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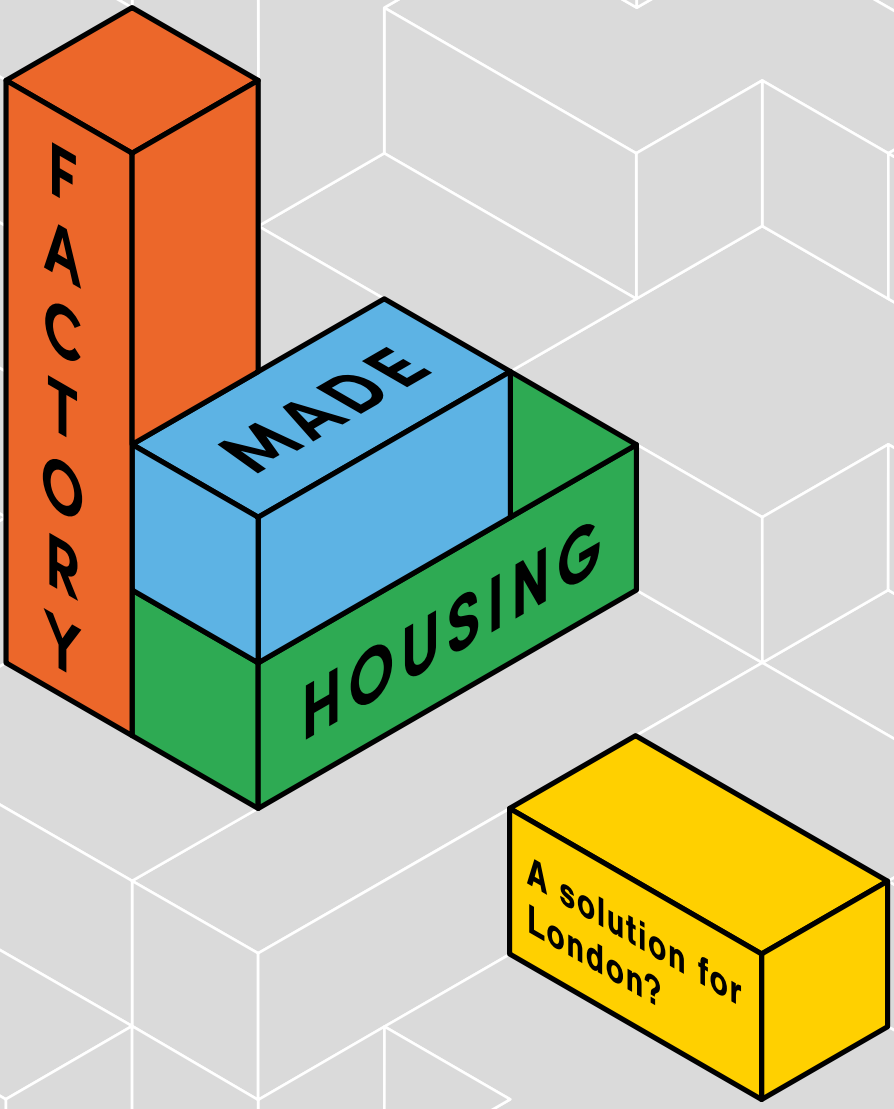
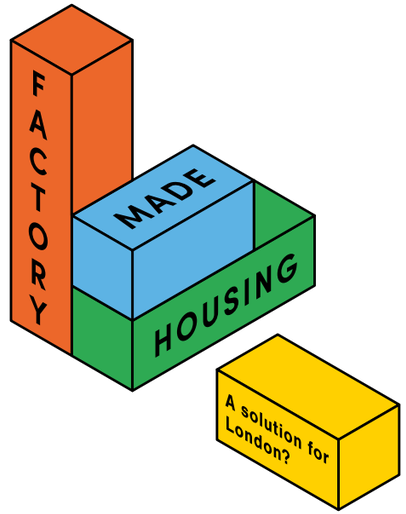


Programme Champions

Programme Supporters



FACTORY-MADE HOUSING – A SOLUTION FOR LONDON?

This NLA Research was published by New London Architecture (NLA) in October 2018. It accompanies the NLA exhibition and events programme *Factory-made Housing: a solution for London?* taking place from October 2018 to January 2019, forming part of NLA's year-round Housing programme, which investigates the future of housing design, delivery and construction.

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www.newlondonarchitecture.org
#NLAHousing

ISBN 978-0-9956144-9-9

CONTENTS

IMAGE

Construction of phase one at Greenford, Ealing, London, by HTA Design LLP and Greystar (2018)

FOREWORD

Peter Murray,
Chairman,
New London Architecture

Richard Crossman was Labour Minister for Housing and Local Government between 1964 and 1966 in the government of Harold Wilson who had promised to forge a new Britain in the ‘white heat of technology’. Crossman’s role was to harness technology to build houses, lots of them. “It does of course mean factory-built housing” he said at the time “but factory-built housing can be just as good as production-line cars. And I think we are going to move to this. The only thing is to make sure they are done by good architects and well-landscaped, that will get over any danger of monotony; the main thing is you standardise the production.”

It didn’t quite work out like that. Yes, they produced the numbers, but the products were shoddily made and erected, the landscaping barely existed and they were monotonous to a degree. The word ‘prefabricated’ has never recovered its reputation.

This time we have to do better. Building technology is much improved, new supply chains can lead to better quality of outcomes and, unlike the 60s when concrete was the only material available, we have a greater variety of structure, cladding and methodology at our fingertips. We also have the benefits of digital technologies which can deliver many benefits of quality, design efficiency, sustainability, flexibility and variety.

Nevertheless the same issues of mass production apply – make a mistake once and you make it many times.

The failures of the 1960s were a huge setback for the concept of factory-made housing, although its benefits were realised by the commercial and hotel sectors with prefabricated cladding systems and volumetric pods. Today, attitudes have changed as a result of the Farmer Review, the shortage of on-site labour and the huge numbers of homes that have to be delivered.

This report looks at the current state of play and how the design and construction industry is responding to the challenges of delivering numbers and quality. Done well, offsite construction can deliver both, but we must remind ourselves of Crossman’s hubris and be vigilant of great political pressure without the support and funding to go with it.

INTRODUCTION

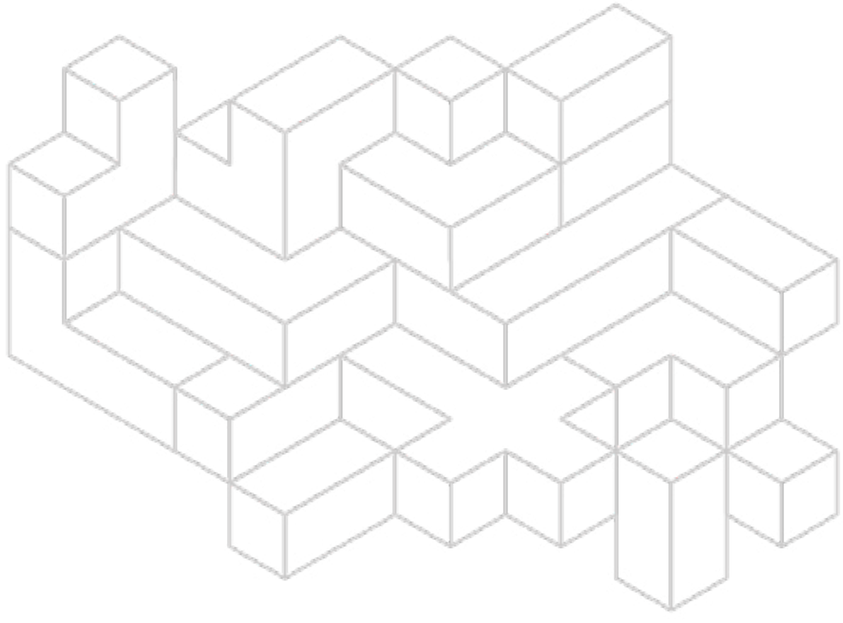
The lack of housing to accommodate a growing population is one of the most challenging issues that London is facing. To reach the Mayor's target of delivering more than 60,000 new homes in London each year – and indeed the UK Government's overall target of 300,000 nationally per year – radical new approaches in housebuilding are being sought to accelerate the pace of delivery, at a time when local authorities have been set demanding targets for completion.

'Factory-made' homes are now being explored and advocated by national and Mayoral policy as one of the key potential solutions to meeting acute housing demand, not only in London but across the UK. The UK Government's Housing White Paper (2017) notes that industry reports suggest homes constructed offsite can be built up to 30 per cent more quickly than traditional methods and with a potential 25 per cent reduction in costs. Furthermore, using a high proportion of precision-manufactured components, materials and systems is reported to bring other significant advantages over traditional construction, including superior quality control through prefabrication, better energy performance and reduced site deliveries, noise and pollution – and thus less disruption to existing communities.

However, factory-made housing still accounts for a very small proportion of the homes built in London each year – less than 10 per cent of total construction output. Concerns about the robustness of supply chains, safety, and product standards, and a lack of detailed guidance for those who wish to explore these methods are among the factors that are currently inhibiting the wider take-up of innovative or new manufacturing processes in the construction and delivery of housing. Similarly, the failure of many of the postwar 'prefab' and system-built blocks built on a large scale has resulted in widespread negative perceptions about 'prefabrication' that endure today.

Perhaps more significantly, housebuilding in London is severely hampered by a lack of skills and workers. As Mark Farmer's hard-hitting recent review of the construction industry has shown, ingrained outlooks and procedures need to be challenged, and indeed overturned, if we are ever to achieve a major stepchange towards meeting housing targets. Many others in the industry agree that along with expanded capacity, a more diverse market, and safeguarding quality and standards, we need a new 'modular mindset' to revolutionise the ways in which housing should be planned, procured, designed and built.

Critically, the emphasis has to be on process as well as product – the use of manufactured elements is not new: it is just an alternative way of delivering the same outcome. The sophistication and range of manufactured systems and components available today – and the opportunities that digital techniques and processes offer – mean that factory-made construction has enormous potential to make a positive contribution to London's housing needs. However, the same level of consideration needs to be given to design, placemaking, amenity, infrastructure and public realm, as it would for any project built using traditional construction methods, to ensure that quality remains at the core of delivering new factory-made homes that will support and sustain London's communities for the long term.



What makes the 'modular mindset'?

Informed by interviews with leading built environment professionals at the forefront of delivering factory-made housing, this research paper examines how factory-made housing has evolved in the UK and internationally, presents the case for a new paradigm of housebuilding, and highlights a wide range of perspectives and projects to demonstrate how high-quality and successful prefabricated homes can transform a place. Factory-made housing will never be a complete solution for every London home, and its take up in contemporary projects is still in relative infancy, but it offers unique opportunities to accelerate the delivery of high-quality, affordable and sustainable homes for London's citizens now and in the future.

A new approach or 'mindset' is required if we are to unlock the potential of factory-made methods of construction to improve the delivery, sustainability and quality of London's housing. This demands:

Sustained collaboration and cooperation

A manufacturing-led mindset requires early, open and detailed engagement between the client, designer, manufacturer and contractor to achieve the right outcome. Detailed project frameworks and agreements are essential as specifications and detailed designs have to be confirmed ahead of fabrication; factory-made buildings are not 'add ons' to existing processes but require a different starting point.

Transparency and knowledge sharing

Maximising the benefits of manufacturing to deliver housing 'not only faster but better' means using rapidly advancing digital applications. Employing these effectively to make building more efficient demands transparency in relation to data sharing. Open communication is also required for understanding the limitations as well as the opportunities provided by different factory-made materials and systems, as not all are appropriate for all sites.

Bold leadership, commitment and ambition

As this publication shows, factory-made housing in a variety of options can be appropriate for a range of different sites in London, but it has yet to be become mainstream. There is an understandable concern to avoid repeating the mistakes of the past, but one of the main challenges faced is embedded attitudes of caution. Using a manufacturing-led approach involves challenging existing conventions and responsibilities and a willingness to embrace innovation.

Flexibility and agility

Factory-made buildings are the 'disruptor' of the conventional construction industry, in the same way that co-working spaces, for example, have altered the form and scope of London's workspaces. Using modern manufacturing methods presents an opportunity to explore new and flexible building typologies adapted to living and working in the 21st century, and to take full advantage of innovations such as digital planning to make decision-making quicker and more agile.

IMAGE ON FOLLOWING PAGE

Habitat, Expo '67, Montreal by Moshe Safdie (1967)

GLOSSARY

GENERAL TERMS AND SYNONYMS

As a starting point for those seeking explanations, this glossary includes terms used synonymously (or nearly so) with ‘factory-made housing’, as well as commonly used categories, materials, components, processes and techniques. Some terms are relatively interchangeable but it is important to note that some are not and can be easily confused: a ‘modular’ building is usually factory-made but not all factory-made buildings are modular, for example. This is not by any means intended to be a comprehensive list, but an introduction to some of the terminology used.

Industrialised building system (IBS)

A term used especially in Asia to describe all aspects of industrialised prefabrication and construction.

Modular construction

Often used synonymously with ‘factory-made’, but strictly speaking this term refers to pre-engineered building units that are delivered and assembled as large or volumetric components or as substantial parts of a building. These can include whole rooms, parts of rooms, or separate highly serviced units such as toilets or lifts.

Modern methods of construction (MMC)

A term used broadly to describe contemporary innovations in housebuilding, many of which are new technologies or involve partial or complete production in a factory. It is the term generally used by the UK Government. It has been described as ‘a wide range of processes that aim to produce more sustainable social housing of better quality, to cost and in less time. This process will involve the use of efficient management processes and may involve elements of offsite manufacture’.[1]

Offsite construction

A term used to describe buildings, structures or parts manufactured (and wholly or partially assembled) away from the site before installation in their final position. This term is widely used in the UK, US and Australia.

Precision manufactured homes/housing

Homes built using a high proportion of components which are produced using modern and technologically driven methods of manufacture, with this production often taking place offsite and the components then assembled onsite. This is the preferred term and definition used by the Mayor of London and GLA.

Prefabricated

Made from a set of parts produced in a factory. A prefabricated building is not always a modular building, as the latter refers to structures in which larger components or rooms are factory-made.

CATEGORIES AND PROCESSES

Closed panel system

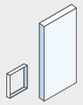
Similar to open panel systems (see below) in that the structural elements of the building are delivered to the site in flat panels. However, they generally include more elements made and added in the factory such as lining materials and insulation and sometimes cladding, internal finishes, services, doors and windows.

See The Residence by Maccreanor Lavington Architects, page 94

Component assembly

Building components such as windows, doors and light fittings manufactured offsite but requiring delivery, storage and assembly using traditional skills onsite.

See Maryon Road by Facit Homes, page 57



Design for Manufacture and Assembly (DfMA)

An approach to design that focuses on ease of manufacture and efficiency of assembly, with the aim of reducing time and cost without compromising quality. Originally found in the automotive and consumer product industries, it is now being used for building components such as concrete floor slabs, structural columns and beams.

See Beechwood West by Pollard Thomas Edwards, page 120

Hybrid system

A system of construction in which complete rooms such as kitchens and bathrooms are typically formed from volumetric units (sometimes referred to as pods), with the rest of the structure made from framing and panellised systems.

See Quaker Court by Levitt Bernstein, page 136

Kit house

A type of self-build home made from a series of prefabricated components bought from a supplier (who may design and manufacture them) and then assembled on site to create a completed house. ‘Suppliers of kit houses may offer a range of components that can be selected and assembled in a number of ways so that the client is able to tailor the design to their personal preferences.’[2]

See Robins Court by Urbane London Ltd, page 51

Non-volumetric assembly

Larger elements preassembled in factory-controlled conditions – such as complete door sets with frame, lining and glazing, and hardware – which require fewer onsite trades to fit and finish on site.

See More Storeys by Azhar Architecture, page 58

Open panel system

The construction of a structural frame using panels made and assembled in a factory. Services, insulation, cladding and internal finishes are installed on site.

‘Plug and play’

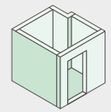
A term describing a prefabricated and assembled unit with mechanical, electrical and plumbing services installed (in the ceiling, under the floor or in service-risers) in the factory. On site the services are then connected directly into the mains.

See PLACE/Ladywell by Rogers Stirk Harbour + Partners, page 125

Pod

A substantial building element or volumetric unit that is generally non-loadbearing and is fitted with fixtures and finishes in the factory. Typically these are complete shower rooms, kitchens, utility cupboards, bathrooms and office washrooms. Pods are commonly steel frame, composite or – especially for smaller units – made from glass reinforced plastic (GRP).[3]

See Castle Street Student Accommodation by Elementa Consulting, page 89



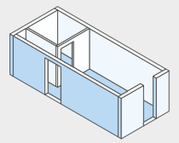
Subassembly

Large elements of the building that can be factory-made but do not form the primary structure. These include foundation systems and cassette panels.[4]

Volumetric (assembly)

Three-dimensional units built in factory conditions that enclose usable space and are then delivered and installed in or on a building or structure. Each unit can be described as a module or – especially for kitchen, bedroom and bathroom units – a pod. They can be used in single units or in multiples. Fixtures and fittings are usually added and finished in the factory to reduce installation time and work on site. Some volumetric units can be joined together on site to form the whole building without the need for any extra structural support.

See Apex House by HTA Design LLP, page 70



MATERIALS AND COMPONENTS

Cross-laminated timber (CLT)

Layers of solid wood bonded together with a structural adhesive, with each laid at right angles to the next, providing great structural strength.

See Dalston Works by Waugh Thistleton Architects, page 97

Engineered wood

A manufactured composite material comprising layers, strands, fibres or boards of wood glued under pressure.

Industrialised building system (IBS)

A prefabricated structural panel of insulated concrete with a brick outer cladding. They can be manufactured with external windows and doors fitted.

Laminated veneer lumber (LVL)

Used in load-bearing structures, this is a manufactured composite of glued and pressed wood veneers, usually with the grain running in the same direction.

Light (weight or gauge) steel frame

A panelised or volumetric system made from light steel frames and used for primary structures. Light gauge steel framing can be used for a building's full frame but also for a variety of roofing, modular options and infill walling applications.[5]

See Berkeley Urban House by Berkeley Homes, page 87

Oriented strand board (OSB)

A composite material made from wooden flakes bonded with resin under heat and pressure, and used in building since the 1980s. It is generally used to make SIPs panels.

Pre-cast concrete (also known as 'factory-engineered concrete')

Precast and pre-stressed units and formwork include elements such as the structural frame, supporting columns, panels, beams and flat slabs. Concrete elements may be factory-finished internally including services, windows, doors and finishes. [6]

See High Point Tower by AKT II, page 86

Structural Insulated Panel(s) (SIPs)

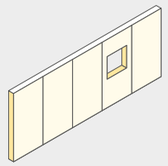
A type of composite sandwich panel structural system, predominantly used for residential and some commercial buildings. It takes the form of an insulating core between two structural facings, usually oriented strand board (OSB) in the UK. [7]

See Croydon Infill by Stitch

Timber frame panel (system)

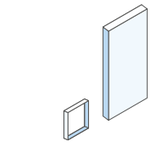
A structural panel – for walls and floors – constructed from small section timber studs, clad with board products. Some of these are closed panel systems fitted with insulation, electrical services, etc.

See Marmalade Lane by Elliott Wood, page 56

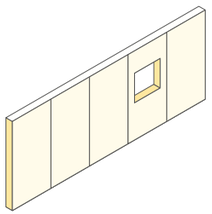


WHAT IS FACTORY-MADE HOUSING?

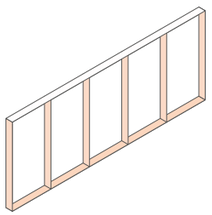
Illustrations courtesy of HTA Design LLP



MANUFACTURED COMPONENTS



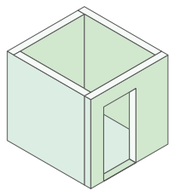
PANEL SYSTEM



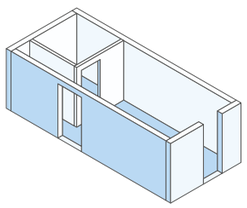
FRAME SYSTEM

‘We shall be judged for a year or two by the number of houses we build; we shall be judged in 10 years’ time by the type of houses we build.’

Aneurin (‘Nye’) Bevan, Minister for Health, 1946 [9]



PODS



VOLUMETRIC MODULAR

‘... purposeful and strategic industry leadership is needed, driving investment in new technology and manufacturing capability that will grow over time to boost capacity and productivity.’

Mark Farmer, Modernise or Die: The Farmer Review of the UK Construction Labour Model (2016) [8]

‘FACTORY-MADE’ CONSTRUCTION: WHAT DOES IT MEAN?

‘What is it generically that we are talking about – large format masonry or innovative use of materials included or just higher levels of offsite processing and manufacturing?’ This is the exact question posed in April 2018 by one of the working groups of the Ministry of Housing, Communities and Local Government (MHCLG) tasked with looking at insurance and finance schemes for ‘modern methods of construction’.[10] A lack of clarity about terminology and definitions – even for the most knowledgeable professionals – is in fact one of the biggest hurdles the industry, decision-makers and wider public have to overcome in relation to factory-made construction.

The multitude of terms used to describe it – offsite, precision-manufactured, modular, and so on – reflects the vast range and scope of different designs, technologies and processes in use today, and to some extent its relative novelty in contemporary terms, as well as a strong reluctance in the UK to use the term ‘prefabricated’ because of negative connotations resulting from postwar ‘prefab’ housing failures (see next section). Internationally, different countries also use different descriptions. On the flipside of this often bewildering complexity and range is a well-embedded misconception that factory-made buildings provide just one single solution of box-like structures, also complicated by the misapprehension that such structures can be a complete panacea for every site. As David Lomax, senior associate at Waugh Thistleton Architects, argued in a May 2018 NLA roundtable: ‘because of the vast number of homes we need to build, it is a danger to say that modular has to be all things to all men’.[11]

‘Factory-made’ does not mean something entirely new and mass produced: in fact, even traditional methods of construction generally use about 40 per cent components manufactured and brought to the site in complete or near-finished form, such as doors and window frames.[12] The Mayor’s London Housing Strategy 2018 uses the definition of: ‘Homes built using a high proportion of components which are produced using modern and technologically driven methods of manufacture, with this production often taking place offsite and the components then assembled onsite.’[13] This is broadly the definition used in this paper, though the preference here is for the description ‘factory-made’ rather than ‘precision manufactured’, the term favoured by the Mayor. Even this wording is complicated by the lack of quantification of what ‘high’ means: ‘there is a lot of talk about embracing “modern methods of construction”’, says David Jones, modular integration director at Legal and General, ‘but I don’t think that policymakers are strict enough in terms of indicating exactly what this means in terms of percentage of manufactured elements – we need more clarity.’

PREFABRICATED BUILDINGS IN THE UK: A SNAPSHOT

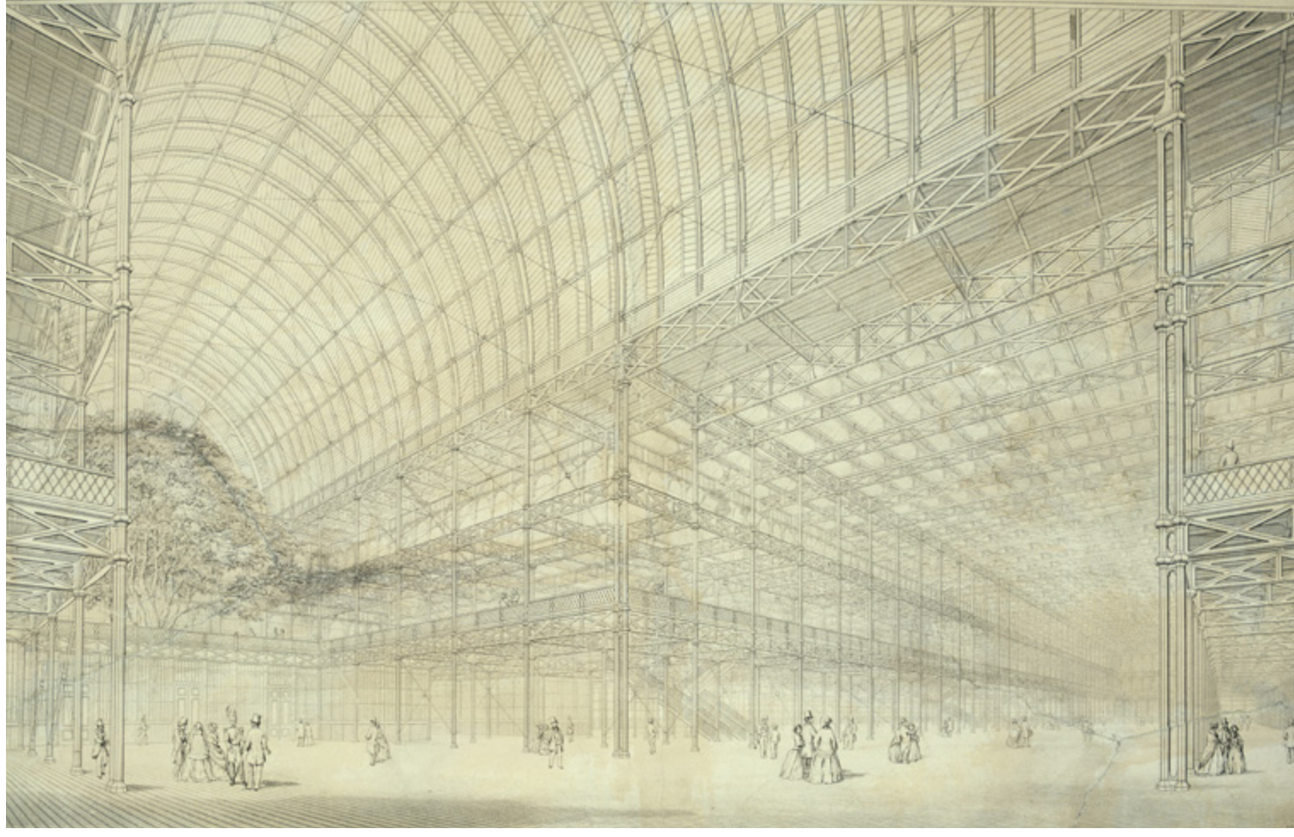
Structures for shelter and other purposes erected partly or entirely from elements that were tooled or fabricated elsewhere – making the best use of available resources – must undoubtedly have been known to some of the earliest human societies. In recorded history, lightweight, portable and demountable buildings made of prepared components have long been associated with military engineering and fortifications, as the need to quickly establish a foothold in enemy territory made speed, economy and robustness of construction (and de-construction) the overarching priorities. Many of the earliest castles or towers built in England by the Normans after the Conquest of 1066, for example, were made not of stone – seen in surviving examples today – but prefabricated timber elements that could be built on top of mottes (flat-topped circular mounds) and surrounded by a fortifying fence, or bailey; these could be abandoned or demolished with their components reused elsewhere as forces advanced inland.[14] Most medieval barns were also erected in a similar way, from pre-cut components pegged together, generally in oak.

Later, the first 'prefabricated' houses made in the UK were a product of the need to rapidly establish settlements in Africa, North America, India and elsewhere as part of European colonisation and exploration. One of the earliest and most often-quoted examples were the wooden houses for settlers made of components produced in England and shipped to Cape Anne, Massachusetts, in 1624. In the 19th century, when the British colonial agenda reached its apogee, the 'Portable Colonial Cottage' was developed by the London carpenter and builder Henry John Manning. Designed to be easily transported, even as far as Australia, it comprised a timber and panel infill system made up of grooved posts, floor plates and triangulated trusses forming a pitched roof, covered with wood panel cladding. It could be easily constructed by unskilled builders without nails, joints or cutting. Such was the success of the venture that Manning developed different sized models.[15]

In the Victorian period, prefabricated structures became one of the most tangible ways of demonstrating ingenious engineering achievements on a vast scale. The best-known example is the Crystal Palace, designed by Joseph Paxton for the Great Exhibition of 1851 in Hyde Park, London. Funded by a public subscription – a precursor of today's crowdfunding initiatives – the huge building, containing 100,000 exhibits and forming the largest covered structure in the world then known, was designed, manufactured and erected in just 16 months before the opening, on time, on 1 May 1851. The building embodied the spirit of invention by being constructed of panes of the new material of sheet glass – over 18,000 were installed on site each week[16] – on a modular cast-iron structure. Its huge size and distinctive form were directly determined by the maximum size of glass panes then available from the supplier, Chance Brothers of Smethwick, near Birmingham. Self-supporting, light but strong, this was the first iconic 'modular' structure, but it was sadly destroyed in a fire in 1936 in its new location in south London.

After World War I there was a serious shortage of skilled labour, essential materials and industrial capacity, since this had all been focused on the war effort. New and experimental forms of construction were explored to meet a critical housing shortage, including more than 20 different types of steel-framed housing systems, such as the Weir and Atholl systems, as well as those based on pre-cast and in-situ concrete, timber and (to a limited extent) cast iron.[17] Today, however, the term 'prefabricated house' (or 'prefab') is still most closely associated with the large-scale building campaigns seeking to provide homes after the devastation of World War II, when more than a million dwellings in London were destroyed or damaged. This severe shortage, 'combined with the need to replace surviving slum housing, required a massive and concerted effort to replace these homes on a scale never before attempted'.[18] In 1942, the British wartime government had already established the Burt Committee (Interdepartmental Committee on House Construction) to examine this urgent problem.

The result was a decision in favour of prefabricated housing that led to the



IMAGES TOP TO BOTTOM

The Crystal Palace by Sir Joseph Paxton (1851)

Uni-Seco Structures Limited training centre, Park Lane, London (1945)

IMAGES LEFT TO RIGHT

Walter Segal meets a self-builder on site at Honor Oak Park, Lewisham, London (1988)

The Portal prefabricated house (1946)

House and guest house for Richard Rogers's parents, 22 Parkside, Wimbledon, London (1970)

Emergency Factory Made Homes programme, which delivered more than 150,000 houses between 1946 and 1949. A large part of the building programme used the capacity available in aircraft production as the war came to an end. Using a prototype, temporary steel bungalow – known as the 'Portal House' (named after the then Minister of Supply, Lord Portal) – private companies were commissioned to design and produce different versions, 11 of which were selected. Some used surplus and recycled (though not always inexpensive) materials from war production, such as aluminium, but despite the speed of production and erection, perhaps as many as 2,000 still survive and are still occupied as homes today.[19]

A continued shortage of traditional materials such as brick and a continued urgent need for housing drove another rapid expansion of factory-made dwellings in the 1960s – the era associated with homes made from factory-made pre-cast concrete floor and wall panels; over 425,000 homes were built in 1968 alone.[20] However, the wider public view of such housing was transformed dramatically with the progressive collapse of Ronan Point, a 22-storey tower in east London, which killed four and injured 17 people in 1968. The building had been largely erected from large concrete panels made offsite that were then lifted into position by crane and bolted together; many construction defects were later found.[21] This tragedy dealt a deep blow to public confidence in factory-made homes and has profoundly shaped perceptions which endure to this day: a survey carried out in May 2018 by YouGov for the Home Group showed that 41 per cent of respondents believed that 'modular' homes are less durable than conventionally built ones.[22]

The priorities of delivering postwar housing through prefabricated construction were to respond to an urgent social and economic need to provide homes (and jobs) through, often, identical, repeated and standardised products. Undoubtedly these were boldly ambitious programmes which delivered on quantity. Much less emphasis was placed on quality, however, especially the long-term social and environmental impacts of such housing at scale, how it would respond to the character of specific places, and how it would be integrated with the wider urban fabric and infrastructure – though over time, a strong community identity emerged in many developments.

