How offsite construction can help address the housing crisis



October 2021

How offsite construction can help address the housing crisis How offsite construction can help address the housing crisis

FOREWORD



Offsite construction offers a valuable solution to several issues facing housing delivery in Ireland - increasing the speed of delivery, delivering more sustainable homes, and reducing the need for onsite labour. This contribution can only be achieved, however, if there is engagement from all stakeholders, including the offsite construction sector itself and the government.

The increasing use of offsite construction methods demonstrates the commitment of the Irish property and construction sector to the adoption of new technologies. Increasing the use of offsite construction in Irish building is an important approach to supporting innovation in the sector, and to encouraging further investment.

PII are pleased to see the focus on MMC and off-site construction in Housing for All, the Government's recent housing policy. Off site construction can play an important role in addressing some of the issues facing us at present – by allowing a more rapid delivery of much need homes and by helping to contribute to Ireland's and the constructions sectors efforts to meet national and sectoral climate change targets.

I am grateful to the companies that gave of their time and allowed us to benefit from their expertise through a series of meetings as we prepared this report.

David Duffy Director PII

PII Sectors





PII Vision A sustainable Irish Property Industry which is creative, responsive, competitive and well integrated in meeting the socio-economic needs of all the stakeholders in the built environment.

PII Mission

To be the trusted partner and provider of "evidence based" information, policies and strategies for the property industry at National level, to the Oireachtas, Government, Local Authorities and Agencies, and for the benefit of the people of Ireland.





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SUMMARY & RECOMMENDATIONS

While many express a willingness to embrace modern methods of construction (MMC), the use of offsite construction is often considered on a project-by-project basis. To maximise the benefits from offsite construction, however, it is necessary for scale to be achieved in what is a manufacturing industry. To achieve scale, offsite construction approaches need to be considered early during the design phase.

By doing this, standardised designs can be incorporated into the project resulting in a more efficient and streamlined project delivery including reduced manufacturing timelines and costs. This report highlights that among other approaches, the government can play a key role in the development and adoption of offsite construction in Ireland by committing to procure a set number of units per annum.

The additional rewards from offsite construction are significant and will naturally accrue as the scale of offsite construction in Ireland increases. Offsite construction methods are increasingly being recognised as having huge environmental benefits such as building energy efficiency, reduction in waste, and reduced construction times due to focused quality control and highly automated manufacturing processes. Offsite construction reduces whole lifecycle costs of

building – some cost savings will be upfront, but additionally, using offsite building methods ensures high quality structures which afford the dweller energy cost savings over the life of the building, and the potential for reuse of the building materials.

The increased use of offsite construction will result in an increase in demand for manufacturing skills - creating jobs regionally. The need for conventional onsite labour which is increasingly difficult to find will be reduced. Scaling up offsite construction will help develop a highly skilled and diverse workforce with greater employment opportunities- again justifying the investment in this industry.

Property Industry Ireland (PII) supports the increased use of offsite construction - not only in public but also in private housing developments.

Increasing the use of off-site construction can benefit the sector and economy by:

- \rightarrow Enhancing productivity
- → Making residential accommodation more cost certain and cost-effective
- \rightarrow Delivering quality improvements
- \rightarrow Reducing costs, including running costs over the lifecycle of the home
- \rightarrow Providing stable jobs in rural locations
- \rightarrow Making construction safer
- \rightarrow Reducing waste, energy consumption and carbon footprint in construction
- \rightarrow Supporting investment in innovation

RECOMMENDATIONS

To help realise the benefits from offsite construction PII make the following recommendations:

- **1. Provide a continuous and stable pipeline:** Government commitment to a pipeline of work opportunities means businesses in the construction and the subsequent expansion of the offsite manufacturing sector in Ireland.
- **2. Minimum offsite construction requirements:** By mandating that a portion of future social and affordable housing be completed using offsite construction methods, the government will encourage more businesses to invest in offsite lifetime of the program.
- **3. Determination of current offsite capacity:** Active MMC companies are required to work with the government to help to define the current output capacity of the sector.
- 4. Establish a Modern Methods of Construction Forum: Government and Industry to establish an MMC Forum to share best practice relating to including certifiers and regulators.

5. Public procurement engages at the pre-tender phase:

Delivery of homes by offsite construction requires a different approach to public procurement to take account of the different production methods. Public procurement should engage with the MMC Forum at the pre-tender phase. Pre-tender engagement with the sector will define projects using building specifications that will allow the use of off-site construction in the delivery of units.

6. Development of labour force's offsite construction skills: Offsite construction companies to examine ways to collaborate with third level institutions and

7. Review of height restrictions:

The Irish Building Regulations apply to buildings constructed in Ireland. Part B of the Building Regulations is related to fire safety and Technical Guidance Documents (TGDs) provide guidance on its implementation. Currently, compliance with TGD B limits the use of timber and restricts its use in multi-storey construction. TGD B also specifically limits the use of combustible materials, e.g., timber, in residential buildings greater than 10 m in height, effectively limiting the use of timber buildings to a maximum of 4 storeys. It is recommended that the regulation be reviewed for multi-story construction and its widespread acceptance in other jurisdictions.

industry will be provided with certainty. This will result in inward investment in technology and skill

manufacturing which will in turn lead to increased speed of delivery. 30% represents a starting point - in line with other EU countries, however this could be increased to 50% -70% over the

manufacturing and commonality at design stage. This group should include all stakeholders

research centres to support specialist further education training within the sector.

