Hertfordshire Growth Board

# Hertfordshire Offsite Manufacture

# Housing Guide

20.06.2022

**‘Hertfordshire alone since the turn of the century has been the cradle for continuous experiment in the making of cities. It was Herts which played host to the world’s first garden cities, Letchworth, commenced in 1903 and the larger Welwyn Garden City, which followed in 1919.’**

Andrew Saint- Towards a Social Architecture 1987

# Housing in Hertfordshire 2022

Government recognises our national housing crisis and, increasingly turning to local authorities for results, in 2018 lifted the Housing Revenue Account borrowing cap, allowing them to plan and deliver housing strategically.

In 2022, the target of building 300,000 homes a year to address the need for housing looks unreachable without further 'muscular' action.

In Hertfordshire, we share our acute need for housing with the rest of the country but here, our commitment goes deeper than numbers. Our version of muscular action, honouring our proud history of city making, is to insist on good growth and high quality placemaking within a significant growth agenda.

Our strategic scale development and regeneration at locations like Harlow and Gilston Garden Town, Hemel Garden Communities, Stevenage Town Centre and Watford Junction Quarter and our developing housing pipeline will deliver homes of the right quality in places that are sustainable in the long term.

By investing in skills and resources we are gearing up our delivery machine and by playing a bigger role in direct delivery we will enable more access to market housing. Offsite and Modern Methods of Construction will help increase the rate of housing delivery, in part because there are not enough construction workers available to deliver these higher rates in Hertfordshire or any other part of the South East. It is also an opportunity to address specialist housing need at the same time reducing unnecessary costs to the public sector.

**Loxley Stables, TAS architects. Tring, Hertfordshire.** Photograph: © James Brittain. Loxley Stables is a sensitive self-build development consisting of three low-energy houses set in the original grounds of Loxley Farm, a 16th century Grade II listed historic house in a Hertfordshire village. One of the houses was built using passive housing strategies to act as a test bed for low-energy, offsite construction. Though each house is unique, featuring handcrafted details, collectively they epitomise a modern, sustainable community.

# Hertfordshire's history of innovation moves into the present day with offsite construction

Hertfordshire's history of innovative construction leapt forward with the post war pre-fabricated schools programme, in which several institutions - The Building Research Establishment (BRE) at Garston, the Fire Research Station at Borehamwood and the Furniture Industry Research Association at Stevenage - played an important role. This concentration of innovation activity continues through to the present day and is gaining national and international recognition. The BRE is a key government partner and Stevenage is attracting significant investment for the life sciences industry with the likes of GSK and Airbus.

In 2017, seeing the potential of this unique and powerful local business eco-system, Herts LEP, the fledgling Growth Board and BRE, hosted Hertfordshire's first Buildings Solutions Conference and committed to offsite manufacture.

Well ahead of national trends and now bearing fruit, actions agreed at the conference included:

- The creation of Herts delivery consortium - bringing together almost 20 housing providers and Herts IQ, supported by the LEP and HGB;
- An offsite construction skills programme with West Hertfordshire College;
- Pilots to explore low rise residential using offsite methods.

**External links:**

**Herts Delivery Consortium**

**Letchworth Garden Homes**. **Letchworth, Hertfordshire.** © Garden City Collection (Letchworth City Heritage Foundation). Experimental steel framed cottages, as well as avant-garde pre-cast concrete systems and site labour-saving formwork systems using waste materials featured in experimental designs at the 1905 Letchworth Cheap Cottages Exhibition.

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# What is Offsite Manufacture/Modern Methods of Construction?

# A Short Introduction

‘Modern Methods of Construction’ (MMC) is a wide term, embracing a range of offsite manufacturing and onsite techniques that provide alternatives to traditional house building. MMC ranges from whole homes being constructed from factory-built volumetric modules, through to the use of innovative techniques for laying concrete blockwork onsite.

Since early in the 20th century, there have been periods of engagement with various alternative methods of construction in order to boost the country’s house building output, most notably in the post-war period.

