

# Offsite & MMC in Affordable Housing

A Collaborative Research Project



# Turning a challenge into an opportunity

Foreword by Richard Hill,  
Director of Programmes & Deputy Chief Executive, HCA

We are entering a time when we need to make sure that the money we spend goes further wherever possible. However, what we must not lose sight of is that quality must never be sacrificed as a result, and that is the focus of this work.

“The case studies compiled in the report are exceptional. Adelaide Wharf which is, in particular, an excellent example of what the integration of different offsite systems can achieve. This project was built utilising a number of offsite technologies, and won awards for design quality. This shows signs of changing attitudes towards offsite manufacturing, and its ability to be at the centre of outstanding projects. It is not just about bathroom pods, which we have all started to view as “traditional”, but a much broader spectrum of technologies.

**I hope this educational report will generate debate around offsite and its benefits, and also to challenge some preconceptions.**

That’s not to say that this report looks purely at the benefits – it also discusses the challenges including that of generating high numbers of repeatable builds. The current changes to the funding of affordable housing may offer greater certainties on volume and this creates an increased opportunity for offsite and other innovative procurement methods.

The need for an increased supply of housing, however, does not - and should not - mean that people ultimately have to settle for a lower quality of housing. This report includes examples of where offsite can help deliver consistency by using advanced technologies to help to reduce errors in construction.

Offsite and MMC can offer clear benefits in terms of cost, speed of delivery and delivery. For these benefits to be delivered, it is important to understand the ways in which offsite can be used and the different construction processes. This report is an excellent place to understand these challenges – and to see excellent examples of work in this area.

Richard



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# An introduction to Offsite &

Housing Associations are continually being encouraged to use more MMC & offsite technologies in their projects, and usage has grown consistently since 2000. The sector has even been a testing ground for many new systems, but the recent focus on sustainability, the Code for Sustainable homes (CfSH), and the severe funding position has changed the emphasis on the need for buildability.



The pressure on the affordable housing sector to build more for less has never been greater - this is true both in terms of cost and CO<sub>2</sub> emissions.

For the benefit of all those involved in the provision of affordable housing, the time has arrived to re-assess where MMC & offsite technology has advanced to as manufacturers are encouraged to improve their products and delivery efficiencies in response to the economic climate.

Mtech, as the UK's only specialist consultancy for MMC & offsite, engaged nine collaborative sponsors and undertook an in depth study of recently completed affordable housing projects which used these technologies, and here provides answers to key questions that Housing Associations need to consider as they develop their future build strategies.

“What is the learning that can be derived from the projects where these systems and technologies have been used?”

“Can offsite and MMC be used to reduce the costs associated with achieving the Code for Sustainable Homes, especially the higher levels?”

“Are there better systems that we should consider, that can deliver real cost and sustainability benefits?”

It should be recognised that case studies of individual projects will always highlight site specific issues which are difficult to separate out, but by providing a carefully considered list of conclusions, we have focused our attention on the most important aspects of what emerged

Although we began by the project by working on seven available technologies that were identified by the sponsors who funded the research, this has expanded to take in additional systems that we believe also warrant consideration.

When most people think of MMC or offsite construction, they think of three dimensional **volumetric modular** blocks of building arriving at site on the back of a lorry. Volumetric maximises the work completed offsite in the factory and so minimises the work that needs to be undertaken on site. The effect of this is to minimise programme time on site and gain the most of the potential benefits of factory based production.

Traditionally volumetric construction has been the most expensive offsite solution and this has limited its' uptake in the housing market, but the new products which are the subject of the case studies in this report are committed to achieving costs which are truly competitive with traditional forms of construction at the level of true project out-turn costs.



# MMC in Affordable Housing



**Open panel timber frame** construction of two and three storey houses has become so common that it is no longer considered an innovative form of construction in the social housing sector. It is reliable, routine and generally cost competitive with traditional forms of construction, with a number of users claiming that it gives better overall project costings than traditional now that they have the processes and supply chains in place to maximise the advantages it can offer. The same techniques are widely used to construct larger buildings such as flats up to four, five or even more stories.

This report shows the emergence of more **advanced timber frame** solutions, with additional value added in the factory, including insulation, windows, doors, external cladding, etc. These solutions take more work offsite, with all the normal benefits associated with offsite techniques, and leads to a more rapid, higher quality dry envelope.

The ultimate in advanced timber frame panel is a **closed panel system**, where in addition to the insulation, windows and doors, the panel is closed off with internal wall linings. This maximises the speed benefit and the work completed offsite, and can start to approach the performance of a volumetric solution, though it does generate a lot more complexity in the jointing and connection details. It is therefore important to use a well

thought out and fully detailed solution using experienced installers and good support from the supplier.

We were encouraged by the number of projects that we identified that were using the more advanced timber frame solutions successfully and that in most cases they were doing so very competitively. This suggests that with further development and optimisation of the process these solutions could offer an even greater benefit in terms of quality, performance and cost.

**Structural Insulated Panel Systems (SIPS)** are another panel solution which give an air-tight shell with good thermal performance, and little cold bridging which is very effective where the design calls for maximised fabric performance to achieve higher levels of code. The costs involved could be justified by the fact that the finished panels do not tend to exhibit the shrinkage associated with conventional timber frame.





Timber is not the only material suitable for panelised building techniques. **Light Steel Frame (LSF)** works in a very similar way, and some would argue has the further advantages of: being a more stable material, is typically stronger section for section of comparable size, and can be more readily sourced in a wider range of structural sizes and strengths. This does make LSF suitable to use in apartments and taller buildings of 3 or more stories (St Georges Grove). In our experience can be a more expensive solution, particularly for low rise developments, but these case studies show that it can now be cost effective (Kirkham House).

The most robust form of construction uses **Concrete Panels**. These are more typically used in affordable housing on multi storey residential projects where their inherent fire resistance and acoustic performance can be exploited to the full. Pre-cast concrete panels are far more common in dwellings where this technology is usually more costly.

**Insulated Concrete Formwork (ICF)** is a simple, low tech, on-site but innovative method of building. They give good uniform insulation values with very limited cold bridging and very good airtightness. This technology has been used most often on smaller developments where the flexibility of building from small, light elements offers a benefit.

**Large Format Blockwork**, offer benefits in terms of reduced time on site and lower heat and air loss through joints that traditional blockwork, whilst retaining the familiarity of a simple material, from established bulk material suppliers. This has proved a very comfortable and cost effective if small step towards more innovative building techniques.

**Cross Laminated Timber (CLT)** is a robust solid wood system, using significant volumes of timber and therefore trapping a great deal of CO<sub>2</sub>, which had previously been considered an expensive premium, German product; however the

(Stadthaus) case study in this report suggests that this premium is now much reduced. The benefits of CLT in a building system are beginning to be appreciated in the UK. Its accuracy and simplicity are being exploited for apartment buildings, schools and other more traditional applications.

We are sure that you will find the information contained in this report as interesting and informative as we have

The team here at Mtech responsible for the compilation of this publication have found the exercise interesting, informative and in some cases surprising. It is our belief that social housing providers throughout the UK will be able to draw valuable lessons from the experience of their colleagues over the last few years.

We would like to take this opportunity to thank all of those who helped with this undertaking and look forward to continuing our support of the affordable housing sector through this challenging time and well into the future as the UK evolves its' standing as the pioneer of new building technologies and techniques.



# GreenGauge Homes - Lingwood - Norfolk

Housing Association: **Flagship Housing Developments for Victory Housing Trust**

Main Technologies Used: **Advanced Timber Frame**

## Drivers for the use of MMC technologies

To demonstrate the use of offsite and how the buildings thermal properties could be improved using these technologies.

The GreenGauge principle offers a potential solution to reducing embodied emissions whilst also saving emissions during occupation. GreenGauge Homes design principles combine low energy offsite technology with the use of sustainable materials and a commitment to using renewable energy sources where practical. It has a central aim of providing cost effective mainstream housing with reduced environmental impacts during construction and in use. The Lingwood development is a demonstration of an innovative approach to rural housing provision.

## Project Description

The development of 15 homes was built on a rural exception site (these are sites on the edge of, or in villages which have not been allocated for development in the local plan, but which might be suitable for small schemes of affordable housing for local people).

The scheme comprises 7 x 3 bed homes and 8 x 2 bed homes with 11 affordable for rent and 4 shared ownership. The homes were built to address the long-term sustainability of the community, and the tenants, who moved into the homes in March 2008 were local to Lingwood or with a local connection to the village.

## Method

A timber frame closed panel system with additional 75mm insulation around the outside fitted in situ, increased U-values beyond those available at the time of construction. Houses were constructed on concrete foundations with beam and block ground floor, cladding is untreated European Larch. The GreenGauge principle meant that the site was split into 4 technology groups:

One **Control** pair of homes heated with gas condensing boiler and controlled using smart energy monitoring.

A **Solar** group using solar power for a substantial proportion of energy requirements where solar

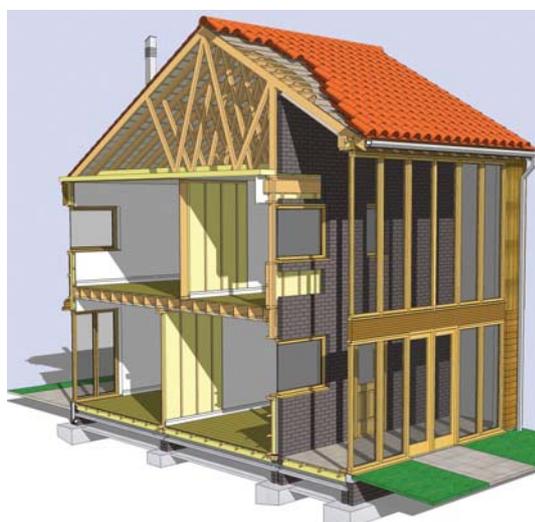
collectors pre-heated water fed to a gas condensing boiler for hot water and central heating, and Photovoltaic's supplement conventional electricity supply for lighting and power.

A **Sunspace** group incorporated a double height conservatory to the south facing elevation, facing brick Trombe wall to store heat during the day, and release it into the sunspace during cooler hours. A heat recovery unit heated and ventilated all rooms using energy from the sunspace, while backup heating was provided by a gas boiler with radiators.

A **Ground Source Heat Pump** group which had no gas supply. All space heating and hot water provided by a deep bore Ground Source Heat Pump in each house with under-floor heating.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£1,618,000
<b>It has a gross internal area of</b>	1149m <sup>2</sup>
<b>Which represents a rate of</b>	£1,394/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£1,618,000



## Additional Cost Data

The above m<sup>2</sup> cost is an average across the 15 dwellings and includes drainage at £30,737, external works at £254,993, and mains services at £41,000, prelims at £184,757, and fees at £68,598.

Average costs per m <sup>2</sup> per technology group	
Control	£760 - £765 / m <sup>2</sup>
Solar	£930 - £965 / m <sup>2</sup>
Sunspace	£940 - £960 / m <sup>2</sup>
Ground Source Heat Pump	£837 - £855 / m <sup>2</sup>

## Time Plan

Start on site March 2007 and completed February 2008.

## Environmental Impact

The University of East Anglia's, Centre for Social and Economic Research on the Global Environment, studied the buildings for a year and identified a significant saving in energy and carbon during both construction and occupation when compared with a notional UK average home. However, the homes that were all electric, despite the use of efficient GSHP technology, indicated high running costs when compared with homes with conventional high efficiency mains gas boilers and renewable technologies. This was attributed to difficulty with tariff choice; a situation that has changed considerably in the years since the project.

The study concluded that for social housing providers, training is fundamental in enabling front line staff to advise tenants appropriately on reducing energy demand and the use of unconventional energy systems.

A generic study by the same group identified that panellised timber frame modular systems,

produce buildings with a 34% reduction in embodied carbon when compared with a conventional heavy masonry construction. This method of construction, including the additional layer of insulation, contributed towards high levels of air-tightness on the scheme.

Production waste was either returned to the manufacturing process or, being produced in quantities that are viable for export offsite, recycled into other alternative processes and products.

During occupation the majority of energy and carbon savings were attributable to the high levels of insulation, attention to air tightness and ventilation.

## Measured Heat Loss

The timber frame, which has integral high performance insulation, was enhanced with an additional 75mm Celotex insulation between frame and larch cladding and had a U-value of 0.18 W/m<sup>2</sup>K

## Code Compliance & Associated Costs

The properties received an Ecohomes 'Excellent' rating and on completion were assessed to the CsSH (which had not been introduced at the time of construction). This assessment suggested they would have achieved Code Level 4.

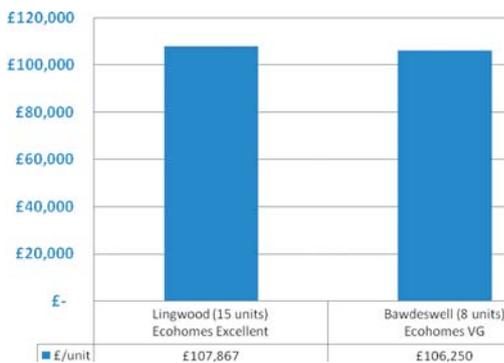
These features were incorporated at 5% above the cost of a standard Housing Corporation compliant scheme, (which was Ecohomes 'Very Good' at the time), and produced significant savings in running costs for the tenants.



## System Benefits

### Cost

A comparison between Lingwood and another locally built site during the same period showed the minimal cost variation and higher results achieved by the use of GreenGauge. Both schemes were built by the same contractor.



It should be possible to build GreenGauge Homes for 3-5 % more than an industry standard scheme if you use the average build cost of the 4 technology groups on the project, however, it is important to note that some categories would provide a lower cost solution and all would benefit from a reduced cost in use for both for tenants and management.

### Quality

No specific comments were recorded as to the quality of the build.

### Time

The project was not conceived to consider the construction time saving benefits and therefore no detailed data is available.

### General

The timber frame supplier was a relatively new company at the time and the manufacturing process used constantly underwent efficiency reviews in order to drive production costs down. As a result of this the electricity inputs into the production process were reduced by 46 % after the study period.

### Known Issues – During and Post Project

On a small construction site, such as those typical to GreenGauge, any 'waste' or surplus materials from unused contingency or over ordered materials are produced in relatively small quantities. Anecdotal evidence from observation of site operations suggests significant barriers, such as time, lack of local infrastructure and health and safety legislation, existed to hinder the reuse of these materials at the time.

The project was completed before the introduction of the Feed-In Tariff schemes and no income was therefore gained from contributions to the National Grid.



**Housing Association:** Flagship Housing Developments for Victory Housing Trust  
**Architect:** Barefoot & Gilles | **Developer:** Flagship Housing Group Ltd  
**Contractor:** Youngs Homes Limited | **Structural Engineers:** Scott Wilson  
**Suppliers:** Space 4 | **Date Complete:** 2008

# Kingshead - Castlefields - Runcorn

Housing Association: **Plus Dane Group**

Main Technologies Used: **Advanced Timber Frame,  
Air Source Heat Pumps.**

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## Drivers for the use of MMC technologies

Compliance to the CfSH, its requirement for lower U-values and improvement to build quality and site safety.

## Project Description

Kingshead was 1 of 10 developments forming part of a wider overall regeneration strategy for the Castlefields area of Halton in Runcorn. Existing large concrete maisonette flats were demolished one by one to make way for new low rise housing, which allowed existing residents to move into new homes before their block of flats was demolished. This scheme consists of 33 units: 18 x 2 bed flats, 7 x 2 bed houses and 8 x 3 bed houses.

## Method

A 90mm advanced closed panel timber frame system incorporating expanded polyurethane foam insulation was used in walls and upper floor cassettes. These were integrated on site with foundations, roof, doors and windows, brickwork and M&E installations. The roof components were assembled on the ground and lifted into place as erection of the timber frame was completed.

The exhaust air source heat pumps which provided space heating and hot water were installed by crane in tandem with the timber frame erection to save on time and crane costs, and solar panel installation was integrated with roof tiles. An immersion heater was incorporated to provide backup if needed. Tube solar thermal collectors were fitted on every property to equal coverage rather than the minimum required for code compliance.

Fresh air was introduced to habitable rooms via passive wall inlets, whilst the heat from the extracted warm air was used to preheat the system.

The first property acted as a 'trial unit' in order to develop the most efficient and integrated approach to all the processes for the remaining units.

## Cost Data

<b>The building was completed for a total net cost of</b>	£4,194,234
<b>It has a gross internal area of</b>	2783m <sup>2</sup>
<b>Which represents a rate of</b>	£1,511/m <sup>2</sup>
<b>Substructure</b>	£192,225
<b>Superstructure</b>	£1,400,586
<b>Abnormal</b>	£368,775
<b>On Costs</b>	not identified
<b>Total</b>	£4,194,234

## Additional Cost Data

These costs include £135,234 in fees, as well as £785,268 for services, drainage and site-works. The Substructure and Superstructure costs were £5,825 and £42,442 per unit respectively. The cost for the timber frame element was recorded as £11,237/ unit.

## Time Plan

The project was conceived in January 2009 with the build programme commencing on site on August 28th 2009 which was followed of 12 weeks of demolition. The project was handed over on September 2nd 2010 concluding a 56 total build programme.



### Environmental Impact

The scheme was built to CFSH Level 4. The advanced timber frame system with low U-values and sustainable credentials, added to the first priority, which was to provide an energy efficient fabric before the installation of renewables. The air-tightness detailing of the system ensured that energy was not lost through the fabric. In addition, the blown insulation was sealed in the robust panels under pressure and will maintain their integrity with no degradation of performance through their lifetime.

The combination of solar thermals with exhaust air heat pumps provided efficient space heating and hot water production as well as natural ventilation for comfort, and the properties incorporated high levels of natural light.

Materials were selected because of their sustainability, low embodied energy and durability (timber frame/ high spec timber windows) and pollution was controlled by selecting low impact materials.

The system provided improved U-values, Zero Ozone Depletion Potential (ODP), Global Warming Potential (GWP) of 1, a 60% reduction in building waste, 25% fewer deliveries to site, 50% fewer movements of vehicles, 50% noise level reduction.

### Measure of Heat Loss

The timber frame panels achieved a value of 0.16 W/m<sup>2</sup>K and the timber windows 1.2 W/m<sup>2</sup>K.

### Code Compliance & Associated Costs

All the properties were built to Code Level 4 standard, which resulted in a CO<sub>2</sub> saving of 44% above that required to meet Building Regulations. The Code uplift costs from Level 3 to 4 worked out at £5,782 per unit as there were additional unforeseen costs to strengthen floor joists in the flats to take the air heat pump units and also to increase sound insulation between flats.

## System Benefits

### Cost

The overall contract costs were reduced due to a reduction in prelims (£50,000 overall saving to contract, shared between client and contractor).

### Quality

Zero reported defects at handover, good air-tightness (5m<sup>3</sup>/m<sup>2</sup>/hr @ 50Pascals), and better control of thermal bridging because of the timber system detailing. Overall consistency of quality, noted specifically was the fit of kitchen units, less internal moisture and associated shrinkage. It is worth noting that the site agent gave top KPI credits for quality, delivery and erection of system.

### Time

There was a 10 week reduction in time on site based on the contract programme with associated reductions in prelims. The panels were delivered "just in time" and lean construction techniques were used to assist integration of systems and eliminate generation of defects in working practices, as well as maximise benefits of the fast erection system.

### General

The architects, engineers, contractor and main subcontractors worked as a team from the early stages to value engineer the design and maximise the benefits from the fast erection of the timber frame. Using lean techniques during construction greatly increased the benefits of using offsite, which resulted in the contract programme, in spite of service diversion delays!

The replacement of concrete blocks of flats built in the 1960s with high performance houses and apartments has had a substantial positive impact on the estate.

Greater control over Health & Safety with no reported accidents on site.

### Known Issues – During and Post Project

Zurich defects insurance was obtained and Maple had the required quality accreditations. The system was first developed for the domestic self build market and regularly attains NHBC approval so obtaining warranty for this scheme was a simple process.

Integration of both technologies and suppliers worked well due to careful planning by the site manager. The use of a consistent supply chain from previous projects meant ongoing improvements in quality partly made possible by the use of a Partnering Contract (PPC2000)

**Housing Association:** Plus Dane Group | **Architect:** John McCall Architects  
**Developer:** Plus Dane Group | **Contractor:** Cruden Construction  
**Structural Engineers:** Sutcliffe | **Suppliers:** MMC: Maple Timber Frame  
**Date Complete:** September 2010

# St. Catherine's View - Fowey - Cornwall

Housing Association: Ocean Housing

Main Technologies Used: Advanced Timber Frame, Air Source Heat Pumps.

## Project Description

7 units consisting of 3 x 3 bed houses, 2 x 2 bed houses & 2 x 1 bed flat, 5 of which were for rent and two shared ownership

## Method

The build used traditional methods of block and beam overlaying poured concrete strip foundations. From the ground floor upwards the superstructure then used an advanced timber panel system.

The advanced timber panels once delivered to site were immediately craned into position. The entire structure was then assembled within a matter of 4 weeks. A platform construction configuration was used throughout this structure, where each floor was set on the walls below, and then another storey of walls and so on up the building.

The panels, of up to 9 metres in length, arrived on site with all door and window openings having been pre-cut during manufacture.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£773,000
<b>It has a gross internal area of</b>	550m <sup>2</sup>
<b>Which represents a rate of</b>	£1,350/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal</b>	£28,000
<b>On Costs</b>	not identified
<b>Total</b>	£773,000

## Additional Cost Data

These costs included £82,000 in prelims, £14,000 for CfSH compliance (£2,000 per house), £13,000 for retaining walls and railings due to the nature of the site, £5,000 for alternative roofing tiles, £9,000 for off-site drainage, £5,000 works to roads and £2,500 for changes to specification of windows.

## Time Plan

Work commenced on site in November 2008 with the timber frame arriving at the end of January

2009. The framing was complete within 4 weeks and the water tight shell was ready for other trades 2 weeks later. The 7 dwellings were completed and ready for handover at the beginning of June. A reinforced concrete frame solution would typically take 40 weeks to complete and this timber frame build was programmed for 32 weeks and completed on time.

## Environmental Impact

Using this timber based construction method over steel and concrete for the superstructure caused significant reduction in carbon emissions, although precise savings have not been quantified.

Waste on site was not cost factored during this project as it was typically less than 1 skip per week.

## Measured Heat Loss

Using 100mm insulation, the U-value achieved exceeded Building Regulations and was calculated at 0.24 W/m<sup>2</sup>K

## Code Compliance & Associated Costs

This development was designed and constructed to meet CfSH Level 3 which was achieved. Ocean Housing reported an additional cost of £2,000 per dwelling when compared to traditional build to meet this code level.

## System Benefits

### Cost

The timber frames were delivered to site on 6 vehicles, which meant a 60% saving in vehicle movements compared to a similar project using concrete.

Direct placement of the timber panels using a mobile vehicle crane meant that a tower crane was not required on site and craftsmen assembled the build in considerably less time, dramatically reducing the builds labour costs.

The scheme saw the introduction of an NEC contract in lieu of the traditional JCT contract, to reflect the new framework in place for using offsite technologies. The contract was executed under option E, cost reimbursable, this resulted in a £50,000 saving from the original budget, even taking account of additional client variations.

### Quality

Neither the Contractor nor the Housing Association commented quality, with both timber frame and traditional build methods reaching the same quality standards.

### Time

Timber frame panels, delivered on time were erected immediately, and the buildings therefore water tight within 2 weeks. The programme benefited from traditional trades starting a lot earlier once the structure and roof of each of the dwellings had been completed. The estimated total time saving was 6 weeks compared to traditional.

### General

It was noted that with the use of timber frame, there were overall, far less defects found at all stages of the build.

### Known Issues – During and Post Project

Although the project was completed on time, there were early delays due to the requirement to relocate an existing underground high voltage cable and issues with the land transfer from Cornwall Council.

There were no tenant complaints at handover or at 6 months. Ocean Housing conducted a tenant satisfaction programme and received 100% satisfaction level of the overall quality of the scheme. Tenants also reported that the running costs were significantly lower compared to previous houses they had rented with either gas central heating or electric storage heaters.

This project was awarded National runner up in the 2010 Considerate Constructors Scheme Awards.



