Innovation Centre, Preston
Main client: UCLan
Architects: Reiach and Hall Architects, Simpson Haugh
Main contractor: BAM Construction
Structural engineer: BDP
Steelwork contractor: Elland Steel Structures
Steel tonnage: 700t

The steel frame is visible through the glazed cladding

building structure 'as the engineering of the building becomes the architecture.'

By having an exposed structural frame behind glazed cladding, the building is promoting itself as an engineering educational tool.

The building's long column-free spaces have provided the university with plenty of flexibility.

In the upper floors, this flexibility provides the ability to move partitions between classrooms to suit future use requirements and also means any services for new equipment will be unrestricted. On the ground floor, it provides open-plan workshop spaces for positioning machinery.

Stability is provided by the precast cores and precast planks acting as a floor diaphragm. As part of the floor, a lightweight T-section allowed for a flat soffit, but during construction, temporary bracing was required before the planks were installed.

The steel bracing, erected by the steelwork contractor Elland Steel Structures, allowed the entirety of the steelwork to be erected at once, removing the requirement of waiting for the planks to achieve diaphragm action and so shortened the construction programme.

Columns were brought to site in 15m-long sections, meaning the structure's 30m-high frame has one splice just above third floor. The internal, and heaviest, columns are 305 UC sections.

The heaviest steel member was only 6t, however the large 250t-capacity crawler crane had to be utilised. With only one location available for any crane on the site, and very little room for it to manoeuvre, the crane had to be able to lift some columns and beams over the entire frame.

Summing up, David Green, Partner, Simpson Haugh and Lyle Christie, Director, Reiach and Hall Architects, say: "The completed building is intended as an open, accessible and welcoming facility and it is genuinely exciting to think of the new ideas and projects that will now emerge from the students, staff and businesses in the building. We hope this new building helps the university project the dynamic and exciting activities contained inside and helps encourage wide engagement in engineering."

The UCLan EIC opened in October 2019.

The completed steel frame

The Centre Building is the highest structure on the LSE campus

Photos: Joas Souza

Exposed design for new London campus

The London School of Economics has used an aesthetically-pleasing exposed steel frame design for its new landmark Centre Building. Martin Cooper reports.

Situated in the heart of the London School of Economics (LSE) estate the steel-framed Centre Building has been described as a bold and beautiful structure, the highest on the campus, and offering spectacular views across the capital's skyline.

Part of a much-larger campus-wide redevelopment programme, the Centre Building offers an internal floor area of 15,507m², while a modern and stylish environment has been created by leaving much of the building's steel frame largely exposed, a design that has required a number of bespoke steelwork elements in order to fulfil the project's architectural vision.

Tracy Meller, Partner and architect, Rogers Stirk Harbour + Partners says: "The Centre Building project presented us with a unique opportunity to work with the LSE to design a building which really reflects the values of the school, creating innovative and inspirational spaces for students and staff, in which to learn, socialise, study and collaborate.

"Embracing sustainable design principles from the offset, the BREEAM 'Outstanding' building provides good daylighting and natural ventilation to over 70% of the accommodation, creating workspaces which enhance the wellbeing of its occupants. In addition it reduces embodied carbon by 30%, harvests rainwater and utilises a biomass boiler and PVs as part of its renewable energy strategy."

Another part of the architectural intent is to provide a slimmed down floor construction, in order to maximise available space. This design has been achieved by using RHS or plated floor beams, featuring bottom plates to support the building's long span precast floor units, which sit within the depth of the beams.

As exposed steelwork plays such an important role within the design, the fabrication process had to rise to the challenge accordingly as Mace Project Director Frank Connolly explains.

"Billington, our steel contractor, was tasked with making sure that the majority of the steel connections were hidden from view in accordance with the client's requirements.

"Flush connections were the order of the day, or alternatively they positioned end-plates to help create shadow gaps, which in turn were then used as repeating architectural features."

Shear forces and torsional moments applied to the RHS beams, in conjunction with the desire to avoid site welding, led to the bespoke hidden connection design. Many of the steel members have an internal bolted connection, hidden from view and accessed via a hatch.

Having the steel frame and the ductwork exposed not only creates an aesthetic environment within the completed building, it also brings ventilation advantages.

Director of Estates at LSE Julian Robinson says: "This building delivers on the two key tenets of our estates strategy, creating a world-class estate and a university quarter in this part of London. The Centre Building, with its emphasis on sustainability, community and collaboration, has created an inspiring academic environment within which to work and study that will enhance the campus experience for our students, staff, alumni and visitors."