In recent years, there has been renewed interest in MMC, with more developers engaging in project trials and going on to make increasing use of the variety of systems available. The 2017 Government White Paper expressed support for the contribution MMC is expected to make to helping solve the nation’s housing crisis and achieve the step-change in housing output that is needed. It pointed to the potential for a 30% improvement in the speed of construction of new homes through the adoption of innovation, with a potential 25% reduction in costs, as well as the potential for advances in improving quality and energy efficiency.

The following document presents in the first instance the principles behind MMC, highlighting how factory-made homes can significantly contribute to providing dwellings of a higher quality. The second part of this guide investigates offsite manufacture and modern methods in Hertfordshire specifically.

The guide is intended for interest to potential designers, house builders, officers, policy makers and anyone with an interest in understanding MMC and its benefits. This guide will be a ‘live’ document and will aim to be kept up to date by including the latest relevant projects as schemes are developed.

**External links:**

**Government White Paper**


**Marmalade Lane, Mole Architects. Cambridge.** Photograph: David Butler. Marmalade Lane is constructed from pre-fabricated CLT (cross laminated timber) structural panels supplied by Swedish manufacturer Trivselhus. CLT systems use solid panels of timber built up from multiple bonded sheets, rather like plywood but much thicker. Insulation is applied to the CLT panels on site and external finishes and other facings, built with traditional methods, are separated from the frame and insulation by a ventilation cavity.

**Marmalade Lane, Mole Architects. Cambridge.** Photograph: Studio Partington.

# Benefits of modular construction - a summary

**Offsite manufacture and Government**
Government is serious about MMC, making interventions to boost delivery wherever it can influence the housing market. It invested £30m in Ilke Homes, a Yorkshire-based modular housing factory and struck a deal between Homes England, the government's housing agency and Japan's biggest house builder Sekisui House to build thousands of modular homes across the UK.

**Industry guidance and guarantees**
Influential organisations like the NHBC help explain how far modern methods have come since post war 'prefabs'. NHBC Foundation's Building on Experience, looks at the history of non-traditional housing through a range of different technologies and advancements since the 19th century. It includes a chapter on the steady re-emergence of timber frame design in the 2020s, setting out the strengths of the approach, relevant to Hertfordshire, and features Herts consortium lead manufacturer Donaldson Timber Systems and its Sigma® II system.

**Governments emphasis on quality: Building Better, Building Beautiful**
Government and industry, with cross party support, is at a pivot point, agreeing on the importance of quality placemaking. Government promises a reset and key to that is the toolkit provided by the National Model Design Code (NMDC) and Planning for the Future, the White paper published March 2020.

**Housing white paper**
The Guidance Notes for Design Codes shows that design is not just about appearance but covers the key characteristics of context, movement, nature, built form, identity, public space, and use.

**The "well-designed" test**
Significant weight should be given to:

a) development which reflects local design policies and government guidance on design, taking into account any local design guidance and supplementary planning documents which use visual tools such as design guides and codes; and/or

b) outstanding or innovative designs which promote high levels of sustainability or help raise the standard of design more generally in an area, so long as they fit in with the overall form and layout of their surroundings."

Refer to Factsheets 2, 3 and 4 for more information.

- **Environmentally friendly – OSM's improved construction and performance standards can help Hertfordshire meet its 2030 zero carbon emissions commitment;**
- **Flexibility – modular constructions can be assembled and disassembled for relocation, refurbishment, and re-use;**
- **Reduced waste – factory production brings about design consistencies to minimise the waste of components. WRAP believes this to be as much as 70-90% waste savings;**
- **High quality – guided by certification, many aspects of construction quality can be controlled more easily in a factory-built environment e.g. acoustic, durability, fire, security, resilience, structural, sustainability and wellbeing;**
- **Address the growing skills shortage required for conventional construction and the consequent inflationary pressures.;**
- **Diversify the housing market;**
- **Improved delivery - speed and cost.**