**Housing Association:** Ocean Housing Ltd | **Architect:** Architects Design Group  
**Developer:** Ocean Housing Ltd | **Contractor:** Gilbert & Goode  
**Structural Engineers:** MBA Consulting | **Suppliers:** Frame Homes  
**Date Complete:** 6th June 2009

# Astling Green - Blackpool - Lancashire

Housing Association: Great Places Housing Group

Main Technologies Used: Closed Panel Timber Frame, Photovoltaics (PV), Mechanical Ventilation with Heat Recovery (MVHR)

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## Drivers for the use of MMC technologies

The scheme was originally designed to achieve CfSH level 3, but to give flexibility for future upgrading to higher Code levels the design team aimed to achieve Level 3 without the use of low carbon energy technologies, relying solely on a high performance fabric. Additional low carbon technologies were used to lift the scheme from CfSH Level 3 to Level 5.

## Project Description

The scheme provided 8 x 3 bed affordable rented, semi-detached properties.

## Method

The walls were constructed using a closed panel timber frame system, with additional insulation to the outer face, a lightweight acrylic render and brick slip system. The low carbon technologies were used to lift the scheme to Level 5; included

18m<sup>2</sup> of PV panels per property, MVHR, Multifit Gas Saver Units and a rainwater harvesting system.

The walls, first floor and roof (closed panel timber frame kit) were provided on a supply and fit basis, and were erected upon the super-insulated beam and infill block flooring system. The external facades were then clad with additional insulation prior to the installation of a lightweight acrylic render and brick slip system, and the roof was finished using a single-ply membrane system. Windows on the project were triple glazed.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£1,174,840
<b>It has a gross internal area of</b>	801m <sup>2</sup>
<b>Which represents a rate of</b>	£1,466/m <sup>2</sup>
<b>Substructure</b>	£52,224
<b>Superstructure</b>	£804,856
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£1,174,840

## Additional Cost Data

Costs shown are based on achieving CfSH Level 5 and also include external works at £221,560 and fees & on costs of £96,200.

## Time Plan

The scheme brief was issued by Great Places Housing Group in September 2008, site analysis and initial sketch proposals were produced with the planning application being submitted in January 2009. The scheme received planning permission on 9th March 2009 with construction work starting on site at the end of May 2009. The period between planning permission being granted and start on site was used to make the Building Regulations submission, and develop a detailed design including the timber frame system. The timely placement of subcontract orders for the timber frame and precast concrete floor was crucial to provide sufficient time to fully design these elements of work, and commence manufacture to meet construction milestones. The overall build period was 48 weeks with handover achieved April 2010.

### Environmental Impact

The closed panel timber frame system allowed the houses to achieve an air tightness of  $4\text{m}^3/\text{m}^2/\text{hr}$  at 50Pascals.

To achieve CfSH Level 5 the scheme had to provide a 100% reduction in carbon emissions compared to 2006 Part L Building Regulation levels through improving building fabric performance and inclusion of low carbon micro-generation power equipment. The code also imposes strict waste management (SWMP) procedures for monitoring, managing and reporting waste as a result of the development.



### Measured Heat Loss

The measured heat loss throughout the building was  $0.12\text{ W/m}^2\text{K}$  for the walls,  $0.10\text{ W/m}^2\text{K}$  for the first floor and  $0.11\text{ W/m}^2\text{K}$  for the roof.

### Code Compliance & Associated Costs

The scheme was originally designed to meet CfSH

Level 3 (utilising offsite technologies) with the option to move up to Level 4 or 5 if additional funding was made available, which eventually it was through the HCA and GPHG to cover the uplift in costs of £23,400 per unit.

### System Benefits

#### Cost

The reduction in the overall construction period led to a reduction in weekly costs such as site management and welfare facilities.

The system used by GPHG incorporated interchangeable design that can deliver CfSH Level 3 through fabric performance alone, so it is easy and cost effective to upgrade to Level 4 and 5 by adding low carbon energy technologies.

#### Quality

The project has received a Building Excellence award from Blackpool Council which demonstrated that the end product was of a high standard. The modern methods of construction contributed greatly to this award in terms of the accuracy of the build and the finish achieved.

#### Time

Using this build system saved approximately 8 weeks compared to traditional brick and block construction. This would amount to a total saving of approximately £13,000 on weekly preliminary costs.

#### Known Issues – Pre Project

There was some issue with the integrity of the fixings of the lightweight brick slips to the external insulation. Work had to stop in wet or cold weather and in retrospect this work might have been better carried out off site.

The lightweight external cladding system created problems with the fixing of external items such as satellite dishes, and a pattress needed to be fixed to the structure before finishing. Residents were also advised that activities such as leaning a ladder against the cladding could cause damage.

**Housing Association:** Great Places Housing Group | **Architect:** Croft Goode Ltd  
**Developer:** Great Places Housing Group | **Contractor:** RP Tyson (Construction) Ltd  
**Structural Engineers:** Carley Daines & Partners  
**Suppliers:** SupaWall timber frame system, Springvale Beamshield  
**Date Complete:** April 2010

# Garden Road - Richmond - Surrey

Housing Association: Network Housing Association

Main Technologies Used: Closed Panel Timber Frame, Air Source Heat Pumps.

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## Note:

At the time of publication, the Garden Road project was still under construction and being built for the affordable housing market. However as this case study shows a recent and interesting solution to typical HA issues, it has been included.

The information contained here relates to Garden Road combined with information from a previous project of 7 apartments in Wimbledon. The previous project was not for the affordable housing market, but our investigations suggest that the information accurately mirrors what will be completed at Garden Road.

## Drivers for the use of MMC technologies

The HA were unable to enter into a contract for the purchase of the building unless it guaranteed that it would be able to receive the building by a specific date and so receive appropriate funding. The main driver then became speed of build.

## Project Description

Garden Road is 4 blocks of 4 and 5 storey buildings with a render and timber façade, comprising 77 flats and 2,322m<sup>2</sup> of commercial offices. There were 4 blocks in total with Block A being all social rented accommodation, 3 x 1 bed, 16 x 2 bed and 3 x 3 bed apartments. In Block B, 4 shared ownership and the rest private/for sale apartments. Block D, 56 private and 21 for the HA. Block C is the rented commercial element of the development.

## Method

Garden Road is using the same closed panel timber frame system complete with a factory finished render and timber cladding fitted on the exterior as was used for the Wimbledon project. Windows and external doors were factory installed as was: the insulation vapour control barriers, internal 18mm plasterboard and first fix M&E including all above ground drainage.

Exhaust air source heat pumps provide hot water and heating as well as fully ventilating the flats. On completion of the superstructure installation, the contractor was/will be left with an internal fit-out to complete.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£9,558,000
<b>It has a gross internal area of</b>	7525m <sup>2</sup>
<b>Which represents a rate of</b>	£1,270/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal On Costs</b>	not identified
<b>Total</b>	£9,558,000

## Additional Cost Information

The contractor is confident in replicating the same cost per m<sup>2</sup> shown above at the Garden Road project. The offsite element within this build is estimated to be £468/m<sup>2</sup>



### Time Plan

The pilot project in Wimbledon had an overall build programme of 22 weeks. The erection of the timber frame took 4 days.

Garden Road was originally conceived as a traditional build in 74 weeks. The use of offsite technologies plans to reduce this to 52 weeks including 10 weeks erection time for timber frame. 18 weeks of work will be carried out offsite first, which includes issue of final plans and manufacturing.

### Environmental Impact

Garden Grove will require 132 vehicles to deliver the structure, all of which will be scheduled on specific dates and times. At Wimbledon the reduction of the build programme meant far fewer traffic movements and subsequently less neighbourhood disruption.

On a traditional building site of similar size you would expect to fill 12 skips, this building system reduced that figure by over 90%.

### Code Compliance & Associated Costs

The manufacturer states that the CFSH Level 4 was achieved on the pilot project with no extra cost when compared to building using traditional construction methods; however we have been unable to evidence this statement against a cost estimate for building the Wimbledon project to a traditional Building Regulation compliant standard.

## System Benefits

### Cost

The increased speed of construction means that projects are completed in a greatly reduced time. The size of the build and the repeated floor plans of these specific projects offered a cost benefit through economies of scale.

### Quality

The joints in the plasterboard are chamfered rather than taped and jointed. Timber is kiln dried and the system uses 18mm plasterboard.

Improved air-tightness through precision engineering made it far easier to achieve CFSH Level 4 and maximising point scoring meant less reliance on more expensive technology to achieve minimum requirements.

### Time

Crane and scaffold were required for a shorter and more precisely defined period. Factory pre-installation of sanitary and electrical services mean reduced time on site.

### Known Issues – Pre Project

The issue highlighted by the manufacturer in respect to the original project related to the education of the contractor and his design team in understanding the need for an early completion to the detailed design.



# Victoria Villa - Margate - Kent

Housing Association: Orbit Housing Association (South)

Main Technologies Used: Open Panel Timber Frame

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## Drivers for the use of MMC technologies

The drivers were the need to achieve a high level of resident comfort and a desire to achieve a high BREEAM rating. A compact site with an extremely restrictive access also necessitated the use of offsite technology.

## Project Description

Victoria Villa is a 3 storey modern building providing sheltered housing for older people with enhanced care needs built in the grounds of a working day hospital. The accommodation is arranged to provide 5 x 2 bed flats and 35 x 1 bed flats.

## Method

The building was constructed using a combination of steel frame and timber frame panels. A podium level with steel frame and concrete/steel composite deck serves the communal areas, with the flats constructed from panelised, pre-insulated timber frame sections.

A crane was retained on site for the critical phases of the construction to facilitate quick deliveries, ensuring that the day hospital sharing the site was not disrupted in any way.

Close liaison with the hospital staff and PFI company was essential throughout the project to ensure that construction activities did not affect the running of the hospital or the hospitals visitors and patients.

To achieve the BREEAM excellent accreditation the buildings have been provided with: enhanced insulation, heat recovery ventilation, solar thermal/hot water panels, combined heat and power gas fired boilers, A and A+ rated appliances, and high scores in respect of waste management and site activities.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£4,633,536
<b>It has a gross internal area of</b>	2666m <sup>2</sup>
<b>Which represents a rate of</b>	£1,737/m <sup>2</sup>
<b>Substructure</b>	£150,706
<b>Superstructure</b>	£2,676,908
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£4,633,536

## Additional Cost Data

The total building cost also included the costs shown below;

Design Fees	£449,106
Site Preparation	£126,603
Electrical Installation	£349,579
Services	£217,295
Mechanical installation	£259,293
Drainage	£177,420
External works	£226,626



### Time Plan

The programme was originally 70 weeks and was completed in 72, despite 2 weeks being lost to inclement weather and 4 weeks lost to delays in the provision of utilities.

### Environmental Impact

The building, despite the high heat requirements of its residents, achieves CO<sub>2</sub> emissions 30% lower than specified in Approved Document L Part L2a 2006, and NO<sub>x</sub> emissions lower than 40mg/kWh. The building achieves this by utilising recoverable heat from its ventilation system, a high efficiency heating plant, incorporating high insulation values, producing electricity from its combined heat and power boilers and using solar technology to heat water.

18% of the energy needed to run the Victoria Villa is sourced from local, renewable or low emission sources.

### Measured Heat Loss

U-values measured were 0.09 W/m<sup>2</sup>K for the ground floor, 0.16 W/m<sup>2</sup>K for rendered external wall, 0.18 W/m<sup>2</sup>K for brick external walls, 0.18-0.20 W/m<sup>2</sup>K for the roof and 1.6 W/m<sup>2</sup>K for the windows.

### Code Compliance & Associated Costs

This scheme was planned and assessed prior to release of the CfSH scheme, and as the building is multi occupancy with shared and communal facilities EcoHomes was not applicable. The building was assessed under the BREEAM scheme to achieve a rating equivalent to an EcoHomes 'Excellent' accreditation.

There can be no direct comparison between CfSH and BREEAM as they are evaluated in different ways using different measures.

## System Benefits

### Cost

The cost of the build using timber frame was more expensive than traditional construction. Cost benefits were achieved by the speed of construction on site and the associated

preliminary costs, but the actual sum saved was not recorded.

### Quality

The quality of construction was found to be excellent, with particular emphasis on the timber frame. The timber frame manufacturer carried out their own snagging and quality control in advance of the contractors snag of the frame elements.

### Time

Time on site was reduced but there are no specific measures recorded.

### General

Disruption to the adjacent hospital and neighbouring houses was minimised and the crane was maintained on site for a shorter period of time.

### Known Issues – During and Post Project

After completion of the project, the timber frame sections of the building experienced pronounced settlement. Whilst this settlement was made good, discussions were ongoing with regards to mitigating the effects of settlement on future timber frame projects.

The building retained heat so well that there was a build up of excess heat in the communal areas on the second floor during summer months, and ventilation adaptations have been considered and will be incorporated into future designs.



# Gileston Road - St Athan - Wales

Housing Association: Wales & West Housing Association (WWHA)

Main Technologies Used: Structural Insulated Panel System (SIPS), Air Source Heat Pumps, Mechanical Ventilation with Heat Recovery, Under Floor Heating, Metal Seam Roofing.

## Drivers for the use of MMC technologies

The core driver was for WWHA to build a community of CfSH level 4 dwellings. It was also an opportunity to experiment and learn about offsite technologies and discover what advantages and disadvantages could be gained from using them.

WWHA also wanted to monitor resident's experiences of using the new eco technologies and provide the community with 'something special' on what was a prominent site in St Athan.

## Project Description

WWHA was involved in the working group for the Knowledge Exploitation Fund – Modern Methods of Construction with the Welsh School of Architecture (WSA), Welsh Assembly Government (WAG) and Building Research Establishment (BRE). Initially the Association's involvement was to provide the control site for measuring performance of traditional build against timber and steel offsite technologies, however as the project progressed the St Athan site was identified as being an opportunity to develop an advanced closed panel system to contribute to the research. The panel system selected was SIPS and working with the WSA and the HA's consultant architect, bespoke WAG compliant dwellings were designed and a site layout produced to provide 16 houses and flats in a variety of sizes.

The development consisted of 2 x 2 bed flats, 6 x 2 bed houses, 6 x 3 bed houses and 2 x 4 bed houses which were for affordable rent through WWHA. All of the properties were offered under the Vale of Glamorgan's Homes 4 U choice based letting system. This coincided with a 'local lettings policy' where preference was given to tenants with a local connection to the area i.e. who had lived or were living in the area.

The site was designed with a southerly aspect to take advantage of free solar gains to offset heating, to achieve good quality day lighting and sunny external spaces.



## Method

This rural exception site formerly housed a Methodist church that relocated to the surrounding area and presented no complications with respect to clearance for the build programme.

Strip foundations were created and the ground floors were concrete slab with insulation, under floor heating and a screed.

The SIPS were pre-cut to size in the factory and delivered to site without external render, windows or doors. The panels were lifted directly from the vehicle mobile crane directly into position.

Balconies were prefabricated offsite with sectional glazing completed once they had been placed and secured. The facade was a mixture of render and cladding the specification of both chosen for their longevity.

A timber truss roof completed the building envelope with a 'metal seam' weather proof system. The choice of metal seam rather than traditional slate or tile was made due to its long, maintenance free life and durability. This was done at no additional cost to the project.

**Cost Data:**

<b>The building was completed for a total net cost of</b>	£2,250,000
<b>It has a gross internal area of</b>	1831/m <sup>2</sup>
<b>Which represents a rate of</b>	£1228/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£2,250,000

**Additional Cost Data**

This was a design and build contract with the contractor and the only additional costs were those to clear the land i.e. demolition of the 1960's church building and scrub clearance a total £25,000.

**Time Plan**

The design process for St Athan commenced in December 2007 and took 12 months. The team included WWHA, WAG, the contractor, WSA and BRE who investigated all build methods that were suitable for the project as it was important to include a link back to the KEF MMC research that was undertaken.

Once it was agreed that SIPS would provide the best solution and allow for upgrading the code from level 3 to level 4, the contractor selected the supplier who commenced detailed design work in April of 2008 with full planning submitted in August 2008.

There was a short interim period between planning consent in December 2008 and work commencing in April 2009, and the first panels started arriving on site 8 weeks later, timed accordingly with the readiness of the site.

The watertight shells for all properties were completed in 9 weeks with no delays. Over the duration of the 40 week build

programme, which included the lead in period of 8 weeks referred to above, there were 6 weeks of delays due to poor weather.

**Environmental Impact**

The new homes reduced CO<sub>2</sub> emissions by 44% using air source heat pumps and under floor heating combined with highly efficient building fabric components, saving the residents an estimated £870 per year on heating bills.

It was reported that 86% of waste generated from the site was either recycled or reused. The masonry structure of the 1960's Methodist church previously on the land was recycled and used for the foundations of the new build.

Water usage on site was reduced by the use of a light weight render system, resulting in a 60% reduction in water compared to similar traditional build projects.

The WWHA board was careful to consider the environmental aspects of the project and there was a general commitment to support the agenda for environmental performance of the new buildings.

The building achieved air-tightness of 1.07m<sup>3</sup>/m<sup>2</sup>/hr @50Pascals for the flats and between 2.6m<sup>3</sup>/m<sup>2</sup> /hr @50Pascals and 2.9m<sup>3</sup>/m<sup>2</sup> /hr @50Pascals for the houses.

Early indications were that the 4 bed houses were using a comparable amount of electricity for heating and hot water to the 3 beds with only a marginal variance of 10%

**Measured Heat Loss**

The calculated U-Values for the project were 0.15 W/m<sup>2</sup>K for the walls, 0.20 W/m<sup>2</sup>K for the floor and 0.13 W/m<sup>2</sup>K for the roof.



## Code Compliance & Associated Costs

Built to achieve CfSH Level 4 instead of Level 3 as previously planned, meant that the properties were over 40% more energy efficient than level 3, which is 25% more energy efficient than traditional builds.

The uplift in cost compared to building to CfSH Level 3 was recorded as being on average £6,000 per property and mainly due to the cost of the heating system. The estimated uplift compared to building to traditional methods was estimated at £9,000 per property.

The design team considered a number of solutions with respect to the SAP calculations and investigated the use of PV cells as well as other renewables. If air source heat pumps and under floor heating had not been used then more renewable technology would have had to be designed into the properties at a significantly higher cost.

## System Benefits

### Cost

The total project cost was less than 1% more expensive than it would have been had the construction methods been traditional, and it should be noted that had the project been larger and the designs simplified, the project would have benefited from economies of scale.

At the time of this report, tenants had not yet been in residence for a full year and therefore the figures were not available to demonstrate true cost savings. WWHA are monitoring the dwellings until 2013 and it are expecting significant reductions in utility bills and that the project will be very close to the construction SAP's

### Quality

The quality of the final finish was reported to be excellent and down to 2 things; the quality and installation of the system, and the standardisation of many of the build elements. The panel manufacturer only needed to train the contractors' staff during the erection of the first dwelling.

## Time

Whilst the external finishing stages were ongoing there were 6 weeks of delays due to temperature and rain. These delays were almost retrieved during the remainder of the build process.

Increasing the CfSH to Level 4 and incorporating new technologies did lengthen the overall programme as the design stage was 12 months in addition to the build time. These technologies were new to the HA and so careful planning was paramount.

## General

WWHA feel that they have achieved what they set out to do in creating a community housing network that did not mirror typical social housing.

By using carefully selected materials and technology such as a roof seam system and self cleaning glazing, they have increased the longevity of the buildings and reduced the maintenance that would be typical for a more traditional style of build.

## Known Issues – During and Post Project

There were no significant issues at handover or in the following months once the tenants had settled into the properties.

The new tenants were invited to an open day before moving in, where they were introduced to the houses and the new way of living they would need to adopt. Following this, engineers were on site for each handover so that tenants were familiarised with the energy systems. After 2 weeks each tenant had a 1-2-1 with WWHA and the engineers to identify any issues relating to the property and specifically the new technologies within. The heating engineers returned in December 2010 to check the systems were working efficiently.

Following a 6 month tenant survey, the feedback identified that some tenants thought the first floor, where there were low temperature radiators was not as warm as the ground floor under floor heating, and this is under investigation to establish whether this is due to perception rather than user error or technical failing.

## Mid Street - South Nutfield - Surrey

Housing Association: Raven Housing Trust

Main Technologies Used: Structural Insulated Panel System (SIPS), Photovoltaics (PV), Mechanical Ventilation with Heat Recovery (MVHR)



### Drivers for the use of MMC technologies

The main driver was to deliver a CfSH Level 5 property instead of the code 3 originally planned by reducing energy demand, maximising passive solar gain and capture, maximising renewable energy and minimising fossil fuel usage.

### Project Description

The 2 x 2 bed flats were initially to be built to CfSH Level 3 however, the Housing Association and the contractor chose to upgrade the specifications to Level 5. This allowed the cost and practicalities of new technologies required to meet the higher levels of the CfSH to be explored on a small rural site before using them in a big development with their greater risks.

### Method

The foundation method used was piling allowing for a beam and block system ground floor with 75mm insulation block infill, 75mm insulation above and a 75mm screed.

Structural Insulated Panel System (SIPS) combined with additional 50mm of external insulation was used to form the inner leaf of the building giving a total thickness of 174mm and providing a thermally insulating airtight barrier.

The extra layer of insulation was needed to achieve the U-values required. The outer skin was completed using bricks and tiles, to provide a traditional appearance. Triple glazed windows minimised heat loss from large windows on the southern elevation while increasing natural light and solar gain. The roof used traditional trussed rafters.

A wood pellet biomass boiler shared between the dwellings powered the under-floor heating with electricity generated by PV panels on the roof. MVHR allowed heat energy to be recovered from out-going air while providing warm filtered fresh air to the house.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£334,000
<b>It has a gross internal area of</b>	132m <sup>2</sup>
<b>Which represents a rate of</b>	£2,610/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£334,000

## Time Plan

The ground work started in May 2007 with foundations being laid in November 2007. The building superstructure was completed to a water tight shell in 7 working days. The overall build was completion in April 2008 following a 32 week complete build programme.

## Environmental Impact

A target air-tightness of 2m<sup>3</sup>/m<sup>2</sup>/hr @ 50Pascals was achieved after being relaxed from the initial target of 1m<sup>3</sup>/m<sup>2</sup>/hr @ 50Pascals because of the inclusion of a wood pellet boiler and central heating system.

## Measured Heat Loss

Walls, which included an extra 50mm of EPS insulation at 0.14 W/m<sup>2</sup>K, Roof with 400mm loft insulation at 0.13 W/m<sup>2</sup>K, ground floor at 0.14 W/m<sup>2</sup>K and Windows at 0.8 W/m<sup>2</sup>K

## Code Compliance & Associated Costs

The price for Mid Street was approximately 20% more than the equivalent unit built to code 3 of £260,000.

## Extra costs to achieve SCH Level 5

SIPS & insulation	£12,800	Under-floor heating	£ 6,100
Air Leakage tapes	£1,000	Photovoltaic Panels	£19,000
Windows & Doors	£ 7,000	Thermal Store	£ 2,000
Heat Recovery system	£ 3,600	Additional fees	£ 13,000
Biomass Boiler	£11,000	<b>Total extra over cost</b>	<b>£70,000</b>



## System Benefits

### Cost

The SIPS system used was called “i-SIP”, where the specification of the panels was higher than normal, and as a result the amount of PV required could be reduced from the initially planned 1.81kWp to 1.59kWp per flat.

Using an independent wood pellet boiler reduced the renewable technology specification costs, with the additional benefit of being able to share the high heating and hot water output between the 2 maisonettes.

### Quality

The SIPS supplier was able to add a factory fitted internal fire protection lining using Lafarge Aqua Check to improve the performance of the i-SIP panel and further improve the air tightness.

Mid Street was quoted as being an ideal opportunity to show that modern houses can be highly energy efficient and aesthetically in tune with the surrounding area. In this case, Mid Street blended in well with the red-brick Victorian architecture of the village.

### Time

Using SIPS meant that a water tight shell was achieved in 7 working days, and allowed other trades to commence work sooner than when compared to traditional build methods.

### General

The contractor quoted that the core lesson to be learnt from this project was that it is necessary to spend extra time in the planning and design of a project using offsite technologies.

### Known Issues – During and Post Project

No reported problems at handover or within 12 months, although tenants had to be trained to use the heating, ventilation and renewable energy systems to maximise operating efficiencies.