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INTRODUCTION

Property Industry Ireland (PII) believes that offsite construction, which involves the partial or full manufacture of building structures at a manufacturing facility remote from the building site, can play a significant role in increasing housing supply, particularly the delivery of quality social and affordable homes.

The production of housing units offsite is a type of Modern Method of Construction (MMC) that includes modular and timber frame construction. In a study (published January 2020) conducted on behalf of the Scottish Government in conjunction with the Construction Scotland Innovation Centre and Scottish Enterprise, it was found that Scotland delivers more than 80 % of its new homes using offsite construction. Many of these projects are, open frame timber panels systems, however, systems such as closed panel, modular and volumetric homes are becoming more common.

Several offsite construction companies currently operate in Ireland. Companies such as DTE Manufacturing, ESS Modular, Kingspan Century, MHI and VisionBuilt have each invested in manufacturing facilities, products, and system development. While

these companies are currently delivering housing that meet all the current regulations and standards, they have the ambition and capacity to deliver significantly more homes into the Irish housing market each year. While the focus is on the delivery of housing, these companies also have the potential to deliver medium-rise apartments. Indeed, offsite timber frame construction has played a role in the delivery of housing since the late 1990s.

In this document, we focus on pre-manufacturing of primary structural systems - 3D (Modular and Volumetric) and 2D (Timber Frame and Light Gauge Steel).

PII believe that offsite construction can play an increasingly significant role in meeting Ireland's housing need, but some policy support is required to underpin an increase in scale and capacity.



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HOUSING SUPPLY

The property sector has increased the delivery of new homes into the market in recent years. Data from the CSO shows that completions rose from below 5,000 in 2014 to over 21,000 in 2019. Despite the impact of COVID lockdowns in 2020 the sector still managed to deliver over 20,000 units in 2020.



Growth in population has exceeded the increase in the housing stock since 2011. The CSO predicts continued population growth. From a current population estimate of around 5 million in 2021, by 2031 they estimate the population will have increased to between 5.2 and 5.6 million. By 2051 it is estimated the population will grow to between 5.6 and 6.7 million. Based on these projections it is estimated in the order of 35,000 new households will be formed each year¹.

The Programme for Government includes the goal to "Increase the social housing stock by over 50,000 over the next five-years". Thus, there is a need to examine a variety of different approaches to raise output from the sector. Additional built infrastructure, such as schools, hospitals, and places of work and leisure will also be required to support the needs of the growing population.

At PII, we believe that offsite construction can play a crucial role in ensuring housing output targets are achieved.

The Programme for Government (2020) commits to:

- \rightarrow Ensuring that the LDA uses modern methods of construction, including offsite construction, to deliver high-quality, sustainable homes quickly and at scale.
- \rightarrow Working to enhance productivity in the construction sector, including utilising modern methods of construction.

ALIGNED WITH ENVIRONMENTAL GOALS

Wider use of offsite construction will also help the delivery of sustainable construction that will make an effective contribution to meeting Ireland's climate change targets. The carbon footprint of the construction sector, including building construction and operations, is very significant, as highlighted in the annual status reports of the UN Environment Programme (UNEP) and the Global Alliance for Buildings and Construction. At a global level, buildings represent 28% of global energy-related CO2 emissions (39% when construction industry emissions are included), while the manufacture and use of construction products represent 11% of global CO2e emissions. The Green Deal launched by the European Commission in 2019 aims to make the EU the first carbonneutral region in the world by 2050. It sets an ambitious legally binding target of reaching netzero carbon by 2050. To get to net-zero carbon building stock by 2030, the International Energy Agency (IEA) estimates that by 2030 direct building CO2e emissions need to fall by 50% and indirect building sector emissions by 60%.

Moving towards offsite construction and specifying materials with a lower carbon footprint will help Ireland to drastically reduce embodied carbon in construction in the context of population growth and the need for 550,000 new homes by 2040.

Government has approved and published the final text of the Climate Action and Low Carbon Development (Amendment) Bill 2021, the aim

"Pre-consultation on the Circular Economy Strategy includes increased use of offsite design and manufacture, and Modular building design in the preliminary outline of actions for inclusion in the Construction Circular Economy Roadmap"

of which is to support Ireland's transition to Net Zero and achieve a climate neutral economy by no later than 2050. The Bill will establish a legally binding framework with clear targets and commitments set in law, and ensure the necessary structures and processes are embedded on a statutory basis to ensure achievement of national, EU and international climate goals and obligations in the near and long term.