The damaged reputation of factory-made homes meant that for several decades innovation was largely restricted to bespoke developments or prototypes that remained one-off, experimental and small-scale, such as 22 Parkside, Wimbledon (1967), by Richard and Su Rogers, using prefabricated steel and glass components – one of the better-known manifestations of the idea of 'system' building in the late 1960s and early 1970s. Around the same period, Hopkins Architects developed its Patera Building System as a standardised, single-storey, metal-framed 'kit of parts' building suitable for industrial or office use. Other key projects included Walter Segal's self-build houses, such as those in Lewisham of the 1980s. These created lightweight, simple and inexpensive buildings made mostly of timber and which – by removing the need for specialist trades such as bricklaying and plastering – enabled residents to construct their own homes, which they were eventually able to purchase.[23]

WHAT HAS CHANGED IN THE 21ST CENTURY?

In the later 20th and 21st centuries, the advent of advanced technologies have transformed approaches to the design and manufacture of components and structures for buildings - alongside vastly improved testing and innovations in materials engineering - to the extent that 3D printing is now being practically explored as a means of building homes (see section 2). Building Information Management (BIM) software provides a complete, shared digital model of a project, down to the detail of every component, and therefore enables much more comprehensive collaboration between different disciplines and more efficient monitoring of information and workflows.[24]

Recent decades have also seen major steps forward in digital manufacturing, such as the use of laser cutters and CNC (Computer Numerical Control) routers and machines, especially for timber products, that offer exponentially increased speed, accuracy and, most importantly, consistent quality. Radio Frequency Identification (RFID) software, for example, also allows the consistent and integrated monitoring of individual building components through manufacture, transport and installation. The latter were piloted at the Leadenhall Building, one of the most notable recent examples of a largely factory-made building (albeit commercial rather than residential) – more than 80 per cent of its components were prefabricated offsite and needed to arrive ready for immediate installation owing to the very confined site, tight timescale and restrictions on deliveries in the centre of the City.[25]

Technology has also generated profound social and cultural shifts. Divisions between home and work and between disciplines and professions are increasingly blurred and fragmented and there is much greater demand for flexibility. Housing and commercial space that is centrally located and well-connected needs to support the collaboration and innovation required to drive forward the knowledge economy (as explored in NLA's Spring 2018 research paper Knowledge Capital). Indeed, many have predicted the advent of the 'Fourth Industrial Revolution' through which advanced production would be combined with digital technologies 'to create a digital enterprise that would not only be interconnected and autonomous but could communicate, analyse, and use data to drive further intelligent action back in the physical world'.[26] Coupled with this is the potential that immersive or enhanced technologies such as Virtual Reality (VR) and Augmented Reality (AR) can offer, especially in the visualisation and presentation of manufactured concepts. While distributed systems of manufacturing can support localised production for self-builders, as well as mass production on a large scale in dedicated factories. AR may also present wider opportunities in the erection of both traditional and factory-made buildings: 3D models could be projected directly on to the workface, with the construction worker wearing a headset that overlays data in the real field of vision, enabling precise correlations to be made (and checked) between the virtual and built structures.[27]

Alongside this are more tangible concerns relating to construction, especially the shrinking numbers and ageing workforce skilled and engaged in traditional construction methods, issues relating to the health and safety of workers on site, and anticipation of a post-Brexit labour shortage. Latest available estimates show that nearly half (45 per cent) of London's construction workforce is from overseas, including 27 per cent from EU countries.[28] In the next decade and a half, 14 per cent of all construction workers in London are due to retire, while the industry also lacks diversity, with, for example, women comprising just 13 per cent of the total number of workers, compared to 44 per cent across all sectors in the capital.[29] These have led to serious concerns about the viability of delivering new homes using only traditional methods at the scale required not only in London but across the UK, and consequently have informed recent national and local government policies (see across).

WHAT IS THE POLICY CONTEXT OF 'FACTORY-MADE' BUILDING TODAY?

Both national and regional policy in the UK advocate the importance of exploring and supporting innovation and delivery in factory-made construction solutions, as part of a wider drive towards an innovation-led economy – although, as noted previously, how this should be done is not always articulated in detail. This focus has emerged only in the last few years, and has been informed especially by the hard-hitting and provocatively titled report, *Modernise or Die*, prepared by Mark Farmer, CEO of Cast Consultancy for the Construction Leadership Council in 2016. Using a medical analogy, he diagnosed the construction industry as having many features 'synonymous with a sick, or even a dying patient', suffering from weaknesses including low productivity, fragmented leadership, lack of collaboration and shortage of investment in innovation.[30]

Defining his use of the term 'pre-manufacture', he noted that, far from the Fourth Industrial Revolution, it is 'clear that in many respects, construction has not even made the transition to "industry 3.0" status which is predicated on large-scale use of electronics and IT to automate production'. One of his 10 key recommendations for large-scale, root-and-branch change urged the Government to:

... provide an 'initiation' stimulus to innovation in the housing sector by promoting the use of pre-manufactured solutions through policy measures. This should be prioritised either through the conditional incentivisation of institutional development and investment in the private rented sector; the promotion of more pre-manufactured social housebuilding through Registered Providers; direct commissioning of pre-manufactured housing; or a combination of any of the above. It should also consider planning breaks for pre-manufactured approaches.[31]

The Government responded by making explicit its support for factory-made housing in the Housing White Paper, (2017), for example indicating its intention to 'consider the opportunities for offsite firms to access innovation and growth funding and support for them to grow'.[32]

This was followed by the Construction Sector Deal announced by the Department of Business, Energy and Industrial Strategy (BEIS) in July 2018, in which the Government promised to invest £420 million in 'bytes and smart mortar construction' through the use of digital design, new manufacturing technologies and offsite manufacturing, as well as procurement. The NHS Shared Business Services Modular Buildings Framework, in place from 2017 to 2021, for example, is so far the only national agreement covering offsite building solutions for purchase, hire and lease, and which claims to offer an average of 5 per cent savings when compared to directly purchasing.[33]

In response to widely voiced concerns about insurance, standards and quality, MHCLG also established a working group to explore solutions to these issues, with the aim of improving collection and accessibility of data on products and manufacturers, identifying a 'robust and unified technical assurance process', and improving links with existing insurance and financial products. However, direct interventions (including commissioning) remain very limited in scale.

In London, the Mayoral Housing Strategy outlines the Mayor's aim to encourage and promote the move to greater precision manufacturing by providing specific funding streams and support for skills development, a decision informed by an influential report by the London Assembly, *Designed, sealed, delivered: the contribution of offsite manufactured homes to solving London's housing crisis*, in August 2017. This urged the Mayor to galvanise the sector by measures such as developing and adopting a 'Manufactured Housing Design Code' that would generate a 'component standardisation "catalogue" approach that can then be configured in multiple combinations as part of a project specific design response'.[34]

BENEFITS AND BARRIERS TO ADOPTING A FACTORY-MADE APPROACH

It is clear that factory-made construction now has the embedded support of policymakers at national and regional level. Using factory-made processes in building has a number of benefits in production, assembly and performance, which have been well articulated and emphasised by both policy and industry alike.

However, as the London Assembly report asks, if there are so many benefits 'why have previous attempts to make offsite manufacturing "mainstream" [in London] failed?'.

Summarised here are the key benefits we hear advocated and some of the obstacles as to why these methods are yet to become mainstream.

✓ **Speed of delivery:**
As components and systems are made in a factory, they are not affected by delays to onsite construction that may be caused by adverse weather. Most importantly, fabrication for ease of assembly is reported to significantly reduce completion times from anything between 30 and 70 per cent quicker than traditional construction methods.

✓ **Controlled production leads to higher quality:**
Vastly improved materials and quality control within the factory can exponentially reduce variation and potential defects, as well as provide quality assurance and rigorous testing on aspects such as acoustic and fire performance, durability and structural resilience. Improved performance and quality may also lead to reduced energy costs and waste: the government-supported charity WRAP believes waste savings to be as much as 70 to 90 per cent.[35]

✓ **Reduced transportation and community impact:**
Reducing building times can substantially mitigate the adverse effects of noise and poor air quality on surrounding households and businesses. Most importantly, factory-made construction relies on considerably fewer deliveries to site and vehicle movements than traditional construction.

✓ **Flexibility and diversity:**
The variety of systems and materials in use mean that there is a solution for almost every site and scale of project, and the interchangeability of many components can allow greater diversity of form and typology. Modular constructions especially can be assembled and de-constructed for relocation and reuse.

✓ **Improved environmental performance:**
Factory-made building can provide significant reductions in embodied carbon and improved energy efficiency, in particular through the increased use of certified timber products.

✓ **Transforming the workforce, skills and the working environment:**
Factory-made construction can dramatically reduce labour input both onsite and offsite, with fewer workers needed to manufacture, deliver and install components – offsite housing is not as affected by the shortage of skilled labour in the construction industry. Moving production to a factory has also been proven to dramatically improve health and safety and also has the potential to transform the public view of construction, and to attract a younger and more diverse workforce.

✓ **Optimising viability of smaller sites and infill:**
As noted by the London Assembly 2017 report, factory-made building can provide significant advantages for London in terms of meeting demand for new homes via small, restricted sites, infill sites and estate intensification, as it offers reduced impacts of noise and vehicle movements and flexibility for building on irregular plots.

✕ **Upfront costs:**
Factory-made housing may be quicker to build but to date it is not necessarily significantly cheaper than traditional construction. One of the most widely voiced concerns is the significant investment required to set up factory production (including purchase of equipment), and the consequent need to ensure a consistent supply of work to feed factory production in order to ensure efficiency and cost-effectiveness.

✕ **Lack of capacity and a diverse supply chain, and concern about skills distribution:**
There is currently limited capacity, certainly in volumetric (modular) construction in England and projects are reliant on a handful of major suppliers. Most factories are located outside London and therefore there is concern that the potential for local skills development, especially in areas of disadvantage, is being lost in London in favour of other UK regions. As Alun Macey, head of construction at Pocket Living, explains: 'the main challenge for us is trying to find a framework of contractors who are credible.'[36] This has meant that major companies are now establishing their own factories to ensure continuity and quality control.

✕ **Lack of demand and continuity of supply:**
Most factory-made projects have been relatively small scale to date. Manufacturing a product of any kind requires upfront investment and a different business model that does not necessarily fit with current procurement methods. A lack of collaboration between potential clients, especially local authorities tasked with delivering housing at scale, has prevented procurement on the scale required.

✕ **Universal standards, quality and accreditation:**
Confusion about terminology and definitions is a major issue, while there are also multiple accreditation and quality assurance schemes, and a significant lack of guidance in an easily accessible (and non-technical) form. There are also concerns raised about data transparency in this respect, with competing standards and systems currently in play.

It is clear, however, that there is a now a concerted effort being made by industry and policymakers to tackle some of these pressing issues. Initiatives are now underway at both national and local levels to explore solutions, especially in terms of design codes and standardisation, testing – especially in the light of reassurance needed in the wake of the Grenfell Tower tragedy – and financial and technical challenges (see section three). Well-publicised past failures mean that a lack of confidence is, however, still apparent. For many local authorities, developers, investors and housebuilders in particular 'there is an understandable degree of nervousness. This approach to building requires a different way of doing business, of funding and delivery, and few are ready to take the plunge which could help create the breakthrough to enable OSM [offsite manufacturing] to realise its full potential.'[37]

As the subsequent sections here will show, factory-made housing is not the 'one-size fits all approach' that it is often still perceived to be – today there are a huge range of different solutions and innovations that can be adapted to different conditions and requirements, all of which are not solutions in their own right, but must be given the same consideration as traditionally built homes in terms of placemaking, facilities, accessibility and public realm. Factory-made housing is not the 'silver bullet' to solving London's housing crisis, but with bold decisions it can transform how we design and build homes.

IMAGE ON FOLLOWING PAGE

Construction of the Leadenhall Building, London (2013), courtesy of Rogers Stirk Harbour + Partners
©Paul Raftery

THE WIDER PICTURE

‘The majority of the housing delivered in Sweden is offsite manufactured. Only a very few residential projects are being built in situ.’

Linda Thiel, director of the London studio of Scandinavian architectural practice White Arkitekter

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A BRIEF INTERNATIONAL HISTORY

In the industrialised world, the story of factory-made buildings has generally been one ‘of desire for a better method of building, a critical questioning of the production norms of the construction industry, and a search for both design and construction innovation’.[38] While cultural, social and economic factors (see below) have differentiated the recent path of factory-made housing in countries outside the UK, technologically the historical development was similar, especially in the 20th century. In the 1920s and 1930s, for example, the Modernist drive towards efficiency and functionality resulted in experiments with modular homes that echoed Le Corbusier’s utopian ideals of the house as a ‘machine for living in’, which had begun with his famous ‘Dom-Ino’ House concept (1914–15), an open floorplan concrete structure, designed as a prototype for mass-producing housing in variable patterns.

In the USA – the birthplace of modern manufacturing and the production line, thanks to car manufacturer Henry Ford – the Empire State Building in New York City was a famous showpiece of the drive towards efficient building, constructed at the average rate of one floor per day between March 1930 and May 1931.

In the Depression era and during and after World War II, prefabrication was used in the USA, as it was in the UK, to provide homes where they were most needed. Among the best-known schemes was that commissioned by the Tennessee Valley Authority for factory-built homes that could be transported to the site of large infrastructure projects. Designed to house workers, they were made of insulation and gypsum board or plywood cladding and intended to be demountable so that they could be transported on trucks and re-erected as required in other locations.[39]

As in the UK, perceived shortcomings in existing housing and a desire to improve and innovate led also to prototypes and concepts that remain influential today. These included Buckminster Fuller’s Dymaxion House design, the house of Charles and Ray Eames in Pacific Palisades, California – designed to be constructed entirely from parts available from steel fabricators – and Habitat 67. The last is a complex of 146 homes designed for the World’s Fair (Expo) of 1967 in Montreal by Moshe Safdie, and was built from more than 300 identical prefabricated concrete parts as a new model for high-density urban living.

Equally significant was the work of the Metabolist architectural movement in 1960s and 1970s Japan, which advocated highly adaptable buildings in response to what its exponents saw as the future ‘dynamic’ and organically evolving city. The practical embodiment of the original Metabolist principles is the Nagakin Capsule Tower (1972), Tokyo, designed by Kisho Kurakawa. Fourteen-storeys high, it comprises self-contained one-person pods that were manufactured offsite with built-in beds, bathrooms and (then state-of-the-art) furnishings; the pods were specifically designed to be flexible and interchangeable, with new pods plugged in to replace older ones. Unfortunately, like so many far-sighted projects, it suffered from a lack of maintenance and is no longer occupied, although attempts are being made to preserve it.[40]

IMAGES LEFT TO RIGHT

Eames house, Los Angeles by Charles Eames (1950)

Nakagin Capsule Tower, Tokyo, by Kisho Kurokawa (1972)

© RIBA Collections

INTERNATIONAL TAKE-UP OF FACTORY-MADE HOUSING: WHY DOES IT DIFFER FROM THE UK?

Such developments took place in parallel to innovations in the UK (see section one), but in other countries the path of factory-made buildings diverged significantly in the mid to late 20th century, as the sustained use of this type of construction on a mass scale continued. While attitudes towards factory-made production as a means of improving the efficiency, quality, sustainability – and, potentially, affordability – of housebuilding in the UK are noticeably changing, the UK is currently still far behind other parts of the industrialised world in using this method of construction as a proportion of total housebuilding. Statistics and available data internationally vary enormously, but Japan and Sweden have long been established as leaders in this field: it has been estimated that up to 90 per cent of single-family homes in Sweden are 'factory built',[41] while available figures from Japan showed that the offsite manufacturing sector has in recent decades resulted in up to 160,000 properties per year, or about 14 to 20 per cent of the annual total.[42]

Other countries such as Germany and the Netherlands, which 'have been identified as having highly efficient traditional or "craft based" house-building industries',[43] also have significant levels of factory-made production. The USA and Australia sit alongside the UK as countries where manufacturing has been employed less frequently, generally at ten per cent or less of total housebuilding. The campaigning organisation Buildoffsite has no definitive data on the contribution that modular/ volumetric specifically makes to UK residential development but it suggests it accounts for about two per cent of the annual total.[44]

In terms of the future global picture, a 2016 study forecast that worldwide demand for prefabricated housing would increase 2.7 per cent per year to 3.4 million units in 2019, with advances in overall housebuilding – as well as greater take up of factory-made systems and components – likely to occur in the Asia/ Pacific region, Africa and Middle East, and Central and South America. In these regions demand will likely increase for both low-cost, multi-occupancy housing units and high-quality homes for more affluent residents, especially in urban areas with high population growth.[45] As might be expected with its focus on rapid urbanisation, China is also taking a lead in cutting-edge construction techniques: in 2015, Chinese company Broad Sustainable Building, for example, reportedly completed a 57-storey skyscraper housing 800 apartments alongside office space in just 19 days, using modular construction methods (with more than 2,500 individual modules) to complete three storeys daily.

Around the world, housing made of prepared components has evolved and been adopted on a large scale, especially in regions with extreme hot or cold climates – where extended construction times on site are impractical in adverse conditions – or geological instability, where buildings have to be quickly reconstructed. But these environmental factors are just one reason for wider take-up of factory-made housing especially in Scandinavia and Japan. Perhaps most significantly, the latter country in particular is synonymous with the innovation of 'lean manufacturing'. Developed by the Toyota car company after World War II, this approach focuses on the drive to eliminate waste and improve productivity, while also allowing scope for customisation, which over time was transferred to the efficient production of buildings. Critically, the success of lean manufacturing has meant that the emphasis is on the process as a means to improve the product.

It is no coincidence that, generally speaking, these countries lack negative associations about manufactured housing – it is simply just accepted as another, and specifically better, means of building – and it has a strong reputation for higher quality, efficiency and sustainability. As Linda Thiel, director of Swedish practice White Arkitekter, observes, 'it's a rational production method, not only cheaper and faster – when housebuilding becomes more efficient, savings should be reinvested into other elements of place, such as landscape and public realm'. Alongside this, other factors such as the varying socially ingrained assumptions of what 'home' means and the average lifespan of buildings have a role to play; in Japan, for example – where there is also a scarcity of land but significant demand for housing – the model of housebuilding 'presumes that the physical house will be replaced every generation, with the mortgage mechanism concentrated on site value. ...The British prefer to constantly repair and remodel, valuing patina and historic character.'[46]

Where factory-made housing has been fully 'normalised' culturally, as noted above, this has generated a different 'modular mindset' and business model, with the result that homebuilding often has a manufacturing- and consumer-led, rather than construction- and cost-led, approach. Naturally, there are factors – especially land ownership – that mean that there are fewer or different constraints than in the UK. In Germany, for example, factory-made buildings fulfil a high proportion of new detached housing, a large proportion of which is built on and purchased by the owners of serviced plots. Such 'self-build' approaches for individual houses have been much more restricted, especially in UK cities, partly because of factors such as engrained historic patterns of long-term ownership, planning regulations, infrastructure provision and constrained sites – although (as shown in section four) factory-made approaches are now being used successfully in the UK in such conditions to supply housing in other types of tenure, especially build-to-rent apartments in areas of suburban intensification. Similarly, in countries such as the Netherlands, notes Gerard Maccreanor, founding director of Maccreanor Lavington Architects, central and local government are more directly engaged in housebuilding, 'government has since the end of the Second World War, incentivised and pushed the industry to continually increase production even through periods of recession. Meeting housing demand is seen as a long term aim. The effect of continuous investment has not only allowed the industry to meet demand but has resulted in increased quality in construction, in dwelling size, and in design. We are all too aware of the stop-start nature of the building industry in the UK and this is one of the main reasons cited that limits investment. In the Netherlands, by contrast, building continues, albeit at a reduced pace, and economic cycles have much less impact on the construction industry and on investment.'

INTERNATIONAL FACTORY-MADE HOUSING TODAY

Streamlined manufacturing approaches, new technologies, and the advantages in increased efficiency, safety and quality that factory-made housing can provide, have led to a noticeable resurgence of global interest in this area, especially as a means of 'disrupting' the housebuilding industry, in addition to established suppliers and models. With one of the world's strongest markets, Japan has well-established providers of factory-made homes such as Daiwa House and Sekisui House, offering a diverse range from single-family, custom-built houses to large-scale rental developments. However, there are now new entrants from outside the construction market, including the retailer Muji, which, as well as developing compact, portable and prefabricated wooden cabins, has also unveiled a larger prototype, two-storey home adapted from a design by Kengo Kuma.[47]

In Sweden – the country with by far the largest proportion of prefabricated homes – major manufacturers such as Lindbäcks, using mostly timber-framed items, can reportedly build components for about 20 multi-storey residences per week.[48] In addition, in the 1990s the BoKlok model – a joint venture between construction company Skanska and retailer IKEA – was introduced as an alternative response to the demand for high-quality but affordable homes, of which 10,000 have now been built. In these homes, larger components such as wall panels, windows and doors are standardised, but individuality and choice for the consumer/homeowner are introduced through variations in smaller fitted elements such as drawer and cupboard fronts. Over and above this, built-in flexibility, such as potential for additional space, is provided by features such as a loft area manufactured with flooring added, and a built-in cupboard that can be replaced with a 'flat-pack' staircase, supplied by IKEA.[49] These self-build or kit homes – selected and purchased from a dedicated supplier, which also usually constructs and installs the building – are among the best-known

IMAGE

Construction of BoKlok homes, Sweden (2016)

types of mass-produced homes in Europe and the USA. The environmentally friendly, customised but prefabricated wood and glass homes produced for over a century by German company Huf Haus have now also become popular in the UK, with over 200 built in the 2010s, but these serve the higher end of the private house market.[50]

In the USA, factory-made buildings[51] make up about seven per cent of market share in construction, but there are well-established manufacturers across the country serving regional markets, with clusters in states such as Georgia, Texas and California.[52] Here, new tech start-ups have also started to emerge as key players in commissioning, development, production and delivery of factory-made homes. Among the most notable is Katerra, founded only in 2015 but now reportedly with investment at over $250 million,[53] with its first factory in Phoenix, Arizona, making extensive use of BIM software to improve manufacturing processes and products. Also offering selected customisation, the company was founded on the principle that 'applying systems approaches to building development, design, and construction would remove unnecessary time and costs and a vision of a future where efficiency wouldn't have to come at the expense of quality or sustainability'.[54] It was reported in 2017 that rocketing prices for homes in and around Silicon Valley in California have compelled Google's parent company Alphabet Inc. to order 300 apartments from a modular-home start-up to serve as temporary accommodation for its employees.[55]

Perhaps some of the most advanced and innovative uses of technologies, however, are still found in experimental projects in Europe, in particular those seeking to apply 3D printing in concrete. In June 2018, Eindhoven University of Technology in the Netherlands announced that it was building five 3D printed houses by 2023, designed to be let on the market as rental properties,[56] while a month later a family moved into a four-bedroom 95 square metre house in Nantes. The result of a collaboration between a housing association, the city council and university, this detached residence – a new prototype for social housing – was 3D printed onsite in 54 hours, with four months to install the windows, doors and roof.[57] Such projects are still prototypes, but offer exciting potential for development.

TOP IMAGE

Project Milestone by Houben / Van Mierlo Architecten, in collaboration with Eindhoven University of Technology, The Netherlands (2018)
©Backbone visuals and concepts

A MODULAR MINDSET

‘There’s no point bolting a spaceship onto a horse and cart. … We need a totally new operating system.’

Alastair Parvin,
Co-founder, Open Systems Lab
(company behind WikiHouse)

A ‘FACTORY-MADE HOUSING’ REVOLUTION? CREATING A NEW PARADIGM

‘We are now at a point where many favourable conditions are aligning to prove the case that OSM [offsite manufacturing] can bridge the gap between what the traditional house-building industry can deliver and what London needs,’ reported the London Assembly Planning Committee in August 2017.[58] While factory-made construction is not automatically an option for every new London home, it can offer huge potential, not least in terms of its adaptability for constrained sites, speed of delivery, reduction of noise, waste, pollution and other environmental factors, as well as potential for creating new jobs, and many other aspects. However, moving construction from the site to the factory environment is not just a case of tweaking existing processes or adapting current models. Using factory methods primarily to design and build any type of new home on any scale requires a complete rethink of established attitudes to commissioning, procurement, finance, design and construction.

New digital technologies across every industry are challenging the existing norms and encouraging new and unexpected partnerships and collaborations to create and deliver successful products. Prefabrication manufacturers in industries such as aerospace – in which the UK is currently a global leader, with growth of 39 per cent between 2011 and 2017 alone[59] – ‘focus on the continuous refinement of quality, design and the performance of the product’, notes Kevin Gray, director at FORMWORK and architectural adviser at Be First Regeneration.[60] In construction, on the other hand, ‘cost has become the key driver, often at the expense of quality and safety’.[61] The site construction process as we see it today is subject to many variables – which in effect means that every new home is essentially bespoke: investment and financial speculation, availability and levels of skills, management of a site workforce of hundreds, if not thousands, increasingly unpredictable weather patterns, and so on.

Achieving a step change and exponential take-up of factory production methods to deliver more and better homes requires a new starting point – one that is geared around knowledge: not just in terms of innovation in materials and technologies but also open communication, transparency of data and information sharing, and a challenge to established orthodoxies about responsibility for delivery and risk. A collaborative stance based on long-term partnerships and agreements – breaking down the barriers between disciplines – rather than an adversarial, competitive, short-term outlook will improve quality, add value and reduce risks, as manufacturing high-quality repeatable components and units demands a system-based approach that focuses on continuous improvement through the cycle of assessment, prototyping, analysis, fabrication and installation. Deeper engagement across and between disciplines and a sustained commitment to improvement can help to ensure that, as Andrew Waugh, director of Waugh Thistleton Architects, argues, we can focus on ‘repeated process, not repeated product’. Below we look at ways in which the built environment industries and its clients might create a new paradigm of housebuilding – and identify where challenges still need to be overcome.

COMMISSIONING, DEVELOPMENT AND PLANNING

IMAGE

PLACE / Ladywell in Lewisham, London by Rogers Stirk Harbour + Partners, AECOM and SIG (2016)

A. Committing to the product

As illustrated in the glossary, the breadth of available products, materials and systems – modular/volumetric, panelised, hydrid, CLT or steel frame, for example – provides almost limitless possibilities, but confusion about what the best solution is for a particular site and scheme is clearly one of the key barriers in the limited adoption of factory-made buildings in the UK. Today, houses are all essentially bespoke, as design work often continues onsite, and the individual craft skills of site trades mean even the best-constructed buildings that look alike externally will have subtle variations (or indeed in the worst cases, as media reports often suggest, failures). Effective factory production, however, is geared primarily to producing repeated, precision-manufactured elements that can be fitted together with minimal tolerances. The client cannot adjust designs on site without incurring major costs and time delays. As David Jones, modular integration director at Legal & General, explains, as a client ‘you have to accept that you are buying a standard product, not converting bespoke designs for manufacture’. Early engagement between client, designer and manufacturer is therefore essential to work out the best options and to achieve a successful outcome.

In an NLA roundtable in January 2018, Quintain’s executive director of construction, Matt Voyce, highlighted that developers need help to make choices: ‘we have real concerns about the covenant strength of the players that are out there’, he said. ‘Where we want to go is to a kit of parts. That’s probably a better solution for us. Volumetric at scale is still a big challenge.’[62] Jeff Endean, housing programmes and strategy team manager at LB Lewisham, which commissioned the award-winning PLACE /Ladywell scheme of volumetric factory-made temporary accommodation in partnership with Rogers Stirk Harbour + Partners, AECOM and SIG, admits that although ultimately successful, the project provided useful lessons in coordinating such a scheme using volumetric construction, as balconies had to be constructed on site

and delays were caused by waiting for power networks to be activated.

In response to the London Assembly report and industry concerns, in April 2018 the Mayor commissioned Cast Consultancy and Bryden Wood to investigate opportunities for standardisation across manufactured systems and components with the aim of generating a digital toolkit (due in late 2018) with design principles and guidance to assist designers and clients in understanding where and how different factory-made approaches can be applied.[63]

B. The housebuilder-developer-manufacturer

One of the most vocal and widespread criticisms of the established housebuilding industry in the UK is that it is dominated by a very small number of large companies building at volume and accumulating plots (and then obtaining planning permission) in a process known as landbanking; houses are built and sold in a stop-start process through which these companies are charged with 'drip-feeding homes into the market at a pace that best serves their profits'.[64] Building affordable homes for private sale – where consumer demand is at its most urgent – at scale is therefore a cyclical process subject to financial viability. Factories of any kind, however, are reliant on a continuous, uninterrupted pipeline of work in order to operate, and even for large-scale developments on publicly owned land, London boroughs are not always able to offer manufacturers a long-term supply.