Major air leakage pathways occurred at the corners of windows where tape had been used to try and create a continuous seal between the windows and the internal vapour barrier, but the joints were not continuously taped, with tape applied being cut off at each corner. This issue was remedied onsite but remedial work was not as effective as getting the structure airtight on the first attempt, particularly when many small, difficult-to-seal air leakage pathways were present. Any air leakage pathways identified early on in a project need to be dealt with immediately.

The layout of the units at Mid Street would have benefited from adjustment pre-planning to take account of the technologies and construction typologies decided upon.



**Housing Association:** Raven Housing Trust | **Architect:** Bloomfield Architects  
**Developer:** Raven Housing Trust | **Contractor:** Osbourne | **Structural Engineers:** N/A  
**Suppliers:** Innovaré Systems Ltd | **Date Complete:** April 2008

# St Andrews - Surbiton - Surrey

Housing Association: Thames Valley Charitable Housing Association

Main Technologies Used: Structural Insulated Panel System (SIPS), Photovoltaics (PV)



## Drivers for the use of MMC technologies

The client wished complete a project which would achieve CfSH Level 4.

## Project Description

16 dwellings for social rent, contained in a 2 block development of 3 storeys each, comprising 2 x 2 bed homes for 4 people, adapted to accommodate a wheelchair user, 10 x 2 bed homes suitable for 4 people, and 4 x 3 bed homes suitable for 5 people.

## Method

The contractor employed a design that utilised offsite technology through the use of SIPS, was given overall responsibility for achieving CfSH Level 4, and as such selected their own preferred method and associated technologies.

Due to the site being on the edge of a conservation area, a full brick skin was required to comply with planning conditions. The site itself was very tightly surrounded by adjoining properties so access was an issue. The use of a mobile crane to place finished panels was an ideal solution.

The panels arrived on site and were assembled to form a watertight shell within a matter of days. Once erected the traditional brick skin was applied while other trades were allowed to continue inside.

PV cells were used mainly to secure the extra points required to comply with CfSH Level 4.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£1,780,000
<b>It has a gross internal area of</b>	1192m <sup>2</sup>
<b>Which represents a rate of</b>	£1,493/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£1,780,000

## Additional Cost Data

£1493/m<sup>2</sup> included all ground works and the cost of communal areas, which represented around 10% of the sum, and made the actual rate in the region of £1350/m<sup>2</sup>.

## Time Plan

The project was conceived in 2004 and was initially designed without any use of offsite technologies, but it was always envisaged that the use of a timber based technology would be required if all the site issues were to be overcome and CfSH Level 4 achieved.

The land was acquired in January 2009 and on site work began in March 2009. The project was completed on time and within budget in the September of 2010.



### Environmental Impact

There was little evidence of reduction in terms of movement of vehicles on site or waste on site due to the requirement for a brick skin rather than using a more modern render or cladding system and its associated activities: scaffolding for example.

It is expected that as a result of using this system combined with a condensing boiler, there will be significant savings over time for the residents heating bills. These savings will be monitored over the 12 month period from the September 2010 completion date.

Thames Valley Housing reported that as a traditional method of construction was not financially viable if the CfSH Level 4 was to be attained, they did not compare like for like, but the use of this system was thought by them to have provided minimal environmental benefit on the site other than those generically associated with the use of offsite technologies.

### Code Compliance & Associated Costs

When compared to building using traditional methods to the same level of code, the use of a panelised system was found to be cheaper, although not quantified definitively. If a more traditional method was chosen additional technologies would have been required to reach the required points score. Volumetric modular was also considered as a method but discounted due to the non uniform layout and shape of the site.

## System Benefits

### Cost

Using such a well insulated system of building combined with a condensing boiler, it is expected that the residents heating bills will be significantly lower throughout the life of the building. The PV cells used provided power to the communal areas reducing any additional costs to the tenants.

### Time

Due to the requirement of a brick skin finish, the time saving benefits of using a panelised system were not fully realised. Although it is believed time savings were achieved when compared against traditional build methods.

### General

There were no general benefits reported on the project.

### Known Issues – During and Post Project

Due to the contractor selecting the method of build and employing their own architects once they had won the contract, there were no issues of integration, quality or cost. It was thought that this early involvement and understanding of the offsite technology used, was essential to the successful completion of the project. Initial feedback from tenants was very good and being monitored on an ongoing basis.

The project suffered no delays related to the use of offsite technologies but did suffer from the usual British weather delays which affected the more traditional methods used on the build.





**Affinity Sutton**

# Helping People

Affinity Sutton is one of the biggest providers of affordable housing in England with over 55,000 homes and a 100-year history. Today over 161,000 people up and down the country call an Affinity Sutton home 'their home'.

A business for social purpose we're committed to helping people put down roots and manage our money well so that we can invest our surpluses in what we believe in – our residents and our communities.

Our approach is to put our customers first and our structure puts residents at the heart of our decision making. We want to deliver excellent services across the country, yet be flexible to local needs. This approach has led to high levels of customer satisfaction.

**Current customer satisfaction levels are at over 80%.**

We invested almost £100 million in our existing homes in 2010. And as well as renting, repairing and managing homes we are also one of the country's top developers of new homes.

**In 2010 we completed nearly 800 new homes and at year end had almost 3,000 either on site or approved to start**

We recognise our homes do not exist in a vacuum and understand we have a wider role to play in our communities. We do this through our active community investment programme, which looks to tackle issues such as unemployment, debt and promoting healthy living.

**Our community investment work is safeguarded through the creation of our Affinity Sutton Community Foundation**



In addition we match-fund our internal £2 million community investment budget with external funding.

We are also here to give a helping hand to some of our communities most vulnerable people – from young people leaving care to older, more frail residents, we have a package of support services and accommodation that enables them to achieve their aspirations.

It's not just vulnerable people that need a helping hand though and we are increasing our offer to help meet the need for good quality affordable housing including part buy/part rent and intermediate rent; as well as homes for outright sale.

As an independent business with a strong sense of social responsibility we are keenly focused on maintaining our financial strength.

**This strength is demonstrated by our Moody's 'Aa2' long term issuer rating and our strong balance sheet.**



# Put Down Roots



## Here's a snapshot of some of our current projects

### Graylingwell Park, Chichester

Our multi award winning Graylingwell Park scheme in Chichester will be the UK's largest carbon neutral scheme and transform an 85 acre former hospital site. Set in parkland will be 750 new and converted homes, community amenities including artists' studios, allotments for residents to grow their own food, a farm shop, gallery space and creative business office space, all managed by a Community Development Trust. It is also estimated the scheme will create around 200 jobs for local people.

### Durand Close, Sutton

Built in the 1960's and in need of regeneration, the first phase of the redevelopment programme will soon be completed. Once complete there will be 420 new homes, a community centre and retail facilities. In addition we have developed over 100 houses across the borough to assist with the re-housing programme whilst the estate is being regenerated.

### FutureFit

FutureFit will help us meet the challenge of retrofitting our housing stock and meet the UK's carbon emissions targets. This £1.2M two year project will test practical approaches to making social housing more energy efficient and has already achieved Housing Forum Demonstration Project Status as well as support from the Energy Saving Trust. Residents and staff have been closely involved in choosing different approaches to help us find out what will work best.

### Affinity Sutton

Level 6, 6 More London Place, Tooley Street  
London, SE1 2DA

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Tel: 0300 100 0303



Three Housing Associations have come together to work in a group arrangement with economic benefits in structure and delivery of services. Operating together under the name of the 'ASK' Framework, the Aster Group, Somer Housing Group and Knightstone have collaborated on the procurement of framework arrangements for Contractors, Employer's Agents and Architects.

**Aster Group Limited**

– Passion for Excellence; Pride in Performance  
Aster Group is an ethical, social enterprise. Our inspiration is having a positive impact on people's lives.

We have assets of over £570 million, a turnover approaching £82 million and employ some 1100 people. We are the parent company of a number of high performing not-for-profit organisations operating in central southern and south west England that provide affordable housing for rent and purchase, care and support, development and property services. Our operating companies own and manage over 17,100 homes and provide services to more than 40,000 people.

We are a Homes and Communities Agency Investment Partner and provide development and other services for Group companies and partners. We have strong links with private sector developers and investors and manage rented homes to high standards for them.

The Group has been awarded Beacon Company status by the South West Regional Development Agency, recognising it as a forward thinking and successful organisation.

In recent years the Group has won numerous regional and national awards for its services and won five 'green' awards between 2009 and 2010. We have most recently achieved ISO14001 accreditation.

**Aster Group Limited**

Sarsen Court, Horton Avenue, Cannings Hill, Devizes, Wiltshire, S10 2AZ

Web site: [www.aster.org.uk](http://www.aster.org.uk)  
Email: [info@aster.org.uk](mailto:info@aster.org.uk)  
Tel: 01380 726001



**Somer Housing Group**

– Inspiring People, Inspirational Homes  
Somer Housing Group is a group of housing associations in the South West. The Group was formed in 2002 and is based in the World Heritage City of Bath.

Our vision is to support successful communities through the provision of housing, other quality services and enhanced partnerships.

Our members are:

- Somer Community Housing Trust
- Redland Housing Association
- Shape Housing Association

Somer Community Housing Trust is a social landlord providing around 10,000 affordable rented homes. Based in Bath, it owns homes across Bath, Somerset, Wiltshire, South Gloucestershire and the Bristol area. The charity has an active social housing development programme and invests £13m a year in its stock.



# Framework - A Joint Venture

Redland Housing Association is based in Bristol and manages 1,400 homes in Bristol, Somerset, South Gloucestershire, Bath and North East Somerset, and Devon. It has a long tradition of developing good-quality, family housing through a number of local authority partnerships.

Shape Housing Association is a specialist supported housing provider working in particular with vulnerable young people and homeless people. It runs a number of projects, including Bath Foyer, which provides support and training for young people aged 18-25, and the Dartmouth Project, which provides emergency temporary accommodation to homeless single people and families in the Bath area.

## **Somer Housing Group**

The Maltings, River Place, Lower Bristol Road, Bath, Avon, BA2 1EP

Web site: [www.somerhousinggroup.co.uk](http://www.somerhousinggroup.co.uk)

Email: [info@somer.org.uk](mailto:info@somer.org.uk)

Tel: 01225 366000



## **Knightstone Housing Association**

Knightstone Housing Association is one of the largest and most dynamic providers of affordable housing in the south west. They own and manage over 11,000 homes across 38 local authority areas.

### **Where are our developments?**

Our developments stretch across a wide area from Hampshire and Dorset in the south, through Wiltshire and Somerset, to Gloucestershire and Herefordshire in the north.

Our development programme provides between 200-250 new homes each year and includes affordable homes for rent, shared ownership and sale. We focus on regenerating key urban areas, affordable homes on large-scale new developments and sustainable homes for people who want to live in rural areas.

### **Partnering**

With an excellent reputation for development, we have approved strategic partner status from key regional local authorities including the Homes West (West of England) partnership. We are also a member of the Partnership South West consortium enabling us to bid for grant from the HCA (Homes and Communities Agency).

By working together with local authorities and major developers we're able to provide homes that meet the needs of local people.

As a result of our good practices and performance, we act as a development agency for a number of smaller Housing Associations in the south west, such as SHAL Housing Ltd, Bristol Community Housing Foundation, and NSHousing.

### **Improving our service**

We work in partnership with a number of external agencies to provide affordable homes that are of a high standard. Following on from our Client Charter status, we are now working to the 2012 Construction Commitments for affordable housing to ensure the continuing improvement of the service.

### **Homes for the future**

As well as building homes that are energy efficient and affordable to live in, we use designs and construction processes that incorporate suitable materials. This process not only reduces waste, but lessens the impact of our homes on the environment.

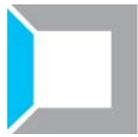
## **Knightstone Housing Association**

Station Road, Worle, Weston-super-Mare, BS22 6AP

Web site: [www.knightstone.co.uk](http://www.knightstone.co.uk)

Email: [talktous@knightstone.co.uk](mailto:talktous@knightstone.co.uk)

Tel: 01934 524300



Dolphin Square Foundation (DSF) is an ambitious independent charity with a mission to provide high quality, affordable homes for people working or living in and around Westminster.



*Proposed Lanhill Road development*

With funds of over £100 million, we aim to deliver 1,000 new affordable rental homes in this complex and challenging part of London by 2020. In addition, we are set to invest £350,000 in local projects through our Grants Programme.

#### **A commitment to our purpose**

DSF was formed in 2005 with an initial endowment of more than £80 million from the Dolphin Square Trust, following the sale of the Trust's leasehold interests in the Dolphin Square residential estate in Pimlico.

Our work is guided by a robust business strategy, focused on making long-term investments, achieving good returns on capital and making good use of expertise in the property market.

A key aim of DSF is to be financially independent and sustainable in perpetuity, gradually growing the size of our estate. This approach will ensure we are in a strong position to make significant investments and deliver much needed homes for an affordable rent, year after year, without any state subsidy.

#### **Setting a new standard**

DSF aims to set a new standard in quality, design and environmental measures for affordable housing in London. To achieve this, and to meet the needs of our customers and the communities we serve, our work is driven by a core set of principles:

- Listening to our customers – we make sure that our development respond to the diverse and changing needs of local communities
- Working with partners – we take a collaborative approach to our work and are always looking for new opportunities in the private sector
- Focusing on delivery – DSF investments are properly targeted and made at the right time to deliver the best results in the long term, for us, our partners and our customers.

All our work is focused on building vibrant new communities in the heart of London and giving people more opportunities to live, work and settle here. Developments range from studio apartments to three-bedroom homes. Rents are set at 60-80% of the market value, providing homes that cost no more than 40% of disposable income.

# A New Standard



Queen's Park development

Sustainability is at the heart of all our developments. DSF homes are low carbon, designed to protect the environment and to allow our customers lead a more eco-friendly lifestyle. To achieve this, we work with expert architectural and design teams to create innovative, cutting-edge designs.

## 2011 milestone

Early in 2011, DSF was given the green light for its first major housing development in Moreton Street, Westminster. The Moreton Street development will deliver 39 high quality homes offering studio, one, two and three-bedroom flats.

Created by Paul Davis and Partners architects, the design has been carefully crafted to complement the local area, whilst the inside of the units will be designed to meet and exceed the modern standards of Central London accommodation.

Construction of this significant scheme from DSF is scheduled to start in Spring 2011 with the new homes ready for occupation by Summer 2012.

With five further Central London developments in the immediate pipeline, this positive planning decision marks the start of an exciting future for our unique organisation.

## Contact Us

We take a collaborative approach to our work and are always looking to work with appropriate partners in the right localities. We know that we can achieve the best results by working with the right organisations, and DSF is looking to collaborate with the private sector, local authorities, other charities and suppliers to share our expertise and ultimately to ensure the best possible delivery for our customers.



Moreton Street development



Proposed Gorleston Street development

**Dolphin Square Foundation**  
1st Floor, 11 Belgrave Road,  
London SW1V 1RB

Email: [info@dolphinsquarefoundation.com](mailto:info@dolphinsquarefoundation.com)  
[www.dolphinsquarefoundation.com](http://www.dolphinsquarefoundation.com)

Genesis Housing Group is a registered provider of social housing. It combines a commercial approach to the business of providing housing with a distinct social ethos. Genesis provides homes, but also supports customers and develops communities. With an annual turnover of more than £230m, the Group is one of the largest and most diverse housing groups in the UK, owning or managing around 40,000 homes across London and the east of England.



Genesis delivers a broad range of housing services and solutions to a cross section of customers and communities. It provides a range of tenures, including affordable rent, shared ownership and various routes to home ownership, delivering innovative programmes to give more choice and flexibility.

Our remit goes beyond building and managing good-quality homes; Genesis is an established leader in developing initiatives within deprived communities, including the provision of training and employment programmes, financial inclusion programmes for young and older people, and tackling anti-social behaviour.

Our services are provided through three housing association subsidiaries: PCHA, Pathmeads and

Springboard as well as our charitable foundation Genesis Community.

Genesis has been at the forefront of building new affordable homes for over a decade and the development programme will deliver about 3,000 homes over the next three years. In 2009/2010, one in every 45 homes built in England was developed by Genesis.

Its resilience during a period of global financial uncertainty is something to be proud of. Genesis completed 2,062 homes in 2009/2010, an increase of 18% when compared with 2009. Over 500 homes were sold through shared ownership and a further 400 let as intermediate market rent.

# to Housing Needs



One of the smaller, but more challenging sites, recently completed was the 11 home development on Dowsett Road, Haringey. The extreme narrowness of this former leather tanning factory provided many challenges and led to an innovative solution to the homes' construction. We used a modular construction method by which homes were constructed offsite. This delivered a particularly efficient programme, with all the parts manufactured to exact

specifications, minimising waste and disruption to neighbours. It has also improved the quality of the area for local residents as waste ground has now been converted into homes.

Today, Genesis offers modern and dynamic solutions to housing needs, as a developer and owner and the provider of high-quality management and support services.



**Genesis Housing Group**  
Capital House, 25 Chapel Street ,  
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With over 60,000 homes and 120,000 customers The Guinness Partnership is proud to be one of the largest affordable housing and care providers in the country. Our top priorities are to deliver great services, homes and neighbourhoods and to be a great place to work.

The Partnership is a strong national force. We have four operating companies: Guinness Care and Support, Guinness Hermitage, Guinness Northern Counties and Guinness South that offer tailored housing and care services to a broad range of customers across the country. We are associated with reliability and financial stability. With a strong track record of success we are here for the long term.

***We are committed to really making a difference to the lives of our customers. This means listening to them and building houses they want to live in.***

In 2009/10 the Partnership's turnover increased to almost £270 million and delivered a strong surplus of 5% of turnover. We invested £40 million improving our existing homes and £77 million on creating new homes.

***Last year over 200 new customers bought affordable homes through our shared ownership and Rent-to-HomeBuy initiatives***

We pride ourselves on creativity and innovation in terms of finance, products and services. Our experienced National Investment Team has a broad range of specialist skills and expertise in using Modern Methods of Construction (MMC), combined with a proven track record for delivering new homes and retrofitting older ones.

Based in offices across the country, the National Investment Team has continued to increase the number of new homes that we procure through off site manufacturing methods. In parts of London where land and new affordable homes are in short supply, we are exploring how we can add additional floors

to existing apartment blocks and address the housing shortage by extending upwards.

***We have a wealth of experience and expertise in building new homes and communities. Between 2011-2013 the Partnership expects to build 3,000 new homes.***

We combine our use of MMC with sustainable solutions. Many of our new developments now integrate sustainable technology such as air source heat pumps, solar panels, rain water harvesting and non-structural kitchen and bathroom pods.

***We are constantly working to improve the quality, cost and design of our new homes through effective supply chains and working with established partners who champion innovation.***



# For The Future



Our priorities for the future are to continue to maximise opportunities for Modern Methods of Construction. The benefits of MMC are clear to us:

- quicker build times
- increased flexibility to build on tight or hard to reach sites
- improved on site health and safety reduced risk of defects and lower build costs
- greater durability and therefore reduce maintenance costs

Our commitment does not stop at MMC. We will work to make our homes easier and more cost effective for us to maintain and for our residents to live in, and we will help our residents look after their homes.

We also support people to access training and employment opportunities and to become active in their communities. In this way we aim to create the sort of social and economic balance that allows communities to thrive.



## Showcasing our homes

### Broughton, Milton Keynes

This mixed tenure English Partnership scheme includes a rainwater harvesting scheme, combined heat and power technology and non-structural kitchen and bathroom pods. All units have an eco-homes excellence rating and there was a 30% reduction in build time and construction waste.

### Denman Road, Wath-upon-Deerne, Rotherham

These timber framed homes are designed to make best use of location and orientation. The scheme is sustainability code level 5 combining a rainwater harvesting scheme, air source heat pumps and photo-voltaic cells which will provide 1.7kw of solar electronic generation to every home.



**The Guinness Partnership**  
17 Mendy Street, High Wycombe,  
Buckinghamshire, HP11 2NZ

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[www.guinnesspartnership.com](http://www.guinnesspartnership.com)

Innovation Chain NW is a knowledge sharing and research partnership of four award winning housing associations with a fundamental commitment to sustainable development and sustainable communities.



The members of the Adactus Housing Group build renovate and manage affordable housing for rent and sale. The Group's principle subsidiaries are housing associations, legally known as registered Providers, and regulated by the Tenant Services Authority.

The Adactus Housing Group was formed in August 2002 although its members trace their origins back to the 1960s.

Together the Adactus Housing Group owns and manages 13,500 homes across 25 local authority areas in the North West of England, employs over 550 staff and has an annual turnover in excess of £40 million.

The Group's main offices are in Chorley, Leigh and Manchester.

#### **Adactus Housing Group Ltd**

Turner House, 56 King Street, Leigh,  
Lancashire, WN7 4LJ

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Email: [info@adactushousing.co.uk](mailto:info@adactushousing.co.uk)



Harvest Housing group is a not-for-profit registered housing provider with over 18,000 affordable, high quality homes supported by excellent neighbourhood services. Our expertise enables us to work with communities to deliver a wide-range of local services to people with different needs in a friendly and professional manner.

Our main focus is our residents and customers – building communities and regenerating neighbourhoods so people can be proud of their homes and the places where they live. We are partners of first choice and leaders in the provision of a wide range of diverse products including social rented housing, traditional affordable housing for low cost home ownership, market-rent housing, housing PFI schemes, Extra Care for older people and staff accommodation for NHS Trusts.

#### **Harvest Housing Group**

Apex House, 266 Moseley Road, Levenshulme,  
Manchester, M19 2LH I

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Tel: 0161 248 2300

# & Research Partnership

Together we share learning, generate economies of scale, deliver efficiencies and drive forward construction innovation. We build green homes, streamlining processes and building constructive relationships with suppliers and contractors to reduce waste, reduce timescales and ultimately reduce costs. For us green means business.

Innovation Chain NW is expert in modern methods and lean construction processes.

Not afraid to do things differently Innovation Chain NW is leading the way on the governments' drive for low carbon housing and the code for sustainable homes agenda.

Some of the work already carried out includes:-

1. Designing a suite of exclusive house plans that meet the many and exacting requirements for social housing projects.
2. Pilot schemes testing methods to effectively meet higher levels of the code for sustainable homes and future zero carbon ambitions.
3. Brokering supply chain agreements for specific construction elements such as timber frames and renewable technologies.
4. Working with contractors to maximise the benefits of lean construction.
5. Investigating the benefits or otherwise of innovative construction materials and off site processes.



Great Places is a housing association that provides over 15,000 high-quality homes in 30 council areas across the North West and beyond. Go to our Development and regeneration page to see a map of the places in which we work.

We count all sorts of organizations among our family and friends. We're constantly working with others to find superb solutions to housing and community needs, and turn grand plans into workable, sustainable reality.

We work in neighborhoods all over the north to help them thrive, shine and be truly great places to live. We develop and manage some of the best affordable housing around and provide all sorts of community support, always with passion, imagination and dedication.

#### **Great Places Housing Group**

Southern Gate, 729 Princess Road  
Manchester, M20 2LT

Web site: [www.greatplaces.org.uk](http://www.greatplaces.org.uk)  
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Tel: 0161 447 5000



Plus Dane Group is a Neighbourhood investor. We maximise investment in neighbourhoods so that people's quality of life, opportunity and choice is continually enhanced.

We are able to spend less on running our business and more on quality services that benefit people, homes and neighbourhoods because we continually engage people in setting our priorities and monitoring our performance.

We have over 15,000 homes in ownership and management across Merseyside and Cheshire and are one of Britain's Top 100 companies to work for, employing over 500 people. We have an asset value in excess of £500m, a combined development fund in excess of £260m and a turnover of £52m.

#### **Plus Dane group**

Baltimore Buildings, 13-15 Rodney Street,  
Liverpool, L1 9EF

Web site: [www.neighbourhoodinvestor.com](http://www.neighbourhoodinvestor.com)  
Info.Developments@neighbourhoodinvestor.com  
Tel: 0151 708 0674

#### **Innovation Chain NW**

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Liverpool, L1 9EF

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# Modern Methods of Const

Orbit Homes is the house-builder and house-seller of the Orbit Group and aims to develop 1000 homes per year by 2012 across the Midlands, South East and East of England. Orbit works with its partners and with communities, helping to regenerate and redevelop in a sustainable way to provide affordable, high quality homes.



