

OFFSITE CONSTRUCTION: A NEW PATHWAY TOWARDS MORE AFFORDABLE, SUSTAINABLE HOMES

EFL TOPIC GROUP CONSTRUCTION:
MEETING, 27TH – 28TH FEBRUARY 2020, OXFORD, UK



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WITH CONTRIBUTIONS FROM ALL PARTICIPANTS OF THE EFL TG CONSTRUCTION OXFORD MEETING,
27TH-28TH FEBRUARY, 2020.



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FOREWORD BY ERIC DANESSE, TOPIC GROUP LEADER

Dear EFL Members,

The Topic Group on Construction had a fantastic two days in Oxford, UK on 27th- 28th February exploring the topic of Offsite/Modular Construction with a number of EFL members. The meeting was organized by our member L&Q.

The meeting was a great success: with so many EU countries represented and highly skilled experts sharing their knowledge, our discussions were open and rich. We not only learnt a lot but also had a lot of fun!

This brochure is based on the contents of the meeting. It explores:

- What offsite construction actually means
- Why we need it
- How it works and what its characteristics are
- How housing associations can deploy it within their own construction policies
- Best practices and case studies

One key subtopic that was unpacked during the meeting was timber frame production, including the logistics behind this process and its sustainability and cost

aspects. As such, the brochure contains a special section dedicated to it.

All the presentations from the meetings are available on the EFL website, in the Topic Groups area, as well as on MS Teams in the *Topic Group Construction* Team. Please feel free to browse and explore the materials and get in touch with Eric (Vilogia) or Joost (EFL) if you have any questions or comments.

I would like to extend huge thanks to Wayne Hill and his team at L&Q for making this meeting possible and to all the participants for such compelling and fruitful discussion.

We hope to see you at the next meeting!

Kind regards,

Eric Danesse,

Leader of EFL Topic Group: Construction,
Directeur Adjoint Design et Relations Internationales, Vilogia

Joost Nieuwenhuijzen

Managing Director, EFL



"I was impressed by the situation in the UK - how the legislation is different from the Netherlands and how easily L&Q can build thousands of dwellings since they have a lot of ground in their portfolio already. It was also nice to see that they have teamed-up with a factory to make dwellings quicker and cheaper."

Gerbrand van Rootselaar, Ontwikkelaar
Nieuwbouw, Eigen Haard (Amsterdam)



"From our point of view, we were really impressed with the presenters on Friday. They gave really compelling insights and thought leadership on the Offsite approach"

Wayne Hill, L&Q, UK

1. OFFSITE CONSTRUCTION IN THE UK: EFL MEETING OVERVIEW

TITLE: 'Offsite Construction in the UK'

WHERE: Oxford and Witney, UK

WHEN: 27th and 28th February 2020

COUNTRIES: 5 (England, Germany, Belgium, France, Netherlands)

PARTICIPANT ORGANISATIONS: L&Q, Stewart Milne Group, Vilogia, Waugh-Thistleton Architects, Habitare +, Deutsche Wohnen, Eigen Haard.

HOSTING ORGANISATION: L&Q Housing Association.

CHAIRMAN: Eric Danesse (Vilogia).

THEMES: Offsite and Modular Construction.

1.1 SHORT SUMMARY OF DAY 1, 27TH FEBRUARY

On the first day, we were hosted by Stewart Milne Groupe in their factory of Witney; we toured round the factory with a guide. In Witney, we also visited a neighbourhood under construction right next to the factory. The site was home to 235 houses: 75% private, 25% affordable.



Figure 1: EFL TG Construction meeting, outside Stewart Milne Factory 28/02/2020. Source: EFL.



1.2 SHORT SUMMARY OF DAY 2, 28TH FEBRUARY

On the second day, our focus was on exchanging experiences between the EFL members and a close study how EFL member **L&Q Housing Association** implemented a strategic approach within their development department.

We first gathered in an Oxford theatre, where **Pascal Chazal**, industrialization consultant, reminded us of the urgency of changing our construction methods for the sake of both planet and people. **Andrew Waugh**, renowned London architect, told us about his experience in timber frame construction – a fascinating insight! We also received a presentation from L&Q about their **Modern Methods of Construction (MMC)**, see below for more details.

2. OFFSITE CONSTRUCTION: A BRIEF INTRODUCTION

Based on presentations by participants, in particular Andrew Waugh, Wayne Hill and Pascal Chazal.

What is Offsite Construction?

Offsite construction refers to the manufacturing, planning, design, fabrication, and assembly of building elements at a location other than their final installed location to support the rapid speed and efficient construction of a permanent structure. Such building elements may be prefabricated offsite in a different location and transported to the site or prefabricated on the construction site and then transported to another location within the same site.