With a very restricted number of UK specialist factories in the field of volumetric building in particular, some organisations are taking a longer-term view by changing the way that they operate, morphing into developers-as-manufacturers. The housing association Swan Housing, for example, took its first steps into development in 2004, with manufacturing – according to Paul Williamson, Managing Director, Swan Housing, its modular housing arm – as its 'natural next step'. In 2017 Swan established a factory in Basildon, Essex, to produce homes for projects such as Blackwall Reach and Beechwood West, with 6,500 homes planned overall. Such 'vertical integration' of commissioning, manufacturing and supply offers certainty in 'derisking the pipeline', says Williamson. Other companies are also adopting this approach, such as Berkeley Homes, which has built a 160,000 sq ft factory capable of providing 1,000 homes per year.[66] Breaking down the conventional barriers between clients and manufacturers is just one way in which mass manufacture may help to accelerate supply, especially in Opportunity Areas, but it is also clear that government itself needs to play a more active role in directly commissioning, which is currently, as Mark Farmer says, the 'big elephant in the room'.[66]

C. Financing, procurement and planning

While recent successful projects across London are evidence of the viability of factory-made housing, costs remain one of the significant stumbling blocks. In any type of manufacturing, cost efficiencies are achieved with producing higher numbers of units, from the smallest components to the largest assemblies. This is because of the initial investment required to set up manufacturing, including purchasing equipment, prototyping, testing and analysis. Currently, the limited scale of factory-made applications in construction means that the cost of building each new home using these methods is comparable to, but not significantly lower than, that of traditional construction. Savings can only be made when the volume increases. However, the precision and higher quality control offered by factory production should, in theory, provide improved levels of building performance that over time will reduce energy bills and maintenance costs, though more research is needed to understand complete lifecycle costs.[67]

The production-line business model also means that clients need to provide payments on different schedules in order to secure manufacturing outputs, and this can be a challenge to conventional procurement methods which only offer payment on delivery and completion. The importance of bringing in finance directors at the very earliest stages may therefore seem obvious, but is absolutely essential for understanding the process, when different cost models come into play. For this reason, much of the focus of factory-made housing in London has so far been on build-to-rent, student accommodation and hotels which can provide a quicker return on investment. However, a major gap in the market remains for high-quality yet affordable individual family homes for private sale, and this is where alternative models such as crowdfunding have begun to emerge. Richard Hywel Evans and Nick Fulford rejected traditional investment models in favour of raising money from 700 investors via a crowdfunding platform for their nHouse design of CLT-built detached, semi-detached and terraced houses: 'by spurning the advances of venture capital, the founders would retain full control over the project, while reflecting its democratic ideals'. [68]

Procurement is an area in which collaboration on a citywide scale could really transform the viability of delivering factory-made housing at scale. Aggregating requirements across different boroughs can start to produce a consistent supply of orders and in turn can potentially help to stimulate demand.[69] In April 2018, taking a lead from the emergence of council-led development companies, the 16 boroughs that form part of the London Councils Temporary Accommodation Supply Group announced the setting up of a not-for-profit company, PLACE Ltd; its function will be to procure and install factory-built homes on 'meanwhile' sites, as a 'cheaper and better quality' alternative to B&Bs and other temporary accommodation for homeless families.[70] In addition, some property tech ('proptech') start-ups are beginning to offer alternative routes to help solve key problems, such as Renkap which offers a digital platform for housing associations, boroughs and developers to aggregate demand for factory-made housing to small and infill sites, which are especially prevalent in London. A danger here is that an emphasis on quantity could emerge at the expense of quality, variety and placemaking. A quarter of London's residential pipeline is in schemes over 2,500 units (30 per cent of which is from just 27 schemes).[71] Jonathan Falkingham, co-founder and creative director at Urban Splash, argues that for this reason government should intervene in large-scale developments: 'the current highly risk-averse procurement process for public land heavily favours the larger housebuilders – smaller housebuilders simply don't have the required balance sheets – opening up land to more housebuilders would deliver

IMAGES TOP TO BOTTOM

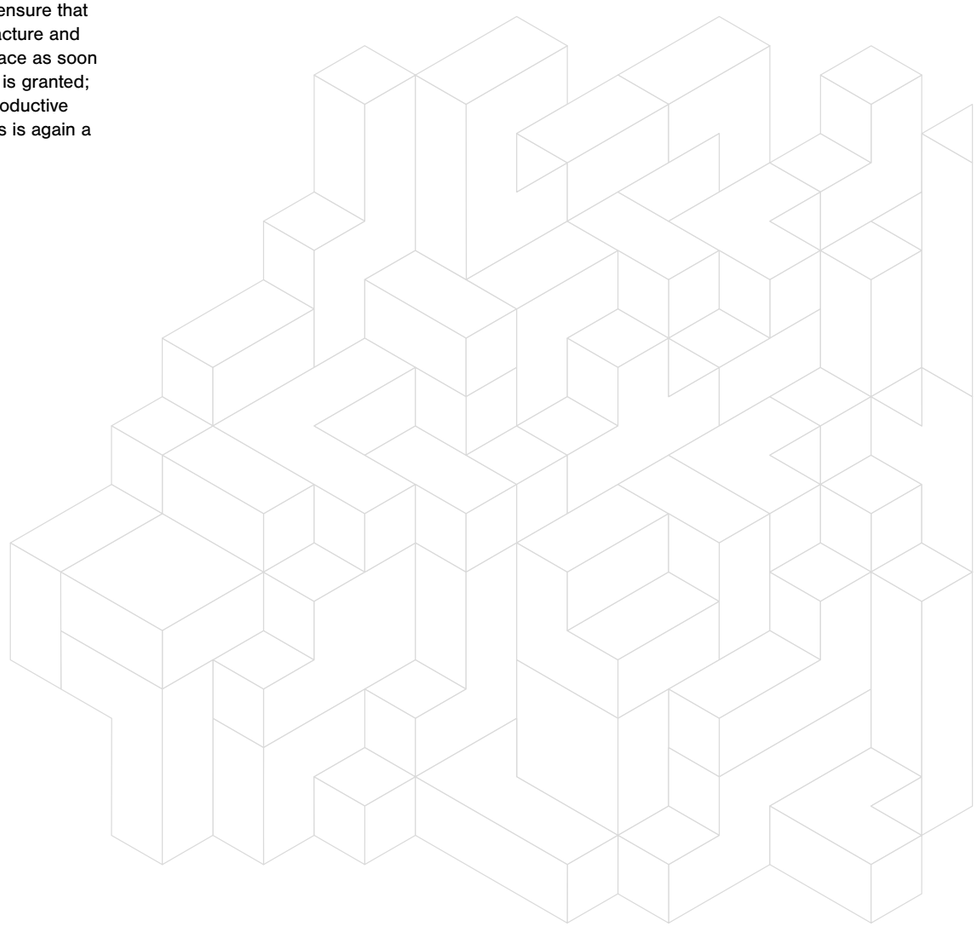
Swan Housing NU Build factory in Basildon, Essex (2018)

Factory for Town House by Urban Splash and shedkm (2016)

greater variety in housing typologies, higher market penetration and speedier delivery.' Such new digital, open and coordinated methods of procurement could potentially also remove some of the barriers to entry for SMEs (small and medium-sized enterprises).

Factory-made construction also presents challenges to the conventions of the planning system. As far back as 2005, a report by the National Audit Office highlighted that for developers and other clients, 'relationships with planning authorities become more critical when using modern methods of construction'.[72] Planners have to be aware that in order to gain full advantage of the on-site time savings that factory-made buildings can offer, there is an imperative to ensure that detailed design stages, manufacture and preparation of the site takes place as soon as outline planning permission is granted; here, early engagement and productive collaboration across disciplines is again a critical factor for success.

Recommendations to the Government by the Farmer Review also included the setting of specific conditions for 'modular' construction on the development of public land, while wider targets for the building of manufactured housing would also act as a stimulus. Harnessing innovations in digital infrastructure could also have the ability to completely transform the planning system, as Future Cities Catapult's 'Future of Planning' programme has shown, which – in conjunction with digital design and manufacture – can offer the potential to replace existing paper-driven, cumbersome systems with faster, open and more transparent processes.



DESIGN AND INNOVATION: QUALITY, STANDARDS AND VARIATION

A. Design for manufacture and assembly

'Economic gain [from using factory methods] is a medium-term target, while at this early stage everyone's focus should be on investment and innovation if we are serious about achieving change and unlocking the full potential of these systems', argued Paolo Vimercati, associate principal at Grimshaw, at the January 2018 NLA housing roundtable.[73] Research and development in design for manufactured buildings is an area in which many London-based companies, especially architectural practices, are currently actively engaged and have built up considerable expertise (see Section four), although the Government and Mayor have only recently made major announcements about investment into innovation. In 2016, the RIBA launched a 'Design for Manufacture and Assembly' (DfMA) overlay to the RIBA Plan of Work to show how design teams can contribute to innovative strategies for factory-made buildings and lead to improved efficiency, safety, quality and teamworking, with reduced risk exposure, lead times and waste.

Critical to the success of this approach, however, is for both clients and designers to understand that this type of construction requires a highly detailed design at an early stage – the ability to make changes in design and space planning is very limited, if not impossible, further down the line without undermining the viability of the project. It can, however, also have a significant positive impact on business efficiency for architects' practices, suggested Rory Bergin, partner, sustainable futures at HTA Design LLP, at a recent seminar at Vision London 2018; this is because the design phase is concentrated in a shorter time period, and as the architect is not required to continue to do additional design work (or reworking) at later stages, they can take on more projects in the same time as they would allow for one traditionally constructed building.[74]

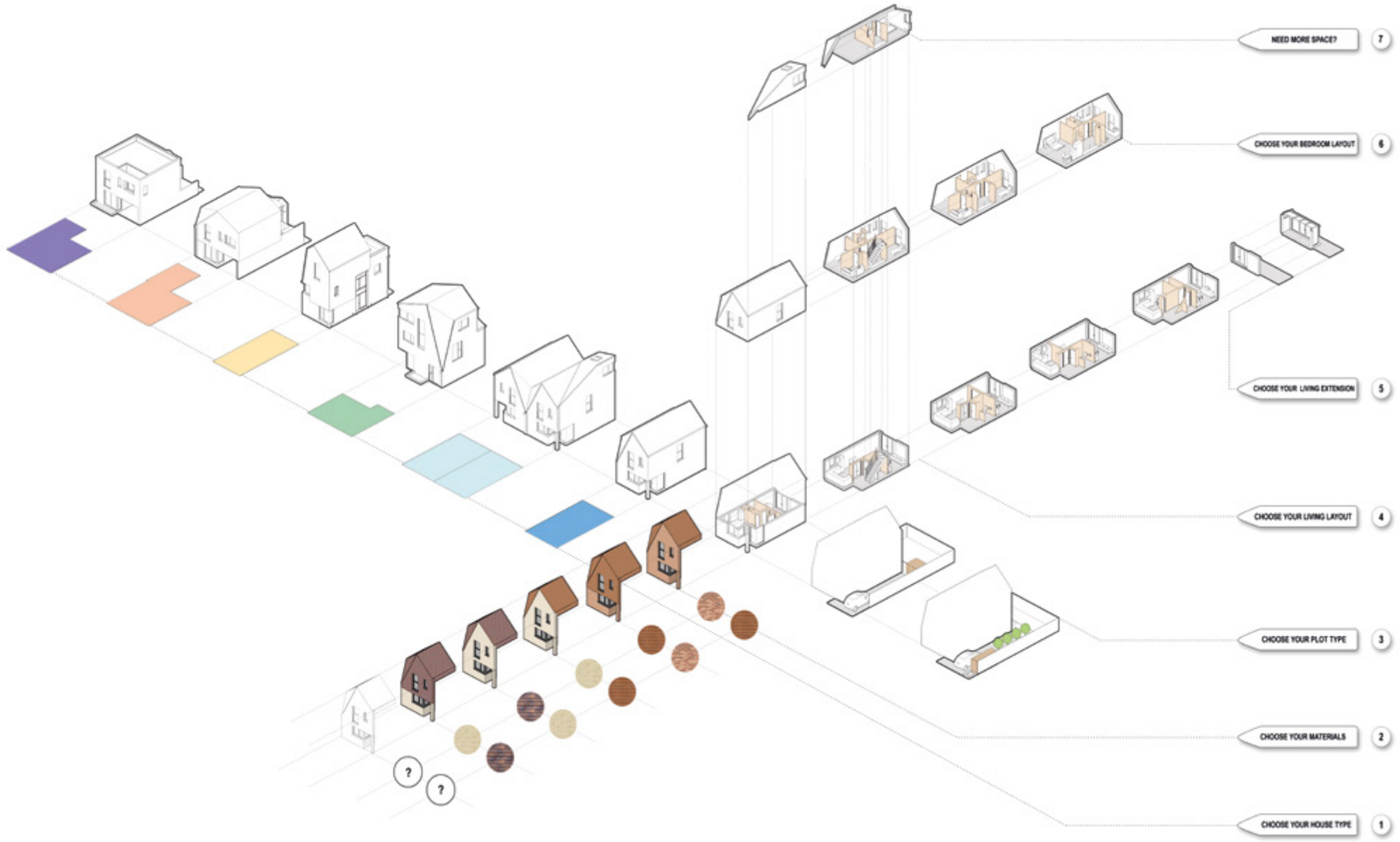
B. Quality and accreditation

With design innovation comes the need for quality assurance. Through applying materials and components made within a controlled environment, with rigorous prototyping and testing, 'inherently you get a better built product', says Gerard Maccreanor of Maccreanor Lavington Architects. Critically, for architects, clients and homeowners alike, precision manufacture means that there is an exact correlation between what is designed and what is built. However, a lack of design codes specific to factory-made buildings and major concerns about durability, fire resistance and safety have meant that lenders and valuers have traditionally been reluctant to offer mortgaging for such homes. 'The last thing the industry needs is a major failure by a major offsite manufacturer', Jeff Maxted, BLP's director of technical consultancy, explains.[75] For this reason, the Buildoffsite Property Assurance Scheme (BOPAS) was established as a joint initiative by Buildoffsite, BLP Insurance, the Royal Institution of Chartered Surveyors (RICS) and Lloyd's Register to offer durability and maintenance assessments, an accreditation process for manufacturers and contractors, and a database to offer lenders and valuers assurances that assessed offsite products and systems are durable for at least 60 years, or two mortgage terms.

C. Design as added value: customisation

As the RIBA DfMA outlines, a strategy that optimises the design-for-manufacture method does not stifle the potential for high-quality design or determine a building's form: defining the strategy early on in the process, and the scale at which manufactured elements are to be employed, 'will include a consideration of components manufactured offsite, to determine which will add value without constraining creativity'.[76] In volumetric or hybrid construction, major structural components no longer have to be repeatable and the criticism that the result is 'little boxes that all look the same', no longer applies.[77] Architects now have freedom in design with volumetric 'to overcome the constraints of tight space requirements of inner city sites'.[78] As Gerard Maccreanor explains, 'you can optimise the benefits that standardisation provides, and still respond to context and character. The factory process no longer needs to lead design, resulting in a straightforward repetitive product. It is now possible to be specific and unique. Today, buildings, built from elements produced in a factory setting no longer betray themselves as a 'kit of parts'. They do not have to look any different from buildings built by traditional means.'

Inspired design for factory-made housing can also contribute positively to placemaking by offering flexibility of typologies and customisation for residents. Carl Vann, partner at Pollard Thomas Edwards, explains that 'we still want buildings to speak of the places they are in ... and be more than wallpapering or decorating a modular solution ... if the standardised [factory-made] product is refined and working well, then an integrated approach to BIM and a more sophisticated factory automation can start to deliver flexibility and thence bring forward site-specific solutions and customer choice.'[79] This focus has been successfully employed by developer Urban Splash in Manchester in its 'House' developments, to give consumers different options through selected combinations, with a focus on space instead of rooms. 'Rather than selling homes on the number of bedrooms, as is usually done, our idea is to encourage the customer to work out how much space they want and then how they want to use it to suit their family circumstance, their lifestyle and their budget – this gives our customers the ability to curate their new homes to suit how they actually want to live', says Jonathan Falkingham. The sophistication of contemporary modular designs in particular can provide a positive message to the potential homeowner or resident in the face of perceptions about 'prefabs' being poor quality – 'people are sometimes surprised by how finished the modules are', says Paul Williamson of Swan Housing. Learnings from other industries such as aerospace, intelligent systems and robotics are also being developed to provide greater flexibility. At the Advanced Manufacturing Research Centre at the University of Sheffield, for example, 'pick and place' robots can assemble a stud wall in one operation, and with changes in automated tools they can produce many design variants with flexible fixturing.[80]



IMAGE

Diagram of customer design choices for Beechwood West, Basildon, Essex
©Pollard Thomas Edwards

MANUFACTURE, LOGISTICS, ASSEMBLY AND CONSTRUCTION

In 2018 the manufacturing sector across the UK was estimated to contribute 11 per cent of the UK economy's Gross Value Added (GVA), employ 2.6 million people and account for 44 per cent of the UK's total exports.[81] The UK is still currently ranked as one of the largest manufacturing nations in the world, yet within the built environment industries there are strong concerns about the security and viability of the supply chain in the face of demands to increase the proportion of factory-made housing, especially with great uncertainty about trading agreements after the UK leaves the European Union. Availability of raw materials is also an issue: the value of the UK steel industry, for example, has declined as much as a quarter since 1990,[82] while more than half of the timber used in this country is imported, mostly from Europe (especially Austria [83]). There are also only a very small number of specialist factories in the UK producing volumetric/modular components, almost all in the North and Midlands, although, with the number of privately owned factories set up by companies such as Berkeley, Legal & General, Laing O'Rourke and Swan Housing, there are opportunities for capacity to increase. Overseas factories already supply components to many manufacturers, and as a means of increasing the UK's resilience in manufacturing, architects HTA Design LLP, among many others, have called for tax breaks and investment grants for the setting up of new factories.[84]

In London, the situation is particularly challenging as although efficient and just-in-time production can reduce site deliveries, components and modules have to be transported from further afield, and any increase in production could have a serious negative impact on logistics through the volume of deliveries required on London's roads. Bringing a factory's processes to site through 'onsite manufacture and assembly' is now being actively explored by companies such as Mace, whose 'Rising Factory' model employed in Stratford, east London, 'has allowed the firm to construct an entire floor that's ready for fit-out in 28 hours,' significantly quicker than anticipated. As their director Shaun Tate has explained, the success of the project means that the firm can start to focus on collaborative, design-led, mass componentisation solutions that can also work for other types of buildings including schools and prisons: 'we want to offer an alternative approach that will still give 85 per cent offsite componentisation, looking much more to onsite production rather than offsite construction.'[85] Larger sites in London can also potentially present opportunities to explore the concept of the 'flying factory' (or 'field factory'): temporary onsite facilities that can be scaled up or down as required and then transported to another location for a new project. Also, as the London Assembly has pointed out, 'there is no reason to believe London-based factories are not viable ... at waterside sites, such as the Old Oak and Park Royal Mayoral Development Corporations and Barking Riverside', especially if demand increases the volume of production elsewhere, 'making transportation costs a bigger proportion of overall value'.[86] Waugh Thistleton Architects' 'Timbertropolis' concept proposes an approach that would see an 'underskilled construction industry ... reinvigorated and invested in its own city', through the creation of sites for making factory-made buildings in timber in the Old Kent Road and in Old Oak Common.[87]

Perhaps the most significant area where fundamental change is required is in construction industry skills and knowledge, specifically in harnessing opportunities to transform innovation, outputs and productivity through advanced digital techniques. As Mark Farmer emphasised in *Modernise or Die*, the 'acceleration of the wider digital revolution combined with a shrinking traditional construction workforce are two issues I would highlight as being critical to the future fortunes of the construction industry'.[88] Currently the construction industry faces challenges in attracting young people because of negative perceptions about health and safety, working conditions, pollution, and an apparent lack of diversity or inclusivity; whereas offsite manufacture in factories, especially using digitised production methods, offer more opportunities for attracting a wider, multiskilled and diverse workforce. With the great variety of complex components and systems available to housebuilders and developers, VR and AR also present an as-yet relatively unexplored avenue to selecting, designing, assembling and erecting on site easier, safer and quicker. As the House of Lords Science and Technology Committee urged in July 2018, the Government 'must therefore ensure that young people entering the workplace are equipped with the digital skills needed for modern methods of construction, including offsite manufacture'. [89]

IMAGE

The Rising Factory by Mace at Plot N08, East Village, Newham, London (2018). Design by Lifschutz Davidson Sandilands
©Mace

In response to such calls, specialist courses tackling this requirement are now being set up, such as architect and broadcaster George Clarke's MOBIE (Ministry of Building Innovation and Education) charity founded in 2017 to 'train and inspire young people to innovate in the design and construction of homes in the UK and abroad';[90] its further and higher education courses in 'Advanced Home Futures' – employing 'digital technologies and skills to maximum effect' – were launched at three UK colleges and universities in September 2018. Digital platforms can also create steps towards truly democratising the production of components and systems for building, allowing distributed manufacture at the smallest scale of the individual, local maker; the WikiHouse concept is perhaps the best known of these. As an open-source and globally accessible digital resource developed by architects, designers, engineers, inventors, manufacturers and builders, it enables makers around the world to collaborate to create, refine and improve high-performance building techniques, producing a flexible and resilient system that does not rely on conventional building professions and trades. While the scale of built projects using this method is still in its relative infancy, such systems have the potential to revolutionise homebuilding, challenging conventional thinking and opening up new possibilities in response to the question 'Who builds?'.

IMAGE

Construction of Chapter student accommodation, Lewisham, London by Weston Williamson + Partners and Greystar (2016)
©Weston Williamson + Partners

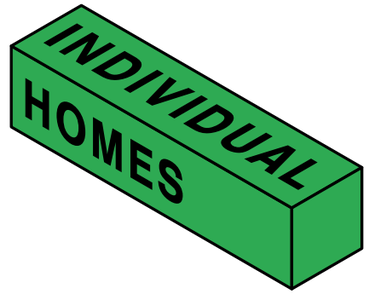
FACTORY-MADE HOUSING SOLUTIONS

In the last few years we have witnessed an increasing interest in how factory methods could provide a response to London's housing crisis and how it can be used to support the regeneration of existing communities and the creation of new ones.

The examples shown in the following pages demonstrate how London's built environment industries are now developing and delivering innovative and high-quality factory-made housing in a huge variety of contexts, forms and tenures, from individual houses on small sites to large-scale developments in major areas of opportunity. UK-wide and international exemplars also feature, selected for their particular lessons or applications to the London housing market.

PROJECT SHOWCASE

COCKWISE FROM TOP LEFT
Void House by Carl Turn Architects ©EDIT
Fab House by George Clarke and TDO
Town House by Urban Splash and shedkm
Construction of Maryon Road by Facit Homes



Manufacturing processes are not only being applied to the construction of large-scale housing but are also disrupting the conventional market for individual detached, semi-detached and terraced homes, especially through customisation and self-build. Companies are developing a ‘vertically integrated’ approach to design, manufacture and construction – often including the building or acquisition of factories – which therefore offers greater control over the production process from beginning to end, and makes the customisation of individual homes more viable by offering different permutations around a core, repeatable manufactured element. Aiming to deliver 2,000 homes a year, ilke Homes, manufactures a wide range of properties in its Yorkshire factory, from two-storey terraced houses to three-storey semi-detached homes, as well as low-rise flats, with a vast range of internal and external finishing combinations. In the same way, Urban Splash’s Town House concept, piloted on a number of sites in the North of England – but potentially adaptable to sites in London, especially in the outer areas – is based on the customer purchasing a home by space rather than number of rooms. The core element is a standardised shell with a stair, kitchen and bathroom pod, from which the purchaser can select sizes, living spaces and layouts, again in an enormous variety of possible arrangements to suit their needs and lifestyle. The complete home can be produced in the factory and delivered to site or the purchaser can choose to fit out the shell themselves.

The past few years have seen the emergence in the UK of new developers and property companies seeking to offer well-designed, factory-made customised homes that exploit the opportunities provided by both conventional and digital manufacture. Attention has been focused recently on how innovative manufactured homes can be suitable for constrained and infill sites. Cube Haus, is working with architects such as Carl Turner and Faye Toogood to deliver high-quality customised CLT homes for small urban sites with simple material palettes manufactured in the UK; these will be commissioned and installed by the company or available as a self-build solution. Richard Hywel Evans’s nHouse also offers different configurations of timber detached, semi-detached or terraced three- or four-bedroom homes for individual self-builders, as well as volume developers, housing associations, local authorities and others. Facit Homes, founded in 2007, takes a similar approach and exploits technology to improve efficiency by employing a purely digital design and production process for customised homes. The pioneering WikiHouse open source library of digital building technologies, which aims to give everyone the tools to build their own low-energy customised home, shows how ‘distributed’ design and manufacture has the potential to truly democratise the process of homebuilding.

TOWN HOUSE

New Islington, Manchester, M4
Status: Completed
Date of completion: May 2016
Unit cost: £1,000 per sqm
Size: 93 to 139 sqm per house
Number of units: 1 to 1000 per site

Town House is a new concept for mass housing which is a direct challenge to the established typologies of the major UK housebuilders. It exploits modular planning to create spacious, flexible and modern customer-designed homes. The familiar pitched-roof form has been turned longitudinally to create a long 'loft-style' spacious home aimed at the urban house-buying market. Purchasers have a choice of two- or three-storey houses and the option of 'loft' or garden-focused living spaces with open-plan or more traditional layouts. The shell of the house contains simply a stair, kitchen and bathroom pod. A series of layouts can then be selected which configure one to six-bedroom homes to customers' preferences, with generous space standards, large windows and insulation and air tightness at a very high standard. Town House is factory-built and delivered to the site fully finished. The challenge is to develop a design that can offer purchasers a choice of sizes, of living spaces and of layouts – as well as different kitchen, bathroom and finishes options – to allow customers to tailor their new home to their individual tastes from over 130,000 possible combinations. Purchasers can select from a variety of layouts and finishes, or can choose to fit out the shell themselves. Although the first pilot sites have been in northern England, the Town House concept has potential for application in London – a modern product that could be easily applied to the regeneration of outer zones of London. Construction costs and speed of construction are controlled by factory production which ultimately achieves a set cost and build programme for the actual dwelling itself.

Viewpoint

'Our view of the world is that everything is becoming more industrialised and being made more efficiently in factories. Housing is one of the last bastions. The UK will either grab hold of modular and get on board or be left behind – as innovators, we want to drive it forward. Town House is leading that future and our products are already at the heart of new communities in Manchester, Salford, North Shields – and soon to be in Birmingham. Town House has brought homes to these communities efficiently, quickly and at the right price, as well as gaining customers adaptable aesthetics to determine the layout of their own home.'

Tom Bloxham MBE,
Chairman, Urban Splash

Client: Urban Splash
Architect: shedkm
Manufacturer: Urban Splash Modular
Contractor: Urban Splash Construction

©Uniform

©Jack Hobhouse

ROBINS COURT

85 Kings Avenue, Clapham,
LB Lambeth, London, SW4
Status: Design stage
Date of completion: March 2019
Cost: £150 per sq ft
Size: 110 sqm per unit
Number of units: 5

Robins Court consists of five houses from the townhouse range of the Urbane toolkit, built with a minimum floor to ceiling height of 2.5 metres and high quality external brick finish. The designs are London Plan Compliant, have NHBC and BOPAS accreditation, and have LABC approval. Each house is manufactured in a day, and installed in a day on site.

These homes comply with Urbane's four key values:

1) Customise the visible, standardise the invisible: a flexible yet standardised toolkit of homes, developed with their manufacturer, enables all projects – from detached homes, terraces, townhouses to apartments – to surpass national policy and building regulations. All homes are created around a series of pre-designed and easily transportable components – these consist of pre-clad SIPS panels, roof and floor panels, to kitchens and bathrooms. The designs are to a high quality baseline specification, which can be applicable to social, private or rental markets (based on London Plan targets).

2) Unlocking constrained London sites: due to the pre-designed and manufactured nature of these homes (utilising Level 3 BIM), speed of erection, quality and cost certainty is guaranteed. This, combined with the flexible yet standardised layouts made up of relatively small components, produces an agile business model which can operate effectively on the full range of challenging London sites from the micro (single plot sites) to macro sites (300+ developments).

3) A team with shared values of social permeability, from designers to manufacturers, deliver Urbane's projects collaboratively. Homes are designed and manufactured in the UK and through partnerships, Urbane are delivering local employment, social enterprise and permeability. For every 50 houses built, one apprentice is employed.

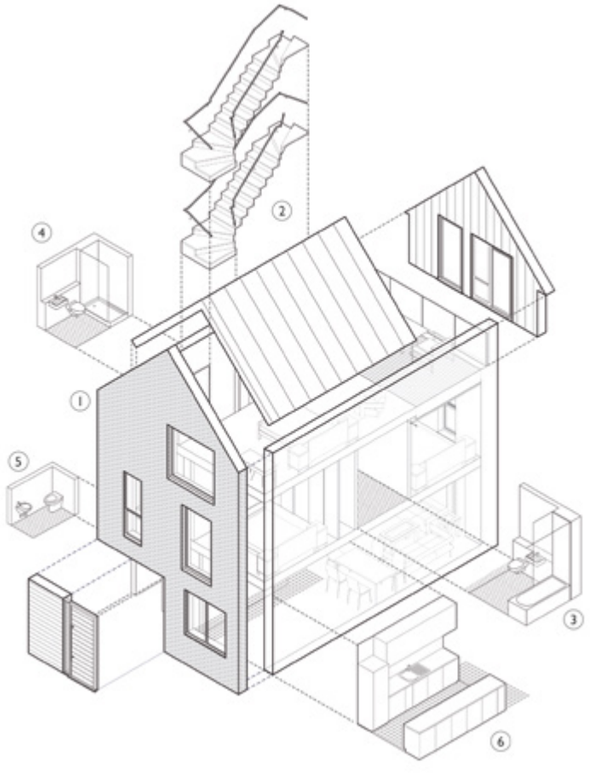
4) Commitment to build: working transparently with the local authorities across London, projects meet local and national planning policy so that the maximum number of homes can be built, with 500 units projected for supply over the next two years on a mixture of Greater London sites.

Viewpoint

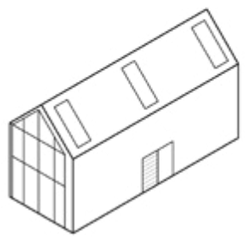
'The team at Urbane has impressed with a fantastically fresh approach. Their inspiring architectural vision is underpinned by a detailed knowledge of the precision manufacturing marketplace and crucially a robust approach to viability. Bringing these core elements together will help ensure that high quality homes and beautiful public spaces can be built quickly and efficiently. Their solution has capacity to improve the image of precision manufactured homes, demonstrating that high-quality design and offsite manufacturing are not mutually exclusive. Responding positively and flexibly to the location will also help maximise the number of homes on each site.'

Robin Oliver, Senior Strategy Manager for Affordable Housing, Transport for London

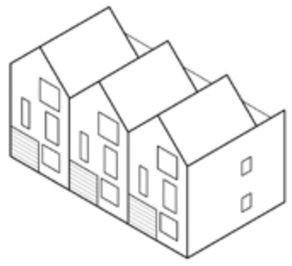
Client: Urbane London Ltd.
Manufacturer: Urbane London Ltd.
Architect: Surface to Air Architects
M&E Engineer: Bryden Wood
Interface Consultant: Westbrook and Bell



SINGLE FAMILY HOUSE



TERRACE

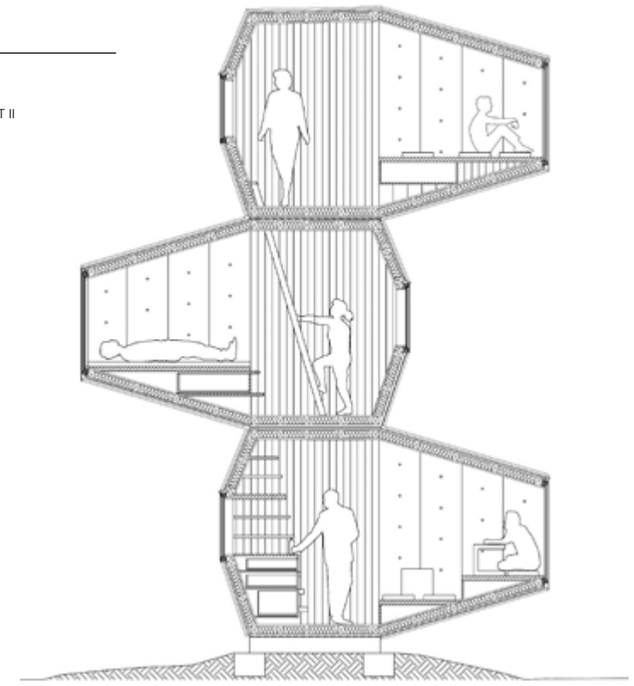


LIVING UNIT

Prototype
Status: Completed
Date of completion: March 2017
Size: 30 sqm per unit

Living Unit is a prefabricated, self-contained wooden shell that is flexible and adaptable to different locations, climate conditions and terrains. The basic unit of 4.50m x 2.50m x 2.70m, with a kitchen, bathroom, bed and seating, offers accommodation for two people, and its modular design allows it to be customised and expanded by combining multiple units, joined horizontally and/or vertically. The low technology structure is made of timber frames which are reinforced by plywood boards on both sides, encouraging self-build possibilities. The facade and interior treatment is adaptable and flexible, so the unit can be used in various site contexts. The use of wood is promoted – natural, sustainable and human-friendly. The compact dimensions mean each unit is easy to transport and can be delivered in volumes that are easy and fast to build.