Overall, the building consists of two conjoined parts; the 13-storey Tower Block and the six-storey Houghton Block. At either end of the blocks, that sit side-by-side for just under half of their lengths, exposed SHS bracings bookend the project and form another highly visible exposed steelwork element.

This exo-skeleton bracing, which sits approximately 300mm outside of the building envelope, is not just an aesthetic element as it is also a structural requirement, sharing the stability with two concrete cores.

Significant forces are transferred both within and into the SHS bracing system and so bespoke cruciform node joints were engineered with machined flush plates to ensure the correct standard of finish was achieved.

Full stability to the structure was only achieved once the entire frame was erected and all of the precast flooring was installed. Until that point was reached Billington had to install temporary bracing to each floor, which was only removed once each level was fully complete.

According to Billington Structures Managing Director Mark Smith, to allow flexibility in the overall build sequence the temporary stability system was developed to largely ignore any benefit that the concrete cores may have offered.

"Due to the architecturally sensitive nature of the exposed frame, we had to be mindful of the subsequent impact of any of the connection points for the temporary bracing, and so bolted cleats were used to negate the need for any removal of welded plates," he says.

The majority of the project's steelwork begins at ground floor level, however in order to form a large subterranean auditorium two large plate girders had to be installed during the basement works programme.

Exposed steelwork is said to create inspirational spaces for students and staff

FACT FILE
London School of Economics Centre Building Redevelopment
Main client: London School of Economics
Architect: Rogers Stirk Harbour + Partners
Main contractor: Mace
Structural engineer: AKT II
Steelwork contractor: Billington Structures
Steel tonnage: 1,100t

Encased in concrete and positioned at ground floor level, the two girders measure 17m long × 1,600mm deep and each one was brought to site in two pieces for ease of transportation. The main steel frame was erected entirely by tower crane, but these girders needed a 400t-capacity mobile crane to be used for their installation.

The part of the basement that contains to the auditorium does not lie beneath the new building, but instead it is positioned in front of the structure and below a new public square.

Access to the auditorium is via the Tower Building's atrium, which accommodates a staircase to the lower level and is a void formed with exposed steel columns that start at basement level.

The atrium also offers access to the Tower's main staircase, known as the meandering stair as it shifts along the structure one bay per floor.

Formed with a lightweight prefabricated steel frame, this staircase was lifted into position piece by piece along with the main steel frame. Its design is said to mimic the movement within the square, as well as allowing better connectivity and collaboration between different departments on different floors.

Summing up, AKT II Director Ricardo Baptiste says: "The contribution of the steel frame, which includes bespoke floor beams contained within the structural floor's depth, goes beyond the construction stage - the clever and skilfully detailed steel frame is visually expressed throughout, both internally and externally, celebrating the 'building's skeleton' by leaving it exposed for all to see."

The Centre Building, which opened in Autumn 2019, hosts a number of academic departments, more than a dozen seminar rooms, hundreds of study spaces and four lecture theatres, including an innovative 'LSE style theatre' designed to allow for both traditional style teaching and collaborative group work.

Photo: Winvic Construction

Students get high-rise living

Topping out at 23-storeys high, a steel-framed student accommodation project is now Coventry's tallest building. Martin Cooper reports.

Coventry is famous for many things, but until recently high-rise buildings was not one of them.

That has now changed since last summer's completion of a new landmark 23-storey student accommodation scheme, which is now the city's tallest building, excluding the nearby cathedral spire.

Towering over the city centre, the Fairfax Street scheme for specialist student accommodation developer CODE Students has delivered 1,192 self-contained studios and achieved a 'Very Good' BREEAM rating.

Overall the scheme consists of four interlinked steel-framed blocks, ranging in height from the eight-storey Block C to the tallest element, the 23-storey high Block B. Meanwhile, Block A has 14-storeys and Block D tops out at 21-storeys, technically making it Coventry's second tallest tower.

According to the client CODE Students, the en-suite studio flats have been purposely built to provide great student housing as they feature everything a tenant would need.

All of the units feature a fully-equipped kitchen, deluxe shower room, a double bed, 200mb broadband and a secure CCTV and fob entrance system. Other features include a spacious wardrobe and relaxing leather chair/sofa, a personal workspace with desk and comfortable office chair.

"We're just a few minutes' walk from Coventry University, as well as offering city-based living for those studying at the University of Warwick," says a spokesperson for CODE Students.

This is the highest project main contractor Winvic has ever built as


The high-rise steel-framed buildings are now a city landmark

FACT FILE
Fairfax Street Student Accommodation, Coventry
Main client: CODE Students
Architect: RG+P
Main contractor: Winvic Construction
Structural engineer: PRP
Steelwork contractor: Caunton Engineering
Steel tonnage: 1,800t


Steelwork aided the project's fast construction programme

the company is primarily known for constructing distribution centres. However, the company is now diversifying and previously completed a similar job for the client in Leicester, although that was low-rise compared to this scheme as it only had eight-storeys.