The Bill includes an embedding of the process of carbon budgeting into law, Government is required to adopt a series of economy-wide five-year carbon budgets, including sectoral targets for each relevant sector, on a rolling 15-year basis, starting in 2021. Actions for each sector will be detailed in the Climate Action Plan, updated annually, while a National Long Term Climate Action Strategy will be prepared every five years.

Government Ministers will be responsible for achieving the legally binding targets for their own sectoral area with each Minister accounting for their performance towards sectoral targets and actions before an Oireachtas Committee each year. It also provides that the first two five-year carbon budgets proposed by the Climate Change Advisory Council should equate to a total reduction of 51% emissions over the period to 2030. The Bill introduces a requirement for each local authority to prepare a Climate Action Plan, which will include both mitigation and adaptation measures and be updated every five years. Local authority Development Plans will also align with their Climate Action Plan.

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Moving towards offsite construction and specifying materials with a lower carbon footprint will help Ireland to drastically reduce embodied carbon in construction in the context of population growth and the need for 550,000 new homes by 2040.

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WHAT IS OFFSITE **CONSTRUCTION?**

Contrary to perception, the Irish Property and Construction sector has shown a high degree of innovation over recent years and has embraced modern technologies, one of which is an increasing use of offsite construction. Another example include the use of Building Information Modelling (BIM) in the design and manufacturing phases. These innovative systems allow construction data to be processed enabling components to be designed and machine manufactured to extremely high levels of accuracy.

"Offsite construction can be categorised as a MMC technique"

"Volumetric forms of offsite construction have also been used successfully in other sectors, both internationally and in Ireland"

Offsite construction can be categorised as a MMC technique which itself has been defined as "The manufacture and pre-assembly of construction components, elements, or modules, in a factory before being fully assembled onsite. There are four main categories: panelised systems, modular or volumetric systems, sub-assemblies and components, and hybrid systems (which combine different categories)2."

Offsite construction is a delivery method that adds substantial value to a product and process due to being manufactured and assembled in a controlled and highly automated environment. Part or all of the construction process is completed in a location other than where the final building is going to be situated. The objective is to deliver elements of the project to the construction site at an advanced state of completion. This can range from individual building elements that are completed and transported to the building site for assembly, to full modular construction in a factory setting. This removes site activity from the construction process. While there is not a fixed metric, offsite construction is where the construction value added offsite is at least 55% of the final construction value at completion. In some cases, this may be in a three-dimensional volumetric form or more commonly for housing in open or closed panel form.



Photo Top Left SISK/Vision Built

Photo Bottom Left Kingspan Century Photo Top Right BAM/MHI

Photo Bottom Right DTE/Glennon Brothers

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"The UK have introduced the concept of a Pre-Manufactured Value, or PMV as it is more commonly known"

"Volumetric forms of offsite construction have also been used successfully in other sectors, both internationally and in Ireland"

The UK have introduced the concept of a Pre-Manufactured Value, or PMV as it is more commonly known. This PMV value calculates how much of the home is manufactured offsite in a controlled environment. A project that is predominantly traditional construction will have a low PMV, whereas a modular based construction project would be likely to have a high PMV. In the UK a PMV estimation tool, linked to the 7 categories of MMC, has been developed which is linked to the Homes England funding prospectus for the Affordable Homes Programme 2021-2026.

Volumetric forms of offsite construction have also been used successfully in other sectors, both internationally and in Ireland. For example, ESS and Vision Built have delivered various education and healthcare facilities using modular construction in both Ireland and the UK. In this paper we focus on the positive effect that extending offsite construction to the housing sector will have on meeting future housing needs.

Definitions of various types of offsite construction have also been developed in the UK by a specialist sub-group of the MHCLG. MMC cross-industry working group (see Annex 3). For this document, we will be focusing predominantly on categories 1 and 2.

Category 1: **Pre-Manufacturing - 3D primary structural systems**

A systemised approach based on volumetric construction involving the production of three-dimensional units in controlled factory conditions. The components are preassembled and delivered to site. These modules are usually steel framed and already fitted out with all internal components, minimising any work to be completed on site. An example of 3D structural systems would be Modular or Volumetric.

Category 2:

Pre-Manufacturing - 2D primary timber structure

A systematic approach using flat panel units used for floor, wall and or roof structure. Predominately made from timber, the most common approach is to use open panels which consist of a skeletal structure only, with services, insulation, external cladding and internal finishes added on site. More complex panels typically referred to as closed panels - involve more factorybased fabrication and include lining materials and insulation. These may also include services, windows, doors, internal wall finishes and external claddings. The system includes structural performance for primary walls and all floors.



Photos Top **Tipperary South General Hospital** 40-bed Ward Extension, ESS Modular

Photos Bottom ESS Modular Units In this paper we focus on the positive effect that extending offsite construction to the housing sector will have on meeting future housing needs.



ESS Modular Apartment Development Site, London

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BENEFITS OF OFFSITE CONSTRUCTION

There are several benefits from using offsite construction. Speed of delivery is most cited but there are a range of additional benefits that will also arise from increased use of this construction method. Off site construction is less weather dependent. Increasing the use of offsite construction in Ireland will increase predictability, quality assurance, faster construction times, less waste, less noise and disruption to neighbours, less, possibly zero defects, lower site accident rates and improved health and safety.