Architect: Ofis Architects
Structural Engineer: AKT II
Contractor: Permiz



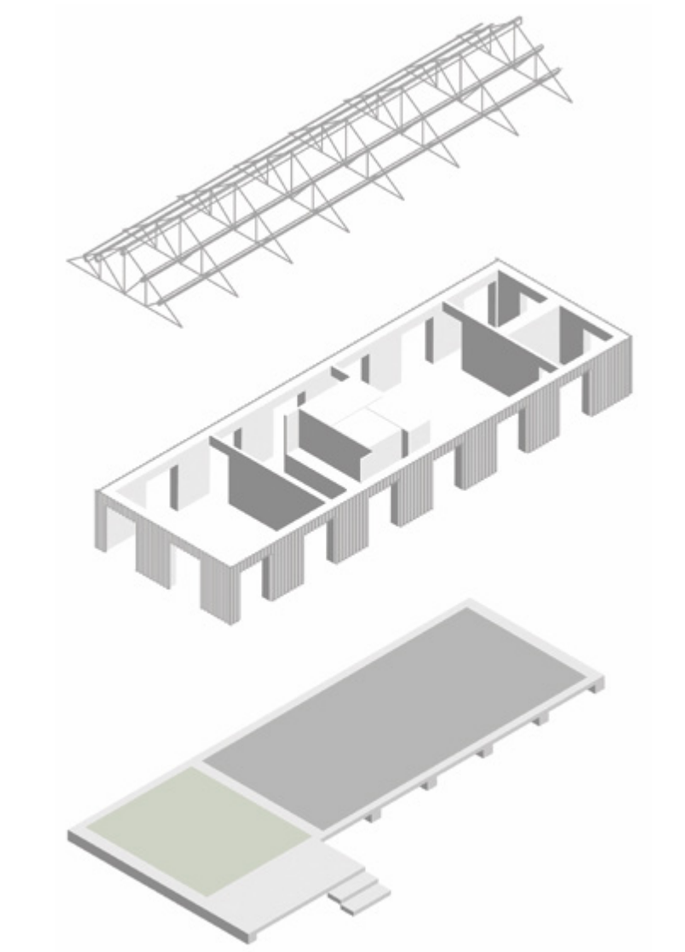
©Janez Martinicic

THE LIGHTBOX HOUSE

Prototype
Status: Design stage
Cost: £140,000 per unit
Size: 90 sqm (116 sqm with pod addition)

The Lightbox House is a two-, three- or four-bedroom terraced house developed from an original prototype for the Homes England Heartlands demonstration site in Cornwall. The wind and watertight shell is customised offsite to meet customer and local planning requirements and then fitted out on site with further customisable options. The Lightbox House uses the cost effective Frame UK FrameThermo system consisting of a factory-insulated wall panels that come complete with internal vapour control layers and a devoted service zone. The concept is currently being developed for a 60 home scheme in Dartington, Devon, providing affordable inter-generational housing to meet local needs, and could be applied to the wider housing sector in London as an alternative to factory produced volumetric construction.

Architect: Ash Sakula Architects
Timber frame manufacturer: Frame UK
Windows and doors:
Russell Timber Technology
Contractor:
Fox Construction and Goulden & Sons



FAYE TOOGOOD X CUBE HAUS

Prototype
Status: Design stage
Date of completion: September 2019
Cost: £250 per sqft
Size: 85 sqm

Updating the familiar pitched-roof geometry of English vernacular dwellings, these houses are built on a modular panel system that allows for ease of construction alongside confidence of design. Suiting both rural and urban contexts, it evokes the ordinary, often-ignored buildings that have been built across Britain for centuries. These 21st-century prefabs are configured in a series of rooms, sequenced from day to night while preserving a sense of the outside world even on restrictive sites. The iterations are distinguished by their bold uniformity of materials – either dark charred timber or raw galvanised steel, playing with the configuration of three architectural elements; a timber truss roof structure, CLT wall panels and a floor plinth, creating a distinctively modern aesthetic inspired by traditional rural architecture.

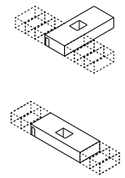
Client: Cube Haus Commissions
Architect: Faye Toogood
Quantity Suveyor & Project Manager: Selway Joyce

CUBE HAUS – VOID HOUSE

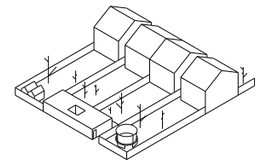
Forest Gate, LB Newham, London E7
Status: Design stage
Date of completion: June 2019
Size: 100 sqm

'Void Houses' aim to realise the opportunity of small sites, with off-site fabrication and renewable CLT construction promoted for economy and ease of implementation on site. Often working with overlooked infill sites, 'Void Houses' enclose individual courtyards, using a simplistic material palette. The orthogonal, modular layout of the building allows it to adopt a variety of different cladding systems to suit both the client and local planning constraints. Where possible, prefabricated cladding systems will be adopted, maximising efficiency of construction and reducing required time on-site. The Cube Haus delivery model helps to make design and innovative architecture accessible to the domestic market. The houses will be commissioned and installed by Cube Haus or available to buy as an 'off-the-peg' or tailored solution for self-builders.

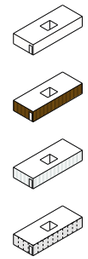
Client: Cube Haus Commissions
Architect: Carl Turner Architects



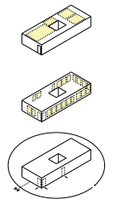
Garage Sites



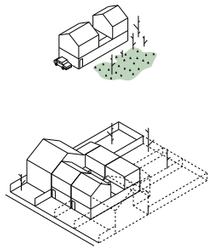
End Of Garden Sites



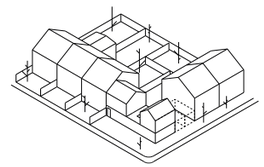
Flexible Cladding Options



Flexible Opening Positions



Open & Infill Sites



End Of Terrace Variations

©Edit

MARMALADE LANE

29 Graham Road, Cambridge, CB4
Status: Under construction
Date of completion: August 2018
Size: 5,350 sqm GIA
Number of units: 42

Marmalade Lane is a co-housing development which ranges from one-bedroom flats to five-bedroom houses. The homes are laid out in terraces around a shared-space lane and as apartments overlooking a communal garden. Construction is fully prefabricated with a closed panel timber frame for the houses, and a CLT frame for the apartment block/ common house. The prefabricated wall panels are made in Sweden and transported to site for assembly. A custom-build approach – enabled though the use of a BIM tool – allowed residents to select from series of options for internal arrangements, external brick colour and front doors. Further effort has also been made to capture the successful process through the development of a collaborative design manual which has formed a template for all future project delivery.

Client: TOWN
Architect: Mole
Structural and Civil Engineer: Elliott Wood
Project Manager: Monaghans
Prefabricated House Supplier: Trivselhus UK
CLT Supplier: Eurban

MARYON ROAD

124a Maryon Road, LB Greenwich,
London, SE7
Status: Completed
Date of completion: July 2015
Cost: £600,000
Size: 220 sqm

At Maryon Road, access was restricted via a small tunnelled driveway. An innovative digital approach overcame access constraints with the use of small, precision manufactured components. Digital manufacturing offered a way to control the costs and delivery, without the need for large-scale offsite manufacturing facilities. The integrated approach is centred around a computer system, where data controlled every process. Every element of Maryon Road was designed within a 3D computer model to generate all the vital information, from quantities and prices to sizes and positions. With the components being manageable by hand (two people), rather than requiring the use of cranes to move them in to position, even the trickiest of plots can be unlocked in an efficient way by leveraging existing technology.

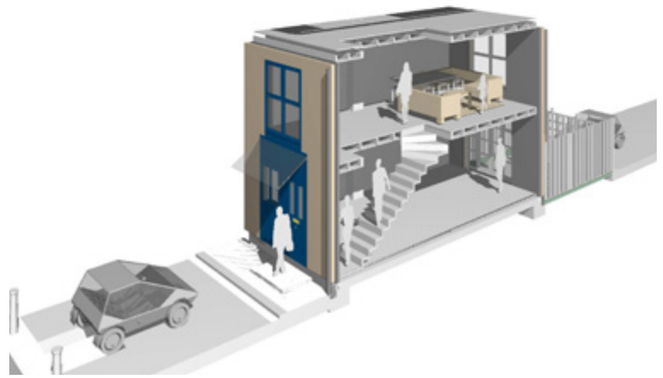
Client: Terry Green and Mickey Dell
Architect: Facit Homes
Structural Engineer:
Constant Structural Design

‘MORE STOREYS’

Gainsford Street, LB Southwark, London, SE1
Status: Planning granted
Date of completion: June 2019
Cost: £2.6m
Size: 1,632 sqm
Number of units: 13

‘More Storeys’ brings together 13 private home owners to expand their individual two-storey terraced homes upwards, by adding additional floors, using a CLT system. The flat panels will be brought on site as panels, to minimise disturbance to neighbours and traffic. The volume and form were tested by using 3D modelling. Simple strong shapes were evolved, in particular the ‘Oriel’ window at the rear, to create openings whilst maintaining a thin structure. Speed of installation is a strong criteria, so as not to disrupt a sensitive established residential area. The existing houses, built in the late 1980s of brick and block construction, would have dimensional discrepancies and a CLT structure can be relatively simply adjusted on site.

Client: The Owners Gainsford Street Houses
Architect: Azhar Architecture
Advisor: Teresa Borsuk
Structural Engineer: Alan Baxter Associates

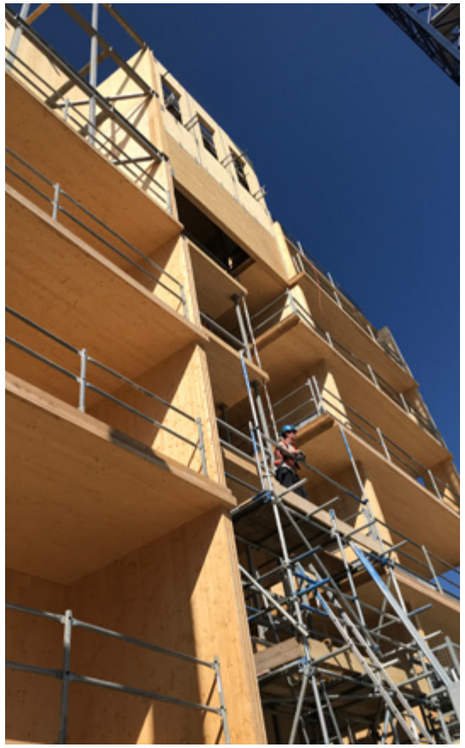


THE PROTOTYPE

Prototype
Status: Design stage
Date of completion: September 2018
Cost: £122,000
Size: 51.4 sqm

In order to better understand build and delivery sequencing, First Home have created The Prototype. Constructed from a hybrid system of CLT panels, bathroom pod and service cupboard, The Prototype illustrates the benefits of modern methods of construction – using offsite manufacturing techniques, sites will be acquired, developed and constructed in up to half the time of traditional construction and generate above average returns for investors. The intention for The Prototype is that it is used as a quality benchmark for any project, which can be visited at any time by the client, design and delivery team, or local authority so that informed discussions and reviews can be had in a real apartment.

Client: First Home
Architect: Flower Michelin
Cross Laminated Timber Engineer: Eurban / William Hare
MEP Designer: Mecserve
Civil & Structural Engineer: Ramboll
Quantity Surveyor: Gardiner & Theobold
Acoustics: Sandy Brown
Building Control: MLM PD - MAC
Facades: FMDC
Planning Consultant: Bidwells
Fire Consultant: Hoare Lea Fire

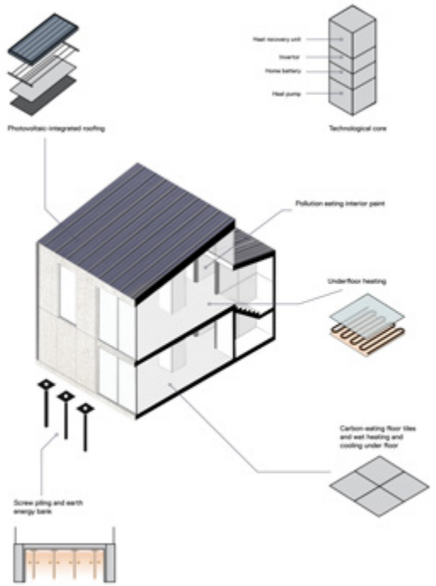


ATELIO

Prototype
Status: Design stage
Cost: approx £180,000 per unit
Size: 72 sqm average

Atelio is a high precision factory-made housing system that aims to bring a sustainable, modular, well-designed and socially minded product to the UK market. This highly customisable system employs TUFECO's cutting-edge automated fabrication process to produce monolithic structural and insulating panels made from a recycled glass-composite. The panels can form all surfaces of the outer shell of the buildings – including roof and ground slabs – with no additional structural, insulation, or weatherproofing required. Each building follows a unique 'screen to construction' delivery process where the customer's choices directly instructs the production in the factory through a web-based 3D BIM environment. The average factory production time is two days, resulting in an order to occupation programme of less than three months.

Architect: Grimshaw and SAM Architects
Environmental Consultant:
The Carbon Free Group
Manufacturer: Tufeco



GALLIONS REACH

Gallions Reach, LB Newham, E6
Status: Completed
Date of completion: May 2017
Size: 2,081 sqm
Number of units: 2

ilke Homes' demonstrator homes were launched in May 2017 in partnership with Elliott and Keepmoat Group. The combination of materials in the hybrid construction enable an 80 sqm two-storey home to be almost entirely factory built and installed in two modules including a pitched roof. Volumetric modules, arrive to site fully finished (internally and externally) with only minor finishing details to complete on site. This enables the installation of four to eight homes in a day.

Client: Keepmoat Homes
Manufacturer: ilke Homes
Supplier: Elliott

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FUTUREHOMES SOUTH GARDENS

Wansey Street, London SE17
Status: Completed
Date of completion: January 2017
Size: 1,700 sqm
Number of units: 15

The scheme has delivered a striking new terrace of 15 bay fronted townhouses on the edge of a Zone 1 Conservation Area. The three-storey terrace is formed of 13 three-bedroom townhouses with two four-bedroom units at either end, all designed to include a raft of sustainable innovations including Passivhaus accreditation, CLT construction, green roofs, additional renewables, smart home technologies and local community initiatives. CLT forms the structure of the townhouses; as trees absorb carbon dioxide while growing, timber is a highly sustainable material. Walls, floors and roofs have been constructed from pre-fabricated panels. Off-site production has meant less on-site waste, a shorter build programme, and whole-life cost savings. A lighter frame and reduced weight has ensured a lighter building and smaller foundations.

Architect: Maccreanor Lavington Architects
Client & Main Contractor: Lendlease
Structure Engineer: Robert Bird Group
Service Engineer: TUV-SUD
Public Realm Designer: Gillespies
Landscape Architect: Churchman
Passive House Consultant: Warm

HOFLAAN HOUSE

Hoflaan 15, 3062 JA Rotterdam, Netherlands
Status: Completed
Date of completion: June 2012
Cost: £1,850 per sqm
Size: 340 sqm

Hoflaan house replaced a two-storey, post-war dwelling with a new modern family home that is more responsive to its context. The building system, services and materials were chosen to minimise the CO2 footprint, and the house is designed to Passivhaus standards. The main structure of the building is an off-site prefabricated timber frame with a wood based insulation production from Unger-Diffutherm, chosen to achieve the environmental aims. The house is CO2 neutral in construction and low energy in use. Walls and ceilings are lined with 36mm reinforced gypsum, and floors at ground level, the first floor study and wet rooms are finished in 25mm stone, which together gives a thermal mass similar to a historical brick house.

Architect: Maccreanor Lavington Architects
Client: Gerard Maccreanor and Ann Bousema
Main Contractor: Gerard Maccreanor
Structural Engineer: Pieters Bouwtechniek
Environmental Consultant:
Sabine Groeneveld

©David Grandorge

CANONBURY HOUSE

13 Alwyne Place, LB Islington, London, N1
Status: Completed
Date of completion: December 2017
Cost: £1,800,000
Size: 300 sqm

Creating a contemporary and sustainable family home, the layout of this courtyard house has produced an open plan, day-lit space connected to the existing mature garden. The construction of the new-build employs a hybrid of traditional construction methods in conjunction with prefabricated timber panels from Slovenia. Offsite manufacturing limited disruptions to the adjacent narrow road and reduced build time to 11 months. However, certain structural elements were completed on-site to allow sufficient tolerances on the tightly constrained site, surrounded by a Grade II listed building on two sides. The brick cladding, made from London stock, was completed on site to match the surrounding buildings. The design and method of construction was fully supported by the community.

Architect: mitzman architects llp
Quantity Surveyor: PT Projects
Structural Engineer: Concept Consultancy
Mechanical Engineer: Boom Collective
Party Wall Surveyor: FPC Surveyors
Rights of Light Consultant:
Schofield Surveyors
CDM Consultant:
Andrew Goddard Associates
Arboriculturist: Wassells
Pre-construction Services: BSB
Fire Engineer: BB7

NHOUSE

Prototype
Status: Completed
Cost: £170,000 (three-bed)
to £225,000 (four-bed)
Size: 95 sqm NIA to 122 sqm NIA

nHouse designs, builds and installs factory built modular dwellings. Each nHouse comprises of a number of ‘quads’ that are built in a quality controlled environment, complete with all fixtures, fittings and finishes, ready for transportation, craning and connecting together on site. All quads are formed from CLT panels, with split glulam beams and columns to provide open spaces across adjoining thresholds, designed to comply with the size restrictions of the transport and lifting methods, without any special permits. nHouses have a high-performance building fabric which exceeds building regulations by 25 per cent resulting in significantly lower running costs than traditionally built new homes. Manufacture of each nHouse takes four weeks, with delivery to site and install taking a further two weeks.

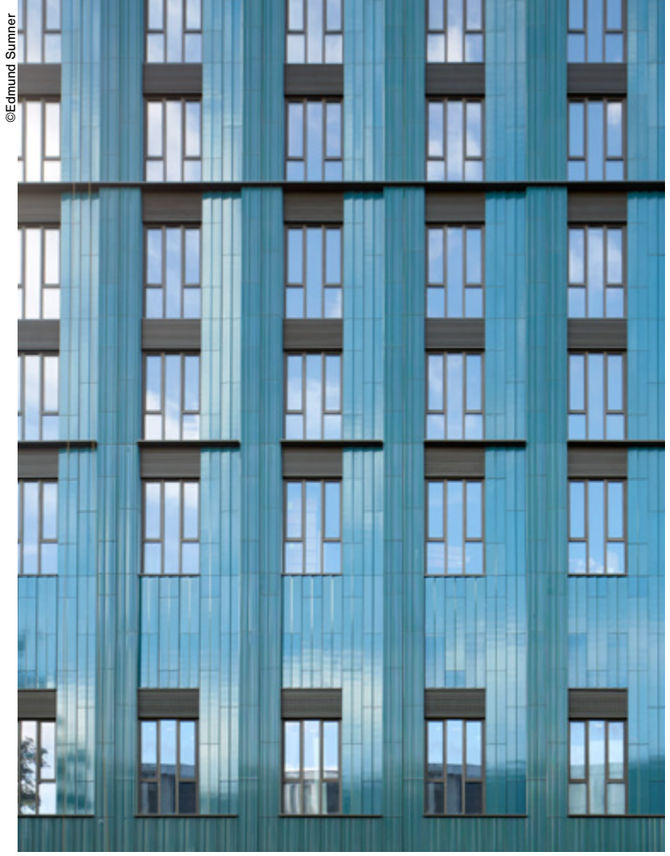
Client: nHouse
Architect: Studio RHE
Structural & Services Engineer: Atelier One

FAB HOUSE

The Plateau, Smiths Dock Site,
North Shields, Tyne and Wear, NE29
Status: Completed
Date of completion: March 2018
Cost: £163,667 per house
Size: 91 sqm GIA per house
Number of units: 10

The brief for Fab House was to develop a new offsite manufactured home typology that is affordable, elegant and spacious, using modular construction. The design embraces efficiency, with the whole house assembled on a production line, reducing time, disruption and material waste on site, whilst also incorporating design strategies such as exposing ceiling joists to create more height than typical modular homes. Fab House's cladding is mounted away from the structure, leaving a void for all services to run outside the house which reduces the need for follow-on trades to enter each property. The gap also aesthetically creates depth and a sense of permanence. Fab House represents a low-cost prototype which can be constructed quickly with little waste and at scale, complementing London's Victorian terraces.

Client: Smiths Dock LLP - Joint venture between Urban Splash and Place for People
Architect: George Clarke and TDO
Structural Engineer: Expedition
Quantity Surveyor: Gleeds
Managing Contractor: USC (Urban Splash Construction)
Modular Contractor: Urban Splash Modular (formerly SIG)



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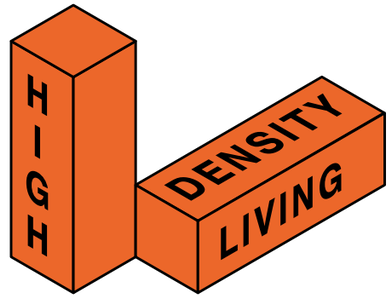
COCKWISE FROM TOP LEFT

The Rising Factory by Mace, design by Lifschutz Davidson Sandilands
©Mace

Mapleton Crescent by Pocket Living and Metropolitan Workshop LLP

Apex House by HTA Design LLP

Dalston Works by
Waugh Thistleton Architects



Being quicker to build, reducing noise, waste and pollution on site, and offering flexibility and adaptability on site through use of repeated elements, factory-made housing has seen its biggest take-up to date in London for larger-scale apartment blocks, hotels and student accommodation. This has emerged alongside the rapid growth of the build-to-rent sector. Employing prefabricated modules and fit-out and/or materials such as CLT for such developments enable design and construction to be completed sometimes up to a year earlier than those using traditional methods, as seen, for example, in HTA's Apex House – at 29-storeys the tallest modular building in Europe. Faster completion times mean that residents can move in earlier and the building's owner or operator can make a return on investment more quickly. Yet the sophistication and customisation of prefabricated systems and building elements available today mean that these high-rise developments, while often containing stacked units, can respond to local context and character effectively through distinctive massing, choice of materials and facades, quite unlike the uniform towers of the modernist era; just one recent example is the green terracotta-clad Mapleton Crescent designed by Metropolitan Works for Pocket Living.

Using frames, panels and modules produced offsite can not only result in fewer deliveries but easier and quicker installation in constrained areas, making them especially appropriate for infill sites and the drive to support housing growth through the intensification and densification of places in and around London's town centres and transport hubs. In the same way, the lighter weight, adaptable configurations and need for minimal foundations mean that prefabricated systems can be especially suitable for opportunities to build over rail and tube lines and on top of existing structures. One of the most significant recent examples is Waugh Thistleton Architect's Dalston Works, the world's largest CLT building for affordable and private rent; constructed over the proposed Crossrail 2 line, it weighs only 20 per cent of a similar structure in concrete. Similarly, Mace's 'Rising Factory' uses manufacturing-led processes to construct a residential project in Stratford's East Village, completing each floor in less than a week and creating a safer, contained working environment. Modern methods of manufacturing also support the development of innovative typologies, especially for family homes, that can also increase density. Berkeley's Urban House, provides high-quality, sustainable family housing in densities similar to mid-rise apartment blocks on the same-sized site. Essential Living's Creekside Wharf development in Greenwich, designed by Assael Architecture, is the first in London to provide a purpose-built rental block intended specifically for families, with balconies designed to keep children safe incorporated as a key feature. In Sweden, the Koggens Gränd scheme in Malmö is just one example showing how the creative use of offsite manufacture components can create a dynamic design far removed from the homogenous box-like structures that factory-made housing is still often perceived to be.

High-rise

APEX HOUSE

Fulton Road, Wembley, LB Brent,
London, HA9
Status: Completed
Date of completion: August 2017
Cost: £46m
Size: 16,600 sqm
Number of units: 558

With 29-storeys of self-supporting modules, and having been constructed within a twelve month period, Apex House completes a trio of innovative buildings in the same urban block in Wembley. Housing 558 student rooms and a café, the 'L' shaped building creates a new street frontage that complements the neighbouring buildings.

The cellular nature of student housing makes it ideal for volumetric modular construction. After the initial assembly of the steel frames, which are carefully engineered to require the minimum structure, the modules pass through plumbing, electrics and finishing – even having the bed installed – within the factory before being delivered to site fully finished. This process is carefully monitored ensuring quality standards are consistently met. All rooms are designed with services located to the same side, making them quick to install and easy to maintain.

Two key structural innovations were required to create the building. A special coupling arrangement, between the steel modules and the reinforced concrete core, accommodates differential movement caused by the gradual settlement of the concrete structure. This works in conjunction with thick steel corner posts incorporated into each module that transfer vertical loads to the foundations.

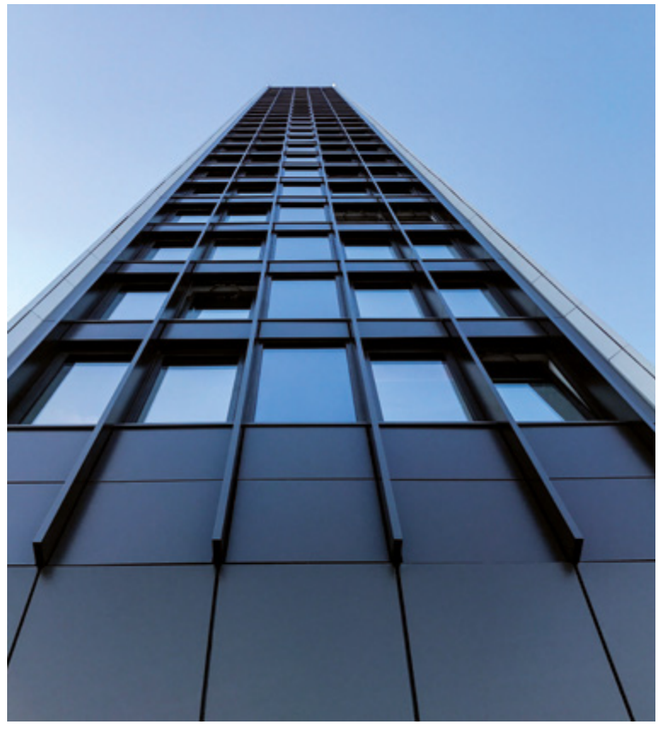
Modular construction reduced the building timescale by up to a year compared to traditional methods, enabling an earlier hand over and quicker returns on investment. This confirms the logistical and financial positives to offsite construction for rented developments and the housing market.

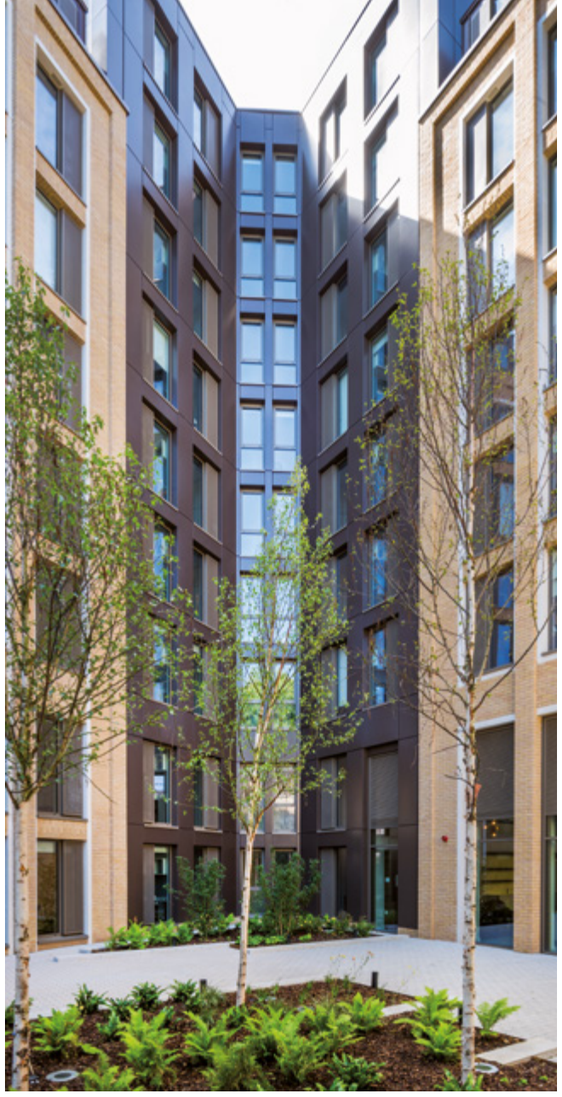
Viewpoint

'Apex House stands tall at 29-storeys, delivered in just 12 months and showcases the great outcomes we can achieve using modular construction. Working closely with HTA we have delivered the tallest modular building in Europe at the moment, where design and technology came together to create quality student housing in the capital. With large numbers of students choosing London as the place to study every year, building student homes at pace is vital. Modular construction can help speed up this process, while respecting quality, cost, and time outcomes.'

Christy Hayes, CEO, Tide Construction

Client: Tide Construction and Vision Modular Systems
Architect: HTA Design LLP
Structural Engineer: Barrett Mahony Consulting Engineers
M&E Consultant: Vecron Design
Module Design: Vision Modular Systems
Daylight/Sunlight Consultant: Malcolm Hollis
Quantity Surveyor, Cost Consultant, Project Manager, CDM Coordinator & Main Contractor: Tide Construction





Medium-rise

SAVOY

164 Old Oak Road, LB Hammersmith and Fulham, London, W3
Status: Completed
Date of completion: May 2018
Cost: £23m
Size: 8,007 sqm
Number of units: 306

Utilising Vision Modular Systems' innovative construction methodology, this project delivers 306 student units housed within seven-storeys and using 338 modules in total. All modules were manufactured by Vision in their purpose-built factory in Bedford, using precision engineering production line techniques designed to streamline the process and deliver a quality end-product at a faster pace of construction.