Orbit Homes uses modern construction methods to support its belief that the housing sector needs to innovate to ensure fit-for-purpose homes for residents. As part of this, Orbit Homes uses the following off site construction methods:

- PassivHaus – offsite timber frame construction leading to faster on-site erection, coupled with provision of highly sustainable homes
- MMC – faster construction, fireproof units, lower maintenance requirements
- Steel frames – Lightweight robust construction with minimal on site waste

## What makes Orbit Homes different from other developers?

- Our social purpose: we re-invest our surpluses into the charitable side of the business
- We are here for the long term: we retain an interest in all of our developments We are a Developer of Choice for our partners, stakeholders and staff: we are good to do business with and stand by our decisions

## The team

Any organisation’s strength lies with the quality of its people. The Orbit Homes development team brings together what we believe is a unique blend of experience, skills and knowledge from the public and private housing sectors. A cohesive and hybrid team that means Orbit Homes can successfully deliver the full range of tenures from social rent to market sale homes.





# Construction for a Brighter Future



## 2010 landmark achievement

2010 saw the start on site of 'Aspire' at Norse Road, Bedford, Orbit's biggest ever development with 326 homes

- Outright sale led
- £4.6 million Kickstart 2 funding obtained
- Apprenticeship links with local college
- Full support from local community and partners

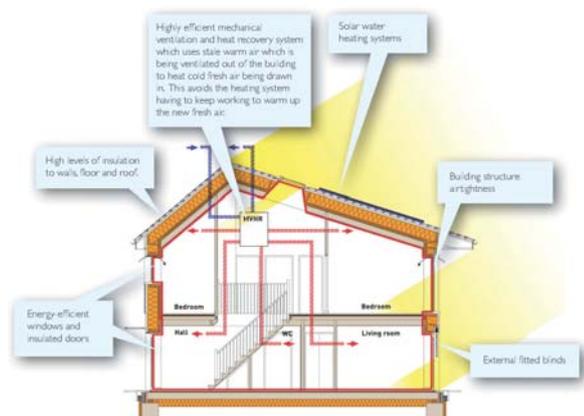
## Sustainability

Orbit Homes works to ensure sustainability in all new developments and is increasingly building to Sustainable Code for Homes level 4 as well as implementing PassivHaus at its Sampson Close site.

## Community

Orbit Homes sets itself apart from other developers by putting surpluses back into the charitable side of the business to meet housing needs. The Orbit Homes development team forms partnerships with communities to understand their needs, working to provide the homes, facilities, jobs and training required – currently there are six training places on Orbit Homes projects and more are planned.

### PassivHaus Features



## Orbit Homes

Garden Court, Harry Weston Road,  
Binley Business Park, Binley, Coventry, CV3 2SU

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[www.orbithomes.org.uk](http://www.orbithomes.org.uk)



Manchester is a powerful city at the heart of Greater Manchester with a great deal of self belief and ambition. Our aim is to be a city that meets and exceeds the needs of its residents and stands unique in its enterprise, creativity and industry.

Loss of much of our manufacturing industry in the last century meant that there was a drain of working households to other neighbourhoods. This led to vacant and abandoned areas, a concentration of social rented homes with significant pockets of deprivation, worklessness, long-term ill health and disability, and a lack of skills and aspiration. Fortunately, through our residents, strong leadership, innovation and dynamism we have had the determination to rebuild and regenerate it to the extent that the city now has the strength of being the core of the economy of Greater Manchester and the north west.

In recent years we have been able to attract employers, so there has been an expansion of economic opportunities leading to a growing population of economically active residents. The number of households in Manchester has increased by 37,549 in the past ten years. There has been major investment in physical infrastructure and the built environment and we have taken the first steps to address the challenge of a failing housing market.

What we have achieved so far:

- We have demolished more than 2000 obsolete homes in the past five years and they are being replaced by high-quality housing – over 24,000 new homes have been built in the past ten years
- The city centre is an attractive place to live for over 10,000 households, and is meeting the demands of a young and mobile workforce
- In east Manchester, former industrial areas have been transformed that now provide quality homes and neighbourhoods

- In partnership with residents we have made dramatic improvements to the homes and estates of social housing through the Decent Homes Programme, which has transferred our housing estates to new not-for-profit landlords
- Private Finance Initiatives are revitalising some of our worst housing estates
- 255 empty properties have been brought back into use over the past two years
- We have increased the energy-efficiency of some 18,500 homes
- There is an established loan and housing assistance scheme that has helped more than 50,000 owners maintain and improve their homes in the past five years
- We have helped thousands of families threatened with homelessness by finding solutions that prevent them from having to move into temporary accommodation



# Creativity & Industry



We must now maintain momentum and refocus on the people who still miss out on opportunities. Housing underpins and supports work to promote aspiration and skills and to ensure that everyone is included in the benefits of the city's growth.

The balance of housing types and tenures is still not right in many neighbourhoods; we want all our localities, different as they are, to offer homes for a mix of lifestyles.

We need to provide housing that attracts and retains new and former residents to the city, and we need to help those who want to be homeowners – more so now mortgages are not easily accessible.

Meeting the challenge of climate change and managing our use of energy are important for our future economy and the wellbeing of our residents.

## A new approach for growth

The economy has changed a great deal over the past two years. At a time when the housing market is likely to remain changeable for some years, and funding is restricted, we need to be innovative to deliver changes for housing in Manchester. We need new partners and new initiatives to keep the city growing. This means:

- Using our land and assets to work with the private sector and institutional investors to meet demand for new homes
- Supporting developers to overcome barriers to building new homes
- Looking for solutions that do not depend on public subsidy

- Tackling the unsustainable use of energy in our housing stock
- Finding new solutions for those households that wish to become homeowners.

## Delivery through our partnerships

We have already achieved a massive change through working together - with other local authorities, with Registered Providers and landlords, with tenants and residents. We look forward to facing the fresh challenge of engaging with new partners in the private sector to deliver new investment opportunities, and to the challenge of delivering our vision with our partners.

Our vision is the creation of neighbourhoods of choice. Successful neighbourhoods that attract and retain people from diverse communities and in which people feel secure and supported and reach their full potential.

We are building places and homes that increase prosperity, happiness and health, and which will meet the needs of a competitive city region.

At the core of what we are doing are three key objectives:

- Enhancing opportunities to access homes for residents with raised aspirations and a sense of self-esteem
- Raising the quality and sustainability of our homes and neighbourhoods
- Increasing the quantity of housing to ensure that the right types of housing are available in the right places

## Manchester City Council

PO. Box 532, Town Hall,  
Manchester M60 2LA

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[www.manchester.gov.uk](http://www.manchester.gov.uk)

Your Homes Newcastle manages around 30,000 properties on behalf of Newcastle City Council and has recently embarked on an ambitious building programme through its Charitable Subsidiary Leazes Homes to build new affordable homes.



Delivery of new build is facilitated through a panel of developers. The developers have been appointed to a design and build framework agreement and respond to opportunities through a call-off process. This arrangement maximises the expertise of all parties and ensures scheme costs are competitive through minimising duplication between the parties. It also provides a flexible and responsive mechanism to delivery with minimum upfront financial commitments needed from the parties and therefore reduced financial risks.

YHN's new build programme has been going for around 2 years. The programme is currently running with 180 affordable homes and 98 private homes. The programme includes a variety of property types and includes both supported and general needs accommodation.

### Showcasing our homes

#### Young Families Housing Scheme

Kenton, Newcastle upon Tyne.  
Construction partner FHM,  
architect Jane Darbyshire and David Kendal.

A Scheme consisting of a block of flats with 15 units and four standalone properties, the accommodation is used specifically to support young families. Analysis has shown if young families are provided with some support at an early stage then the likelihood of positive outcomes for employment, education and health are greatly enhanced.

#### General Needs Housing Scheme

Throckley, Newcastle upon Tyne.  
Construction partner Barratt Homes North East,  
architect ID Partnership.

Mixed tenure scheme consisting of homes for sale and affordable homes for rent, all units built to Code for Sustainable Homes Level 3.

#### Learning Disabled Housing Schemes

Fossway and Napier Street, Newcastle upon Tyne.  
Construction partner FHM, architect Jane Darbyshire and David Kendal.

The two schemes to provide supported housing are designed to provide high quality, bespoke housing for people with learning disabilities, but also reduce the revenue costs to the statutory sectors in providing support to this client group. Timber frame construction in both cases with a BREEAM very good standard for both.



# Building Programme



## **Bolam Coyne, Renovation**

Construction partner Wates, architect Ryders.

Bolam Coyne is a property that sits within the Byker Estate. The Byker Estate was designed by Ralph Erskine and has a Grade II\* listing and is regarded as being one of the United Kingdom's most important 20th century housing schemes. Bolam Coyne is a distinct building originally consisting of 19 dwellings of different types. Bolam Coyne is cited as being one of the most important buildings on the estate.

The building had been empty for 10 years, is in a state of disrepair and classified as an abandoned building. The scheme will provide 15 dwellings that meet the current housing needs of the local community.

The building is being brought up to modern standards and will achieve Code 3 for Sustainable Homes Level 3 but also preserve the character, appearance and special interest/ significance of Bolam Coyne, including its landscape features.

## **General Needs Housing Scheme**

Blakelaw, Newcastle upon Tyne.

Construction partner Keepmoat Homes, architect John Thompson and Partners

A mixed tenure scheme consisting of homes for sale and affordable homes for rent with all affordable units being built to Code for Sustainable Homes Level 4.



## **Your Homes Newcastle**

YHN House, Benton Park Road,  
Newcastle upon Tyne, NE7 7LX

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[www.yhn.org.uk](http://www.yhn.org.uk)

# John Bond House - Tower Hamlets - London

Housing Association: Gateway Housing Association

Main Technologies Used: Light Steel Frame (LSF), Floor Cassettes



## Drivers for the use of MMC technologies

The main contractor chose this form of technology to meet the requirement of the HA to use offsite within the build. Additional drivers included; immediacy of erection from delivery vehicle, speed of build, and resolution of other issues surrounding construction on a compact urban site.

## Project Description

John Bond House is a 4 storey mixed tenure apartment building comprising 24 units, of which 8 are shared ownership, and 16 for rent through the HA. The flats consist of: 4 x 1 bed, 9 x 2 bed and 1 x 3 bed. The maisonettes are 5 x 3 bed, 5 x 4 bed. The site was located in an urban area with pavements on 2 elevations and buildings on the other 2.

## Method

The load bearing cross walls were double leaf separating walls manufactured using 100 x 1.6mm C sections at 600mm centres. The cross walls were braced to resist the imposed wind loads and provide support for the floor cassettes.

The external cladding to the steelwork was a mixture of brickwork for the lower floors and insulated render above.

The floor cassettes were a maximum of 5.9 metre span and width of 2.5 metres for transport with 18mm OSB pre-fixed to the upper face. They were designed to support the weight of the stairs within the duplex apartment and had the potential to add in disabled lift access due to the inclusion of a “knock-out” panel in the floor cassette. The cassettes were manufactured from 250mm deep x 2mm thick C sections placed at 400 mm centres with Z sections attached to their ends. This enabled the cassettes to be supported by one leaf of the separating wall.



**Cost Data:**

<b>The building was completed for a total net cost of</b>	*£3,100,000
<b>It has a gross internal area of</b>	1963m <sup>2</sup>
<b>Which represents a rate of</b>	£1579/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£3,100,000

**Additional Cost Data**

\* This cost is the overall contract value including all services and external works

**Time Plan**

12 weeks were allotted to supply and install the cassette floors and prefabricated walls out of an overall build programme of 45 weeks. An installation rate of 5 cassettes per day and up to 150m<sup>2</sup> of wall panels was achieved with a 5 man crew. A single delivery per day was programmed to site at a time to suit local traffic.

**Environmental Impact**

Waste was designed out of the system enabling the factory construction of the steel structure to be extremely efficient. Factory waste was in the region of 0.5%.

The LSF was manufactured in a factory in South Wales and delivered to site in London.

The air-tightness within the development was less than 5.0m<sup>3</sup>/m<sup>2</sup>/hr @ 50Pascals.

**Measured Heat Loss**

The external steel walls achieved a U-value of 0.19 W/m<sup>2</sup>K using 60mm of closed cell PIR board externally and 100mm of mineral wool placed between the wall sections. Floors achieved a U-value of either of 0.15 or 0.2 W/m<sup>2</sup>K with roofs achieving 0.15 W/m<sup>2</sup>K.

**Code Compliance & Associated Costs**

The building was built to CfSH Level 4 and the Lifetime Homes Standard.





## System Benefits

### Quality

The build up of the floating floor was designed to satisfy the 5dB improvement on the Building Regulations as required CfSH Level 4 for acoustic requirements.

A high accuracy in manufacture and installation was achieved and the measured end gaps for the floor cassettes did not exceed 3mm.

### Time

The 12 week erection programme of the LSF meant that the whole project could be completed in 10 months, potentially 6 months quicker than more traditional methods of construction.

### General

The “just-in-time” delivery principle saved the

requirement for on site storage as well as the double handling of components.

The open design of the wall panels meant that external finishes could be applied from inside the building, which was necessary as due to the close proximity of the adjacent buildings there was no scaffolding.

### Known Issues – During and Post Project

The original manufacturer of the LSF went into administration during the early days of the project and finding an alternative caused delays within the construction process.

The choice of stairs was changed from prefabricated steel to precast concrete during the course of the project. This was not the preferred option of the HA due to perceived issues with the CDM regulations and how the stair would be supported.

# Kirkham House - Whitby - North Yorkshire

Housing Association: Broadacres

Main Technologies Used: Light Steel Frame (LSF) & Floor Cassettes

## Drivers for the use of MMC technologies

The speed of build appealed to the main contractor as a way of enabling the smooth interfacing with subsequent trades. Another significant driver was that the use of LSF enabled the number of site operatives to be reduced dramatically meaning only one site manager needed to be employed.

## Project Description

The project is a 3 storey development consisting of 12 apartments with 8 for rental and 4 for sale through part ownership.

## Method

The LSF panels for the external and internal walls were constructed from 75mm cold rolled steel sections for the non-load bearing internal walls, and 100mm sections for the external and internal load bearing walls. The external walls were supplied from the factory with rigid insulation externally and the internal walls as panels only. All the wall panels were delivered using stillages. The finishes to the external wall panels were a mixture of brickwork and insulated render.

The ground floor was constructed as a raft foundation, and the intermediate floors were

supplied as steel floor cassettes. The floor cassettes typically comprised 250mm high sections 2.4m wide and were supported in between structural beams. All the prefabricated walls were manoeuvred by forklift for the ground floor elements and hoisted into position for the 2nd and 3rd floors.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£690,000
<b>It has a gross internal area of</b>	670m <sup>2</sup>
<b>Which represents a rate of</b>	1,029/m <sup>2</sup>
<b>Substructure</b>	£570,000
<b>Superstructure</b>	£120,000
<b>Abnormal On Costs</b>	not identified
<b>Total</b>	£690,000

## Additional Cost Data:

This included the cost of the foundations but excluded the cost of the external works and services.

## Time Plan

The build programme allowed 6 weeks for the installation of the steelwork on site using the contractors own installers.





### Environmental Impact

Testing of the individual apartments revealed that the air-tightness exceeded Building Regulations with an average of  $3\text{m}^3/\text{m}^2/\text{hr}$  @ 50Pascals

In total there were 6 vehicle drops required to deliver the prefabricated elements to site.

The only waste by-product of unloading the prefabricated LSF elements was the banding used to tie the panels to the stillages.

The floors were designed with an acoustic sound reduction of 59dB and an impact sound of 54dB.

### Measured Heat Loss

The overall U-value achieved with 65mm of rigid insulation to the external frame and brickwork skin was  $0.18\text{ W/m}^2\text{K}$

### Code Compliance & Associated Costs

The development achieved CFSH Level 4.

## System Benefits

### Cost

The light weight nature of the superstructure enabled the raft foundations to be much lighter than normal, providing a saving of approximately 30% on groundwork costs to the client.

### Quality

No specific benefits in terms of quality were reported by the site.

### Time

Completion of the superstructure was much faster than it would have been using traditional build techniques, which meant that other trades were able to access the building and complete their works sooner.

### General

The fact that the entire fabrication, assembly and installation were provided by a single contractor appealed to the main contractor from the outset with it requiring less management.

The use of LSF resulted in a cleaner site with fewer on site operatives.

### Known Issues – During and Post Project

There were some minor on-site problems with tolerances being out of range and these were rectified prior to the installation of the wall panel frames.

There were no defects other than minor snagging issues from the tenants. The comments received were very good from both the housing association and tenants.



# St George's Grove - Tooting - London

Housing Association: Thames Valley Housing Association  
Main Technologies Used: Light Steel Frame (LSF) and Bathroom Pods

## Drivers for the use of MMC technologies

The contractor, Willmott Dixon wanted to demonstrate to the HA the benefits of using offsite technologies; improved efficiency, greater build predictability, leaner construction processes, less waste, greater opportunities for standardisation. The key drivers for the HA using LSF and Bathroom Pods were speed, repeatability in design and avoiding the shrinkage issues experienced previously with timber frame.

## Project Description

The project consisted of 557 key-worker rented bed-spaces and 78 shared ownership flats. The key-worker units provided residents with fully furnished studios, 1, 2, 3, and 4 bed cluster flats. The socially rented homes consisted of 54 studio flats, 28 x 1 bed, 45 x 2 bed, 35 x 3 bed and 70 x 4 bed apartments. The New Build Homebuy (This shared ownership option offers brand new homes for sale on a part buy / part rent basis), was made up of 40 x 1 bed and 38 x 2 bed apartments.

## Method

The St Georges project utilised a highly engineered factory insulated light weight steel frame system, where the external and load bearing walls were manufactured using 100mm 'C' studs, 1.2mm to 3.2 mm, depending on the applied loading from the floors above. These floors were manufactured in large pre-boarded cassettes with a combination of 250mm deep C section and lattice joists.

The three large blocks up to 5 storeys in height had a total floor area close to 25,000m<sup>2</sup> and the long span steel floor cassettes gave flexibility to the internal fit out of the individual apartments.

The External panelised wall and floor cassettes and the bathroom pods were delivered 'just in time' as required on site and were lifted into position by a tower crane.



## Cost Data:

<b>The building was completed for a total net cost of</b>	£37,484,047
<b>It has a gross internal area of</b>	25,115m <sup>2</sup>
<b>Which represents a rate of</b>	£1,492/m <sup>2</sup>
<b>Substructure</b>	£1,657,172
<b>Superstructure</b>	£20,785,647
<b>Abnormal</b>	£1,330,442
<b>On Costs</b>	not identified
<b>Total</b>	£37,484,047

## Additional Cost Data

\*These are contractual costs supplied by Thames Valley Housing. Completion due in March 2011.

This was a PFI deal with the hospital trust, which included a 35 year lease to Thames Valley HA and had an agreed maximum price of £37M for both phases.

## Time Plan

Start on site was July 2007 with completion March 2011, due to the size of the scheme residents remaining on site and a huge decant process, it was necessary to split the project into 2 phases. Phase 1, which provided 381 key-worker rented bed-spaces started on site in July 2007 and completed in August 2009. Phase 2 which built out the remaining key-worker rented (176 bed-spaces) and the 78 Shared Ownership flats began in September 2009 will be complete in March 2011.

The installation period of the light steel framing was 26 weeks out of a 92 week overall construction period for the project. A 12 man installation crew was used throughout the 26 weeks, achieving an impressive 300 m<sup>2</sup> floor completion rate per week and representing a saving of some 10 weeks against more site-intensive construction methods.

## Environmental Impact

A central plant room was provided which serves all 557 bed spaces; the plant room currently contains 3 modulating high performance gas boilers along with water boosters and a tank which also serve the sprinklers that are fitted through the accommodation. The centrally located plant room facilitates the easy installation of future renewable/energy efficient plant without disrupting the residents.

Materials are used efficiently in off-site manufacture by exact ordering of materials &

reduction in waste in line with Willmott Dixon's target of Zero waste to landfill by 2012.

The average acoustic results are 8dB better than Building Regulations for floors and walls and the average air tightness level was 6.76m<sup>3</sup>/m<sup>2</sup> /hr @50 Pascals.

## Measured Heat Loss

The external walls achieved a U-value of 0.21w/m<sup>2</sup>k provided a 40% improvement over Building Regulation minimum.

## Code Compliance & Associated Costs

The cost associated with taking the 78 shared ownership flats to CfSH Level 3 was estimated at £100k.



## System Benefits

### Cost

There have been significant shared savings throughout the project, but as both phases are not yet complete, the final accounts have not yet been agreed.

### Quality

No specific quality benefits were reported.

### Time

The faster construction was achieved by adding value off-site, manufacturing more developed components (both large structural elements and smaller pre-assemblies) which could be combined in a 'right-first-time' way.

### General

The interfaces between the frame and the other components were all been captured as 'standard' details so that they did not have to be 'reinvented' on every project.

One of the biggest benefits during construction phase was the fast and quiet construction which was particularly important to the NHS as the construction site was shared with over 500 staff from the hospital.

The scheme was built in partnership with St George's Healthcare NHS Trust. A Nominations Agreement ensures all key worker rented accommodation is prioritised for NHS Trust staff with rents between 60% -70% of market rents including utility bills.

For Willmott Dixon, the advantages of the system were speed of installation, minimal waste and much improved reliability and accuracy. The light weight steel construction system also saved on foundation costs and time-consuming ground works.

### Known Issues – During and Post Project

Due to the change of LSF supplier during the project there were issues with the marriage of the bathroom pods to the LSF panel system. This resulted in changes in wall dimensions to allow for

the insulation added once the panels were erected on site. There were also issues regarding flue locations, which were remedied on site by the contractor.

There were issues with bathroom pods being slightly out of alignment which caused valves to fail and subsequent leaking. Although a small issue, this did require additional time on site and remedial work had to take place before following trades could continue.

Once completed there were very few defects found and minimal cracking of plaster.



# St John's Way - Stockton on Tees - County Durham

Housing Association: Housing Hartlepool / Tri Star Housing

Main Technologies Used: Volumetric Modular, Photovoltaics (PV)

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## Drivers for the use of MMC technologies

This was the pilot site for the "Evolve built for Life" volumetric housing system. The objective of the system is to provide high quality housing at a competitive rate with price certainty.

## Project Description

The site consisted of a terrace of 3 x 2 Bed 4 person houses for affordable tenancies.

## Method

The houses were supplied from the factory as two large format volumetric modules per house, one module for the ground and one for the first floor. This is a full turnkey solution with the units being fully fitted out including kitchen and bathroom (including vinyl flooring), plaster, paint, and light bulbs. The basic structural frame followed normal timber frame practice for platform construction, adapted to the requirements of building a volumetric module from the panels in a factory.



The design is based on one of the manufacturers' standard house types, with optional variations to suit the requirements of the Housing Hartlepool specification. The modules were sited on traditional foundations with block walls up to sole plate level, with mains services in place. The units were finished on site with the addition of external insulation and a masonry skin to the external walls, a timber fink truss roof structure with additional insulation, tiles and external plot groundwork.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£284,910
<b>It has a gross internal area of</b>	257m <sup>2</sup>
<b>Which represents a rate of</b>	£1,109/m <sup>2</sup>
<b>Substructure</b>	£12,413
<b>Superstructure</b>	£154,451
<b>Abnormal</b>	£22,081
<b>On Costs</b>	£95,965
<b>Total</b>	£284,910

## Time Plan

The units were all delivered to site and installed in less than 2 weeks. With the scheme being the first pilot there were numerous obstacles encountered that had to be managed on site, the learning from the first pilot scheme will be shared and taken forwards to reduce future build programmes. Even with the obstacles encountered the overall scheme was built out in 20 weeks, the anticipated construction period for traditional would be 24 Weeks.





### Environmental Impact

As is typical of all timber frame housing systems their timber has a negative CO2 impact. All the timber was softwood and came from sustainable sources, is certified and fully traceable back through the supply chain.

The purchase of materials and factory process is optimised to minimise waste and there is very little waste generated on site with the transportation wrappings for example doubling up as the external breather membrane.