The benefits include:

- SPEED OF CONSTRUCTION \rightarrow
- **ADDITIONAL CAPACITY TO DELIVER** \rightarrow **ON HOUSING NEED**
- **HIGH QUALITY** \rightarrow
- **ENVIRONMENTAL BENEFITS REDUCED** \rightarrow **CARBON FOOTPRINT/ENERGY EFFICIENCY**
- WASTE MANAGEMENT \rightarrow
- **ECONOMIES OF SCALE** \rightarrow
- \rightarrow **REGIONAL EMPLOYMENT / SKILLS DIVERSITY**

OFFSITE: CONSTRUCTION SCHEDULE



START

SITE BUILT: CONSTRUCTION SCHEDULE

|--|

START

Offsite and onsite construction timelines (From: Building Offsite, An Introduction)



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FINISH

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PEED OF **CONSTRUCTION**

Offsite construction improves the delivery time of construction projects by streamlining the process in a controlled environment. This can have numerous knock-on benefits including less time on-site, limiting noise pollution and other environmental impacts for homes and businesses in close proximity to the site. It will also result in quicker delivery of homes for families in need. Use of offsite construction enables interior trades such as plastering and electrical wiring to begin work earlier in the build programme, as the interior will be exposed to weather for less time. For example, Glenveagh Properties have found that construction using a timberframe unit can reduce the construction time of a single unit by 4 to 6 weeks. Couple this with improved efficiencies across trades and finishing and the total time saving can be up to 8 weeks'



ADDITIONAL CAPACITY TO DELIVER ON HOUSING NEED

Developing and supporting offsite construction will help to increase the housing delivery capacity of the construction sector. It can work in conjunction with the use of traditional construction methods to complete more homes each year. It is estimated that offsite construction (timber-frame and volumetric/modular) delivered approximately 6,300 units in 2019, approximately 30% of the total output. Of the 6,300 units delivered in 2019, it is estimated that approximately 5,000 were timber frame and the remaining 1,300 were constructed via volumetric/modular methods. A study on offsite construction in Scotland found that, in 2020 there were an estimated 33 companies manufacturing offsite homes in Scotland, employing more than 1800 people. This figure is set to rise to 1900 by 2023. The capacity of the companies to supply the housing sector in Scotland is the equivalent of approximately 12,400 units per annum.



The use of offsite construction, more akin to modern industrial manufacturing, means that most quality control and checks can take place in a controlled and safe environment. This way there are not the same pressures and restrictions as would be normally associated with quality control on-site such as weather impacts or planning permission time restrictions/limitations. In addition, this reduces the number of minor defects that a contractor must rectify before a home can be occupied (snagging). This also means that onsite construction time is reduced, translating into reduced onsite risk exposure.

Offsite manufacturing means that it is an engineered product produced in a manufacturing facility with controlled quality assurance in fabrication. Thus, off site fabrication can allow a high quality to be achieved. In addition, the manufacturing process allows a more efficient use of material due to controlled engineering and fabrication. Material stock control can be managed very closely, and precision cutting can be used to ensure minimal material waste.

All offsite construction buildings are designed and constructed in accordance with Irish building regulations. The timber frame sector is governed by IS 440:2009 +A1:2014 which is an Irish standard for timber frame construction launched by the NSAI in 2009. Three dimensional or volumetric forms of offsite construction are built in accordance with NSAI Agrément.

BENEFITS REDUCED CARBON FOOTPRINT/ **ENERGY EFFICIENCY**

Decarbonising our built environment will require investment in sustainable and off-site construction. An increased focus on environmental standards and targets for the reduction of the impact on the environment highlights benefits from the use of off-site construction. Use of off-site results in reduced road traffic movements, with congestion and pollution benefits, reduced energy use on site, reduced waste and reduced energy use in operation. These benefits remain in place when account is taken of energy use at the manufacturing operation. Many of the sustainability benefits are coupled with financial benefits for the developer and the home-owner.



Offsite manufacturing solutions have a reduced impact on the environment compared to traditional construction through the use of a controlled manufacturing process. Most process waste will not leave the manufacturing site and can be more easily managed and subdivided for recycling. In addition, this greater control of the process leads to increased productivity and a more streamlined manufacturing process. Research has found that use of offsite timber or steel frame structures can deliver 6-22% less waste when compared with traditional construction (BRE UK analysis).



ECONOMIES

An increase in the use of offsite construction will decrease the overall overheads of offsite construction manufacturing facilities. This in turn will lead to increased efficiencies and lower costs of construction. These economies of scale can only be achieved once there is sufficient throughput from demand for offsite output. Economies of scale will increase the speed of project delivery and drive down the costs charged to the client.

Many of these benefits are already being enjoyed through the delivery of some off-site construction projects in Ireland. However, to maximise the full benefit from offsite construction, a government commitment to increase the scale of offsite construction is required. Increasing the use of offsite construction methods will support the delivery of more homes and will also help meet environmental targets.