Positioned within a conservation area, the design of the building is sympathetic to the surrounding neighbourhood through the distribution of the building massing and the choice of materials which include stone and brick work, combined with a zinc mansard roof. The design restores street frontage to the Westway and Old Oak Road and, importantly, restores legibility to Savoy Circus whilst taking inspiration from the cinema which previously occupied the site.

The articulation of the windows, piers, and brick infill is matched to the rest of the tower and is symmetrical about its centre. The composition of the typical street elevation consists of brick pillars, setback infill brickwork with reconstituted stone framing the windows. Towards the rear, a lighter buff brick was used to subdivide the gable end elevations and reflect more light into the courtyard.

The successful use of handset brick and cast stone to clad a fast-track modular building proves that modular buildings can be indistinguishable from other types of construction systems whilst maintaining the benefits of time, cost and quality that this construction methodology delivers, which is ideal for student housing. The project was handed over to the operator a year earlier, making a return in its investment more quickly than projects which are constructed traditionally. The project counters any perceptions that factory-made buildings are temporary or compromise architectural freedoms, demonstrating how London's diverse contexts, high architectural standards and needs for a robust, long-lasting built environment can all be met through offsite construction.

Viewpoint

'It was a great opportunity to work with HTA on the design of such a unique modular development like Savoy Circus. We have successfully delivered quality student accommodation with a significantly shorter construction programme, reducing disruption to the local area during the building process. Savoy Circus is a great example of how architectural creativity and modular methods of construction can blend together to offer sympathetic design for local communities, alleviating housing need at the same time.'

Christy Hayes, CEO, Tide Construction

Client: Greystar Europe Holdings Ltd
Architect: HTA Design LLP
Structural Engineer: Barrett Mahony Consulting Engineers
M&E Consultant: Vector Design
Quantity Surveyor & Cost Consultant: Tide Construction
Module Design: Vision Modular Systems
Project Manager, CDM Coordinator & Main Contractor: Tide Construction

High-rise

ADDISCOMBE GROVE

28 - 30 Addiscombe Grove,
LB Croydon, London, CR0
Status: Under construction
Date of completion: March 2020
Cost: £30m
Size: 9,472 sqm
Number of units: 153

Addiscombe Grove occupies 97 per cent of the site's total ground floor area. Maximising the site's area called for an innovative construction method, built offsite to cope with such extreme building conditions and challenging logistics.

Pocket Living's first project in Croydon represents a high quality, high density alternative to the proliferation of poor quality 'permitted development' (PD) homes currently under development in the borough. As well as providing affordable homes for local first time buyers, this 21-storey tower will provide the residents with a range of shared amenity spaces and aims to reinvigorate the public realm around the main entrance improving the pedestrian experience along the street.

Addiscombe Grove will be built using volumetric construction techniques which will deliver considerable benefits to the project including programme savings, an improved health and safety regime and most importantly, dramatically reduced logistic issues – an important factor given the high percentage of site area coverage the new building will achieve.

Pocket 1b1p (one bedroom one person) homes proposed at Addiscombe Grove are highly compatible with modular techniques due to their prescriptive nature in both specification and layout. Both the specification and design were concluded at planning stage, enabling the modular contractor to begin assembly as soon as the tendered contract was signed.

The controlled factory environment enables efficient quality control of flat finishes and an ordered snagging process. Fitting out flats earlier in the project programme allows improvements to be explored and implemented. Any amendments can often be explored by producing prototypes in-factory for client approval prior to implementing the detail on the assembly line.

Viewpoint

'Pocket Living are committed to delivering housing projects of exceptionally high quality within emerging urban areas like Croydon. Addiscombe Grove is no exception with its highly contextual architectural response inspired by Croydon's post-war architectural heritage. Our creative collaboration with both the architect and supply chain has enabled the use of volumetric construction and will ensure the speedy delivery of much needed affordable homes to local first time buyers in Croydon. This project has enabled us to build upon an existing relationship with a talented architectural practice and a committed professional contractor.'

Angharad Palmer, Head of Design, Pocket Living

Client: Pocket Living
Architect: Metropolitan Workshop LLP
Structural Engineer: Parmabrook
MEP Engineer & Sustainability Consultant: TUV SUD

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High-rise

BOLLO LANE

100 Bollo Lane, LB Ealing, London, W4
Status: Under construction
Date of completion: June 2019
Cost: £31.5m
Size: 7,121 sqm
Number of units: 112

Pocket Living's third development in Ealing is a three-, eight-, and fourteen-storey brick and glass reinforced concrete tower containing 84 one bedroom Pocket homes as well as 28 open market apartments. These affordable homes are targeted towards first time buyers who live or work in the area.

Bollo Lane will be built using volumetric construction techniques which will deliver considerable benefits to the project, including reduced logistic issues – extremely beneficial to this particular site in close proximity to a number of railway lines.

At Bollo Lane, the 1b1p (one bedroom one person) Pocket homes consist of two modules with a concrete base and steel structure assembled in a factory. The modules are transported individually on a lorry, and arrive watertight with windows already installed before being craned in and joined together for stability.

Through the process of working on Bollo Lane, Pocket Living has identified learnings applicable to the wider housing sector following its experience with offsite methods:

– Standardise flat typologies as much as possible. Contractors prefer standardised flats as the modules can be fast-tracked into production, due to the advanced nature of design work.

– Avoid awkward or wasteful layouts. These increase the number of modules required per flat and the number of joins required on site.

– Plan ahead. Ensure internal flat layouts, including socket locations, and specification finishes have been approved by the clients prior to signing the build contract. When a space in the contractor's assembly line becomes available, there should be minimal design items left to resolve.

– Mobilise your team. Ensuring the necessary team is available from the moment the first module goes into production is imperative. The process is fast-paced and a team is required to react to this, especially when working with a new contractor or product.

Viewpoint

'Developing Bollo Lane W4 would have been incredibly difficult using traditional methods (the site has railway lines on three of four sides), however the nature of building with volumetric construction has made delivering these affordable homes possible. Having developed four previous schemes with the same contractor, they are very familiar with our product, and our team is used to their factory. We had learnt a whole host of collective lessons and therefore the process of designing and producing the modules in the factory was much quicker and more streamlined.'

Angharad Palmer, Head of Design, Pocket Living

Client: Pocket Living
Architect: PRP
Planning Consultant: Rolfe Judd
Structural Engineer: Peter Brett Associates
MEP Engineer & Sustainability Consultant: Peter Brett Associates
Facade Consultant: NET Façade Consultants

High-rise

MAPLETON CRESCENT

11 Mapleton Crescent,
LB Wandsworth, London, SW18
Status: Completed
Date of completion: July 2018
Cost: £23.2m
Size: 4,685 sqm
Number of units: 89

Completed in August 2018, Mapleton Crescent was delivered at speed using volumetric modular construction on a constrained site in Wandsworth. As with all Pocket Living schemes, the majority of the 89 homes have been sold to local eligible first time buyers, who live or work in the borough.

The slender 27-storey tower is comprised of 254 weather-tight steel-framed modules, manufactured offsite. The modules were stacked, fixed back to the core and sealed together at a rate of approximately one floor per day, using a special crane mounted to the top of the core – last implemented on The Shard. The building is clad in a jewel-like iridescent terracotta tile using a glaze developed along-side a ceramicist Lorraine Rutt.

The use of offsite techniques has delivered considerable benefits, including a dramatic saving in construction programme (between 40-60 per cent), reduced disruption to neighbouring properties in a busy part of town and improved build quality.

Unlike traditional construction methods, the design process for factory built homes focuses on finalising and building internal flat layouts at the very early stages, sometimes even prior to building the sub frame. Choosing the flat specifications and determining the setting out as soon as the building contract has been signed can be very challenging for a design team, however incredibly beneficial to the overall project programme, as demonstrated at Mapleton Crescent.

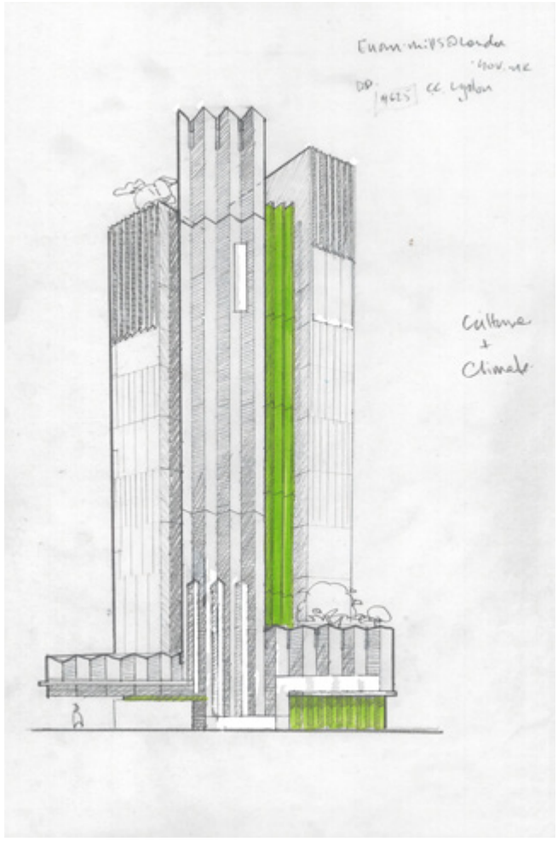
Modern methods of construction and factory built methods have enabled Pocket Living to build hundreds of high quality homes in London efficiently. Pocket believe that more competitors are needed in the offsite market to lower barriers to entry and progress product design and quality. MMC contractors in London especially need to improve the sustainable credentials of their constructions to align with the aspirations of the future London Plan.

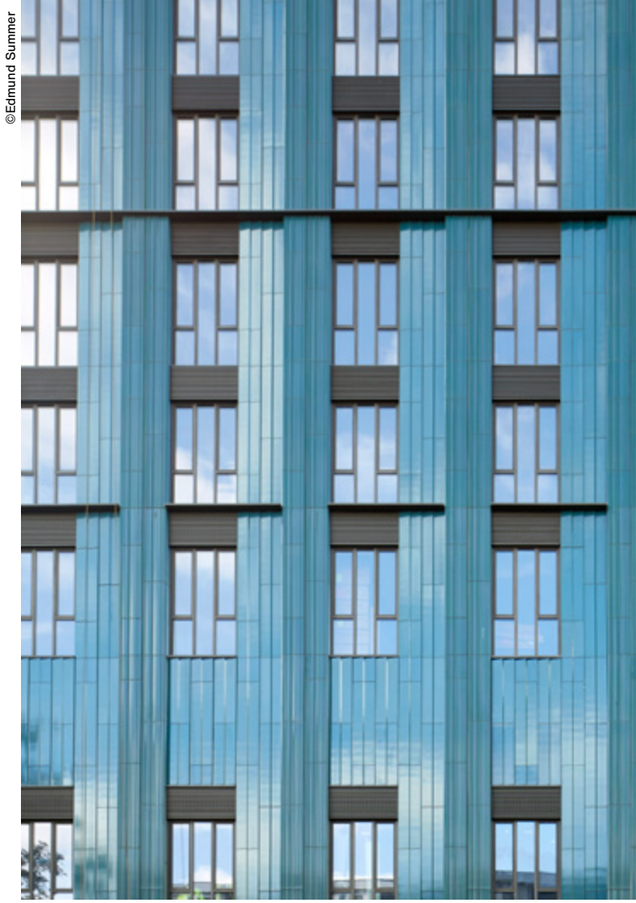
Viewpoint

'Mapleton Crescent has been built on our smallest site to date – an incredibly constrained plot but one that has secured the provision of much needed affordable homes for local first time buyers. The use of volumetric modular construction unlocked the site for development, where traditional methods would not have been able to do so. Building the modules off site meant more time could be spent on achieving the best design quality and the highest quality of cladding installation – something I believe was pivotal to the success of the project.'

Angharad Palmer, Head of Design, Pocket Living

Developer: Pocket Living
Architect: Metropolitan Workshop LLP
Structural Engineer: Barrett Mahoney, Clancy & Barrett Mahony
Planning Consultant: Rolfe Judd
Facade Consultant: NET Consultancy
M&E Consultant & Lighting Consultant: Mendick Waring
Quantity Surveyor & Employers Agent: WT Partnership
Principal Designer: Bailey Garner
Main Contractor: Donban Contracting UK





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Medium-rise

THE BOILER HOUSE

The Old Vinyl Factory site, Blyth Road,
LB Hillingdon, London, UB3
Status: Completed
Date of completion: May 2018
Cost: £10m
Size: 4,627 sqm
Number of units: 54

Part of U + I's Old Vinyl Factory development in Hayes, The Boiler House building houses two commercial units at ground level, with 54 apartments above. Its stainless steel-clad walls and bright orange staircase echo the industrial aesthetic of its predecessor - a boiler house which provided heat and power to the site. Apart from the concrete-framed ground floor, the remainder of the building was constructed using a CLT frame, making the development one of the largest structures in the UK to use CLT for private housing. Stride Treglown took the project forward from the concept architect Studio Egret West, working closely with the CLT system designer Eurban to resolve the complexities of the design, including the sloping external walls. Unusually for a CLT-framed building, a large number of balconies – some recessed, others projecting and some both – have been incorporated requiring a number of intricate engineering solutions.

Additionally, a roof garden for occupiers has been created, with the thickness of the structural roof elements increased by 25 per cent to enable semi-mature trees to be planted. Accurately manufactured off site, the CLT frame was erected in just under seven weeks, significantly reducing noise pollution, dust and waste on site and reducing both the number of deliveries as well as the quantity of materials requiring storage. The Boiler House is designed to minimise its carbon footprint and the use of the CLT system contributed substantially to this; a tonne of concrete releases an equivalent of one tonne of CO2, whereas each tonne of CLT captures 2.5 tonnes of CO2. The timber used for the building came from a fully certified managed sustainable forest adjacent to the production mill, with all waste from manufacture being recycled or used to generate power for the machinery.

Viewpoint

'We wanted to use CLT for environmental reasons. It was also ideal to create the building's distinctive inclined facades. The additional benefits have been considerable, not least quality of finish and speed of construction, but also having a safe, clean site meant we could bring potential purchasers to the building much earlier than traditional concrete framed buildings. The health and safety benefits of having a fraction of the number of tradespeople on site during construction shouldn't be underestimated. CLT has a role to play in delivering housing at speed, but would always be considered against other methods to best suit individual projects.'

Damien Sharkey, Development Director, HUB Group

Client: Boiler House Development LLP
Concept Architect: Studio Egret West Ltd
Executive Architect: Stride Treglown Ltd
Structural Engineer: Whitby Wood
Contractor: Henry Construction Projects Ltd
Planning Consultant: Lichfields Planning and Development Consultancy
Project Manager: Faithful + Gould

Medium-rise

CHAPTER LEWISHAM

Thurston Road, LB Lewisham, London, SE13
Status: Completed
Date of completion: September 2016
Cost: £45m
Size: 10,435 sqm
Number of units: 611

At the heart of Lewisham town centre, two 12-storey blocks provide 611 student bedrooms and 560 sqm of prime commercial space, bringing a new student community to the area as well as creating valuable employment opportunities. The scheme uses self-stacking volumetric units for the residential floors, with all rooms fully fitted offsite under precise factory conditions.

Having originally been designed as a concrete frame structure, the transition to modular allowed for the onsite construction period to be halved to 10 months. At the peak of delivery, 42 modules were being installed on site per week - seven modules a day or 1.5 floors per week.

The wider community also benefited from the use of volumetric offsite construction with significant reductions in onsite waste – 90 per cent diverted from landfill – but also a reduction in associated activity such as noise, dust and air pollution.

Like many infill sites across London, Thurston Road presented challenges including its long and narrow plot immediately adjacent to a railway embankment and a busy through road. Yet, with 90 per cent of the building being procured offsite, the requirements for onsite storage were greatly reduced.

Successful delivery of the project was achieved under strict time constraints to ensure completion for the forthcoming academic year - this was only possible through collaborative between the integrated design team and an experienced supply chain.

The repetitive and precise nature of factory controlled construction ensures that it was completed to a high standard, elevating the student accommodation offer in the local area.

Viewpoint

'A key challenge we faced was demonstrating to planners that the design quality of our earlier planning consent would not be lost by converting the construction to factory-made. A test that we delivered on by taking officers on a journey to understand the factory system, how it works and the benefits it would deliver in faster delivery and design control. Historic perceptions of failed offsite fabricated buildings have changed massively over the last two years. We have reached a point where expressing repetitive modules through thoughtful well-articulated facade design, rather than hiding them with over-dressing is sought after. Some change!'

Philip Breese, Senior Partner, Weston Williamson + Partners

Client: Greystar Europe Holdings Ltd
Architect: Weston Williamson + Partners
Structural Engineer: Barratt Mahoney
Civil, M&E & Sustainability Engineer: Vector/Red
Planning Consultant: Indigo
Project Manager, Cost Consultant & Contractor: Tide Construction

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High-rise

PLOT NO8, EAST VILLAGE

75 Celebration Avenue,
Stratford, London, E20
Status: Under construction
Cost: £191m
Size: 51,000 sqm
Number of units: 481

The arrival of the 2012 Olympic Games changed the face of East London, funnelling much needed resources and infrastructure into the local economy. Stratford has been transformed into a desirable location where demand for homes outstrips supply.

Lifschutz Davidson Sandilands, architects of two of the buildings in the Athletes Village, were appointed to transform it into a destination neighbourhood now known as East Village. It comprises carefully curated social infrastructure and more than 25 independent shops, bars and restaurants. Get Living is the owner and operator of the private rental homes and N08 is the first new phase to be built following the Games.

It comprises an eight-storey podium, two wing buildings and two towers, creating 481 homes. The podium buildings are designed to be robust in appearance with a heavier masonry construction and the lighter towers that emerge are designed with a square plan and a common core with no columns between it and the external walls. This provides great flexibility in layout but also the opportunity for standardised methods of construction and fit-out.

As a key delivery partner for the Games, and with a reputation for embracing innovation, Mace was challenged to build N08. Its approach came in the shape of the UK's first rising factory, a six-story structure built around the tower, creating an indoor construction site. This resulted in a much quieter and considerate site, and reduced safety risks by eliminating working externally at height.

The factory, using 630 tonnes of steel, sits on four corner columns and has gantry cranes operating inside it. A special bracket fits onto each column attached to the factory and a hydraulic jack sits above a metal plate on top of the bracket, meaning the whole weight is held on just two inches of steel in each corner.

Each of the jacks can lift a weight equivalent of the Statue of Liberty, about 300 tonnes, and the factory applies 2.7MN of force to the building, equal to a space shuttle's main engine during take-off.

Thanks to pioneering offsite fabrication, Mace pushed the boundaries of quality as well as pace. An unprecedented 98 per cent of the superstructure was pre-fabricated. The towers were built without tower cranes, instead using a climbing mechanism that allows the team to entirely complete a floor a week, delivering the facade, bathroom pods, utility cupboards, vertical and horizontal multi-service distribution modules.

This factory-style construction method has transformed Mace's approach to residential housing projects. It won the new 'Sir Michael Latham' prize, an award created by the Government to recognise construction firms who adopt modern methods of construction and innovative technology, and the New Civil Engineer 100 Award for 'Construction Innovator of the Year'.

The company plans to use the lessons learnt at East Village to further develop its innovative method as it delivers the programme's third phase N06, adding 524 new homes for private rental to the neighbourhood.

Client: Qatari Diar Delancey
Architect: Lifschutz Davidson Sandilands, Adamson Associates Architects
Engineer: Walsh Associates, Dorman Long Technology, Davies Maguire Whitby
Structural & M&E Engineer: Arup
Main Contractor: Mace

High-rise

HIGHPOINT TOWER

80 Newington Butts, London, SE11
Status: Completed
Date of completion: December 2017
Cost: £125m
Size: 38,572 sqm
Number of units: 457

Highpoint is a 47-storey octagonal precast concrete residential tower with an accompanying eight-storey podium block of CLT; the development aimed to create a new structural typology for residential living in London with a lean, flexible approach driven by standardisation and prefabrication. The symmetrical design repeats a series of precast concrete blade walls, set out to maximise internal flexibility and provide the required stiffness such that an holistic stability system is created where all vertical and lateral structural elements work compositely. The adjacent CLT podium block exceeded expectations and was measured as being 25 per cent faster than a precast reinforced concrete equivalent with a fifth of the transport movements.

Client: Mace & Realstar Group
Architect: Axis Architects
Concept Architect:
Rogers Stirk Harbour + Partners
Structural Engineer: AKT II

Low-rise

BERKELEY URBAN HOUSE

Weigall Road, LB Greenwich, London, SE3
Status: Completed
Date of completion: March 2018
Size: 148 sqm
Number of units: 15

The Berkeley Urban House is a new typology of housing that delivers homes at double the density of traditional buildings, similar to a six-storey apartment block on the same piece of land. As an innovative new patented housing typology, the homes provide three-bedrooms and roof top garden with flexible living solutions. Each house consists of three steel-framed insulated pods, manufactured and finished internally offsite. The brickwork facade, terraces and external staircase were fitted on site The Berkeley Urban House not only ensures reduced wastage but it also allows more sustainable home of higher standards, and most crucially halving the timeframes for build and delivery.

Developer & Architect: Berkeley Home

High-rise

RAVENS WHARF

Norman Road, LB Greenwich, London, SE10
Status: Design stage
Date of completion: 2021
Cost: £30m
Size: 10,000 sqm
Number of units: 100+

The massing for Ravens Wharf evolved from a study of the Creek's industrial heritage, leading to the weaving of brick patterns in an organic, free-flowing form, arranged radially. The radial plan was designed from the outset for offsite construction, using CLT panels in a hybrid structure. The segments are joined in different combinations to create single, panoramic and duplex flats. The modular nature of these units provide the flexibility to maximise user experience, and allow for wide living areas and sheltered amenity pockets. The project demonstrates that offsite production does not automatically lead to mundane, square-box housing and that a crafted design approach can turn structural efficiency into high-quality and dynamic places to live.

Client: Land Edition
Architect: Craftworks

Medium-rise

CASTLE STREET STUDENT ACCOMMODATION

29-31 Castle Street, Luton, LU1
Status: Completed
Date of completion: October 2015
Cost: £7m
Size: 6,100 sqm
Number of units: 180

Castle Street Student Accommodation is a pre-fabricated 11-storey development consisting of 180 rooms, constructed from steel – for structural integrity and to allow stacking – and timber volumetric modular units. The complete bedroom and bathroom pods were fully completed offsite with umbilical connections for drainage, water, power and data. Offsite manufacturing reduced the onsite construction programme by a third and allowed for rigorous checks of both quality and functionality, as well as providing a clean dry environment in easy access areas and safe working conditions at ground level. As the site is close to a major roundabout, offsite manufacture guaranteed the consistency of the robust details required to achieve the acoustic standards. The scheme incorporates innovative heating and ventilation strategies with push switch operations. The ventilation and kitchen systems were all pre-installed, tested and verified before ever reaching site, making the onsite handover simple and robust.

Client: GolDev
Architect: Maber Associates
Building Services Engineer:
Elementa Consulting

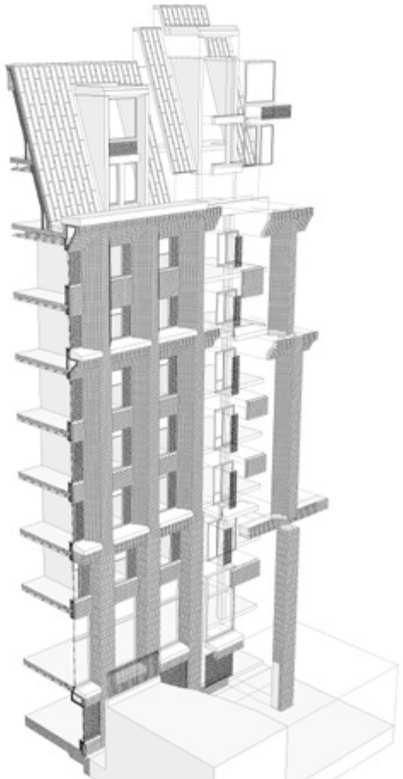
High-rise

WARDIAN

Marsh Wall, Isle of Dogs,
LB Tower Hamlets, London, E14
Status: Under construction
Date of completion: July 2020
Cost: £270m
Size: 77,700 sqm
Number of units: 768

This pair of 55- and 50-storey blocks adjacent to Canary Wharf feature factory-made balconies, facade modules and bathroom pods, shipped to site and installed with minimal adjustments. Facade elements have been designed to allow the facade and balcony installation to take place independently from the tower crane, with a high level of detail and precision achieved by using factory conditions for all assembly and manufacturing processes. BIM and 3D modelling used to test the pre-fabricated elements for easy on-site maneuverability additionally improved construction safety given the limited operations and activities onsite. Due to the projects' high level of pre-fabrication, the speed of installation and build quality have been enhanced and costs optimised.

Client: EcoWorld Ballymore
Architect: Glenn Howells Architects
Facade Contractor: Sipral Facade CZ
Bathroom Pod Manufacturer: Stone Bathware
Structural Engineer: WSP Structures
Facade Consultant: Billings Design Associates



Medium-rise

GARDEN HALLS

1 Cartwright Gardens,
King's Cross, London WC1H
Status: Completed
Date of completion: September 2016
Cost: £140m
Size: 59,831 sqm
Number of units: 1,200 rooms

These new student halls for the University of London replace the former 1930s and 1950s buildings to accommodate 1,200 student rooms, making it one of London's largest student halls of residence. The entire 4,500 sqm brick facade was manufactured offsite as brick-faced precast concrete panels. Prefabrication has allowed the design team to develop stepped brick details that reference the detailing of traditional load-bearing masonry. The depth of the facade also allows it to be constructed from large load-bearing units which require fewer movement joints than contemporary site-laid brick cladding. This leads to a building with a more monolithic character akin to traditional masonry while minimising onsite labour. The overall development was delivered to budget within a tight 26-month programme.

Client: University Partnerships Programme (UPP) acting on behalf of the University of London
Principal Facade Architect: Maccreanor Lavington Architects
Executive Architect: TP Bennett
Contractor: Brookfield Multiplex
Specialist Precast Sub-contractor: Thorp
Precast Structural & Services Engineer: Cundalls
Planning Consultant: CBRE
Landscape Design: Macfarlane Wilder
Cost Consultancy & Employers Agent: McBains Cooper

Medium-rise

ROYAL DOCKS HOTELS

Dockside Road, LB Newham, London, E16
Status: Completed
Date of completion: February 2017
Cost: £53m
Size: 13,100 sqm
Number of units: 2 hotels

These volumetric built hotels form part of phase two of the Royal Docks masterplan. Despite their outward appearance of heavy masonry - reminiscent of the warehouses that once proliferated in the area – each of them has employed prefabrication extensively to meet programmatic requirements. Floor-by-floor, a double bank of hotel rooms was assembled around the central corridor and a stiffening spine of prefabricated bathroom pods. This allowed for a fast and effective assembly. Depth, relief, texture and colour are used to elaborate the well-proportioned grids of the facades to create a differentiated urban identity.

Client: Hilton & Vastint EU
Architect: MaccreanorLavington
Project Manager: Adobe Partnership LLP
Executive Architects: Stride Treglown & Living Architects
Contractor: RG Group
Consultant: Marick Real Estate

Medium-rise

THE RESIDENCE

Ponton Road, Nine Elms, London SW8
Status: Completed
Date of completion: October 2017
Cost: £120m
Size: 20,636 sqm
Number of units: 190

This mixed tenure development comprising of 114 PRS units, 32 shared-ownership and 44 affordable units replaces a number of warehouse units from the 1970s, which had been built after the demolition of the Nine Elms railway terminus in 1968. The regular bays allow for repetition, while the articulation of the facade helps to accommodate and disguise panel joints between the composite precast panels which include the external skin, insulation, internal skin and windows. The facades utilise the potential of prefabrication to achieve a variety of brick colours and orientations as well as precast elements in the form of cills, decorative spandrel panels and lintels. Areas of facade with less repetition such as the ground floor were completed on site.

Client & Contractor: Bellway Homes
Architect: Maccreanor Lavington
Executive Architect: Grid
Specialist Precast Sub-contractor: Decomo
Structural Engineer: Gravity
MEP Engineer: MLM
Planning Consultant: Savills
Landscape Design:
Camlins Landscape Architects

High-rise

PROJECT STACK

Prototype
Status: Design stage
Size: Up to 30,000 sqm
Number of units: 340

Project Stack is a modular housing concept, which aims at maximising the inherent strength of a volumetric module to allow it to cantilever and create a distinctive silhouette for a tall building. The building is set out to a 3-metre grid, with a square core and a facade that follows the same grid. The plan consists of four one-bed and four two-bed apartments. The modules are delivered as watertight units, with the chassis fitting on a flat-bed lorry with a wide load so it can be easily transported to site. There is a high degree of repetition within the flat types and modules, which is ideal for mass-production. The typical floor repeats, however the balcony position has three variants. Special floors can be introduced to incorporate larger three-bed units.

Architect: Sheppard Robson
Structural Engineer: Eckersley O'Callaghan

Medium-rise

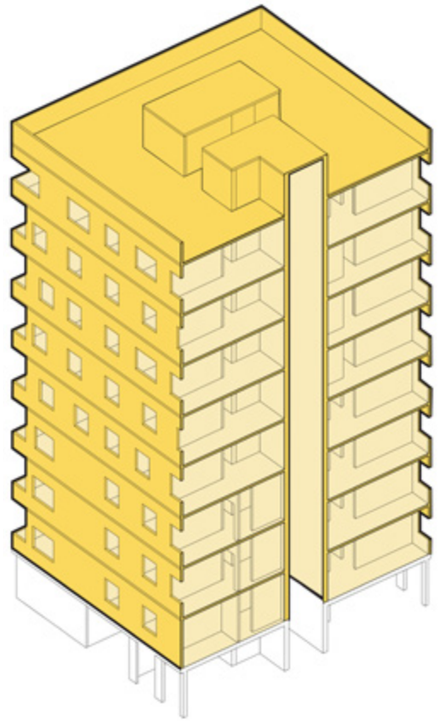
MURRAY GROVE

Murray Grove, LB Hackney, London N1
Status: Completed
Date of completion: 2008
Cost: £3.86m
Size: 2,540 sqm
Number of units: 29

Murray Grove was the first mid-rise building to have its superstructure formed of CLT. The structure above the first floor slab is comprised of CLT panels with the solid timber walls, floor slabs and lift cores working together like a honeycomb, providing a very stable and efficient building. Different floorplans to accommodate a mix of different sized flats were facilitated through the use of load-bearing CLT panels, which form party walls and some internal partitions.

In creating a world first, the design team, contractor, timber supplier and client collaborated to overcome regulatory hurdles and demonstrate the resilience and safety of the building. This exemplar project spearheaded the introduction of CLT in the UK, and pioneered an international movement in tall timber construction.