A small array of PV cells on the roof provide enough zero carbon energy to allow the house to meet CfSH Level 4 with a conventional, high efficiency combi gas boiler, MVHR in the loft space, good fabric thermal performance and good air-tightness..

Three complete house structures, fully fitted out delivered to site with only 6 vehicle movements.

### Measured Heat Loss

The walls achieve 0.27 W/m<sup>2</sup>K, but with the addition of the 50 mm of polyisocyanurate insulation and the masonry skin on site Wall achieve 0.19 W/m<sup>2</sup>K, the ground floor achieved 0.18 W/m<sup>2</sup>K with the roof achieving 0.12 W/m<sup>2</sup>K.

Air-tightness tested on site; 3.46 and 4.39 m<sup>3</sup>/m<sup>2</sup>/hr @ 50Pascals, against Building Regulations of 10, and an average traditional performance of 5.5. The design team have indicated that a target of 1 m<sup>3</sup>/m<sup>2</sup>/hr at 50Pascals was achievable. There is a programme in place to enhance air-tightness and achieve this target as production continues.

### Code Compliance & Associated Costs

This development achieved CfSH Level 4 although Housing Hartlepool could have taken an option to enhance the performance of the units to meet a higher CfSH level.

The Evolve product is costed to be competitive with traditional build costs for similar CfSH compliant houses built using traditional construction.





## System Benefits

### Cost

Cost competitive for this specification or standard social housing and with high cost certainty to the HA from the outset.

Installed in 2 Days by 2 craftsmen using simple hand power tools and materials supplied as part of the house kits, substantially reducing labour costs and man hours on site.

### Quality

Overall the quality of finish was good.

### Time

The units were delivered just-in-time through the period of unusually bad weather experienced in the run up to Christmas 2010. Despite this there were few delays and they were installed immediately.

### Known Issues – During and Post Project

This site was used to finalise BM Trada Q-Mark and LABC Registered Detail approval for the Evolve built for Life system and it will be covered by NHBC warranty.

The system has been reviewed by LABC New Homes Warranty and Premier Building Guarantees who have both indicated that they would be willing to offer cover.

This project completed as this report was compiled and so no feedback from tenants was available.



**Housing Association:** Housing Hartlepool | **Architect:** Blake Hopkinson Architecture  
**Developer & Contractor:** Frank Haslam Milan NE | **Engineers:** Queensbury Design  
**Suppliers:** Evolve Built for Life limited | **Date Complete:** January 2011

# Dolwyddelan - Snowdonia - North Wales

Housing Association: Cymdeithas Tai Clwyd Housing Association

Main Technologies Used: Volumetric Modular

## Drivers for the use of MMC technologies

The key driver was the local authority's desire to use Welsh timber in a new and innovative product. Additional drivers included the speed of the build and the quality and sustainability of the product.

## Project Description

The development of 4 x 3 three bed affordable homes located in a sensitive area of the Snowdonia National Park, was a partnership between the Forestry Commission Wales and the HA. The Forestry Commission Wales released the land which it previously managed on behalf of the Welsh Assembly Government, in order that the Housing Association could develop these affordable homes to meet local people's needs.

## Method

4 x 4.8m x 11.1m modules were delivered on 4 separate articulated lorries accompanied by a police escort, and were lifted into place by a mobile crane on site. The installation took

4 and a half hours to assemble 2 properties including the installation of the roof. The roof was built on the floor prior to delivery and then lifted into position. This project saw the contractor and developer work together to provide a turnkey solution to the client.

The Ty Unnos (house in a day in Welsh) volumetric modules were constructed from a box and ladder beam timber solution using Welsh Sitka Spruce, graded, machine cut, kiln dried then treated and fabricated into structural components. They arrived on site in 2 sections and came complete with windows, doors, stairs, fitted kitchens, bathrooms, tiles, full internal decoration and a full electrical fit out.

Their location required the use of sensitive external treatment in keeping with local planning policy which included the use of slate, rain-screen timber cladding and render. The external finishes were site applied and the slate roof added last to complete the build.





**Cost Data:**

<b>The building was completed for a total net cost of</b>	£505,000*
<b>It has a gross internal area of</b>	352m <sup>2</sup>
<b>Which represents a rate of</b>	£1,435*/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£505,000*

**Additional Cost Data**

The £505,000 cost was secured from the Welsh Assembly Government's Social Housing Grant and Cymdeithas Tai Clwyd Housing Association.

\*The costs represent the cost of the building work including foundations and services.

**Time Plan**

Completion of the on site works, which included roof, brickwork, cladding, roads, gardens, driveways, services, etc., was programmed to take 6 weeks, but due to the extreme weather conditions that were experienced following the initial installation of the modules had been delivered, the actual programme extended to 10 weeks.

**Environmental Impact**

The timber used to manufacture the modules was procured from local forests with Forestry Stewardship Council approval to maintain a locally sourced product. The manufacturer is based in Oswestry and delivered to site 51 miles away. The locality of all of these components enabled the carbon footprint of the timber and the transport operations to be minimised. Components are manufactured from a single

standard timber component dimension. Off-cut materials are fed back into the manufacturing process for re-work and integration into the next structural component.

The measured airtightness of the houses was 2.9m<sup>3</sup>/m<sup>2</sup>/hr @ 50Pascals.

**Measured Heat Loss**

The external walls achieved a U-value of 0.17 W/m<sup>2</sup>K, the ceiling 0.13 W/m<sup>2</sup>K and the floor 0.17 W/m<sup>2</sup>K.

**Code Compliance & Associated Costs**

The development achieved CfSH Level 4



## System Benefits

### Cost

The costs of the build were comparable with that of traditional construction methods for this standard in this location, and was contained due to the abundance of raw material and the efficient fabrication methods adopted during the product's development.

### Quality

The housing association were happy with the quality of the finished product citing good comments received from the tenants.

### Time

The speed of the build proved a plus point for the client.

### Known Issues – During and Post Project

There was a delay in the project do to the adverse weather experienced in late December 2010. Fortunately, with both the developer and contractor collaborating to be the turnkey solution provider, this had no adverse implications on other trades.

The size of the modules meant that their delivery required pre-planning and co-ordination in order to navigate through the rural and sometimes narrow roads to the building site.



# Hereward Hall - Fenland - Cambridgeshire

Housing Association: Home Group

Main Technologies Used: Insulating Concrete Formwork (ICF).

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## Drivers for the use of MMC technologies

The project was developed to examine how MMC could be used to alleviate housing shortages in growth areas.

## Project Description

The SmartLife project was a site measurement research programme undertaken to study and compare the construction processes for the construction of 106 homes in the Fenland District of Cambridgeshire. The Hereward Hall development compared 20 dwellings of traditional brick and block construction with 15 dwellings constructed using an ICF system. The project consisted of 5 x 2 bed; 5 x 3 bed "L" shaped homes and 5 x 3-bed "rectangular" shaped homes for private and shared ownership as well as social rent.

## Method

The properties were constructed using a trench fill foundation with block work to DPC. This supported a composite flooring system with a structural concrete upper.

The ICF system was assembled using components consisting of lightweight crossies, rails and 50mm thick extruded polystyrene (XPS) formwork blocks. A concrete pump was the only specialist resource required to pour the concrete once the formwork was assembled.

155mm wide concrete core walls were used for the majority of the above ground construction, with 206mm cores used for party walls in order to obtain the required sound attenuation.

The work was carried out by 2 of the groundwork contractors whose operatives were trained on site to install the system. The operatives returned to the plots to finish the gable ends following the erection of the roof trusses and to complete the roof terrace walls.

The external skin of each property was clad with a mixture of brickwork, render and tiles, the latter being the most prevalent.

## Cost Data:

<b>The building was completed for a total net cost of</b>	£915,000
<b>It has a gross internal area of</b>	1305m <sup>2</sup>
<b>Which represents a rate of</b>	701/m <sup>2</sup>
<b>Substructure</b>	£666,500
<b>Superstructure</b>	£248,500
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£915,000

## Additional Cost Data

\* Note that these costs represent the actual cost of the work for the different house types. They do not include the cost of the foundations, external works, services and statutory undertakings. They are an average of all the unit types across all ranges and configurations.

## Time Plan

Work was completed close to the planned programme. Work started on the ICF superstructure 5 weeks ahead of schedule in order to build the show homes for the private sale plots. 12 weeks were provided in the programme for the first 8 plots and 13 weeks for the remaining 7, with an 8 week overlap between both schedules.

### Environmental Impact

Site based waste management was carried out and included the segregation of timber, plasterboard, ICF insulation and inert waste.

The air-tightness figures achieved were in the region of  $2\text{m}^3/\text{m}^2/\text{hr}$  @ 50Pascals.

### Measured Heat Loss

The external ICF walls had a U-value of  $0.27\text{W}/\text{m}^2\text{K}$ , they were made up of a 155mm concrete core and 50mm of XPS formwork insulation to the outer and inner face. This value does not take into account the internal and external wall finishes.

### Code Compliance & Associated Costs

This development was planned before the CfSH was introduced as a requirement for social housing and so was not assessed against the code. It was assessed under Eco-Home where it achieved a "Very Good" standard.

There can be no direct comparison between the two systems, as they are evaluated in different ways using different measures.

## System Benefits

### Cost

The cost of the ICF homes was generally comparable with that of the brick and block built homes to the same specification.

### Quality

No specific comments were recorded in respect to quality.

### Time

Construction of the superstructures took 100 man-hours less than the traditional brick and block superstructures that were also part of the development.

### General

Only 2 operatives were required to build the ICF structures on site, requiring significantly less on site labour personnel than for the on site brick and block construction.

The ICF system comprised lightweight components that meant that no heavy lifting equipment was required on site.

### Known Issues – During and Post Project

ICF is normally clad using render or brick slips as the most economical form of external finish, on this occasion however; a full brick skin to the lower section was specified. This was not the expense that led to a further issue with the alignment of the upper tile hangings, which required a substantial, complex sub-structure of timber battens to the formwork in order for the tiles to overlap the thickness of the brick. This finish proved the most labour intensive to apply and in retrospect unnecessarily increased the cost of the project.

There were some remedial works required to the ICF structure after a "blow out" of the concrete pour for one of the plots. This meant that work had to be repeated on a section of second floor, but this was not the cause of the site time over run.

The site shared an access road for a County Council office and primary school. The shared access with the Primary School restricted delivery times of materials hampering the efficiency of the construction process.



**Housing Association:** Home Group | **Architect:** Churchill Hui and Proctor and Matthews  
**Developer:** Smartlife | **Main Contractor:** Inspace Partnerships – Regeneration and New Homes Ltd | **Structural Engineers:** Avebury | **Suppliers:** Polarwall  
**Date Complete:** February 2008

# 62/64 Twentieth Avenue - Blyth - Northumberland

Housing Association: Homes for Northumberland / Northumberland County Council

Main Technologies Used: Insulated Concrete Formwork (ICF), Structural Insulated Panel System (SIPS), Solar Panels

## Drivers for the use of MMC technologies

The outline brief was to produce modern house designs using offsite technologies which would appeal to prospective tenants and perform to at least CfSH Level 3.

## Project Description

Northumberland County Council planned to regenerate a large, existing but rundown housing estate by redeveloping the area and introducing attractive new homes built to high standards as a means of improving the quality, both of the housing stock and the reputation of the area.

A site was selected on which to build a pair of semi-detached 3-bed houses as prototypes for the much larger regeneration scheme to follow. These houses were replacements for the existing properties which had been condemned following a gas explosion.

The selection of cladding was independent of the structure, and offered a wider choice of finishes sympathetic to local preferences and the planning requirements.

## Method

An ICF system was used for both substructure and superstructure. Solid ground and first floor ICF construction was employed and SIPS specified for the roof construction to maximise usable space within the building envelope.

External cladding was of render applied directly to the face of the ICF system with a single ply membrane system as the roof covering. Internal cladding was dry lining.

Roof mounted solar panels provide under-floor heating and hot water, with low energy light fittings and rainwater harvesting using underground storage.

## Cost Data:

**The building was completed for a total net cost of** £289,000

**It has a gross internal area of** 196/m<sup>2</sup>

**Which represents a rate of** £590/m<sup>2</sup>

**Substructure** not identified

**Superstructure** not identified

**Abnormal** not identified

**On Costs** not identified

**Total** £289,000

## Additional Cost Data

The m<sup>2</sup> cost relates to the pair of prototype houses and includes all other project and site works costs, foundations, re-routing of mains drainage, removal of existing substructures, access licenses, crane hire and CfSH certification. These costs compared favourably with industry norms but took no account of savings to be made from economies of scale on a larger project.





The floor was  $0.18 \text{ W/m}^2\text{K}$  and the glazing  $1.8 \text{ W/m}^2\text{K}$

### Code Compliance & Associated Costs

ICF construction was selected for the building fabric as it provided a strong, durable structure with potential energy performance up to CfSH Level 6 requirements.

The building achieved CfSH Level 3, with 64 points when 57 points were required. The superstructure as built almost achieved CfSH Level 4 and would easily be upgradeable to Level 5 & 6

Using ICF and SIPS, to achieve CfSH above Level 3, the additional costs would have been:

Level 4 add  $\text{£}80/\text{m}^2 = \text{£}630/\text{m}^2$

Level 5 add  $\text{£}190/\text{m}^2 = \text{£}740/\text{m}^2$

Level 6 add  $\text{£}465/\text{m}^2 = \text{£}1,015/\text{m}^2$

To produce the build to a non code level the base price was  $\text{£}550/\text{m}^2$

### Time Plan

25 weeks were programmed for completion of the works on site. From completion of design plans, the lead time to delivery for the ICF and flooring systems was 2 weeks and the roof system was 4 weeks.

The actual time to overall completion was 30 weeks, with delays being incurred in organising access to site and road closures, as well as the extra time required to remove existing infrastructure and replace.

### Environmental Impact

The predicted annual heating bill per property is noted to be  $\text{£}216 \text{ pa}$  and for hot water is  $\text{£}41 \text{ pa}$ . The dwelling Target Emission Rate (TER) for this specific house type was calculated as  $19.53 \text{ KgCO}_2/\text{m}^2$  and the Dwelling Emission Rate (DER)  $12.75 \text{ KgCO}_2/\text{m}^2$ , which provides a 34% improvement, and all units achieved a band B SAP rating

The underground rainwater harvesting tanks (3000ltr) used to supply the WC's had the capability to collect over 48,000 litres of water per year.

The part L1A air permeability test achieved  $4.78 \text{ m}^3/\text{m}^2/\text{hr}$  at 50Pascals.

### Measured Heat Loss

The measured heat loss in the walls was found to be  $0.19 \text{ W/m}^2\text{K}$  and for the roof was  $0.16 \text{ W/m}^2\text{K}$ .



## System Benefits

### Cost

Areas for cost reduction in the design and specification have already been identified by the ICF supplier and a more detailed review of the energy performance will reduce the need in the future for expensive renewable energy equipment.

The solar panel system used was expected to realise savings of approx 3,500KWh per year.

The rain water harvest system has the capability of collecting/saving the tenant 48,545 litres of water per year. This can be used in the toilet and outside taps but a main water supply was still required for general use.

Tenants have reported that the houses are very warm and that they rarely need to use the heating for sustained periods. They also report large gas savings based on usage at previous properties. Satisfaction and comfort levels are notably higher than recorded for previous tenants' feedback.

### Quality

The contractor was a local development company who normally operated in the private housing market and had developed a good reputation for the standards and quality of workmanship anyway.

The use of ICF was a simpler and more practical method of construction which encouraged better standards of workmanship and was more reliable in achieving specified levels of performance.

### Time

The actual construction period was 30 weeks, in comparison to the original programme of 25 weeks. The extra time required did not relate so much to the building process as to obtaining permits for access and temporary works etc. associated with construction on a confined site in a residential area. Installation of the substructure and utilities to service the new dwellings also took longer than programmed due to existing site conditions which were not identified pre-contract.

### General

Construction of the project employed a higher proportion of locally procured materials than normal and wastage rates were reduced as a consequence of the method of building (e.g. waste on the building shell was less than 2%).

The use of ICF reduced the number of components variations and deliveries required to site, with construction plant and equipment requirements also reduced. Apart from reducing costs and simplifying site organisation, this also reduced noise, pollution and disruption levels on site and in the neighbourhood.

### Known Issues – During and Post Project

The reaction of the local community to building works adjacent to their homes was good and relationships were maintained throughout the project, helped by the reduced noise, pollution and disruption of the building process.

As the project progressed, local reactions became increasingly positive to the construction of houses quite different to the normal generic house styles. On completion there was substantial enthusiasm for the new homes on the part of both community and local authorities.

Tenants living in the new low energy homes were initially uninformed of the new technologies, but as they became more familiar with the performance of the building and how it could be controlled, there was a shift towards more efficient management of the building environment.



# The Pinnacle - Basingstoke - Hampshire

Developer: Miller Homes

Main Technologies Used: Large Format Blockwork



A variety of heating and ventilation strategies were used across the 5 homes. The simplest system was a wet central heating system with Mechanical Ventilation with Heat Recovery (MVHR) for Code 1; Code 3 had an air-source heat pump to supply the radiators and a ground-source heat pump was used on the Code 4 home to supply under-floor heating.

The level 5 and 6 homes utilised biomass boilers for heating combined with MVHR and varying levels of photovoltaic panels. The highest specification was designed to have extremely low levels of air-permeability, 1/10th the required levels for Building Regulations.

## Drivers for the use of MMC technologies

The Pinnacle was initiated as a Research & Development project comparing different construction methods, and to understand the cost differential of buildings to meet various levels of the Code for Sustainable Homes (CFSH).

## Project Description

The 4 bed houses are among 79 built for private sale on the 3 acre development site. Using the same layout as other homes on the site, the 5 research houses were designed to meet the CFSH Levels 1,3,4,5 and 6.

## Method

The ground floor was constructed using a standard 100mm insulated beam and block system for 4 of the homes, whilst the level 6 home utilised a 300mm thick pre-cast floor with an additional 100mm of insulation. Large format blocks and panels manufactured with Aircrete were used for the walls.

The roofs on all of the houses were constructed using timber joists insulated with rigid insulation and layers of low emissivity foil. The thickness of the roofs varied between 160mm and 280mm depending on the required thermal performance.



## Cost Data:

<b>The building work was completed for a total net cost of</b>	not identified
<b>Each house has a gross internal area of</b>	85m <sup>2</sup>
<b>Construction costs:</b>	
<b>Code Level 3</b>	£985/m <sup>2</sup>
<b>Code Level 6</b>	£1,423/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal On Costs</b>	not identified
<b>Total</b>	not identified

## Additional Cost Data

The 6 houses were all designed to the same external dimensions and style, the construction cost for the Building Regulations compliant house was £98,000. The higher levels of compliance with CfSH resulted in thicker, more heavily insulated walls and therefore the internal dimensions varied between houses. In addition to this, the external car-port and ancillary space for the Biomass boilers means that a direct comparison of price per square metre cannot be made.

For further cost information see under “code compliance”

## Time Plan

Use of the system reduced the construction time on site although there was a learning curve as these methods had not been used previously by the contractor.

## Environmental Impact

80% of Aircrete is made up of pulverised fuel ash, a by-product of coal power stations, this material was traditionally sent for land fill and so the product can claim excellent environmental performance. Reflecting this, the blocks achieve an A+ rating in the ‘Green Guide to Specification’ for wall construction.

The thin joint system used required significantly less mortar and in turn less water, it also helped to minimise thermal bridging and with fewer joints the air-permeability achieved was 0.8m<sup>3</sup>/m<sup>2</sup>/hr @50pascals.

## Carbon

The Code 6 home achieved:

- Annual carbon emissions in use (CO<sub>2</sub>/m<sup>2</sup>): 5.84Kg not including the energy produced by the photovoltaics.
- Including energy produced by the photovoltaics the annual carbon emissions in use (CO<sub>2</sub>/m<sup>2</sup>): -14Kg.

- Total annual building carbon emissions (CO<sub>2</sub>): -1200Kg

## Measured Heat Loss

The Code 1, 3 and 4 homes with rendered blocks and 90mm full-fill cavity walls achieved a U-value of 0.30 W/m<sup>2</sup>K

The Code 6 home was constructed with 200mm panels with rendered 200mm external insulation; this provided a U-value of 0.09 W/m<sup>2</sup>K

## Code Compliance & Associated Costs

The 5 research homes were constructed to the same style as several other properties on the site that were built to comply with 2006 Part L, a direct comparison could therefore be made of the additional costs to comply with the CfSH as detailed below:

The build costs on this site were higher than more traditional sites due to the bespoke, contemporary design and specification of the homes. The Code 3 home cost between £5,000 and £7,000 more to build than a standard house on the development, and the Code 4 home between £7,000 and £10,000 more. The Code 6 home cost an additional £50,000 of which approximately £30,000 was for Photovoltaics.

The sales prices of the homes varied in accordance with the specification and build costs, although the final sale prices did not fully account for the additional cost required to meet Levels 5 & 6.



## System Benefits

### Cost

No specific cost savings have been given, however it was noted that cost savings could be attributed to the reduction in construction time due to the speed of erection.

### Quality

There was no specific information given regarding the build quality of the project; however the very low air-permeability achieved could be used as an indicator of a well constructed envelope.

### Time

The speed of construction of the vertical elements was noted as significantly faster than brick and block construction. The simple method of construction meant the inner skin of the house could be erected extremely quickly and although it was dependant on a mechanical (crane) lift; this allowed follow on trades to begin much sooner than would normally be possible.

Use of the large format blocks provided a time saving due to their size, and the fast drying thin

joint system also gave a benefit as it meant that there was little restriction on the number of blocks that could be laid in one day.

### General

The contribution to thermal performance, the speed of construction and the air-permeability that was achieved were all cited as advantages over traditional brick and block construction.

### Known Issues – During and Post Project

The developer believed that compliance with the CfSH had in part been a ‘tick-box’ exercise, adding technologies to a property to score points and achieve the required levels. The result was not necessarily the most sustainable or energy efficient design and led to the inclusion of complex systems that required detailed Home User guides. The layout of the buildings was fixed before the technologies and construction typology were selected, but it would have been preferable to design the layout based on the selected technologies and typology.



Image courtesy of Chris Pearsall Photography

**Architect:** Fraser Brown MacKenna Architects / Miller Homes | **Developer:** Miller Homes  
**Contractor:** Miller Homes | **Structural Engineers:** N/A | **Suppliers:** H+H Celcon  
**Date Complete:** January 2009

# Rowan House - Sivell Place - Exeter

Housing Association: Exeter City Council - HCA

Main Technologies Used: Large Format Blockwork, Pre-cast Concrete Slabs, Mechanical Heat Recovery Ventilation System (MVHR), Solar Panels

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## Drivers for the use of MMC technologies

Exeter City Council carried out a consultation process and technical workshops with tenants and various other interested parties to determine how best to construct the new flats using green technologies. The conclusion was to use heavyweight construction methods to achieve both PassivHaus standards and CFSH Level 4.

## Project Description

The site was on Council owned land which was used for domestic garages and 'wild cat' parking for local residents and businesses.

Rowan House is a block of 1 x 2 bed and 2 x 1 bed apartments available for social rent.

The apartments were included in the Council's 'downsizing initiative' for over 55's wishing to downsize from larger council owned properties, which were then made available for larger families.

## Method

The build began with simple strip foundations followed by precast concrete floors at both

ground and first floor level. The floors were later finished with ceramic tiles throughout.

Traditional wet trade block work with internal plaster started the superstructure of the build with 250mm expanded polystyrene external wall insulation with a standard external render product providing a water tight shell.

The roof was traditionally constructed using trussed rafters with insulation, felt, batons and traditional tiles.

The electrical circuits were installed as a radial circuit to reduce electro-magnetic fields.

Each flat was designed to provide as healthy a living environment as possible, with the installation of ceramic tiles throughout to reduce dust mite habitats, the reduction in the use of Volatile Organic Compounds (VOC's) in the flats by omitting PVC in pipes, wiring and glues used in kitchen cupboards.



**Cost Data:**

<b>The building was completed for a total net cost of</b>	£472,000
<b>It has a gross internal area of</b>	170m <sup>2</sup>
<b>Which represents a rate of</b>	£2,776/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal</b>	£65,000
<b>On Costs</b>	not identified
<b>Total</b>	£472,000

**Additional Cost Data**

The project was £195,000 part funded by the Labour Governments ‘New Build’ programme.