**External links:**

**Japan's biggest house builder enters UK market with £90m deal**

**The Construction Playbook**

**Modern methods of construction: building on experience (NF88)**

**Modern methods of construction: who's doing what? (NF82)**

**National Model Design Code (NMDC)**

**Planning for the Future**

**The White Paper emphasises the importance of design quality: 'Our reformed system places a higher regard on quality, design and local vernacular than ever before, and draws inspiration from the idea of design codes and pattern books that built Bath, Belgravia and Bournville'.**

Planning for the future
The Rt. Hon. Robert Jenrick MP
Secretary of State for Housing, Communities and Local Government

Swan NU build factory. Photograph: ©Agnese Sanvito

**Beechwood Village, Pollard Thomas Edwards. Basildon.** A new neighbourhood of over 250 volumetric family houses for sale to people on moderate incomes. Factory-built modular technology offers an outstanding range of consumer choice, creating unique homes, which customers have designed to suit their own needs and aspirations.

**SLO, South Chase Newhall, Proctor and Matthews Architects. Newhall, Harlow, Essex.** These homes were built with modular steel units manufactured by Ayreshire metal from a system called 'Spaceover'. The architects have used the canopies and front entrances as the main architectural feature, providing a high quality applied screen behind which the modular units combine to create deceptively simple houses. Note the very high quality of internal finish that can be achieved with factory modules. Though the 'Spaceover' product is no longer available the design principles are common to other modular steel schemes - see also Murray Grove on page 16.

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# Offsite Manufacture and Modern Methods in Hertfordshire

# Why Hertfordshire?

Hertfordshire boasts important construction ability with many major construction firms headquartered here and strong skills in advanced manufacturing and digital technology. Opportunity Hertfordshire Nov 2020 confirmed progress. In 2005 the BRE Innovation Park was set up as a small-scale demonstration of offsite manufacture and went on to showcase, innovative construction and technologies, and low and zero carbon buildings such as Sigma House and Zedpods - first homes for young people and key workers constructed offsite. BRE is supporting Hertfordshire in securing offsite investment.

The 2017 Building Solutions Conference and the Building Solutions document took a construction industry perspective to cover advantages, and challenges with MMC and Offsite.

Since then, a lot more work has gone on: the Herts IQ Offsite Manufacturing Prospectus:

*Hertfordshire Offsite Manufacturer Prospectus*

and an event with BRE Group CEO Gillian Charlesworth on Hertfordshire Opportunity: Building a Sustainable Future, again bringing under one roof key stakeholders and construction companies.

More recently, members of the County's local authority and affordable housing sector have come together to form the Hertfordshire MMC consortium.

**Cole Thompson Anders. Letchworth Garden City, Hertfordshire.** Photograph: © Morley von Sternberg. A low-energy addition to Letchworth Garden City built to the code for Sustainable Homes level 4 using pre-fabricated timber panels.

**Oxley Wood, Rogers Stirk Harbour and Partners. Milton Keynes.** Photograph: Richard Bryant. Built as part of the Design for Manufacture programme Oxley Wood won many design plaudits. The construction is a closed panel timber frame, with insulation and facings boards fitted in the factory. Service including a mechanical ventilation unit were pre-fabricated and delivered in the pyramid shaped roof 'pod'.

**The Consortium has committed to:**

- **Supporting the LEP in attracting inward investment to create two new manufacturing plants;**
- **Supporting manufacturers to bring forward community benefits in terms of jobs, training and participation in education and development;**
- **Offsite manufacturers such as Donaldson Timber Systems are funding the new West Hertfordshire College MC Course creating 12 Apprenticeships;**
- **Pilots are underway in the county to explore in detail the benefits of MMC using category 1 and 2 manufacturer products.**

# How we have defined and - some background

Having quickly recognised offsite construction as part of the solution to the housing crisis. Hertfordshire LEP and Hertfordshire Growth Board produced Building Solutions - A Growth Model for Hertfordshire. The introduction and definition to MMC and Offsite Manufacture it provides is still current in 2022. Building Solutions explained the difference between MMC and Offsite.

MMC refers to the means of construction; Offsite Fabrication takes place in a factory setting. MMC components can be wholly fabricated in a factory setting, wholly fabricated where development takes place, or a combination of the two.