Offsite construction is characterized by an integrated planning and supply chain optimization strategy. Offsite manufacturing (OSM), offsite production (OSP) and offsite fabrication (OSF) are used when referring primarily to the factory work proper.

Modular Construction, sometimes used as a synonym for Offsite Construction, is the most complete type of Offsite construction, where up to 95% of building parts are shipped and assembled as 3D prefabricated units that are service or structural units to be joined on-site.

Why Do We Need Offsite Construction?

Based on presentations by Pascal Chazal and Andrew Waugh.

Major Environmental Effects

The construction industry is currently a major contributor to global environmental degradation, notably as the main sector contributing to global pollution worldwide. To give just one example, concrete counts for 8% of the total CO₂ emissions globally and 50 billions tons of sand are used each year to make it. Building construction and operations are responsible for more than 50% of human consumption of the planet's resources – a quite incredible amount. With an annual industry growth rate of around 3%, there is an urgent need to render construction processes and building materials more environmentally-friendly.

Over-Complexity and Inefficiency

This environmental impact is exacerbated by the inefficiency and wastefulness of contemporary construction

processes. While other industries have gained efficiency with advancing expertise and technologies, the efficiency rate in the construction sector has greatly diminished over the years. To put this in context, automakers have seen an 85% increase in efficiency over the last century or so. Your average car factory looks nothing like it did in 1920, but your average construction site is almost exactly the same.

Inefficiency in processes and use of materials is so great in construction today that 30% of all materials and time dedicated to constructing a building go to waste. The central reason for this great inefficiency is that the process of real estate production has become far too complex. Today, each new building is typically developed in a unique way as its own prototype – rather than as part of a larger scale rollout of buildings - and requires a whole host of different actors with varying expertise. The complexity of the process means that a higher degree of error is likely. In addition, very complex skills are needed to ensure high quality and safe buildings, which can be a problem in countries where such skillsets are not always easy to come by.

Moreover, fragmentation among real-state and other construction organisations means that each “part” in the construction “chain” is focused on its own product, rather than on a shared overarching end-goal. Ultimately, this leads to a massive lack of collaboration or standardisation – both of which are needed to bring about quicker, more efficient building processes.

Another reason is the lack of adoption of new (notably digital) technologies. The potential of digital building tools, like BIM and CIM, to make construction more efficient and reduce silos is huge, but their actual usage remains relatively low. BIM penetration is very high in a handful of countries, for instance it is used by 42% of contractors in the Netherlands, but in other countries it is used much less, if at all.

Innovating the Construction Sector for the Sake of People and Planet

The unsustainable and inefficient nature of current construction processes is not simply a problem for the sector itself: it has a major impact on human societies worldwide.

Our world has a growing and increasingly urban population; this is particularly true of the developing world – think of Lagos, Nigeria, a city of 40 million people that is predicated to reach 100 million by 2050. In almost every part of the world, there is, therefore, a need to innovate construction not only to reduce its noxious effects on nature, but also to quickly provide affordable housing to the world's growing population.

This is no less the case in Europe: the housing sector continues to face the major challenge of providing more sustainable, more affordable and good quality housing quick. In the context of multiple crises - the climate crisis, the ongoing refugee crisis, and a continent-wide affordable housing crisis – this challenge is more pressing than ever.

Offsite Construction: A Golden Bullet Solution?

The logical industrial response to these issues in the housing and construction sector is offsite construction. Prefabricated buildings are nothing new – they go back to the “kit homes” of early 20th century America and the post WWII pre-fabs of Europe. However, it has largely remained a niche part of the construction sector in most countries, until recently.

In the context of growing momentum to change the construction sector – the Architects' declaration for climate change being only one example – and increasing global recognition of

its success in particular markets, for example Sweden, offsite construction has come back into fashion. As a result, it has seen a recent annual global growth rate of over 3%.

This is largely because, compared to traditional construction processes, offsite construction offers major advantages in terms of sustainability and efficiency, including:

- Faster turnaround time and lower risks
- A low carbon and environmental footprint as construction and waste emissions are halved and recycling/circular use of materials is common. For instance, with timber production, much of the wood used derives from Scandinavian production woods.
- Better quality, because production processes are standardised and better controlled resulting in a low degree of error
- Optimised costs – fewer employees, fewer transportation issues, upcycled materials, leaner manufacturing processes, greater use of digital tools, less risk, and greater standardisation and collaboration lead to up to five times less costs
- Improved working environment – workers are more protected from the weather and from many of the traditional dangers of construction sites.

Read on for case studies and more information about how your organisation could deploy offsite construction methods.



3. STATE OF PLAY ACROSS DIFFERENT EU COUNTRIES: PROJECTS, PLAYERS AND PROGRAMMES

FRANCE

Information partly provided by: Fabien Lasserre, Technical Innovation Leader, Vilogia

The Situation in France:

France is the homeland of concrete; it has an old tradition of concrete construction and of sub-sub-contracting and making profits from low salaried employees in the construction industry. This was a fast and cheap way to erect apartment buildings in urban settings in the 1950s (think Le Corbusier). France also had a bad experience with industrialisation after WWII.