At the time of this report, the final cost breakdown was not available from the contractor, though it was felt that the high costs for this project were due to extensive landscaping, removal of 0.5m of top soil due to land contamination and the restrictive nature of such a small site, (access and storage issues). Included in “abnormal” the costs associated with the unforeseen requirement for a sewer at £54,000 and a man hole to the rear of site at £11,000.



**Time Plan**

The project started on site April 2010 and completed in December 2010, giving a total build time of 33 weeks. The build was always expected to take longer to complete than a more traditional offsite method such as timber frame because of the attention to detail that was required with respect to the air-tightness of the buildings envelope.

**Environmental Impact**

The properties were reported to be completely thermal bridge free and the measured airtightness was 0.6m<sup>3</sup>/m<sup>2</sup>/h @50Pascals.

The primary energy use was 25kWh/m<sup>2</sup> and the heating load recorded as 10 W/m<sup>2</sup>.

For the landlord, Exeter City Council, there was significant kudos from building apartments to such a high environmental standard as this had never been done by, or for them before.



**Measured Heat Loss**

The measured heat loss for the property was calculated at 0.13 W/m<sup>2</sup>K for the walls, 0.1 W/m<sup>2</sup>K for the roof, 0.1 W/m<sup>2</sup>K for the floor and 0.8 W/m<sup>2</sup>K for the windows and doors.

**Code Compliance & Associated Costs**

The building achieved CfSH Level 4 and met the PassivHaus standard (awaiting PassivHaus certification). As this was the first development project Exeter City Council had conducted in some 20 years, they had little to compare any associated costs, but are aware of the overall cost being high in comparison to a traditional build.

## System Benefits

### Cost

This project was never cost factored beyond the Council's normal due diligence to provide value for money, and for such a small build project it was always expected that the build price was going to be relatively high.



It was strongly felt by Exeter City Council that if funding allowed them to develop further sites then the overall build costs would fall. To comply with PassivHaus, buying triple glazed windows and having to do so from overseas at a higher cost is one example of where a wider adoption of PassivHaus technologies would benefit procurement costs

The PassivHaus standard focussed on reducing the energy use of the building and tenants benefit from heating bills as low as £50 per year, as well as much reduced hot water bills from the installation of solar hot water panels. This means fuel bills estimated at up to 70% cheaper than a traditionally built home.

### Quality

The build quality was of a very high standard and attention to detail was rigidly observed, which meant a higher use of tapes and DPC to maintain the required air-tightness.

### Time

There were no time benefits realised on this project as the build was slower than a traditional build

and even more so than timber frame due to the enhanced requirements.

### General

For Exeter City Council's first build in many years, and the first using such modern concepts, the learning curve will allow future developments to be improved in terms of cost, time and quality.

### Known Issues – During and Post Project

There were land clearance issues at the site caused by the existing garages and as such 0.5 of a metre contaminated top soil was cleared prior to any building works.

The tenants did experience learning issues and a certain degree of culture change for living in such a modern property with no traditional heating system. The tenants were helped with this transition by the Architects and the council's technical department hosting a presentation session at handover where they displayed how the system works and how it should be used. Exeter City Council also produced a handbook which included detailed but friendly sections on the technical aspects of the apartments green credentials.

The findings of a tenant feedback questionnaire after 4 weeks of residency showed very good feedback and that the tenants were enjoying the benefits of the property.



**Housing Association:** Exeter City Council | **Architect:** Gale & Snowden  
**Contractor:** ISG Pearce | **Structural Engineers:** In house | **Suppliers:** Sto Ltd  
**Date Complete:** December 2010

# Adelaide Wharf - Hackney - London

Housing Association: Family Mosaic – with Housing Corporation funding  
Main Technologies Used: Bathroom Pods, Unitised Cladding, Pre-fabricated Balconies, Pre-fabricated Steel Floor Reinforcement.

## Drivers for the use of MMC technologies

The design evolved from an initial key-worker study carried out by the Architects on behalf of the developer, to create a building that reduced trades, waste and construction time on site.

## Project Description

The development contained 147 mixed tenure apartments in one 6-storey block, including 1, 2, 3 and 4 bed flats, and 700 m<sup>2</sup> of office space. 73 flats for private market, 41 key-worker shared ownership, and 33 social rent.

## Method

The architecture was a mix of engineering brick at ground level with bright, glossy, enamel clad panels in red and yellow. Balconies were suspended from beams at roof level, which cantilevered over the roof. A craned-in unitised cladding system formed horizontal grey zinc bands broken up by vertical panels of rough sawn Siberian larch.

Typical office building technologies were used; a concrete frame, flat slabs, and blade columns used prefabricated reinforcement mats clad with

a unitised cladding system, which was craned from delivery vehicles directly on to the building without the need for scaffolding. Pre-fabricated bathroom pods, plant rooms, balconies and dry lined internal partitions were also used.



## Cost Data:

<b>The building was completed for a total net cost of</b>	£18,737,394
<b>It has a gross internal area of</b>	13,403m <sup>2</sup>
<b>Which represents a rate of</b>	£1,398/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	not identified
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£18,737,394

## Time Plan

Work commenced on site in January 2006 and was completed in October 2007. The build was completed in 18 months but had been scheduled for 17 months. This was due mainly to the change of bathroom pod supplier part way through the project

## Environmental Impact

For the building fabric, a concrete frame was used with insulated unitised cladding panels interlocked to provide a high level of thermal performance, reducing the anticipated energy consumption by 35%.

Heat and power generation by a centralised gas-powered heating system, using gas condensing boilers, which provided energy-efficient heating and hot water for each apartment through

localised heat exchangers. All timber used for the building was FSC certified.

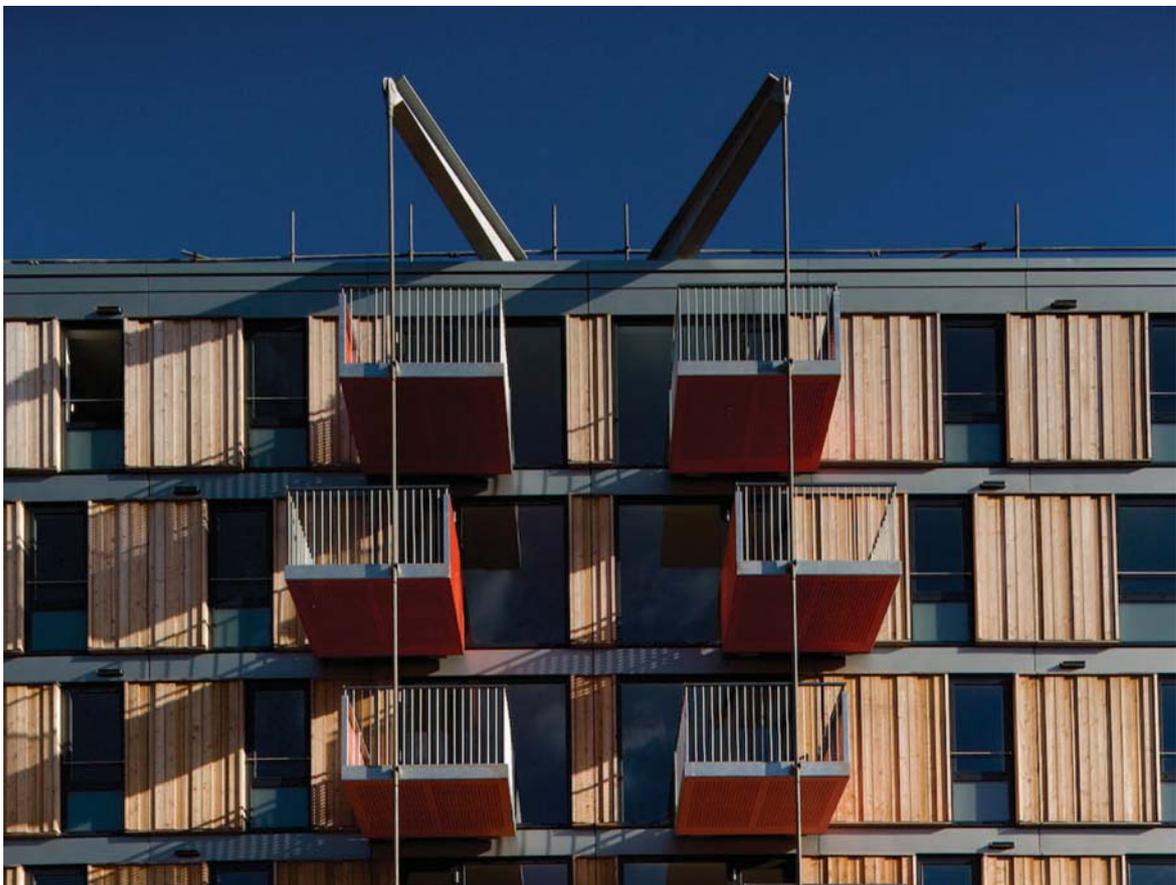
Using pre-fabricated insulated cladding panels and attention to workmanship on site maximised air tightness: 4 to 7m<sup>3</sup>/m<sup>2</sup>/hr at 50pascals, depending on apartment.

## Measure of Heat Loss

Using a187mm rigid insulation integrated within the cladding panels the walls reached a U-value of 0.23 W/m<sup>2</sup>K. The roof, a reinforced concrete flat slab with hot-applied bituminous membrane and 140mm of rigid insulation held down by ballast achieved a U-value of 0.12 W/m<sup>2</sup>K. The windows were powder coated aluminium-frame fitted with double glazed unit and had a U-value of 1.3 W/m<sup>2</sup>K.

## Code Compliance & Associated Costs

This development was planned before the CFSH was introduced as a requirement for social housing, and so was not assessed against the code. It achieved a BREEAM rating of 'Eco Excellent'. There can be no direct comparison between the two systems, as they are evaluated in different ways using different measures. However, what can be said is that the project was successfully completed for a fixed price design and build in line with the original budget.



## System Benefits

### Cost

The developer calculated that the project's design efficiency saved six months of construction time, and by using offsite technologies the contractor bought in the project for a fixed price, and on target: for the 1 bed flat of £40,000 and the 2 bed of £60,000

### Quality

The quality of bathroom pods were specifically commented on, as was the use of the façade, which was found to increase the buildings performance.

### Time

Construction cost and delivery time were reduced by 20%. These time savings contributed to a 10% increase in the property values across the schedule.

### General

The project used a pre-packaged central plant-room on the roof, providing energy efficient heating and hot water to each apartment, through localised heat exchangers. All flats have

50-60% low energy light fittings and movement sensors trigger lighting in public circulation spaces. Aerated taps, dual flush cisterns and low flush showers reduce water consumption.

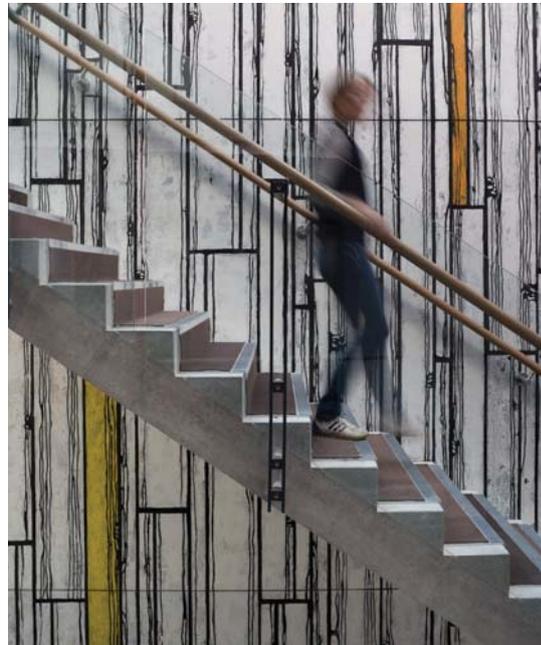
### Known Issues – During and Post Project

The use of concrete in the project led to limited internal space adaptation, an issue raised by the developer.

For a number of reasons the original pod manufacturer was not used to complete the project and a replacement supplier was found. The replacement supplier used a different floor system and major remedial work was needed to accommodate this. Pods were delivered to a holding area close to the site and were installed 'Just in Time'.

After handover the tenants complained of overheating in the common areas, and as a result purged venting was required and radiators removed.

Prefabricated stacks for the M&E generated multiple leaks (crimped pipe work systems) and tenants had to be re-housed due to flooding.



**Housing Association:** Family Mosaic | **Architect:** Allford Hall Monaghan Morris  
**Developer:** Bovis Lend Lease – First Base | **Contractor:** Bovis Lend Lease – First Base  
**Structural Engineers:** Adams Kara Taylor | **Suppliers:** Sipral (cladding), AJ Morrisroe & Sons (Concrete Frame), PAD Contracts Ltd (balconies), OCP Ratgrad (bathroom Pods) | **Date Complete:** 2007

# Stadthaus - Murray Grove - East London

Housing Association: Metropolitan Housing

Main Technologies Used: Cross Laminated Timber Panel System (CLT)

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## Drivers for the use of MMC technologies

Following two previous planning refusals, the architects succeeded in securing planning by evolving the project into an exceptionally green building.

## Project Description

The 9 storey building, "Stadthaus", occupies a site of 17m x 17m, with ground floor commercial space and above that, 3 storeys of affordable / social housing (majority family apartments) and 5 storeys of private sale units. This created a total of 11 x 1 bed, 10 x 2 bed, 5 x 3 bed and 3 x 4 bed apartments, a total of 29 apartments; 19 private sale; 9 affordable tenancies and 1 shared ownership.

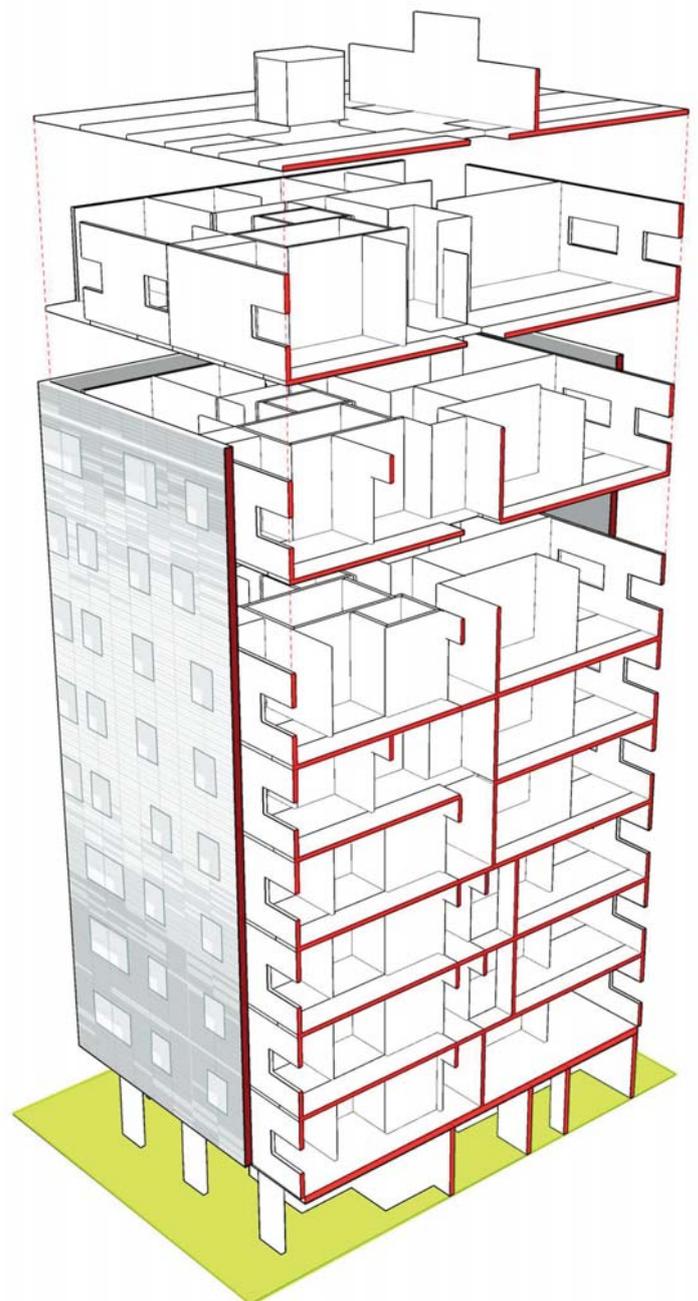
## Method

The ground floor was constructed using poured on site concrete walling above piling foundations, from the first floor upwards the project was constructed using an advanced timber panel system. The cross-laminated timber (CLT) panels consisted of timber planks stacked, glued and laminated in 5 perpendicular layers. Manufactured in sheets of up to 16.5 m by 2.95 m, the panels are then cut to client specification in the factory.

Off loaded panels were immediately craned into position, reducing this element of the build time considerably, see benefits. The entire structure was assembled within 9 weeks. A platform construction configuration was used throughout this structure, where each floor was set on the walls below, and then another storey of walls rose and so on up the building. Joints were secured with screws and angle plates. Stresses were generally very low throughout the structure and at points where cross-grain pressures were high; screws were added to reinforce the timber locally. Progressive collapse was avoided by providing sufficient redundancy so that any single element could be removed.

The panels, up to 9 metres in length, arrived on site with door and window openings having been pre-cut during manufacture. Compressed

insulation, followed by a 55 mm screed (into which under-floor heating was installed), sat above the timber floor slabs giving superior acoustic separation. The ground floor level was clad using blocks of Lignacite, and 5,000 panels of Eternit rain screen completed the building.



**Cost Data:**

<b>The building was completed for a total net cost of</b>	£3,930,000
<b>It has a gross internal area of</b>	2750m <sup>2</sup>
<b>Which represents a rate of</b>	£1,429/m <sup>2</sup>
<b>Substructure</b>	not identified
<b>Superstructure</b>	£3,144,000
<b>Abnormal</b>	not identified
<b>On Costs</b>	not identified
<b>Total</b>	£3,930,000

**Time Plan**

A reinforced concrete frame solution would typically take 72 weeks to complete. Stadthaus was programmed for 49 weeks and completed in only 46. The ground floor concrete structure including foundation was started at the same time as the manufacturing of the timber structure, and both were completed within 12 weeks. The timber structure was completed in 27 days by 4 men, each working a 3 day week, and electrical work originally scheduled for 6 weeks was completed in 10 days.

**Environmental Impact**

The timber structure was produced in a facility in Austria, relying completely on the waste material created by the manufacturing process to power the facility, making it completely 'off grid' and waste free.

PV cells located on the lift shaft provide adequate power to not only power and light the lift but also the communal areas.

Waste on site was not cost factored during this project as it was typically below 3 skips per week, which using traditional methods of construction could easily have been a per day number.

**Carbon**

- Annual carbon emissions in use (CO<sub>2</sub>/m<sup>2</sup>): 30.3 kg
- Total annual building carbon emissions (CO<sub>2</sub>): 56.4 tonnes
- Carbon removed from the atmosphere and retained in timber: 196 tonnes
- Reduction of carbon compared with comparative reinforced concrete structure: 125 tonnes

**Measure of Heat Loss**

Using 70mm insulation the U-value achieved exceeded Building Regulations and was recorded at 0.27 W/m<sup>2</sup>K

**Code Compliance & Associated Costs**

This development was planned before the CfSH was introduced as a requirement for social housing and so was not assessed against the code. It was assessed under Eco-Home where it achieved a "Very Good" standard.

There can be no direct comparison between the two systems, as they are evaluated in different ways using different measures. The architect believes that by using 300mm CLT timber panels for the buildings internal walls and super structure, the building could have achieved a CfSH Level 5.



## System Benefits

### Cost

Delivered to site in only 21 vehicle drops, the system saved approximately 60% in vehicle movements compared to reinforced concrete.

Direct placement of panels using a mobile crane meant that a more expensive tower crane was not required on site and 4 craftsmen assembled the entire 9 storey structure in 27 days, dramatically reducing labour costs.

Only simple hand power tools and off-the-shelf screws and fixings were required for the assembly substantially reducing machinery hire and the cost of design and manufacture of specialised fixings.

### Quality

Cross laminated timber panels have a particularly high density, and as such sound attenuation in excess of building regulations: 55db protection between flats and 53db between floors was achieved. Using a solid CLT structural core in combination with the CLT superstructure there was no movement differential between materials.

Most walls obtained a fire protection class of F60 due to the density of the panels with the outer laminate acting as a sacrificial layer. As standard panels can be load bearing this meant that any internal wall could become a party wall, allowing for different plan types

### Time

Pre-fabricated panels, delivered just-in-time meant that they were assembled immediately and allowed for a safer, cleaner and more efficient site. The programme benefited from traditional trades starting once the structure of each floor was complete:

The overall project was delivered within 46 weeks in comparison to the equivalent concrete construction programme, which would have been of 72 weeks. Using this extremely accurate system a faster time to clad was achieved as the building only deviated 4mm over 9 storeys and required no shimming.

### General

Using this timber method, over 186 tonnes of carbon were captured within the building fabric, and over 57 tonnes of carbon emissions were saved from entering the atmosphere by not using steel and concrete for the superstructure.





#### Known Issues – During and Post Project

The KLH system already had ETAG and approval from Zurich Building Guarantees but Telford Homes required that it should obtain an NHBC Warranty. This was only given after the BRE had signed a 60 year lifespan warranty. This process took 6 months to achieve due to lack of understanding in the UK of such systems.

Most trades were finished before the agreed schedule and none were late. Overall schedule was reduced by 3 weeks. The architect believed that there were no supply chain issues specifically as a result of his early involvement in the project.

There were no tenant complaints at handover and at 6 months Telford Homes conducted a tenant satisfaction programme and for the first time in its history scored 100%.

**Housing Association:** Metropolitan Housing Trust | **Architect:** Waugh Thistleton  
**Developer:** Telford Homes Plc | **Contractor:** Telford Homes Plc  
**Structural Engineers:** Techniker Ltd | **Suppliers:** KLH  
**Date Complete:** January 2009

# Has Offsite and MMC deliv

These case studies demonstrate that it clearly has; systems such as timber frame are commonly used and this particular technology has been adopted very successfully to build large numbers of homes in the last few years, delivering on all the Housing Associations requirements of cost, quality and sustainability.



### Competitive build cost

In reaching such a high proportion of the Affordable Housing market it is evident that timber frame has equalled or bettered the cost of more traditional forms of construction. On this basis it makes a reasonable benchmark for the whole offsite sector. The case studies do not provide irrevocable proof that all offsite and MMC solutions routinely provide a competitive outturn cost because project specific variables for each site have a very significant impact on costs. However in most case studies the outturn cost was not reported as a negative issue.

### Informed application not volume

Interestingly, the case studies show that high volume of repetitive product is not necessarily the only means of achieving cost competitiveness. In many cases even on quite small sites with little repetition the project team adopted offsite solutions to deliver a highly cost sensitive development. The difference in each case was a well informed project team that understood the offsite technology and implemented it in a highly integrated manner.

These successful teams took specialist advice where needed to learn from previous experience and worked closely with the supply chain manufacturers to hone the coordinated design to a much greater level than we would consider necessary for a traditional build. This preplanning appears to work.

### Delivering practical sustainability

The case studies also demonstrate that offsite and MMC systems are delivering on the sustainability agenda, often in more ways than is immediately obvious or recognised at the outset. Exceptional fabric performance with minimal cold bridging and very high levels of airtightness contribute to delivering CfSH Level 3 and above at increasingly competitive cost.

The unforeseen sustainability benefits of offsite such as very low levels of waste arising on site, significantly reduced transport impact, both for site deliveries and operatives, and health and safety improvements have clearly surprised many project teams. These are real sustainability issues which appear to bring improvements across the whole process.

The environmental case for offsite is now being recognised by the manufacturers as they are amongst the first to measure their whole life costs using formal Life Cycle Assessment modelling. Studies completed on one of the case studies demonstrated that CO<sub>2</sub> emissions could be reduced by over 50% compared with traditional construction methods.



# ered for Affordable Housing?

## Satisfied tenant

While the evidence of tenant feedback is rather limited across the case studies what feedback that has been collated is very positive. Tenants appreciated the better quality with fewer call backs relating to the offsite elements, the lower running costs from low energy usage solutions and the reduced disruption during the build programme.

