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CAMEO CASE STUDIES

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INDEX PAGES AND LINKS TO CAMEO CASE STUDIES

Each cameo case study listed on the **"INDEX PAGES"** is linked directly to the appropriate cameo case study. Simply click on a title and the relevant page will be displayed.

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The document is also bookmarked on the left-hand side of the page. These bookmarks have been designed to aid navigation and are broken down into several categories.

BOOKMARKS TO MARKET SECTOR

Under the bookmark "MARKET SECTOR" there are five subordinate bookmarks (click on the small plus sign to expand these). Under each of the subordinate bookmarks you will find a list of all the case studies relevant to that market sector – ie *Civil and infrastructure*, *Housing and residential*, *Retail and commercial*, *Public sector* and *Community and social*.

BOOKMARKS TO APPLICATION

Under the bookmark "APPLICATION" there are 11 subordinate bookmarks. Each of those 11 bookmarks is further broken down to smaller groups under which the case studies are listed.

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Cameos 1 to 149 were produced as part of a DTI funded research project; project managed by CIRIA with Loughborough University Construction Management Team the appointed research contractor. All information providers for the original research project were contacted for permission to reuse the Cameos which were further edited and reformatted together with the opportunity to provide more recent pictures for the purpose of producing this Cameo Library for Buildoffsite.

INDEX OF CASE STUDIES

Precast concrete service pits

Main drivers/constraints

- Minimising time spent on site
- Achieving predictability of quality
- Reducing health and safety risks
- Reducing environmental impact during construction

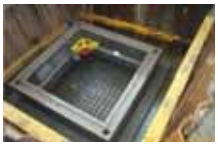
Project information

The work involved construction of service pits, called P-pits, within airports. These relatively large chambers contain high-tension power equipment, with various cable entry points. They are awkward to build on site, take up resources and demand a lot of in and out movement of materials from the airport. They must also fit tight tolerances of just ± 3 mm at pavement level and sustain high loads. As a consequence, the P-pits have usually been constructed in situ, taking around three weeks to complete.

A standard solution would be to make them as single precast units, but they are too large for that. The team devised a way to precast the chamber using interlocking units. Rectangular “ring” sections are locked together with grooves and tongues before being grouted. Cast-in jacks enable the tolerances to be achieved. The units are designed with lifting points and kept within weight limits, keeping plant requirements low and manual handling to a minimum.

Benefits achieved

- With this system a pit takes just 15 man-hours to assemble on site, excluding initial excavation, against the 300 hours previously required
- Many fewer operatives need to pass to and fro through airside security checks and truck journeys are cut from nine HGVs to five
- The excavation is reduced in size since less working space is required, and confined space working is almost eliminated
- The site is also noticeably cleaner because there are no offcuts or loose components, and spare concrete wastage is reduced
- Crucially, hot works like spark-causing steel cutting are eliminated, and there is no messy, noisy scabbling. The end result can also be modified easily
- The pre-cast solution could now find a much wider use for similar pits such as drainage manholes, extending the social, safety and environmental benefits further.



Contact information

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Acknowledgements

NCE (2002). “Commended concrete P-pits: rethinking an ‘impossible’ precast brings wide benefits”, BAA Sustainable Construction Awards, NCE, May 2002, page v

Toilet pods - City of London

Main drivers/constraints

- Minimising time spent on site
- Achieving high quality.

Project information

Ninety-one individual toilet and washbasin pods were installed in a new-build steel-frame City of London office building. The project was one of the first to use toilet pods in the City since the early 1990s. The client chose the pods for their high-quality internal finishes of granite, slate and glass. Secondary programme objectives were to simplify the on-site process, reduce risk and to maintain "as built" quality by keeping units locked until completion. The total cost of the toilet pod package was £620 000 and average cost per pod was £6800.

Points of learning

- Importance of the client's commitment to the use of prefabricated pods
- Services ducts require more detailed design
- Detailed testing and inspection of the prototype is required to ensure that all potential problems are identified before production.

Benefits achieved

- On-site installation, excluding services connections, took four weeks, compared with 18 weeks required for conventional construction
- Finish quality was high.

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Acknowledgements

Building (2002). "Cost model", Building, 15 Feb, p 69

Modular student accommodation 1

Main drivers/constraints

- Ensuring project cost certainty
- Ensuring a firm project completion date
- Achieving high quality.

Project information

The project was to construct a 750-bed student residence on a brownfield site using prefabricated bedroom, kitchen and staircase modules. The completed building was to be clad in a terracotta rainscreen with a pitched roof to meet the planners' requirements.

Principal objectives

Modular construction was used chiefly to ensure certainty of completion for the start of the academic year. The use of modules made this large scheme feasible by compressing the programme and simplifying the completion and handover of large numbers of rooms. Secondary development objectives included: avoidance of delay, cost certainty and achievement of high-quality construction at a reasonable cost.

Benefits achieved

- Pre-planning the work resulted in cost benefits from time saved on site
- Pre-manufactured products improved project planning
- Modular improved the cost/quality ratio.

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Acknowledgements

Building (2002). "Cost model", Building, 15 Feb, p 70

Timber-framed college extension and prefabricated roof panels

Main drivers/constraints

- Minimising time spent on site
- Achieving performance predictability throughout the life-cycle
- Maximising environmental performance throughout the life-cycle
- Implementing respect for people principles.

Project information

Chulmleigh Community College urgently needed to replace several outdated temporary buildings used as a technology department and general classroom space. The redevelopment was completed in October 2003.

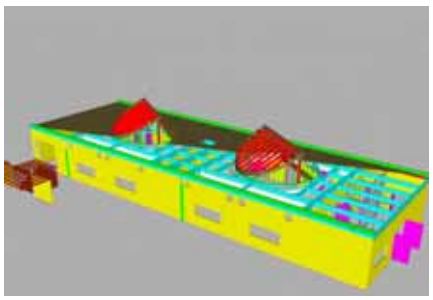
Prefabricated timber-frame external walls freed the internal space from structural elements. The walls were designed to resist the horizontal wind loading and vertical loads from the roof and cladding, as well as being detailed to provide fire resistance and thermal and acoustic insulation.

The flat roof structure was also prefabricated, using roof cassettes for speed of assembly.

Distinctive features of the project were the two circular north lights, which allow light into the central classroom and technology block. These structures were prefabricated using timber frames and span 9 m between supports.

Benefits achieved

- On-site construction time minimised
- Internal space freed from structural requirements
- Energy consumption minimised, and a comfortable classroom environment was provided.



Courtesy Devon County Council

Contact information

Client: Chulmleigh Community College
Architect: Devon Property
Structural engineers: Chiltern Clarke Bond

Acknowledgements

TRADA (2003). Newsletter for TRADA members, no 50, Dec

Precast concrete panel system

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Restricted site layout and space.

Project information

This project, for a school extension, involved offsite construction of structural concrete wall panels, both internal and external, with all openings pre-formed. Panels were delivered to site and fixed using the company's own fixing methods. Panels could be cut to size on site where required. The structure was then clad to match existing buildings. All panels have an insulated core and met the existing Building Regulations.

Benefits achieved

- Remained within budget; reduced prelims
- Completion achieved well ahead of programme
- No health and safety problems associated with shared access on "live" site
- Less on-site storage required (important on a tight school site).

Client: London Borough of Bromley
Architect: Mouchel Parkman
Supplier: Structherm

Courtesy Structherm Ltd

Contact information

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Acknowledgements

John Hemsley, project officer
Education & Capital Projects Team
London Borough of Bromley

Pre-assembled building services – Manchester

Main drivers/constraints

- Minimising time spent on site
- Reducing health and safety risks
- Restricted site layout or space
- Limited or very expensive available skilled on-site labour
- Short overall project timescale.

Project information

Victoria Call Centre is a three-storey office complex situated within the Manchester M.E.N. Arena complex. The building includes several large open-plan call rooms, training rooms, a section containing individual offices, a large reception area and a security facility. Fast-fit pre-assembled services units, comprising pipes and valves, were delivered to site and simply installed with only four joints. The installation was completed within three months.

Benefits achieved

- Eliminated the need for hot working
- Reduced the requirement for expensive on-site labour
- Reduced the requirement for on-site storage.

Client: JD Williams Catalogue Group
Contractor: ABB Building Technologies

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Acknowledgements

Tour & Andersson Ltd

Timber cassette system for schools

Main drivers/constraints

- Minimising overall life-cycle costs
- Achieving performance predictability throughout the life-cycle
- Maximising environmental performance throughout the life-cycle.

Project information

The design of this school was based on the principles set out in the Egan report. The framework system fuses flat-pack-style prefabricated construction techniques with sustainable design.

Structural timber frames, with separate ceiling and floor cassettes, have been used for the buildings. They are designed to be assembled on site, without cranes or wet trades. It is also envisaged that the system could be used for office buildings and community facilities.

Benefits achieved

- Reduced the life-cycle costs and energy consumption of traditional classrooms
- Performance of heat and water recycling exceeded Building Regulation standards
- The system can provide energy-efficient permanent buildings for the cost of temporary structures.

Architect: Loates-Taylor Shannon

Courtesy Loates-Taylor Shannon

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237 Long Lane
London SE1 4PU
Tel: +44 (0)20 7357 7000

Acknowledgements

Building Design (2001). “School prefabs take on sustainability”, Building design, News, 27 July, p 5

Modular apartments

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Achieving high quality.

Project information

City-centre apartments for single people at affordable rents in Leeds. The project brief was to design 45 unsubsidised one- and two-bedroom city-centre flats on a semi-circular site in Leeds. The challenge was to devise a proposal that kept costs to a minimum while providing high standards at affordable rents.

The solution included the detailed design of prefabricated modular units that were quickly assembled on site to create the completed building in only 36 weeks from site possession. This project was completed in June 2000 with a construction cost of £2 million.

Benefits achieved

- Costs minimised while high standards provided at affordable rents
- On-site construction time minimised.

Client: Joseph Rowntree Foundation
Architects: Levitt Bernstein Associates Ltd

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Fax: +44 (0)20 7275 9348

Acknowledgements

Levitt Bernstein Associates Ltd

Pre-assembled building services – west London

Main drivers/constraints

- Minimising time spent on site
- Minimising overall project time
- Achieving high quality
- Restricted site layout or space.

Project information

GlaxoSmithKline's £315 million global headquarters are on a tight site between the M4 motorway flyover and the Great West Road. Among the technical innovations of GSK House was a prefabricated system of structured cabling designed by the IT consultants. Known as "pre-terminated cabling", it is laid out to size on a continuous mat in the factory, then unrolled and connected up on site. With this method, 90 miles of cables were installed each week. This contributed to the 930 000 m2 of building being completed in a contract period of 39 months.

Benefits achieved

- On-site duration reduced with 90 miles of cables installed each week
- In-situ damage and failures reduced.

Client: GlaxoSmithKline
Architects: Hillier and RHWL Architects
Construction manager: Mace
Project manager: Gardiner & Theobald
IT consultant: Coleman Bennett International

Contact information

RHWL Architects
77 Endell Street, London WC2H 9DZ
Tel: +44 (0)20 7379 7900
Fax: +44 (0)20 7836 4881

Acknowledgements

Spring, M (2001). "Fast-acting relief: GlaxoSmithKline's £315m global HQ in west London has echoes of BA Waterside – but it was built more than twice as quickly", *Building*, 19 Oct

Proposal for pre-assembled elements for art gallery

Main drivers/constraints

- Minimising time spent on site
- Achieving performance predictability throughout the lifecycle
- Maximising environmental performance throughout the lifecycle
- Restricted site layout or space, with potential weight limits.

Project information

This £12.6 million visual arts centre takes its name from 19th century artist J M W Turner. The gallery will be designed to withstand wave forces of a 1 in 10 000-year storm, but pragmatism dictates that the breakwater building, housing public facilities and a restaurant, be designed for a 1 in 100-year storm.

The structural engineers have looked at ways of prefabricating parts to speed up the construction process. One proposal is to fabricate elements in the winter and build in the summer months when weather conditions are more favourable. Prefabrication is also favoured for reasons of weight and manoeuvrability, as there are doubts whether the breakwater is strong enough to cope with fully laden concrete trucks. Prefabricated components offer distinct advantages on a site with such restricted access.

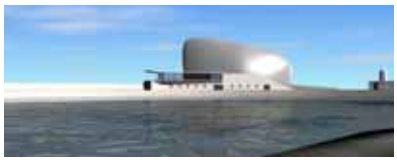
Construction is expected to get under way in 2005, with completion scheduled for 2006–7.

Potential benefits

- Faster construction process
- Addresses issues of weight and manoeuvrability
- Assembling ready-made components offers advantages on a site with such restricted access.

Client: Thanet District Council and Kent County Council
Architect: Snøhetta & Spence
Consultant: Whitby Bird/Arup





Photos from <http://www.snoarc.no/default.asp?V_DOC_ID=842>

Acknowledgements

Kitching, R (2004). Art under attack,
New Civil Engineer, 15 Jan 2004, p18–19

Modular timber units for foyer

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Achieving high quality.

Project information

The Harlow Foyer project comprises training suites, communal facilities, a café, and 76 bedsits for young, single, homeless people plus 44 one-bedroom flats as “move-on” accommodation. Offsite-prefabricated timber volumetric units have been used with a polyester-coated aluminium rainscreen. The project was completed in 2001 for a construction cost of £4.5 million.

Benefits achieved

- Construction costs minimised
- On-site construction time minimised
- High standard of finish achieved.

Client: East Thames Housing Group
Architects: Levitt Bernstein Associates Ltd

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Acknowledgements

Levitt Bernstein Associates Ltd

Pre-assembled pedestrian bridge

Main drivers/constraints

- Minimising time spent on site
- Implementing respect for people principles
- Restricted site layout or space
- Live working environment limits site operations.

Project information

The new 9.5 m-span footbridge for the Royal Ballet School in Covent Garden crosses Floral Street at fourth-floor level and provides a direct link between classrooms and stage for the ballet dancers and staff. The design addresses a series of complex contextual issues and is legible both as a fully integrated and as an independent architectural element with a strong identity. Fabricated in works in Austria and west London it then arrived at site on the back of a lorry to be lifted into place. The design is geometrically and structurally simple, comprising a series of 23 square hoops or portals sandwiched together along the length of the bridge, supported from a fabricated aluminium spine beam.

Benefits achieved

- The complete bridge structure was pre-assembled offsite, being craned into position in one efficient operation
- An innovative solution to an access problem
- The beauty of the bridge is evident from both the outside and the inside.

Client: The Royal Ballet School
Principal designer: Wilkinson Eyre Architects
Principal contractor: Benson
Bridge subcontractor: Gig Fassadenbau




Contact information

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F: +44(0)20 7608 7901

Acknowledgements

NCE (2003). "BCI Awards", *New civil engineer*, 23 Oct, p 36

Timber panellised system for housing – Tower Hamlets

Main drivers/constraints

- Minimising overall project time
- Achieving performance predictability throughout the life-cycle
- Maximising environmental performance throughout the life-cycle.

Project information

The Lefevre Housing scheme in Tower Hamlets, London, is a new-build social housing project of 172 houses. For this fast-build project all external wall panels were fabricated offsite and brought to the site fully insulated and ready to install. The insulation used was EcoTherm HCFC-free Selthaan board. The panels were delivered protected by a red breather membrane, ready for external cladding to be fixed.

Benefits achieved

- No increase in scheme costs compared with traditional approaches
- Cost predictability
- Increased time predictability leading to greater certainty of handovers for residents
- Faster construction meant earlier occupation and earlier generation of rental income and also reduced time for regeneration of existing neighbourhood
- Fewer defects and improved quality of end product for greater customer/resident satisfaction
- High thermal insulation of the building envelope reduces running costs.

Client: Tower Hamlets HAT
Architect: BPTW
Contractor: Willmott Dixon Housing
Supplier: Marlows of Bury St Edmunds

Contact information

Chris Durkin
Willmott Dixon Housing
Tel: +44 (0)1462 814455

Acknowledgements

RCI (2003). "EcoTherm specified for fast-track homes", Roofing cladding & insulation, Aug, p 20

Panellised wall and roof system

Main drivers/constraints

- Ensuring project cost certainty
- Minimising overall project time
- Achieving high quality
- Maximising environmental performance throughout the life-cycle.

Project information

The 12 new holiday chalets assembled in Croyde Bay, north Devon, were built as part of a major park refurbishment. The structural insulated panel (SIP) quick-build wall and roof panel system adopted allowed the units to be supplied and assembled to the site within a 16-week programme. The units included full external finishes, interior fitting out and disabled facilities successfully achieved the planned budget.
The SIP wall and roof panels effectively replaced conventional wall and roof construction. SIPs offer improved insulation qualities over standard construction. Fewer fossil fuels need to be burned, resulting in lower heating and electric bills.

Benefits achieved

- Fast-track build and to budget
- Low cost, low labour cost
- High insulation values achieved
- Environmental benefits achieved.

Client: Unison
Contractor: ITL Impex Ltd
Supplier: SIP Tec

Contact information

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Acknowledgements

ITL Impex Ltd

Pre-assembled insulated roof panels

Main drivers/constraints

- Minimising time spent on site
- Maximising environmental performance throughout the life-cycle
- Limited or very expensive available skilled on-site labour.

Project information

Launched in 2000, this is a component for tiled or slate-covered pitched roofs that can increase the efficiency of the house-building process and add value to the end product.

The roof panels span from eaves to ridge with a minimum number of purlin supports, to provide readily usable roof space. Manufactured in the Netherlands, the panel has an inner and outer layer of 8 mm-thick moisture-resistant chipboard bonded to an insulating core of expanded polystyrene, which provides a warm roof construction.

Benefits achieved

- Increased efficiency of the house-building process and added value to the end product
- Offers U values between 0.37 W/m^{2}K and 0.20 W/m^{2}K
- Where dormer or roof-light windows are to be included in the roof, the panels can be cut on site
- Panels are easy to handle, require minimum skill to install and provide weatherproof cover in a single application.

Contact information

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Belvedere, Kent DA17 6BG
Tel: +44 (0)20 8320 9100
Fax: +44 (0)20 8320 9110

Acknowledgements

Building Homes (2001). “Runner-up – Vencel Resil’s Jablite roof element”, Building Homes, Nov

Pre-assembled wall, ceiling and roof elements

Main drivers/constraints

- Reducing health and safety risks
- Implementing respect for people principles
- Limited or very expensive available skilled on-site labour.

Project information

Most European housing industries face similar image problems as the UK's, resulting in shortages of skilled labour. This trend is mainly a factor of the poor working conditions on building sites, confirmed by high accident rates.

A Bavarian-based brick manufacturer responded to the skills shortages by developing a modern production process for house building. The basis for the new technical concept was the creation of a comfortable and safe working environment. The company invested about £5 million in research and development and a new factory with production technologies normally associated with the car industry. Here wall, ceiling and roof elements are pre-assembled using the traditional brick as the basic component.

The company has introduced working methods similar to those found in other industrial sectors, setting new standards for working conditions in house building. The driver was that a working environment minimising the risk of accidents and injuries benefits employer and employee alike. All aspects of the assembly line and tools were ergonomically designed.

Benefits achieved

- Created a comfortable and safe working environment
- Helped to resolve the skills shortages.

Contact information

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Acknowledgements

Building Homes (2001). "Quicker by brick", Building homes, Nov, p 45

Timber component building system

Main drivers/constraints

- Minimising overall project time
- Achieving high quality
- Restricted site layout and space.

Project information

The £80 000 house at Downderry in south Cornwall is built on a steeply sloping site. The architect specified a building system based on a range of load-bearing recycled timber blocks that simply slot together. Although its use for housing is quite widespread in its native Switzerland until now it has not been commercially available in the UK. The blocks are made of softwood offcuts from tongue-and-groove flooring. The standard module measures 160 x 640 x 320 or 240 mm and is hollow. Only half of the 70 m^2 Cornish house was built with this system; the upper floor features floor-to-ceiling glass walls. The product can be used to build structures several storeys high.

Benefits achieved

- "We were intrigued by the possibilities of the blocks – their speed and precision," says Michael Spooner, designer at DRMM. "It allows very clean, simple operations on site and the blocks are very lightweight and manageable. There's also very little waste and it should be more eco-friendly."
- It is extremely quick. The first floor went up in a weekend," says Spooner. "It's quite a precisely machined system. It is impressive if you're happy to work to a grid system – very crisp, orthogonal construction." The softwood blocks can also be modified simply by sawing them up.
- The adaptability of the system suits the project says Spooner: "The house does not have full set of construction drawings so it is being resolved as it goes along, which is exciting".

Architect: de Rijke Marsh Morgan (DRMM)
Engineer: Michael Hadi Associates
Contractor: Richard Rosevere

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Email: email@drmm.co.uk

Acknowledgements

Building (2002). "Swiss ease", Building, 1 Feb, pp 52–54

Volumetric apartments for students and key workers – Southampton

Main drivers/constraints

- Ensuring project completion date is certain
- Minimising overall life-cycle costs
- Achieving high quality.

Project information

A £20 million contract was awarded for construction of 125 prefabricated apartments for students and key workers in Southampton, Hampshire. The client, a developer, is a leading provider of key-worker housing in the UK.

The development, in Duke Street in the centre of the city, opened in September 2004. It includes a main building that varies in height from six to eight storeys and a 16-storey tower. The development has shops, a doctor's surgery and car parking. The apartments can accommodate 538 people. All the buildings are prefabricated. The individual volumetric units were lifted by crane on to the site.

Unite provides a standardised manufactured product, using significant levels of automation while still maintaining high quality and greatly improved construction lead times.

Producing one fully furnished bedroom unit every 22 minutes, Unite said: "We are providing universities with improved-quality modular rooms, constructed in our own factory, which are then shipped out to the sites for installation".

Benefits achieved

- Produced in a factory to agreed schedules
- Pre-engineered to reduce life-cycle cost
- Guaranteed quality.

Client: Unite
Architect: Unite's in-house architects
Supplier: Unite
Contractor: Carillion

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Email: info@unite-group.co.uk

Acknowledgements

Unite (2003). "Modular rooms bring down cost while improving quality", Building, 9 May, p 14

Pre-assembled building services 3 and plant rooms

Main drivers/constraints

- Minimising construction costs
- Achieving high quality
- Multi-trade interfaces in restricted work areas.

Project information

A company operating as systems integrators in the intelligent building controls sector of the UK construction industry has collaborated with two M&E suppliers to develop standard building solutions. These include fan coil unit assemblies, air handling units, skid-mounted boiler systems and complete rooftop HVAC plant rooms. All are pre-designed, pre-assembled and pre-commissioned offsite and are supplied complete with all controls.

Benefits achieved

- Substantial cost savings
- Better quality achieved
- Time on site substantially reduced.

Supplier: Colledge Trundle Hall
Plant Energy Systems Ltd and Waterloo Air management Plc

Contact information

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Email: cth@cthltd.co.uk

Pre-assembled building services 4

Main drivers/constraints

- Minimising time spent on site
- Reducing health and safety risks (eliminating hot working)
- Restricted site layout or space (limited storage space)
- Limited or very expensive available skilled on-site labour
- Short overall project timescales.

Project information

A six-floor office block, with a fast-track programme.

Benefits achieved

- Fast-fit, pre-assembled units delivered to site were simply installed with only four joints
- Reduced need for expensive on-site labour
- Hot working eliminated
- Mechanical services handed over five weeks early.

Client: Jones Lang Lasalle
Contractor: Lorne Stewart Plc
Supplier: Tour & Andersson Ltd

Contact information

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125 High Street
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Acknowledgements

Tour & Andersson Ltd

Pre-fabricated panels for housing

Main drivers/constraints

- Minimising overall life-cycle costs
- Minimising time spent on site
- Achieving high quality.

Project information

External Insulation and Finishing Systems (EIFS) was developed in Germany after the Second World War. This house in Teesside is the first commercial residential property in the UK to use the system. EIFS comprises a series of prefabricated polystyrene panels, which are lifted into place and attached to a lightweight steel frame on site. The panels are coated with flexible chemical render to prevent cracking. The system can also provide lintels, window surrounds and external features. The EIFS system has a British Board of Agrément certificate.

Benefits achieved

- High thermal efficiency (the EIFS house has a U-value of 0.25 W/m^{2}K, compared with 0.35 W/m^{2}K required for a solid wall in the current Building Regulations
- Use of EIFS cut at least 10 weeks off traditional build time
- High aesthetic quality with the appearance of a rendered house
- Reduced site waste
- The lightweight frame and panels mean foundations do not need to be as strong.

Client and project manager: Bellway Homes North East
EIFS subcontractor: WA Browne

Courtesy BBC

Contact information

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Acknowledgements

Hampton, J (2002). “Bye bye bricks”, Construction manager, Jun, pp 20–22

Pre-assembled multi-service chilled beams

Main drivers/constraints

- Minimising construction costs
- Minimising overall project time
- Restricted site layout or space (low-height structure).

Project information

A 40-storey tower near Earls Court in London, with low storey heights, had been empty for several years. Architects and engineers combined successfully to recycle this building by having an exposed soffit with multi-service chilled beams. These incorporated lights, speakers, PA etc. To demolish and rebuild would have extended the programme by two years and resulted in a revenue loss of £24 million.

Benefits achieved

- Cost and installation time saved compared with fan coils
- Shorter programme time
- Multi-service chilled beams allowed the removal of all suspended ceilings, maximising floor to ceiling heights
- All services were incorporated into the chilled beams.

Architect: Wilkinson Eyre
Developer: Land Securities
Main contractor: Bovis Lend Lease
Services consultant: MG Partnership
Supplier: Trox UK

Comments

"Multi-service chilled beams maximised the existing floor to ceiling height, creating an optimised volume for the end user." *(Ed Holloway, architect, Wilkinson Eyre)*

"Programme and prefabrication benefits of MSCBs assist the construction process by offering programme and cost certainty." *(Darryl Hpa, building services executive, Bovis Lend Lease)*

"The system [MSCB] provides a solution with low running and maintenance costs that requires only limited access to the user space." *(Chris Gaines, mechanical service consultant, MG Partnership)*

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Acknowledgements

Trox UK

Timber wall panels for university building

Main drivers/constraints

- Ensuring project completion date is certain
- Achieving performance predictability throughout the life-cycle
- Maximising environmental performance throughout the life-cycle.

Project information

The Institute for Middle Eastern and Islamic Studies of University of Durham is a purpose-built, two-storey, 1200 m^2 facility, which houses seminar and reading rooms, offices and amenities for students and staff.

The original design of the building was based on a brick and block construction within a steel frame. However, following the construction of the initial phase, it was apparent that this would not provide a fast enough build time to meet the tight deadline of the new academic year. In order to complete construction within the rigid time constraints, the brick and block construction was replaced by "zero heat" single timber infill panels.

Benefits achieved

- The tight deadline of the new academic year was met
- Good thermal performance
- The unusual combination of a structural steel frame and timber-based infill panels enabled special architectural features to be incorporated, particularly the curve incorporated into the elevations and roof-line, stretching the length of the building.

Client: University of Durham
Architect: Howard Litchfield Partnership, Durham
Contractor: Bowey Construction, Durham
Supplier: Murus Ltd

Courtesy Murus Building Systems Ltd

Contact information

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Acknowledgements

Murus Building Systems Ltd

Pre-assembled timber frame for visitor's centre

Main drivers/constraints

- Achieving high quality.

Project information

The National Forest Millennium Discovery Centre, known as "Conkers", attracts 300 000 visitors a year. It is situated within the National Forest at Moira, near Ashby-de-la-Zouch. The centre has been built on a reclaimed opencast mine.

The project's quantity surveyors realised the benefits of standardising the components of this otherwise bespoke structure. The timber-framed structure was designed as a series of identical components, allowing offsite fabrication. Likewise the original window designs were modified so as to standardise units and reap the benefits of component standardisation. This approach contributed to the successful completion of the project.

Benefits achieved

- Better quality achieved under factory conditions.

Client: Heart of the National Forest Foundation
Quantity surveyors: Turner and Townsend

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Pre-assembled building services – Slough

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Achieving performance predictability throughout the life-cycle.

Project information

A prefabricated multi-service spine module designed for a 5400 m^2 new building at 208 Bath Road, Slough, Berkshire. The spine module houses heating and cooling pipework, fresh-air ductwork, lighting and busbar for the fan-coil units. It also provides a containment basket for lighting control, BMS and fire-alarm bus cables.

By designing for offsite prefabrication significant cost savings were achieved compared with traditional on-site construction. Assembled by the main contractor's prefabrication division, use of the module ensured that less time was spent rectifying faults on site.

The project also includes prefabricated plant rooms containing boilers, hot-water generators and heating and distribution pumps.

Benefits achieved

- Significant cost savings compared with traditional on-site construction
- Lower labour costs, better productivity
- Less time spent rectifying faults on site
- Commercial advantage over potential competitors.

Client: Slough Estates
Main contractor: Skanska Rashleigh Weatherfoil (SRW)
Designer: Roberts & Partners

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Acknowledgements

Building Services and Environmental Engineer, 17 Jul 2002

Pre-assembled steel frame for prison extension

Main drivers/constraints

- Minimising time spent on site
- Achieving performance predictability throughout the life-cycle
- Live working environment limits site operations.

Project information

This project was the first in a wider programme of refurbishment of prison facilities in Eire by the Justice Department. It was completed in February 2003.

This 200-bed extension to St Patrick's Prison, Dublin, substantially upgrades the existing pre- 1930s building. The structural team designed and constructed a solution using a combination of steel-frame units with a roof truss system and insulated composite roof panels. To minimise disruption the two-storey building was partially assembled offsite before installing it on site for overall completion and fitting out.