Nowadays, only 10% of construction in France is wood and this is mainly for single houses. There has, however, been a dynamic increase in the last few years as there is increasing pressure to hit environmental performance indicators and stagnating construction productivity is increasingly forcing companies to develop offsite. However, there remains a strong cultural barrier to implementing industrial construction processes and transitioning towards the offsite “mindset”. Some tests have happened in the field of off-site retrofitting and a few companies are now working on offsite construction, mainly with wooden structures.

In addition, there is a strong public driving force arising from the Olympic Games 2024 to develop more offsite, driven by a new sustainability law coming into play in 2022 (see more below).

So far, in France, timber frame construction is still 10% more expensive than traditional construction methods. This is due to the fact that the offsite construction market is still emerging and is still mainly composed of many small companies.



Figure 3: Bordeaux Hyperion Group (under construction). Source: Dezeen group.



Figure 4: Ossabois Bronze Building in Paris. Source: Ossabois' website.



Figure 5: An 11-storey building made entirely of wood in Strasbourg. Source: LeFigaro.fr.

Example Projects

Some iconic modular wood buildings have been constructed or commissioned recently - for example:

Example Industry Players

- Cognaud: much more on tertiary construction (offices, schools etc.); no housing.
- Algeco is the same as Cognaud.
- Ossabois: the biggest player when it comes to housing built by offsite construction.
- Woodeum: Ossabois' biggest competition operating only in the timber buildings space; also acts as a developer.
- Many smaller companies like: Trecobat and Booa.

Government Programmes and Incentives

The French government recently unveiled plans for a sustainability law mandating that all new public buildings financed by the state will have to be built from at least 50% timber or other natural materials as of 2022. This will hugely boost offsite timber construction. This mandate will also apply to buildings constructed for the 2024 Paris Olympics.

Moreover, French regulations currently allow wood buildings to up to 28 meters and 7-8 Stories high (Loi ELAN and Loi ESSOC).

In 2019, the French government emphasised that they wanted to invest in innovating the French housing and construction sector - in particular in offsite construction methods - expressing a desire to position France as a world leader in this area. However, few concrete measures or

policies have emerged putting these words into action yet. *“At Vilogia, we aim to stimulate innovation in the construction field. We are involved in the Energiesprong project, an EU-funded Dutch initiative aiming to raise the number of homes that have been retrofitted to be more energy-efficient. The end goal is to create zero-emissions buildings and introduce public reporting on offsite construction.” Fabien Lasserre, Technical Innovation Leader, Vilogia*

NETHERLANDS

Information partly provided by Gerbrand van Rootselaar, New Construction Developer, Eigen Haard

The Situation in the Netherlands:

Both offsite and circularity are already major themes in the construction sector in the Netherlands. Amsterdam-based housing associations, for example, plan to refurbish many of the older properties and make them energy efficient, based on the principles of circularity and re-use of materials. There are a number of offsite construction tests going on in several parts of the country. However, a lot of traditional redevelopment and demolishing of old buildings is happening in the Netherlands.

Example Projects

Eigen Haard housing association is taking part in a test project with TU Delft through which it cooperates with a South African company, whose panels and house elements, like steel frames, are produced and shipped to the Netherlands to be constructed. This project may lead to the construction of an offsite factory, possibly in Netherlands or Germany.

De Zalmhaven, Rotterdam, the world’s largest prefab building:



Figure 6: Zalmhaven Rotterdam.
Source: dezalmhaven.com.

Example Industry Players

Byldis, Voorbij Prefab, Sustainer Homes, Guwa, Tribute Space, Prefab Systeembouw B.V.

Government Programmes and Incentives

In the Netherlands, the government wants housing organisations to build quicker and cheaper – quicker, because we need more homes and cheaper, because a lot of people in the “first-time buyer” and “middle -income” categories need a house but cannot find anything affordable. Indeed, the issue of the so-called “squeezed middle” is a defining characteristic of the current Dutch housing regime. Offsite construction could help to alleviate the lack of affordable housing for first-time and middle-income buyers in Holland, and this is recognised by the government and many housing companies, although it is not exactly prevalent yet. The main issue related to offsite construction in the Netherlands at the moment is developing it further and achieving offsite housing in greater volumes.