In 2019 the MHCLG (now the DLUHC) regularised and refined the term MMC, by describing the broad spectrum of innovative 'Modern Methods'.

**Derwenthorpe, Studio Partington. York.** The scheme was named best sustainable project at the AJ Architecture Awards 2017.

**External links:**

**Modern Methods of Construction: introducing the MMC definition framework**

**Derwenthorpe, Studio Partington. York.** This house illustrates the use of modern methods and offsite manufacture. The roof was delivered as a single "cassette" with insulation, waterproofing and tiling battens pre-fixed in the factory. The walls use a method known as thin bed blockwork where highly insulating aerated blocks are bonded together to make the inner leaf of the cavity wall. Note that the whole house can be insulated and watertight, here the windows are already installed, before the external finishes are built up. These methods were used because of the speed of constructing walls and roofs, with the external facing finishes off the 'critical path', and to allow a variety of facings including the base of recycled random-coursed stone walling.

# Offsite in Hertfordshire

**Good growth and high quality placemaking**
Numerically, the national contribution to offsite/MMC appears through the Affordable Homes Programme 2021-26 where Homes England 'strategic partners' are expected to deliver a minimum of 25% of homes through MMC.

All housing provider partners are expected to focus on promoting significant use of MMC, high-quality sustainable design and working closely with local small to medium-sized enterprises (SME) house builders.

We began this guide highlighting Hertfordshire's insistence on good growth and high quality placemaking. Determined to make real Government's and our own commitment to those goals, in the following paragraphs we show how this will happen in the context of offsite manufacture in Hertfordshire.

The challenge for Hertfordshire is to achieve the efficiencies, economies of scale and certainties secured through consortia and frameworks and at the same time optimise good design and place-making principles.

To 'raise the bar' and to give confidence that the early Hertfordshire Consortium developments are in line with government design policy:

- Strategic developments (over 100* homes) going through planning 2021-25 will be supported by local design review panels. Although many Districts have design review panels, such as Watford, St Albans, Dacorum, those that do not, can use the Hertfordshire County Council Design Review Panel. (*To ensure Hertfordshire Consortium's commitment to delivering exemplary projects, this number will be reviewed over the coming years with the aim that most developments, including those with fewer homes, will be required to go through planning supported by design review panels);

- A post occupancy evaluation (POE) process to evaluate built quality plus a resident satisfaction questionnaire to evaluate lived quality will be put in place, carried out a year after completion of the first homes to allow continuous learning and improvement.

The Herts offsite consortium is working with Donaldson Timber Systems and Elements Europe to open a factory, create a pipeline and produce pattern books.

**SLO, South Chase Newhall, Proctor and Matthews Architects. Newhall, Harlow, Essex.** Modular units craned into position onto pre-prepared foundations. Note this form of construction is less suitable for constrained or hilly sites. Level access and enough room is needed for the delivery vehicles and cranes and the modular units must be located on a very level base to keep their alignment as units are stacked one above each other. Though the 'Spaceover' product is no longer available the design principles are common to other modular schemes - see also Murray Grove (image to the right).

**Murray Grove, Cartwright Pickard. Hoxton, London.** Photograph: © Martin Charles. Construction detailing of the ground floor requires particular attention in volumetric projects as the floor construction itself is at or below ground level and potentially vulnerable to water ingress and thermal bridging (cold spots where the insulation is not continuous).

**Murray Grove, Cartwright Pickard. Hoxton, London.** Photograph: © Martin Charles. An early volumetric scheme for key workers built by Peabody. The timber and terracotta cladding was applied on site but the volumetric units were delivered with all of the bracketry and fixings necessary to receive the cladding. Internally they were fully fitted out and decorated. The attention paid to detailing and the high quality external materials have ensured that this building retains its appeal twenty years after its construction.