Benefits achieved

- Disruption to the prison was minimised
- Non-removable fixings installed in all exposed steelwork throughout extension provide additional security against tampering.

Client: Justice Department
S&P provider: Glenbeigh Modular Frame Systems/ Ward Building Components

Contact information

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Acknowledgements

Ward (2003). Ward modular construction expertise lands Eire contracts

Pre-assembled chilled beams and unitised cladding panels

Main drivers/constraints

- Minimising overall life-cycle costs
- Minimising time spent on site
- Restricted site space.

Project information

Riverside House is a concrete-framed building, founded on piles, built in the 1960s. It is situated on the south bank of the River Thames in Southwark. The brief called for the extensive remodelling of this building, demolition of the neighbouring building, and rebuilding to produce a single integrated building for office use. It was completed in May 2002.

The building has about 3350 m of multi-service chilled beams (MSCBs). Delivered pre-plumbed and pre-wired in 3 m lengths, the 80 cm-wide by 20 cm-deep beams were suspended 8 cm below the ceiling. This helped to solve the problem of headroom. Since the MSCBs do not require a suspended ceiling, the room height is increased, and the system can take advantage of free cooling provided by the building's exposed mass, reducing running costs and boosting energy efficiency. Pre-assembly in a factory significantly reduced the time needed for installation and commissioning and allowed simple on-site co-ordination and installation.

Riverside House is clad in glass, aluminium and yellow terracotta. The 1.8 m-wide floor-to-floor unitised cladding panels were assembled offsite. In this collaborative project, the aluminium was imported from Austria and the terracotta from Germany.

Benefits achieved

- Reduced running costs
- Reduced installation time and simple on-site co-ordination
- Helped to resolve the problem of limited headroom
- Increased energy efficiency.

Client: Chelsfield plc
Architect: Renton Howard Wood Levine (RHWL) Architects
Main contractor: Bovis Lend Lease Limited

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Acknowledgements

Kernan, P (2003). "Down by the riverside", Construction Manager, Sep, pp 38–39

Bathroom pods 1 and steel wall and floor panels

Main drivers/constraints

- Ensuring project cost certainty
- Ensuring project completion date is certain
- Achieving high quality
- Multi-trade interfaces in restricted work areas
- A problem transporting manufactured products to site
- Unable to freeze design early enough.

Project information

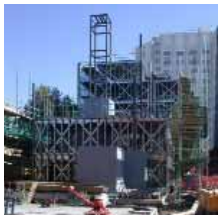
This housing project combined the use of light-gauge steel panels for floors and walls, volumetric bathroom units and hot-rolled steel for balconies and other "visually expressed" steel components. The development provides 65 housing units, a tenants' meeting room and an underground car park for 44 vehicles. The project was completed close to time and budget in July 2003 for £7.7 million. Total construction time was 73 weeks.

One reason for favouring a hybrid system and panels was the flexibility in design that they offered, bearing in mind the complex pattern emerging from the planning restrictions and the particular mix of accommodation. Services to the bathroom, including ventilation ducts, were preset into a narrow duct at the side of the module and then fitted together on site without disturbing the bathroom finishes.

Benefits achieved

- Design flexibility achieved
- Remaining site work predominantly dry and clean
- High quality of construction
- Minimum wastage of materials
- Floor panels were pre-decked to provide safe working platforms during erection.

Client: Peabody Trust
Architect: Feilden Clegg Bradley Architects
Client's representative: Walker Management
Services consultant: Max Fordham & Partners
Light-gauge steel contractor: Ayrshire Metal Products
Structural engineer: Michael Barclay Partnership



Contact information

Walker Management Ltd
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Acknowledgements

The Peabody Trust

Timber-framed housing – West Malling, Kent

Main drivers/constraints

- Minimising time spent on site
- Minimising overall life-cycle costs
- Maximising environmental performance throughout the life-cycle.

Project information

A timber-framed house in West Malling, Kent, was built in 2002 to trial this form of construction, partly to reduce build times. The trial proved so successful that the house-builders placed an order to build a further 30 homes in timber frame, and the developer is looking at using the system at another of its sites. The trial four-bedroom house was built in just 17 days using a double workforce. In normal production it is estimated that the homes should each take about nine weeks to build.

Rather than sourcing timber frame from a UK supplier, the house-builder became the first in the UK to sign up to Super E House. The arrangement is effectively a partnering relationship between the UK house-builder and a Canadian house production company. The latter aims to introduce Canadian manufacturers of timber-frame systems and technology such as heat-recovery ventilation systems to UK house-builders.

Benefits achieved

- Reduced construction period
- 40 per cent reduction in heating costs anticipated
- Although the trial house cost about 6–8 per cent more to build than a traditional home, added value has been gained – in energy-efficiency, quality, sound reduction and health
- It is expected that design development will bring future costs down.

Developer: Sunley Homes and Environ Country Homes
Architect: Clague
Supplier: MIC-Aouette

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Acknowledgements

Smit, J (2002). “Prefabs with a difference”, *Homes*, Jul, pp 12–14
Building Homes (2002). “Tapping into timber”, *Building homes*, 28 Jun

Timber-framed housing 2

Main drivers/constraints

- Minimising time spent on site
- Not possible for follow-on projects to use the same processes.

Project information

A 1827 ft^2, four-bedroom show home was built in less than six weeks, instead of the usual 22 weeks, by using timber frame and maximising build efficiency. This was achieved by bringing the project team together early, organising just-in-time deliveries of materials apart from the timber frame and windows, closely sequencing trade contractors, and arranging for the project architect to be on site for an hour and a half each day to resolve any queries.

More timber-frame homes will be built on the site, but the developer admits that the speed of build of the show home was a one-off, driven by the desire to generate maximum sales. “We couldn’t sustain it for every unit on the site,” says Rameen Firoozan, regional director with Laing Homes. “But we are focusing our attention on how to remove downtime to get greater efficiency. It will benefit customers in creating more time at the end for us to spend on the finishing process.”

Benefits achieved

- Built in less than six weeks instead of the usual 22 weeks
- Working downtime minimised and greater efficiency obtained.

Developer: Laing Homes
Architects: John Thompson and Partners (masterplan), The Omega Partnership (house)

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Acknowledgements

Smit, J (2002). “What’s the spec?”, *Homes*, Jul, p 19

Bathroom pods 2

Main drivers/constraints

- Minimising time spent on site
- Achieving predictability of quality
- Multi-trade interfaces in restricted work areas.

Project information

To enable it to combine a rapid expansion in room numbers with consistency of brand, a hotel chain developed a bathroom pod solution to overcome the variations in construction quality that it often experienced.

The client and the manufacturer's teams jointly developed an interior specification that is durable and cost effective. Once the model had been developed for a standard bathroom, a disabled version and a shower version were then devised and added to the range. The added benefit of a standard approach is that a continuous improvement programme can be applied to the product to accommodate the latest materials and changes in individual requirements.

Consistency of products means that pods are almost ex-stock, so can be delivered at short notice using rapid-build methods of either timber or steel-frame systems.

Benefits achieved

- Faster opening of hotels, therefore increased revenue
- Brand standards maintained
- Continuous improvement.

Client: Compass Group UK Ltd
Main contractors: Anglo Holt, Barnes Construction, Bovis LL, Butchers of Warminster, Dean & Bowes, Finchley Construction, GMI, Marshall Mowlem, Pochin, Robertson Construction, Stacey Construction, Try Construction, Weaver Construction
S & P supplier: RB Farquhar

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Acknowledgements

RB Farquhar Manufacturing

Modular hotel units

Main drivers/constraints

- Ensuring project cost certainty
- Minimising time spent on site
- Achieving high quality
- Multi-trade interfaces in restricted work areas.

Project information

A standard product comprising a two-room unit and its associated services was developed for use as medium-term temporary accommodation on high-turnover sites throughout the world. The 25 m^2 units are able to link horizontally and vertically. All services are installed in the factory.

Pre-galvanised sheet steel is the main material used to form stiffness in the skin itself. The unit has to be waterproof during transport and erection, therefore the detailing of the structure is critical. A worldwide patent was obtained to cover the stress-skin structure of the pod.

Benefits achieved

- Each room has a prefabricated services stack which enables a simple plug connection between the pods
- The shower room itself is fabricated separately from the structure carcass and is slid into place when complete
- The nature of the design almost eliminates the possibility of error at any stage of installation.

Client: Hamstead Securities
Architect: Bryden Wood Associates

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Acknowledgements

Bryden Wood Associates

Modular hotel concept

Main drivers/constraints

- Ensuring project cost certainty
- Minimising overall project time
- Achieving high quality.

Project information

The second concept application of the modular hotel units (see also Example 032) is the 260-bedroom hotel building at the ExCel Exhibition Centre in Docklands.

An intended short construction programme will allow high-quality accommodation to be provided quickly for both exhibitors and visitors to this prestigious venue.

Expected benefits

- Short construction programme
- High-quality accommodation.

Architect: Bryden Wood Associates

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Acknowledgements

Bryden Wood Associates

Panellised insulated formwork system

Main drivers/constraints

- Minimising construction costs
- Minimising overall project time
- Achieving predictable quality
- Limited or very expensive available skilled on-site labour.

Project information

The project is a care centre consisting of 25 low-energy houses of varied size and design in north Ayrshire. Prefabricated permanent formwork comprising highly insulated storey-height panels and floors, complete with openings and service ducts, were erected on site and filled with concrete. This resulted in a highly insulated shell ready for second fix and finishing.

The first panels were supplied on 28 October 2003 and the units were occupied on 16 April 2004, less than six months later. The project was finished on schedule and within budget.

Benefits achieved

- The lightweight panels can be manhandled into place avoiding the need for costly plant
- Lightweight panels are economic to transport. Being heavy, the concrete provides high thermal mass. It is sourced locally, which saves transport costs, and is easily placed using pumps
- Casting the walls and floors from in-situ concrete provides a very strong monocoque
- Joints in the structure that historically have been problematic have been eliminated
- The process is highly automated.

Client: Moorpark Developments, Kilbirnie, Ayrshire
Manufacturer: FormworksUK Ltd

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Acknowledgements

John Letton RIBA
FormworksUK Ltd

Pre-engineered toilet system

Main drivers/constraints

- Ensuring project cost certainty
- Minimising time spent on site
- Achieving high quality
- Multi-trade interfaces in restricted work areas.

Project information

A pre-engineered toilet system brings a new logic to the installation of conventional toilet facilities. Pre-engineered components and sub-assemblies are delivered and installed within a pre-formed or existing room, providing all appliances, surrounding finishes and supporting plumbing and electrics.

Benefits achieved

- Assembly takes a fraction of the time of a conventional installation
- Significant reductions in labour time allow the system to compete on cost with more conventional particle-board products
- The standard enamelled, toughened glass and stainless steel finishes are more resistant to scratches and are unaffected by water or cleaning fluids
- The resultant aesthetic is strikingly modern, with an elegant simplicity of form and detail
- Modular components can be configured to satisfy any toilet provision small or large
- The steel shell construction ensures an exceptional robustness suitable for all commercial applications. Components cut by computer numerical control (CNC) are of exceptional dimensional accuracy and the quality of finish would be unobtainable by conventional building methods
- The rapidly assembled kit of parts allows the system to be installed in new or refurbishment projects requiring only door width access.

Architect: Bryden Wood Associates

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Acknowledgements

Bryden Wood Associates

Pre-assembled building services – University of Oxford

Main drivers/constraints

- Minimising overall life-cycle costs
- Minimised time spent on site.

Project information

The University of Oxford Department of Chemistry required a new chemistry building to provide advanced laboratory space for around 400 researchers along with write-up space and supporting ancillary areas. In total, approximately 16 000 m^2 of new laboratory was needed. The facility would bring together four chemistry departments from different buildings. This demanded a flexible approach, enabling three traditionally distinct branches of the science – organic, inorganic and physical – to come together under one roof.

The main requirements were to enhance the existing facilities, provide state-of-the-art research facilities and to offer staff and visitors to the new building the best possible environment in terms of safety and aesthetic quality.

The following pre-assembled building services were delivered:

- 400 high-capacity fume cupboards
- Extension of the university's heating and ventilating system
- Localised plant provided for specialised areas
- 26 data outlets in each lab, with an additional 22 in each write-up area.

Benefits achieved

- Providing maximum energy efficiency and reduced running costs were key to delivering sustainability and maintainability
- Prefabricating, pre-installing and testing the modules reduced time and disruption on site
- Offsite prefabrication lessened the project's impact on the surrounding area
- The work was constructed on programme
- Risk to operatives' health and safety was minimised throughout the project.

Client: The Chancellor, Masters and Scholars of the University of Oxford
Architect: RMJM
M&E consulting engineer: Faber Maunsell
M&E contractor: Crown House

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Acknowledgements

Crown House

Bathroom pods – Kenilworth

Main drivers/constraints

- Achieving high quality
- Multi-trade interfaces in restricted work areas
- Live working environment limits site operations.

Project information

The brief was to build, deliver and install 64 high-quality bathrooms for a four-star hotel extension in Kenilworth, Warwickshire. The £300 000 extension was in response to high occupation levels and demand created by a thriving conference business. The client required minimum disruption on site for the existing hotel building and demanded a better quality of internal finish to the bathrooms than had been possible using traditional methods.

The manufacturer took the principal specification and proposed a floorless pod that would sit directly on the slab. The bottom layer of tiles was omitted in the factory and delivered loose with the pods to enable it to be fixed alongside the floor tiles at a later date.

The manufacturer provided the crane and unloaded the pods floor by floor on to a landing platform. The pods were wheeled into position, levelled and then left fully wrapped while other work proceeded on the hotel.

Benefits achieved

- Higher quality of finish
- Less disruption on site
- Better control of costs
- Minimal snagging.

Client: Principal Hotels
Main contractor: Walter G Birch
Supplier: RB Farquha

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Acknowledgements

RB Farquhar Manufacturing

Toilet pods – Newcastle-upon-Tyne

Main drivers/constraints

- Minimising time spent on site
- Achieving high quality
- Multi-trade interfaces in restricted work areas
- Site restrictions by external parties.

Project information

The new Orange call centre in Newcastle-upon-Tyne required 16 identical toilet blocks. The building structure is a steel frame with concrete floors. The toilet units were pre-assembled and built on legs to be compatible with a raised access floor system. Timescales were tight as the building was already under construction when the pods were commissioned. The total project value was £200 000.

The manufacturer developed a suitable specification to meet the client's needs. WC wastes were linked at the rear of the pods where they were positioned back to back with a service area for maintenance access. Basins were pre-plumbed on the opposite side with an electric hand dryer and mirrors. White ceramic wall tiles were complemented by fully vitrified contract-grade floor tiles and a suspended ceiling. The pods were delivered two per lorry and unloaded by a forklift that moved them into position in the building. The pods were positioned and levelled on the slab by the Farquhar site team and left fully protected until subsequently commissioned.

Benefits achieved

- Speed of completion
- Quality of finish
- Control of costs.

Client: Orange
Main contractor: Tilbury Douglas
S&P provider: RB Farquhar

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Acknowledgements

RB Farquhar Manufacturing

Pre-fabricated car park system 1

Main drivers/constraints

- Minimising overall project time
- Achieving predictability of quality
- Implementing respect for people principles
- Restricted site layout or space.

Project information

The individual components of the system such as decks, ramps and foundations are manufactured under closely controlled conditions.

The car park system can be used to build new facilities or to extend existing car parks with the addition of extra floors, which means that much of an existing car park can remain open, minimising parking restrictions during construction. The components are configured to meet the requirements of individual projects.

For new work, construction of the car park begins with the installation of the foundations. The steel framework is then erected. The columns arrive on site pre-drilled and cut to size, so that simple bolting methods can be used to secure them. Once the steel frame is complete, the prefabricated parking decks are installed, then ramps are added along with features such as hand rails, barriers and lighting.

Benefits offered

- A simple, efficient, cost-effective solution to car park construction, ideally suited for building projects where there are tight space constraints or where facilities are needed fast
- It provides more space for parking and a much lighter, safer and more inviting environment for car park users
- Disruption to the daytime operations of existing car park facilities was minimised
- It keeps noise levels, dust and waste to a minimum.

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Modular house

Main drivers/constraints

- Ensuring project cost certainty
- Minimising time spent on site
- Maximising environmental performance throughout the life-cycle.

Project information

The structure is a modern detached brick house that has been fully prefabricated offsite in a controlled factory environment. It responds to the Egan principles of innovative techniques and environmentally conscious design elements. This prototype is a typical three-bedroom family house, but any type of property, to any specification, can be manufactured using the same technique. Avoiding the usual on-site delays, this specialist system, for volumetric and modular buildings, is fast, efficient and non-intrusive.

The modular system uses heavy steel frames and solid concrete floors. The house is moved to its permanent location in four units that are installed on to ground works in a single day, allowing a fully functioning dwelling to be assembled in less than 24 hours. Site work is confined to the laying of foundations and the connecting of modules and landscaping.
(Note: this system is no longer in production.)

Benefits achieved

- Increased predictability in costs and build time
- Dramatic reduction in installation time
- Excellent thermal values
- Wall heights up to 12 m.

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Acknowledgements

Hanson Brick

Modular hotel – Travel Inn

Main drivers/constraints

- Ensuring project cost certainty
- Minimising overall project time
- Achieving high quality
- Reducing environmental impact during construction.

Project information

A two-storey 60-bedroom hotel, with core areas and reception, on a brownfield site. The construction is steel frame with modular units.

There was complete offsite manufacture of room modules, including total fit-out of M&E services, internal decoration and furnishings. The room design was highly standardised.

Benefits achieved

- Speed, quality and value. The targeted room development budget of £25 000 was achieved; 35 per cent reduction in build time against traditional construction methods; 20 per cent reduction in build time against fast-track timber-frame construction. These benefits are optimised when elements of standardisation are pre-engineered into the building design
- Undertaking site preparation in parallel with manufacturing modules significantly reduced the overall build-time, enabling earlier occupancy and return on investment
- Offsite manufacturing enabled the production of a prototype room before mainstream manufacture began; project partners were able to test room design and interior fit-out
- By minimising the works on site and the number of deliveries, inconvenience and disruption to the local community was limited.

Client: Travel Inn
Main contractor: Willmott Dixon
Construction supplier: Rollalong

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Acknowledgements

Rollalong Limited

Modular school extension – Roding Lane School

Main drivers/constraints

- Minimising overall life-cycle costs
- Ensuring project completion date is certain
- Maximising environmental performance throughout the life-cycle.

Project information

To cope with increasing roll numbers at Roding Lane School a two-storey classroom extension was needed. A brick-clad modular building extension with a 60-year design life was constructed to provide additional open classroom space with storage and cloakroom facilities. The new building encompasses notable architectural features such as a curved glass brick stairwell and decorative brickwork designed to fit aesthetically with the existing 1930s school buildings.

Benefits achieved

- Planned low maintenance costs
- High-quality modular building delivered on programme
- Incorporated a variety of specified architectural features
- Achieved a good acoustic and low-energy performance.

Client: London Borough of Redbridge
Supplier: Rollalong Ltd

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Acknowledgements

Rollalong Limited

Modular detention centre

Main drivers/constraints

- Minimising overall project time
- Achieving predictability of quality
- Reducing health and safety risks.

Project information

Harmondsworth Immigration Detention Centre provides secure office and administration facilities for both staff and visitors alike. It is a three-storey 2900 m^2 modular steel-framed building. Overall, the project took under a quarter of the time of a traditional construction programme with no compromise in building design or quality. An engineer's design life statement was provided to confirm that the modular structure achieved equivalence to traditional build. The building also had to achieve specific standards of robustness and anti-terrorist resistance. Internally the building provides both open-plan areas and partitioned office space.

Benefits achieved

- Manufacture and construction of the modular units was completed in four months
- 60-year design life certification provided
- Specific standards of robustness and anti-terrorist resistance achieved.

Client: UK Detention Service
Main contractor: Tilbury Douglas Construction
Supplier: Rollalong Ltd



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Rollalong Limited

Modular hospital extension – Mayday Hospital, Croydon

Main drivers/constraints

- Minimising construction costs
- Minimising overall project time
- Live working environment limits site operations.

Project information

The Mayday Hospital in Croydon needed a new eye unit, which was to be built on top of the existing outpatients department. The facility required 25 clinical rooms and two waiting rooms. The steel-framed modular unit was put into place over a weekend after all sections had arrived on site complete with internal walls, basins, toilets, decorations, most of the electrical wiring and some flooring. In external appearance, the modular eye unit blends seamlessly with other hospital buildings. The unit was opened in around half the time that a traditional building would have taken to construct and at a substantially lower cost.

Benefits achieved

- The modular solution delivered a fast and economic way to provide quality space within weeks.
- It met the needs of the hospital, as Mayday chief executive Keith Ford explained: “We needed more space to see more outpatients more quickly”.

Client: Mayday Healthcare NHS Trust
Main contractor: Tilbury Douglas Construction
Supplier: Rollalong Ltd

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Rollalong Limited

Modular office building –Wokingham Council

Main drivers/constraints

- Minimising overall project time
- Achieving predictability of quality.

Project information

Wokingham Council required a new bespoke office to replace their old temporary buildings.

A two-storey, 40-year-design-life modular building was designed to accommodate the council's present and future needs. Its features include a metal deck roof, and interior facilities, such as kitchenette areas, staff rest rooms and toilet facilities, were all fitted at the factory and delivered as a complete unit. As part of the overall project the manufacturer also undertook all the ground works and landscaping.

Benefits achieved

- The overall project time minimised. The whole duration was 14 weeks
- High quality requirements were met.

Client: Wokingham District Council
Supplier: Rollalong Ltd




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Rollalong Limited

Modular office building – Defence Estates

Main drivers/constraints

- Minimising overall project time
- Achieving predictability of quality
- Maximising environmental performance throughout the life-cycle.

Project information

Defence Estates required quality office accommodation for more than 50 staff, conference space for 60 delegates and a computer mainframe room at its Laffan House site. Laffan House is set in an important rural area, so design and development of the project needed to be sympathetic to the surrounding environment. An important part of the brief was to maintain flexibility in the design for possible future relocation or adaptation.

The solution chosen was a single-storey modular building with a 40-year design life. Close liaison with the users ensured that an optimum internal layout was achieved, with a central conference room surrounded by open-plan and individual offices. The modules were factory-finished and included the internal fit-out and installation of all mechanical and electrical services before delivery to site, erection and connection to mains services.

Benefits achieved

- Ground works started in December 2001 and the building was completed in just three months
- High-quality office accommodation was achieved
- Designed for low energy consumption.

Client: Defence Estates
Supplier: Rollalong Ltd

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Rollalong Limited

Modular office and training facility

Main drivers/constraints

- Minimising overall project time
- Achieving high quality.

Project information

As membership numbers increased, the Bournemouth Flying Club needed more accommodation for office space, briefing rooms and toilet facilities. A modular building, with a 20-year design life, that would also provide flexibility to extend or relocate at a later date, provided the ideal solution.

Five steel-framed modules, each measuring 3 m x 9.6 m, were used to provide 150 m^2 of additional space. The new building was linked to the existing one by a connecting corridor. Finished externally with a textured colour coat and installed on to pad foundations with a brick skirt, the modules provided a seamless extension to the existing structure.

Benefits achieved

- The new accommodation was installed in a single day and was ready for occupation just two weeks later
- The new building has been internally finished to a high specification.

Client: Bournemouth Flying Club, Hurn Airport
Contractor: LiNX
Supplier: Rollalong

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Modular hospital extension – Kings College Hospital, London

Main drivers/constraints

- Minimising overall project time
- Reducing environmental impact during construction
- Implementing respect for people principles
- Restricted site layout or space.

Project information

Kings College Hospital, London, needed extra ward accommodation, with reception desks, shower, toilet facilities and full wheelchair access. The building, in the centre of London, required a design sympathetic to the surrounding area while making best use of the space available.

The solution provided was a two-storey building of steel-framed modules clad with brickwork to fit in with surrounding buildings. Internally, the building was fitted out with suspended ceilings, low-level hand basins, toilet and shower facilities accessible to wheelchair users, and overhead lamps and emergency call buttons for patients. The modules were factory-finished, including the internal fit-out and installation of all mechanical and electrical services before delivery to site, erection and connection to mains services.

Benefits achieved

- The contract was secured and delivered in eight months
- A sympathetic design was provided to the surrounding area combined with maximum utilisation of space
- Disruption to the working hospital and surrounding neighbourhood was minimised by offsite manufacture
- Reduced on-site time and fewer trades on site.

Client: Kings College Hospital NHS Trust
Supplier: Rollalong

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Modular hospital

Main drivers/constraints

- Minimising overall project time
- Achieving predictability of quality
- Reducing health and safety risks
- Reducing environmental impact during construction
- Restricted site layout or space.

Project information

Bradford Hospital was the UK's largest single healthcare scheme built offsite, with a contract value of £9 million. The project enabled up to 10 000 additional inpatients to be cared for each year and represented an investment of £15 million for the Trust.

The building was constructed of steel-framed modules, fully finished internally, manufactured in a factory environment with production line technology. The modules were delivered by road to site then craned into position in just a few days.

Benefits achieved

- Halving programme times, allowing earlier occupation and reductions in waiting lists
- Guaranteed quality
- Less disruption to existing operations and patient care during construction
- The development of a restricted site
- The completion of new healthcare facilities on time and to budget
- Less dependence on the weather
- Improvements in site safety.

Client: Bradford Teaching Hospitals NHS Trust
Structural engineers: Engineering Design Partnership
Supplier: Yorkon

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Acknowledgements

Bradford Hospital

Modular prison extension – HMP Kirkham

Main drivers/constraints

- Minimising overall project time
- Reducing environmental impact during construction
- Live working environment limits site operations.

Project information

Located at HMP Kirkham with a project value of £3 million. The accommodation for inmates consists of 22 cells in seven modular-system billet blocks, and a healthcare centre for the Prison Service. The healthcare centre was originally to be of traditional construction, but time was critical for the occupation of the centre. A modular system was offered as an alternative, which met Home Office requirements and provided a speedier delivery.

The modules arrived with electrical conduit and internal boarding already prefixed ready for first and second fix works to proceed once installed on site.

Benefits achieved

- Reduced project time
- Predictable delivery provided by manufacture
- Minimum disruption to the running of the prison.

Client: HM Prison Service
Supplier: Wates Group Ltd




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Modular prison extension – Haverigg, Cumbria

Main drivers/constraints

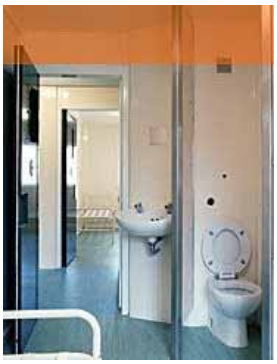
- Achieving performance predictability throughout the life-cycle
- Reducing health and safety risks
- Reducing environmental impact during construction.

Project information

This £4.3 million project is located at Haverigg, Cumbria. It consists of seven modular-system billet block accommodation units, with 22 cells in each. The development also included the refurbishment of four associated buildings, with one of the buildings being transformed into a mandatory drug-testing unit.

The project created interesting challenges because of the prison's maximum security status and its geographical isolation. The billet blocks were constructed offsite and had a high level of security incorporated. The inner walls, floors and ceilings of the individual cells were lined with steel sheets, 3 mm thick. All the services were concealed within the walls or above in the roof void. A former billet block was reconstructed and refurbished to form a comprehensive drugs testing facility, which also required a high level of security within the structure. Temporary and permanent CCTV was installed as part of the contract.

Client: HM Prison Service
Supplier: Wates Group Ltd



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Wates Group Limited

Modular health building

Main drivers/constraints

- Minimising overall project time
- Reducing environmental impact during construction
- Implementing respect for people principles
- Limited or very expensive available skilled

Project information

The Ladies Walk Centre has been developed to provide the local community in Sedgley with a “one stop shop” for a wide range of health and social services. Seventy-two steel-framed modules were manufactured offsite in York and delivered to the site, where they were craned into position in two stages in line with the phased development. The Centre has been designed around a central “street” to create a warm and welcoming environment. Internally there is a full-height glazed entrance and a glazed roof to maximise the penetration of natural light.

Benefits achieved

- Earlier occupation and commissioning of the building was possible
- Programme times were reduced by around 40 per cent
- Quality was guaranteed
- Disruption to the local community and existing operations was minimal
- Future maintenance has been reduced
- Work on site was safe, quiet and clean
- Provided a solution to the shortage of skilled labour that is affecting the construction industry severely.

Client: Partnership Dudley Priority Health, Dudley Metropolitan Borough Council, Norwich Union Public Private Partnership, Yorkon

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Yorkon

Modular hospital extension – Northallerton NHS Trust

Main drivers/constraints

- Minimising overall project time
- Achieving high quality
- Reducing environmental impact during construction
- Implementing respect for people principles
- Live working environment limits site operations.

Project information

Following the transfer of Ministry of Defence health services from Catterick Garrison to Northallerton, the Northallerton Healthcare NHS Trust needed to increase bed capacity at Friarage Hospital by around 15 per cent.

In a contract worth about £3 million, two purpose-designed buildings were manufactured and delivered to site complete with plumbing, electrics, partitions, internal doors and windows. This halved the programme time from around 12 months to 26 weeks.

The new three-storey building accommodates a 27-bed orthopaedic ward, a 29-bed surgical ward, offices and meeting rooms. This is linked at first-floor level to the two-storey Millennium Building, which provides an intensive therapy unit, two six-bed wards and two single-bed wards.

Benefits achieved

"We were very impressed with the rapid progress of both schemes since the start of work on site. The modular building method also ensured that disruption to our existing operations was minimised during construction because so much of the work took place off-site in York. The quality of the buildings is excellent, helping us to provide the best possible health services to army personnel, their families and the people of Northallerton."