“Eigen Haard is using a strategic approach to reduce the energy consumption of its housing stock. Both offsite construction as well as circular construction are part of the company’s development strategy. If possible, new projects will be designed and delivered according to this circular construction approach.” Gerbrand van Rootselaar, New Construction Developer, Eigen Haard

3. STATE OF PLAY ACROSS DIFFERENT EU COUNTRIES: PROJECTS, PLAYERS AND PROGRAMMES

BELGIUM – HABITARE +

Information partly provided by Sven Van De Vijver, Habitare+

The Situation in Belgium:

Belgium has a strong building tradition in brick construction. Many buildings remain from the industrial era. Only a small proportion of buildings in Flanders have now been built offsite; for these, offsite concrete elements are often taken to the building site.

Example Projects

However, circularity is growing – for example, Flanders Circular - and there is also (slow) growth in wooden offsite construction projects.

Main Offsite Players

Many Dutch, French and UK players are operating in Belgium, as well as some (but very few) local players.

Government Programmes and Incentives

There are almost no governmental efforts to promote offsite construction.

GERMANY - DEUTSCHE WOHNEN

Information partly provided by Anna Vetter, Deutsche Wohnen

Germany - Deutsche Wohnen

Information partly provided by Anna Vetter, Deutsche Wohnen

The Situation in Germany:

Many buildings in Germany are still from the Bauhaus era. The Germans have a culture of total individualism, which is in direct contradiction with the idea of collective offsite planning. Landmark architecture is still the philosophy; industrial production is thus not seen as key.

However, Germany really began to increase new construction a few years ago, presenting increasing opportunities for offsite construction to be adopted.

Example Projects

Terrace House, Affordable Housing Complex, Frankfurt by NL Architects and STUDYO:

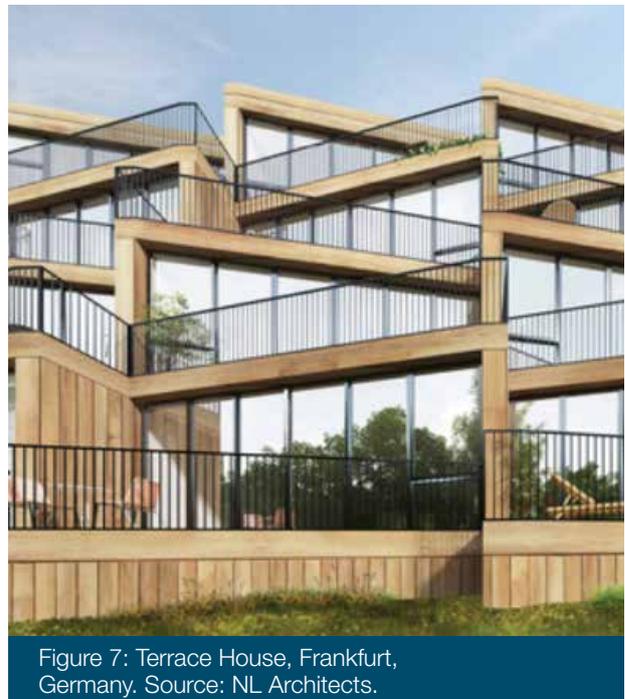


Figure 7: Terrace House, Frankfurt, Germany. Source: NL Architects.

Example Industry Players

DFH, Equistone assets (Bien-Zenker and Hanse Haus), WeberHaus, FingerHaus and Polish-headquartered Danwood, Fertighaus Weiss, SchwörerHaus, Büdenbender, Baufritz, Regnauer, LUXHAUS, Vonovia

Government Programmes and Incentives

There is no dedicated governmental subsidy program in place for prefabricated houses in Germany at the moment, but the German Energy Saving Ordinance (EnEV), with its higher energy efficiency requirements, support the offsite construction industry.

Quote from Deutsche Wohnen:

“As with the rest of Germany, Deutsche Wohnen really began to increase new offsite construction a few years ago. We currently have a project underway with 24 units across 4 buildings, for which the construction time is 1,5 years. We are using timber panels, with the aim of achieving certification in DGNB Platinum standard. One top tip we recommend is to choose a special target group of tenants with a pro-ecological mindset to trial offsite construction; this is more likely to result in acceptance by tenants” Anna Vetter, Deutsche Wohnen

UK – L&Q

Information provided by Lanre Gbolade, Production Innovation Lead, L&Q and Stewart Dalgarno, director of product development at Stewart Milne Timber Systems.

The Situation in the UK

Scotland leads the way with British offsite construction, with 92% of Scottish housing production currently timber frame and 84% offsite, compared to only 10-15% in England. In the UK in general, there are lots of organisations active in innovation in construction.

After the 2008 financial crisis, offsite construction and manufacturing innovation funding increased, with a cluster of innovation initiatives taking place from around 2010 onwards. The UK sought to emulate the German model used to establish their strong manufacturing base, by encouraging collaborative R&D between industry and academia, and transfer these innovations into commercially viable industrial applications. In 2013, the UK Government made an official commitment to promote and fund innovation in offsite construction; although the exact numbers are not clear, the government simply says that offsite construction can play a significant part in its commitment to provide 300,000 new homes per year. There has been significant investment in construction R&D funding through the Industrial Strategy Challenge Fund's (ISCF) Transforming Construction challenge, which is helping to advance offsite construction in the UK.