# The Hertfordshire promise

**Numbers of offsite homes/ projects being delivered in Hertfordshire now**

**Herts Housing delivery pathway**

**Housing LHN and annualised rates**

**Delivery issues – housing delivery test**

# Offsite manufacturers in Hertfordshire

Most consortia such as Communities and Housing Investment Consortium (CHIC), Efficiency North (EN), Efficiency East Midlands (EEM), Procure Plus(PP), the South East Consortium (SEC) were set up for other purposes and then expanded to new build housing including MMC. The Hertfordshire consortium provides an opportunity for manufacturers to move to the County solely to develop new build MMC housing.

Outside Hertfordshire, individual developers established their own manufacturing capability. Examples include Accord (now Greensquare Accord), LoCaL homes who produce timber frames, Legal & General who established a factory in Leeds for homes made from Cross Laminated Timber (CLT) and Swan Housing, manufacturing light gauge steel modular housing and a CLT volumetric system for use in their own and others development programmes (see Who's Doing What).

**CHIC offers the following routes to procure MMC:**

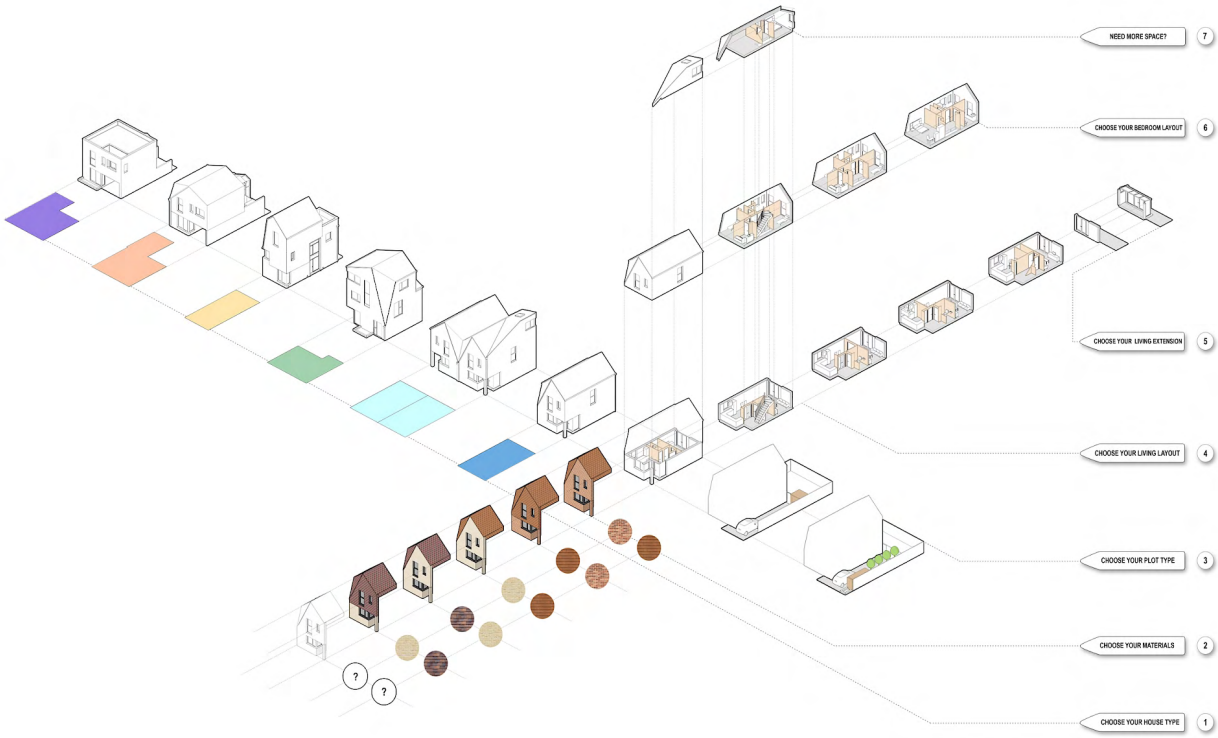
**Option 1 - Direct Appointment for a turnkey solution:** Members are able to directly call off Elements Europe from the Framework for the development of the site – Elements Europe take on the main contractor role as well as the supply of the modules.