Brigadier Johnny Wardle,
Chairman of Northallerton Healthcare NHS Trust.

Client: Northallerton Healthcare NHS Trust
Supplier: Yorkon

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Yorkon

Modular endoscopy unit

Main drivers/constraints

- Ensuring project completion date is certain
- Reducing environmental impact during construction
- Live working environment limits site operations.

Project information

A new three-storey theatre and endoscopy unit at West Wales General Hospital. The facilities were to be located in a totally enclosed courtyard on the hospital site. The purpose-designed facility was intended to free up much needed space within the hospital and provide a highly flexible healthcare facility to meet future local needs. Designed and built by the manufacturer, the new 38-module unit was craned into the courtyard over the single-storey fully operational accident and emergency department in a highly sensitive manoeuvre.

Benefits achieved

- Significantly reduced time on site
- Noise levels were minimised
- No disruption to the provision of patient services.

"The use of offsite construction allowed us to develop a fully enclosed site within the hospital complex and thereby expand our theatre facilities. No other building method could have achieved this without causing major problems to service provision.

"The implication of any construction work on the running of a hospital is a key issue. What had the potential to be a very difficult and disruptive period was completed on time, with no inconvenience at all to our patients and to the highest standards. Both staff and patients are delighted with the new facilities."

(Robert Elliott, head of estates, Carmarthenshire NHS Trust)

Supplier: Yorkon
Client: NHS Trust, Carmarthenshire

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Yorkon

Timber panellised system for housing – Sandwell Council

Main drivers/constraints

- Minimising overall life-cycle costs
- Minimising overall project time.

Project information

INTEGER is an action research network that since 1998 has completed a range of new-build housing projects in the UK.

Sandwell Metropolitan Borough Council wanted to use INTEGER to challenge the perceived mediocrity in current homebuilding practice, and so increase public expectations of social housing. They chose to build 15 new homes on the fringes of a 40-acre estate of high-rise blocks and low-rise dark brick homes. The project was a mixture of six one-bed apartments, six two-bed apartments, two three-bed houses and a single two-bed house. Timber wall panels filled with recycled cellulose insulation provided speedy construction and near-perfect SAP energy-efficiency scores. The exterior was part clad in western red cedar and part painted with red acrylic to create visual interest. the homes also featured a low-maintenance aluminium roof.

The total cost of the Sandwell project came in at around 107 per cent of the build cost of comparable traditional social housing. However, the benefits achieved more than made up for the slightly higher initial cost.

Benefits achieved

- Reductions in cost in use
- Reduced construction time
- An enhanced standard of living for tenants.

Client: Sandwell Metropolitan Borough Council
Architects: Cole Thompson Associates
Contractor: Wates Construction

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INTEGER

Modular school buildings

Main drivers/constraints

- Ensuring project cost certainty
- Ensuring project completion date is certain
- Achieving predictability of quality
- Maximising environmental performance throughout the life-cycle
- Restricted site layout or space.

Project information

With the next intake of pupils due in September and the final site not selected until January of the same year, the project had to be delivered in just eight months from identification of the site.

The buildings were to provide for 360 secondary students at Bishop Challoner Catholic Collegiate School. The three-storey buildings included a sports hall, on-site catering facilities, IT suites, workshops and external play areas.

The manufacturer had to provide a flexible system to suit the architect's design and enable the completed school to open on time. This was achieved by using steel-framed modules constructed offsite, which were assembled on site in just 60 days.

Benefits achieved

- The architect worked successfully with the prefabrication supplier to provide extensive accommodation to DfES approval on time, on budget, and to a quality level beyond that expected by the school
- Design problems typical of school design were overcome.

Client: Diocese of Westminster
Architect: DLG Architects
S&P supplier: Pyramid Building Systems

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DLG Architects

Timber-framed housing – former Withington Hospital site

Main drivers/constraints

- Ensuring project cost certainty
- Minimising overall project time
- Achieving high quality
- Maximising environmental performance throughout the life-cycle.

Project information

The mixed-use development constructed at the former Withington Hospital site comprises 350 residential units, 275 000 ft^2 of office space and a 150-bed hotel. Released in phases, the project delivered 91 residential units in phase one, 204 residential units in phase two and 55 residential units on the Bryant site at Nell Lane.

Planning for phase one was submitted in July 2002 and approved in October 2002.This approval gave jurisdiction and direction to the local authority to process all further applications under delegated powers for the proposed ongoing rolling programme.

The construction commenced immediately upon receipt of planning approval (working drawings prepared at risk). By pushing the boundaries and limitations of timber-frame construction and researching modern cladding systems with a palette of materials normally reserved for commercial and city centre buildings, a unique aesthetic product has been achieved in a sensitive residential area.

Benefits achieved

- Fast-track build and to budget
- Low cost, low labour cost
- High insulation values achieved
- Environmental benefits achieved.

Client and master planning: Countryside Strategic
Contractor: Countryside Properties (NW) Ltd and Bryant Homes Ltd

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Modular convenience stores

Main drivers/constraints

- Minimising overall project time
- Achieving predictability of quality
- Implementing respect for people principles.

Project information

A large supermarket chain has a programme to create up to 150 new stores on petrol forecourts. This is bringing convenience shopping with quality and value to residential and suburban areas nationwide. The client formed a partnership with a manufacturer in January 2001 to build around 49 new convenience stores across the UK over a four-year period that started in January 2001 The 50th store was delivered to site in January 2005. The complete project is worth in the region of £10 million.

Following completion of an extensive product development process, the manufacturer introduced a specially designed building module for the client. It is used to create standardised convenience stores providing 2000 ft2 or 2500 ft2 of retail space. Each convenience store is delivered to site by road and craned on to pre-prepared foundations in just one day. Checkouts, cigarette gantries, freezers, chillers, toilets and tiled floors are all pre-installed in York to ensure faster completion on site and improved quality.

The first three convenience stores were installed at South Oxhey in Hertfordshire, Olton near Birmingham and Chadwell St Mary's in Essex.

Benefits achieved

- Significantly quicker and, with volume, more cost-effective
- The manufacture of identical stores across the UK also allows the client to increase operational efficiencies enabling staff to focus on serving customers
- Guaranteed quality offered.

Client: Tesco
Supplier: Yorkon

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Yorkon

Modular offices and laboratory facilities

Main drivers/constraints

- Minimising overall project time
- Reducing health and safety risks
- Maximising environmental performance throughout the life-cycle
- Live working environment limits site operations.

Project information

The merger of two agribusinesses, the formation of a new company and the division of the Grangemouth site created a shortfall in office and laboratory accommodation. A new, purpose-designed office scheme that would reflect the new company's strong corporate image was needed.

The £1.5 million headquarters building was completed just five months after the start of work on site by using factory-finished, steel-framed modules. Designed by the manufacturer, the scheme has a light grey external finish with contrasting charcoal glazing and tinted glass in keeping with Syngenta's high-tech image and reputation for innovation.

The interior is modern and spacious. The use of full height glazing on both the front and rear elevations adds interest to the exterior and allows a large amount of natural light to enter the building.

Benefits achieved

- Significant savings in programme time were achieved, so new facilities were able to be brought into beneficial use much earlier – a key advantage in a fast-changing industry
- The solution allowed closer monitoring of construction activities offsite. This reduced the impact on the existing operations and production activities, causing less disruption and considerably improving site safety.

Client: Syngenta
Supplier: Yorkon

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Yorkon

Modular hotel extension - Thistle Hotels

Main drivers/constraints

- Minimising overall project time
- Achieving high quality
- Live working environment limits site operations.

Project information

A two-storey, 55-bedroom extension to an existing hotel was located on site in just three working days using factory-finished, steel-framed modules. It was part of an overall project incorporating additional conference/board meeting facilities, restaurant/bar extensions and refurbishment and additional car parking. The total on-site build programme was 11 weeks.

The client was so delighted with the quality of product that it now negotiates directly with the modular builder for its future requirements.

Benefits achieved

- The income flows started earlier thus the finance costs were reduced
- The high-quality finish was predictable
- Minimum time and disruption on site.

Client: Thistle Hotels
Supplier: Caledonian

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Caledonian Building Systems

Modular hotel - Choice Hotels

Main drivers/constraints

- Minimising overall project time
- Achieving high quality.

Project information

Construction of a new three-storey, 51-bedroom hotel incorporating conference facilities, restaurant and bar. This hotel was the first the client had constructed in the UK entirely using pre-engineered steel-framed modules. It was fully operational within 20 weeks. Since then the building has recently been extended to add further bedrooms on top of the original three storeys.

The client found that using factory-finished modules provided a speed and quality that could not have been achieved with traditional methods.

Benefits achieved

- The income flows started earlier
- The quality of finish was exceptional
- The finance costs were reduced.

Client: Choice Hotels Europe
Supplier: Caledonian

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Caledonian Building Systems

Modular student accommodation 2

Main drivers/constraints

- Ensuring project cost certainty
- Ensuring project completion date is certain
- Minimising overall project time
- Achieving predictability of quality.

Project information

At nine storeys high, this 612-bedroom student accommodation block, including 79 kitchens/ common rooms, is one of the tallest pre-engineered building in Europe. Steel-framed modules, with fully fitted en-suite bedrooms, were delivered on site 15 weeks after the start of the project and erected in just 26 weeks. The building was completed in time for the year's intake of students.

Benefits achieved

- Fixed price
- Certainty for occupation planning
- Speed – faster than traditional build, reducing overall completion times by at least 50 per cent
- Minimum site disruption
- Higher quality and minimal rectification
- DfEE-supported method
- Reduced maintenance
- Less chance of weather disruption.

Client: Royal Northern College of Music
Supplier: Caledonian


Week 15 – Ground Floor Modules Installation


Week 26 – Fourth Floor Installation


Week 35 – Seventh Floor Installation


Completed Building as at 31 October 2001

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Modular school extension – St Mary's College, Hull

Main drivers/constraints

- Ensuring project cost certainty
- Minimising overall project time
- Achieving predictability of quality
- Maximising environmental performance throughout the life-cycle.

Project information

To replace existing buildings and mobile classroom units, new facilities were built, including a sixth form building for 250 pupils, drama space, kitchen and a dining area for 450. The new buildings had to match the existing ones. The work was completed in 20 weeks from approvals.

Benefits achieved

Using modular building for education projects has proved far quicker than traditional building methods. The accelerated building programme provided the following benefits:

- A fixed-price contract
- Faster than traditional building methods, with proposed completion time reduced by 50 per cent
- Guarantee of high quality
- Guaranteed minimal site disruption
- Accurate occupancy planning guarantees
- A DfEE-supported programme.

Client: St Mary's College, Hull
Supplier: Caledonian

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Caledonian Building Systems

Modular prison

Main drivers/constraints

- Minimising overall life-cycle costs
- Minimising overall project time
- Reducing health and safety risks
- Maximising environmental performance throughout the life-cycle.

Project information

The construction of two houseblocks, a segregation block for category C prisoners, along with other facilities, was completed within 39 weeks using prefabricated modular units.

Benefits achieved

- Rapid construction programme
- Easily adapted to extend existing accommodation quickly with minimum disruption
- Improved versatility, able to satisfy rigorous requirements for all security categories
- Provided a full range of accommodation necessary to the secure environment
- Minimum maintenance solution.

Client: HM Prison Service
Supplier: Caledonian

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Caledonian Building Systems

Modular police station

Main drivers/constraints

- Minimising overall life-cycle costs
- Minimising overall project time
- Reducing health and safety risks
- Maximising environmental performance throughout the life-cycle.

Project information

From design and construction, a five-cell custody suite for the Metropolitan Police was fully operational within 10 weeks using prefabricated modular units.

Benefits achieved

- Minimum maintenance solution
- Rapid construction programme
- Easily adapted to extend existing accommodation quickly
- Minimal disruption when providing secure accommodation
- Building versatility able to satisfy requirements for all security categories
- Provision of a full range of accommodation necessary to the secure environment.

Client: Wandsworth Police Station
Supplier: Caledonian

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Caledonian Building Systems

Modular surgery

Main drivers/constraints

- Ensuring project cost certainty
- Ensuring project completion data is certain
- Implementing respect for people principles.

Project information

Single-storey, five-doctor practice/medical centre, incorporating consulting and treatment rooms, meeting rooms, administration area, waiting area, reception, dispensary and crèche. The completed building was fully operational within 12 weeks from receipt of order using prefabricated modular units, with traditional construction linking the open-plan areas.

Benefits achieved

The modular building approach to construction provided an ideal solution. It was built in less than half the time taken with traditional methods. Benefits included:

- Fixed project costs before construction
- A guaranteed construction programme enabling accurate opening dates
- Speed of construction
- Scope for upgrading facilities or adding new ones with little or no disruption to existing services.

Client: Harleston Doctors' Surgery
Contractor: Laishley Ltd
Supplier: Caledonian

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Caledonian Building Systems

Modular nursery and infant school

Main drivers/constraints

- Minimising overall project time
- Achieving performance predictability throughout the life-cycle
- Implementing respect for people principles.

Project information

When fire destroyed a Cheshire nursery and infant school, the authority was faced with providing 1300 m^2 of temporary accommodation for up to two years that was of a sufficiently high standard for young children and that could be put in place extremely quickly to minimise disruption to the children's education.

Nine classrooms, a nursery, hall/dining area, library, multi-purpose community room, staff offices, toilet facilities for adults and small children, storage and a commercial kitchen were provided in nine weeks. This was achieved by hiring 42 fully fitted modules. They included a fully fitted kitchen and many specific requirements for the safety of the children, such as heaters with low surface temperature; finger guards to the doors, and intruder alarm and CCTV system.

The single-storey unit was provided as a package with foundations, drainage and main services.

Benefits achieved

- Speed from concept to completion
- Quality of finish
- Accommodation met the specific requirements for young children.

Client: Cheshire County Council
Consultant: Nigel Rose and Partners
Supplier: Foremans Buildings Ltd

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Foremans Buildings Ltd

Modular office building – Elvington, near York

Main drivers/constraints

- Minimising non-construction costs
- Minimising overall project time.

Project information

Sheppee International, based in Elvington, near York, needed to upgrade and expand its offices quickly. It achieved this by buying and relocating an existing two-storey modular office complex located in Warrington. The building consisted of 14 12.2 m × 2.94 m modules, giving a total floor area of just over 500 m^2.

The building was delivered direct to the site and erected immediately over a two-day period on to previously prepared foundations without interim storage. The whole project, which included refurbishment of the interior, was completed on time in 14 weeks.

Benefits achieved

- Delivery and double-handling costs saved
- Overall project time minimised.

Client: Sheppee International
Supplier: Foremans Buildings Ltd

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Steel wall panel system

Main drivers/constraints

- Minimising non-construction costs
- Minimising overall project time
- Multi-trade interfaces in restricted work areas

Project information

Following a fire that destroyed a large area of the Safeway supermarket in Taunton, the construction schedule for the rebuild was critical, because of the need to minimise the time during which the store was not functioning.

The original store comprised a structural steelwork superstructure with brick-and-block cavity walls. The outer leaf also had considerable detailing in both clay-brick specials and reconstituted stone. For the reconstruction, it was decided that prefabricated external wall panels would be preferable in order to keep on-site trades to the minimum and to ensure a fast rebuild time. A composite panel system, Wonderwall II, comprising Styrofoam sandwiched between two thin steel plates was selected.

The panels were finished with 25 mm brick slips to match the existing clay bricks. Reconstructed stonework and corbel details were also included in the 100 prefabricated panels.

Benefits achieved

- Offsite construction of external wall panels minimised non-construction costs
- Overall project time minimised
- On-site trades minimised.

Client: Safeway
Main contractor: Kajima
Supplier: Hanson TiS (NB: this system is no longer available)

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Acknowledgements

AJ Company Profile, Safeway Store, Taunton,
Architect journal: company profile, 28 Mar 2002, p 5

Pre-assembled steel platform system

Main drivers/constraints

- Minimising overall life-cycle costs
- Ensuring project completion date is certain
- Short overall project timescales
- Achieving high quality

Project information

The client required approximately 80 m of railway platform and ramps to be manufactured within five weeks and installed on the site within two weeks. A pre-assembled steel system, offered as a complete package with single-source responsibility including design, met the client's requirements including the rapid procurement and installation period. The system offers full adjustability in both horizontally and vertically to accommodate differences encountered on site. This is of benefit for future track level adjustments or the need to allow for the effects of trains travelling at different speeds.

Benefits achieved

The steel-framed platform system offers all the benefits associated with modular construction.

- A reduction of site costs
- Improved cost certainty
- A rapid and simplified procurement process
- Improved programme certainty through standard build times
- Reduced lead times from standard components
- Reduced site build time with associated reduction of work in high risk environments
- Standardised design
- Consistent quality
- Standardised components allowing easier assembly with the opportunity for the exchange or addition of modules.

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Corus Rail Modular Systems

Modular hospital accommodation

Main drivers/constraints

- Minimising overall life-cycle costs
- Minimising overall project time
- Maximising environmental performance throughout the life-cycle.

Project information

The Ronald McDonald House provides accommodation for parents whose children are undergoing treatment at the Royal Hospital for Sick Children in Yorkhill, Glasgow. The three-storey, 24-bedroom, 1600 m^2 accommodation includes en-suite bathrooms together with communal lounges, kitchens, dining and laundry facilities. The client chose a light steel-frame modular system of construction, mainly clad with brick.

All modules were built at a factory near Hull and delivered to site before being hoisted in a single lift from the roadside to their final position. Each module came to site pre-fitted with furniture, finishes and sanitary ware. The overall programme of 36 weeks consisted of a six-week design period, followed by 10 weeks for manufacture. Site installation was completed within 20 weeks. Each floor was installed within three days.

Benefits achieved

- Cost-competitive with traditional methods of procurement
- Rapid erection – site installation completed in 20 weeks
- Complemented traditional Glasgow architecture and included a curved frontage
- Designed to meet BBA 60-year Agrément Certificate.

Client: Royal Hospital for Sick Children, Glasgow
Supplier: Britspace Modular Building Systems Ltd

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Corus Construction

Modular hotel extension – Posthouse Hotel, Dublin Airport

Main drivers/constraints

- Minimising overall project time
- Achieving high quality
- Maximising environmental performance throughout the life-cycle
- Live working environment limits site operations.

Project information

The 60-bedroom extension to the Posthouse hotel at Dublin Airport was built using a light steel modular building system, clad in brick. The need to minimise disruption and disturbance to the operation of the existing hotel was a major factor. The factory-built units achieved consistency and high quality. Being adjacent to the airport, the building needed high-performance sound insulation, which was incorporated into the design. The overall construction time was just 15 weeks from the start of the ground works to practical completion. This speed of completion allowed the hotel to generate revenue earlier than would have been possible had traditional construction methods been used.

Benefits achieved

- Fast-track construction period, early return on investment
- High-quality bedroom modules
- High-quality building performance with excellent sound and thermal insulation levels
- Minimal site disturbance.

Client: Forte UK
Contractor: Volumetric Ltd
Supplier: Potton Ltd

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Steel Construction Institute

Prefabricated bathroom components

Main drivers/constraints

- Minimising construction costs
- Ensuring project completion date is certain
- Restricted site layout or space
- Limited capacity of suppliers.

Project information

This £7.5 million block accommodating 345 students at the University of Northumbria was completed just in time for the 2002 autumn term.

Pre-coated shower room linings, supplied in custom lengths, to eliminate on-site cutting and priming were used. It had been intended to use pre-assembled pods for the en-suite bathrooms to minimise on-site work, but the pod manufacturer's production capacity could not satisfy this project. The contractor compromised by using a prefabricated shower base that also supported a basin and toilet.

Benefits achieved

Pre-assembled solutions can go wrong if the supply chain does not deliver. The connections to the riser services did not suit the changes made, making installation of the shower bases more complex than it would have been with the pods.

Consequently, the project ran four weeks over the 60-week programme. The delay was mainly attributable to the problem of bathrooms constructed traditionally rather than using volumetric pods as originally intended.

Client: Unite
Contractor: Birse Build

Contact information

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Acknowledgements

Birse Build, Northern

Pre-assembled steel-frame lifts and plant room for hospital

Main drivers/constraints

- Ensuring project cost certainty
- Minimising overall project time
- Maximising environmental performance throughout the life-cycle
- Live working environment limits site operations.

Project information

Kingston NHS Trust had an accommodation crisis and needed a three-storey extension for 132 beds with supporting medical facilities. The original tender programme was 35 weeks, but the £3.4 million extension was built in just 19 weeks using pre-assembly to avoid wet trades and save time. In addition to a pre-assembled steel-frame system for the structure, pre-assembled lifts and plant room were specified, saving eight weeks. As time was of the essence, the team adopted a time-bound consultation process coupled with firm and rapid decision-making by the Trust's chief executive and the supplier's construction director.

Benefits achieved

- Strict time scheduling saved on project management and overhead costs
- Contract delivered on programme
- The client specified a building with a 5–10-year life, but the adopted solution will exceed this
- Keeping wet trades in the factory was a more sustainable solution because site time and waste was reduced.

Client: Kingston NHS Trust
S&P provider: Terrapin Ltd

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Acknowledgements

Terrapin Limited

Modular extension for house

Main drivers/constraints

- Minimising overall project time
- A problem transporting or delivering manufactured products to site.

Project information

A new extension has added a modern dimension to an Art Deco home in Handforth, Cheshire, while retaining the period feel of the property.

A rendered steel construction was used for the prefabricated extension, which was delivered to site. The curved roof extension, housing a bedroom with en-suite facilities, connects to the full-height bow-frontage, containing a spiral stair. Large glass doors open out on to a timber deck over the existing roof. Because of the size of the prefabricated structure, the module was divided into two parts after factory assembly for ease of transportation.

Benefits achieved

From start to finish, work took just six weeks in the factory, where all fixtures and fittings were built into the unit

- The site operations to offload and fix the units took one day, so that the clients were able to sleep in their new penthouse suite the same night. Connections and general interface items took a further week.

Client: John and Charlotte Thompson
Supplier: Hanson TiS (NB: this system is no longer available)

Factory construction, courtesy Hanson TiS

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Acknowledgements

Williams, A (2002). “Absolutely pre-fabulous”, The architects’ journal, 6 Jun 2002, pp 38–39

Modular accommodation concept

Main drivers/constraints

- Minimising time spent on site
- Maximising environmental performance throughout the life-cycle
- Implementing respect for people principles
- Restricted site layout or space.

Project information

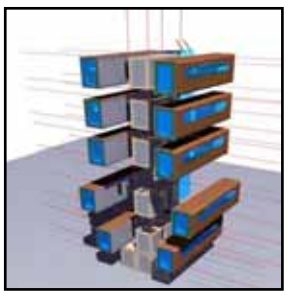
The Modular Accommodation System (MAS) is a response to the increasingly transient lifestyles apparent in contemporary cities such as London. Proximity to the workplace and being able to move quickly are becoming predominant factors in city-dwellers' choice of home. This shift in emphasis means that cities will need to become more adaptable to meet short-term changes in demand.

MAS consists of two mass-produced elements: the accommodation module and the core module. All elements can be easily plugged together and taken apart. A specialist lift/hoist is able to move individual accommodation modules on and off the core tower so a standard container truck can deliver a module without additional handling equipment. The construction and finishes are comparable to a yacht or high-speed train.

Benefits achievable

- Speed of erection
- This more flexible approach will result in a more efficient urban environment
- All elements can be easily plugged together and taken apart to suit different requirements
- A standard container truck can deliver a module without additional handling equipment.

S&P provider: Bluebase
Supplier: Bluebase



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Acknowledgements

Bluebase

Pre-assembled building services –Laing O'Rourke HQ

Main drivers/constraints

- Minimising construction cost
- Minimising time spent on site
- Achieving predictability of quality.

Project information

The design and installation of the mechanical and electrical services for Laing O'Rourke's new headquarters were based upon pre-design, offsite production and pre-engineered components. The building is a four-storey office space of about 7700 m^2 gross external area, with provision for 350 parking spaces. The M&E supplier offered a number of initiatives and innovations within the design to provide a high-quality installation and to meet the demands of both cost and programme.

The displacement system for the air conditioning was a simple and cost-effective alternative to a traditional fan coil system. It utilises large volumes of conditioned air from two roof-mounted, packaged air handling units.

In addition, the M&E supplier opted for cutting-edge technology that included:

- A modular wiring system
- A syphonic rainwater system
- Pre-wired air handling units/invertors
- Combined duty and standby pump sets
- Combined chilled water and heating pressurisation unit
- Prefabricated trench heating units
- Electromagnetic water conditioners.

Benefits achieved

- Demands of cost and programme were met
- First class product and quality installation were provided.

Client: Laing O'Rourke
Architect: Geoffrey Reid Associates
Services consultant: Buro Happold
Supplier: Ellis Mechanical Services Ltd

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Acknowledgements

Laing O'Rourke

Brick-faced precast concrete arches

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Limited or very expensive available skilled on-site labour.

Project information

The single arches at first floor and double arches at second floor are precast brick-faced units cast with Ibstock Leicester Red stone bricks. The stretcher bond brickwork is built in-situ off the arch bricks and tied back to the concrete backing with stainless steel dovetail cramps. The precast units are supported by means of stainless steel bearing angles fixed to the structural columns.

Benefits achieved

- Construction costs saved and on-site duration cut
- The need for scarce and expensive skilled site labour eliminated.

Client: Regentcrest plc
Architect: David Rosemont Stuart Passey & Partners
Engineer: Broad & Gloyens
Contractor: G Percy Trentham Ltd
S&P provider: Trent Concrete Ltd

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Acknowledgements

Trent Concrete Ltd

Brick- and stoned-faced precast concrete cladding

Main drivers/constraints

- Ensuring project cost certainty
- Ensuring project completion date is certain
- Achieving predictability of quality
- Reducing environmental impact during construction
- Restricted site layout or space.

Project information

Of the three main elevations of the building one features reconstructed Portland stone, another is brick-faced and the third is in natural Portland stone. All the stone and brickwork cladding could have been hand-set in-situ, but precast was selected as the best option as Aldercastle is a tight site in central London with nowhere to store bricks, stone etc. The brackets and fixings for the cladding were incorporated into the steel frame during fabrication.

Benefits achieved

- Precasting meant certainty of quality, programme and cost. The supplier's own erection team fitted six panels per day, achieving in no more than three hours on site what would have taken bricklayers two to three weeks. The downstream benefits of precast far outweighed the higher initial cost. Savings were made on preliminaries because of the shorter build period. External scaffolding was not required, as all the panels and windows were designed to be fitted from the inside.
- Prefabrication meant the site could be kept clean, tidy and quiet, causing less disruption in the surrounding area.

Client: Argent Developments
Architect: Siddell Gibson
Consulting engineers: Waterman Partnership
Contractor: Carillion
Supplier: Trent Concrete Ltd

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Precast concrete cladding –Leith, Edinburgh

Main drivers/constraints

- Minimising time spent on site
- Achieving predictability of quality
- Maximising environmental performance throughout the life-cycle.

Project information

An insulated sandwich cladding panel, incorporating a patented insulation method called Thermomass, was used on the Ocean Terminal retail and leisure development in Leith, Edinburgh. Glass-fibre and polymer composite rods are used instead of traditional rigid metal connectors to tie the pre-cast concrete leaves together, eliminating thermal bridging. The panels are made of a white reconstructed stone mix with an acid-etched exterior face.

Benefits achieved

- Speed of construction
- Precasting the sandwich panels meant production in a quality-controlled factory environment with just-in-time delivery to site for immediate erection
- Thermal advantages enabling reduced heating and cooling costs over the lifetime of the building
- Good insulation of airborne sound.

Client: Ocean Terminal Ltd
Architect: Conran and Partners with Keppie Architects
Engineer: Bingham Cotterell
Contractor: Bovis Lend Lease
Supplier: Trent Concrete Ltd

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Precast concrete cladding –City of London

Main drivers/constraints

- Minimising time spent on site
- Reducing health and safety risks
- Implementing respect for people principles
- Restricted site layout or space
- Site restrictions by external parties.

Project information

The office development is on a tight site in the City of London. Lack of on-site storage space, combined with severe parking restrictions on a heavily congested road junction, and the need to maintain pedestrian access to the Underground station occupying the site, would have proved problematic to the effective management of an in-situ scheme. Prefabrication was therefore essential to overcome these problems. The cladding units were delivered to an agreed schedule and erected immediately, eliminating the need for on-site storage.

The prefabricated façades were designed to give the appearance of traditional masonry. Joints between the natural stone-faced cladding panels were carefully detailed to be concealed behind the mullions.

Benefits achieved

- Minimised construction time on site
- Factory manufacture reduced need for site activity, resulting in a cleaner, safer, more controlled site environment
- Eliminated need for on-site storage.

Client: Skanska AB/Marktune Limited
Architect: Sheppard Robson Architects
Engineer: Skanska Konsulter AB
Contractor: Balfour Beatty Building Limited
Supplier: Trent Concrete Ltd

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Precast concrete beams

Main drivers/constraints

- Achieving high quality
- Site restrictions by external parties.

Project information

As part of rebuilding the original Financial Times building 372 precast primary floor-support beams, each typically 16 m long, were used.

Connections to in-situ columns were made via two “keyhole” nodes, with up to 16 reinforcing bars of 32 mm diameter used to make the column-to-beam connections, so accurate placement of the reinforcement was critical to avoid clashes and to ensure adequate compaction. Dimensional accuracy was also essential to meet setting-out tolerances as tight as ± 3 mm.