REGIONAL **EMPLOYMENT** / SKILLS DIVERSITY

Offsite construction manufacturing facilities are for the most part in rural locations, providing employment in regional locations. This regional employment will have a two-fold effect of helping to upskill local jobseekers and generating positive economics in communities surrounding offsite facilities.

Offsite construction represents an opportunity to make a much higher proportion of the home's value (i.e. pre-

manufactured value or PMV) elsewhere and distribute much more value in other parts of the country whilst retaining jobs and opportunities regionally where they are most needed, according to the National Development Plan.

In addition, the construction industry workforce is aging, and offsite construction offers the opportunity for older construction workers to continue to earn a livelihood in a safer environment, as well as being a more attractive career option for school leavers and will be more attractive to potential new entrants and attract a greater diversity of recruit.

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"...the time required to construct and commission an offsite building being typically reduced by 50% - 60% in cases where large elements can be prefabricated..."

BuildoffSite OFFSITE CONSTRUCTION: Sustainability Characteristics June 2013.

George's Place, Dun Laoghaire, Co. Dublin, Kingspan Century.

Irish Green Business Council Award Winning NZEB project -Nearly Zero Energy Buildings (achieved NZEB standard prior to it becoming a regulatory requirement). The scheme is designed by Dún Laoghaire-Rathdown County Council's architects.

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Some of these are challenges that the MMC sector itself must address through engagement with the public and private homebuilding sector.



PIPELINE UNCERTAINTY

Given the financial investment required to establish offsite construction capacity, pipeline uncertainty in the housing market is a key challenge for home builders looking to use offsite construction. The time it takes for a development to move through the national planning system has been highlighted by PII as a key issue in the delivery of homes. Its unpredictability means that pipeline cannot be assumed until planning is completed leading to uncertainty for the industry. This is particularly challenging for those working in offsite construction as efficient factory production requires regular workflow and labour planning which remains difficult without a long-term view of work opportunities.

DESIGN FOR MANUFACTURE

At present, housing design is very fragmented in Ireland. There is a need for greater amount of standardisation in housing design to allow a more efficient use of offsite construction products. Having a wide range of designs also makes it difficult for developers and the government to benefit from economies of scale that would accrue from sustained output from a factory production line. There needs to be a move towards a 'Design for Manufacture' approach where industry stakeholders collaborate and define a standardised overall design.

→ ROLE OF GOVERNMENT **PROCUREMENT MODEL**

A key goal for public procurement is the delivery of value for money projects. While PII recognises the huge importance of value, we also see that the lowest price tag does not always ensure the best products for homeowners. Accordingly, guantifying value for money in the delivery of housing should also focus on product quality. The government currently has set ambitious targets for itself for the delivery of social housing. Use of off-site construction will help in meeting this target. The public and private sector can work together to help the delivery of off-site units into the market. Pre-tender engagement with the sector to help define projects using building specifications that will allow the use of offsite construction will allow the delivery of units.

In addition, use of offsite construction will help meet environmental targets and so when assessing building concepts through a "value for money" lens, it is important to recognise that from a whole life cost perspective, higher initial capital expenditure can deliver the economic outcomes of higher productivity, better quality and lower carbon.

FELLING LICENCES

For Ireland to embrace the concept of offsite construction (timber frame in particular), timber must be readily available to all manufacturers. Felling licences have become a major issue within the Irish Forestry industry in recent years. Delays in issuing felling licences has put the supply chain at serious risk. Failure to address this problem could lead to huge disruption in the planned felling programme and will prevent enough timber being delivered to the country's sawmills which will in turn put Ireland's domestic supply of timber at risk.

CHALLENGES TO THE INCREASED USE OF OFFSITE CONSTRUCTION

Outside of housing, offsite construction has been used successfully in Ireland in several sectors including healthcare and education. However, due to the relatively small size of the Irish market and the risks involved in investing in offsite construction methods, there has been a slow take-up of offsite construction.

Offsite construction is attractive where there is sufficient demand. There is a need for this demand to be of a common standard design, otherwise the benefits of offsite construction are lost. Offsite construction can decrease both cost and construction time if designs are standardised, and if scale is provided. Any downtime undermines economies of scale and this can only be offset with clear planning and a sufficient demand for offsite construction.

Government, as part of its housing policy planning, should work with industry to assemble and publish a comprehensive pipeline of demand in the new build housing sector. This should be along the same lines as the National Infrastructure Pipeline, seeking to bring private developers and investors into this as far as possible to assist with longer term innovation and skills investment planning.

Farmer Review of the UK construction industry (2016)

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Offsite construction is attractive where there is sufficient demand. There is a need for this demand to be of a common standard design, otherwise the benefits of offsite construction are lost.

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RECOMMENDATIONS ON HOW TO SUPPORT OFFSITE CONSTRUCTION

Property Industry Ireland (PII) believes that offsite construction can play a vital role in meeting the estimated levels of housing demand. Pll support the increased use of offsite construction not only in public but also private housing developments.