**Option 2 – Single Stage Design and Build:** The member and their cost and QS team procure under framework mini comp arrangements but develop their own contract documents for the main contractor with Elements Europe or Donaldson Timber Systems as a "named sub contractor / supplier".

**Option 3 Single Stage Design and Build:** In this option the member elects to procure with the support of CHIC utilising the already developed frameworks for their range of six MMC suppliers and main contractors frameworks and utilise the established contract documentation.

**External links:**

**Affordable Homes Programme 2021-26**




**Beechwood Village, Pollard Thomas Edwards. Basildon.** The homes were custom build. This was used as a marketing tool to generate interest and demand and to attract residents to the scheme.

# Streamlining the route to delivery

The way a development is procured has a significant impact on the speed and quality of delivery.

Hertfordshire research shows how much time is lost by repeatedly carrying out Public Contracts Regulations (PCR) compliant processes on individual projects: designing tender and performance specifications, identifying minimum financial and other requirements, presenting the tender to the market, responding to queries, and evaluating the submissions. There is also a significant cost to bidders.

Consortia including CHIC, EN, EEM, PP and SEC have already completed Public Contracts Regulations (PCR) compliant procurement of MMC contractors.

Hertfordshire's delivery consortium is working with the Communities and Housing Investment Consortium (CHIC- see fact sheet 6) and can save time by using the pre-procured MMC contractors and in turn speed and smooth overall housing delivery for Hertfordshire. Consortium members of course are free to use other consortium frameworks or manufacturers but as public bodies they will still have to ensure compliance with PCR.

CHIC's MMC delivery frameworks incorporate five manufacturers. Two of them are in discussions to establish a manufacturing base in Hertfordshire: Elements Europe manufacture category 1 modular homes and Donaldson Timber Systems (DTS) manufacture category 2 structural panel systems and category 3 timber frame homes.


**Ilke Homes.** Homes built using a volumetric system where a section of a home is delivered complete with external finishes and internal fittings. Although the dimensions of the volumetric unit are standardised (for manufacture and transportation) a variety of house forms and heights is achievable. The brick cladding is applied in the form of thin bonded brick 'slips' with joints between panels grouted or filled on site: a difficult detail to execute, which sometimes belies the applied nature of the brick slips.

# Standardisation in Hertfordshire

The pattern books - in this case standard floor plan layouts - have been tested with members of the consortium for liveability and can be deployed to take some leg work out of development. The notion of liveability has been drawn from housing providers' knowledge, working with housing designers, of customers' needs and management and maintenance practicalities.

Using standard layouts can positively benefit large scale projects, simplify architecture and allow greater emphasis on public realm, landscape and creating a healthy outdoor environment.

Standard layouts will not always be suitable, for example when there are difficult site conditions, or special positive site features to be addressed, or where they do not meet locally defined standards. Using design codes, soon to become integral to planning, is a good way to make sure the standard layouts are right for each site. We are lucky in Hertfordshire to be piloting the best approaches to using design codes with Dacorum Borough Council and can learn together.

**Lighthouse by Sheppard Robson. Watford.** Photograph: ©Hufton + Crow. One of the Building Research Establishment (BRE) Innovation Park demonstration homes built near Watford. The home uses SIP (structurally insulated panels) and achieved the highest level of environmental performance. The innovations from this prototype home were then applied at scale at Barking Riverside.

**External links:**

**National design guide**

**Building Better, Building Beautiful Commission**

**Living with beauty: report of the Building Better, Building Beautiful Commission**

**Beechwood Village, Pollard Thomas Edwards, Swan Housing Association. Basildon.** Constructed utilising MMC at Swan's in-house factory using Cross Laminated Timber (CLT).


**Barking Riverside by Sheppard Robson. London.** Photograph: ©Simon Kennedy. Large scale application of offsite manufacture at Barking Riverside. Housing Design Award winner in 2013

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# A welcoming environment for Offsite Manufacture in Hertfordshire

# What we have done:

1. Since the turn of the twentieth century, Hertfordshire has been welcoming innovation. We are following this tradition by creating a favourable context for the next wave of innovation – namely Offsite Construction. We have held conferences, convened groups and consortia, written guides, attracted manufacturing plants, brought forward jobs and training and piloted live projects.