Example Projects

Local Homes (Accord):



Figure 8: Local Homes, Beacon View, Sandwell Estate, West Bromwich. Source: L&Q.

Urban Splash – House Project with ShedKM:



Figure 9: Urban Splash House Project, New Islington, Manchester. Source: L&Q.

3. STATE OF PLAY ACROSS DIFFERENT EU COUNTRIES: PROJECTS, PLAYERS AND PROGRAMMES

UK – L&Q

Information provided by Lanre Gbolade, Production Innovation Lead, L&Q and Stewart Dalgarno, director of product development at Stewart Milne Timber Systems.

Vision Modular – George Street, Croydon:



Figure 10: Vision Modular, George Street, Croydon, London. Source: L&Q.

Example Industry Players

Stewart Milne Timber Group, L&Q, Waugh-Thistleton Architects, Legal & General, Laing O'Rourke, Urban Splash, Nu-Build, Barratt Homes, HTA Architects, Countryside, Local Homes (Accord), Offsite Solutions, Hawkins Brown, B & K Structures, ilke Homes, shedkm, CITU, Sigmat, Kier Group, Mace, Cygnum, Walker Timber, Elements Europe, Vision Modular Systems.

Government Programmes and Incentives

The Self and Custom Build Housing Act 2015 and the Government's Housing and Planning Bill benefit offsite housing manufacturers in their focus on increasing and facilitating access to new housing. The increasing trend towards more ecological thinking, demonstrated by the rise of the Extinction Rebellion movement in the UK, and the UK and European governments' focus on energy efficiency is also creating favourable conditions for offsite construction.

The Industrial Challenge Strategy Fund via Innovate UK, have funded many design & construction research projects, including the Advanced Industrialised Methods for the Construction of Homes (AIMCH), a pioneering 3-year project starting in 2020. AIMCH aims to build 120,000 homes a year for the duration of the project via offsite construction, simultaneously tackling all the challenges the housing sector currently faces: skills shortages, an ageing workforce, poor productivity, low output and low affordability. It will identify and develop industrialised offsite solutions needed to meet current and future house building demands in the UK, and potentially beyond.

4. HOW TO USE OFFSITE CONSTRUCTION IN YOUR COMPANY: EXPERT INSIGHTS AND BEST PRACTICES

4.1 OFFSITE CONSTRUCTION WITH TIMBER

4.1.1 CROSS-LAMINATED TIMBER SOLUTIONS: INSIGHTS FROM ANDREW WAUGH, OFFSITE TIMBER CONSTRUCTION EXPERT, WAUGH-THISTLETON ARCHITECTS



Figure 11: WTA Website Homepage. Source: WTA.

Some Background About Andrew Waugh

Andrew Waugh is a well-known English architect, specialized in the design and construction of CLT (Cross Laminated Timber Solutions) Buildings and cofounder of Waugh-Thistleton Architects (WTA). He is also well known in the Dutch construction sector.

What is CLT?

Concrete has long been the construction material of choice for building quick, solid and – crucially - tall urban buildings. Today, as Andrew Waugh explained during our Oxford meeting, new timber technologies are emerging that offer similar, if not superior, opportunities to concrete.

In particular, CLT (Cross Laminated Timber) solutions are leading the way in this area. CLT is a wood panel product made from gluing together layers of solid-sawn lumber – i.e. lumber cut from a single log. Each layer of boards is usually oriented perpendicular to adjacent layers and glued onto the wide faces of each board, usually in a symmetric way so that the outer layers have the same orientation.

An odd number of layers is most common. By gluing layers of wood at right angles, the panel is able to achieve better structural rigidity in both directions.

Opportunities and Advantages Offered by CLT

A special characteristic of CLT is its robustness. Compared to construction with traditional timber frames, buildings in CLT can be realized as system for high rise apartment buildings and flats. This is because the stacking of boards in perpendicular layers allows plates or surfaces – effectively walls – to be manufactured. Its boards can reach enormous dimensions: between 2.40 m and 4.00 m high, and up to 12.00 meters long.

CLT offers many plus points: an enormous reduction of used materials via re/upcycling of pre-used wood, a warm and natural environment, low carbon emissions as the wood contains sequestered carbon, a high degree of standardisation and offsite fabrication, and notably the ability to build tall.

There are already 100 CLT buildings in the UK. One of the user cases of CLT construction in the UK is housing association Swan Housing.

Some examples of WTA's work:



Figure 12: Curtain Place, Shoreditch. Source: WTA.

4.1 OFFSITE CONSTRUCTION WITH TIMBER



Figures 13: OJEU Social Housing Project, Mions, France. Source: WTA Website.