The overall height of the building was restricted by planning regulations intended to protect views of nearby St Paul’s Cathedral. Additionally, the floor-to-ceiling heights of the nine storeys had to be minimised. To achieve this, the soffits were designed to be exposed and level with the suspended ceilings spanning between them. Dimensional accuracy and quality of finish were of prime importance.

Benefits achieved

- The precast beams provided a structural and decorative design solution on a fast-build project
- Precasting enabled the tolerances to be met
- The precast beams overcame the restricted floor-to-ceiling heights of the nine-storey building.

Client: Obayashi Europe BV
Architect: Michael Hopkins & Partners
Engineer: Ove Arup & Partners
Contractor: Trollope & Colls Construction Limited
Supplier: Trent Concrete Ltd

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Acknowledgements

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Precast concrete columns, floor and roof units

Main drivers/constraints

- Minimising overall life-cycle cost
- Achieving high quality
- Maximising environmental performance throughout the life-cycle.

Project information

The superstructure for Toyota's headquarters in Surrey is a hybrid concrete structure using precast concrete columns and coffered floor and roof units with in-situ concrete beams and floor screed to provide structural integrity. The circular columns are up to 8 m tall and 500 mm in diameter and the floor units are 3 m wide x 6 m long. All the units were cast in glass-fibre-lined moulds to produce the high-quality ex-mould finish that was specified to eliminate the need for decoration.

The contract for the manufacture, supply and erection of the precast units was worth more than £1 million.

Benefits achieved

- Saved a further trade and reduced maintenance costs over the life of the building
- Achieved high-quality finish
- The exposed concrete surfaces provide greater thermal capacity, contributing positively to the building's energy management and helping achieve the client's low-energy concept.

Client: Toyota (GB) Ltd
Architect: Sheppard Robson
Structural engineer: Whitby Bird & Partners
Contractor: Takenaka (UK) Ltd
Supplier: Trent Concrete Ltd

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Acknowledgements

Trent Concrete Ltd

Precast concrete structure

Main drivers/constraints

- Minimising overall life-cycle costs
- Achieving high quality
- Live working environment limits site operations.

Project information

The £42 million first phase of the development of Paddington station involved a new check-in and waiting facility for the Heathrow Express and a new food court and retail area within a glass enclosure. The two-storey support for the glass enclosure had to be free-standing and isolated from the existing building by movement joints.

The requirement for moment capacity at the joints made traditional reinforced concrete impractical. Instead a precast hybrid solution was used, consisting of 6 m-high, 400 mm-diameter circular columns cast vertically round 200 x 200 steel sections, with structural steel connections at the joints with bolted and welded connections. Glass-fibre moulds, giving a high-quality architectural finish, were used to cast the 90 floor slabs, 36 columns and 32 beams. No further treatment was needed for aesthetic or fire protection purposes, and little ongoing maintenance is required. Variations to meet the dimensional inconsistency of the existing structure were accommodated by adjusting the sides of the moulds.

Benefits achieved

- Low-maintenance finish reducing life-cycle costs
- High quality achieved
- The station remained open while this construction work was carried out.

Client: Railtrack Plc
Architect: Nicholas Grimshaw & Partners
Structural & building services engineering: WS Atkins
Design and management contractor: Taylor Woodrow Construction
Supplier: Trent Concrete Ltd

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Acknowledgements

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Prefabricated car park system – Scottish Airports Ltd

Main drivers/constraints

- Minimising construction cost
- Minimising overall project time
- Achieving high quality.

Project information

An airport car park with a capacity of nearly 2000 spaces was designed and constructed using a prefabricated system that can be customised according to the client's specific requirements. The contractor worked with the client throughout the definition stages. The end result was so successful that it has become the standard product for use at other airports across the UK.

The managing contractor on the project oversaw the installation of piling, cladding, curtain walling, M&E services, lift installation, structural steelworks, installation of the car park management systems and ensured a high-quality fit-out. Careful management of the supply chain reduced cost and cut time on site, allowing the client to generate revenue earlier than would otherwise have been possible.

Benefits achieved

- Reduced costs
- A shorter overall programme than was achievable using the traditional procurement route
- Directly overseeing the work ensured a high-quality fit-out
- Reduced time on site enabled the client to generate revenue earlier.

Client: Scottish Airports Ltd
Contractor and supplier: Laing O'Rourke

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Acknowledgements

Laing O'Rourke

Catalogue design methodology for housing

Main drivers/constraints

- Ensuring project cost certainty
- Minimising overall project time
- Achieving high quality
- Maximising environmental performance throughout the life-cycle.

Project information

Based on an idea for a new housing typology for brownfield sites in London, this project is a hybrid of the European horizontal apartment and the English vertical terraced house. The building is less than 2 m away from a viaduct carrying a mainline railway.

Each apartment enjoys an interior organised as a large, open double-height living space, with enclosed bedrooms and stairs, which form a concrete buffer to the railway. Construction consists internally of high-quality exposed concrete, overclad externally with insulated rainscreen. Other than the in-situ concrete structure, all components are prefabricated and specified from international sources according to the architect's catalogue-design methodology.

Benefits achieved

- Low overall costs
- Fast-track build programme
- High quality achieved
- Good environmental benefits achieved
- High insulation values achieved.

Client: Lake Estates
Architects: dRMM

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Acknowledgements

dRMM

Modular nursery school extension

Main drivers/constraints

- Achieving performance predictability throughout the life-cycle
- Implementing respect for people principles

Project information

Prefabricated modules to accommodate up to 50 children have provided an extension to the Little Jogs Day Nursery in Hungerford, Hampshire. After careful planning between the client and manufacturer, the standard nursery school modules were chosen because of their ability to be customised from a range of standard options to provide specific child-friendly features for both toddlers and pre-school children, including a specially designed baby unit.

The children's playrooms are designed around the staff areas, which ensures the adults are always close to the children. Features such as bright blue doors, child-level toilets and sinks and dedicated play areas all have a positive effect on the children.

A laundry room, fully functioning kitchen, staff room/training room and manager's office are incorporated into the design.

Benefits achieved

- A building specially designed with little people in mind
- The nursery's unique design helps the staff with their daily tasks.

Client: Childcare UK Ltd
Supplier: Portakabin – Lilliput nursery

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Acknowledgements

Portakabin

Timber-framed housing – Tilbury

Main drivers/constraints

- Ensuring project cost certainty
- Achieving high quality
- Maximising environmental performance throughout the life-cycle.

Project information

This self-build project in Tilbury tackled the twin issues of producing low-cost housing and reducing unemployment. The architect designed the block of 10 flats and construction has been shared by a contractor and the people who now live in the building.

The part-prefabricated, open-panel, timber-frame design integrates sustainable building traditions into the Housing Corporation's tight funding schedule. Rainscreen cladding consists of precast concrete panels on three sides and larch-faced boarding on the west-facing elevation.

Benefits achieved

- Elements of the project, including the timber boarding completed by self-builders rather than professionals
- An innovative way of promoting a sense of ownership through inclusion in the project's construction.

Client: Owner-occupiers
Architects: Sergison Bates

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Acknowledgements

Sergison Bates Architects
The Wood Awards 2003

Modular office building – Luton

Main drivers/constraints

- Minimising non-construction costs
- Minimising overall project time
- Achieving high quality
- Implementing respect for people principles.

Project information

Following a merger, the client needed additional office accommodation quickly at its headquarters in Luton in order to meet deadlines for the transfer of staff. The manufacturer designed and built the 1300 m² of prefabricated steel modules to provide high-quality office accommodation in three stages, which allowed for the seamless integration of personnel into the merged operation.

Benefits achieved

- The extension was built in less than nine weeks, compared with the 32 weeks it would have taken if built traditionally
- The buildings include a responsive climate-control system in offices that are light, airy and comfortable
- High-quality office accommodation was delivered to tight timescales
- A large open-plan office arrangement provided space that is conducive to the company's business
- The physical transfer of personnel in the changeover had a minimal effect on the company's business.

Client: EasyJet
Supplier: Portakabin

Contact information

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Acknowledgements

Portakabin

Modular dance studio

Main drivers/constraints

- Ensuring project completion date is certain
- Achieving performance predictability throughout the life-cycle
- Implementing respect for people principles
- Restricted site layout or space.

Project information

With more and more students taking up the performing arts at Buckingham School, the department decided to invest in a specialist dance studio to help usher in the next generation of performing superstars. Located in the school's quadrangle, a state-of-the-art building system was used to provide 115 m² of dedicated dance space. The flexible configuration meant that the building could be erected in an existing enclosed quadrangle. To ensure the studio provided a professional dance facility, the school worked with the manufacturer's design team to include a 3 m-high ceiling with high-level windows that allow the installation of full-length dance mirrors. These enable students to perfect their dance routines. The studio also features a reinforced, non-slip, cushioned floor and specialist recessed lighting and heating.

Benefits achieved

- Erected within the six-week window dictated by the school's summer holidays
- A building that will enhance the image of performing arts.

Client: Buckingham School
Supplier: Portakabin

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Acknowledgements

Portakabin

Modular office building – Breckland Council HQ

Main drivers/constraints

- Minimising non-construction costs
- Achieving high quality
- Maximising environmental performance throughout the life-cycle
- Implementing respect for people principles.

Project information

The decision to build a new headquarters for Breckland Council was made following a "best value" audit. The major conclusion from this was that alternative accommodation was needed to facilitate more cost-effective working, better use of space and improved communications between staff and departments. Steve Harris, head of facilities management at Breckland Council, said: "Modular building was chosen when the results of the best value audit showed very strongly that we could vastly improve working practices and save between £500 000 and £750 000 per year by building a new head office that would bring all departments under one roof".

Benefits achieved

- The modular building system delivered operational cost efficiency through its energy-efficient attributes
- A high-quality working environment
- A positive impact on internal communication
- Reduced greenhouse gas and carbon dioxide emissions
- A design that met the Disability Discrimination Act requirements.

Client: Breckland Council
Supplier: Portakabin

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Acknowledgements

Portakabin

Modular office building – Caterpillar

Main drivers/constraints

- Minimising overall project time
- Achieving high quality.

Project information

With more office space needed in the main building as a result of business reorganisation, the client commissioned new modular accommodation. The new building has 400 m² of high-quality floor space, accommodating around 50 employees. It provides a centralised location for the Logistics and Transport departments in a comfortable and purpose-designed environment, with flexible office space and dedicated meeting rooms. Commenting on the completion of the building, Bob Smith, assistant staff engineer, Plant Engineering Department, adds: “It was ready for occupancy almost immediately”.

Benefits achieved

- Supplied with all services including climate control, the new building was fully operational on site in three weeks
- A tailored-made environment for Caterpillar’s office staff
- Dedicated workstations and ample storage space.

Client: Caterpillar Logistics Services (UK) Ltd
Supplier: Portakabin

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Acknowledgements

Portakabin

Modular clubhouse

Main drivers/constraints

- Minimising overall project time
- Achieving high quality
- Maximising environmental performance throughout the life-cycle
- Implementing respect for people principles.

Project information

The £1.4 million clubhouse at Cowdray Park brought together modern and traditional building skills. The end result is an attractive clubhouse that looks out over the West Sussex golf course. While the modular steel framework was being fabricated in Salisbury, the sawmills were preparing the larchwood cladding straight from the Cowdray Estate.

The clubhouse was designed to be attractive and requiring minimal maintenance. It blends in well with the surrounding countryside and yet the construction stands on its own as aesthetically pleasing.

Benefits achieved

- The build time was drastically reduced compared with traditional methods without compromising the quality of the finish
- Complete construction took just six months
- The end result is a modular building that successfully combines the traditional and the modern
- Low-maintenance design.

Client: Cowdray Park Estate
Supplier: AEP (Modular Construction) Ltd

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Acknowledgements

AEP (Modular Construction) Ltd

Prefabricated roofing system – McDonalds Restaurants

Main drivers/constraints

- Minimising time spent on site
- Minimising overall project time
- Achieving high quality.

Project information

A roofing system, prefabricated offsite and transported to site in sections by lorry, enabled McDonalds Restaurants to cut construction time dramatically. The roof was completed in just 3 h 40 min after the lorries arrived on site.

Benefits achieved

- Construction time was minimised
- Low-maintenance solution
- Delivered a lightweight finish that looked traditional and so satisfied local planning requirements.

Client: McDonalds Restaurants
Supplier: AEP (Modular Construction) Ltd

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Bathroom pods 4

Main drivers/constraints

- Ensuring project cost certainty
- Achieving high quality
- Multi-trade interfaces in restricted work areas.

Project information

Completed in 2002 for €39 million, phase one of this development comprised 21 500 m^2 of science, technology and office-based industries. This included telemarketing, data processing, software development and information technology, mixed with ancillary services such as restaurants, cafes, shops, a gym and a crèche.

Pre-assembled bathroom pods were specified for more than 200 locations in the project. By incorporating a special slim floor construction into the product line, the pods fitted on to the solid floor construction without a large step up or, alternatively, the need, expense and time required to raise the solid floor level to the same level as a standard pod construction.

Benefits achieved

- Greater control of the project costs and more predictable of construction periods
- More efficient use of pods on solid floors
- Consistent high quality in finishes achieved
- Site labour reduced.

Client: Landmark Developments
Architects: Traynor O'Toole Partnership
QS: Peter Curtin & Associates
Contractor: John Paul Construction
Supplier: Qpods Ireland

Contact information

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John Paul Construction,

Pre-engineering over-roofing system – Fieldhead Hospital

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Live working environment limits site operations.

Project information

A pre-engineered prefabricated galvanised steel roofing system was installed over Fieldhead Hospital's Bretton Villa and Day Block roof area, as part of a major refurbishment programme. The roof system was chosen to revitalise the look of the 1960s building while providing a permanent solution to the water ingress problems caused by its original flat roof. In addition to covering an existing flat roof, which surrounds a central courtyard area, the flat-to-pitch pre-engineered system has also been used on four annexes added during the refurbishment of the whole block. The system is designed and tailor-made for each project and versatile enough to accommodate special details.

Benefits achieved

- Delivering to site in a fully pre-engineered form enabled the system to be installed quickly, minimising on-site time, labour costs and disruption to staff and patients
- A uniform look has been achieved over the whole 2500 m^2 of roof
- Spanning wall-to-wall avoided the need for further loading of the existing flat felt roof
- The trusses are designed on a minimum of 3 m centres, which allows greater access to plant and services in the roof void.

Client: Fieldhead Hospital
Architect: Pinderfields Hospital NHS Trust Estate Dept
Roofing contractor: William Cooper Ltd, Barnsley
Supplier: Ward Building Components Limited

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Acknowledgements

Ward Building Components Limited

Bathroom pods – Marlborough Hotel, London

Main drivers/constraints

- Ensuring project cost certainty
- Ensuring project completion date is certain
- Achieving high quality
- Multi-trade interfaces in restricted work areas.

Project information

Ninety-nine pre-assembled bathroom pods were installed in the Marlborough Hotel, London. The main reasons for their choice were the elimination of waste, guaranteed quality, consistency of finish and reduction of delays associated with the construction of traditional bathrooms on site. In addition, each pod unit was equipped with its own service duct containing all the plumbing and electrical installations. The pods were delivered at a fixed price. This provided a significant incentive for the both designer and contractor.

Benefits achieved

- Fixed price
- Guaranteed lead time
- Excellent quality
- A single contractor.

Client: Marlborough Hotel
Supplier: Eurocomponents

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Acknowledgements

Eurocomponents S.r.l.

Windhill Primary School

Main drivers/constraints

- Minimising non-construction costs
- Minimising overall life-cycle costs
- Minimising time spent on site
- Achieving performance predictability throughout the life-cycle
- Maximising environmental performance throughout the life-cycle
- Live working environment limits site operations.

Project information

Windhill Primary School, at Shipley, Bradford, has suffered 15 years of leakage through its flat roof. The roof has also been damaged by people climbing on to it and throwing objects at it. The multi-level flat roof is unable structurally to take any further loads, so any new roofing solution needed to be lightweight and impose no extra load. The chosen solution was a flat-to-pitched roof conversion system. This incorporated a pre-engineered galvanised steel framework clad with single-skin profiled metal cladding finished in colours complying with local planning requirements.

Benefits achieved

- The school's specific structural and aesthetic needs were met. The school remained open during the entire installation
- Thousands of pounds were saved in not having to relocate the children
- The new roof has a guaranteed life and is low-maintenance
- Water ingress problems were eliminated
- Increased insulation improved energy efficiency and reduced building running costs
- The serviceable life of the building has been extended by more than 25 years.

Client: Windhill Primary School
Main contractor: Holroyd Construction, Wetherby
Roofing contractor: William Cooper Ltd, Barnsley
Supplier: Ward Building Components Limited

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Ward Building Components Limited

Pre-engineered over-roofing system – Greenwich Council

Main drivers/constraints

- Minimising overall life-cycle costs
- Achieving performance predictability throughout the life-cycle
- Maximising environmental performance throughout the life-cycle.

Project information

A major refurbishment project of blocks of traditionally built flats for Greenwich Council, included the installation of monopitch double curve roof structures, to create a modern effect and to improve watertightness cost-effectively.

The monopitch roof truss structure was designed to support the required curvature and to provide an interior walkway for easy and safe access to water tanks. This was achieved using a pre-engineered lightweight roof system clad with a trapezoidal roofing profile, valley gutters and fixings. The structure also incorporates bull-nose flashings and side eaves with special curved ends.

Benefits achieved

- Low maintenance
- Pre-engineered solution minimised disruption to tenants
- High insulation.

Client: Greenwich Council
Architect: Shepherd, Epstein & Hunter
Main contractor: Llewellyns
Roofing contractor: Wembley Roofing Ltd
Supplier: Ward Building Components Ltd

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Ward Building Components Ltd

Modular student accommodation – Lincoln University

Main drivers/constraints

- Ensuring project completion date is certain
- Minimising time spent on site
- Achieving predictability of quality.

Project information

A new four-storey office and administration building at Lincoln University has been completed using a modular building system.

The framework included the sub-assembly of cold-rolled pre-formed floor and roof sections with hot-rolled pre-formed columns and brackets. These were delivered to the module manufacturer as part of a carefully phased programme in kits of parts for assembly. It then fitted all the required flooring, roofing and partitioning. Once complete the modules were delivered and installed on site.

Benefits achieved

- Scheduled deliveries to manufacturer and site
- Reduced time on site
- Guaranteed quality.

Client: Lincoln University
Main contractor: Linpave
Modular contractor: Pyramid Building Systems Ltd
Supplier: Ward Building Components Ltd

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Acknowledgements

Ward Building Components Limited

Timber panellised system for holiday chalets

Main drivers/constraints

- Minimising overall life-cycle costs
- Minimising overall project time
- Maximising environmental performance throughout the life-cycle
- Short overall project timescales.

Project information

To provide guests with high-quality accommodation during their stay at its new Sherwood Forest development, Center Parcs chose a structural insulated panel-based system for 75 new luxury chalet-style two- and three-bed villas. The system was designed to cater for clients' increasing preference for thermally efficient buildings and fast-track construction. Ease of assembly enabled approved contractors to erect one chalet a day to meet the project's challenging deadline. The project involved a total of 8000 m^2 of structural insulated panels (SIPs).

Benefits achieved

- Lifetime energy-saving benefits
- Speed of erection
- Reduced on-site construction time
- Timber from renewable sources used, meeting the requirements of Center Parcs' environmental policy
- Thermal performance and cost-effectiveness of the SIP-based system provided U-values significantly better than the statutory requirements
- Minimal wastage.

Client: Center Parcs
Main contractor: Robert Woodhead Ltd
Supplier: Kingspan Insulation Limited

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Acknowledgements

Kingspan Insulation Limited

Modular gatehouses

Main drivers/constraints

- Minimising overall life-cycle costs
- Achieving predictability of quality
- Implementing respect for people principles
- Restricted site layout or space.

Project information

In an overhaul of its incoming goods procedure Jaguar Cars Limited in Birmingham required gatehouses to house security personnel. The criteria Jaguar set for the gatehouses were: minimum site disturbance during installation; minimal future maintenance costs; high levels of insulation and comfort for the personnel manning the security posts 24 hours a day; good visibility; must project Jaguar's corporate identity. A standardised pre-assembled modular system was used because it would comply with all these criteria.

Benefits achieved

- GRP finish to the panels means the gatehouses will continue to look their best with the minimum of maintenance
- Once the factory assembly work was complete, the client carried out pre-delivery inspections before the gatehouses were delivered to site to ensure quality.

Client: Jaguar Cars Limited
Supplier: Glasdon Manufacturing Limited

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Acknowledgements

Glasdon Manufacturing Limited

Prefabricated roofing system – Tesco

Main drivers/constraints

- Minimising time spent on site
- Minimising overall project time.

Project information

A roofing system, prefabricated at the manufacturer's workshops, can be transported in sections by lorry to site ready for quick assembly. Larger projects can be flat-packed for piecemeal transportation.

This system has allowed Tesco to cut the construction time of its superstores dramatically. This reduction in overall project time meant that a recent 3000 m^2 superstore was completed in just ten days. By traditional methods it would have taken 17 weeks.

Lightweight finishes for both roofing and walling are designed to suit planning requirements.

Benefits achieved

- Roof construction time was cut dramatically – just ten days compared with 17 weeks if constructed traditionally
- Thanks to the speedy installation of a dry shell, all interior work was under way far more quickly than conventional building methods would have allowed.

Client: Tesco
Supplier: AEP (Modular Construction) Ltd

Courtesy Tesco

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Acknowledgements

AEP (Modular Construction) Ltd

Pre-engineered over-roofing system –Manchester

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Live working environment limits site operations.

Project information

The need to re-roof a three-storey block of flats with minimum disruption to residents led the architects in Manchester to choose a pre-engineered roofing system. The flat roof to the block belonging to Manchester and District Housing Group at its Slademount property in Levenshulme had an inherent water ingress problem. The work had to be undertaken without moving residents from their flats, which dictated the choice of a lightweight prefabricated system that would not penetrate the existing roof and would be able to span between outer walls.

Benefits achieved

- This prefabricated system provided the quickest and most cost-effective solution
- The steel structure arrived on site with all sections pre-punched and cut to length, making it quick and clean to use
- Once the materials were located at roof level, the construction of the roof was self-contained and not reliant upon other operations, thereby speeding up assembly.

Client: Manchester and District Housing Group
Architect: Triangle Architects
Roofing contractor: Stamford Pickard Ltd, Crewe
Supplier: Ward Building Components Limited

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Acknowledgements

Ward Building Components Limited

Timber panellised system for housing 3

Project information

The system provides thermally efficient shells for low-rise housing. The package comprises cassette floors and insulated external panels pre-fitted with doors and windows. These are delivered to site and are assembled by locally engaged CITB-certified teams. A wide range of standard house types and apartments is supplied for private housing in addition to increasing numbers of Housing Corporation-compliant designs.

The highly automated factory uses CAD-CAM links directly from a specific design to the machinery. At the high-volume rate of manufacture of more than 5000 (four-bed) houses a year, construction projects can be continuous. The structural shell of a 1200 ft^2 house can be assembled in as little as one working day. The internal fit-out starts at the same time as bricklaying; streamlining the construction process.

The system carries quality assurance through BBA, BRE and Q-Mark-Plus certifications as well as acceptance for subsequent NHBC or Zurich approval. Houses built with the system are mortgageable under normal terms.

Benefits achieved

- Precision-engineered flexible manufacturing
- Cost-effective rapid-build process
- Accurate and consistent quality
- Certainty of build programme for high volume
- Safe, dry, working conditions for other trades.

Supplier: Space4 Ltd

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Space4 Ltd

Modular houses

Main drivers/constraints

- Minimising construction costs
- Minimising overall project time
- Achieving performance predictability throughout the life-cycle
- Maximising environmental performance throughout the life-cycle.

Project information

Southern Housing Group has built new homes on the site of an old school house to provide social housing for local people in New Romney, Kent. Working in partnership with the landowner, Shepway DC, contractors and main suppliers, the project employed factory-made modules that were fitted together on site.

The form of construction is based on techniques originally designed for temporary buildings. The manufacturer has developed the system to provide permanent structures. The modules consist of a core of galvanised steel framing on to which the internal and external walls are attached

Benefits achieved

- Reduced costs
- The on-site development process is reduced by up to 70 per cent
- Factory-based quality control
- The process is not dependent on the weather or skilled labour availability
- The houses have good energy and sound insulation performance
- The finished appearance is in keeping with the local area despite the innovative technology.

Client: Southern Housing Group
Supplier: Elliott Group

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Acknowledgements

Elliott Group

Modular sheltered accommodation

Main drivers/constraints

- Achieving predictability of quality
- Maximising environmental performance throughout the life-cycle
- Implementing respect for people principles.

Project information

Prime Focus decided on offsite-manufactured modules as the most beneficial construction method for its specialist housing for the frail elderly. It worked in partnership with the manufacturer to produce 131 pre-engineered one- and two-bedroom flats in three buildings at different locations in the Midlands.

Benefits achieved

- Built to high performance specifications and with the special needs of the tenants incorporated
- Easily maintained buildings.

Client: Prime Focus
Supplier: Terrapin Limited

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Acknowledgements

Terrapin Limited

Timber-framed airport buildings

Main drivers/constraints

- Minimising overall project time
- Achieving predictability of quality.

Project information

As part of its redevelopment, London Luton Airport required a 350 m^2 departure lounge extension and a new 393 m^2 valet parking reception. The use of prefabricated timber-framed buildings provided the most appropriate solution and were installed in seven and 10 weeks respectively. The buildings were negotiated under a rental agreement, saving capital for further airport expansion. Both are spacious, comfortable and built to high interior specifications.

Benefits achieved

- Fast completion times achieved
- High quality.

Client: London Luton Airport
Supplier: Terrapin Limited

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Terrapin Limited

Timber-framed office building

Main drivers/constraints

- Minimising on-site duration
- Reducing health and safety risks
- Live working environment limits site operations
- Site restrictions by external parties.

Project information

By using a prefabricated timber-frame construction a 150 m^2 office for National Grid's Nursling electricity substation was constructed to a five-week programme. The strictest safety standards had to be observed as the site was close to live 400 kV and 132 kV substations.

Adopting a pre-engineered manufacturing solution ensured that on-site work was minimised and each pre-engineered component was integrated with carefully planned precision.

Benefits achieved

- On-site work minimised
- Five-week programme achieved
- The work met the strict safety requirements.

Client: National Grid
Supplier: Terrapin Limited

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Terrapin Limited

Timber-framed call centre

Main drivers/constraints

- Ensuring project cost certainty
- Minimising overall project time
- Achieving predictability of quality.

Project information

Altro Ltd urgently needed a customer call centre at Letchworth, Hertfordshire. The new timber-frame 650 m^2 double-storey building was prefabricated offsite to high mechanical and electrical specifications and delivered on time and to budget.

Benefits achieved

- Delivered to budget
- Six-week completion time achieved
- High mechanical and electrical specifications met.

Client: Altro Ltd
Supplier: Terrapin Limited

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Terrapin Limited

Timber-framed shop

Main drivers/constraints

- Minimising on-site duration
- Restricted site layout or space
- Live working environment limits site operations.

Project information

Demonstrating the flexibility inherent in pre-engineered timber-frame buildings, a gift and souvenir shop was constructed in a very tight site near to the Tower of London and accessible only from one direction. Because much of the work was carried out using offsite techniques, the building could be erected overnight, minimising disturbance to this busy tourist area.

Benefits achieved

- Minimal time on site
- Minimal disturbance when few people were around.

Supplier: Terrapin Limited

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Terrapin Limited

Modular hotel – Manchester

Main drivers/constraints

- Ensuring project cost certainty
- Achieving high quality
- Implementing respect for people principles.

Project information

The first large-scale application of a new concept for modular construction (see Example 32) will be a new hotel facility in Manchester. The hotel is designed as a landmark building, part of an £80 million redevelopment of the city's old industrial quarter.

Benefits achieved

- The modular technology will offer contemporary accommodation at an affordable price.

Architect: Bryden Wood Associates

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Bryden Wood Associates

Volumetric apartments for student and key workers – Bournemouth

Main drivers/constraints

- Ensuring project completion date is certain
- Minimising overall life-cycle costs
- Achieving high quality.

Project information

This key-worker housing project in Bournemouth, Dorset, is a mixed-use development of between seven and 11 storeys, with student and key-worker housing and some office space. Volumetric offsite construction is being used to reduce the cost, while improving quality.

Benefits achieved

- Quick to install on site
- Brings down the cost while improving quality
- Low maintenance.

Client/architect: Unite Solutions plc
Contractor: Warings Contractors Ltd

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Acknowledgments

Unite (2003). “Modular rooms bring down cost while improving quality”, Building, 9 May 2003, p 14

Steel-framed school building

Main drivers/constraints

- Ensuring project completion date is certain
- Achieving predictability of quality
- Maximising environmental performance throughout the life-cycle
- Restricted site layout or space.

Project information

The project is a new 3000 m^2 building for Kenton School, Newcastle-upon-Tyne, costing £1.6 million. The steel-framed pre-engineering construction method provided a robust solution to the school's requirements. Interior specifications were high, including state-of-the-art IT facilities, four science laboratories and Category 2 lighting.

This was a turnkey project delivered by the manufacturer's design and build team.

Benefits achieved

- Short on-site construction period
- High quality achieved
- Flexible and robust construction delivered to programme.

Client: Kenton School
Supplier: Terrapin Limited

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Terrapin Limited

Steel-framed church centre

Main drivers/constraints

- Ensuring project cost certainty.

Project information

Requirements for a multi-purpose church centre in All Saints Oxhey, south of Watford, were fulfiled through use of a steel-framed construction. The original church had been condemned and the Development Committee was struggling to find a building solution within its budget. The manufacturer's expertise enabled the project to be realised at a cost of less than £500 000, including extensive external works such as car parking, paths and landscaping.