2. Offsite manufacture's inherent benefits are amplified by the Hertfordshire quality promise to assure good growth and high quality placemaking, matching the Government's ambition for excellence.

3. By framing processes with manufacturers and suppliers in co-ordination with local government, tailored to the local context, Hertfordshire expects to smooth the passage of housing delivery through planning and create the most stable possible housing pipeline.

4. Creating a welcoming environment for offsite manufacture and speeding delivery helps Hertfordshire contribute to the urgent need for new homes.

# What we are doing next:

**Policy Focus**

- Creating an enabling policy and delivery environment, using this document to create a platform for debate and knowledge sharing through the Hertfordshire Growth Board;
- Tactical changes to future policy, such as creating wording for agreement that can make OSM a material consideration under certain conditions;
- Design coding and master planning that can support OSM use;
- Create model planning conditions to safeguard quality;
- Create model 106 agreements.

**Design and delivery Focus**

- Working with the HGB Accelerated Housing strand, carry out a housing site audit to assess site suitability for OSM development;
- Review process for first projects created by consortium, challenging initial designs, evaluating built quality, questioning residents for lived quality etc. Post occupancy evaluation (POE) will be put in place.

**Training and communications**

- Develop a programme tailored for the distinct groups with timelines, including consortium members, to receive and give training, host visits etc.- recognising different specialisms and experience.

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Appendix 1

# MMC - Q and A

# 1. What should I think about first when considering MMC, particularly modular construction?

- Understand the benefits and limitations of modularity (See fact sheets 2, 3 and 4). A lot is common sense, (see question 2 for town centre sites). Like any sort of design, there are few limitations. Quality and efficiency are best achieved when details are decided - from the position of soil and vent pipes to windowsill design, well before manufacture. Offsite construction benefits quality by forcing decisions that are sometimes left to the last minute (therefore not properly planned and co-ordinated) to be factored in from the start. In traditional construction, achieving high quality takes a team of people from clerks of works, Building Control officers to site managers, spotting faults, and workers redoing work to bring it up to standard. Costs not normally counted in the building sums but in modular not even incurred because quality is assured offsite.

  Late decisions are more difficult to absorb than with in traditional construction and when they happen, compromise modular's advantages.

- The more repetition, the more efficient and cost effective a building will be at scale. 'Special' features or layouts will lose these efficiencies and add to costs but are as justifiable with modular as with any method if they help to achieve buildings of character that can respond to their context. By developing pattern books, manufacturers offer pre-designed layouts to co-ordinate repetition across sites and deliver efficiencies. Of course, the pattern book layouts will need to offer the same standards of space, light and ease of use as any designs would, to provide decent places for people to live.

# 2. What should I think about specifically for a town centre site?

- All the phases are shorter than traditional construction. There is an average build out rate of one house a day which means overall, there is less disruption to residents, to traffic and so on. For example, there will be fewer deliveries, less noise, less dirt, shorter street closures, less blocked pavements, less wear and tear caused by heavy lorry movements, less danger to pedestrians etc. Average construction time is reduced by 10% using modular/MMC.

- On the other hand, **for a tight town centre site**, while offsite construction will minimise disruption, some types of MMC may still may not be right. The first thing a modular supplier will do is to check the location - from a practical perspective - to see if it is possible to physically deliver modular units. Are there low overhanging buildings on route to the site? Ordinary site deliveries for any products would always be checked and modular is the same. For example, is there space for a crane?

  As usual the size of the crane and how flexible deliveries could be, would depend on what is being built. The difference is that a modular unit cannot be sliced up; the articulated lorries that bring them are wider than normal ones, the lorry needs to have space to line up with the crane etc. A developer would check a specific site with the supplier. For more strategic considerations, such as whether street widths and turning circles shown on a master plan would need to change to allow the preferred form of MMC, planning officers should contact suppliers directly.