Several offsite construction companies currently operate in Ireland. PII believe support is required to underpin an increase in scale and capacity. It is estimated that off-site construction (timber frame and light steel gauge) delivered approximately 6,300 units in 2019, approximately 30% of the market.

In June 2020, as part of Project Ireland 2040, the Government published a paper entitled "Construction Sector Group - Building Innovation". The paper outlined the collaborative steps that both Government and industry needed to take to harness innovation and meet future demands placed on the construction sector.

These steps included:

The need to increase certainty and visibility of the pipeline of project opportunities to provide the industry with the confidence to invest and individuals to choose a career in the built environment.

The need for industry, particularly SME's and small firms. to increase its investment in innovation and technology.

The need for ongoing regulatory reform of public procurement, environmental, labour and other areas in order to streamline and assist in achieving competitiveness and sustainability.

RECOMMENDATIONS

Property Industry Ireland (PII) recommends the following to ensure offsite construction becomes an integral part of delivery housing in Ireland.

1. Providing a continuous and stable pipeline

Government should commit to a considerable social and affordable housing build programme using offsite construction methods. This would require a reform of procurement methods to facilitate and encourage the use of universal design-types.

This commitment would allow providers to invest in facilities and recruit and train staff as necessary to meet this demand. A key element of this commitment would be to use a limited number of repeatable designs.

This should be a multi-annual commitment. Certainty of demand will allow companies to invest and scale-up while also allowing government to take advantage of the economies of scale available at higher volumes of production.

2. Minimum offsite construction requirements

By mandating that a portion of future social and affordable housing is completed using offsite construction methods, the government will encourage more businesses to invest in offsite manufacturing and to commit to increasing the speed of delivery. 30% represents a starting point - in line with other EU countries, this could be increased to 50%-70% over the lifetime of the program.

3. Determination of current offsite capacity

Active MMC companies are required to work with the government to help to define the current output capacity of the sector.

4. Establish a Modern Methods of Construction Forum

Government and Industry to establish an MMC Forum to share best practice relating to manufacturing and commonality at design stage. This group should include all stakeholders including certifiers and regulators. Wider acceptance of Offsite construction requires work and engagement by all stakeholders, including the offsite construction sector itself. It is important the offsite construction companies work with the private and public sector to highlight the benefits from offsite construction and how these benefits will be achieved. There are challenges but these can be overcome through cooperation and consultation.

5. Public procurement engages at the pre-tender phase

Delivery of homes by offsite construction requires a different approach to public procurement to take account of the different production methods. Public procurement should engage with the MMC Forum at the pre-tender phase. Pre-tender engagement with the sector will define projects using building specifications that will allow the use of off-site construction in the delivery of units.

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6. Development of labour force's offsite construction skills

The fallout from the economic recession substantially reduced employment in the construction sector. This in turn saw the numbers studying construction related disciplines reduce dramatically resulting in a skills shortage for the sector.

Further use of offsite construction would lead to increased levels of manufacturing output and as a direct result would increase the demand for specialist manufacturing skills and resources, as well as some traditional construction skills. In line with Future Jobs Ireland, companies in the offsite construction sector are keen to liaise with the education sector to develop new and innovate upskilling programmes for the sector. These programmes would complement the existing suite of courses available and would include degree level qualifications, apprenticeships, springboard programmes etc.

In 2019, the Scottish Construction Innovation Training Board announced £1.2M in funding for training programmes specifically for offsite construction. This funding will increase the skills capacity within offsite construction and will target school leavers and existing staff looking to upskill. This investment will futureproof the skills needs of this sector as it continues to grow in the future.

7. Review of height restrictions

The Irish Building Regulations generally apply to buildings constructed in Ireland. Part B of the Building Regulations is related to fire safety and Technical Guidance Documents (TGDs) provide guidance on its implementation. Currently, compliance with TGD B limits the use of timber and restricts its use in multi-storey construction. TGD B also specifically limits the use of combustible materials, e.g., timber, in residential buildings greater than 10 m in height, effectively limiting the use of timber buildings to a maximum of 4 storeys. It is recommended that the regulation be reviewed for multi-story construction and its widespread acceptance in other jurisdictions.

Housing Projections and Environmental Targets







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ANNEX 1 ACKNOWLEDGEMENT

This policy paper has been prepared by PII following consultation with our members. We are grateful to these member companies for their time and input.

These members are:









🔰 ESS modular



ANNEX 2

MANUFACTURING COMPANY PROFILES AND CASE STUDIES

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How offsite construction can help address the housing crisis

INNOVATION INCREASING SUPPLY

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DTE Manufacturing Ltd part of Glennon Brothers, specialise in the supply and installation of timber frame homes and engineered roof trusses to the construction industry and to one-off self-builders. With manufacturing facilities in both Ireland and the UK, DTE have been providing closed panel, timber frame homes to the Irish market since the early 1990's.

This project, located in County Louth, consisted of 50 social and affordable housing units, and was delivered using timber frame construction. The 50 units were manufactured and installed over a 28 week period.