Benefits achieved

- Cost certainty to a limited budget
- Short on-site construction time.

Client: All Saints Oxhey
Supplier: Terrapin Limited



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Acknowledgments

Terrapin Limited

Steel-framed hospital

Main drivers/constraints

- Minimising construction costs
- Minimising overall project time.

Project information

The £5 million hospital project was built to a demanding construction programme at Russell's Hall, Dudley. The building provides 180 beds plus intensive care and all supporting services. A pre-assembled steel-framed construction provided a cost-effective method of enclosing the structure quickly in winter-time. The design incorporates reinforced concrete interfloors at the ground, first and second levels, with standard pre-engineered GRP panels for external cladding.

Benefits achieved

- Completed the £5 million project within a demanding construction programme
- Cost-effectiveness of enclosing the structure quickly in winter-time
- The structure allowed for high internal planning flexibility.

Client: Russell's Hall Hospital
Supplier: Terrapin Limited

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Acknowledgments

Terrapin Limited

Pre-assembled steel frame and flooring system

Main drivers/constraints

- Ensuring project cost certainty
- Minimising time spent on site
- Maximising environmental performance throughout the life-cycle
- Restricted site layout or space
- Live working environment limits site operations.

Project information

The 130 m x 33 m steel-frame building, known as De Brug (The Bridge) was constructed for Unilever at the Nassaukade in Rotterdam. The 2400 t structure was constructed 250 m from its final location and then manoeuvred into place above the factory. The structure consists of a four-storey frame and flooring system that sits on top of 25 m-high steel columns that straddle Unilever's existing factory.

The Slimdek flooring system was selected to offer a simple cost-effective solution. This proven, engineered solution has been used in a variety of multi-storey building applications where a minimum-depth floor thickness has been viewed as beneficial.

Chris de Jonge of JHK Architecten comments: "Hollandia, the steel contractor, selected the Slimdek system for this project to speed construction and minimise waste".

Benefits achieved

- Improved cost certainty
- Construction speeded up
- The shallowness of the floor system offers simple service integration and, in the majority of cases, eliminates the need for fire protection
- The unusual feature of this case was that the structure needed to be moved. The weight saving offered by the flooring system helped to reduce the overall building weight.

Client: Unilever
Designer: JHK Architecten of Utrecht
Steel contractor: Hollandia
Supplier: Corus

(Photos from <http://www.jhk.nl/jhk.htm>)

Contact information

HK Architecten of Utrecht

Acknowledgments

Building (2003). "Unilever bridges a gap in Rotterdam", What's new in building, Dec, p 28

Timber panellised roof system

Main drivers/constraints

- Minimising time spent on site
- Minimising overall project time
- Maximising environmental performance throughout the life-cycle
- Implementing respect for people principles.

Project information

The stone-built Springhead Mill, an 18th century woollen mill in West Yorkshire, has been converted into five modern housing units, each consisting of four split-level floors. The underside of the roof has been left open to form a vaulted ceiling and to create extra living space.

In the early stages of this project the client was anxious to make the roofing area secure and provide safe access to on-site operatives. The client also wanted to provide completely safe cover for those working inside the building. For these reasons a prefabricated roof system was selected. A team of six fully trained operatives took only three days to erect the 400 m^2 of pre-insulated timber roofing panels.

Benefits achieved

- Speedy on-site installation
- Provided a secure base for foot traffic during construction and the necessary strength to take the weight of stone flag tiling
- Ideal for creating useable room-in-roof space because the lack of trusses maximises the unobstructed area
- U-values as low as 0.10 W/m^2K can be achieved
- The proprietary jointing techniques yields lower leakage rates than traditional roofing systems.

Client: Burley Developments Ltd
Supplier: Kingspan Insulation Limited

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Acknowledgments

Kingspan Insulation Limited

Timber panellised house building system

Main drivers/constraints

- Minimising overall life-cycle costs
- Minimising time spent on site
- Minimising overall project time
- Maximising environmental performance throughout the life-cycle.

Project information

A private house-builder adopted the “try before you buy” approach when he built his own family home in the Hope Valley, Derbyshire, using a panellised system before offering it to his customers. The house-builder was looking for a fast-track method of construction and a system that would provide maximum warmth with minimal heating bills. He achieved this by using structural insulated panels. It took him and three of his staff just 10 days to erect almost 600 m^2 of wall and roof panels and complete the shell.

Benefits achieved

- It was very easy to keep warm and contributed to substantially reduced heating costs for the winter quarter
- Speed of construction
- The flexibility of the system easily accommodated the choice of an underfloor heating system and state-of-the-art mechanical ventilation and heat recovery system
- The useable warm roof space enabled the original plans to be enlarged to provide five additional bedrooms
- Unlike traditional timber-frame construction, the system is delivered already insulated, which saves considerable time
- The system achieves U-values no worse than 0.20 W/m^2K
- The jointing techniques used for this type of construction yield air leakage rates as low as 0.08 air changes per hour at normal air pressures. This is considerably lower than regulatory requirements.

Client: Robin Grayson
Main contractor: RE Grayson and Sons
Supplier: Kingspan Insulation Limited

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Acknowledgments

Kingspan Insulation Limited

Brick-faced precast concrete cladding

Main drivers/constraints

- Minimising on-site duration
- Achieving high quality
- Restricted site layout or space
- Live working environment limits site operations.

Project information

The new seven-storey European headquarters of the US banker Merrill Lynch close to St Paul's Cathedral in the City of London demanded prestige aesthetics. The large size of the building along with its historic location presented the architect with major challenges. The client's desire for a building of permanence, gravity and solidity has been interpreted in the form of a steel-framed structure clad with Portland stone, glass curtain walling and the refined appearance of gauged brickwork. A system of stack-bonded brick panels was developed, using an innovative technique to achieve precise alignment of the stack-bonded bricks with a consistent 3 mm joint. Some brick-faced spandrel panels are 13.3 m long x 1.1 m high. The building also has cast flat underslung arches faced with Portland stone. The arch slabs, 1.5 m wide and spanning 12 m, were post-tensioned in the factory to achieve a thickness of only 150 mm.

Benefits achieved

- Met the demand of accelerated construction
- An efficient method of providing a brick aesthetic
- Helped resolve restricted urban site problems.

Client: Merrill Lynch
Architect: Swanke Hayden Connell
Contractor: Mace
Supplier: Techrete (UK) Ltd

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Acknowledgments

Techrete

Precast concrete cladding

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Achieving high quality.

Project information

Speed of construction over traditional methods was a major factor in the specification of precast concrete panels for the Edinburgh Exchange Plaza project. Product quality and competitive costs were also considered major benefits. Typically, the precast panels are 7.5 m x 3 m, those at ground level being faced either in natural stone in a red/brown colour mix or in Dunhouse sandstone. Most of the finishing is smooth, although a “sparrow-pecked” effect is also featured. At upper levels cornices and panels were cast in reconstructed stone to match Dunhouse sandstone elements.

Benefits achieved

- Competitive costs
- Faster than traditional methods
- Better product quality achieved.

Client: Cala Morrison & Standard Life
Contractor: Morrison
Architect: Cochrane McGregor
Supplier: Techrete (UK) Ltd

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Techrete

Precast concrete basement – St Albans

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Achieving high quality
- Maximising environmental performance throughout the life-cycle.

Project information

Using Swedish technology, eight prototype homes with precast concrete basements were built in St Albans. The precast concrete sections enabled the contractor to complete a basement in one day. The sections involve a special type of concrete able to support up to five storeys yet light enough to make installation easy and cost-effective. This special concrete also ensures total waterproofing, increases insulation values by more than 50 per cent – well ahead of current Building Regulation requirements – and provides five times more resistance to chemicals than traditional construction.

Benefits achieved

- Structural strength yet sufficiently light to make installation easy and cost-effective
- Speed of construction
- Increased insulation reduced water and heating bills
- Increased the square footage of homes without the need for extra land.

Client: Individual home purchasers
Supplier: Laing Homes

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Acknowledgments

Laing Homes

Precast concrete structural wall panels – Honley High School

Main drivers/constraints

- Ensuring project completion date is certain
- Reducing environmental impact during construction.

Project information

A two-storey, 12-classroom school extension was completed in January 2002 for Honley High School using a precast concrete panel system. Construction time during the winter months is weather-dependent. The contractor was faced with a tight programme and the likelihood of bad weather during the winter months. By using the panel system, the project was completed on time, in 22 weeks, ready for the pupils' spring term. A continuous dialogue between all parties of the project team ensured no detail oversight and any incorrect details were improved.

Benefits achieved

- Enabled both time and cost to be predicted from the outset. The savings generated by the reduction in materials and preliminaries can be identified early on
- The structure was completed to dry-shell stage in 16 weeks
- Increased useable area: the load-bearing elements are 40 per cent thinner than traditional forms of construction
- Achieved a high level of airtightness
- Acoustic testing demonstrated that the division walls between the classrooms achieved 44 Dbw, which exceeded the specified value of 38 Dbw
- Time losses and defects were minimised
- Applying a precast solution improved health and safety on site by reducing site exposure, noise and air pollution for school residents and contractors
- Staggered delivery times ensured the project was managed tidily and effectively.

Client: Kirklees Metropolitan Council
Contractor: Jarvis Construction
Supplier: Structherm Ltd

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Acknowledgments

Structherm Ltd

Precast concrete structural wall panels – Patchway High School and timber roof beams

Main drivers/constraints

- Minimising overall project time
- Achieving performance predictability throughout the life-cycle
- Maximising environmental performance throughout the life-cycle.

Project information

An extension to provide a library and a boiler room to an existing four-classroom block at Patchway High School was completed in March 2000 using a prefabricated structural panel system. The extension is hexagonal with an overall size of 262 m² internally and is joined to the existing building by a link corridor.

A special aspect of this building is the hexagonal open roof. The roof slope measures 17.5° and at its apex reaches a height of 7.4 m. The open roof was achieved with glulam structural timber beams and purlins bearing on to the structural wall panels and supported by a glulam circular central post. The beams and purlins feature tongue-and-groove timber structural decking.

The building was completed with a site-applied brick-effect render finish to match the existing building. Aluminium gutters and drainpipes were used to avoid vandalism.

Benefits achieved

- The structure was completed to dry-shell stage in six weeks
- The required wall U-value of 0.25 W/m² was achieved, while the roof structure measured a U-value of 0.38 W/m²
- Aesthetically compatible with existing buildings.

Client: Patchway High School
Supplier: Structherm Ltd

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Acknowledgments

Structherm Ltd

Precast concrete system for warehouse

Main drivers/constraints

- Minimising time spent on site
- Minimising overall project time
- Construction during winter months (inclement weather).

Project information

The shortest possible construction time was required for the European headquarters for Johnson Controls in Redditch, Worcestershire. Much of the work would have to be carried in the winter, so it was necessary to overcome the difficulties of cast-in-situ construction during inclement weather. To meet these requirements pre-cast dock leveller pits, precast ground beams and a precast walling system were selected.

The dock leveller pits, fabricated to the tenant's own specification, reduced construction time, allowing the main floor slab to be laid faster and ensuring easy and accurate location within the building. The walling system provided a direct replacement for the inner skins of blockwork, eliminating the need for strip footings, and provided rapid on-site construction. The precast ground beams were quick to install, which enabled construction to go ahead independent of the weather.

Benefits achieved

- Maintained progress on the site through inclement winter conditions
- Ensured completion on schedule.

Client: Celexa REIM
Main contractor: Bryant Construction Ltd, Solihull
Architect: Mason Richards Partnership, Edgbaston
Supplier: Roger Bullivant
Tenant: Johnson Controls

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Acknowledgments

Roger Bullivant

Pre-assembled steel/concrete composite bridge units

Main drivers/constraints

- Minimising time spent on site
- Achieving predictability of quality
- Live working environment limits site operations.

Project information

A fast-track solution was required to replace a railway bridge over the A638 Cleckheaton Road just outside Bradford. Four pre-assembled composite units provided the solution. Eight steel beams were fabricated and trial-erected at Fairfield Mabey then transported in pairs to the manufacturer's Accrington works, where a 225 mm-thick deck was cast to produce the skewed bridge units on an incline, a particularly challenging design. Slabs were cast with projecting links to enable jointing on site. All services were run through 15 service ducts and fixed to the underside of the units before delivery. The units were also waterproofed at the factory.

The new units were delivered and erected in one 54-hour and two 29-hour possessions of the road. The units required only three in-situ concrete stitch joints to provide the complete bridge structure.

Benefits achieved

- Speed of construction
- High quality
- Minimum disruption to traffic.

Client: Railtrack
Main contractor: May Gurney Construction Ltd
Consulting engineer: Pell Frischman
Supplier: Buchan Concrete Solutions

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Buchan Concrete Solutions

Precast concrete segmental tunnel lining system – London Underground Jubilee Line extension

Main drivers/constraints

- Minimising overall project time
- Reducing health and safety risks
- Achieving predictability of quality
- Restricted site layout or space.

Project information

More than £11.25 million-worth of precast concrete expanded and bolted segmental lining sections were used in the London Underground Jubilee Line Extension Project (Contracts 102 and 105). The rings were bolted together with curved bolts and the segments fitted with a hydrophilic sealing gasket.

Benefits achieved

- Project time was minimised
- Health and safety risks were reduced
- Consistent high quality. Achieved variations as low as 8 per cent on water permeability tests and within 20 per cent for oxygen diffusion tests – commendable results from highly sensitive testing procedures that demand micro-measured accuracy.

Client: London Underground Limited
Main contractor: Balfour Beatty/AMEC Contract 102, Aoki-Solentanche Joint Venture Contract 105
Consulting engineer: Mott MacDonald Contract 102,Sir William Halcrow & Partners Contract 105
Supplier: Buchan Concrete Solutions

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Acknowledgments

Buchan Concrete Solutions

Precast concrete segmental Tunnelling lining system – Fylde Coast, Lancashire

Main drivers/constraints

- Minimising overall project time
- Reducing health and safety risks
- Implementing respect for people principles
- Restricted site layout or space.

Project information

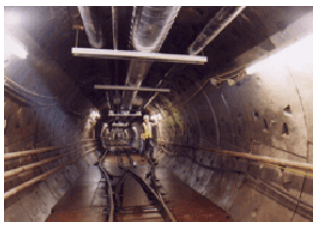
Precast concrete sections were designed, manufactured and supplied for the shafts and tunnel lining for the 11.5 km length of a smoothbore tunnel along the Fylde Coast near Blackpool in Lancashire as part of the Fylde Coastal Waters Improvement Scheme. The tunnel lining consisted of six-segment (trapezoidal) tapered rings with bolts on circular and cross joints and compression gaskets on all joints.

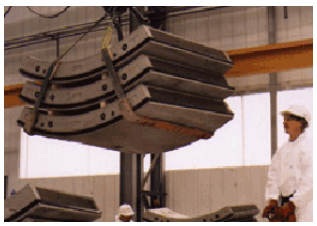
A total of 70 554 tunnel segments, complete with coarse-thread plastic grout/lifting sockets, plastic non-return valves and threaded grout plugs, was delivered over an 18-month period. Eighteen shafts, ranging in diameter from 6.0 m to 10.67 m, were sunk at depths of up to 35 m using prefabricated smoothbore shaft linings. More than 500 1.0 m-wide shaft rings were supplied together with a large number of precast landing and roof slabs.

Benefits achieved

- Project time was minimised
- Reduced health and safety risks.

Client: North West Water
Main contractor: AMEC Tunnelling
Consulting engineer: North West Water Engineering
Supplier: Buchan Concrete Solutions





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Acknowledgments

Buchan Concrete Solutions

Precast concrete wall and floor panels for a prison

Main drivers/constraints

- Minimising overall project time
- Reducing health and safety risks
- Implementing respect for people principles.

Project information

More than 5700 precast concrete wall and floor panels were designed and manufactured for Kilmarnock Prison. The manufacturer was responsible for the structural design of the panels; detailing for manufacture, including the incorporation of mechanical and electrical services, windows, doors; and erection on site. Overall project duration was tight. Following completion of the first drawings, lead-in time to first manufacture was four weeks. Manufacture and erection on site was completed in 40 weeks.

Benefits achieved

- The benefits of offsite incorporation of services, windows and doors and the speed of panel erection considerably reduced the overall build time
- Health and safety risks were reduced.

Client: Premier Prison Services
Main contractor: Kvaerner Construction
Consulting engineer: Kvaerner Technology
Supplier: Buchan Concrete Solutions

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Acknowledgments

Buchan Concrete Solutions

Precast concrete superstructure for a museum

Main drivers/constraints

- Ensuring project completion date is certain
- Achieving predictability of quality
- Implementing respect for people principles.

Project information

The Scottish Museum of Country Life landmark building in East Kilbride, near Glasgow, has been built with a specially designed and manufactured precast concrete superstructure. Precast concrete was used to ensure a high-quality surface finish for the exposed superstructure. The architects also wanted to take advantage of the speed of construction associated with precast concrete to ensure delivery of the project on time.

In all, 985 individual reinforced concrete components for walls, beams and columns were designed and supplied together with 1800 m^2 of double tee beams and 1900 m^2 of pre-stressed planks for the flooring. Lateral stability for the overall structure was provided by an integrated design utilising the precast core walls with the floors acting as horizontal diaphragms. The manufacturer undertook the on-site erection of the precast concrete units.

Benefits achieved

- Delivery of the project on time was ensured
- Stability for the overall structure was guaranteed
- A quality surface finish was achieved.

Client: Scottish Museum of Country Life
Main contractor: Kvaerner Construction
Architect: Page & Parks Associates
Consulting engineer: Will Rudd Associates
Supplier: Buchan Concrete Solutions

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Buchan Concrete Solutions

Precast concrete acoustic barrier

Main drivers/constraints

- Minimising construction costs
- Achieving predictability of quality
- Implementing respect for people principles.

Project information

The new acoustic wave wall at Gatwick Airport stands more than 11 m high and is 430 m long. Running between the North and South passenger terminals, it is designed to protect local residents from aircraft noise and exhaust blast. The structure needed to be engineered to fulfil architectural, structural and transportation requirements. Each unit had to have sufficient integrity to meet construction requirements, wind loads and the additional blast loads.

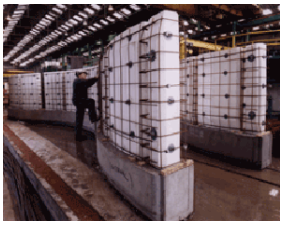
The precast solution was to make up a series of 43 independent cantilevered wall sections comprising separate units tied together vertically. As a complete structure, the wall is made up of 344 units, each 1.4 m deep x 10 m long x
500 mm thick and weighing just under 12 t.

Benefits achieved

Criteria for the final design, engineering and appearance of the wall were met, in particular:

- The overall cost was kept down by the effective cost engineering of the materials
- Structural requirements were met
- Effective transportation logistics were satisfied.

Client: British Airport Authority
Main contractor: Pavement Team
Consulting engineer: Sir Anthony Hunt & Associates
Supplier: Buchan Concrete Solutions



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Buchan Concrete Solutions

Timber panellised system for housing 4

Main drivers/constraints

- Minimising construction costs
- Minimising overall project time
- Achieving performance predictability throughout the life-cycle
- Limited or very expensive available skilled on-site labour.

Project information

It took approved contractors less than two working weeks to assemble the two pairs of semi-detached houses and a separate unit comprising one ground-floor flat and one first-floor flat, using a total of 1166 m^2 of prefabricated wall and roof panels.

The TEK Haus system used to prefabricate walls, floors and roofs was awarded the BBA Innovation Award at Interbuild 2002.

Benefits achieved

- Fast-track, low-wastage construction
- Achieves U-values no worse than 0.20 W/m^2K and lower U-values are easily achievable
- Jointing techniques yield air leakage rates as low as 0.08 air changes per hour
- Carbon index of 8.8 and national home energy rating of 10.0.

Client: Longhurst Housing Association
Contractor: Robert Woodhead Ltd
Supplier: Kingspan

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Acknowledgments

Kingspan Insulation Limited

Timber panellised system for housing – Durham

Main drivers/constraints

- Minimising construction costs
- Minimising overall project time
- Maximising environmental performance throughout the life-cycle
- Limited or very expensive available skilled on-site labour.

Project information

Prefabricated structural insulated panels were used for a pair of semi-detached three-storey town houses in a luxury homes project on the outskirts of Durham. Situated directly off a busy main road where it was important to minimise disruption to traffic, the individual panels were delivered to site rather than being transported in assembled sections.

The factory-manufactured structural insulated wall and roof panels incorporate state-of-the-art mechanical ventilation and a heat-recovery system to reduce humidity levels and heating bills.

Benefits achieved

- Fast-track, low-wastage construction
- Achieves U-values no worse than 0.20 W/m^{2}K and lower U-values are easily achievable
- Jointing techniques yield air leakage rates as low as 0.08 air changes per hour
- Carbon index of 8.8 and national home energy rating of 10.0
- Reduced need for site labour.

Client: Newton Moor Construction
Supplier: Kingspan

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Kingspan Insulation Limited

Prefabricated wall panels and roof plates for a school extension

Main drivers/constraints

- Minimising overall life-cycle costs
- Reducing environmental impact during construction
- Maximising environmental performance throughout the life-cycle
- Implementing respect for people principles.

Project information

This new building for Waseley Hills High School in Worcestershire was built using factory-manufactured wall panels and roof plates. The 1850 m^2, two-storey expansion houses eight classrooms, an IT suite, music suite, a drama studio, gymnasium and changing rooms.

Intermediate precast concrete floors, with an integral air movement system, were used. For the air movement system to work effectively, it was essential that the building had a highly insulated thermal envelope, provided by the wall panels. Externally, the panels are clad in a combination of brick and Douglas fir, with energy-saving triple-glazed windows.

The building features some of the largest roof plates ever produced, measuring 12 m x 2.4 m x 400 mm deep. The roof is finished with an aluminium standing seam roof covering.

Benefits achieved

- Highly energy-efficient structural envelope helps to minimise the building's heating costs
- Meets Worcestershire County Council's policy of reducing environmental impact, both in the building's ability to minimise energy consumption and because all the component materials are from sustainable or recycled sources
- The highly insulated envelope and the integral air movement system provide a comfortable and healthy environment for pupils.

Client: Waseley Hills High School
Supplier: Excel Industries Limited

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Acknowledgments

Excel Industries Limited

Precast concrete basement

Main drivers/constraints

- Minimising on-site duration
- Implementing respect for people principles.

Project information

The site is at Riverside Cambridge, on the banks of the River Cam. The land was contaminated from its former use as a sewage pumping station. Remedial works included excavating contaminated material to a depth of up to 15 m and replacing it. This enabled basements to be incorporated as an integral part of 35 houses, maximising the housing density on this city-centre site. The basements include kitchen, dining and utility space. Many of the properties will have sunken patios – a private space to bring light and natural ventilation into the lower sections of the house.

The precast supplier carried out design and installation of the basements. The project took 20 weeks to build, providing more than
2000 m^2 of living space.

Benefits achieved

- Speed of construction.

Client: Martin Grant Homes
Supplier: ThermoneX

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ThermoneX

Modular rooftop houses

Main drivers/constraints

- Minimising time spent on site
- Reducing environmental impact during construction
- Restricted site layout or space.

Project information

This project is the transformation of two roof tank rooms at the Piper Building, London SW6. The building is a former British Gas laboratory that was originally converted in the mid-1990s into luxury accommodation. The redundant roof tank rooms have been turned into two penthouses using a high-quality, modular, steel-framed construction system. Fully finished in the factory, the components were craned into place and installed in a few days. The external skin is made of metal mesh intended to catch and shimmer in the light, while the two ends are fully glazed, framing dramatic views.

Benefits achieved

- Speed of construction
- Minimal disruption to occupants of main building
- High quality achieved.

Client: Private ownership
Architect: Pierre d'Avoine Architects

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Acknowledgments

Pierre d'Avoine Architects

Timber panellised system for housing – West Malling, Kent

Main drivers/constraints

- Ensuring project completion date is certain
- Maximising environmental performance throughout the life-cycle
- Implementing respect for people principles
- Limited or very expensive available skilled on-site labour.

Project information

Architects turned to a Canadian timber panellised system to beat labour shortages and ensure that the project was built on time. The architects were so impressed with the Super-E system that it was used on 100 houses constructed at West Malling, Kent.

In what is thought to be one of the first uses of the prefabricated system in England, the 2.4 m x 4 m panels were shipped across the Atlantic, craned on site with windows and insulation already in place, then nailed together. The services were stacked in a vertical zone, making more economic use of space than traditional systems in which ducts and pipes run all over the building.

From the foundations being laid to the erection of the timber frame, construction of the first house took approximately 21 weeks, whereas conventional construction would have taken about two months longer.

Benefits achieved

- Project completion date ensured
- Helped resolve problems associated with labour shortages
- Good insulation and consistent high quality provides better comfort than a conventionally built house.
- Maximised use of space.

Architect: Clague Architects
Contractor: Sunley Homes

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Acknowledgments

Building Design (2003). “Canadian panels aid Kent housing”, Building design, 4 Jul, p 6

Precast reconstructed stone components

Main drivers/constraints

- Ensuring project completion date is certain
- Achieving high quality
- Limited or very expensive available skilled on-site labour.

Project information

Prefabricated reconstructed stone components were selected for the Wellcome/CRUK Institute Phase 2 at the University of Cambridge.

Elements of construction included a mixture of geometrically complicated ashlar and large cladding units incorporated in external elevations to form ornamental band coursing on the main building and components forming hard landscaping and wall copings for the external works associated with the east and west terraces.

The specification for the reconstructed stone provided for crushed Gloucestershire limestone and white cement, with all exposed surfaces being acid-etched. This gives a buff, lightly textured finish simulating Bath stone.

Benefits achieved

- Project completion date was ensured
- High quality achieved
- Skill shortage for on-site work was solved.

Architect: RH Partnership
Structural engineer: Whitby Bird & Partners
Main contractor: Sir Robert McAlpine Ltd
Supplier: Histon Concrete Products Ltd

Courtesy Wellcome

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Contact: Nigel Barber

Acknowledgments

ACA (2002). “An educated decision”, Façade: Newsletter of the Architectural Cladding Association, Autumn 2002

Prefabricated corrugated steel tunnel arches

Main drivers/constraints

- Minimising time spent on site
- Live working environment limits site operations
- Limitation to movement of pre-assembled units around site.

Project information

As part of the £31 million South Stockton Link project, two 41 t corrugated steel arches used for a 110 m-long, twin-bore railway tunnel were each lifted into place during overnight track possession. The tunnels will carry the link road over the Middlesbrough to Darlington railway.

The 15 m-span arches are the biggest ever to be used in the UK, and the designer had to seek approval from Network Rail and the Highways Agency to adopt standards from Canada, where larger tunnels are more commonly used. Current Agency Standards limit the span of such structures to 8 m. The designer favoured corrugated steel arches because long sections of tunnel can be prefabricated beside the railway and lifted into place, requiring fewer possessions than the alternative concrete arches, which have to be lifted in smaller sections.

Benefits achieved

- Speed of construction – fewer possessions required than needed for concrete arches.

Client: Stockton-on-Tees Borough Council
Contractor: Birse Civils and AW Lewis
Designer: Arup

Photo from <http://www.southstocktonlink.com/#>

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Acknowledgments

New Civil Engineer (2003). “Lifting the limit”, New civil engineer, 18 Sep, p 8

Precast concrete segmental lining system –Heathrow link

Main drivers/constraints

- Minimising time spent on site
- Implementing respect for people principles
- Restricted site layout or space.

Project information

The high-speed Heathrow Express rail link from Paddington to Heathrow runs through a tunnel at the airport. The steel-lined support structure of the tunnel had to be clad at stations and in public areas. This has been done with 14 000 m^2 of coffered GRC panels. GRC was chosen for its durability and appearance and because special curved panels could be produced.

The panels were secret-fixed with stainless steel fixings and faceted around the curve of the tunnel. The joints were fire-stopped and lined with purpose-made gaskets. At platform and public areas the lower three panels are infilled with toughened glass to give extra protection. A row of glass-filled panels at higher levels is used for back-up signage. Special curved panels were made to accommodate the complex armature of the structure around escalators and curved walls.

Benefits achieved

- Speed of construction
- Lightweight GRC improved ease of installation
- High quality.

Client: BAA and British Railways Board
Architect: Wolff Olins
Contractor: Laing Bailey
Supplier: Techrete (UK) Ltd

Contact information

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Acknowledgments

Techrete

Precast concrete columns and permanent shuttering

Main drivers/constraints

- Minimising time spent on site
- Achieving high quality
- Implementing respect for people principles.

Project information

At the National Botanical Gardens of Wales the toroidal geometry of the great glasshouse is described by a circle of a particular radius r, rotated around a centre point at a radius R. All plane sections of the torus result in complex curves. Precast concrete elements were used as permanent shutters for the shell soffit, taking advantage of the repetitive geometry of this element to achieve a high-quality architectural finish. For the same reasons, precast concrete was used for the columns propping the ring beam at the northern side and forming the concourse to the internal landscape.

Benefits achieved

- On-site duration minimised and work process made simple
- High-quality architectural finish achieved.

Client: National Botanical Gardens of Wales
Architect: Foster & Partners
Engineer: Anthony Hunt Associates
Contractor: Byrne Bros
Supplier: Histon Concrete Products Ltd

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Acknowledgments

Histon Concrete Products Ltd

Precast concrete components

Main drivers/constraints

- Minimising time spent on site
- Achieving high quality
- Implementing respect for people principles
- Limited or very expensive available skilled on-site labour.