4.1.2. LARGE-SCALE TIMBER CONSTRUCTIONS (OF ALL TYPES): INSIGHTS FROM STEWART DALGARNO, DIRECTOR OF PRODUCT DEVELOPMENT, STEWART MILNE GROUP

Some background on the Stewart Milne Group

Steward Mile Timber Systems is one of the UK's leading independent housebuilders, operating over 35 sites across the North East of Scotland, Central Scotland and North West England. The company designs, produces and realises new housing, and develops completely new neighbourhoods. The homes are both sold to private homeowners, as well as private investors and social housing associations. Most of the homes that are constructed by Steward Mile are row houses or single-family homes.

The Stewart Milne Group in Figures:

- The company currently makes homes for over 32 sites in the UK
- It produces 8000 houses a year
- The total surface of the factory is 105,000 ft² (approx. 9,754m²)
- 129 factory and yard operatives (over two shifts) supported by 19 production managers and administrators work in the factory. There is a similar make-up of people at their other operations in Scotland.
- As a whole business, they employ 433 people – 179 white collar/252 blue collar; 426 full time/7 part time; 381 male/52 female

- They have 51 design and engineering-orientated workers across the country, working across a mix of office and home-based locations
- Stewart Milne are a major partner in AIMCH, the governmental Advanced Industrialised Methods for the Construction of Homes programme launched by Innovate UK in 2020.

The Production Process

The Factory: Producing the Timber Frames



Figure 14: Stewart Milne Timber Group Factory, Witney. Source: EFL.

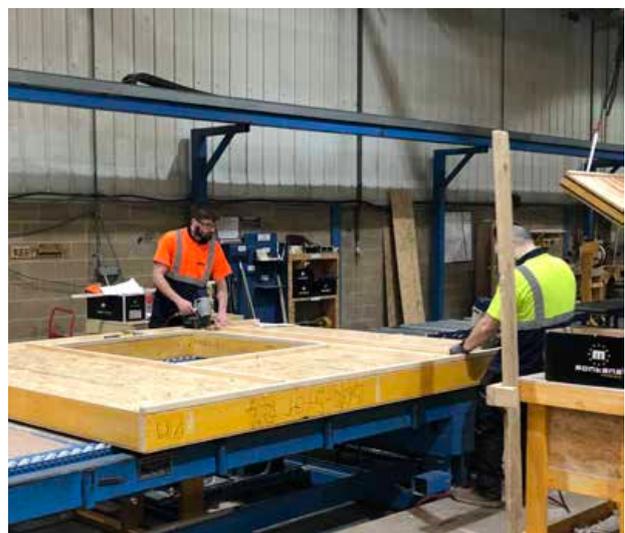


Figure 15: Stewart Milne Timber Group Factory, Witney. Source: EFL.

Stewart Milne's offsite factory in Witney, about 20 km north east of Oxford, is the one of the locations where timber frames are produced before they are distributed to construction sites across the rest of the UK.

In three large halls within the factory, wooden frames for residential construction are produced. The timber wood mainly derives from Scandinavia and is delivered on a daily base. All the elements like floors, frames for inside walls, windows, doors, attics and bathrooms are assembled of pure timber wood. The outside walls can consist of other materials, including bricks.

Putting the Frames Together Onsite



Figure 16: External View of House on Site next to Stewart Milne Factory



Figure 17: Internal View of House on Site next to Stewart Milne Factory. Source: EFL.

When finished, the elements and frames are transported to the construction site and within a period of 10 days, both inner construction and roof are assembled.

The first phase includes:

- Erection of the scaffolding
- Erection of the timber kit
- Covering of the kit with a roof

As soon as the inner frame of the dwelling is ready, internal works can start. As the house is covered by its roof, most of the required activities can take place simultaneously. With traditional construction, inner construction cannot start before the outer walls are ready and the building is watertight. With timber construction, in contrast, there is no need to wait before the outer walls are ready and the roof is constructed.

The outer walls of most of Stewart Milne's timber frame homes are brick. This is because brick walls in the UK are traditional and are the desired façade of most tenants. Bricklaying still has to be done by hand and is the most time-consuming part of the whole construction process. It is conceivable, though, that in future, brick walls will also be factory-built. Stewart Milne is also working on a robot to install windows.

The total construction time of one new house is maximum 18 weeks, or shorter. Compared to a traditionally constructed house, this constitutes a timesaving of at least 50%. The speed in which new homes can be realized is one of the major advantages of offsite construction.

The advantages of wooden frames include:

- Use of BIM technology for design and floorplans. The digital designs are used to produce the automated production of frames (sizes, form) in the factory.
- Energy efficiency: the elements produced have a very low U value, meaning that the heat loss of each element is much lower. The lower the U value, the better.