Winvic started work on site during October 2017, and began by installing piled foundations in readiness for the steel erection to begin. The plot had previously been used as a surface car park and the client had already remediated the site before the main contractor started.

The choice of a steel-framed solution for the scheme was made primarily for the material's speed of construction.

The client wanted the accommodation completed as quickly and efficiently as possible. Consequently, the team went with a steel frame construction with metal decking as it offered the fastest method.

This design decision proved to be the correct one as after only 11 months on site 315 bedrooms were already completed. Block A and a portion of the adjacent Block B, were handed-over in September 2018, just in time for the new University term.

By the following month (October), steelwork contractor Caunton Engineering had competed the majority of its programme, having erected Blocks A, B and D, and then completing Block C.

RG+P Architect Laura Davison says: "The exterior of Fairfax Street features a number of large 'fin' extensions as well as deep recesses and reveals. These create shadows, texture and make the overall impression of the buildings much more dynamic. Steelwork offered the flexibility to be able to deliver this design intent within the time period and to the desired quality."

The final piece of the steelwork jigsaw was then completed in February 2019 when Caunton returned to site to erect 26t of steel that formed a single-storey podium deck situated in front of Block C. This accommodates ground floor retail units and a landscaped private garden on the first floor.

Caunton Engineering were employed on a design and build contract for the scheme. The company's Senior Structural Engineer Colin Winter says: "Although there are four blocks and a podium, much of the steelwork was fairly straightforward and repetitive as each of the accommodation blocks have identical floor plans."

The four accommodation blocks have widths between 13m and 15m, with only one internal column line. These members are offset from a central line, allowing them to be positioned one side of the corridor that separates two rows of bedrooms on each of the block's floors.

Meanwhile, perimeter columns are generally set at 6m or 7m intervals, with stability for the frames derived from full height vertical bracing systems.

The bracing forms steel cores around stairs and lifts, which are located in the two tallest towers, Blocks B and D.

"The entire scheme is essentially two large steel frames, separated by a movement joint between Block C and B," explains Mr Winter.

The regimented tower block grid lines even include non-bedroom areas such as the ground and first floor areas which will accommodate retail and student communal areas.

Some of these areas will be subjected to higher loadings and so larger beams, measuring 350mm × 300mm, have been installed at first floor level in Block A where a student gym will be located.

The entire Fairfax Street accommodation scheme was handed over during the summer of 2019.

Steelwork keeps academia active

A world-class sport hub has been created at the University of Warwick with the aid of steel construction.

Last year Willmott Dixon completed the University of Warwick sports hub, a project that relied on steel construction's numerous attributes to deliver a project that has positioned the client as a leader in sports facilities, and on track to achieve its objective of being the "most physically active campus community in the UK by 2020".

Students, staff, as well as the local community, now have access to a multi-functional sports hall and a 230-station gym – said to be the largest at a UK university. The hub also has a 25m-long 12-lane swimming pool that, with the touch of a button, allows flexible configuration and an adjustable height to accommodate different users and abilities. To top that, a dramatic 17m-high climbing wall offers 706m² of climbable surface, with 144 different routes.

Adding to the hub's array of facilities, it also boasts retractable bleacher seating for over 1,000 spectators, a martial arts hall, squash courts, outdoor 3G sports pitches and netball courts.

Willmott Dixon Construction Manager Nick Preedy says: "This project was complex in design and there were many aspects to the build that were new to me. I needed to identify the high-risk elements of the build to focus everyone's attention.

"We were working within a live campus and replacing all the existing sporting facilities. I was part of the team right from the start, allowing me to get involved with initial designs to drive efficiencies and solve issues that may arise during the build. That included redesigning aspects like the cut and fill, resulting in zero materials leaving site and ultimately saving our customer over £1 million."

Cost is always a major factor in any construction scheme and this project was no different. Early in the design phase, Willmott Dixon engaged with the steelwork contractor Hambleton Steel to help with a value-engineering exercise.

The project's original design envisaged a steel frame supporting precast planks to form the hub's upper floors, but for this project it was decided that it would be more cost-effective to use metal decking.

"We changed all the floors to metal decking with the exception the wet changing rooms and areas near to the pool because of chlorine corrosion concerns," says Mr Preedy.

"This meant we had to add extra beams to support the decking as it couldn't span as far as the planks, but overall we used less steel tonnage as a lighter frame was needed, which ultimately saved the client more money."