Client: Telford Homes/Metropolitan Housing Trust
Architect: Waugh Thistleton Architects
M&E: Michael Popper & Associates/ AJD Design Partnership
Structural Engineer: Techniker/Jenkins & Potter
Timber Manufacturer: KLH
Planning Consultant: CMA Planning



Medium-rise

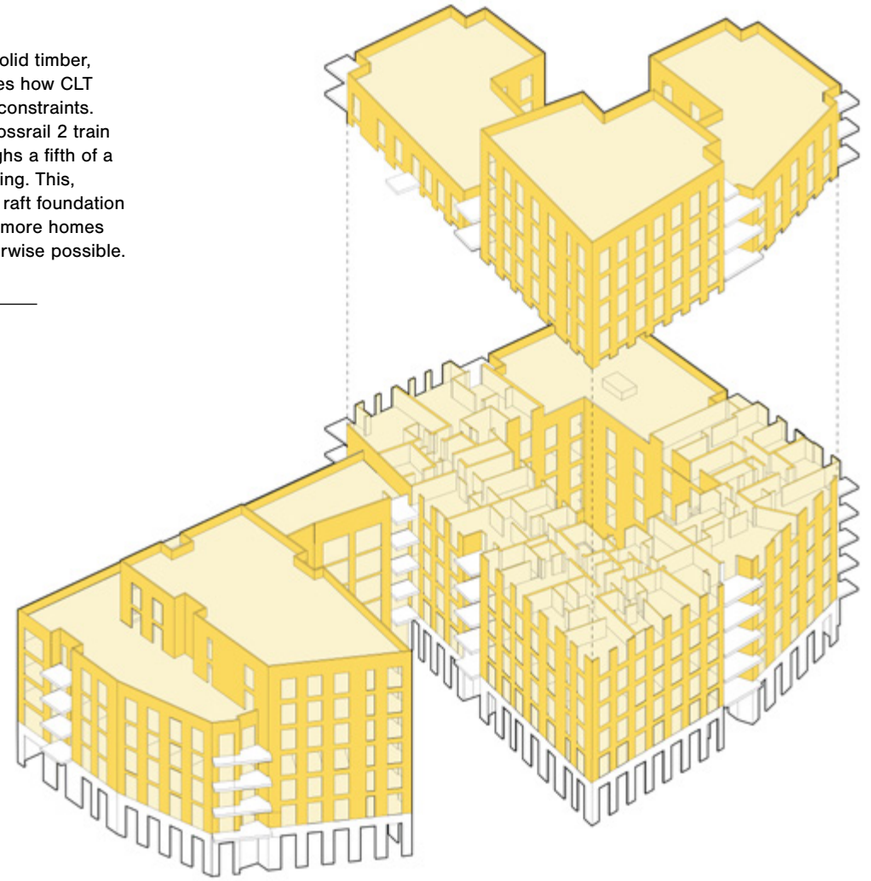
DALSTON WORKS

67-71 Dalston Lane, LB Hackney, London E8
Status: Completed
Date of completion: October 2017
Cost: £24m
Size: 11,900 sqm
Number of units: 121

Designed as a village within a city, delivering 121 new affordable and private-for-rent homes alongside 3,500 sqm of commercial space, the large site is broken down into discernible volumes, orientated to maximise daylight to courtyards and living spaces. The building's intricate brickwork references the surrounding period housing and the detailing of local warehouses, providing a contemporary addition to the local streetscape.

Conceived of and built in solid timber, Dalston Works demonstrates how CLT can help to overcome site constraints. Built over the proposed Crossrail 2 train line, the CLT structure weighs a fifth of a comparable concrete building. This, combined with the minimal raft foundation enabled the building of 35 more homes than would have been otherwise possible.

Client: Regal London
Architect: Waugh Thistleton Architects
Structural Engineer: PJCE
Timber Engineer: Ramboll
Timber Manufacturer: Binderholz
Timber Contractor: B&K Structures
M&E /Sustainability Engineer: XCO2
Planning Consultant: CMA
Contractor: Regal Homes
Planning Consultant: CMA Planning



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Medium-rise

KOGGENS GRÄND

Koggens Gränd 3, Malmö, Sweden, 21113
Status: Completed
Date of completion: June 2012
Cost: approx. £9.9m
Size: 44 sqm to 123 sqm per unit
Number of units: 31

Malmö's West Harbour district, one of Europe's first neighbourhoods to reinvent itself through sustainability-led regeneration, was the perfect testbed for Koggens Gränd. The scheme was an opportunity to implement new concepts, energy systems and construction technologies drawn from White Research Lab's experimentation and spur progress in the Swedish housing market. Shortening the construction schedule, the building uses a pre-cast concrete framing system and floor slabs with a pre-fabricated external facade of a multi-layer sandwich panel. Despite the high level of offsite-manufactured building components, an unconventional design language was achieved by stacking varying storey heights on top of each other. The apartment layouts offer full flexibility, except for the bathroom modules as the only fixed element; owners can alter plan arrangements and create mezzanine levels within some of the homes.

Architect, Client & General Contractor:
White Arkitekter AB

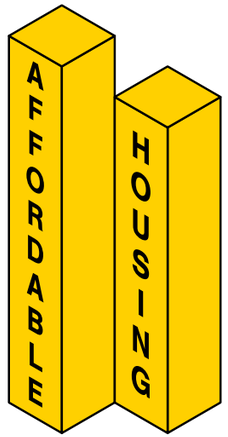
COCKWISE FROM TOP LEFT

Construction render of Narrow Gauge Modular Housing by Cousins & Cousins

Module construction at Watts Grove by Waugh Thistleton Architects

Murray Grove (1999) by Cartwright Pickard

Murray Grove under construction (1999) by Cartwright Pickard



Delivering genuinely affordable housing is one of the most critically important issues for London, and has become a key tenet of the Mayor's Housing Strategy, which outlines a target of 35 per cent of such housing for the capital, along with an aspiration for 50 per cent. The potential of modern manufactured elements to speed up the process and pace of construction and delivery has thus generated much interest as a potential answer to the housing crisis, but is not new. In 1999, Cartwright Pickard's ground-breaking Murray Grove scheme in Hackney for Peabody – comprising 30 homes for keyworkers – was the first of its kind to use innovative steel framed modules (manufactured in the UK by Yorkon) to improve quality and to radically reduce build times. Today, attention is moving towards development of affordable housing in outer London, which has capacity for 55 per cent of London's new homes, according to the Strategic Housing Land Availability Assessment (SHLAA) in 2017. In Barking and Dagenham, faced with the challenge of delivering housing at scale, BeFirst's head of affordable housing, Jenny Coombs, told an NLA roundtable in 2018 that the authority is keen to make offsite its favoured method. Standardisation, she also noted, could bring certainty for the delivery of affordable housing by enabling local authorities and housing associations to navigate and select appropriately from the complexity of options available. Many also regard viability as the key challenge still to be overcome: the volume and scale of delivery need to increase exponentially in order to bring down costs to the level where offsite construction makes housing for affordable private sale, shared ownership and rent substantially cheaper to build.

It is evident, however, that new models of development and delivery, and closer collaborations between housing associations, local authorities, the GLA and the private sector, are starting to exploit the advantages that manufacturing processes can bring in helping to increase the supply of high-quality affordable homes. These include, for example, Waugh Thistleton Architects' and Swan Housing's partnership on projects such as Watts Grove, among others, and the discounted sale type of tenure created by developer Pocket Living. The Pocket tenure, aimed at younger 'city makers', as the firm describes them, specifies that buyers must be first-time purchasers, live or work in the local authority, and earn moderate annual incomes. The company has also announced collaborations with housing associations such as Optivo, most recently on a scheme of shared ownership and one-bedroom flats at Addiscombe Grove, Croydon, where the proportion of affordable homes has reportedly been increased from just 12 per cent to 100 per cent. Exemplars further afield can also provide useful models that could potentially be adapted for building in London and elsewhere, such as Gomos Housing in Portugal, which primarily uses precast concrete; it could offer a less expensive and more sustainable alternative to other, imported systems and materials.

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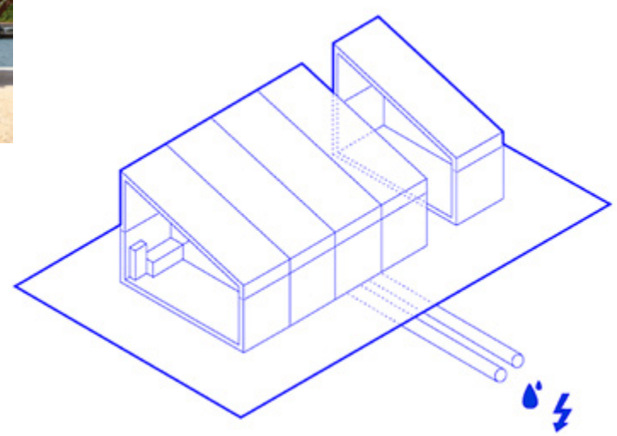


GOMOS HOUSING

Quinta do Cerrado, Lugar de Penso,
Portugal, 4540-188
Status: Completed
Date of completion: September 2015
Cost: €70,000
Size: 80 sqm

Gomos Housing is an affordable prefabrication system which creates housing quickly and efficiently without sacrificing on design. 'Gomos' is a factory-made system, comprising insulated precast concrete units. Individual volumetric modules are fully fitted-out, plumbed, insulated and clad in a factory, then transported to site, and assembled into a variety of arrangements on ground bearing slab foundations. The system can generate various arrangements, in plan and in section, creating either mono-pitched or gabled forms. Alternatively, the units can be staked together in height. Structurally, the individual pre-cast concrete units are formed by a series of rigid tube structures, connected lengthways, providing composite action between the precast elements to enhance strength, stiffness and ductility, leading to rigid behaviour. The units can be unassembled and recycled into modules for transportation. Designed originally as a solution to Portugal's housing crisis, the 'Gomos System' has the potential to address London's affordable housing shortage. According to the Strategic Housing Land Availability Assessment, more than 50 per cent of the capacity for new homes in London is in outer London. These are areas where the land is cheaper and housing is lower density. This solution provides the opportunity to close the existing gap in the offer-demand-ratio and, consequently, lower prices. If adopted in the UK, this design system will give communities the chance to customise their homes by size, layout, energy efficiency and performance. The primary material (precast concrete), is cheap and locally sourced, which is an advantage in comparison to other modular systems with heavy importation costs. Minimizing the environmental impact and increasing the relevance in a post-Brexit economy scenario, Gomos is prefabricated offsite, with materials that have low embodied carbon and are designed to be low energy. Gomos could provide an effective response to London's current and future housing crisis with a system that brings together simplicity and affordability from design stage right through to its construction.

Viewpoint

'There will be a need for approaches using very efficient prefabricated construction, able to respond quickly and effectively in terms of technical quality to an ever-increasing housing demand. The prefabricated elements have managed to integrate the science of prefabricated infrastructure and architecture.'

Alejandro Gastón Aravena Mori, Executive Director, ELEMENTAL S.A.

Architect: Summary
Structural Engineer:
FTS Technical Solutions & Cundall
Prefabrication & Assembly:
Grupo Farcimar
Supply of Building Components: AECA

WATTS GROVE

Gale Street, LB Tower Hamlets, London, E3
Status: Starting on site
Date of completion: July 2019
Size: 6,227 sqm
Number of units: 65

Watts Grove will provide 65 shared ownership and affordable rented apartments on the site of a former electrical substation in Tower Hamlets. Using precision engineering, the homes will be made from sustainably forested CLT. Assembled and fitted out in the factory, the modules will be delivered to site complete with kitchens, bathrooms and windows, leaving the onsite team to add the external cladding and connect the modular homes to services.

Expected to be constructed in 50% less time than a traditional build and at 10% less cost, Watts Grove unlocks a difficult site.

These high quality modular homes are energy efficient and sustainable, and yet can be indistinguishable from traditionally built homes. However, unlike a traditionally built block, the structure of Watts Grove will be made using 2,350 metres cubed of CLT, which will lock away 1,857 tonnes of CO2. The building itself will be a long term carbon store.

Using Watts Grove as a testbed, Waugh Thistleton Architects are collaborating with Swan to develop a design guide to ensure that the benefits of CLT modular construction are at the heart of every Swan design.

Designing for modular requires the team to adopt a different approach to traditional building design. Whereas a design and build contract allows the contractor to complete the design, resulting in changes and cost savings during the construction phase, offsite modular construction requires consideration of how each module is made, transported and installed at every stage of the design development. Information for manufacture needs to be fully coordinated before fabrication begins which means that the quality and accuracy achieved by the design team far exceeds that produced for a typical design and build contract. The guide sets out the considerations for designing modular housing based on the NU build modular CLT fabrication system. The purpose is not to standardise homes, but to take on board the implications of manufacture on the design process in order that the advantages of offsite manufacture are fully realised.

Viewpoint

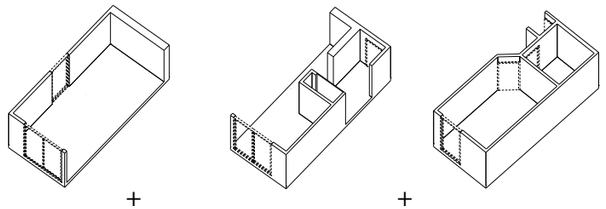
‘With our partners, we are delivering on our ambitions to bring much needed affordable homes to the London Borough of Tower Hamlets. Watts Grove has been a really interesting project for us. By using our new offsite modular housing factory, we will build modern, high quality, 100 per cent affordable homes faster, more sustainably and with less disruption to residents. Modular construction has unlocked this long vacant site, setting a new standard for affordable housing in London and allowed us to develop the UK’s first ever mid-rise CLT modular scheme.’

Geoff Pearce, Executive Director of Regeneration and Development, Swan Housing Association

Architect: Waugh Thistleton Architects
Client: Swan Housing
MEP Engineer: MWL
Superstructure Engineer: Ramboll
Substructure Engineer: PGCS
Landscape Architect: LLA
Principle Designer: CSUK
Planning Consultant: RPS Group
Main Contractor: NU living

AMODULAR

Sugden Way, LB Barking, London, IG 11
Status: Planning pending
Date of completion: April 2019
Size: 155,763 sqm
Number of units: 13



amodular is a volumetric modular housing system which allows councils to procure and build their own affordable housing at a full turnkey. Sold at a price per sq ft, councils can commission housing depending on available sites and budgets, with the possibility to be paid back on a lease basis. The modular housing kit of parts (patent pending) is based upon the creation of a flexible housing solution with a minimum number of variables that maximises standardisation within the factory. The offsite system halves programme time and reduced on-site construction time by over 75 per cent, reducing disruption to local communities. The councils benefit from the development uplift on the land price, enabling the construction of further affordable homes within London.

Architect: astudio
Manufacturer & Installer: Rollalong
Planning Consultant: DLP Planning Ltd
M&E Engineer: Thornton Reynolds
Structural Engineer: Heyne Tillett Steel
Fire: Astute Fire
Acoustic Consultant: MACH Acoustics
Transport: Markides Associates
Access: About Access Ltd.

NARROW GAUGE

Prototype
Status: Design stage
Size: from 55 sqm (one-bed)
to 106 sqm (three-bed)

Each home is formed by joining standardised modules to create dwellings that conform to the GLA's housing standards and are suitable for use as social or affordable rented accommodation. Structural integrity is provided by Structural Insulated Panels, sealed to deliver Passivhaus-standard insulation and air-tightness. Larger module dimensions are used in the majority of modular housing systems, causing logistical issues. This narrow gauge system uses smaller modules, designed to the international standard shipping container grid, which can easily and efficiently be transported by road, rail and sea. Narrower modules are also appropriate for tight sites with limited access; a perfect solution for addressing housing requirements in cities like London, which have narrower infrastructure and a requirement for high density projects on infill sites.

Client & Management Contractor:
Campus 360
Architect: Cousins & Cousins Architects

MODOMO

Prototype
Status: Design stage

Leveraging on collaborations with leading pre-fabricated housing manufacturers, Modomo offers best in class solutions to address the substantial and diverging supply-demand gap prevalent across London's affordable housing landscape. Founded by industry leaders, this platform partners with institutional and public landowners to unlock the potential of underutilised land and incorporates a flexible, sustainable approach to address a social problem.

Key Characteristics:

Sustainable – units are manufactured from sustainably sourced, almost entirely natural materials limit footprint

Plug & Play – installation can be in a matter of hours, and units can be re-purposed with minimal impact to the land

Stackable – can be stacked up to seven storeys (or higher upon request), and can be infinitely connected horizontally

Customisable – interior and exterior can be highly customisable to suit requirements

Founding Partners: Round Hill Capital and G3 Spaces
Product Partner: Finch Buildings

SMART LIVING

Prototype
Status: Design stage

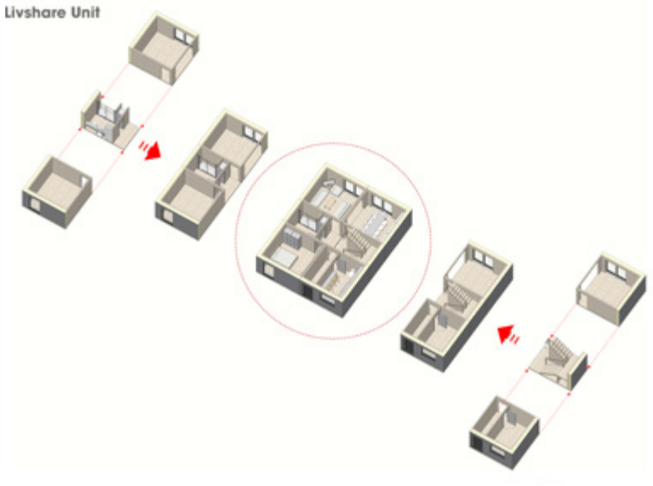
SMART LIVING provide local councils and housing associations with a fast, cost effective and sustainable solution to help increase the supply of both public and private sector housing. Constructed in a factory-controlled environment, Smart Homes are designed for portability and easy transportation, with an adaptability for various configurations and therefore can provide tailor made solutions for each site or application. They have the flexibility to serve as temporary structures, allowing them to be reused or reconfigured for alternative locations.

Client: SMART LIVING
Architect: Cityzen Design
Procurement of Land: Anthony Browne of Chelsea Consultants

LIVSHARE

Prototype
Status: Design stage

Livshare uses prefabricated bedroom and bathroom modules to create large five to nine-bedroom townhouses. The concept shows how sharing larger homes and communal facilities can provide higher living standards, more amenity space and dignity for people living in affordable homes than the conventional strategy of small dedicated facilities. These affordable homes can occupy gap sites in high-value areas normally only afforded by larger, wealthier households. Prefabricated CLT volumetric modules are manufactured offsite in a factory and craned into place in a matter of hours on pre-prepared foundations. The floorplans are optimised for factory assembly, showing how a Georgian or Victorian-era townhouse can be created using offsite construction. Each room has its own heavy-duty exposed laminated timber floor and ceiling, reducing structure-borne noise transmission.



Architect: ZEDfactory Europe Limited

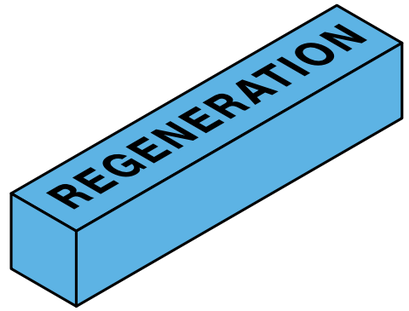
ZEDPODS

Prototype
Status: Completed
Date of completion: March 2018
Size: 38 sqm

A capacity study conducted by ZEDfactory shows that approximately 70,000 space standard compliant zero carbon ZEDpod urban system homes can be created over existing public car parks, at the same time as upgrading them with EV charge points to reduce air pollution. This effectively decouples the cost of building key worker homes from the cost of purchasing land and does not use up any land already allocated to housing.

Prefabricated CLT volumetric modules are manufactured offsite in a factory and craned into place in a matter of hours on pre-prepared foundations. The ZEDpods are mortgageable provided, they are installed on long leases, and they can also be relocated with near zero waste if car park owners wish to develop their land in future.

Client: ZEDpods Ltd.
Architect: ZEDfactory Europe Ltd.
Structural Engineer: Smith & Wallwork



COCKWISE FROM TOP LEFT

PLACE / Ladywell (2016) in partnership with Lewisham Council, AECOM and SIG Build

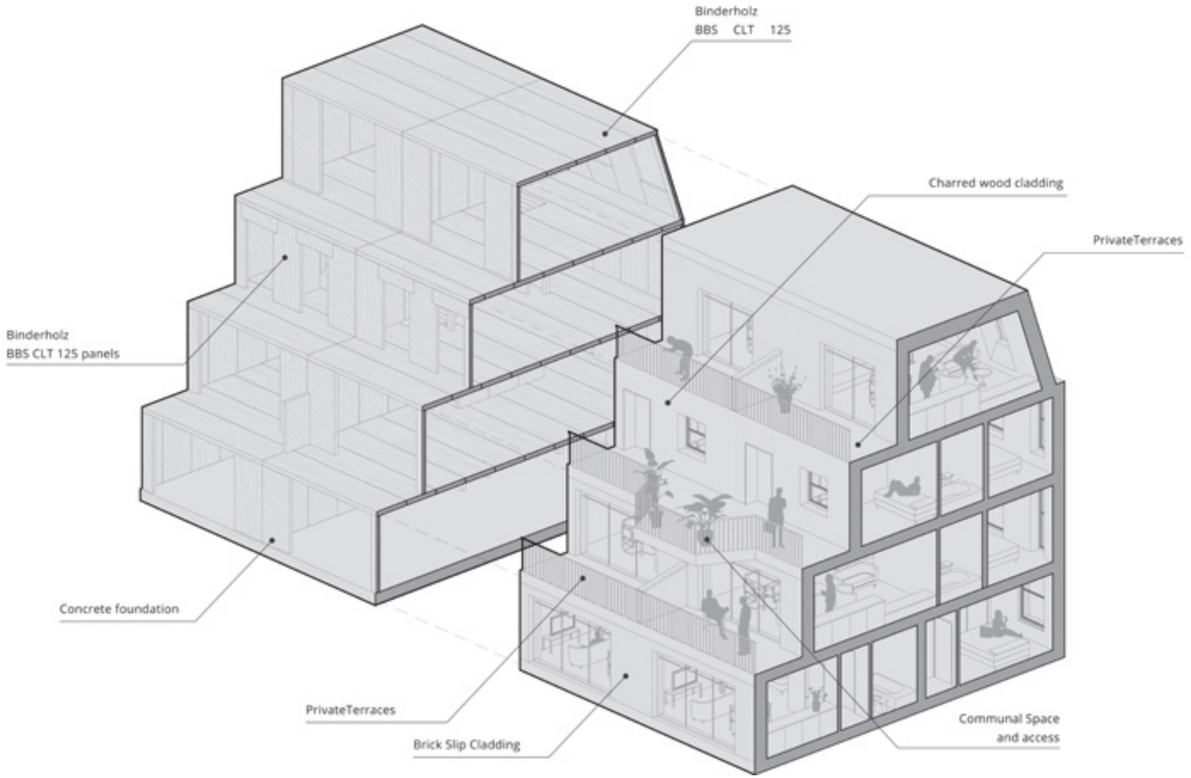
William Street Quarter by AHMM

Beechwood West by Pollard Thomas Edwards

Greenford by HTA Design LLP and Greystar

Factory-made housing can provide innovative and high-quality temporary as well as permanent solutions to urgent housing need in areas undergoing long-term regeneration and/or for brownfield sites. The Y:Cube project designed by Rogers Stirk Harbour + Partners for YMCA London South West in Mitcham, completed in 2015, is a pioneering example of affordable housing comprising self-contained factory-made units with services already incorporated, that can be taken down and reconstructed in other locations, and to which additional units could be added. The architects followed this with their scheme PLACE / Ladywell (2016) in partnership with Lewisham Council, AECOM and SIG Build. This uses volumetric timber construction for two-bedroom apartments for families in temporary accommodation, combined with ground-floor spaces for community and business use. Again, the intention is to redeploy the project on other council-owned sites once the final masterplan around its current location has been agreed. The new not-for-profit company PLACE Ltd (Pan-London Accommodation Collaborative Enterprise) represents an innovative collaboration among London local authorities to acquire modular temporary accommodation in a move to tackle the pressing issue of homelessness. Funded in part by the GLA and London Councils, it seeks to procure and deliver 200 high-quality homes, meeting the London Plan space standards, on ‘meanwhile’ sites across London, with the first on site planned for 2021.

Factory-made housing is now coming to the fore as a solution for wider regeneration in and around London. The William Street Quarter in Barking, for example, designed by Allford Hall Monaghan Morris – the first social housing scheme in the UK built totally with private funding – features a central 10-storey tower with a structure, floors, cladding and balconies all fabricated offsite. Manufactured homes can also support the aims of estate regeneration to improve quality and minimise disruption for existing residents, for example at bptw partnership’s Beechwood North project on the Craylands Estate in Basildon, where volumetric units developed with Nu living will create new homes on infill and garage sites. Other schemes show the potential for factory-made homes to unlock the regeneration of town centres, such as Swan’s collaboration with architects Pollard Thomas Edwards and C. F. Møller at Laindon, where new homes using offsite methods will be delivered alongside new facilities including retail spaces and a health centre. A similar approach is being applied in Greystar’s new mixed-use canalside neighbourhood on a derelict 20-acre site in Greenford, which will be one of the UK’s largest purpose-designed build-to-rent schemes incorporating modular homes in a variety of types across seven main buildings alongside gardens and other amenities. Pioneering international whole-house refurbishment using factory fabrication, developed in the Netherlands, and now being applied in a pilot programme in Nottingham, shows the potential for using innovative net zero energy approaches to not only improve environmental performance but also to drastically reduce household energy bills in existing buildings.



SOUTH HARROW PLACE (PHASE 1)

South Hill Avenue, LB Harrow,
London, HA2
Status: Design stage
Cost: £11.5 m
Size: 3680 sqm
Number of units: 41

Creating a design solution to solve a range of challenges that could not be overcome with conventional design and construction techniques, this concept shows how a difficult site can be unlocked by adopting precision manufactured housing. TfL appointed EVA Studio to rethink how transport oriented development could be delivered at South Harrow Place – a site that consists of a TfL car park adjacent to South Harrow Station – ultimately leading to a design solution which enables faster delivery, higher build quality, and a scheme which is economically viable under 100 per cent affordable tenure.

Addressing the transport interface has been a key challenge, but ultimately led to a scheme concept which is deeply embedded in the local community. A required three metre wide service corridor along the tracks created an opportunity to establish a step-free pedestrian route to and from the tube station. This landscaped corridor forms an integral part of the proposed new public realm, with the original 1920s station platform building proposed for conversion into a café and community centre.

Comprised of three blocks, a range of housing typologies establish a new frontage, thus rebuilding the fabric of the street. The housing modules frame an intimate public plaza in front of the historic platform building which is opened up to the community through a large arch and staircase. Local vernacular informs both the aesthetics and the construction of the buildings; all modules have been based on the concept of load-bearing outer walls with a five metre span. These proportions, typical of British brick and joist houses, offer total internal flexibility and ease of construction, while providing generous interior space and storage.

Walls, floors and ceilings are entirely constructed out of CLT, with dimensions optimised for manufacture using Binderholz's BBS 125 CLT panel. Being more sustainable and cost effective than brick or concrete, CLT can be precisely prefabricated and flat-packed for delivery within six weeks. The construction programme is similarly minimized and the building can be ready for occupancy within six months from construction start.

Through these approaches and innovations, South Harrow Place would solve previously irresolvable challenges to provide 41 new affordable homes and a vital public realm where new and existing residents can meaningfully engage – ultimately creating a new archetype for community-focused suburban densification.

Client: TfL Property Development
Architect: EVA Studio
CLT Manufacturer: Binderholz
Cost Consultant: Alinea
Engineer: Mott MacDonald

Viewpoint

'TfL has been tasked with an ambitious programme for housing delivery: by March 2021, we will have started on sites which will deliver 10,000 new homes. To provide the thousands of homes that London needs, we must look to unlock complex, challenging sites which are sometimes impossible to deliver using conventional methods of construction. South Harrow is one such case.

This design by EVA Studio represents a fresh approach – one that tackles the site's unique constraints by applying modern methods of construction to the London design context. The concept makes clear that MMC is not incompatible with creativity in architecture; indeed, it can provide new and novel design solutions to longstanding barriers to housing delivery. We are delighted with the team's concept, which we hope will inspire further innovation across the industry.'

Derek Wilson, Senior Sustainable Development Manager, Transport for London Property Development

GREENFORD (PHASE 1)

Greenford Road, LB Ealing, London, UB6
Status: Under construction
Date of completion: February 2020
Cost: £100m
Size: 45,000 sqm
Number of units: 379

Greenford is the UK's first 'multifamily' Build to Rent development. This modern, canalside neighbourhood in Ealing comprises around 2,000 new homes, approximately 75 per cent of which will be purpose-designed and built for rent within a wider mixed-use neighbourhood. The development will include a range of apartment sizes, shared resident amenities, retail and commercial spaces, and on-site services. Greystar will retain ownership of the site and will manage the facilities via an on-site team. The 379 apartments are to be built using factory-made modular construction, and four further rental buildings totalling over 1,000 homes have been designed to allow a similar method to be adopted. A modular approach provides a range of benefits, including: up to 50 per cent less time on site, allowing earlier completion and lease-up of new homes; quality control, as most fit-out works are completed offsite, minimising on-site snagging and defects, and making maintenance more efficient; design efficiencies, such as slender party wall construction that achieves full acoustic separation resulting in enhanced area, and additional units within large buildings; cost certainty, a stable supply chain, and reduced dependence upon site-based labour; and a positive impact on placemaking, such as an 80 per cent reduction in site deliveries, with less noise and dust, creating a better place for early residents and the surrounding community.

Modules for Greenford are being constructed in a factory in Bedford which generates 80 per cent less materials waste and provides a stable environment for the local workforce. Once the foundations, ground floor and podium structure are complete, the modules will be delivered to site with the mechanical and electrical fittings, kitchens, bathrooms, decorations and windows already installed. The build programme is just 12 months, from construction starting to the first residents moving in – the entire project to be completed in approximately seven years. Greenford is the first Build-to-Rent project that Greystar and Tide Construction are delivering via modular construction and it will bring the total number of units the partnership has delivered in London so far to 1,600 units. Without a doubt, modular will play a central role in the future of residential construction.

Viewpoint

'We have an amazing opportunity to revitalise this previously neglected site in Greenford to create a new mixed-use canalside neighbourhood which is strong and inclusive, with placemaking at its heart. By embracing the numerous benefits of factory-made modular construction, we can do this more quickly, more efficiently and with less impact on the local area than by using traditional construction methods. As a leading Build to Rent developer and operator, our objective of delivering a successful long-term, rental-led community means that we welcome the quality, reliability and improved environmental impact that a modular solution can provide.'