Project information

The precast concrete units used for the Garden Quadrangle, St Johns College, Oxford, have different surface textures to emphasise different elements of the structure and to simulate some of the surface finishes found in traditional stone-built classical architecture. The soffits of the arches have a polished finish. The centre section of the twin beams and the domed soffit were needle-gunned. The four supporting columns at each pendentive were also polished, and the plinths that support them were grit-blasted. The L-shaped columns at the corner and the base of the external staircase structure were heavily rusticated to simulate blocks of stone, with pointed tooled edges and grit-blasted grooves.

Benefits achieved

- On-site duration minimised and work process made simple
- High-quality architectural finish achieved
- Overcame shortage of skilled site labour.

Client: St Johns College, Oxford
Architect: MacCormac Jamieson Prichard
Engineer: Price & Myers
Contractor: Try Construction Ltd
Supplier: Histon Concrete Products Ltd

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Histon Concrete Products Ltd

Precast concrete cladding – Ludgate Hill

Main drivers/constraints

- Achieving high quality
- Implementing respect for people principles
- Restricted site layout or space
- Limited or very expensive skilled on-site labour.

Project information

The architect's brief for this project at Ludgate Hill, London was to design a building suitable for state-of-the-art office space. The location required a highly articulated traditional style appropriate to the surrounding streetscape of Fleet Street and St Paul's.

The cladding panels have reconstructed stone window surrounds and spandrel panels with inset limestone features. The use of reconstructed stone allowed the architect to articulate the elevations. With the omission of edge beams at floor levels, the structural rigidity was designed into the cladding panels, allowing the frame contractor to make rapid progress.

Benefits achieved

- High quality of detail achieved
- Highly articulated traditional style achieved
- Rapid construction of frame.

Client: Rosehaugh Stanhope
Architect: SOM
Contractor: Rosehaugh Stanhope
Supplier: Techrete (UK) Ltd

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Techrete

Precast concrete cladding – Charlotte Quay, Dublin

Main drivers/constraints

- Minimising overall project time
- Achieving high quality
- Multi-trade interfaces in restricted work areas.

Project information

Charlotte Quay was the first high-rise apartment block in Dublin, and precast cladding with a honed finish was chosen to facilitate speed and simplify erection.

The main frame and in-situ floor slab were taken to full height before cladding began.

In-situ stitching of some panels to the slabs was involved where traditional ironmongery was not possible. The total area of cladding on the complex is approximately 3000 m^2.

Benefits achieved

- Cladding of the tower block took a total of 14 weeks, which is an average of one floor a week
- Erection of cladding simplified
- High quality of detail achieved.

Client: Zoe Developments
Architect: O'Mahony Pike
Contractor: Zoe Developments
Supplier: Techrete (UK) Ltd

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Techrete

Precast reconstituted stone cladding

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Maximising environmental performance throughout the life-cycle.

Project information

Connaught House, Dublin, was initially envisaged as a natural stone-faced building, and classical detail was used extensively on the project. A value-engineering process was carried out to try to generate a more economical solution. This resulted in the use of reconstituted stone rather than Portland stone and involved designing many repetitive cross-section features for mould economics.

Benefits achieved

- Significant cost savings
- Shorter lead-in time
- Lighter panels: the installation went extremely smoothly
- Much more durable than Portland stone.

Client: Treasury Holdings
Architect: Arthur Gibney & Partners
Contractor: John Sisk & Son
Supplier: Techrete (UK) Ltd

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Techrete

Pre-assembled structural balconies

Main drivers/constraints

- Minimising time spent on site
- Achieving predictability of quality
- Reducing health and safety risks
- Implementing respect for people principles
- Multi-trade interfaces in restricted work areas.

Project information

The structural balcony units are a major feature of developer St George's mixed-use scheme at Putney Wharf, London, to take advantage of the riverside location and views of the Thames. The design of the reconstituted stone-finished balconies has been developed to include hoppers, ducts and outlets for the control of rainwater, and cast-in fittings. The top surface of each balcony was paved with tiles before delivery to site. Eighty balcony units weighing up to 5 t were produced for the site and delivered on a just-in-time schedule.

Benefits achieved

- On-site finishing activity was eliminated, reducing construction time
- The paving work was completed to a higher standard in a factory-controlled environment, and more safely by working at ground level.

Architect: PRC Feuster
Engineer: JSA Consulting Engineers
Precaster: The Marble Mosaic Company Ltd

Courtesy St George.com

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Acknowledgments

ACA (2002). "Structural balconies a major feature of Putney Wharf mixed-use scheme", Façade – Newsletter of the Architectural Cladding Association, Autumn 2002

Pre-assembled unitised cladding system

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Achieving predictability of quality
- Reducing health and safety risks.

Project information

Through a partnership arrangement between the main contractor and the supplier, an offsite unitised panel system was developed to meet the architect's cladding requirements for Walsgrave Hospital, Coventry. This delivered significant construction and financial benefits.

The panels were installed on three interlinking towers that comprise the 120 000 m^2 hospital. The panels are 6 m wide by 4 m high with casement windows integrated. The manufacturing process was carried out offsite and the fully glazed panels were transported to site and lifted straight into position.

Benefits achieved

- The ability to back-fix the unitised system obviated the need for external scaffolding, with a positive impact on site safety and costs
- The faster erection time provided an immediately weathertight external wall, allowing the internal fit-out to start earlier, and also reduced the on-site programme by about 50 per cent
- Greater quality control could be exerted
- More flexible and less affected by the vagaries of the day-to-day construction programme.

Architect: Nightingale Associates
Main contractor: Skanska Construction
Supplier: SIAC Construction (UK)

Acknowledgments

Kawneer (2003). "Unitised panel system for faster build", Roofing cladding & insulation, Oct, p 36
<http://www.nightingaleassociates.com>

Precast concrete system for railway platforms

Main drivers/constraints

- Minimising construction costs
- Minimising time spent on site
- Achieving predictability of quality
- Reducing health and safety risks
- Live working environment limits site operations
- Site restrictions by external parties.

Project information

A modular platform system is being used to extend railway station platforms on the Chiltern Railways line between London Marylebone and Birmingham Snow Hill. The whole of the platform has been standardised. The platform system is formed of stub columns, cross-heads, longitudinal beams and deck slab that can be bolted together easily and quickly.

Working on or adjacent to a railway line is strictly regulated. In the majority of cases, a "possession" of the railway is required, ie service trains are not permitted to run while construction is taking place. As well as disrupting freight traffic and passenger journeys, possessions increase train operating companies' costs. The system was therefore developed so that a platform could be constructed while trains are still running.

Benefits achieved

- No wet trades are required during the construction process, which reduces labour, costs and time
- Platforms constructed with minimum disruption to railway operations.

Client: Chiltern Railways
Strategic adviser: Mott MacDonald Ltd

Courtesy Construction Products.org.uk

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Acknowledgments

Information provided at a CIRIA workshop by Ashley Taylor of Mott MacDonald Ltd

Timber wall and roof panels for housing

Main drivers/constraints

- Minimising construction costs
- Minimising overall life-cycle costs
- Minimising time spent on site
- Achieving high quality
- Reducing environmental impact during construction
- Maximising environmental performance throughout the life-cycle
- Restricted site layout or space.

Project information

All elements for a new house at North Queensferry, Fife, Scotland, were erected in under three days. The architect was looking for speed of erection and ease of inserting recycled newspaper (Warmcell) insulation offsite with the intention of using the same system for future projects.

The architects started work months in advance of the main contract being awarded to ensure that the wall and roof panels could be erected early. However, the 10–12-week lead-in time for the panels meant that this initial work was largely wasted as the manufacturer's construction drawings were only started once the main contract was awarded. This is an important lesson to note for designers and contractors proposing to use offsite manufacturing techniques.

Points of learning

- Co-ordination between main contractor and subcontractor is critical
- Some minor problems with walls that were out of alignment caused large knock-on effects because they were only discovered when it was too late to alter the frame
- Snagging immediately on completion of erection of the pre-assembled frame must be carried out.

Client: Private client
Architect: ICOSIS Architects
Supplier: Eden Frame

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Acknowledgments

ICOSIS Architects.

BAA Pier 6 connector construction

Main drivers/constraints

- Minimise closure of taxi way
- Minimise airside work and risks to operations.

Project information

Gatwick Airport is the second largest airport serving London and the South East of England and is the second busiest airport in the UK after Heathrow. The airport has two terminals; North and South. The 2700 tonne, 200 m long bridge was constructed to allow for access on foot from the North Terminal to Pier 6. Built at the edge of the airport to avoid disruption to services, the pier was transported 1.5 km before being lifted 25 m into the air allowing for two steel trestles to be placed underneath to a point of 10 mm of accuracy where huge locating pins were installed as effective connection points. The pier connector has eliminated thousands of coach movements per year and provided enhanced passenger and airline service levels.

Benefits achieved

- The taxi way was closed for only 10 days while the pier was put into place
- Programme reduction through parallel working and less lost time than usual airside
- Protected programme for construction of the bridge, improved predictability
- Better managed safety – low level work removing the need to work at height and over an operational airfield
- Easier supervision and enhanced quality off-site
- Bridge consolidation centre used for site works
- Saved client resources as construction workers did not need to pass through security daily
- Off-site fabrication of complete shell and core provided consistently high quality finishes
- Off-site fabrication removed costly scaffolding erection and airfield located works.

Acknowledgements

Client: BAA

Lead designer: Arup

Concept architect: Wilkinson Eyre

Construction manager: Mace

Steelwork fabricator/erector: Watson Steel

Fit out: Warings

Façade: Schmidlin

M&E: WSP with NG Bailey supplier design

Concrete works: Laing O'Rourke

Roof: Prater

Moving specialist: Fagioli PSC

Pipe modules for a commercial office building

Main drivers/constraints

- Limited space, therefore a need to minimise number of operatives on-site
- Minimise waste, plant and exposure to accidents
- Limited availability of skilled labour.

Project information

The project is the 12 storey, 60 000 m^2 regional offices for the Royal Bank of Scotland in Manchester city centre, including a basement and a roof top plantroom. The primary heating and cooling systems to the ten floors of office space is via fan coil units. The primary distribution pipework from the risers was installed in prefabricated mappress pipework modules in lieu of traditional on site installations.

Benefits achieved

- Cost savings achieved in manufacture, construction and installation
- Cost savings achieved in site process costs
- Reduction in the time spent working on-site
- Off-site models were considered significantly better in level of quality than traditional ones
- Modules performed better on health and safety aspects including ratios of people and operations performed on-site.

Contact information

Acknowledgements

Developer: Allied London
Client: The Royal Bank of Scotland
Architect: Fairhurst
Concept and structural detail designers: Waterman Gore
Main contractor: Sir Robert McAlpine
M&E contractor: Bailey

Recycled and Refurbished Modular Building – Nursery, London Docklands

Main drivers/constraints

- A more sustainable approach to construction
- A high quality building within the client's budget constraints
- A calm and welcoming environment for young children.

Project information

A new, purpose-designed nursery building was required for the University of East London's Docklands campus. The Children's Garden Early Years Centre was constructed from recycled and refurbished building modules.

The nursery facility demonstrates the potential and flexibility of this approach to sustainable construction. The centre is clad in untreated Scottish larch, which helps to integrate the building into the streetscape, and is naturally cross ventilated. Windows overlooking the educational garden provide a high level of natural light and the interior is designed to be free from reception desks, corridors and signage to simplify the children's experience.

The use of pre-owned modular buildings, which are fully compliant with Building Regulations, generates less than 10 per cent of the carbon emissions and uses less than three per cent of the energy during construction compared to a newly manufactured building of equivalent size.

Benefits achieved

- A building that is robust, substantial and aesthetically pleasing
- Completion on time and on budget
- A highly sustainable alternative to new build and a positive way of reducing the building's carbon footprint
- The centre met Ofsted requirements without any adaptation to the design, and provides an attractive new facility, which has been well received by staff, children and parents.

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Acknowledgements

Client: University of East London

Architects: Arts Lettres Techniques

Main contractor/Modular building supplier: Foremans Relocatable Building Systems

New Teaching Resource Centre, Birchwood High School, Bishop's Stortford

Main drivers/constraints

- A prototype building was required by Hertfordshire County Council as part of the DfES' Teaching Environments for the Future Initiative
- The new building would help innovative teaching ideas and practices, and be replicable in other schools and education authorities
- The building would provide a flexible, adaptable environment that would be open for use across the extended day and throughout the year.

Project information

The completed building is used as additional teaching space for tutorials and larger groups, as a satellite facility for Hertfordshire's teacher training centre and is available to all schools in the area, the local community and businesses.

Cartwright Pickard Architects' response to the innovative nature of the brief was to use modern methods of construction for the building. Eight steel-framed modules were manufactured, pre-clad offsite and craned into position. Externally, the building is clad in vertical timber battens, with splashes of colour provided by red steel, which is visible between the timber cladding. Two sliding timber screens provide additional sun shading to the glazed doors and an overhanging metal roof creates a protected external space.

Facilities in the centre include reception, toilets, server room, cleaner's store, and the teaching space that can be divided by two moveable walls into three separate rooms – a break-out area with soft seating, a group/IT hot desking room, and a main teaching space. From a sustainability perspective, the building was designed to be highly flexible and adaptable for change, and has the options of natural or mechanical ventilation depending on internal occupancy conditions and demand.

Commenting on the project, James Pickard, Director of Cartwright Pickard Architects, said "The principle advantages of offsite construction for this project were reductions in site time of around 50 per cent, less disruption to staff and pupils at the school during construction, and the highest quality of finish both internally and externally."

Benefits achieved

- Site time was reduced by around 50 per cent
- There was significantly less disruption to staff and pupils during the build process with the use of offsite construction
- The finishes are of the highest quality, both internally and externally
- The building was designed to be flexible and adaptable for change
- To improve sustainability, the building has the option of natural or mechanical ventilation, depending on internal occupancy conditions and demand.

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Acknowledgements

Client: Hertfordshire County Council
Architects: Cartwright Pickard Architects
Project managers and cost consultants: Mace
Modular building specialist: Elliott Group
Structural engineers: Richard Brooke Partnership

Sixth Avenue Apartments, York

Main drivers/constraints

- This award-winning project was the first factory-built affordable housing scheme to be built in the outskirts of York
- The client was looking to explore innovative and positive housing solutions, as part of its ongoing commitment to innovation
- The brief was for a bold and attractive scheme to help meet the affordable housing needs of York.

Project information

The four-storey £2m development comprises 24 high quality apartments providing three, two and one-bedroom homes for a mixed community of families, single people, couples and the elderly.

The exterior is designed to reflect the more innovative nature of the building's construction, using interesting and low maintenance alternatives to conventional brickwork that enhance the building's appearance and were faster to install. Each apartment has the benefit of a generous timber-decked balcony or private garden area.

48 11-tonne steel-framed modules were manufactured offsite and craned into position in just a few days complete with kitchens, bathrooms, plumbing, heating, doors and windows, in preparation for the installation of the claddings, balconies, lift and stair tower.

Because the scheme is factory-built, air tightness was improved so heat loss is minimised, resulting in lower running costs for tenants. Larger 3.6 m wide modules were used to improve efficiency, quality and reduce time on site, and floor ducts were built into the modules to allow tenants to conceal cabling. The design of the apartments maximised space internally and the type of construction allowed larger openings, which could be used for the glazed patio doors.

Benefits achieved

- By employing a more innovative approach to construction and a partnering arrangement, the development programme for the apartments was halved. From inception to completion, the total programme took less than 15 months, helping to address the serious shortfall in affordable housing in York
- This pioneering scheme illustrates the benefits of building offsite, a genuine partnership approach and contemporary architectural design
- Awards have included a RICS Award for Innovation, a Civic Trust Award and Best Housing Association Development at the AJ/National HomeBuilder Design Awards.

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Acknowledgements

Client: Yorkshire Housing/City of York Council
Architects: Cartwright Pickard Architects
Off-site specialist: Yorkon

New Student Accommodation, University of Southampton

Main drivers/constraints

- Three new student accommodation buildings were required for the University of Southampton's Wessex Lane campus
- The extension to the Montefiore Residences would provide an additional 159 study bedrooms.

Project information

The design aims to reflect the stimulating learning environment of the University and its progressive culture. A variety of contemporary materials were used for the external façades, including terracotta tiles, timber and metal cladding. The four-storey buildings are located around a landscaped courtyard, which provides an attractive amenity space for students. The accommodation is arranged in clusters of five to seven bedrooms, each sharing a kitchen and dining area.

There is a central staircase for each block to maximise space internally, which is fully glazed to provide light and add interest to the building envelope. The overhang of the silver monopitch roof offers solar shading to the upper floors and expresses the roof as a protective element.

Steel-framed modules were manufactured offsite and craned into position onto pre-prepared foundations complete with windows, doors, bathrooms, carpets and study bedroom furniture.

The buildings were designed for energy efficiency, both in terms of the method of construction and to minimise future energy consumption and running costs.

Benefits achieved

- The buildings were built offsite and completed in just 10 months
- The accommodation was delivered on budget and to high quality standards
- There was significantly less disturbance during the building programme, to the benefit of students studying for exams
- Positive feedback was received from students, staff and local residents following completion
- This project demonstrates how off-site construction can enable clients to develop attractive, modern architecture quickly, efficiently and with reduced running costs.

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Acknowledgements

Client: University of Southampton
Architects: Cartwright Pickard Architects
Main contractor: Bluestone plc

New Sports Hall, Winton School, London

Main drivers/constraints

- The London Borough of Islington had a requirement for a new sports hall on the roof of an existing primary school
- The new facility was funded under the Government's Space for Sports and Arts initiative
- The sports hall would be designed for out-of-hours use by the local community in line with Government policy.

Project information

The building design was developed so that a pre-fabricated panelised form of construction could be used for the project. Structural steel wall and roof panels were pre-assembled and pre-clad offsite under factory conditions, which were then craned into position in just a few days.

Wood was specified as the primary cladding material for the sports hall façade. The scheme, which was nominated for a Wood Award, was clad in western red cedar laid across the envelope to create a strong horizontal emphasis and express the double height sports hall.

The use of wood was continued inside the sports hall, with plywood lining the interior walls to a height of 2.5 m. Low level etched glazed windows to the south elevation allow a high level of natural light and removable opaque panels give the option of privacy from the street when required.

The extension provides a 20 m by 20 m sports hall for badminton, basketball, gymnastics, dance and drama, and an ancillary block with changing rooms.

Benefits achieved

- The pre-fabricated approach significantly reduced disruption to the school, which remained in operation throughout the construction period
- The extensive use of wood added warmth and texture and complements the Victorian brick building below
- The offsite building method resulted in a high standard of finish both internally and externally
- The prefabricated panels were pre-clad in the factory, which meant that the fixing and quality of the wood façade was carefully controlled. This also minimised construction work at height – a much safer approach

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Acknowledgements

Client: Islington Council
Architects: Cartwright Pickard Architects
Main contractor: Bluestone
Off-site specialist: Corus
Structural engineers: James Lupton
Quantity surveyors: BPP Construction

Recycled and Refurbished Modular Buildings – Hospital of St John and St Elizabeth, London

Main drivers/constraints

- A new, high quality building was required to house specialist medical facilities during an £11m development project to extend the hospital's services
- Delivery on time and on budget
- Reduced disruption and time on site.

Project information

The facility comprises 36 pre-owned building modules, which were refurbished and fitted out off-site at Foremans' production centre in East Yorkshire. The crane programme was carefully planned to meet the restrictions associated with a central London site.

The building accommodates fully air conditioned offices, consulting rooms, a medical examination room and a pressure chamber for treating patients with complex tissue disorders, carbon monoxide poisoning and diving injuries – one of only two in the London area.

Three of the steel-framed building modules were reconfigured to incorporate a concrete floor to support the weight of the five tonne hyperbaric chamber and the end wall was designed to be demountable to allow for its installation. The chamber was successfully relocated to the new building with a planned downtime of only 24 hours to minimise disruption to patient care.

Benefits achieved

- The new two-storey scheme was completed with minimal disruption, two weeks ahead of schedule
- The building met the client's needs and budget, providing a high quality, purpose-designed facility
- A highly sustainable alternative to the demolition and disposal of buildings in landfill sites, which has significant environmental implications.

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Acknowledgements

Client: Hospital of St John & St Elizabeth

Modular building supplier: Foremans Relocatable Building Systems

Recycled and Refurbished Modular Buildings – Lecture Theatre and Campus Building, University of East London

Main drivers/constraints

- New accommodation was required to meet the continuing growth in student numbers
- High quality facilities, delivered on time and on budget
- Reduced disruption
- A more sustainable alternative to new build.

Project information

A campus building and lecture theatre were designed and constructed by Foremans from pre-owned steel-framed modules, which were refurbished and fitted out offsite and craned into position on to pre-laid foundations in just a few days.

The 300-seat lecture theatre is now the biggest on the Stratford campus. It has tiered seating to ensure good visibility from every angle and was developed to be accessible rather than intimidating and to encourage interaction between lecturer and students.

The new 93-module campus building has brought a number of facilities together under one roof for the first time. The £1.3m building accommodates an IT suite, offices, seminar rooms, café, music centre and recording studio, and a range of mock-up classrooms for the training of educational professionals for domestic science, design and technology.

Benefits achieved

- The lecture theatre is now UEL's most popular and highly utilised facility on the Stratford campus in terms of bookings and attendance rates
- Both projects were completed on time despite challenging programmes
- The use of recycled and refurbished building modules met the university's budget requirements and provided high quality facilities for the fast-changing campus
- Reduced disruption to staff and students during construction.

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Acknowledgements

Client: University of East London

Modular building supplier: Foremans Relocatable Building Systems

Recycled and refurbished modular buildings – new healthcare facilities, Warwick Hospital

Main drivers/constraints

- The hospital had a requirement for a cardiac angiography laboratory to expand facilities for the treatment of heart disease, and a new day surgery building to free up bed space for elective surgery
- Quality facilities were required in a short timescale
- A constrained and challenging site.

Project information

The single-storey wing for elective surgery was constructed by Foremans from recycled building modules in just three months and accommodates a 12-bed ward, pre-operative assessment clinic, waiting area and reception. The building is fully compliant with NHS Health Technical Memoranda and Health Building Notes.

Foremans was then awarded its fourth contract at Warwick Hospital – to design, construct and fit out a cardiac catheter laboratory. This order brought the total value of work undertaken by Foremans at the hospital to around £1.8m and follows completion of two ward projects, one of which was a 21-bed medical ward constructed over the day surgery unit.

The new purpose-designed single-storey cardiac lab accommodates highly specialised x-ray technology for the diagnosis and treatment of heart conditions. It comprises radiology, waiting area, recovery bays, nurse's station, treatment room and toilets. It was built in just 12 weeks and is linked to the main hospital building.

Benefits achieved

- The buildings were constructed offsite, minimising disruption to staff and patients
- Both projects were delivered on time and on budget
- The client reported that the quality is very good and Foremans' performance was excellent
- The pre-owned modular approach is a more sustainable alternative to new build, generating less than 10 per cent of the carbon emissions and using less than three per cent of the energy during construction compared to a newly manufactured building of equivalent size.

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Acknowledgements

Client: South Warwickshire General Hospital NHS Trust

Modular building supplier: Foremans Relocatable Building Systems

Classrooms for the future: Lord Silkin Secondary and Wrockwardine Wood Junior Schools

Main drivers/constraints

- Prototypes of the *Classroom for the Future* initiative from DfES to push back boundaries for education and design
- Needed to promote enthusiasm and well-being among teachers and students.

Project information

The *Classroom of the Future* is a Department for Education and Skills (DFES) initiative to push back the boundaries of design for teaching and learning. The project for the Borough of Telford & Wrekin was one of 12 to create new prototype classrooms. The classroom design is used at two schools in Telford – Lord Silkin Secondary School and Wrockwardine Wood Junior School.

Each classroom is a totally self-contained building allowing it to be used by the community outside school hours. Groundbreaking technology and a range of new innovations in design and construction have created two highly sustainable and energy efficient learning centres. Features include wind catchers to naturally ventilate the classrooms, under floor heating to free up wall space for teaching aids, a living sedum room, photovoltaic cells to generate electricity and solar panels to provide hot water.

This high profile project demonstrates how good design can be used to create exciting education buildings with all the speed and quality benefits of off-site construction.

Benefits achieved

The modular approach:

- Halved the programme time
- Guaranteed quality
- Reduced disruption to teaching while the new classrooms were being built
- Provided each school with highly flexible and energy efficient teaching accommodation to meet changing local needs
- The project won the CABE/Arts Council England Building Sights Award.

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Acknowledgements

Client: Borough of Telford & Wrekin

Architects: INTEGER/Cole Thompson Associates

Main contractor/Modular building supplier: Yorkon

New Primary School, South Lanarkshire Council

Main drivers/constraints

- South Lanarkshire Council had an urgent requirement for a complete new primary school building to replace a 1960's storm-damaged school in East Kilbride
- The new teaching environment should motivate and inspire children to learn
- A fast construction solution was essential because of the poor state of the existing school and there should be no interruptions to teaching during the build process.

Project information

Yorkon was awarded the £5m design and build contract for the new Our Lady of Lourdes School, which is believed to be the UK's first complete school to be built off-site.

The contract included the construction of a 16-classroom 500-pupil school and nursery alongside the existing school, which would then be demolished and replaced with landscaping and an all-weather floodlit sports pitch.

Features of the new school include an impressive full height glazed entrance, a pre-school nursery, main hall and dining room, library, extensive landscaping and soft play areas. The two-storey building, designed by Yorkon, has pitched roofs above the main entrance and the main hall. The exterior is finished in two shades of blue with co-ordinating blue windows and doors.

Benefits achieved

- Constructed in half the time of traditional construction methods with no compromise on quality
- The project was designed to meet the needs of teaching staff and pupils, creating a stimulating and attractive educational environment
- The phased development significantly reduced disruption to the running of the school, which remained fully operational throughout construction of the new building
- The building could be leased if built using modular construction, allowing the Council to take advantage of funding from other sources – a major advantage given the limited capital resources available.

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Acknowledgements

Client: South Lanarkshire Council

Main contractor/Modular building supplier: Yorkon

West Leeds Specialist Inclusive Centre, Leeds

Main drivers/constraints

- The original school was destroyed by a fire – a replacement school was urgently required to minimise the impact on the children's education. Speed was therefore the principle driver for off-site construction and the timescale was challenging
- Minimising disruption to the adjacent school during construction of the new facility was also a consideration.

Project information

Yorkon designed, manufactured and fitted out the new school in a £1.2m contract, which also included provision of mechanical and electrical services, data cabling, laboratory facilities and benches, partitions and internal doors.

Built around a central courtyard, the single-storey self-contained school accommodates seven general classrooms; an ICT suite; design technology, science and food technology laboratories; music and art rooms, and offices.

The building is constructed from 26 steel-framed modules, which were manufactured off-site and craned into position during half term. This approach minimised disruption to teaching at the adjacent school, which remained fully operational throughout the construction programme.

Benefits achieved

- A high level of quality in finishing
- The design was sufficiently flexible to meet the school's specific requirements
- Reduced disruption to teaching in adjacent building during construction
- Construction completed only five months after the contract was awarded and earlier occupation for staff and students
- The building was delivered on time and on budget.

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Client: Leeds City Council
Design and build contractor/Modular building supplier: Yorkon

New Cardiac Unit, Lister Hospital, Stevenage

Main drivers/constraints

- Reduction in cardiac patient waiting lists by increasing capacity by 1500 people/year, allowing the trust to quadruple capacity and meet Government targets
- Constraint in building the facility so close to other hospital departments, including A&E, while still operation, and ensuring safety, privacy and security for patients
- Reduction in programme time with the use of off-site construction

Project information

The single storey building was manufactured off-site in York and craned into position ready for fitting-out and installation of the new scanner. The unit was located in an under-utilised courtyard and linked to the main hospital.

Yorkon scheduled the cranage operations for weekends, when outpatient clinics are closed, to further minimise disruption. The speed of the modular approach limited the time on site, which was another important advantage for the Trust.

Yorkon completed the design and construction of a new £2.3m cardiac suite just seven months after the start of work on site – a reduction on the programme time of around 30 per cent compared to conventional site-based building methods. The cardiac unit accommodates the latest in medical scanning technology, a full catheterisation laboratory and control room, associated treatment rooms, a nine bay recovery ward, staff facilities and reception area.

Benefits achieved

- Achieved a 30 per cent reduction in construction time compared to traditional site-based building methods
- Allowed earlier occupation of the new facilities to the benefit of cardiac patients
- Met the Trust's requirements for quality of finish
- Enabled access for emergency vehicles to be maintained at all times, despite the close proximity of the A&E department.

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Acknowledgements

Client: East & North Hertfordshire NHS Trust
Design and build contractor/Modular building supplier: Yorkon

St Mary's Treatment Centre, Portsmouth

Main drivers/constraints

- Government's Independent Treatment Centre programme, which aims to reduce patient waiting times by increasing capacity in the NHS
- Challenging programme time to have the centre open and treating patients
- Essential to minimise disruption as the centre is located on a busy hospital site.

Project information

The contract awarded to Yorkon by AMEC was for a rainscreen-clad modular building, developed and operated by Mercury Health in partnership with Portsmouth City Teaching Primary Care Trust.

72 steel-framed modules were manufactured by Yorkon off-site in York and craned into position ready for fitting out and completion of the external claddings. This provided a watertight envelope for fitting out only 12 weeks after start on-site and reduced the programme time to just 42 weeks. Yorkon also succeeded in handing over the building one week ahead of schedule.