Another benefit resulting from this design change was a quicker steel

FACT FILE
University of Warwick sports hub
Main client: University of Warwick
Architect: Space & Place
Main contractor: Willmott Dixon
Structural engineer: Arup
Steelwork contractor: Hambleton Steel
Steel tonnage: 900t

The climbing wall is 17m high and offers more than 700m² of climbable surface

Raking columns form a series of signature Ws

erection programme. Including the metal decking installation and the remaining precast planks, the work was completed in 13 weeks instead of the previously estimated 18 weeks.

Enabling the design team and site team to fully coordinate any changes, BIM level 2 was used, as Mr Preedy explains: “This was a big commitment for a project at that time, as it was only just starting to be used, but we had full buy-in from all stakeholders from the start.

“BIM was critical through all stages – it enabled the seamless installation of highly complex multiple faceted roof intersections and drove a right-first-time strategy as sequences were fully understood.

“Most significantly, through extensive use of digital technology, I was able to have the plant room fully manufactured offsite and brought in on skids – effectively a ‘plug and play’ which reduced the installation time to just three days!”

Overall the sports hub is one large steel frame, which gains its stability from strategically-placed cross bracing, and offers 14,000m² of floor space.

Two large open-plan areas dominate the building and are placed at either end of the 200m-long structure. At the northern end of the structure the sports hall is a large column-free space reaching the full-height of the building. The hall is formed with a series of 11 spliced 40m-long × 2m-deep trusses, which weighed 8t each.

The trusses are supported at one end by tubular raking columns that form the architectural feature façade for a viewing gallery.

Another design innovation from Hambleton was a series of beams that cantilever out from the top of the sports hall’s roof and over the lower roof of the adjoining areas. Willmott Dixon supported the scaffold for the cladding installation on these sacrificial beams, which were removed once the cladding was complete.

“This helped speed up the installation of the scaffolding as it would have ordinarily been supported from ground level. By using the beams the scaffold was erected more rapidly, which allowed us to get started on the cladding earlier, and meant we got the sports hall watertight earlier,” says Mr Preedy.

At the southern end of the hub there is an 8m-high swimming pool hall, which is another large open column-free space. This zone is formed by a series of 30m-long glulam beams supported on steel columns.

The columns in the pool area will be left exposed in the completed building, as will most of the sports hub’s steel frame. To this end, all of the project’s steelwork has been painted with a high-spec protective coating to prevent any corrosion from the potentially humid and chlorinated conditions.

The sports hub’s other facilities occupy the large area between these two column-free zones, as well as running along the entire eastern elevation. In these parts, the hub has three floors, a basement – mainly accommodating changing rooms and offices, a ground floor with the main entrance, climbing wall and squash courts, wet changing facilities and a café, and a first floor containing a 330-station gym and multi-purpose studios.

As well as internal exposed steelwork, some of the hub’s exterior steel also remains visible as architectural features.

Adjacent to the pool hall a large cantilevering canopy, partially supported by raking CHS columns, creates an outdoor terrace for the hub’s café.

At the opposite end of the hub, a similar canopy forms the roof for the facility’s main entrance, again supported by raking columns.

These raking 273mm-diameter columns also extend along the exterior of the eastern elevation, joining the two canopies with a series of large W’s, which obviously stand for Warwick.

The hub has a 25m-long swimming pool

Steel for Life
Steel for Life is a wholly owned subsidiary of BCSA, created in 2016, with funding provided by sponsors from the whole steel supply chain. The main purpose of Steel for Life is to communicate the advantages that steel offers to the construction sector. By working together as an integrated supply chain for the delivery of steel-framed solutions, the constructional steelwork sector will continue to innovate, educate specifiers and clients on the efficient use of steel, and market the significant benefits of steel in construction.

British Constructional Steelwork Association
BCSA is the national organisation for the steel construction industry: its Member companies undertake the design, fabrication and erection of steelwork for all forms of construction in building and civil engineering. Industry Members are those principal companies involved in the direct supply to all or some Members of components, materials or products. Corporate Members are clients, professional offices, educational establishments etc which support the development of national specifications, quality, fabrication and erection techniques, overall industry efficiency and good practice.

www.steelconstruction.info
is the go to resource for all steel construction related information and guidance.

Follow us on:
Twitter: @steelcoinfo
LinkedIn: steelconstruction.info
Facebook: steelconstruction.info

Produced for:
The British Constructional Steelwork Association
www.steelconstruction.org
and
Steel for Life
www.steelforlife.org
by Barrett, Byrd Associates
www.barrett-byrd.com

January 2020