4.1 OFFSITE CONSTRUCTION WITH TIMBER

- Thermal comfort by high degree of insulation.
- Provide a healthy environment: no gasses from possible toxic materials. Wooden homes are healthy to live in.
- Ecological: wooden homes are examples of circular construction (renewable). Materials can be re-used, and if eventually thrown away, do not pollute the environment. They are also carbon-neutral usually due to carbon sequestered in the wood.

Compared to regular, brick and concrete construction, timber frame construction methods provide some other cost savings:

1. Savings in labour due to increased speed
2. Less finance costs during construction due to faster construction and earlier lets (or sales)- quicker return of capital outlay
3. Reduced carpentry costs as windows and door frames can be factory-fitted
4. Less material waste
5. Fewer weather delays
6. Less risk due to higher standardisation

4.2 MODERN SYSTEMS TO FACILITATE OFFSITE CONSTRUCTION

4.2.1 L&Q'S APPROACH TO MMC: MODERN METHODS OF CONSTRUCTION

Information from presentation by Wayne Hill, Director of Production Strategy, L&Q

Background on L&Q and MMC

L&Q Housing Association aims to produce 100,000 new homes by 2028, covering low-density homes, high-density apartments and a limited number of elderly homes. This means a yearly production of about 10,000 new dwellings. In order to achieve this goal, L&Q have developed their own approach to MMC (Modern Methods of Construction), as their way to modernize planning and production processes and innovate their business. MMC results in more production, fewer costs by way of standardisation, and greater innovation (see more details below).

They take the attitude: "if you want to work with manufacturers, think like a manufacturer!". This is what led them to create their approach: their way of modernizing the planning and production process and innovating their business.

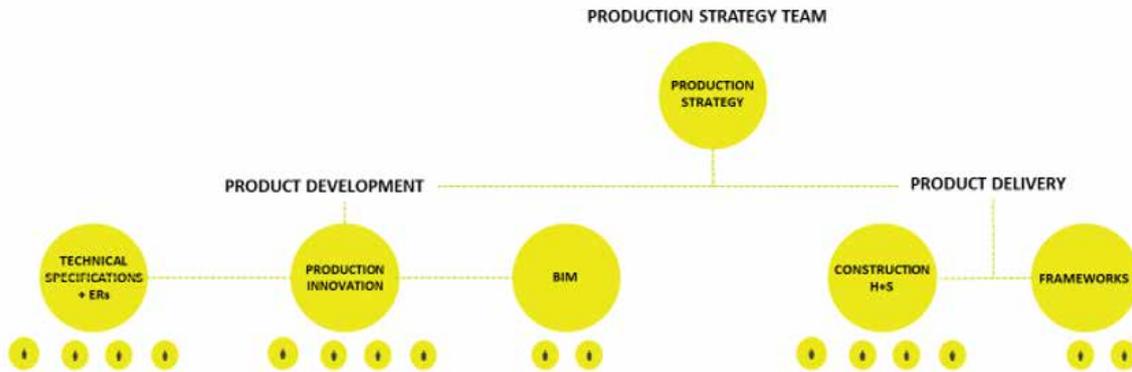
How will their MMC Work?

A dedicated and efficient approach is needed to meet L&Q's ambitious house-building goals. Thus, they have created their own development and innovation department and integrated their MMC philosophy, into all governance processes within the organisation.

The construction process is led by the Production Strategy Team, made up of architects, designers, engineers, project managers etc.. This team is split into two central subgroups:

- The Product Development Unit, responsible for design, innovation, technical specifications and BIM (Building Information Model)
- The Product Delivery unit, responsible for construction, factory healthy and safety, and frameworks.

MMC DELIVERY STRATEGY



L&Q

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Figure 18: L&Q MMC Presentation. Source: L&Q.

A core must-have element for fast design and construction is to invest in continuous learning from the industry. L&Q use Design for Manufacture + Assembly (DfMA), which is a method that allows this learning as it is based on standardisation and repetition, volume and typologies. This method is both used for single family homes as well as apartment buildings.

L&Q essentially rely upon the three core pillars of offsite construction:

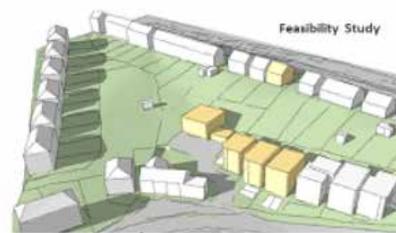
- Repetition
- Predictable volumes
- Typology: not the same solution for all products, but a number of specified solutions that can be easily reproduced.

The journey, in a nutshell – Houses

Step 1 – Select from pre designed product range, arranged by housing type



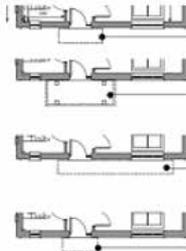
House Types
 2 Bed Version 1
 2 Bed Version 2
 2 Bed Version 3
 3 Bed V 1
 3 Bed V 2
 4 Bed V 1...