Il units achieved an A2 BER Energy rating which included a U-Value of 0.18 W/m2k and an air filtration rate of 2m3/hr/m2 @50Pa. In addition to this, all walls were insulated, airtight and pre fitted with plasterboard to achieve a 60mins fire rating. All homes were also fitted with 304 mm Open web joists flooring systems for ease of M&E installation. All of these features were designed to achieve homes that not only look good, are environmentally friendly and are constructed in a short period of time.



💋 ESS modular

ESS Modular is an industry leader in modern methods of construction (MMC) in the UK and Ireland. Founded in Dublin in 1989, the company currently employs 280 people across five sites in Manchester, Dublin, London, Belfast and Laois. The company manufactures steel framed buildings in a controlled environment offsite for the residential, healthcare, education and commercial sectors. The precision manufacturing process includes fitting out the building up to 80% before transporting to site where all siteworks have been completed. ESS Modular operates solely as the Main Contractor and has the capacity to manufacture up to 3000 modules per annum across its three manufacturing facilities.

Spectrum House is a residential complex consisting of 42 high-end apartments build in a densely populated location in north London with restricted access routes and surrounding neighbours. As part of the early design development, the client indicated their desire to add an additional floor to the building. ESS allowed for the additional floor during the foundation design to ensure there was no knock-on effect. This demonstrates how flexible and adaptable this method of construction is.

All units achieved an A-Energy rating and included solar PV, triple glazed windows and a mechanical ventilation heat recovery systems. The project included all mechanical and electrical installations, decorations, external hard and basement parking. The transport and installation process took just 21 days on site from finished foundations to full building envelope being installed and sealed.

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Kingspan Century specialises in innovative modern methods of off-site construction such as timber frame walls, floors, and roof systems. With its primary manufacturing facilities based in Co.Monaghan, Kingspan Century have over 40 years' experience in the design, manufacture, and erection of Engineered Timber Frame systems.

This social housing project, located in South County Dublin, consisted of 90-, 3- and 4-bedroom, timber frame homes and was completed by Kingspan Century 2019. The structures for the initial 73 units were manufactured and site assembled in just 13 weeks. Phase 2, consisting of 17 units, was subsequently delivered over a 7-week period.

All homes achieved an A2 BER rating (average 46kWh/m2/a) and an air infiltration rate of less than 2m3/hr/m2@50Pa. The timber frame building system, which consisted of a 0.15 W/m2k U-Value Closed Panel External wall system, practically eliminated thermal bridging. The high dimensional accuracy of the construction system also enabled components such as windows and kitchen units to be preordered based on the timber frame fabrication drawings and provided reliability for standardised M&E installation layouts. All of which contributed to the speed of construction.



🖬 bam 🔍 MHI

MHI provide a quality assured, factory controlled, off-site volumetric build system serving the residential construction sector in Ireland. Their steel frames volumetric homes are constructed at their manufacturing facility based in Co.Cavan. This lowrise residential system allows for 80% of the homes construction to be completed off-site.

This social and affordable housing project, located in Ardee, Co. Louth, consists of 102 housing units delivered using offsite rapid system builds. The main superstructure is made up of structural grade cold formed steel.

The project took 20.5 weeks to manufacture, 12 weeks on site to install and the overall site duration was 48 weeks for all 102 units to be handed over. Over 90% of the superstructure and finishes of the houses were constructed offsite in a quality-controlled manufacturing environment (including all internal finishes such kitchens to bathrooms). This Factory Production Control process is audited by MHI's in-house team and also externally by the NSAI to ensure conformance to certification. MHI managed all aspects of the project including design, construction, civil works, volumetric manufacturing, on-site installation, external completions and final certification and handover.

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VisionBuilt is an Ireland and UK based company specialising in the design, manufacture and installation of offsite rapid building structures using modern method of construction. Vision Built have in excess of 30 years' experience and employee 38 members of staff and operate across two West of Ireland manufacturing facilities with over 125,000sq foot of capacity. Their products are fully certified with NSAI Agreement and SCI certification for up to ten floors across Europe and the UK.

This rapid build social housing project, located in Dublin City, consisted of 88 residential units which were completed in 2019. The project was delivered using 2D panelised light gauge steel including floor joists, walls and roof joists. This lightweight method of construction meant that the foundation design was greatly reduced (and thus critical factors of cost, programme, carbon footprint, etc). Floor area of total of 8,824m² installed in total 29 weeks.

Cherry Orchard (Phase 2) consisted of 52 terrace housing units (28 3 bedroom and 24 2 bedroom houses) with a floor area of 5,275m². Installed took just 17 weeks. Cherry Orchard (Phase 2A) consisted of 19 terraced housing units (16 2 and 3 3-bedroom houses) with a combined floor area of 1,824m2m². Installation took just 6 weeks. Woodbank Drive consisted of 4, 3 bed terraced housing units with a combined floor area of 406m². Installation took just 1 week. Rathvilly Park consisted of 13 terraced housing units (7 2-bedroom house & 6 3-bedroom houses) with a combined floor area of 1,319m². Installation took just 4 weeks. As a direct result of this project, Dublin City Council has since specified Light Guage Steel in selected Rapid Build tenders, because of their positive experience with LGS.