James Pargeter, Senior Director, Projects, Greystar

Client: Greystar
Professional Team (masterplan / sitewide)
Architect: HTA Design LLP (lead), supported by Hawkins\Brown, SLCE Architects, Mae, Flanagan Lawrence
Engineer: Meinhardt
Planning Consultant: Iceni Projects
Cost Consultant: Alinea
Landscape Architect: HTA Design LLP
Employer's Agent: TowerEight
Retail Consultant: CF Commercial
Main Contractor (Phase 1): Tide Construction
Modular Supplier (Phase 1):
Vision Modular Systems
Demolition: R Collard
Infrastructure: Galldris
Energy Centre: E.on

© Tide Construction

GATESHEAD INNOVATION VILLAGE

Acacia Road, Gateshead, NE10
Status: Under construction
Date of completion: March 2019
Cost: £7.5m
Size: 3,613 sqm
Number of units: 41

Gateshead Innovation Village (GIV) is a live research project that is looking to identify dynamic new construction solutions and offer the sector greater confidence in using modern methods of construction at scale, challenging public perceptions and enabling affordable housing to be delivered at pace. GIV creates 41 homes - 16 volumetric houses and 19 modular houses, alongside six traditional houses. Three different styles will be built, using a range of traditional and modular construction methods to robustly compare and contrast the performance of traditional construction against different modular methods. Home Group undertook a market assessment using three key criteria; design flexibility, affordability and 'mortgageability' to select the five key suppliers.

A streamlined vision has been guaranteed through a strong approach to placemaking, ensuring this site does not look like a test-pilot and that it is not possible to discern the construction method. This project is not just about comparing construction methods to come out with the cheapest or fastest product; it is about finding products which best fit particular sites, markets and situations and can be delivered at scale.

Issues include the interface between groundworks contractor and modular supplier; ensuring visual consistency through detailed specification; and rethinking phasing and being able to respond quickly to deliver a unique scheme at pace. Speed and efficiency of construction methods is one of the biggest areas of impact from the research for the London market. Viability is often a challenge when trying to achieve high quality affordable housing; suppliers have been challenged to meet targets both in terms of cost and programme. This will be carefully evaluated at the end of the project. Tolerances are virtually non-existent which is an initial challenge for contractors but makes for a better end product. Variation and consistency will be recorded to support learnings. This will give Home Group the confidence to deliver much-needed affordable housing faster.

Viewpoint

'I would describe the process as a journey of learning and endeavor. Journeys can be described as 'A to B'; in comparison to traditional schemes this was very much 'B to A' at times. We invested significantly more time upfront interviewing suppliers and understanding limitations; pushing suppliers beyond their comfort zones; establishing how far they could flex on design; U-values and accommodation of complex systems, all before design started. We set the site design and methodology so six constructions and four heating strategies can be reviewed comparatively. Despite time and cost pressures, we are maintaining intent and integrity without compromise.'

Craig Kaminsky, Quality Assurance Manager, Home Group

Developer & Housing Association: Home Group
Grant Funding: Homes England
Contractor: Engie
Local Authority: Gateshead Council
Architect: ID Partnership
Quantity Surveyor: Elliot Associates
Engineer: Fairhurst
Supplier: Icarus, ilke Homes, Xella UK, Extreme Low Energy, Loxone, Nest, Storm Tempest, Wondrwall

BEECHWOOD WEST

Beechwood West, Basildon, Essex, SS14
Status: Under construction
Date of completion: 2022
Size: 68,900 sqm
Number of units: 251

Responding to the government's new custom and self-build initiatives, this scheme creates 251 customisable modular homes at Beechwood West as part of the regeneration of the Craylands Estate in Basildon.

The homes will be pre-constructed out of CLT modules in a factory close to the site, providing a highly controlled finish, extensive environmental benefits and a reduced timescale from purchase to moving in. Buyers use an online configurator to choose their plot and select a plan type (open or cellular, adding additional rooms) and external materials (brick colours, tile cladding), plus specify appliances, sanitaryware, cupboards and floor finishes; amounting to more than a million different combinations. This gives customers the chance to design a home relevant to them, and contribute positively to the suburban phenomenon of individualisation; yet maintaining cost effectiveness through volumetric production. Their unique technical information can then be instantly sent to the production line.

The fully-fitted modules are transported to site, erected and connected to services. All mechanical and electrical equipment to power, heat and light the homes is contained within the loft module for each house. The final building is clad in-situ creating a seamless finish and a final appearance which can be controlled depending on the context of the site.

Through the use of prefabrication, the manufacturing environment is sheltered from the unpredictable British climate, and is more accessible and safer than a building site. Here, supply chains are easier to manage and Swan Housing Association have been able to utilise local labour skills.

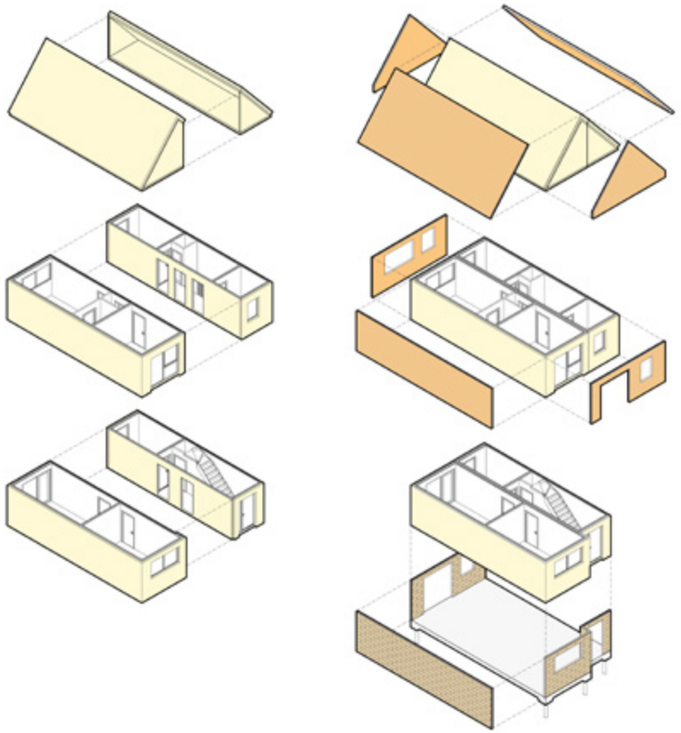
The success of Beechwood West has encouraged Swan to develop the technology for larger, multiple-storey buildings, such as the Laindon Centre. These projects have a number of lessons for increasing housing supply, especially in outer London boroughs where resistance to development is greater. This is not a 'one-look-fits-all' approach, but combines 21st century technology with an appearance which is responsive to regional vernacular.

Viewpoint

'At Beechwood, working with our partners, we are committed to delivering modern, high-quality homes that people want to live in, as well as creating a sustainable, mixed tenure community. Swan is an innovative organisation and we are using offsite manufacturing to not only deliver high-quality regeneration but also to give buyers the opportunity to customise their own home. This approach sets schemes like Beechwood apart, pushing the bar higher whilst delivering better quality homes for residents. I am convinced that offsite will enable us to deliver more high-quality homes, more quickly, to help meet the growing demand.'

Geoff Pearce, Executive Director of Regeneration and Development, Swan Housing Association

Client: Swan Housing
Architect: Pollard Thomas Edwards
Structural, Sustainability and M&E Engineer: Ramboll
Main Contractor: NU living



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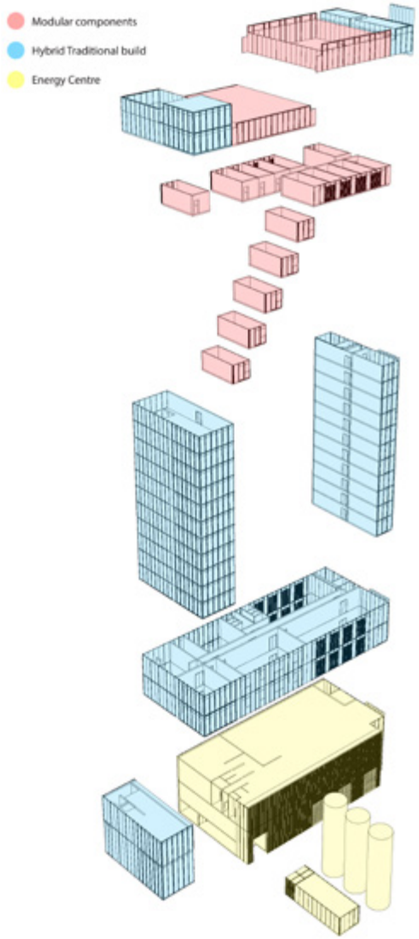
BEECHWOOD NORTH

Beechwood Village (formerly Craylands Estate), Essex, SS14
Status: Planning granted
Date of completion: December 2021
Size: 8,320 sqm
Number of units: 96 homes

Beechwood North will utilise factory made houses to deliver new homes on infill sites across the Craylands Estate. The scheme will replace existing poor quality maisonette blocks and associated garages with factory made houses. The new dwellings are being developed with Nu build's in-house construction and factory manufacturing team. Four simple house types, manufactured using CLT at the Nu build factory in Basildon, will be delivered as full volumetric units. This process will improve quality, speed up construction and minimise the disruption for the existing residents. Across London, numerous small and infill site programmes would benefit from applying this type of factory-made housing to speed up delivery, reduce construction cost and minimise disruption to local residents.

Client: Swan Housing
Architect: bptw partnership
Contractor: NU living
Planning Consultant: Iceni
Landscape Architect: Outerspace



THE POWER STATION, POOLE ROAD

2A Riverside House, Woking, SE1
Status: Planning pending
Date of completion: September 2020
Cost: £43m
Size: 3,195 sqm
How many units: 204

This hybrid modular co-living prototype comprises of a two-storey energy centre, two floors of intermediate communal space for the co-living accommodation on the second and third floor, 12 floors of accommodation, plus conference space, plant space and a terrace at roof level. The localised Energy Centre CHP which forms part of the scheme provides combined heat and power to a number of residential schemes in Woking. A prototype for both co-living design and modular construction, The Power Station acts as a test bed for the future of young professionals living and working in the same place - a prototype for the digital community of the future.

Client: Thameswey Development Group
Architect: Broadway Malyan

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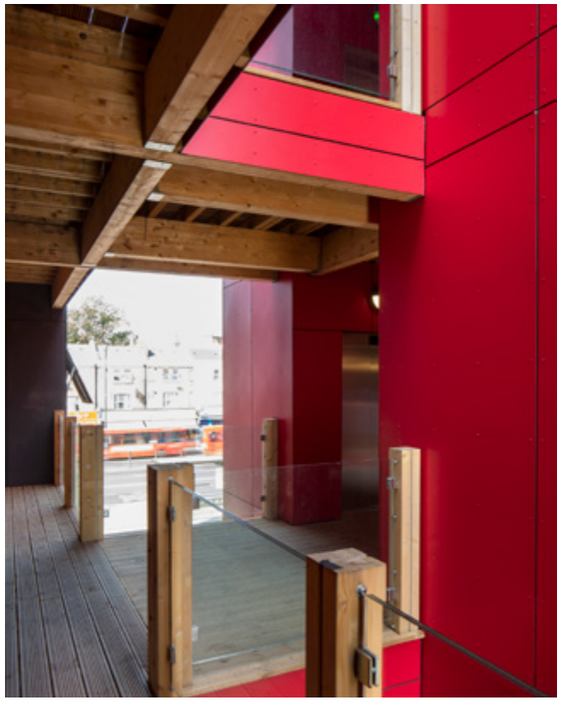


PLACE / LADYWELL

261 Lewisham High Street,
London, SE13
Status: Completed
Date of completion: September 2016
Cost: £1200 per sqm
Size: 2990 sqm
Number of units: 64

PLACE / Ladywell was the result of RSHP's partnership with Lewisham Council, AECOM and SIG Build, to create a deployable residential development using a volumetric construction method on the site of the former Ladywell Leisure Centre, which was demolished in 2014 and left vacant pending redevelopment.

The 24 two-bedroom apartments for families in temporary accommodation, and four ground-floor non-residential units for community and business use, were manufactured from standard timber components, and constructed as 64 fully fitted-out units - complete with bathroom, kitchen, flooring and interior finishes – in a factory in Nottinghamshire.

Each unit took approximately one month to be completed in the factory, and the construction team could install a full floor (16 units) in a single week. From preparatory ground works to practical completion the construction programme was nine months. Site preparation was faster than a traditional development since the lightweight timber modules did not require deep foundations and no ground slabs were required to be constructed on site; instead, modules were sited on foundations directly and then lifted in by crane. External circulation areas and precast concrete lift/stair cores were manufactured and installed on-site as separate components and connected between the units and the core. The entire module was covered in a waterproof and impact-resistant membrane.

Each of the two-bedroom flats has exceeded London space standards by 10 per cent, with floor to ceiling heights of 2.6 metres and full-height windows. Each unit has a large balcony and storage area and two layers of sound-proofing between flats, resulting in acoustics which are 60 per cent above regulations and energy consumption which is 40 per cent less than traditional buildings.

This approach has provided many benefits. The factory environment which ensured that there was 0 per cent waste, compared with 15 per cent for a traditional build. The site became a delivery point rather than a construction site, minimising the negative impact on local people and amenities. The programme was significantly reduced resulting in lower construction costs - a key factor in the viability of the project for the council. It has allowed for greater client flexibility, creating spacious and affordable homes for its residents, while addressing important social issues.

PLACE / Ladywell will remain on site while a wider masterplan for the area is agreed and implemented. After this time, the scheme can be redeployed on other Council sites up to five times and with a design life of up to 60 years. It is a permanent solution for a temporary location.

Viewpoint

'We are very proud of Lewisham's award-winning pop-up village for homeless families, PLACE / Ladywell, which provides vital homes for local families in desperate need. The design helped us build these much-needed homes quickly and cost efficiently. We are pleased to be working with Rogers Stirk Harbour + Partners, in collaboration with AECOM, on three further projects.'

Damien Egan, Mayor of Lewisham

Client: London Borough of Lewisham
Architect: Rogers Stirk Harbour + Partners
Consultant: AECOM
Contractor: SIG Build

PARK | RIDE

Prototype
Status: Design stage

‘PARK | RIDE’ is a derivative of the typology deployed at PLACE/Ladywell, and is aimed at a specific type of marginal opportunity site.

PLACE/Ladywell takes advantage of volumetric, factory manufactured construction techniques to build high quality housing for a short programme and for reduced costs. The 24 two-bedroom apartments and four community/retail units were constructed in a factory as 64 fully fitted out units, before being transported by road to site and lifted into place. This offsite manufacture approach provides several advantages. The programme is significantly reduced resulting in lower construction costs, a key factor in the viability of the project for the council. Waste is minimised, and in addition to the use of timber as the primary construction material, the building is far more sustainable than a traditional building. It allows for greater client flexibility, creating spacious and affordable homes for its residents whilst addressing important social issues.

In June 2017 Studio B+W carried out a pilot study for new housing in North Kensington, as a response to the Grenfell Fire as a contribution to an initiative by West London Architects, the RIBA branch which represents Architects of West London.

The design provides up to 27 new units of varying sizes on an underused site. The apartments are planned on three floors over existing parking, with minimal disruption to the carpark arrangement below. RSHP provided their expertise in offsite construction, selected to minimise disruption to residents, and to shorten the construction programme at no additional cost relative to traditional construction. The designs address the constraints typical of such sites, with narrow plot format and changes in alignment. The concept has been developed as PARK | RIDE, a solution to the many similar underused marginal sites to be found alongside railways, underused garages, carparks, etc. It demonstrates how this specialised variant of the modular housing concept can be deployed to utilise marginal and underused sites throughout London.

Viewpoint

‘The project arose from our desire to contribute after the Grenfell Fire. Working with RSHP, we were able to develop a pilot study design which could be erected quickly, with minimal disruption to residents and to the existing parking on site. It soon became apparent that the concepts developed for a specific site in the area could contribute to London’s need for more housing, soon, and we were able to join with RSHP in developing the PARK | RIDE concept, adaptable to the wide variety of narrow linear sites to be found alongside transport routes or other similar underutilised sites.’

Allan Baird, Director, Studio B+W Ltd

Client: West London Architects
Architect: Rogers Stirk Harbour + Partners and Studio B+W Ltd
Engineer: AECOM

CROYDON INFILL

Croydon, London, SE25
Status: Under construction
Date of completion: October 2019
Cost: £9.4m (all sites)
Size: 600-1500 sqm (sites vary)
Number units: 9-19 units (sites vary)

Brick by Brick's Smaller Sites Programme for London Borough Croydon is delivering over 1,000 new homes on council owned infill land. In April 2017, five sites received planning permissions, of which four now have started on site.

A key aim was to leverage the scale of development across the programme to introduce offsite manufacturing benefits to small individual sites. The sites are of differing size, presenting the challenge of coupling unique design solutions on the difficult sites with the intrinsic benefits of offsite construction.

The restricted site access led to the adoption of a pre-fabricated timber panel methodology. This approach ensures: manageable pre-fabricated unit sizes that can be efficiently transported and assembled on site; adaptability in design, when the prospect of a repeated standardised solution is low; a familiar construction technique that allows a wider base of tender interest; a high level of thermal efficiency in a building envelope that reaches weathertight stage faster than traditional construction.

The timber SIP construction is formed from two OSB sheets adhered to an EPS foam insulation core. Thicknesses vary to meet thermal performance targets, and panel build-up leads to high thermal and air tightness efficiencies and structural performance. SIP panels are manufactured using CNC processing which increases accuracy, reduces wastage and allows bespoke elements. Time spent in early stage design coordination is compensated by reduced time on site and earlier completion. The SIPs can be manufactured in parallel with site preparation, reducing overall construction times. Variations in panel size and shape are accommodated in the manufacturing process, allowing flexibility in design. Build programming is more reliable as assembly and connection interfaces are designed prior to implementation on site. M&E coordination means factory fitted service penetrations and service zones can be incorporated.

The Croydon Smaller Sites programme demonstrates small infill developments can make a meaningful contribution to the delivery of housing in London, in addition large regeneration schemes. The projects show that pre-fabricated timber panel systems are a viable means of bringing the benefits of offsite manufacturing to small constrained sites which are inevitably low rise and difficult to develop.

Viewpoint

'These projects are part of the wider Brick by Brick smaller sites programme which will yield over 1,000 new homes accross 50 sites. The key challenge was to make the smaller sites viable and deliverable while maintaining the individual characters and the design quality we aspired to.
A detailed study of offsite construction methods across our programme found the most deliverable form to be panelised timber frame. It allows efficiencies to the schemes within the concealed fabric, and was a technology that most contractors can work with, allowing us to competitively tender the project.'

Chloë Phelps, Head of Design, Brick by Brick

Architect: Stitch Architects
Developer: Brick by Brick
Contractor: Osborne Homes
Timber Frame Manufacturer: Innovare
Civil & Structural Engineer: GSP Hove
M&E Design: IWA
M&E Dontractor: Baystar

LAINDON PLACE

High Street, Laindon, Essex, SS15
Status: Starting on site
Date of completion: December 2022
Cost: £54m
Size: 109,900 sqm
Number of units: 224 homes,
71,069 sq ft commercial units

This landmark scheme will create a new, mixed-use town centre for Laindon. A new high street includes flexible retail spaces, a re-provided health centre, supermarket, office for Swan and 224 new homes, to be constructed using a range of materials including modern offsite construction methods. These homes will be built in Swan's new £3m factory in Basildon, by its in-house construction team, NU Living, using CLT. They are built and fitted out in the factory before being transported on lorries to the development site, where they will be clad and roofed and, once complete, will be indistinguishable from traditionally built homes. Swan is reducing production time by 50 per cent, reducing defects, increasing quality and delivering greener, more sustainable homes, plus expecting to see a minimum 10 per cent reduction in costs initially, with up to 90 per cent reduction on waste compared to a traditional building site. The off-cuts of CLT will be used to heat and power the factory.

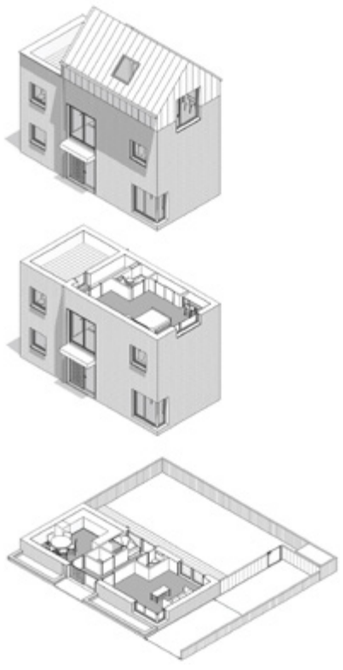
Swan is adopting a volumetric approach, focusing on the benefits of offsite modular construction, including the ability to precision engineer homes more efficiently in a high-quality factory setting. This approach not only allows the creation of a weather-proof environment for homes to be built, but a better environment for staff, helping attract both experienced construction workers and a new, diverse workforce. As a mixed-use scheme, Laindon Place is a great example for London-based developments looking to use offsite manufacturing. Offering both apartments and commercial units, the use of traditional and offsite methods showcases the way in which difficult sites can be unlocked to allow for new, much needed homes to be built, as well as its ability to allow for less time on site, reducing disruption to surrounding residents and businesses.

Viewpoint

'It has been a privilege to be part of the architectural team developing this visionary place-led masterplan for the redevelopment of the Laindon Shopping Centre. As a practice, this process has allowed us to work in a collaborative manner with Swan, PTE Architects and the rest of the design team to produce an extremely rewarding, design focused development. We have shaped the masterplan based on our abundant knowledge on placemaking, architectural quality, and our extensive engagement in public consultations. Accordingly, we are delighted to be working with Swan to deliver the technical design and look forward to starting on site.'

Rolf Nielsen, Associate Partner, C.F. Møller

Client: Swan Housing Group
Architect: C.F. Møller and Pollard Thomas Edwards
Manufacturer: NU Living



WILLIAM STREET QUARTER

Linton Road, LB Barking
and Dagenham, London, IG11
Status: Completed
Date of completion: June 2014
Cost: £34.7m
Size: 24,024 sqm
Number of units: 201

This project consists of three mews streets lined with brick terrace houses defining the perimeter of the site, while a ten-storey tower terminates a mansion-block lined boulevard. Offsite manufacturing allowed for both enhanced character and construction efficiency, with greater delivery predictability, quality and accuracy achieved in factory conditions. Precast concrete cladding panels arrived with windows already installed, external balconies were then clipped on, and panels lifted into position and bolted to the frame. The mews houses were constructed using an offsite timber framing system clad in a single layer of brick, with roof structures assembled on the ground and lifted into place, serving as a case study of the effectives of offsite manufacture for affordable housing scheme.

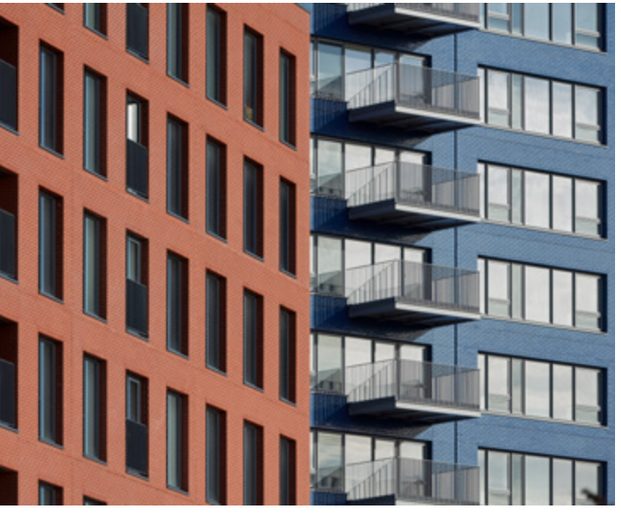
Architect: Allford Hall Monaghan Morris & Maccreanor Lavington
Contractor: Laing O'Rourke
Structural, Civil & Services Engineer: Arup
Planning Consultant: Savills
Landscape Architect: Plincke

TWO FIFTY ONE

251 Southwark Bridge Road,
LB Southwark, London, SE1
Status: Completed
Date of completion: September 2018
Size: 21,684 sqm
Number of units: 335

A 41-storey residential tower with lower level commercial and retail space, this project also includes an adjacent smaller office building and garden. The tower's distinctive parallelogram shape transforms as it rises to the top where it is cut through on two sides to form two sloping surfaces. The project involved significant prefabrication, with the structure formed from prefabricated concrete columns, and slab walls and beams selected from a library of components developed and patented by Laing O'Rourke. The main facades, modular interlocking precast concrete units, were delivered with windows and aluminium panelling pre-installed. Bathrooms were pre-constructed off site, and main risers and plant components were pre-installed on permanent metalwork stillages allowing them to be slotted into place as the structure progressed, bringing efficiency and enhanced construction quality to the end product without impacting on its appearance.

Client: South Central Management
Architect: Allies and Morrison
Contractor: Laing O'Rourke
Structural Engineer: Waterman Structures
Services Engineer:
Waterman Building Services
Quantity Surveyor: McBains Cooper
Planning Consultant: DP9
Landscape Architect:
Townshend Landscape Architects



LONDON CITY ISLAND

Orchard Place, Leamouth,
LB Tower Hamlets, London, E14
Status: Under construction
Date of completion: September 2019
Cost: £500m
Size: 163,900 sqm
Number of units: 1,706

The project comprises a residential led, mixed use development of 13 buildings of up to 22 floors, incorporating non-residential uses such as a new building for the English National Ballet and space for the London Film School. Residential buildings are constructed using prefabricated concrete structural panels. External walls are formed using a system of prefabricated, brick faced cavity wall panels with a full brick outer leaf and loadbearing RC inner leaf. Windows are pre-installed offsite, along with thermally broken stub connections to receive external balconies. The approach to prefabrication has a significant benefit on the project, particularly by accelerating delivery. Residential floors can be complete, including glazing, on a seven-day cycle. This is an agile solution, delivering a high-quality finish with robustness, speed and safety of construction.

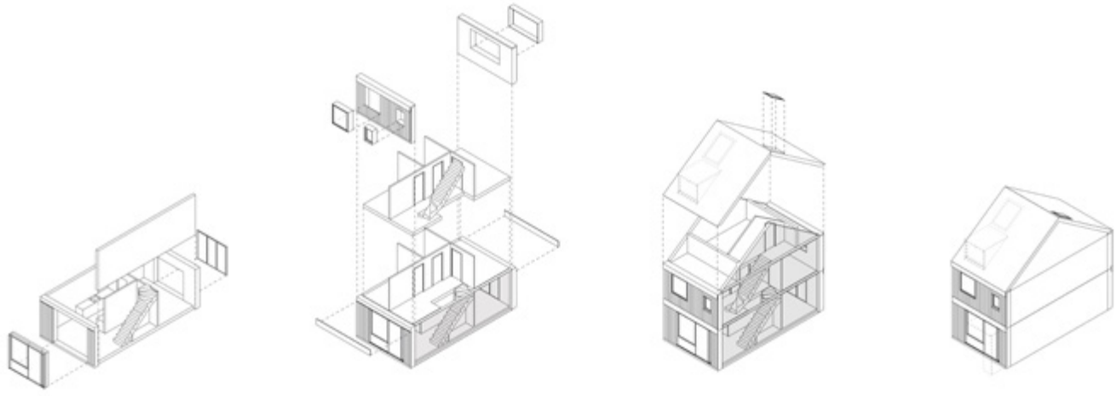
Client: EcoWorld Ballymore
Architect: Glenn Howells Architects
Structural Engineer: OCSC
Contractor: Roundstone
Prefabricated Concrete & Glazing Subcontractor: Hurks (Byldis UK)

BAYCLIFF ROAD

Baycliff Road, Liverpool, L12
Status: Planning pending
Date of completion: May 2019
Size: 2,033 sqm
Number of units: 19

In the suburbs of Liverpool, Baycliff Road is an innovative terraced housing project providing 19 three-bedroom homes, which gained approval from the LCC planning committee in August 2018. The innovative ‘kit of parts’ homes have a standardised core with interchangeable plan and elevation options. The viability of the project is crucial to its implementation, and the construction method is core to achieving this. The houses will be manufactured offsite as prefabricated, externally finished cassette panels, which are assembled on site in approximately 12 hours per unit. Substantial pre-planning design work has been necessary to coordinate the visible interface details between panels, these details have been built as 1:1 prototype’s to increase certainty in the design.

Client: Osco Homes
Architect: Haworth Tompkins
Delivery Engineer: Modularize



QUAKER COURT

Banner Street, LB Islington,
London, EC1Y
Status: Design stage
Date of completion: January 2021
Number of units: 40

This project seeks to add 40 new homes into an existing residential estate through a series of rooftop extensions, infill, a row of family mews houses and a new apartment building, all the while carefully knitting into the fabric of the existing community. With residents remaining in their homes during construction, offsite manufacturing is key in limiting the impact of the build to those living there. Taking a hybrid approach, using the best method and system where suitable, combining panelised systems with volumetric, this project demonstrates how a factory-made modular approach can be used to create a bespoke solution. Banner Street illustrates the potential for other complex sites across the borough and beyond, particularly for those including rooftop extensions.

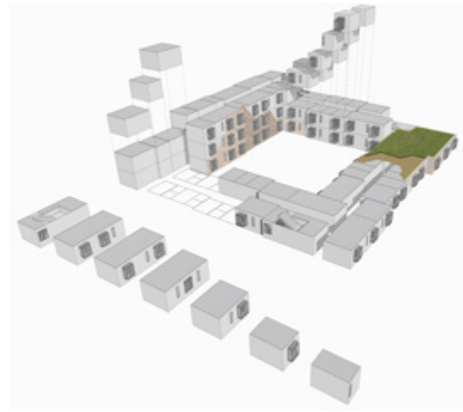
Client: London Borough of Islington
Architect & Landscape Architect: Levitt Bernstein
Structural & M&E Engineer: Design Buro

BURNHOLME CARE HOME

Bad Bargain Lane,
Burnholme, York, YO31
Status: Planning pending
Date of completion: March 2019
Cost: £8m
Size: 4,000 sqm
Number of units: 80 en-suite bedrooms

The Burnholme Care Home is an 80 en-suite bedroom, three-storey modular building. The home, that is arranged around a courtyard, is divided into clusters of nine and 11-bedrooms. Every cluster is self-sufficient, providing residents with a dining/lounge room with terrace, an assisted spa room and a quiet room. At the ground floor, the social “hub” contains a café, arts & crafts workshop, beautician and gym. The building can be built using just seven modules of different dimensions. The modules would be delivered on-site fully finished and ready to be craned into place. Volumetric modular construction using cold rolled steel chassis will provide robust, high-quality spaces that can deliver high-quality homes for London and the rest of the country.