- For a **difficult sloping site** modular should be as possible as any other building. Sometimes a combination of factors such as a steep gradient coupled with a narrow road entrance might make delivery so complex that efficiency benefits are lost.

## 3. I am in development control and developers tell me modular construction makes inset balconies impossible. Are they right?

- There is no reason why inset balconies are not possible, and it goes back to pre-planning and design. Inset balconies do take up precious usable floor space but that has nothing to do with modular construction. An inset balcony would require a shorter 'special' module, the width of the balcony, for the back apartment wall to line up at the other end. Not efficient as a 'one-off' it could become so with sufficient repetition.

- Projecting balconies or bay windows are achievable but any addition to the maximum module width might need a special convoy escort along the motorway. They can be fixed on as separate forms on site but will add to construction time and require separate trades. The bigger problem for projecting balconies, as we approach or aim for Passivhaus (where homes are built to optimise thermal gain and minimise thermal losses) is how to maintain both thermal separation and watertightness.

- Accessible terraces and setbacks in the building form and massing at upper floor levels as well as ground floor setbacks would carry the same limitations, sufficient repetition could make them just as cost effective. Similarly, shops on the ground floor can be done within a module. Usually, length is less of constraint than width (see above).

## 4. What about materials? In Hertfordshire we are proud of our local vernacular and materials. (Dacorum Strategic Design Guide). I am told modular homes can use the same materials as any others and look like any others. Is this true?

- If there is a difference, it may be that modular homes are too perfect, and we are used to the imperfect and irregular! Precision made modular units with factory-made brick slips as cladding on the outside for homes look unfamiliar because there is no human 'error'. However, good designers are used to making modern materials work in most settings without having to resort to pastiche or use exact replicas of heritage materials.

- To make the modular 'box', modular manufacturers use different materials, either a wooden frame and infill, steel for the frame with post and beam or lattice work in between, or cross laminated timber (CLT) to create the whole unit. But probably planners will be as interested in the external appearance as the box construction. Once the box is made, any sort of cladding can be used although post Grenfell some forms of cladding (such as ACM) can be problematic. Brick 'slips'- which are like brick tiles are common and timber cladding is seen as well. As with any building, the more expensive the materials are, the more expensive the facade will be.

## 5. What about insulation and other improvements to make homes sustainable? Can modular homes meet Passivhaus standards?

- This is where modular construction really comes into its own. Lowering the amount of heat lost from the building is at the heart of sustainable construction and energy saving. Reducing heat loss relies partly on having highly insulated walls, rooves and floors but traditional buildings fail most frequently at the junctions between them and every time a hole is made in the 'envelope'. Even letter boxes are a famous source of leakage and can seriously undermine the overall 'airtightness' of the building. Quality can be assured for modular units because they are made in advance under factory conditions and are not left to the vagaries of site conditions.

## 6. How about window positions?

- Modular gives freedom to position windows in as many ways and wherever the designer wants, even 200mm above the floor if necessary. The frame can be easily broken up but the more windows there are the more structure will be needed, relying on steel instead of traditional lintels. Dual aspect on one unit probably works better than with traditional construction.

## 7. I am worried that the housing layouts are more limited than in other forms of construction. Should I be?

- Several modular developers offer customisable layouts to allow buyers to design their own homes. Within the modular unit itself the possibilities are endless but as always it is a discipline to design good, cost-effective layouts. Combining different unit sizes - 1, 2 or 3 bed homes in one apartment is the same as designing any other project except that here, designers are working with the modular units as the 'building blocks'.

## 8. Good to know- taller homes

- Because of the way modular units are made, additional costs for higher rooms and better ceiling heights are less than with traditional construction. Overall, the apartment will be taller because rather than using the same plane for the floor and the ceiling, one will always be stacked on top of another. Advantages include far better sound insulation between flats. Additional height might be disadvantageous if they need to be limited for protected heritage views or for other conservation reasons.

Layout and Design by
**Studio Partington | www.studiopartington.co.uk**