## “What hasn’t worked for Offsite & MMC?”

It would be wrong to claim that offsite and MMC has all the answers and that there are no issues. The case studies did show that things can go wrong.

## Risks to competitive prices

There remains an historic perception that offsite and innovative construction costs more. While the case studies show this is not necessarily the case, this concern inevitably affects the uptake of offsite solutions. It is clear that without good planning and process control the costs for offsite enabled developments can quickly overrun. The payment profile through the project is also generally very different with more cost earlier in the process, including the need in some cases for payment for goods offsite in the factory.

Where factories can not achieve a smooth volume of work to be efficient costs can escalate; though it appears that standardisation or repetition from the same project is not as critical as commonality across a number of projects.

## A national approach to job creation

Offsite factories can clearly help to address the unemployment agenda providing secure long term jobs for low skilled workforce. However factories do centralise the employment opportunities and the regeneration benefit which perversely tends to conflict with the localism

agenda encouraged by local authorities for new jobs in their area. It is clear that for offsite to continue to flourish the benefits these new factories can bring needs to be understood and accepted at a national level.

## Quality of service to the tenant

Offsite solutions increase the physical distance between makers and the users, so it is more critical to take steps to ensure that information transfer is effective. If things do go wrong then the errors are likely to be repeated across an entire scheme, making right first time critical and for the long term, the supply of spares and maintenance arrangements need to be considered as part of the contract.

## “So what next?”

### Intelligent integration

These case studies demonstrate that there are real opportunities to adopt offsite techniques on a more extensive basis for building homes across the UK. Used in an intelligent and highly integrated manner offsite can clearly deliver very substantial benefits. However it is clearly essential that the right level of expertise and skill is applied throughout the process to ensure that these benefits are delivered through to the project’s bottom line.





### Collaborating demand

While it is clear that large projects are not a prerequisite for successful adoption of offsite construction it is important that Housing Associations and contractors understand the importance of smoothing the demand pipeline through the factory to maximise the cost effectiveness of the technology. This will mean that collaborations and sharing of demand and knowledge between users will pay dividends to everyone in the supply chain.

### Developing the offsite product

As offsite solutions are developed to increase their capability or the scope of what they can provide, the benefits that these technologies bring to the delivery team increase quite dramatically. The move from open cell timber frame to more advanced closed cell timber frame is a good example, with the case studies demonstrating significant benefits at all levels within the project process. This bodes well for all offsite solutions as manufacturers refine and improve their product offering

### Build sophistication

As houses become more sophisticated either because of the requirements of the CfSH, consumer demand or future legislation it is clear that factory based solutions will be better able to meet this need. Offsite and MMC can adapt quickly to meet these future challenges with fewer defects and ultimately at lower cost.



### The Way Forward

The learning and the conclusions we can draw from these case studies should be welcomed by all sides of the affordable housing sector. Perhaps unsurprisingly it accords very well with what many close to the industry have been advising for some time, including ourselves at Mtech Consult.

Offsite and MMC are clearly going to be major influences on the way we build our future affordable homes. Indeed there are some clear lessons here for the private and self-build housing sectors, and the opportunity for technology transfer are very significant.

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# MMC in affordable housing – a European perspective



Image courtesy of Huf Haus

The need for affordable housing is a common feature for all European countries, and while each national and local government approaches this need with different priorities and strategies, all countries have used some form of industrialised housing delivery within their social housing sector.

It is clear that this use of offsite and other MMC technologies is however rooted in a country's history and culture, which means that each country approaches the building of homes in very different ways. In many cases these differences are also linked to the climatic conditions, which can impose significant restrictions on the build methods as well as the specification and style of the living space.

For example in the Nordic countries building methods are dominated by the short build season and the cyclical nature this enforces on the industry. Difficult site conditions in these countries have forced house builders to adopt more systemised and factory based construction methods. At the other extreme housing in southern Europe is far more site based, and issues such as thermal mass and retaining coolth become far more critical. The result is that build times are more relaxed and issues such as airtightness and acoustic performance are far less stringently enforced. These climatic and cultural issues may also be reflected in the history of house building within

each country. For good logical reasons the Nordic countries use far less concrete and water based build methods and therefore timber based housing is extremely popular, with steel a close second. Whereas countries such as Holland, Germany and Italy have a strong history of using pre-cast concrete methods of construction and this has fed through to housing. This use of pre-cast concrete is generally far more sophisticated than we would typically experience in the UK, where factory produced precast concrete is rarely a feature in residential build and almost never seen in new build dwellings.

Tied up within these cultural differences is the national approach to home ownership, which as we in the UK know has a dramatic affect on how we build our homes. While the impact of this national home ownership is felt more keenly in the private sector, it invariably feeds through to the affordable sector, and affects how tenants set preferences for their rented homes. Invariably, this makes countries with a high level of home ownership far more conservative in their choice of build method and use of technology.

Holland is a good example of where the adoption of systemised house building is considered far more acceptable, and as a result the country has developed a range of standardised house building solutions based on pre-cast concrete. Factory build is accepted to such an extent that fair faced concrete straight from the factory is not unusual as the final finish for systemised housing.

Precast concrete build methods for apartments is a well understood technique in Germany and Italy, though perhaps more common in both countries is the use of factory produced panellised permanent formwork such as twin-wall systems, where precast concrete is used as the permanent formwork facing. In these systems the steel reinforcing is formed in the factory together with the external faces of the formwork to create the twin wall panel. These panels are quickly erected and joined together on site and concrete is pumped into the cavities to create the finished build.

Germany also has a strong history of sophisticated timber framed housing solutions produced in generally small factory operations. Most of us will be familiar with the Huf Haus product brought to our attention by the Grand Designs TV programme. What is less well known is that in Germany there are some 40 or so similar producers of this type of closed panel very advanced form of timber frame for housing which has yet to take off in the UK.

In fact Germany has a strong history of using all forms of offsite construction in housing. For instance the use of factory produced bathroom pods is relatively common for apartments where prebuilt bathrooms make sense both commercial



and from a buildability perspective. This even extends to apartment refurbishment where panellised bathroom pod systems are used to provide high quality, rapid remodelling solutions to existing apartments.

## Conclusions from Europe

The question is of course is what can we in the UK learn from our neighbours in the rest of Europe? At Mtech Consult we have spent a considerable amount of time working with European manufacturers, in particular helping them export their products to the UK. The main conclusions we draw from this experience are:

- European countries approach affordable housing in many different ways based on their culture and climatic drivers. This has led to a diverse range of offsite solutions that we in the UK can certainly learn from.
- What works well in one country does not mean for certain that it will easily translate into success for the UK affordable housing market.
- Obtaining appropriate UK certification and ensuring the product is capable of meeting UK legislation is obviously critical for any European build system that is destined for use in this country.
- Having said this there are some real opportunities to exploit offsite housing systems from Europe to increase the diversity available for developers and contractors across the UK. And probably most importantly
- Understanding the impact of project specific design on the supply logistics is important. Our experience is that many European housing system manufacturers do not fully appreciate the full implications of the variation in design that is normal for the UK affordable housing market.

## Precast concrete housing from Belgium

Danilith Ltd has been producing this novel factory produced panellised housing system for over 15 years in relatively small volumes (<300 per annum) for their home market. The housing system is highly developed and includes electrics and plumbing and internal finishes. It enables Danilith to erect a complete house within two days onto prepared foundations, see their website for more details: [www.danilith.be](http://www.danilith.be)



## Twin wall permanent formwork from Germany

Germany has a number of twin-wall manufacturers using both precast concrete and board systems such as cement bonded particle board or fibre reinforced cement board products. The precast twin-wall factories are typically highly sophisticated as shown here with an ability to customise the panels to suit the specific nature of each build project.



## Bathroom & kitchen pods from Italy

Italy hosts a number of manufacturers that produce bathroom and kitchen pods for the housing market both home and abroad, such as Sterchele and Bath Systems. The Italian home market in common with a number of its European neighbours has a history of using bathroom pods and now kitchen pods for their new build apartments. This now extends to other highly serviced areas such as airing cupboards and plant rooms. We are also seeing examples of structural bathroom and kitchen pods being used for multi-storey flats giving a very rapid method of build.

See: [www.bathsystem.com](http://www.bathsystem.com) for more details



# The Affordable Housing Supply Chain

[www.offsiteonline.co.uk](http://www.offsiteonline.co.uk)

Offsiteonline is a unique reference resource for the latest information on companies supplying quality Offsite construction solutions into the UK construction market. For the purposes of this report, what follows is an abridged version of the Offsiteonline directory listing all those companies who supply materials, systems and services into the affordable housing market.

Offsite construction technology has been here for more than 10 years, and has become a recognised alternative construction method for a wide range of building applications. It is becoming a mainstream method of building throughout the UK and the market for quality offsite solutions is growing rapidly in all sectors of the market.

Substantial investments are being made to increase manufacturing capacity and to offer increased choice of solutions and to further improve quality and value for money. As the directory indicates, the UK has become the focus both for an unprecedented increase in home-grown manufacturing talent and investment and as a priority marketplace for leading overseas producers.

With almost 1000 manufacturers and suppliers to choose from, specifying from this relatively new supplier base can be intimidating.

Architects, Specifiers, Buyers, and Contractors now have a clear window into this diverse supply base supported by an extensive search and selection capability.

You can have confidence that this tool will help you choose the most appropriate offsite technology from the most appropriate manufacturer for your project.

- It provides an informed supplier selection process

- Offers a continually up dated list of offsite manufacturers
- Provides independently verified information on the selected manufacturer to enable straightforward and consistent comparisons
- Gives access to supplier capability that is not readily available direct from the manufacturers published information
- Ultimately it should increase the use of and demand for offsite across the UK

Offsiteonline is the expert at your finger tips when you want to know which offsite products to use in your construction project and where to obtain them.

It will provide the user with the confidence to create a short list, safe in the knowledge that they have made a thoroughly informed search.



**offsiteonline**  
OFFSITE SYSTEMS SUPPLIERS DIRECTORY FOR SPECIFIERS

**mtech**  
CONSULT

**m2i**

**Building**

## Bathroom & Kitchen Pods

ALA Rational System	<a href="http://www.alarational.it">www.alarational.it</a>	0423 639223
Altor UK	<a href="http://www.altor-industrie.co.uk">www.altor-industrie.co.uk</a>	01476 590069
Ardmore Construction	<a href="http://www.ardmoregroup.co.uk">www.ardmoregroup.co.uk</a>	0208 344 0300
Bathsystem UK	<a href="http://www.bathsystem.com">www.bathsystem.com</a>	0870 1416006
Baudet Composites	<a href="http://www.baudet-composites.com">www.baudet-composites.com</a>	00332 51662785
Betonelement	<a href="http://www.betonelement.dk">www.betonelement.dk</a>	0045 70103510
Buchan Concrete Solutions	<a href="http://www.buchanconcrete.com">www.buchanconcrete.com</a>	01606 843500
CPL Modular Ltd	<a href="http://www.cplgroup.co.uk">www.cplgroup.co.uk</a>	01543 363840
Deba Systemtechnik GMBH	<a href="http://www.deba.de">www.deba.de</a>	0049 390183130
EJ Badekabiner UK	<a href="http://www.ej-badekabiner.co.uk">www.ej-badekabiner.co.uk</a>	01670 707270
Elements Europe	<a href="http://www.elements-europe.com">www.elements-europe.com</a>	01691 656591
Ensuite Solutions	<a href="http://www.ensuitesolutions.co.uk">www.ensuitesolutions.co.uk</a>	01327 830380
Eurocomponents SpA	<a href="http://www.neweurocomponents.com">www.neweurocomponents.com</a>	0039 0306871387
European Ensuites	<a href="http://www.europeanensuites.co.uk">www.europeanensuites.co.uk</a>	01923 711234
Gateway Pods	<a href="http://www.gatewaypods.co.uk">www.gatewaypods.co.uk</a>	01430 444400
Glafiba Aps	<a href="http://www.glafiba.com">www.glafiba.com</a>	0045 39186181
Kondor Bathroom Pods	<a href="http://www.kondor-pods.co.uk">www.kondor-pods.co.uk</a>	0870 8504547
McAvoy Group	<a href="http://www.mcavoygroup.com">www.mcavoygroup.com</a>	028 87740372
Nordman Profile	<a href="http://www.nordman.ie">www.nordman.ie</a>	00353 659052011
Nu-style Products Limited	<a href="http://www.nu-styleproducts.com">www.nu-styleproducts.com</a>	01224 823000
Oep-Raterad	<a href="http://www.lfmggroup.com">www.lfmggroup.com</a>	01524 841266
Offsite Solutions	<a href="http://www.offsitesolutions.biz">www.offsitesolutions.biz</a>	01278 780807
Paddington	<a href="http://www.paddingtonoffsite.com">www.paddingtonoffsite.com</a>	020 8344 6650
Parmarine	<a href="http://www.parmarine.fi">www.parmarine.fi</a>	00358 34127396
Partab	<a href="http://www.partab.nu">www.partab.nu</a>	01455 238282
Pod Modules	<a href="http://www.pod-modules.co.uk">www.pod-modules.co.uk</a>	020 83124495
Polypod	<a href="http://www.polypod.ie">www.polypod.ie</a>	00353 18205004 Å
Preformed Offsite Design Systems	<a href="http://www.pods.ie">www.pods.ie</a>	00353 214355452
Qpods UK	<a href="http://www.qpods.com">www.qpods.com</a>	028 87788040
RB Farquhar	<a href="http://www.rbfarquhar.co.uk">www.rbfarquhar.co.uk</a>	01466 793231
Roll Formed Fabrications	<a href="http://www.henrybrothers.co.uk">www.henrybrothers.co.uk</a>	028 79631631
Saniflex UK	<a href="http://www.saniflex.co.uk">www.saniflex.co.uk</a>	02392 379555
SchwoererHaus GmbH	<a href="http://www.schwoererbau.de">www.schwoererbau.de</a>	0049 3093899143
Sterchele	<a href="http://www.sterchele.it">www.sterchele.it</a>	0039 444975555
Swift Horsman Limited	<a href="http://www.swifthorsman.co.uk">www.swifthorsman.co.uk</a>	01920 466795
Taplanes of Harrogate	<a href="http://www.taplanes.com">www.taplanes.com</a>	01423 771645
Tenon Washroom Systems	<a href="http://www.tenonwashrooms.co.uk">www.tenonwashrooms.co.uk</a>	08701 229950
Walker Modular Ltd	<a href="http://www.walkermodular.com">www.walkermodular.com</a>	01482 586812

## Foundation Systems

ABC Anchors	<a href="http://www.abcanchors.co.uk">www.abcanchors.co.uk</a>	01380 850885
Fast Foundation Solutions Limited	<a href="http://www.foundationssolutions.co.uk">www.foundationssolutions.co.uk</a>	07775 730502
Roger Bullivant	<a href="http://www.roger-bullivant.co.uk">www.roger-bullivant.co.uk</a>	01283 511115
Thermonex	<a href="http://www.thermonex.co.uk">www.thermonex.co.uk</a>	01204 559551
Van Elle Limited	<a href="http://www.van-elle.co.uk">www.van-elle.co.uk</a>	01773 580580

## Light Steel Frame

Absolute Steel Framing	<a href="http://www.absolutesteelframing.co.uk">www.absolutesteelframing.co.uk</a>	0121 5551385
Atkin Trade Specialist	<a href="http://www.atkingroup.co.uk">www.atkingroup.co.uk</a>	029 20442060
Ayrshire Metal Products	<a href="http://www.ayrshire.co.uk">www.ayrshire.co.uk</a>	01327 300990
Bankside Patterson	<a href="http://www.bankside-patterson.com">www.bankside-patterson.com</a>	01964 545454
Bourne Steel	<a href="http://www.bournegroup.eu">www.bournegroup.eu</a>	01202 746666
Buma SA	<a href="http://www.buma.com.pl">www.buma.com.pl</a>	0048 12 2972222
Composite Ltd	<a href="http://www.compositeltd.co.uk">www.compositeltd.co.uk</a>	023 80645700
Cornercare	<a href="http://www.cornercare.co.uk">www.cornercare.co.uk</a>	01562 515200
Cover Structure	<a href="http://www.coverstructure.com">www.coverstructure.com</a>	0113 2350088
Creative Modular Solutions	<a href="http://www.creativemodularsolutions.com">www.creativemodularsolutions.com</a>	0141 9506300
EOS (Engineered Off-Site Systems)	<a href="http://www.eosuk.org">www.eosuk.org</a>	01325 303030
EWALL Technology	<a href="http://www.ewall.co.uk">www.ewall.co.uk</a>	01642 370636
Glenbeigh Offsite	<a href="http://www.gosuk.co.uk">www.gosuk.co.uk</a>	07554 000230
Hadley Group	<a href="http://www.hadleygroup.co.uk">www.hadleygroup.co.uk</a>	0121 5551300
Kingspan Off-site	<a href="http://www.kingspanoffsite.com">www.kingspanoffsite.com</a>	01767 676 400
Lindab	<a href="http://www.lindab.co.uk">www.lindab.co.uk</a>	0121 5852780
Metcon	<a href="http://www.metcon.ie">www.metcon.ie</a>	00 353 469026326
Metek UK	<a href="http://www.metekbuildingsystems.co.uk">www.metekbuildingsystems.co.uk</a>	01453 794800
Metsec Plc	<a href="http://www.metsec.com">www.metsec.com</a>	0121 6016000
Modern Construction Methods	<a href="http://www.mcmethods.com">www.mcmethods.com</a>	0845 459 2049
Natural Building Technologies	<a href="http://www.natural-building.co.uk">www.natural-building.co.uk</a>	01844 338338
Nordman Profile Ltd	<a href="http://www.nordman.ie">www.nordman.ie</a>	00 353 65 9052011
Ruukki UK	<a href="http://www.ruukki.com">www.ruukki.com</a>	01757 249334
Stanta Crowley	<a href="http://www.stanta.com">www.stanta.com</a>	00353 949255682
Structural Systems	<a href="http://www.structural-systems.co.uk">www.structural-systems.co.uk</a>	0117 9149961

## Permanent Formwork

1st Insulation Partners Limited	<a href="http://www.walltransform.co.uk">www.walltransform.co.uk</a>	01642 714123
Beco Wallform	<a href="http://www.becowallform.co.uk">www.becowallform.co.uk</a>	01724 74 576
Eco Block UK	<a href="http://www.eco-block.com">www.eco-block.com</a>	01794 368657
Ecoslab Limited	<a href="http://www.ecoslab.co.uk">www.ecoslab.co.uk</a>	0800 028 5377
Euromac Building Systems	<a href="http://www.euromac.ie">www.euromac.ie</a>	00353 61620703
Eurozone Building Solutions	<a href="http://www.eurozone.ie">www.eurozone.ie</a>	00353 53 9243333
Formworks UK	<a href="http://www.formworksuk.com">www.formworksuk.com</a>	01273 478110
IntegraSpec	<a href="http://www.integraspec.ie">www.integraspec.ie</a>	00353 469074064
Logix	<a href="http://www.logix.uk.com">www.logix.uk.com</a>	0845 6076958
Nudura Corporation	<a href="http://www.nudura.com">www.nudura.com</a>	07766 118711
Polarwall	<a href="http://www.polarwall.co.uk">www.polarwall.co.uk</a>	0845 8382181
PolySteel UK	<a href="http://www.polysteel.co.uk">www.polysteel.co.uk</a>	08703 822229
Professional Formwork Solutions	<a href="http://www.pfsolutions.ie">www.pfsolutions.ie</a>	00353 18352898
Quad-Lock (England) Limited	<a href="http://www.quadlock.co.uk">www.quadlock.co.uk</a>	0870 4431901
Shellform Limited	<a href="http://www.shellform.com">www.shellform.com</a>	023 80528866
Springvale EPS	<a href="http://www.springvale.com">www.springvale.com</a>	01457 863211
Styro Stone UK	<a href="http://www.styrostone.com">www.styrostone.com</a>	0034 966468490
Thermal Foams Inc	<a href="http://www.thermalfoams.com">www.thermalfoams.com</a>	001 716 8746474
Vencel Resil	<a href="http://www.vencel.co.uk">www.vencel.co.uk</a>	020 83209100

## Precast Concrete

ACP (Concrete)	<a href="http://www.acpconcrete.co.uk">www.acpconcrete.co.uk</a>	01900 814659
Aggregate Industries UK	<a href="http://www.aggregate-uk.com">www.aggregate-uk.com</a>	01530 510066
Barcon Precast	<a href="http://www.barconprecast.co.uk">www.barconprecast.co.uk</a>	01204 690088
Bell & Webster	<a href="http://www.eleco.com/bellandwebster">www.eleco.com/bellandwebster</a>	01476 562277
Bison Manufacturing Ltd	<a href="http://www.bison.co.uk">www.bison.co.uk</a>	01283 495000
Buchan Concrete Solutions	<a href="http://www.buchanconcrete.com">www.buchanconcrete.com</a>	01606 843500
Carter Concrete	<a href="http://www.carter-concrete.co.uk">www.carter-concrete.co.uk</a>	01263 823434
Collier & Henry Concrete (Floors)	<a href="http://www.chcfloors.com">www.chcfloors.com</a>	0161 872 8410
Coltman Precast Concrete	<a href="http://www.coltman.co.uk">www.coltman.co.uk</a>	01543 480482
Cornish Concrete	<a href="http://www.cornishconcrete.co.uk">www.cornishconcrete.co.uk</a>	01872 864808
CPM Group	<a href="http://www.cpm-group.com">www.cpm-group.com</a>	01902 356220
Decomo	<a href="http://www.decomo.be">www.decomo.be</a>	0032 56 850711
Eleco Plc	<a href="http://www.eleco.com">www.eleco.com</a>	01920 443830
Flynn Concrete Products UK	<a href="http://www.flynnconcreteproducts.ie">www.flynnconcreteproducts.ie</a>	01323 832334
H+H UK Ltd	<a href="http://www.hhcelcon.co.uk">www.hhcelcon.co.uk</a>	01732 886444
Hanson Building Products	<a href="http://www.hanson.co.uk">www.hanson.co.uk</a>	08705 258258
Litecast	<a href="http://www.litecast.co.uk">www.litecast.co.uk</a>	024 76356161
Longley Concrete Floors	<a href="http://www.longley.uk.com">www.longley.uk.com</a>	01924 464283
Milbank	<a href="http://www.milbank.co.uk">www.milbank.co.uk</a>	01787 223931
Milbury Systems	<a href="http://www.milbury.com">www.milbury.com</a>	01275 857799
Robeslee Concrete	<a href="http://www.robesslee.co.uk">www.robesslee.co.uk</a>	0141 7752677
Roger Bullivant	<a href="http://www.roger-bullivant.co.uk">www.roger-bullivant.co.uk</a>	01283 525043
SCC	<a href="http://www.sccltd.co.uk">www.sccltd.co.uk</a>	0161 4327700
Structerm	<a href="http://www.structerm.co.uk">www.structerm.co.uk</a>	01484 850098
Tarmac Precast	<a href="http://www.tarmacprecast.co.uk">www.tarmacprecast.co.uk</a>	01778 381000
ThermoneX	<a href="http://www.thermonex.co.uk">www.thermonex.co.uk</a>	01204 559551
Thomas Armstrong	<a href="http://www.thomasarmstrong.co.uk">www.thomasarmstrong.co.uk</a>	01900 68211
Trent Concrete	<a href="http://www.trentconcrete.co.uk">www.trentconcrete.co.uk</a>	0115 9879747
Waycon Precast	<a href="http://www.wayconprecast.com">www.wayconprecast.com</a>	01752 335777

## Roofing Systems

Cover Structure	<a href="http://www.coverstructure.com">www.coverstructure.com</a>	0113 2350088
Dibsa Structures	<a href="http://www.dibsa.co.uk">www.dibsa.co.uk</a>	01706 342598
Kalzip Ltd	<a href="http://www.corus-hipoint.com">www.corus-hipoint.com</a>	01942 295500
Milbank	<a href="http://www.milbank.co.uk">www.milbank.co.uk</a>	01787 223931
Shellform Limited	<a href="http://www.shellform.com">www.shellform.com</a>	023 80528866
Smartroof	<a href="http://www.smartroof.co.uk">www.smartroof.co.uk</a>	01675 442345
SpeedDeck Building Systems Limited	<a href="http://www.speeddeck.com">www.speeddeck.com</a>	01379 787291
Supa Wall Ltd	<a href="http://www.supawall.com">www.supawall.com</a>	01995 679801
Unidek Limited	<a href="http://www.unidek.co.uk">www.unidek.co.uk</a>	0845 074 7477