Client: City of York Council
Care Provider: HC-One
Architect: Penoyre & Prasad
Structural Engineer: MLM
M&E Engineer: Couch Perry Wilks (CPW)
Landscape Architect: Enzygo
Developer: Ashley House PLP

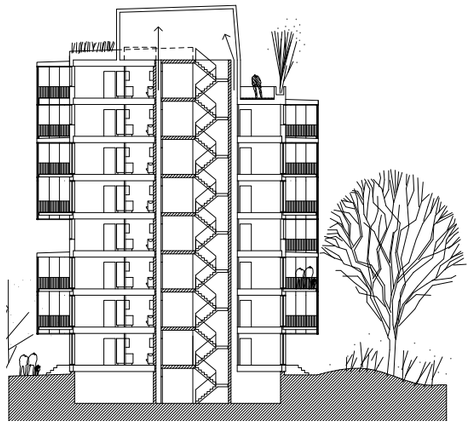


NOTTINGHAM CITY HOMES 2050 PILOT

Sneinton, Nottinghamshire, NG2
Status: Completed
Date of completion: January 2018
Cost: £650,000
Number of units: 10

Ten hard-to-heat homes in Nottingham are the first in the UK to adopt Energiesprong whole-house refurbishment, using factory fabrication. This revolutionary net zero energy approach, creates desirable, warm and affordable homes for life, tackling both fuel poverty and climate change. It is pioneered in the Netherlands, where a thousand homes a year are now receiving this high-tech makeover. New super-insulated wall panels and roofs are manufactured offsite and craned into place, with residents in situ. Solar roofs and state-of-the-art ground source heating systems have dramatically reduced household energy bills, making homes warmer and healthier for residents. The Dutch experience suggests that economies of scale will come with mass rollout and volume prefabrication. There is significant scope to apply the model to improving housing in the capital.

Client: Nottingham City Homes (ALMO)
Architect: Studio Partington
Structural Engineer:
ADEPT Consulting (UK) Ltd
Specialist Contractor: Melius Homes Ltd
Services Engineer: Sasie Ltd



FROSTALIDEN

Frostaliden 8, Skövde, Sweden, 54142
Status: Completed
Date of completion: June 2018
Size: 3,660 sqm
Number of units: 52

Prefabrication of timber-framed roof, floor elements and wall panels, standard in Sweden since the 1950s, is enjoying a revival due to updated technologies. In Skövde, an entire neighbourhood using prefabricated timber components, is part of the city's commitment to sustainable construction. The newly completed garden district, Frostaliden, has become one of the largest blocks in Sweden using wood construction with its 1,200 homes for 4,000 inhabitants. White Arkitekter contributed two buildings (52 homes), with floors and walls constructed in CLT, delivered in large format (up to 16 metres long), which meant fewer panels, fewer joints, higher density and faster assembly. The building's exterior is clad with cedar shingles, an honest expression and reminder that the residential towers are 'the real deal'.

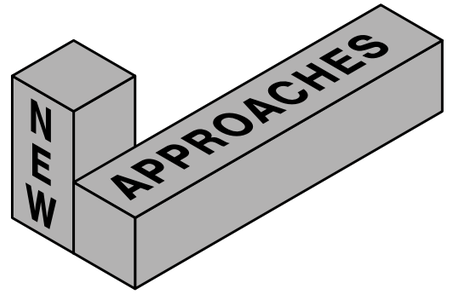
Architect: White Arkitekter
Client: Brunnen Bostad
General Contractor: Fristad Bygg

KITCHENER BARRACKS

Dock Road, Chatham, Kent ME4
Status: Under construction
Date of completion: December 2020
Cost: £50m
Size: 47,700 sqm
Number of units: 302

Kitchener Barracks is a community of 302 sustainable homes set within a historic site in Chatham. The delivery platform TopHat, design, manufacture and install volumetric timber homes. TopHat's concept to blend design process with an integrated supply chain creates a controlled value chain, and combined with automated manufacturing, offers certainty in quality and cost. The complex site constraints at Kitchener Barracks take advantage of this highly flexible system to enable diversity in scale, type and architectural quality. The unique planning consent offers potential buyers the ability to customise their homes without further statutory applications. Faster, more flexible and certain construction is key to delivering the UK's housing need and Kitchener Barracks is a demonstration of the benefits an integrated manufacturing solution can offer London.

Client: J G Chatham
Design: TopHat
Manufacturer: TopHat
Planning consultants: Montagu Evans



There are many emerging concepts, systems and processes that are changing the way we approach factory methods to produce not just housing, but projects across other sectors too.

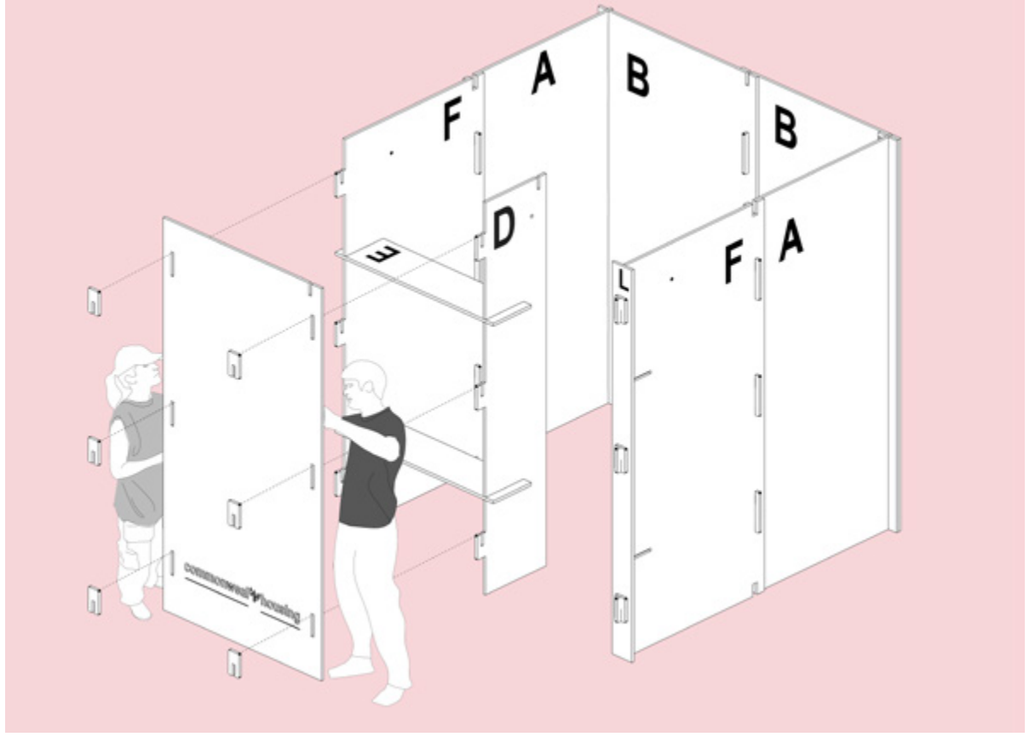
From a solution for temporary homeless shelters to new technologies and systems, there is a wealth of new ideas that London should draw on if it is to successfully adopt factory methods as mainstream. This short section illustrates some of these innovations.

CUT IN FACTORIES, MADE BY PEOPLE

Here East, Queen Elizabeth Olympic Park, Hackney, London, E15
Status: Completed
Date of completion: May 2018
Size: 1,000 sqm
Number of units: 23

The Here East Gantry evidences the potential for high performance pre-fabricated homes, with vast customisation, that are cut out by factories and made by people. Hawkins\Brown & Architecture 00 adopted the Wikihouse design and construction toolkit, developed initially as a solution to democratise and encourage self-build housing, and re-appropriated it to design and deliver 23 artist studios. The toolkit facilitates the delivery of modular plywood buildings, precision manufactured using CNC milling machines. Developing a flexible parametric design tool where every joint and detail – effectively the entire construction system – was embedded into this software from concept design, meaning new cutting information, for each unit, is automatically regenerated at the push of a button enabling variation across the 23 studios. Lessons from housing design applied to workspace, and vice versa.

Client: Here East / Delancey
Architect: Hawkins\Brown & Architecture 00
Research Partners: Wikihouse
Fabricator: Leisure Technique
M&E and Plumbing Engineer: Cundall
Structural Engineer: Momentum
Quantity Surveyor: Gardiner & Theobald
Planning Consultant: Deloitte



THE COMMONWEAL POD

Prototype
Status: Design stage
Cost: £1,400
Size: 8 sqm

For some of the 1,000 people on London's street each night, sleeping rough is preferable to options such as dormitories in night shelters or over-crowded rented accommodation. Following research into Romanian migrant workers living in tent encampments, Commonweal Housing held a design competition to find a solution that could bring empty and underused non-residential buildings back into use. The Commonweal Pod has been designed to create reusable, short term accommodation, adaptable to suit rough sleepers in night shelters. Measuring approximately two by two metres, the Pod is fabricated from eight standard plywood sheets using CNC milling technology. Each pod interlocks with the next to make efficient use of materials and space, providing privacy, security and dignity for its users, helping them to make the transition from the streets to more permanent housing.

Client: Commonweal Housing Limited
Research Partner: Thames Reach
Architect: Reed Watts Architects
Structural Engineer: Price & Myers

PARAMETRIC PRE-FABRICATION

A new system,
by BuroHappold Engineering

The design-procurement-construction process across the UK has not fundamentally changed in generations. The process is inefficient. It starts with the design, driven by planning envelopes that determine building volume and aesthetics; buildings are designed from the outside in. Floor plans try to optimise the sellable area, often with little regard for the clarity and quality of the spaces they create. Engineering input is introduced late in the process, often leading to overly complex solutions where true integration may not be achievable at all. Construction considerations or contractor input feature too late in the process, if at all.

This system is a rethinking of the way design is approached and it starts with offsite manufacturing. Buildings are considered as an assembly of engineered parts. These parts already exist in the market but often due, to complex layouts, we do not see their full potential. Our system considers building design from both the inside-out and the outside-in.

Standardising the interfaces between elements, we control how parts come together, but the elements can vary in size to allow flexibility in the design solution. An integrated computational design platform sits at its heart of the system. Using the standard BIM/Revit tool, it manages the process, removes the complexity and forms a direct link from design to production. It has a database of a growing number of individual components, which can be parametrically manipulated and adjusted. It provides the means for full geometrical coordination and has interfaces with our analytical design software, creating a fully integrated engineering design workflow, for all engineering disciplines. The tool has an intuitive Rhino/Grasshopper user interface that links to a Revit output model, which is directly usable for the production of construction drawings, models and schedules.

Individual preferences can be programmed and the kit of parts can be manipulated to suit individual or multiple project needs as well as expanded through elements or families developed specifically for a project or a bespoke application. This means the system is not limited to one material type, nor a particular geometry, but can utilise the existing supply chain rather than a small number of highly specialised integrated manufacturers.

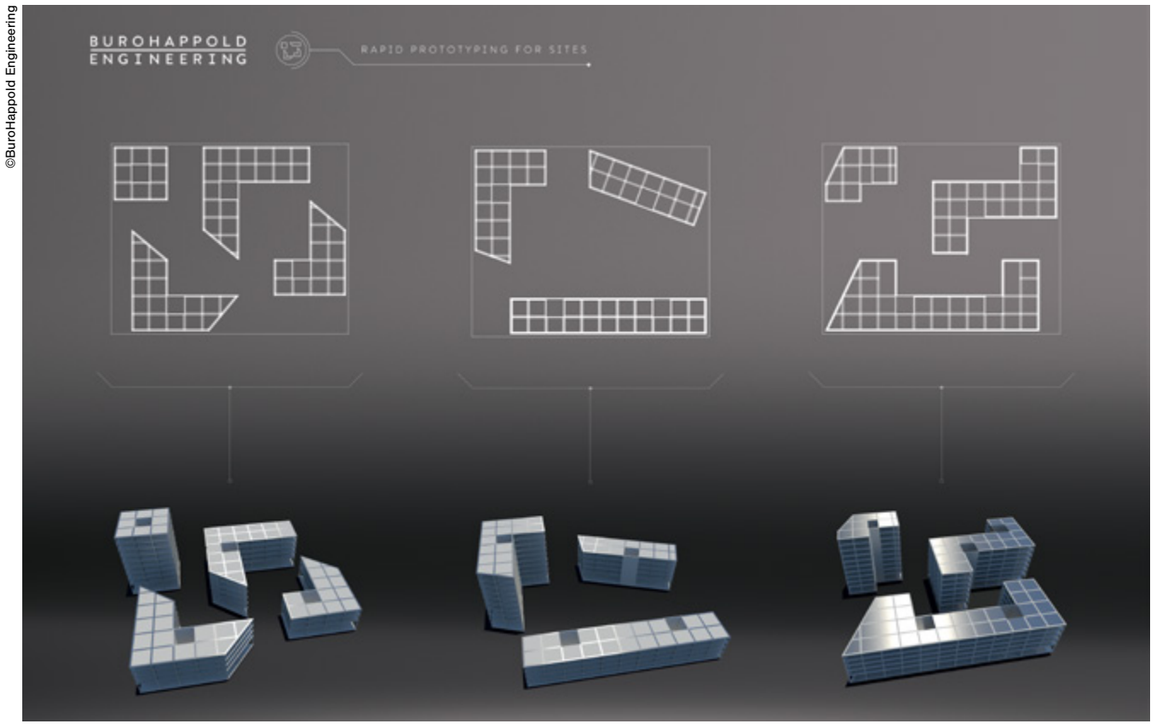
The future for this computational approach is linking it with data driven placemaking. Parameters are applied to help inform key decisions on the building form, i.e. maximising daylighting on a floor, minimising overheating, prioritising vista, etc. while never losing the manufacturing rigour that is embedded in the code. This rapid prototyping approach is compelling because improves visibility to the design process and allows the team to choose the right solution for the project, not merely forcing a product on a place.

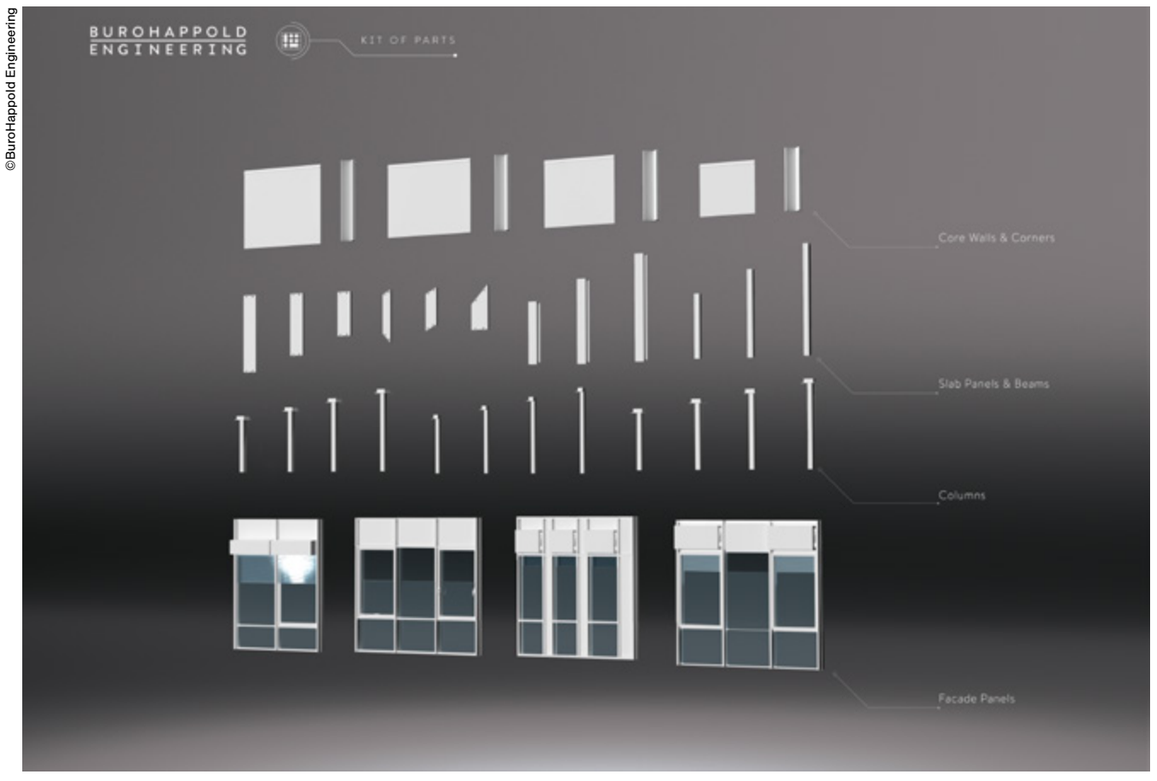
Viewpoint

‘The real MMC hurdles are not in the technology but in the deployment of the technology. We can deliver far better, cheaper and faster houses and we can avoid the real challenges of scalability and investment in the supply chain/factory. We have a computational industrial flatpack system that requires no particular supply side pre-investment and is not limited by the output of a particular factory. Further, the system is open source and so there is no risk that in using our system you might be held over a barrel or that the system might disappear if anything happens to us.’

Adam Poole, Associate Director, BuroHappold Engineering

Engineer: BuroHappold Engineering





QUANTIFYING BENEFITS OF OFFSITE CONSTRUCTION WITH OFFSITE READY REVIEWS

New design tools by Ramboll

The benefits and savings of offsite construction are often talked about but how can a project team quantify these benefits to make informed decisions? Ramboll's Offsite Reviews are an innovative technique being used to demonstrate the savings of various offsite methods by going through planning cycles multiple times with different systems.

The number and variety of offsite systems available can be overwhelming, with each one having different technical and procurement considerations. Ramboll has developed a suite of digital design tools to carry out Offsite Ready Reviews that provide an easy to understand technical analysis of the different design options, including overall cost, on-site construction and overall programme timings, and future flexibility.

An Offsite Ready Review of Dalston Works, a 10-storey CLT residential development in Hackney (see page 97), carried out by Ramboll, compared a mixed used CLT frame with traditional concrete and steel frame options. With High Speed 1 and Crossrail passing under the building site, the choice for CLT was unequivocal with its lighter construction weight enabling smaller foundations and a further two-storeys of accommodation.

Offsite construction requires coordination but thrives with data-rich collaboration. In addition to Ramboll's assessment, B&K Structures, the specialist timber subcontractor for Dalston Works, created a relative cost summary of CLT panel widths which showed that minor adjustments to panel widths could lower costs by 10-20 per cent.

The Victoria Quarter in Ashford, Kent is a large residential site developed by Neighbour, consisting of seven buildings of around six- to seven- storeys. Taking into account the client's aims for the site and key drivers, the offsite technical database and digital toolkit was used to undertake rapid option assessments of the building forms for the site – both offsite and traditional.

Ramboll's Dynamic Masterplanning tool assessed hundreds of building masses in minutes and suggested the optimum structural forms for the offsite systems that best aligned with the client drivers. Secondly, their Offsite Review tool assessed the concept stage floorplans for each offsite system, scoring them on several technical metrics and suggesting amendments to improve the value gained by offsite construction.

Alongside this technical analysis, the overall client and project approach to offsite construction were also assessed, including procurement process, BIM process, and design collaboration extent, to highlight opportunities for further value. A modular volumetric steel design delivered optimum cost and programme benefits and, as a result, was the chosen method of construction.

If offsite construction is to deliver value, understanding the constraints, be it manufacture, handling, transportation, lifting or installation, as well as site-specific criteria such as geotechnical conditions, must lead the design approach. Architects in particular must understand these constraints and develop the design concept around them.

To meet the volume of housing needed across London and the UK, innovative techniques need to be adopted. Ramboll has shown that combining digital design with offsite construction enables architects and developers to make informed decisions and deliver well designed, quality housing, fast.

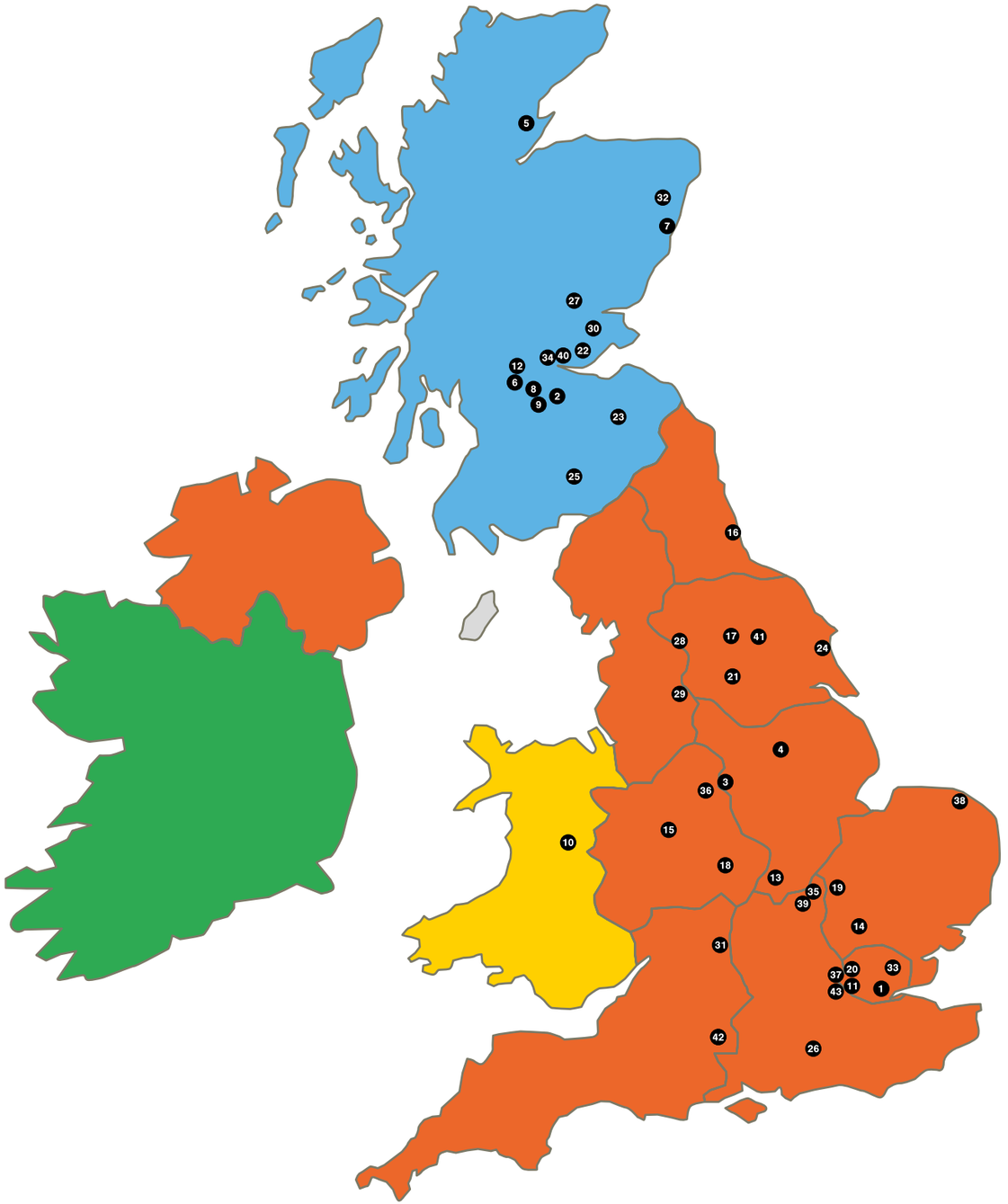
Viewpoint

'Our clients want to explore offsite construction, but struggle to see the wood for the trees – there are so many offsite systems which all purport to be the most suitable. By embracing the opportunities afforded by digital analysis and design we have helped clients navigate this wood and see what is the best solution for their project. I have seen many established developers reap significant benefits from this high level early design assessment to maximise their opportunity to use offsite construction.'

Gavin White, Director, Ramboll

Structural Engineer: Ramboll

INDEX



MAP

Information kindly provided by HTA Design LLP and FORMWork

OFFSITE MANUFACTURERS UK

1 | **Berkeley** | berkeleygroup.co.uk
2 | **BHC Ltd** | bhc.ltd.uk
3 | **BK Structures** | bkstructures.co.uk
4 | **Caledonian** | caledonianmodular.com
5 | **Carbon Dynamic** | carbondynamic.com
6 | **CCG** | c-c-g.co.uk
7 | **Deeside Timber Framing** | deesidetimberframe.com
8 | **Enevate** | enevate.co.uk
9 | **Enewall** | enewall.co.uk
10 | **F1 Modular** | f1modular.co.uk
11 | **Facit Homes** | facit-homes.com
12 | **Fleming** | fleming-buildings.co.uk
13 | **Fusion Building Systems Ltd** | fusionbuild.com
14 | **Hadham Construction Ltd** | hadframe.co.uk
15 | **Taylor Maxwell** | taylormaxwell.co.uk
16 | **Icarus Light Steel Frame** | icarus-lsf.com
17 | **ilke Homes** | ilkehomes.co.uk
18 | **Innovare** | innovaresystems.co.uk
19 | **Kingspan** | kingspan.com
20 | **KLH** | klhuk.com
21 | **Legal and General** | legalandgeneral.com/modular
22 | **MGM Timber** | mgmtimber.co.uk
23 | **Oregon** | oregon.co.uk
24 | **Premier Modular** | premiermodular.co.uk
25 | **Robinsons** | rbscotland.co.uk
26 | **Scandi Haus** | scandia-hus.co.uk
27 | **Sidey** | sidey.co.uk
28 | **Sigmat** | sigmat.co.uk
29 | **Simple Modular Solutions** | simplemodularsolutions.co.uk
30 | **Sips Eco Panels** | sipsecopanels.co.uk
31 | **Stewart Milne Timber Systems** | stewartmilnetimbersystems.com
32 | **Stewart Milne Group** | stewartmilne.com
33 | **NU build** | nubuild.co.uk
34 | **Thornbridge** | thornbridgesawmills.co.uk
35 | **Tide Construction** | tideconstruction.co.uk
36 | **TopHat** | tophat.co.uk
37 | **Treehaus** | firsthome.london
38 | **Tufeco** | tufeco.com
39 | **Vision Modular** | visionmodular.com
40 | **Walker Timber** | walkertimbergroup.com
41 | **Yorkon** | yorkon.co.uk
42 | **24.7 Living UK** | 247livinguk.com
43 | **63000 Homes** | 63000homes.com

ADDITIONAL OFFSITE MANUFACTURERS UK

ENG | **Adston UK Ltd** | adstonconstruction.com
ENG | **Brooke Homes Developments Ltd** | brookehomes.co.uk
ENG | **BSJ System**
ENG | **BuroHappold** | burohappold.com
ENG | **Bylidis** | byldis.com
SCT | **Cairnhill** | cairnhillstructures.co.uk
ENG | **Elements Europe** | elements-europe.com
ENG | **Elliott Group** | elliottuk.com
ENG | **Enegroup** | enegroup.co.uk
ENG | **Eurban** | eurban.co.uk
ENG | **Greencore Construction** | greencoreconstruction.co.uk
ENG | **Jade Global Group** | jadeglobalgroup.com
ENG | **Metek** | metek.co.uk
SCT | **Newton Steel Framing** | newtonsf.co.uk
ENG | **Parabuild Solutions Ltd** | parabuildsystems.co.uk
ENG | **Pinewood** | pinewood-structures.co.uk
ENG | **Rollalong** | rollalong.co.uk
SCT | **Rowan Timber** | rowan-timber.co.uk
SCT | **Scotframe** | scotframetimberengineering.co.uk
ENG | **SIG Building System** | insulshell.co.uk
ENG | **SIP Build UK Ltd** | sipbuilduk.co.uk
ENG | **SIPS UK** | sips.uk.com
ENG | **Taylor Lane** | taylor-lane.co.uk
ENG | **Terrapin** | terrapingroup.co.uk
ENG | **Vinvo Group Ltd** | vincogroupltd.com
ENG | **Wienerberger** | wienerberger.co.uk
ENG | **Xella** | xella.com

INTERNATIONAL OFFSITE MAUFACTURERS OPPERATING IN THE UK

SP | **CIDARK** | cidark.com
DEU | **Huf Haus** | huf-haus.com
SWE | **Trivselhus UK** | trivselhus.co.uk
DEU | **Weberhaus** | weberhaus.co.uk
IRL | **WElink** | welink-group.com

ACKNOWLEDGEMENTS

NLA would like to thank our Programme Champions, Supporters and contributors whose support made this study possible.

Special thanks to the following people for sharing their time, expertise and insights, and their own research, via interviews and participation in NLA workshops in January and May 2018.

Mark Baigent,
London Borough of Tower Hamlets

Simon Bayliss, HTA Design LLP

Rory Bergin, HTA Design LLP

John Bibby, Greater London Authority

Denise Chevin, Freelance writer, researcher, editor

Jane Collier, Waugh Thistleton Architects

Bjorn Conway, ilke Homes

Jenny Coombs, BeFirst

Ben Cousins, Cousins & Cousins Architects

Graeme Craig, Transport for London

Neil Deely, Metropolitan Workshop

Jonathan Drage, Metropolitan Workshop

Liz Earwaker, AECOM

Russ Edwards, Lendlease

Jeff Endean, London Borough of Lewisham

Jonathan Falkingham, Urban Splash

Mark Farmer, Cast Consultancy

Peter Flint, AECOM

Adrian Friend, Friend and Company

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Designing buildings that are inherently sustainable by virtue of their construction allows us to address context, form and proportion in our work. Our architecture is human in scale, and our buildings and places are designed to encourage communities to flourish.

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AHEC pioneered the environmental impact assessment (EIA), an approach that has since been adopted by other industries. This measures a number of impacts: primary energy demand (from renewable and non-renewable resources); global warming potential; acidification potential; eutrophication potential; and photochemical ozone creation potential.

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Pocket Living's award-winning affordable one bedroom Pocket homes for local first time buyers are affordable in perpetuity and sold outright to people on low to moderate incomes. The company has delivered in excess of 400 homes over the past decade and last year agreed new funding with the Mayor of London, together with additional funding from the Homes and Communities Agency (HCA) and Lloyds Bank. Pocket Living has committed to delivering a pipeline of over 1,000 new homes for first time buyers in the capital by 2021.

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With its rich culture of innovation, WICONA has positioned itself as a leader in providing highly energy-efficient aluminium solutions for sustainable, urban design.

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MultiPly

As part of the exhibition *Factory-made Housing: a solution for London?* the installation MultiPly will be on display in the crescent, just outside of NLA at The Building Centre, throughout October 2018.

Originally created for London Design Festival and exhibited at the Victoria & Albert Museum in September 2018, this collaborative project between Waugh Thistleton Architects, the American Hardwood Export Council (AHEC) and Arup, challenges how we build our towns and cities.

Combining sustainable American tulipwood with innovative methods of modular construction, MultiPly confronts two of the current age's biggest challenges – the pressing need for housing and the urgency to fight climate change.

NLA would like to thank partners Waugh Thisleton Architects, Arup, and the American Hardwood Export Council for making this possible.

MultiPly will be on display throughout October 2018 at Store Street South Crescent.

www.multiply.london
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Housing Programme

This NLA Research was published by New London Architecture (NLA) in October 2018. It accompanies the NLA exhibition and events programme *Factory-made Housing: a solution for London?* taking place from October 2018 to January 2019. It is part of NLA's year-round Housing programme, a forum for new ideas on the future of housing design, delivery and construction, covering key issues such as affordable housing, public

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