ANNEX 3 DEVELOPER CASE STUDY

Glenveagh Properties is one of Irelands leading homebuilders and is committed to providing customers with great value, high quality homes in the areas they want to live in. Glenveagh Properties has a strong commitment to innovation, embracing modern methods of construction and new technologies, contributing to delivery targets and pursuit of their environmental and sustainability agenda.



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As part of an ongoing commitment to utilise the latest in construction technology and innovation, in October 2019, Glenveagh Properties acquired a 175,500 sq. ft. facility in Dundalk, Co. Louth to develop a timber-frame manufacturing facility and entered into an exclusive multi-year supply agreement with Keenan Timber Frame (KTF). At present timber-frame manufacturing accounts for approximately 750 units yearly. With manufacturing operations expanding an incremental increase in production to over 1500 units by 2025 is expected. At present approximately 75% of Glenveagh Properties housing stock is delivered through timber-frame construction and central to the use of timber-frame is the ability to own and control critical path items and the ability of timber-frame construction to integrate with site processes. Investing in timber-frame manufacturing helps Glenveagh Properties scale production with demand, assure quality, improve energy efficiency of units, add value to the house kits by reducing the number of moving parts, imprint high standards of health and safety, target carbon neutrality, reduce carbon footprint and improve environmental management.

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ANNEX 4 HOUSING FOR ALL AND MMC

The Governments recent Housing for All includes initiatives related to MMC. PII welcome the focus on MMC and look forward to working with Government to ensure that these measures are implemented.

Housing for All includes a commitment to the promotion, development and support for innovation/modern methods of construction (MMCs) using digital and manufacturing technology, including support for SMEs to develop scale and to adopt MMCs and Building Information Modelling (BIM) techniques for residential construction.

The DETE, supported by the DHLGH, will promote a culture of innovation in residential construction. This will be achieved through, inter alia:

- development of Modern Methods of Construction (MMC);
- establishment of a Centre of Excellence Demonstration Park for MMC;
- publication of exemplar case studies of MMC developments;
- development of design for manufacture guidance for industry so that dwellings are suitable for MMC;

This work will be underpinned by the development of Key Performance Indicators for MMC and Cost of Construction, which will be reported on quarterly. The public sector will continue to provide exemplar projects to help with the capacity building process through public tenders for innovations such as rapid delivery housing and design and development of low-carbon buildings and will support enterprises to reduce cost of materials in construction.

Initiatives such as standardised design to better facilitate MMC at scale and lean construction management education will be rolled out.

Additional reading

Building Offsite: An introduction, Lead Author: Dr Robert Hairstans, Edinburgh Napier University

Farmer, M., (2016) The Farmer review of the UK construction labour model

Homes for Scotland (2015) Research into mainstreaming Offsite methods of Construction (MMC) in Housebuilding.

Taylor, S. Offsite production in the UK Construction Industry – prepared by HSE. A Brief Overview.

De'Ath, M and M. Farmer (2020) Build Homes, Build Jobs, Build Innovation: A blueprint for a housing led industrial strategy.

Increasing Offsite Housing Construction in Scotland: An evidence base to support new policy and systems, Final Report, January 2020

KPMG, 2016, Smart Construction: How Offsite manufacturing can transform our industry.

Daniela Krug and Professor John Miles, Offsite Construction: Sustainability Characteristics June 2013



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ANNEX 5 MMC CATEGORIES

The definition framework identifies the following 7 MMC categories:



1. Pre-Manufacturing - 3D primary structural systems

The components are delivered to site as three-dimensional modules, to be assembled there. These modules are usually already fitted out with everything internal, so there is not much to finish on site.

2. Pre-Manufacturing - 2D primary structural systems

A flatpack of floor and wall panels is delivered on site and assembled there. The rest of the building is completed on site either traditionally or combining other MMC solutions.

3. Pre-Manufacturing -Non systemised structural components

A series of structural components (such as walls, beams etc.) which are pre-manufactured (for instance, SIPs, fabricated steel or pre-cast concrete), transported to site and then site assembled to form all or part of the building's structure.

4. Pre-Manufacturing -Additive Manufacturing

3D printing is used to extrude part of a building such as concrete walls, or smaller structural or non-structural components using printers, which are located on- or off-site.

Pre-Manufacturing – Non-structural 5. assemblies and sub-assemblies

Items that form parts of buildings but not the actual structure. Think bathrooms or kitchens, cupboards, plant or distribution assemblies, roofing, facades etc.

6. Traditional building product led site labour reduction/productivity improvements

Building materials which have been improved so they don't need so much labour. Large masonry blocks, modular 'plug and play' wiring looms, jointless flexible pipework and so on. It can also include traditional building items that have been tailored and marked up before delivery to site, to reduce on-site labour. This includes materials such as skirting boards, tiling, facades etc.



7.



Site process led labour reduction/ productivity improvements

This category aims to encompass innovative site based construction techniques such as lean construction, augmentation, workface robotics, drones and the adoption of new technology led plant and machinery"



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