Step 2 – Apply Finish options



Step 3 - Select optional bolt-on features (Site-specific)



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Figure 19: L&Q MMC Presentation. Source: L&Q.

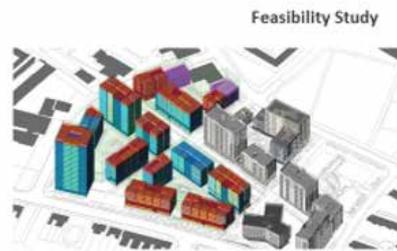
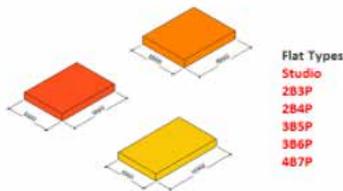
4.2 MODERN SYSTEMS TO FACILITATE OFFSITE CONSTRUCTION

Although they only started to implement this method two years ago, they have already created a product catalogue for the core elements of new constructions. These include

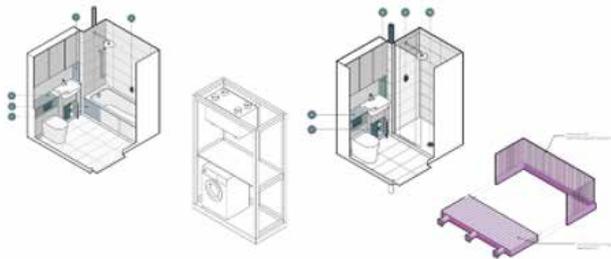
catalogues for kitchens, cupboards, internal flat designs and wooden frame systems.

and the Flats...

Step 1 – Select from pre designed product range, arranged by flat type



Step 3 – Select optional MMC features (Site-specific)



Step 2 – Apply Finish options



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Figure 20: L&Q MMC Presentation. Source: L&Q.

Step 4 – Select internal spec preferences



Step 5 – Finished product identical in appearance and function to a traditionally procured development



Figure 21: L&Q MMC Presentation. Source: L&Q.

Good examples



What might not work



Figure 22: L&Q MMC Presentation. Source: L&Q.

And for apartment buildings:

L&Q's MMC system is a success because of a number of different factors:

- They carry out their own development and use the system to build and retain expertise within the organisation.
- Scaling (quantity) is possible due to standardisation and typologising.
- High design-quality and production is possible as the process is fully controlled by L&Q.
- Co-operation with (fixed and trusted) stakeholders in the chain ensures an efficient process and security on both sides.

Year 2



Figure 23: L&Q MMC Presentation. Source: L&Q.

L&Q's Three Core Pillars to Think Industrial:

- **Repetition** – Standardise your homes and designs, so you can get value from building multiple units at a time.
- **Volume** – Create enough standardised homes that you can get value through quantity.
- **Typology** – Don't just use the same old solution for different types of homes: make sure you use the right type of Offsite construction that offers the best efficiency for the types of homes you want to build.

5. CONCLUSIONS: EFL'S TOP TIPS FOR SUCCESSFUL OFFSITE CONSTRUCTION

1. **Invest in organisational change:** successful offsite construction requires **collaborative and agile organisations**. The culture is completely different from onsite culture: here we find segmented organisations and no culture of integration.

2. **Use Design for Manufacture and Assembly (DfMA)** for increased efficiency and standardisation.

3. **Go for proper lean, industrial methods.**

4. **Use BIM technology** between the partners in the development chain (architects, consultants, constructor, principals etc.)

5. Transition your construction philosophy **from building to buildings: take a product approach.**

6. Create or use a standardised process.

7. Industrial process: **set up partnerships (chain integration)**

8. **Choose easy solutions:** Develop your strategy in stages, starting off with easy solutions **(no 3D printing yet!)**



6. EXAMPLE BUILDINGS AND PROJECTS



Figure 24: Hotel Jakarta, Amsterdam, interior. Source: Pascal Chazal.

Hotel Jakarta, Netherlands

A good example of offsite production is Hotel Jakarta, in Amsterdam, Netherlands. Modules for the rooms were completely finished in the factory, with concrete floors with piping/electrics included, and delivered to the site. The whole hotel was constructed in only one-year time, resulting in much less noise for local residents. Modules also arrived at night, when traffic was at its lowest level, to speed up construction.

Ikea Boklok Project: Sweden and Estonia

Ikea's Boklok project in Sweden is a good example of affordable, residential offsite construction. Although people can't change anything inside, they can access good quality, affordable 1, 2- and 3-bedroom family homes, and they get some money to buy IKEA furniture as part of the package.



Figures 25 and 26: Ikea Boklok examples. Source: Pascal Chazal.



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