The two-storey 3300 sqm building comprises three operating theatres, an endoscopy suite, preparation zone, clinical sterilisation services department, recovery bays, consulting rooms, reception and office accommodation. The £11m centre carries out around 6500 day surgery procedures, more than 10 000 diagnostic investigations and up to 50 000 attendances at its minor injuries unit and walk-in centre every year.

Benefits achieved

- A high quality treatment centre
- Delivery to a challenging programme, one week ahead of schedule
- Consistent with user needs
- Off-site approach meant a quieter and cleaner construction process which minimised any disruption to patient care
- A landmark building for a prominent site
- The use of claddings, glazing options and other architectural features successfully demonstrates the design flexibility of modular construction.

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Acknowledgements

Client: Mercury Health
Architects: Nightingale Associates
Main contractor: AMEC
Modular building supplier: Yorkon

Shepton Mallet Treatment Centre

Main drivers/constraints

- Government initiative to increase capacity in the NHS, improve patient choice and speed up access to surgery
- Challenging timescale
- Construction with the minimum disruption to the local community.

Project information

The contract to design and build the new treatment centre was awarded to Yorkon. The £12m project is the UK's first ISTC to be built off-site and is believed to be the most complex modular building project in the UK. The 4100m² centre was built in less than 10 months and is carrying out more than 11 000 operations every year.

The hospital accommodates: four operating theatres for orthopaedic, ophthalmology and general surgery, on-site sterile services, radiology, an endoscopy unit, MRI scanner, physiotherapy suite and 34 in-patient beds.

The two-storey building was manufactured off-site in York and was craned into position as steel-framed modules up to 14 m long. The design features roof glazing above the waiting area, western red cedar cladding panels between windows and timber brise soleil to offer shading from the sun.

Benefits achieved

- Minimal disruption during construction
- Time constraints were overcome and project was finished to schedule and on budget
- Designed and built to the highest specification
- A highly sustainable method of construction with fewer vehicle movements to site, less materials waste and improved air permeability, which reduces energy consumption, running costs and carbon emissions.

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Acknowledgements

Client: UK Specialist Hospitals
Architects and Project Managers: Atkins
Main contractor/Modular building supplier: Yorkon

St Peter's Hospital, Chertsey

Main drivers/constraints

- The local community in Chertsey have benefited from a new purpose-designed day surgery unit and additional ward accommodation providing 56 in-patient beds for emergency admissions
- Reducing disruption was a key driver for off-site construction.

Project information

The two buildings were manufactured off-site in York, minimising disruption to hospital staff and patients, and removing the need for decanting. This innovative approach to construction also reduced the programme time to less than eight months.

The two-storey ward block comprises 10 four-bed wards and 16 single bedrooms. Extra facilities include a nurse's station, bathrooms, toilets, patients' day room, discharge lounge, offices, staff room and a link to the main hospital street. Externally, the scheme is clad in brickwork, rendered panels and cedar boarding to create an attractive finish as the building is prominently located at one of the main hospital entrances.

The day surgery unit, which was fitted out by Yorkon and linked to the main hospital building, comprises an operating theatre, anaesthetics room, preparation area, reception and a 12-bed recovery ward.

The two construction projects totalled £5m and are part of a £13m reconfiguration programme which involves the relocation of emergency and medical services to St. Peter's Hospital and elective surgery to Ashford Hospital including the creation of an Orthopaedic Treatment Centre and rehabilitation services at that hospital.

Benefits achieved

- Programme time was reduced to less than eight months
- On a constrained, busy site, moving the work off-site and into the factory allowed expansion of the facilities at St Peter's with as little disruption to the running of the hospital as possible
- Off-site construction was more cost-effective for these two schemes than site-based building methods
- The off-site building system was sufficiently flexible to allow a bespoke appearance for the building, which was important for its prominent location on the hospital site
- The project also achieved the required high quality finish internally.

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Acknowledgements

Client: Ashford and St. Peter's Hospitals NHS Trust

Architects: Todd Architects

Main contractor/Modular building supplier: Yorkon

Pre-assembled packed plant rooms – HBOS additional premises

Main drivers/constraints

- Reduction in overall programme times
- Reduction in health and safety risk on occupied site
- Greater efficiency in construction and fit out processes.

Project information

HBOS commissioned additional office and equipment accommodation on two of their existing sites in Copley and Pudsey, Yorkshire. Due to the internal environmental conditions demanded there was a heavy chilled water load. The equipment installed included 3600 kW plate heat exchangers, pumps, deaerators, side-stream filters and control equipment.

Plant rooms for the Copley site were combined into a single enclosure with dividing wall and measured 20 m × 12 m. The unit was delivered in five sections.

Plant rooms for the Pudsey site were separate with each one measuring 11 m × 8 m and were split into two sections.

All plant room and details were modelled in 3-D allowing the client a virtual walkthrough before any manufacture or procurement started.

Benefits achieved

- Cost and programme objectives achieved
- Plant rooms removed from the critical path
- Health and safety risks reduced for an occupied site
- Reduced site prelims and services
- First class product and quality installation were provided.

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Acknowledgements

Client: HBOS
Main contractor/project manager: Structuretone
Services Consultant: Cundall Johnson
Services Contractor: Rotary Yorkshire
Plant room manufacturer: Armstrong Integrated Systems

Accommodation – Crowne Plaza, London Docklands

Main drivers/constraints

- A need for an emblematical and high quality building
- Construction time to be fast-tracked
- Programme certainty
- Cost certainty
- Durability
- Flexibility
- Speed of construction
- Quality of surface finish
- Thermal mass
- Predictability.

Project information

One of the UK's most modern business hotels, the Crowne Plaza London Docklands is a four star superior hotel consisting of 210 bedrooms and featuring contemporary styling to appeal to a cross section of visitors in London. Buchan Concrete Solutions was awarded the contract to provide a suitable modular concrete solution for the accommodation floors.

Using our modular pre-cast concrete system, Buchan Concrete Solutions developed the ideal solution for this fast track project, while maintaining the required quality and safety standards.

Buchan's design team devised a method of providing overall stability, which was achieved by the diaphragm action of the floors spanning between the wall panels, which in turn act as shear walls. In common with all other wall units in the system, the shear walls were structurally connected together by *in situ* concrete stitched joints, which have been designed, detailed and constructed to ensure transfer of all forces acting on the structure. This allows transfer of loads to the first floor *in situ* transfer slab. Through being involved from inception and throughout the design process, Buchan was able to produce a flexible design, enabling the varying room size criteria to be met.

Benefits achieved

- Working at height risks reduced at source
- Early involvement enabled best solution to be developed
- Early dry structural envelop to reduce period of critical path activities
- Early design freeze
- Defects substantially reduced through factory produced elements
- Long term maintenance benefits.

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Acknowledgements

Client: Sir Alfred McAlpine
Main Contractor: Buchan Concrete Solutions

Accommodation – Holiday Inn, Glasgow City Centre

Main drivers/constraints

- Need for a building of high standing and quality
- Need to fast-track the construction process to enable structural release for follow-on trades
- Programme certainty
- Cost certainty
- Durability
- Flexibility
- Speed of construction
- Quality of surface finish
- Thermal mass
- Predictability.

Project information

Recently benefiting from a £2m investment and winning the *Scottish Business Hotel of the Year* award, the four star Holiday Inn Glasgow City Centre occupies a pivotal position in the heart of Glasgow's Theatreland.

Buchan Concrete Solutions was awarded the contract to provide modular construction to four storeys of accommodation, 80 bedrooms, commencing at first floor. The hotel in recent times has since been extended to 113 rooms.

Buchan developed a crosswall solution for this fast-track project comprising concrete internal crosswalls, the external wall, inner leaf and solid slabs including the concrete slabs at roof level. The corridor walls were formed by the pod with a frame made up on site for the bedroom door. All the concrete panels were structurally connected together by insitu concrete stitched joints, which have been designed, detailed and constructed to British Standards set out in BS8110.

The walls were constructed off a first floor *in situ* transfer slab connected by cast-in reinforcing bar from the transfer slab. Buchan were able to erect the hotel within a four week timescale enabling early structural release for follow on trades.

Benefits achieved

- Early involvement at design to enable the most cost-effective solution to be developed
- Long-term low maintenance
- Fast track programme enabled early release of areas to follow on trades
- Safe systems of work both on site and within the production facility.

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Client: Balfour Beatty

Contractor: Buchan Concrete Solutions

Accommodation – Dovegate Prison

Main drivers/constraints

- One stop shop for design, manufacture and erection of structural envelope
- Comprehensive design co-ordination capability
- Just in time deliveries on constrained site
- Teamwork
- Robust design
- Quality of surface finish
- Thermal mass
- Predictability
- Services integration
- Design Integration
- Robustness.

Project information

Dovegate Prison is an 800 place category B prison operated by Premier Prison Services. The prison holds 600 inmates and attached to this is an area for a further 200 in a therapeutic community building. The main buildings comprise house blocks, a sports hall and medical centre, education block, admissions and a visitor centre, kitchen, chapel and three therapeutic house blocks. It was decided early in the design process that the majority of buildings would be formed using Buchan's pre-cast concrete crosswall system constructed on concrete strip footings.

Buchan worked closely with Skanska technology during the structural design stages to ensure that a fully co-ordinated design solution could be achieved.

Over 11 000 wall panels were required to form the building envelopes. To co-ordinate the design effectively, a 3D model was produced, which was used extensively by the structural engineer, mechanical and electrical engineer and the architect whenever changing the building layouts. From this model, using state of the art software, Buchan was able to design the layouts of the concrete wall panels and where possible standardise units (helping to improve the efficiency of the panel manufacture) before being individually customised to fulfil the client's specific requirements. From this information, shop drawings were produced to ensure correct manufacture was achieved. This fully co-ordinated approach eliminated costly remedial actions on site and ultimately repetitive design costs. At peak production Buchan, had up to ten gangs receiving 35 deliveries per day of the precast wall and floor units.

Benefits achieved

- Programme certainty
- Cost certainty
- Durability
- Flexibility
- Speed of construction.

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Client: Skanska Construction
Contractor: Buchan Concrete Solutions

Education – Ravensbury Community Primary School

Main drivers/constraints

- Minimising disruption
- Robust construction, generating low maintenance
- Non moveable deadline
- Design, manufacture and construction
- High quality finish
- Working close to live school
- Constraints due to Commonwealth Games.

Project information

The project involved the amalgamation of the junior and infant schools onto a single site to provide facilities flexible enough to ensure the correct delivery of education over the next 50 years. With a total floor area of 2514 sq.m, the building included community facilities and a 60 place nursery in order to act as a focal point for the entire community. This project has become a catalyst for the regeneration of New East Manchester for the following 10 years.

The Commonwealth Games, which were being held nearby, placed severe restrictions on construction activities.

Buchan played a key role in the design and construction of the school. By using their pre-cast concrete crosswall panel system they were able to offer many benefits to the scheme. The school was built adjacent to an existing Victorian building that was demolished on completion of the new school. The quick erection programme and low noise method of construction along with overall reduced construction traffic deliveries, made this project an all round success.

The school was used as a demonstration project by the movement for innovation (M4i) whereby Ravensbury achieved one of the highest scores of any demonstration project undertaken at both regional and national levels, with an average score of 4.1 (out of 5) in all assessment areas.

Benefits achieved

- Quality of surface finish
- Thermal mass
- Predictability
- Robustness
- Programme certainty
- Cost certainty
- Durability
- Flexibility
- Speed of construction
- Adaptability.

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Acknowledgements

Client: Manchester City Council

Main contractor: Amec

Modular building supplier: Buchan Concrete Solutions

Health – Mental Health Unit, Walsgrave Hospital, Coventry

Main drivers/constraints

- Predictability
- Cradle to grave structural envelope solution
- Comprehensive design co-ordination capability
- Speed of construction
- Low noise construction techniques
- Robust structural solution
- Low maintenance running cost.

Project information

The mental health unit with a footprint of 8700 m² was constructed alongside an existing entrance to the hospital. It was mainly two storey but with a significant single storey element. Skanska considered alternative methods of construction including steel and traditional masonry, but with detailed knowledge of Buchan's pre-cast concrete crosswall system, was keen to learn if and how we could improve this particular project. Our teams worked closely with Skanska to develop a solution that offered the best combination of off-site manufacture and speed of assembly on-site.

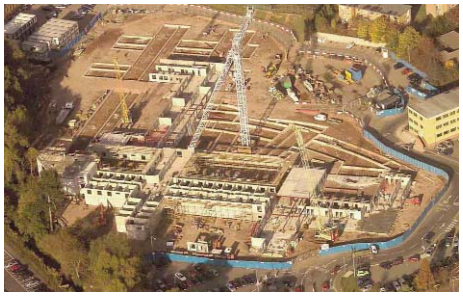
Buchan proposed that the internal skin of the external walls, together with one of the corridor walls, should be constructed using their pre-cast concrete crosswall system and that the floors should be formed in hollowcore, spanning distances of up to 12.5 m.

Having demonstrated in early 2006 that the proposal was cost-effective, Skanska formally placed an order for the structure in April 2003. Erection on site started in September and was completed in January 2004. More than 1000 pre-cast elements were supplied, with over 900 having service runs cast in them.

Buchan also supplied and erected over 200 tonnes of structural steel for the roof structures. A combination of tower cranes and crawlers were used for the erection, receiving at times over 300 tonnes of concrete components per day. In recognition of Buchan's careful planning and high standard of safe working, Skanska presented them with a safety achievement award under the health and safety improvement initiative.

Benefits achieved

- Quality of surface finish
- Thermal mass
- Predictability
- Programme certainty
- Cost certainty
- Durability
- Flexibility
- Speed of construction.



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Client: Skanska Construction
Contractor: Buchan Concrete Solutions

BAA Pier 6 connector construction

Main drivers/constraints

- Minimise closure of taxi way
- Minimise airside work and risks to operations.

Project information

Gatwick Airport is the second largest airport serving London and the South East of England and is the second busiest airport in the UK after Heathrow. The airport has two terminals; North and South. The 2700 tonne, 200 m long bridge was constructed to allow for access on foot from the North Terminal to Pier 6. Built at the edge of the airport to avoid disruption to services, the pier was transported 1.5 km before being lifted 25 m into the air allowing for two steel trestles to be placed underneath to a point of 10 mm of accuracy where huge locating pins were installed as effective connection points. The pier connector has eliminated thousands of coach movements per year and provided enhanced passenger and airline service levels.

Benefits achieved

- The taxi way was closed for only 10 days while the pier was put into place
- Programme reduction through parallel working and less lost time than usual airside
- Protected programme for construction of the bridge, improved predictability
- Better managed safety – low level work removing the need to work at height and over an operational airfield
- Easier supervision and enhanced quality off-site
- Bridge consolidation centre used for site works
- Saved client resources as construction workers did not need to pass through security daily
- Off-site fabrication of complete shell and core provided consistently high quality finishes
- Off-site fabrication removed costly scaffolding erection and airfield located works

Acknowledgements

Client: BAA

Lead designer: Arup

Concept architect: Wilkinson Eyre

Construction manager: Mace

Steelwork fabricator/erector: Watson Steel
Fit out: Warings
Façade: Schmidlin
M&E: WSP with NG Bailey supplier design

Concrete works: Laing O'Rourke

Roof: Prater
Moving specialist: Fagioli PSC

Wolverhampton University student accommodation – world's tallest modular building takes shape

Main drivers/constraints

- Important new urban residential project, which emphasises the benefits of offsite manufacture
- At up to 25 storeys, the buildings are the tallest modular constructions in the world and represent a massive step forward in this technology
- A study was made by SCI of the sustainability benefits of the new form of construction
- The whole construction period was an ambitious 15 months starting in July 2008 to meet the start of the academic year in 2009.

Project information

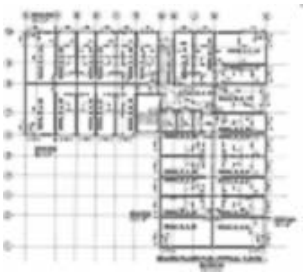
The Vision Modular structures building systems is extended up to 25 storeys. The urban residential project emphasises the benefits of offsite manufacture. The client, on behalf of Wolverhampton University, commissioned three multi-storey student residences, which are purpose designed and built in modular construction.

The project is located next to the main railway line north of the centre of Wolverhampton and the buildings will significantly enhance the local environment and become an important focal point. All three blocks are constructed either on a concrete ground slab or first floor podium. A novel feature of the construction is the use of integral corridors manufactured within the modules, which has the advantage of reducing the number of separate components, creates a weather tight envelope and eliminates damage to finished modules.

There are three separate blocks in the first phase of this project and a further block planned. Cladding is in the form of ground supported brickwork at the lower levels and a mixture of insulated render, composite panels and rain-screen metallic panels at the upper levels. The lightweight cladding was installed without scaffolding using hoist towers. The project was monitored by regular site visits to ascertain the rate of installation of the modules, site productivity, number of major deliveries of components and materials and waste created.

Benefits achieved

- World's tallest modular building at 25 storeys high
- Speed of construction increased by 40 per cent
- Fully modular construction sits on podium level
- Fire resistance of 120 minutes
- Modules include an integral corridor
- Wind loads are transferred by diaphragm action to concrete core
- Rapid construction programme – modules installed at an average rate of 7.5 per day.



Project team

Client: Victoria Hall Ltd
Architects: O'Connell East Architects
Consulting Engineers: Bailey Johnson Hayes and Barrett Mahoney Consulting
Contractor: Fleming Construction
Modules: Vision Modular Systems

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Acknowledgements

The Steel Construction Institute
BCS582/Case studies residential

Modular design goes high-rise in London

Main drivers/constraints

- Modular building designed to reduce local site and environmental impacts and provide much needed affordable accommodation
- Site access difficulties
- Sustainability benefits.

Project information

Berkeley First chose modular construction for its key worker and starter homes project called Paragon in Brentford, West London because of the sustainability benefits. Sandwiched between the M4, suburban housing and a school, the site presented access difficulties solved by modular construction. Modules were delivered at an average rate of eight per day and were installed in a 40 minute turn around without requiring road closure. It utilises over a 1000 modules 2.8 m × 12.0 m in size but some up to 4.2 wide which is the maximum for motorway transport.

The use of modular construction is conventionally limited to 8 to 10 storeys; the extension to 17 storeys was achieved by a concrete core, which provided overall stability. Caledonian Building Systems were able to manufacture a wide range of module types, many with open sides, so that two modules could be placed side by side to provide wider rooms. The modules comprise a hot rolled steel frame with light steel floors and walls.

The £26 million project provides much needed accommodation for key workers and for students at Thames Valley University. The 17 storey building is currently Britain's tallest modular construction. A total of 14 months was saved by the use of modular construction relative to *in situ* concrete and site waste reduced by over two-thirds. Noise and dust in site operations were dramatically reduced.

Benefits achieved

- Modular construction up to 17 storeys
- Rapid construction system reduces the overall development programme by 14 months
- Minimises logistical problems on-site
- Waste on-site reduced by over two thirds
- Excellent acoustic insulation
- Open-sided modules for flexible space planning
- Modules supported by steel podium.

Project team

Developer: Berkeley First

Architects: Carey Jones

Structural engineer: Capita Symonds and Alan Wood and partners

Modular contractor: Caledonian Building Systems

Contact information

The Berkley Group holding plc

(Sustainability Working Group)

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Acknowledgements

The Steel Construction Institute

BCS582 *Case studies residential*

Caledonian project

Modular design alleviates London's housing shortage

Main drivers/constraints

- London's East End is going through considerable regeneration and the need for rapid-build housing is being met by a variety of off-site manufacturing technologies
- Noise and disruption to the adjacent residential buildings kept minimal
- The building construction specifications had to take into account the acoustic requirements of noise from the nearby Commercial Road traffic.

Project information

A multi-storey social housing project in London's Commercial Road that consists of 38 flats each comprising two light steel modules provides much-needed high quality accommodation. The L-shaped residential building called Painter House is built using 76 modules that cascade from five to two storeys on a first floor concrete podium. Tower Hamlets Community Housing occupies the office space at ground floor and a hot rolled steel frame provides the access core and walkways to the upper levels.

The façade is clad with Trespa lightweight panels at the upper levels and brickwork at the lower levels. The roof is mono-pitch and is clad using Kingspan roofing with a secret gutter and is fixed to the top floor module.

The project started on site in July 2005 with the demolition of the existing building and the 76 modules were installed over a three week period at times to suit the traffic on London's busy Commercial Road. Expected completion August 2006, represents a saving of six months on conventional site-intensive construction.

The light steel modules were designed, manufactured and fully fitted out by Rollalong in Dorset. All modules were completed with doors, windows, kitchens, bathrooms, heating (gas condensing boilers) and pipework to minimise final connections and commissioning on site. The modules were designed to offer both spacious accommodation within the housing association's budget and to be delivered using the motorway and local road network without requiring closure.

Benefits achieved

- Speed of construction (saving of six months)
- Minimum disruption to the locality during construction
- High quality through off-site manufacture
- External walkways to each flat provide independent access
- Modules sit on podium
- Lightweight construction
- 60 year life, allowing purchasers to obtain property mortgage.

Project team

Client: Tower Hamlets Community Housing

Contractor: Hill Partnerships Ltd

Architect: BPTW

Structural engineer: Colin Toms and Partners

Modular supplier: Rollalong

Steelwork: Anglia Steel

Contact information

Hill Partnerships Ltd
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Acknowledgements

The Steel Construction Institute
BCS582 *Case studies residential*

Modular housing vision for Basingstoke

Main drivers/constraints

- ❑ Modular system for private and social tenure to meet the challenge of fast build high quality procurement in residential sector
- ❑ Modular technology saved 70 per cent on the project time period relative to *in situ* concrete construction
- ☐ Sustainability benefits make this technology ideally suited for urban residential projects.

Project information

Fleming Developments UK and Sentinel Housing Association team up to provide one of the first projects in the UK using Vision Modular Structures in Basingstoke. The Vision system is suitable for structures up to 16-storeys high and has capability for bespoke interior finishes and a broad range of external cladding options.

The 360 modules were installed from October 2006 to February 2007 at an average rate of eight per day. The modules are designed to act together to create the overall structure. The Vision modular system was selected because of its speed of manufacture and assembly, quality of finishes, minimum disturbance to the nearby hospital and its ability to achieve the 11-storeys required for this high density project.

The module floor consists of a 150 mm deep concrete floor with PFC steel channel sections at the perimeter of the floor. The use of a concrete floor provides a very robust, fire resistant and acoustically excellent solution. For block B, a 11-storey building, all the modules were installed within just 15 days, which meant that cladding and follow-on trades could start immediately.

Benefits achieved

- ❑ Rapid on site – 400 modules installed in 20 weeks
- ❑ Acoustically excellent floors
- ❑ Manufactured in a controlled, factory environment
- ❑ Minimum disruption to the locality
- ❑ 120 – minutes fire resistance
- ❑ On site labour greatly reduced – safer system and reduction of risks on site
- ❑ BRE and IAB certification
- ❑ Waste eliminated on site and in manufacture.

Project team

Client: Sentinel Housing Association

Developer: Fleming Developments UK

Architect: PRP for Fleming

Module manufacturer: Vision Modular Structures

Structural engineer: Barrett Mahoney

Contact information

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Acknowledgements

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BCS582 *Case studies residential*

Modular living by MoHo in Manchester

Main drivers/constraints

- To demonstrate the benefits of rapid-build high quality construction for modern living
- The total construction period for the whole project was 17 months and the use of modular construction saved as estimated seven months
- The innovative building uses mixed steel technologies to achieve 'light and airy' building feel and represents a breakthrough in this technology
- First modular building intended for sale.

Project information

This innovative project, MoHo (short for modular housing), is the first modular building in the UK for sale rather than social housing for rent and represents an important breakthrough in this technology.

The U shaped building consists of six residential levels over one commercial and retail floor. By inter-mixing the apartment types and cladding, a lively mix of panels has been created across the facades. The structural engineer and architects came up with a modular design in which modules are arranged parallel rather than perpendicular to the faced and are constructed with an open side by using intermediate posts. Apartment sizes vary and could be increased by additional bedroom 'pods'. Kitchens and bathrooms are manufactured as internal 'pods' or islands.

The balcony frames are fixed to the front of the modules and lateral forces are transferred through the module to the primary steel frame. The modules can be designed with partial or fully open sides, which enhance the 'airy' feel of the space. The Yorkon modules comprising the living space took only five weeks to install at a rate of six per day. Modules were delivered 'just in time' as required to suit local traffic conditions.

The primary steel structure was constructed concurrently with the manufacture of the modules, thereby reducing 'lead-in' time. Modules were installed inside the completed steel frames. This novel system is being developed further for future use in residential projects.

Benefits achieved

- Modular construction leads to 30 per cent reduction in total construction period
- Modules are arranged to provide a high degree of fenestration
- Overall stability is provided by a steel frame located in the corridor zone
- A variety of apartment configuration is possible
- A variety of cladding materials is used
- Podium at ground floor for retail use
- As built construction cost, including basement car parking was £1330/m².

Project team

Client: Urban Splash

Construction management: Urban Splash

Architect: ShedKM

Structural engineer: Joule Consulting Engineers

Contractor: Dew (for concrete) Thircon (for steel frame)

Modular contractor: Yorkon

Contact information

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Acknowledgements

The Steel Construction Institute
BCS582 *Case studies residential*

Urban street-scape created by light steel framing

Main drivers/constraints

- The Sentinel Housing Association embarked on a major redevelopment of the 1960s housing in the Oakridge area of Basingstoke, Phase 2 extends the successful, award-winning earlier phase
- 'Urban village' plan, the strong street-scape and use of a palate of materials was important to the design concept
- The buildings are constructed to 'Lifetime Homes' and 'Secure by Design' standards.

Project information

Phase 2 of the award-winning Oakridge development in Basingstoke consists of an 'urban village' comprising houses, flats, shops and community facilities. The composition of Phase 2 of the project (Phase 1 being mainly private housing) is 110 housing units for key workers. The buildings in both phases are constructed from light steel frames in two or three storeys.

Phase 2 started on site in late 2003 and was completed at end of 2005. The use of light steel framing ensured early fit-out and time savings on site. High levels of thermal and acoustic insulation were achieved. Considerable design effort was made in the area of standard building technologies to optimise the manufacture and installation options.

The light steel framing consists of 100 mm C-sections in the walls and 200 mm C-sections in the floors. The floors were installed as large cassettes and were supported by load-bearing walls below. The same basic building technology was used in two and three storey configurations. The shops and community buildings were constructed in light steel framing which required some hot rolled steel components. The rendered insulation was directly attached to marine grade plywood screwed to the light steel frames. Brickwork was used in the ground floor level.

Benefits achieved

- Palate of cladding types
- Speed of installation
- Excellent acoustic insulation
- Disabled facilities built-in
- Lightweight construction
- The development has received a CABE 'Building of Life Gold Standard' and an RIBA Housing award.

Project team

Client: Sentinel Housing Association

Architect: HTA Architects Michael Associates

Contractor: ROK (formerly Walter Llewellyn)

Light steel framing: Forge and Ayrshire Metal

Rendered façade: Permarock and George Howe Ltd

Contact information

ROK Construction

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Acknowledgements

The Steel Construction Institute

BCS582 *Case studies residential*

SmartLIFE project confirms benefits of steel

Main drivers/constraints

- Sustainability benefits investigated
- Assessment of different construction methods
- Minimising construction cost
- Productivity increased (man hours)
- Build time reduced by 20 per cent
- Reducing average waste generated.

Project information

The genesis of the SmartLIFE was a demonstration project in which benefits of Modern Methods of Construction (MMC) in housing were assessed on site. The project was a mixture of private tenure and social housing, constituting 106 2-storey units of two and three bedroom houses built on three 'greenfield' sites. The projects were investigated by BRE in their report Smart-life Lessons Learnt report and the important conclusion of the SmartLIFE project was that steel framing system proved to be the most economic in terms of construction cost and in speed of construction, when compared to traditional brick- blockwork, timber framing and insulated concrete formwork construction.

The light steel framing system developed by Fusion Building Systems consists of prefabricated wall panels. The floors were also delivered as two dimensional cassettes with regular openings for services. The pre-fabricated wall panels are X-braced to resist all wind loads, independent of the cladding that is used.

The wall and floor panels are delivered 'just in time' to site and are highly accurate in their manufacture. Storage on site and wastage are eliminated by using light steel floor and wall panels. The panels were lifted into place by a crane which means the construction process was very rapid and efficient. A weather-tight envelope is created rapidly and the overall construction period is reduced by over 20 per cent including the foundations or 40 per cent excluding foundations.

Benefits achieved

- ☐ Steel framing is shown to be comparable to traditional building in cost terms
- ☐ Steel framing is 20 per cent faster and more productive in overall building programme
- ☐ Site waste is reduced by 50 per cent and all steel is recycled in manufacture and construction
- ☐ Eco-homes 'very good' standard was achieved, designs could be adapted to achieve Code for Sustainable Homes Level 3
- ☐ Average waste generated from traditional construction reduced by over 50 per cent using light steel framing.

Project team

Client: Cambridgeshire County Council

Architects: Proctor Matthews and Churchill Hui

Contractor: Inspace (Willmott Dixon)

Light steel framing: Fusion Building Systems

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Acknowledgements

The Steel Construction Institute

BCS582 *Case study Spaceover adaptable housing*

Cartwright, P, Moulinier, E and Novakovic, O (2008) *Smartlife lessons – lessons learnt*, BR 500, Building Research Establishment

Adaptable housing using modules

Main drivers/constraints

- Modular construction is widely used for multi-storey single person accommodation but the breakthrough into mass housing has been slow
- Organisations involved were able to take a more active part in the procurement and construction process in order to maximise the benefits of off-site manufacture.