## Structurally Insulated Panel System (SIPS)

AcerMetric	<a href="http://www.acermetric.co.uk">www.acermetric.co.uk</a>	01245 216780
ARM Buildings	<a href="http://www.armbuildings.co.uk">www.armbuildings.co.uk</a>	01889 575055
Custom Homes	<a href="http://www.customhomes.co.uk">www.customhomes.co.uk</a>	01787 377388
Ecotech Group	<a href="http://www.eco-techgroup.com">www.eco-techgroup.com</a>	01635 44830
Emmedue M2 Building Systems	<a href="http://www.mdue.it">www.mdue.it</a>	0039 721 856211
Excel Industries	<a href="http://www.excelfibre.com">www.excelfibre.com</a>	01685 845200
Fillcrete Limited	<a href="http://www.fillcrete.com">www.fillcrete.com</a>	01474 872444
Glenbeigh Offsite	<a href="http://www.gosuk.co.uk">www.gosuk.co.uk</a>	07554 000230
Hemsec SIPS	<a href="http://www.hemsecsips.com">www.hemsecsips.com</a>	0151 4267171
Innovare Systems	<a href="http://www.innovaresystems.co.uk">www.innovaresystems.co.uk</a>	0845 6740020
Kingspan Off-site	<a href="http://www.kingspanoffsite.com">www.kingspanoffsite.com</a>	01767 676 400
Kingspan Tek	<a href="http://www.tek.kingspan.com">www.tek.kingspan.com</a>	0870 850 8555
K-Panels Limited	<a href="http://www.k-panels.co.uk">www.k-panels.co.uk</a>	0842 226 0214
Mantle Panel	<a href="http://www.mantlepanel.com">www.mantlepanel.com</a>	0845 1300970
McVeigh Group	<a href="http://www.mcveigh-uk.com">www.mcveigh-uk.com</a>	0161 3679090
Milbank	<a href="http://www.milbank.co.uk">www.milbank.co.uk</a>	01787 223931
Modcell	<a href="http://www.modcell.co.uk">www.modcell.co.uk</a>	0117 9547325
Norman Piette	<a href="http://www.norman-piette.com">www.norman-piette.com</a>	01481 245801
Nu-style Products Limited	<a href="http://www.nu-styleproducts.com">www.nu-styleproducts.com</a>	01224 823000
OFP	<a href="http://www.ofpltd.com">www.ofpltd.com</a>	01304 613298
OJM Ltd	<a href="http://www.whmltd.com">www.whmltd.com</a>	01743 874550
Opstalan	<a href="http://www.opstalan.nl">www.opstalan.nl</a>	0031 135231313
Passive House Solutions	<a href="http://www.passivehouse.co.uk">www.passivehouse.co.uk</a>	0560 1122330
Scotframe Timber Engineering Limited	<a href="http://www.scotframe.co.uk">www.scotframe.co.uk</a>	01467 624440
SIP Build	<a href="http://www.sipbuildltd.com">www.sipbuildltd.com</a>	0870 8502264
SIP Building Systems	<a href="http://www.sipbuildingsystems.co.uk">www.sipbuildingsystems.co.uk</a>	0870 224 8040
SIP Construction Company Limited	<a href="http://www.sipitscotland.co.uk">www.sipitscotland.co.uk</a>	0141 9562277
SIP Energy Homes Limited	<a href="http://www.sip-energy.com">www.sip-energy.com</a>	00353 9187 4290
SIP Kits	<a href="http://www.sipkits.co.uk">www.sipkits.co.uk</a>	01686 611130
SIPit	<a href="http://www.sipitscotland.co.uk">www.sipitscotland.co.uk</a>	0141 9562277
SIPS Industries (Bpac)	<a href="http://www.sipsindustries.com">www.sipsindustries.com</a>	01383 823995
SIPtec	<a href="http://www.siptec.co.uk">www.siptec.co.uk</a>	01234 881280
Space4	<a href="http://www.space4.co.uk">www.space4.co.uk</a>	0121 7488383
Springvale EPS	<a href="http://www.springvale.com">www.springvale.com</a>	01457 863211
T J Crump Oakwrights Limited	<a href="http://www.oakwrights.co.uk">www.oakwrights.co.uk</a>	01432 353353
Telling Architectural Limited	<a href="http://www.telling.co.uk">www.telling.co.uk</a>	01902 789777
Thermal Foams Inc	<a href="http://www.thermalfoams.com">www.thermalfoams.com</a>	001 716 8746474
Thermastructure Europe	<a href="http://www.thermastructure.co.uk">www.thermastructure.co.uk</a>	01273 492212
Unidek Limited	<a href="http://www.unidek.co.uk">www.unidek.co.uk</a>	0845 074 7477
Unilin Systems	<a href="http://www.unilin-systems.com">www.unilin-systems.com</a>	0044 7817655326
Va-Q-tec	<a href="http://www.va-q-tec.com">www.va-q-tec.com</a>	0049 931359420



## Timber Frame

AcerMetric	<a href="http://www.acermetric.co.uk">www.acermetric.co.uk</a>	01245 216780
Advanced Panel Systems (UK) Ltd	<a href="http://www.advancedpanelsystems.co.uk">www.advancedpanelsystems.co.uk</a>	01579 370740
Advanced Timber Craft	<a href="http://www.advancedtimbercraft.com">www.advancedtimbercraft.com</a>	028 90838951
Alexander Timber Design	<a href="http://www.alexanderstimmerhomes.com">www.alexanderstimmerhomes.com</a>	01292 679679
Allwood Buildings	<a href="http://www.allwoodtimber.co.uk">www.allwoodtimber.co.uk</a>	01404 850977
Alouette International Housing	<a href="http://www.maisonlouette.com">www.maisonlouette.com</a>	0014 505393100
Armstrong Timber Engineering	<a href="http://www.ate.ie">www.ate.ie</a>	00353 40233477
Arnold Laver Timber World	<a href="http://www.laver.co.uk">www.laver.co.uk</a>	0114 2764700
Aspire Timber Structures	<a href="http://www.aspiretimberstructures.com">www.aspiretimberstructures.com</a>	08000 828483
Avonhill Timber Frame	<a href="http://www.avonhill.ltd.uk">www.avonhill.ltd.uk</a>	01698 459777
CCG (OSM)	<a href="http://www.c-c-g.co.uk">www.c-c-g.co.uk</a>	01236 795913
Chandos Timber Engineering	<a href="http://www.chandostimber.co.uk">www.chandostimber.co.uk</a>	01706 510860
Clarke Homes	<a href="http://www.clarkeltd.com">www.clarkeltd.com</a>	028 6772 1286
Code4 Timber Frame Limited	<a href="http://www.newenglandtimberframe.co.uk">www.newenglandtimberframe.co.uk</a>	01905 455250
Cowlin Timber Frame	<a href="http://www.cowlin.co.uk">www.cowlin.co.uk</a>	01443 209953
Crendon Timber Engineering	<a href="http://www.crendon.co.uk">www.crendon.co.uk</a>	01844 201020
Crocodile Timber Frames	<a href="http://www.crocodile.uk.com">www.crocodile.uk.com</a>	01793 821555
Custom Homes	<a href="http://www.customhomes.co.uk">www.customhomes.co.uk</a>	01787 377388
Cygnum Timber Frame	<a href="http://www.cygnum.co.uk">www.cygnum.co.uk</a>	01449 771782
Deeside Homes Timberframe	<a href="http://www.bancon.co.uk">www.bancon.co.uk</a>	01569 767123
Dempsey Timber Engineering	<a href="http://www.dte.ie">www.dte.ie</a>	00353 40231704
Derbybeech	<a href="http://www.derbybeech.com">www.derbybeech.com</a>	01482 868993
Donaldson Timber Engineering	<a href="http://www.donaldsontimber.com">www.donaldsontimber.com</a>	01592 715026
Drumbow Timber Frame	<a href="http://www.drumbowhomes.co.uk">www.drumbowhomes.co.uk</a>	01506 815940
Eco Timber Frame	<a href="http://www.ecotimberframe.co.uk">www.ecotimberframe.co.uk</a>	01566 775100
Ecoframes	<a href="http://www.ecoframes.co.uk">www.ecoframes.co.uk</a>	01938 559159
Ecotech Group	<a href="http://www.eco-techgroup.com">www.eco-techgroup.com</a>	01635 44830
Ecowarm	<a href="http://www.ecowarm.net">www.ecowarm.net</a>	0151 7081400
Eleco Plc	<a href="http://www.eleco.com">www.eleco.com</a>	01920 443830
English Brothers	<a href="http://www.englishbrothers.co.uk">www.englishbrothers.co.uk</a>	01945 587500
Fawcett Frames	<a href="http://www.fawcettframes.co.uk">www.fawcettframes.co.uk</a>	01935 850973
Fforest Timber Engineering	<a href="http://www.fforest.co.uk">www.fforest.co.uk</a>	01792 895620
Finnforest UK	<a href="http://www.finnforest.co.uk">www.finnforest.co.uk</a>	01375 856855
Finnhaus	<a href="http://www.finnhaus.at">www.finnhaus.at</a>	0043 274228380
Fleming Buildings	<a href="http://www.fleming-buildings.co.uk">www.fleming-buildings.co.uk</a>	0141 7761181
Flight Timber	<a href="http://www.flighttimber.com">www.flighttimber.com</a>	01787 222336
Frame UK	<a href="http://www.frameuk.com">www.frameuk.com</a>	01209 310560
Frame Wise	<a href="http://www.framewiseltd.co.uk">www.framewiseltd.co.uk</a>	01544 260125
Framework BSL	<a href="http://www.frameworkbsl.com">www.frameworkbsl.com</a>	08700 718728
Gibbs Timber Frame Ltd	<a href="http://www.gibbstimberframe.co.uk">www.gibbstimberframe.co.uk</a>	01983 522188
Glennon Bros Timber	<a href="http://www.gbt.ie">www.gbt.ie</a>	00353 4350800
Grainger Timber Frames	<a href="http://www.graingertimberframes.co.uk">www.graingertimberframes.co.uk</a>	01677 470194
Guardian Homes	<a href="http://www.guardiantimberframe.co.uk">www.guardiantimberframe.co.uk</a>	01229 870522
Guildway	<a href="http://www.walkertimbergroup.co.uk/guildway">www.walkertimbergroup.co.uk/guildway</a>	01205 350555
Harlow Timber Systems	<a href="http://www.hstimber.co.uk">www.hstimber.co.uk</a>	01530 516990
Hedalm Anebyhus AS	<a href="http://www.hedalm.co.uk">www.hedalm.co.uk</a>	01702 522208

Heritage Designs	<a href="http://www.heritagedesigns.co.uk">www.heritagedesigns.co.uk</a>	01239 614462
Highvalue Timber Frame	<a href="http://www.highvalue-timber-frame.co.uk">www.highvalue-timber-frame.co.uk</a>	01225 792939
Holbrook Timber Frame	<a href="http://www.holbrooktimberframe.co.uk">www.holbrooktimberframe.co.uk</a>	01656 721700
Homelodge Buildings	<a href="http://www.homelodge.co.uk">www.homelodge.co.uk</a>	01962 881480
Howarth Timber Group	<a href="http://www.howarth-timber.co.uk">www.howarth-timber.co.uk</a>	01284 772700
Huf Haus	<a href="http://www.huf-haus.com">www.huf-haus.com</a>	0870 2000035
Hunter Off-Site	<a href="http://www.hunter.co.uk">www.hunter.co.uk</a>	01622 716200
IJM Timber Engineering	<a href="http://www.ijm.ie">www.ijm.ie</a>	029 20263618
Interhabs Canada Limited	<a href="http://www.interhabs.co.uk">www.interhabs.co.uk</a>	01282 446100
Karlsonhus Industries	<a href="http://www.karlsonhus.co.uk">www.karlsonhus.co.uk</a>	0046 47455500
Keenan Timber Frame	<a href="http://www.ktf.ie">www.ktf.ie</a>	00353 416850978
Kelly Timber Frame	<a href="http://www.kellytimberframe.ie">www.kellytimberframe.ie</a>	00353 18643290
Kilbroney Timberframe	<a href="http://www.kilbroneyhomes.com">www.kilbroneyhomes.com</a>	028 41739077
Kingdom Housing Association	<a href="http://www.kingdomhousing.org.uk">www.kingdomhousing.org.uk</a>	01592 631661
Kingspan Century	<a href="http://www.century.ie">www.century.ie</a>	00353 4781270
Kingspan Off-site	<a href="http://www.kingspanoffsite.com">www.kingspanoffsite.com</a>	01767 676 400
K-Panels Limited	<a href="http://www.k-panels.co.uk">www.k-panels.co.uk</a>	0845 226 0214
Lakeland Timber Frame	<a href="http://www.lakelandtimberframe.co.uk">www.lakelandtimberframe.co.uk</a>	01524 782596
Leisureline Joinery	<a href="http://www.leisurelinejoinery.co.uk">www.leisurelinejoinery.co.uk</a>	01271 311960
Lincolnshire Timber Frame	<a href="http://www.timberframe-uk.co.uk">www.timberframe-uk.co.uk</a>	01522 694374
Lindisfarne Timber Frame	<a href="http://www.lindisfarnetimberframeltd.co.uk">www.lindisfarnetimberframeltd.co.uk</a>	01670 810472
Lomond Homes	<a href="http://www.lomondhomes.com">www.lomondhomes.com</a>	01592 776644
Lowfield Timber Frames	<a href="http://www.lowfieldtimberframes.co.uk">www.lowfieldtimberframes.co.uk</a>	01743 891922
Maple Timber Frame	<a href="http://www.mapletimberframe.com">www.mapletimberframe.com</a>	01995 679444
Maritime Homes	<a href="http://www.maritimehomes-sales.com">www.maritimehomes-sales.com</a>	001902 5272510
MBC Timber Frame	<a href="http://www.mbctimberframe.ie">www.mbctimberframe.ie</a>	00353 5245090
Merronbrook	<a href="http://www.merronbrook.co.uk">www.merronbrook.co.uk</a>	01252 844747
Metnor Construction	<a href="http://www.metnor.co.uk">www.metnor.co.uk</a>	0191 2684000
Midland Timber Engineering	<a href="http://www.mte-leicester.co.uk">www.mte-leicester.co.uk</a>	0116 2321777
MK Timber Systems	<a href="http://www.europeantimbersystems.co.uk">www.europeantimbersystems.co.uk</a>	01355 598900
Moreys Timber Engineering	<a href="http://www.moreys.co.uk">www.moreys.co.uk</a>	01983 822725
Nationwide Engineered Timber	<a href="http://www.nationwideengineeredtimber.co.uk">www.nationwideengineeredtimber.co.uk</a>	01283 735353
Natural Building Technologies	<a href="http://www.natural-building.co.uk">www.natural-building.co.uk</a>	01844 338338
Neatwood Homes	<a href="http://www.neatwoodhomes.co.uk">www.neatwoodhomes.co.uk</a>	01981 240860
New World Timber Frame Ltd	<a href="http://www.newworldtimberframe.com">www.newworldtimberframe.com</a>	01799 531122
Norman Piette	<a href="http://www.norman-piette.com">www.norman-piette.com</a>	01481 245801
Norscot Joinery	<a href="http://www.norscot.co.uk">www.norscot.co.uk</a>	01955 641303
Oakworth Homes Limited	<a href="http://www.oakworthhomes.co.uk">www.oakworthhomes.co.uk</a>	0114 261 1150
OFP	<a href="http://www.ofpltd.com">www.ofpltd.com</a>	01304 613298
Oregon Timber Frame Ltd	<a href="http://www.oregon.co.uk">www.oregon.co.uk</a>	01750 724940
Oswestry Timber Frames	<a href="http://www.oswestrytimberframes.co.uk">www.oswestrytimberframes.co.uk</a>	01691 656511
Patrick & Thompsons Ltd	<a href="http://www.pandt.co.uk">www.pandt.co.uk</a>	01553 762026
Pinewood Structures	<a href="http://www.pinewood-structures.co.uk">www.pinewood-structures.co.uk</a>	01767 651218
Prestoplan	<a href="http://www.prestoplan.co.uk">www.prestoplan.co.uk</a>	0870 6000077
Quality Timber Frames	<a href="http://www.qtfhomes.co.uk">www.qtfhomes.co.uk</a>	028 40632494
Regal Carpentry Limited	<a href="http://www.regalcarpentry.co.uk">www.regalcarpentry.co.uk</a>	01234 838833
Rob Roy Homes	<a href="http://www.robroyhomes.co.uk">www.robroyhomes.co.uk</a>	01764 670424
Robertson Timberkit	<a href="http://www.timberkit.co.uk">www.timberkit.co.uk</a>	0191 5136950
Roe Group	<a href="http://www.roeltd.co.uk">www.roeltd.co.uk</a>	01843 232888
RTC Timber Systems	<a href="http://www.rtcts.co.uk">www.rtcts.co.uk</a>	01343 547474
Scotframe Timber Engineering Limited	<a href="http://www.scotframe.co.uk">www.scotframe.co.uk</a>	01467 624440
Seven Oaks Joinery	<a href="http://www.sevenoaksjoinery.co.uk">www.sevenoaksjoinery.co.uk</a>	01639 620240
Skye Homes	<a href="http://www.skyehomes.co.uk">www.skyehomes.co.uk</a>	01478 611211
Smartply Europe	<a href="http://www.smartply.com">www.smartply.com</a>	01322 424900
Southern Timber Frame	<a href="http://www.southerntimberframe.com">www.southerntimberframe.com</a>	023 80293062

Space4	<a href="http://www.space4.co.uk">www.space4.co.uk</a>	0121 7488383
Spruce Timber Frame	<a href="http://www.sprucetimberframe.co.uk">www.sprucetimberframe.co.uk</a>	01294 221435
Stewart Milne Timber Systems	<a href="http://www.stewartmilne.com">www.stewartmilne.com</a>	01224 747000
Streif UK Limited	<a href="http://www.streif.co.uk">www.streif.co.uk</a>	01273 423230
Supa Wall Ltd	<a href="http://www.supawall.com">www.supawall.com</a>	01995 679801
Swift Timber Homes	<a href="http://www.swifttimberhomes.com">www.swifttimberhomes.com</a>	01388 835222
Sydenhams Timber Engineering	<a href="http://www.sydenhamtimberframe.co.uk">www.sydenhamtimberframe.co.uk</a>	01983 535187
T J Crump Oakwrights Limited	<a href="http://www.oakwrights.co.uk">www.oakwrights.co.uk</a>	01432 353353
Target Timber Systems	<a href="http://www.targettimber.com">www.targettimber.com</a>	01483 266620
Taylor Lane Timber Frame	<a href="http://www.taylor-lane.co.uk">www.taylor-lane.co.uk</a>	01432 271912
The Timber Frame Company	<a href="http://www.tffc.ie">www.tffc.ie</a>	00353 539144200
The Timber Frame Company Limited	<a href="http://www.thetimberframe.co.uk">www.thetimberframe.co.uk</a>	01749 814951
Thomas Armstrong	<a href="http://www.thomasarmstrong.co.uk">www.thomasarmstrong.co.uk</a>	01900 68211
Thomas Mitchell Homes	<a href="http://www.thomasmitchellhomes.com">www.thomasmitchellhomes.com</a>	01592 774401
Timber Frame Homes	<a href="http://www.tfhomes.co.uk">www.tfhomes.co.uk</a>	028 37552651
Timber Frameworks	<a href="http://www.timberframeworks.com">www.timberframeworks.com</a>	01506 870101
Timber Kit Solutions Ltd	<a href="http://www.timberkitsolutions.co.uk">www.timberkitsolutions.co.uk</a>	01952 770990
Timberdwell Homes Ltd	<a href="http://www.timberdwellhomes.com">www.timberdwellhomes.com</a>	028 71812422
Timberframe Wales	<a href="http://www.timberframewales.co.uk">www.timberframewales.co.uk</a>	01269 595255
Torwood Timber Systems	<a href="http://www.torwoodtimbersystems.com">www.torwoodtimbersystems.com</a>	01506 414105
Tru Homes	<a href="http://www.tru-homes.com">www.tru-homes.com</a>	01392 879636
Tyrone Timber Frame	<a href="http://www.tyronetimberframes.com">www.tyronetimberframes.com</a>	028 82252201
Unitek Timber Frame Systems	<a href="http://www.unitektd.com">www.unitektd.com</a>	0845 5552000
Utree Timber Frame Homes	<a href="http://www.utree.co.uk">www.utree.co.uk</a>	028 86751815
Walker Timber	<a href="http://www.walkertimbergroup.com">www.walkertimbergroup.com</a>	01506 823331
Wave Homes	<a href="http://www.wavehomes.com">www.wavehomes.com</a>	01908 576810
William Cooper	<a href="http://www.williamcooperltd.co.uk">www.williamcooperltd.co.uk</a>	01226 779776
Williams Homes & Timber Frames	<a href="http://www.williams-homes.co.uk">www.williams-homes.co.uk</a>	01678 521781
Wyckham Blackwell	<a href="http://www.wyckham-blackwell.co.uk">www.wyckham-blackwell.co.uk</a>	01675 442233
Younger Homes Ltd	<a href="http://www.youngerhomes.com">www.youngerhomes.com</a>	028 79643725

## Volumetric Modular

Britspace Modular Buildings	<a href="http://www.britspace.com">www.britspace.com</a>	01430 444400
EOS (Engineered Off-Site Systems)	<a href="http://www.eosuk.org">www.eosuk.org</a>	01325 303030
ErgoHome	<a href="http://www.ergohome.com">www.ergohome.com</a>	0845 2267543
First Penthouse	<a href="http://www.firstpenthouse.com">www.firstpenthouse.com</a>	020 75849894
Futureform Design and Build Limited	<a href="http://www.futureformltd.com">www.futureformltd.com</a>	01293 851555
Glenbeigh Offsite	<a href="http://www.gosuk.co.uk">www.gosuk.co.uk</a>	07554 000230
Hunter Off-Site	<a href="http://www.hunter.co.uk">www.hunter.co.uk</a>	01622 716200
Oakworth Homes Limited	<a href="http://www.oakworthhomes.co.uk">www.oakworthhomes.co.uk</a>	0114 261 1150
Omar Homes	<a href="http://www.omar.co.uk/divisions.asp">www.omar.co.uk/divisions.asp</a>	01842 810673
Open House	<a href="http://www.openhouse.se">www.openhouse.se</a>	0046 040533730
Portakabin	<a href="http://www.portakabin.co.uk">www.portakabin.co.uk</a>	0845 4010020
Rollalong	<a href="http://www.rollalong.co.uk">www.rollalong.co.uk</a>	01202 824541
Stanta Crowley	<a href="http://www.stanta.com">www.stanta.com</a>	00353 949255682
Terrapin Limited	<a href="http://www.terrapin-ltd.co.uk">www.terrapin-ltd.co.uk</a>	01908 270900
Thurston Building Systems	<a href="http://www.thurstongroup.co.uk">www.thurstongroup.co.uk</a>	01924 265461
Unite Modular Solutions	<a href="http://www.unite-group.co.uk">www.unite-group.co.uk</a>	01453 794200

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Mtech was established in 1995 and is a specialist construction consultancy working with Offsite and MMC technologies. We operate throughout the whole construction supply chain, using our expertise to identify for our manufacturing clients the most cost effective ways to make, and our construction clients to incorporate, new and innovative forms of technology to construction projects.

Working on a vast array of projects, from low cost housing to high end hotels and hospitality projects, schools to hospitals, the markets we work in are as diverse as our service offering.

Offsite technologies can offer key benefits when it comes to Sustainability. Selecting the right ones for a project can have a huge impact on its environmental credentials.

Our expertise has been applied by many International companies: Marriot and Hilton Hotels, McDonalds Restaurants Ltd., Corus, the Malaysian Government, UK Government (dept for children, schools and families), and many more.

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