Project information

Spaceover has pioneered the concept of extendable and affordable housing using fully modular construction for its 78 unit project in Harlow, Essex. The key to the use of modular construction is the development of extendable building forms for two, three and four bedroom houses and for one and two bedroom apartments in two to four storey configurations.

A total of 177 house modules and 72 apartment modules were installed at a maximum rate of 10 per day. The modules are fully fitted out in one of Spaceover's licensed assembly plants and the finishing work on site is limited to foundations, cladding, roofing and services connections. Excellent quality control is maintained and speed of construction on site is maximised.

The 3.75 m wide × 12 m long modules are manufactured using welded light steel frames based on the Ayrframe system by Ayrshire Metal in Daventry. The walls of the modules are only 85 mm wide so that allowing for installation gaps and tolerances, the total width of adjacent modular walls is only 240 mm.The double layer of construction of the walls and floors provides excellent acoustic insulation. Spaceover investigated the economic viability of renewable energy sources and chose ground sourced heat pump. This technology provides up to 65 per cent of the total heating energy use in a typical house.

Benefits achieved

- Rapid construction technology – construction periods reduced by 50 per cent
- ECO Homes Excellent rating – Code for Sustainable Homes Level 3 *
- Extendable and adaptable building forms using modular construction
- High levels of quality control
- Renewable energy provided using ground sourced heat pumps.

Project team

Client/developer: South Chase New hall Ltd

Housing association: MOAT Housing Association

Turn-key contractor: Spaceover Ltd

Architects: Proctor and Matthews

Structural engineer: Peter Dann Associates

Module fabricator: Ayrshire Metal

Modular fit-out: Rollalong Ltd, Tingdene Ltd and Team Ltd

Acknowledgements

The Steel Construction Institute

BCS582 *Case studies residential*

Hale for unite high-rise

Main drivers/constraints

- The project was scheduled to be completed in only 10 months from ground slab, reducing the construction period by over a half relative to in-situ construction
- Extremely high accuracy achieved in module installation
- Sustainability benefits.

Project information

Unite Modular Solutions (UMS) undertook its fourth high-rise building as part of Hale Village project in Tottenham, North London. The student residence is part of a larger urban regeneration next to the main line Tottenham Hale station. The innovative part of the UMS design is the installation of braced light steel corridor cassettes to transfer wind loads from the vertical stack of modules to the cores at the four corners of the building, supplemented by intermediate X-braced 'shear' walls. The proximity to the main railway line meant that the precaution was taken to mount the modules on neoprene strip bearings, an innovation in the UMS system.

Modules were delivered to site from UMS's Stroud factory to meet the planned site installation programme. Upper floors were completed three to four times faster than *in situ* construction and this was many times more productive in terms of site work.

The benefits of off-site manufacture in terms of sustainable construction were also apparent both in terms of speed of installation and reduced impact on the local environment. The site waste of modular components was essentially eliminated and only one skip per day was collected for the non-modular waste. Modules are installed to very high accuracy by using lasers passing from the base slab passing through holes in the external face of the modules. Setting out errors were virtually eliminated. Modules were installed at an average rate of 12 per day during the winter months although a maximum of 22 modules was installed in one day.

Benefits achieved

- Rapid construction – 12 modules installed per day on average
- Wind loads transferred through braced corridor
- Very high accuracy achieved in modular installation (<3 mm positioning accuracy)
- Modules installed on anti-vibration pods
- BREEAM 'very good' rating achieved.

Project team

Client: Hale Village/Unite Modular Solutions

Architects: DMWR

Structural engineer: Walsh Associates and WSP

Management contractor: Woolf

Modules: Unite Modular Solutions

Contact information

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Acknowledgements

The Steel Construction Institute
BCS582 *Case studies residential*
Case study Unite Hale village

Aspire "stair in a day" for soldiers

Main drivers/constraints

- Health safety benefits due to less reliance on scaffolding
- Building regulation and fire compliant
- Early access in construction programme through the establishment of a stair core.

Project information

Bourne Off-Site Solutions have recently secured the contract for the third phase of construction for Project Aspire. The contract, carried out in conjunction with Corus Living Solutions, involves the delivery of new single living accommodation for the British army on Salisbury Plain. In total, the project aims to provide improved living standards for over 18,700 soldiers (20 per cent of the British army). Bourne Off-Site Solutions have been contracted to continue their successful work carried out in the first two phases of the contract, to supply volumetric stair cores for incorporation into the new accommodation blocks. Bourne's "stair in a day" modules offer a fast track on-site installation, providing a stair access that is available for immediate use. Establishing a working staircase at a relatively early stage of the construction process provides enormous benefits in terms of access and health and safety, by dramatically reducing the reliance on scaffolding and other forms of temporary access.

The "stair in a day" product provides a fully contained stair solution, which can be used in any structure. Steel staircases are enclosed within steel framed modules that are fitted out to client requirements. Each module is designed to be fully compliant in terms of Building Regulations and Fire Regulations, to enable a simple interface with a wide range of building structures.

Benefits achieved

- Self supporting modules up to 12 floors in height
- Internal or external stair solutions provided
- Fully insulated and internally lined with high impact resistant finishes
- Externally clad and glazed off site, with first fix M&E installation
- Rapid installation times
- Counter terrorism measures if required.

Project team

Client: Rreef

Main D&B contractor: Bourne Parking Ltd

Cladding contractor: Bourne Off-Site Solutions

Architect: Broadway Malyan

Engineer: Scott Wilson

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BAA East Terminal works – night time bridge

Main drivers/constraints

- Restricted access, logistically challenging night time steel erection
- A bridge to carry utilities in preparation for the new East London Terminal
- Exacting tolerances.

Project information

Bourne Off-Site Solutions has recently completed another complex night time steel erection for the pre-enabling works for the new Heathrow East Terminal, further demonstrating the exceptional capabilities of their Airport Installations team.

Eventually replacing Terminal Two, the new building will require some major service lines to be installed prior to the main construction work beginning. Much of this preliminary work has involved Bourne Off-Site Solutions erecting steel service towers and bridges, which will carry utilities over the surrounding busy roads.

John Hanson, Bourne Off-Site's Project Manager, said: *"Heathrow is extremely busy and we only had a four hour night time working window for the lifting and erection work"*

The largest installation involved Bourne Off-Site erecting a 34 m-long pre-assembled bridge between two steel towers. The bridge was manufactured in two 17 m long sections, which were then assembled together on site, before being lifted into place as one complete assembly weighing 15 t and measuring 34 m in length.

The operation was completed in one night and allowed pre-assembled steel service modules to be lifted into place over the following nights. The project is still on-going, with further service bridges scheduled for installation over the forthcoming weeks.

Benefits achieved

- Quick programme, fast installation during a four hour night-time time slot
- Minimum disruption to surrounding infra structure
- Innovative assembley and erection techniques.

Project team

Client: British Airport Authority

Main term contractor: Balfour Beatty

Cladding contractor: Bourne Off-Site Solutions

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Heathrow Airport: BAA air-side coaching station

Main drivers/constraints

- Air-side construction requiring restricted delivery and lifting times
- No disruption to 24 hour working of the airport
- Coaching stations factory engineered and clad off-site.

Project information

Bourne Off-Site Solutions have recently completed a number of remote coaching stations at Heathrow Airport. The coaching stations provide transit areas for embarking and disembarking passengers, and as such, they are the first contact with the airport for thousands of passengers every day.

Bourne Off-Site Solutions were tasked with the manufacture and installation of these buildings, which are all located in air-side locations. Working air-side at any airport is a complex and challenging task, with deliveries and lifting times severely restricted. Accordingly, it was imperative that these buildings were installed in a timely manner, without causing any disruption to the 24 hour operation of the airport.

Bourne Off-Site Solution's specialist airport team coordinated every aspect of this challenging project in conjunction with the client's architect, BAA and the term contractor Mansell Plc. The coaching stations were engineered to be prefabricated and clad off-site in Bourne's off-site factory in Henstridge, before being delivered and installed during a foure hour window at night. the pre-enabling.

The buildings were finished externally with a combination of glazing and composite panel, and were linked into the existing terminal structure. As part of the integration with the existing terminal, Bourne carried out some refurbishment to the stair areas, which included the installation of a lift shaft, using the Bourne "lift in a day" product.

Benefits achieved

- Quick programme, fast installation during a four hour night-time time slot
- Minimum disruption to surrounding infra structure
- Innovative assembley and erection techniques.

Project team

Client: British Airport Authority

Main term contractor: Mansell construction

Cladding contractor: Bourne Off-Site Solutions

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BAA Heathrow Air Traffic Control Tower, Terminal 5

Main drivers/constraints

- Construction had to take place on the airfield without disrupting Heathrow's busy operations.
- Minimising time spent on site
- Restricted site space
- Live working environment limits site operations.

Project information

Construction of Terminal 5 (T5) to the west of the airport significantly extended Heathrow's airfield, creating need for a new, taller air traffic control tower positioned in a more central location so that air traffic controllers could view aircraft movements in the area around T5. At 87 m, Heathrow Airport's new air traffic control tower is more than twice the height of the existing tower and has been constructed in an extremely difficult airport environment using highly innovative prefabrication and erection techniques.

The completed 850 tonne, eight storey structure was transported 1.5 km across the airfield to the tower's permanent location by Terminal 3 in a single, overnight operation that took just under two hours. The final erection to full height was completed by jacking the cab vertically and inserting internally fitted out prefabricated sections of mast underneath.

Comments were made by: Dr Chris Millard, Head of Engineering, T5 BAA: "the resulting tower exemplifies teamwork at its very best and stands as a testament to all that is great in British design, construction and engineering." and Tony Douglas, former BAA Managing Director of Heathrow:"the project team have fully met the challenges of constructing a major element of infrastructure in the middle of the world's busiest airport, which will serve Heathrow well into the future."

Benefits achieved

- Control tower's erection was completed without a single reportable accident or disruption to the airport's operation.

Project team

Client: BAA

Principal designer: Arup

Concept architect: RRP

Principal contractor: Mace

Steel structure: Watson Steel

Facades: Schmidlin

M&E: AMEC

M&E concept: DSSR

Fit-out: Warings

Lifts: Schindler

Substructures: Laing o'Rourke

Substructure designer: Connell Mott MacDonald

Contact information

Images courtesy BAA Ltd

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Heathrow Airport BAA: “lift in a day” modules

Main drivers/constraints

- Air-side construction requiring restricted delivery and lifting times
- No disruption to 24 hour working of the airport
- Modules factory engineered and clad off-site.

Project information

Bourne Off-Site Solutions have recently carried out another “lift in a day” installation for BAA at London Heathrow.

As part of a contract to install a number of air-side coaching stations, providing transit areas for embarking and disembarking passengers, Bourne Off-Site Solutions were asked to provide a lift core to enable easy passenger access. These installations are normally complex and timely affairs, as all works are carried out under strict “air-side” regulations. However, whilst a traditionally built lift core would have taken a number of weeks to complete, Bourne Off-Site Solutions used their volumetric “lift in a day” product and completed the main installation within one night.

Bourne Off-Site Solutions provided a single volumetric steel structure, which provided the complete lift shaft, ready for the final installation of the lift car on site. The lift shaft arrived on site shrink-wrapped, having been lined, insulated and fully clad within Bourne’s off-site facility in Henstridge. Bourne’s expert installation team managed the project from start to finish ensuring a smooth operation, with the minimum of disturbance to the air-side operations.

Bourne’s “lift in a day” product provides a fully contained structural lift solution, which can be used in any structure. The lift shafts can be fully prepared with fixings and running rails installed off-site. Each module is designed to be fully compliant in terms of Building Regulations and Fire Regulations, to enable a simple interface with a wide range of building structures.

Benefits achieved

- Quick programme, fast installation in one night
- Minimum disruption to surrounding infra structure
- Factory fixed rails and fixings, fully insulated and internally finished, externally clad off site
- Providing lateral stability to other structures (contact Bourne Off-Site Solutions for further details).

Project team

Client: British Airport Authority

Cladding contractor: Bourne Off-Site Solutions

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Modular stair towers for Pinewood Studios

Main drivers/constraints

- Restricted access, logistically challenging night time steel erection
- A bridge to carry utilities in preparation for the new East London Terminal
- Exacting tolerances.

Project information

The 007 James Bond Studio Building at Pinewood has been totally rebuilt after a disastrous fire destroyed the original building in 2005. A challenging design and build program was necessary to ensure filming of the next 007 film could start in March 2007.

The building comprises a large hall some 120 m × 40 m × 12.5 m high to the underside of the massive steel trusses, which support the roof and a complex of runway beams for rigging lights, scenery etc during filming activities. The runway beams are accessed by a series of walkways tucked between the trusses, with four internal stair towers strategically located to act as working access and emergency escapes. The stair towers need to be free standing structures and be fully enclosed to give one hour fire resistance.

This installation was made all the more challenging as the stair towers were located close to the walls, and extend upwards in between the roof trusses, with only millimeters clearance either side. Also, the fast track program for the project meant that there could be no break in the installation of the main structural works for construction of traditional stair towers.

Bourne Off-Site Solutions was selected to provide a modular solution, using their renowned “stair in a day” solution. Using the expertise gained from completing numerous modular stair installations, each of the four stair towers were designed for off-site manufacture at Bourne’s off-site factory in Henstridge. Each staircase consisted of five self supporting modules with a top hood module to give security and fire resistance. The modules comprised fully welded structural steel frames with cold rolled studwork panels fitting into the framework. Accurate jigs were used to achieve +0 mm/-3 mm tolerance. The internal and the external sides of the studwork were boarded with high impact, fire resistant, Megadeco Board to achieve the specified one hour fire resistance.

To install the modules inside the finished shell of the building, an ingenious system of temporary runway beams and hoists were used to lift and slide the modules into place. Installation on site took two days per tower with a minimum of on site work to complete the handrail and lighting.

Benefits achieved

- Quick programme, fast installation during a four hour night-time time slot
- Minimum disruption to surrounding infra structure
- Innovative assembley and erection techniques.

Project team

Client: Pinewood studios

Main term contractor: Bluestone plc

Modular stair tower D&B subcontractor: Bourne Off-Site Solutions

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Sculptural feature cladding for The Moor car park, Sheffield

Main drivers/constraints

- Restricted access, logistically challenging city centre site
- Innovative modular design and erection methods
- Exacting tolerances.

Project information

Bourne Off-Site Solutions have just completed an innovative and architecturally challenging feature cladding contract on an 18 split level car park in Sheffield. The project at The Moor, forms part of a wider regeneration project within Sheffield that is aimed at providing the area with a new lease of life through the development of new residential, retail and commercial facilities.

The car park was constructed on an extremely compact and logistically challenging city centre site, with only 600 mm clear access on each elevation, meaning that scissor lifts, scaffolding or cherry pickers could not be used. The cladding system was a striking design that incorporated 4,700 individual aluminium profiles and ventilation grills of differing sizes.

Bourne Off-Site Solutions designed a bespoke panelised cladding system, consisting of polyester powder coated aluminium sheets fixed onto cold rolled steel frame panels, all manufactured off-site, to exacting tolerances in their production facility in Henstridge.

Exactly 728 panels were transported to site in stillages, before being lifted into their specific position by a spider crane located on the roof of the car park structure. The entire system was delivered and installed within a matter of weeks, achieving an installation rate of up to 40 panels (300 m^2) per day. In total, 4,500 m^2 of cladding was erected, with the final finish providing a contoured effect around all sides of the building.

Benefits achieved

- Quick programme, fast installation 300 sqm a day
- Minimum disruption to city centre
- High quality, robust, aesthetic solution.

Project information

Client: Rreef

Main D&B contractor: Bourne Parking Ltd

Cladding contractor: Bourne Off-Site Solutions

Architect: Broadway Malyan

Engineer: Scott Wilson

Contact information

Bourne Off-Site Solutions
Ferguson House
9 Church Road
Poole, BH14 8UF
Tel: 01202 710000
Email: tim.smithson@bournegroup.eu

Modular educational facility fits in historic setting

Main drivers/constraints

- To deliver a building with all the benefits of off-site construction and standardisation, whilst providing a bespoke solution and an outstanding architectural design that is in keeping with the existing school buildings and its national park location
- To meet the requirements of the planning authorities, resulting from the historic and environmentally sensitive setting for the building
- To provide a sustainable building solution for the school.

Project information

Christ College is a co-educational independent boarding and day school, which was founded by Royal Charter in 1541 by King Henry VIII. Located in the Brecon Beacons National Park in South Wales, the school is one of Britain's oldest schools, with buildings dating back to the 13th century.

Following a major bequest, the school had a requirement to expand its science facilities, bringing all its laboratories together under one roof and replacing an outdated 1950s block which is currently used for physics.

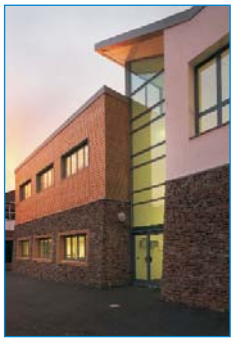
16 steel-framed modules were manufactured off site in York, arriving at the school during the holidays to further reduce disruption to teaching. There are clear spans of 12.0 m providing flexible teaching space over time.

The scheme has a number of sustainable features, such as solar water heating to reduce energy consumption, energy-efficient lighting, natural ventilation and daylight and high levels of insulation to conserve energy.

Through careful choice of local materials, the building is rich and warm in appearance and incorporates local materials such as Welsh sandstone from a nearby quarry, together with render and timber cladding to complement surrounding buildings.

Benefits achieved

- Two physics laboratories, two biology laboratories, a sixth form project room, laboratory technician's rooms
- Double height central atrium space that functions as a teaching area and exhibition space
- The scheme has a number of sustainable features
- Wide spans of up to 12.0 m
- Completed during the holidays, short construction period
- On budget, £1.3m contract.



Project information

Architects: P+HS Architects

Modular contractor: Yorkon Limited

Contact information

Yorkon Limited

Huntingdon

York

YO32 9PT

Modular emergency facilities provide innovative clinical environment

Main drivers/constraints

- To provide a purpose designed emergency assessment unit with the benefits of off- site construction and also with a direct impact on the patient experience
- Fast completion to provide early beneficial use of building and reduce patient disruption
- To provide an internal, defect-free environment to the highest clinical standards.

Project information

A purpose-designed Emergency Assessment Unit was required at the University Hospital of North Tees in Stockton, as part of the Government's drive to reduce waiting times for emergency cases.

The £2.8m ProCure 21 project was awarded to Yorkon by Interserve Project Services, for the off-site construction and fitting out of the 42-bed Emergency Assessment Unit.

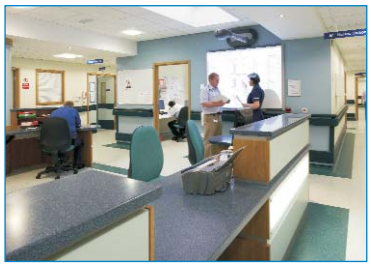
The 1,710 sqm single storey extension to the existing emergency department was delivered in just over six months from start on site and provides a range of facilities for acute emergency care.

The building comprises 42 steel-framed modules, with designed in features giving the unit the quality and appearance of the best traditionally built building. The unit adopts the latest thinking in emergency care staffed by specialist teams to give quicker access to treatment.

Roof lights were incorporated into the design to increase the amount of natural light in the centre of the unit, and it has been equipped with the latest technology. Wireless workstations are available for use at patients' bedsides and this is one of the first units in the country to have an electronic information board.

Benefits achieved

- Four-bed wards, single en-suite bedrooms, an isolation ward and high dependency beds, support accommodation
- Defect-free environment to the highest clinical standards
- Six month programme reduced and on budget
- Client business objectives met quickly from operational efficiencies and increased capacity.



Project information

Architects: Interserve Project Services

Modular contractor: Yorkon limited

Contact information

Yorkon Limited

Huntingdon

York

YO32 9PT

Off-site construction and off-site fitting works well for Tesco

Main drivers/constraints

- Requirement was to have a temporary store for seven weeks to reduce disruption to customers during the redevelopment of the existing superstore
- One of the largest temporary modular supermarkets for Tesco on a constrained site (to be relocated to a permanent site at a later date)
- Maintain the look and feel of a permanent store.

Project information

The Barnsley store was delivered by Yorkon in just 11 weeks from receipt of order to trading – a time saving of around four weeks compared to former temporary stores.

The new modular supermarket, which is almost three times the size of the convenience stores manufactured by Yorkon for Tesco previously, has been engineered to increase the level of off-site fitting out and to minimise the number of internal columns to create maximum clear spans.

The supermarket was constructed from 26 14 m long steel-framed modules, which are manufactured and substantially fitted out off site in York.

Included in the off-site fitting out were Ceramic floor tiles, roller shutters, freezers and chillers, shelving, internal walls, plumbing, electrics, mechanical ventilation, sanitary ware, doors and shop front glazing are all pre-installed at the Yorkon production centre.

Yorkon has developed the new 10,000 sqft modular store for Tesco – its largest supermarket for the food retailer. The building is installed on site in just three days, and is open to customers less than three weeks later, significantly reducing the completion time for new stores.

Yorkon has worked with Tesco for the past eight years, delivering modular convenience stores for both standalone sites and petrol forecourts, and is the UK's market leader in off-site construction solutions for the retail sector.

Benefits achieved

- Reduced disruption to trading and customers shopping experience
- Up to 90 per cent fewer vehicles movements to site
- A high level of design flexibility, both internally and externally
- Improved thermal efficiency for lower running costs and carbon emissions
- Material wastage reduced by up 90 per cent
- Delivery on time and on budget
- Programme times reduced by up to 50 per cent, allowing earlier completion and a faster return on investment.

Project information

Architects: Tesco Projects

Modular contractor: Yorkon limited

Contact information

Yorkon Limited

Huntingdon

York

YO32 9PT

Largest modular Acute Admissions Unit in the country

Main drivers/constraints

- To provide a purpose designed emergency assessment unit with the benefits of off- site construction and also with a direct impact on the patient experience
- Fast completion to provide early beneficial use of building and reduce patient disruption
- To provide an internal, defect-free environment to the highest clinical standards
- Parellel working, start of manufacture and fitting out before demolition work shortens programme.

Project information

West Hertfordshire Hospitals NHS Trust is undertaking a £34m reorganisation and modernisation of acute services in the area. A new model of care will be employed to improve the patient experience with rapid, consultant-led diagnosis for emergency cases and treatment closer to home.

The £25m ProCure21 contract at Watford General Hospital was been awarded to Medicinq Osborne. The project includes a new Acute Admissions Unit (AAU), which will be constructed off site by Yorkon in a £12m contract – believed to be the UK's largest modular building contract in the healthcare sector.

Medicinq Osborne will also undertake the refurbishment of wards and other accommodation, and the reconfiguration of access roads and car parking at the hospital.

Designed by Murphy Philipps Architects, the three-storey building will provide 120 beds for emergency admissions, two cardiac catheterisation laboratories, diagnostics including x-ray, ultrasound and CT scanner, pharmacy manufacture and robotics, library and a roof-top plant room.

The building is now being manufactured off site in York. 150 steel-framed modules will be delivered to site and craned into position in the spring, complete with partitions, electrics, plumbing, sanitary ware and finishes already in place.

Benefits achieved

- 120 beds for emergency, single en-suite bedrooms, cardiac catheterisation labs, diagnostics, pharmacy and robotics and library
- Defect-free environment to the highest clinical standards
- Parellel working, manufacture and fitting out started in factory before demolition work carried out on site, enables to short programme
- Client business objectives met quickly from operational efficiencies and increased capacity
- Ethos of Procure 21 partnership and openness between stakeholders, contractors and subcontractors achieved a guaranteed maximum price for the project quickly.

Project information

Architects: Murphy Philipps Architects

Modular contractor: Yorkon limited

Contact information

Yorkon Limited

Huntingdon

York

YO32 9PT

Modular state-of-the-art communications facility for York's newest secondary school

Main drivers/constraints

- To provide a flexible teaching space unit with the benefits of off- site construction
- Fast completion to provide early beneficial use of building and reduce student disruption
- To provide "state of the art" language and communications facilites
- To provide a sustainable school building
- To provide a purpose designed emergency assessment unit with the benefits of off- site construction and also with a direct impact on the patient experience
- Fast completion to provide early beneficial use of building and reduce patient disruption
- To provide an internal, defect-free environment to the highest clinical standards
- Parellel working, start of manufacture and fitting out before demolition work shortens programme.

Project information

York High School – York's newest secondary school, had a requirement for a purpose-designed and highly sustainable education building to extend the site of the former Oaklands School, and create a new, larger campus following the merger of two schools.

The £10m contract was awarded to Clugston Construction to refurbish and extend the campus. Yorkon was appointed to construct a £2m building using off-site construction. This comprised 52 steel-framed units in two different sizes, which were craned into position in just six days, reducing disruption and time on site by around 50 per cent.

Completed in only six months, the new two-storey 1,900 sqm scheme has replaced a number of sub-standard teaching buildings with state-of-the-art education facilities, and accommodates the communications faculty for english and modern languages, and the inclusion faculty.

Benefits achieved

- The building comprises general classrooms, four language laboratories, a new science laboratory, dining and social facilities, behavioural management units, offices, a hygiene suite, and welfare facilities
- Architectural features include a barrel vaulted roof with central light wells and a range of external panels to create a statement building
- Sustainable elements to reduce energy consumption, carbon emissions and running costs include biomass heating, passive ventilation, natural daylight, rainwater harvesting from toilet flushing and cladding from sustainable sources
- Ethos of Procure 21 partnership and openness between stakeholders, contractors and subcontractors achieved a guaranteed maximum price for the project quickly. Yorkon took responsibility for the construction of the building reducing the overall management time required.

Project information

Architects: Murphy Philipps Architects

Modular contractor: Yorkon limited

Contact information

Yorkon Limited

Huntingdon

York

YO32 9PT

Bridge House Croydon – modular one and two bedroom apartments

Main drivers/constraints

- To achieve EcoHomes "very good" standard
- Tapered elevation required design of individual modules
- Module widths dictated by delivery considerations
- Apartments designed for social and private housing
- Need to incorporate a range of claddings, walkways as well as green and brown roofs.

Project information

The Bridge House development in Croydon occupies an L-shaped site in between the main market street in Croydon and an NCP car park. Due to the tight nature of the site a 500 tonnes crane was used to lift the modules into place. Once in place a bridge was constructed from the new apartment development to link into the neighbouring shopping centre to provide easy access for residents.

As the development was within the M25 and module widths were around 4 m, night time deliveries and installation was required.

The modules sit on a concrete plinth, with retail units on the ground floor. One of the aspects of this project was that stair and lift shaft modules were extended through the concrete plinth to level 1, which meant with an in-situ staircase instant access was provided to the modular structure above.

Benefits achieved

- Modules craned into position in five weeks
- Reduced disruption to trading and customers shopping experience
- Up to 80 per cent fewer vehicles movements to site
- A high level of design flexibility, both internally and externally
- Improved thermal efficiency for lower running costs and carbon emissions
- All factory waste diverted from land fill, with 80 per cent of site waste recycled.

Caledonian was a finalist for the Building Magazine Sustainability Awards for Sustainable Manufacturer of the Year 2011

Project information

Client: Clowater Investments

Architect: AWW

Engineer: Alan Wood and Partners

Project Managers: PSP

Contact information

Ian Kemp

Business Development Director

Caledonian Building Systems

01636 821645

BAA Heathrow T5C modular toilet. Design for Manufacturing Assembly + Commissioning (DfMA+C)

Main drivers/constraints

- Programme
- Health and safety
- Reduced trades and interfaces on site
- Saving on materials due to more efficient design
- BAA's requirement for continuous improvement
- Quality: work to be completed in a controlled factory environment with zero re-working on site
- T5A & B: T5C having to conform to the design of the BAA design performance standard.

Project information

In response to BAA's DfMA+C brief, Carillion proposed the idea of an off-site produced toilet. They explored the market place for potential suppliers who could deliver all of the packages related to a toilet build under a single source.

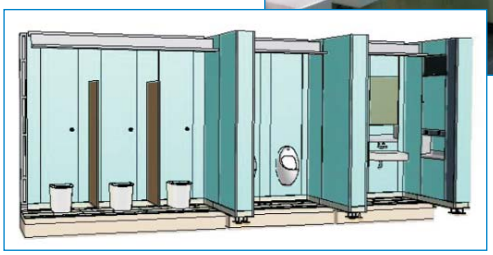
During the design the goal was to help make the assembly simpler, use more common and shared parts, minimise interfaces and make construction safer and efficient. These goals helped to deliver the strategy as laid out in Carillion's DfMA+C strategy document.

Although the basis of the design was related to the toilets as installed in T5A and B, Carillion challenged and drove forward a solution that enabled the pre-fabrication of system in a factory environment and in doing so helped to reduce the number of interfacing trades on site. The selected modular toilet supplier (Swifthorsman) delivered the toilets with the services completed off-site giving both programme and cost benefits.

Programme	=	approximately 30 per cent less than traditional build
Cost	=	11 per cent less than traditional build
Trades on site	=	80 per cent reduction in the number of trades involved with the toilets fit out

Benefits achieved

- Optimised and improved tolerance
- Improved quality and panel system robustness
- Minimised interfaces – one trade contractor
- Shorter programme – approximately 30 per cent saving
- Reduced assembly risk
- Fewer on site trades – over 80 per cent reduction in trades
- Zero damage and no inventory loses – zero accidents.



Project information

Client: BAA

CBI: Carillion Building

Architect: P+W

Contractor: Swifthorsman

Contact information

Design Manager DfMA (Carillion): Jas Dhami

Project Manager (Carillion): Roger Tarling

Technical Leadership (BAA): Richard Kelly

Design (BAA): Kay Greetham