

## The Power of Modular as a Catalyst for Change

### Background

The Irish Construction Industry finds itself in uncertain times as Covid 19 continues to bring the sector to a halt. Figures such as those released by Ulster Bank's monthly construction purchasing managers' index show that the industry has fallen to 28.9 in March from 50.6 in February. The plunge represents the biggest and fastest since the height of the global financial crisis. Despite the current lockdown, modular construction continues to play a critical role in fighting this global pandemic. An example of this is the construction of Wuhan Caidian Huoshenshan Hospital, which was started on January 23<sup>rd</sup> and opened on February 5<sup>th</sup>. The hospital was quickly built because of its modular structure, which provided a housing-like form for each unit. With a site area of 34,000 square meters, the hospital can accommodate up to 1,000 patients. The wards are modular sanitary units that house many functions, including emergency treatment, surgical treatment, and clinical testing.

As the construction industry continues to stand still, it offers opportunities to look at alternative ways of doing business for when the sector eventually recommences construction activities post-Covid 19. The next CitA Digital Transformation Series to be held on 22<sup>nd</sup> April 2020, will provide a focus on using modern methods of construction (MMC) as a catalyst for change. This will be accomplished through presentations by four keynote speakers from Modern Homes Ireland, Project Etopia, Studio Ayno, and Reliance Interiors.

### Modern Homes Ireland

Modern Homes Ireland provides a quality assured, factory controlled, off-site volumetric build system serving the residential construction sector in Ireland. The company constructs quality assured steel-framed

homes and commercial buildings within a precision-controlled environment with units being up to 95% constructed before leaving the factory. Some of the key benefits of using the Off-site Construction model versus traditional methods are:

- Developers achieve significant cost savings within the areas of build cost and time savings (preliminaries, funding, etc.) and significant revenue gains through increased output of completed units.
- Reduced safety risk for all stakeholders by taking so much of the build process off-site and into a factory controlled environment.
- Superior quality dwelling offered to the end-user by utilising quality assured standards within a factory environment.
- Low Rise residential build system allowing up to 80% construction off-site.

The off-site phase can extend to fully mechanically and electrically serviced units rendered with bathrooms/ensuites tiled, and kitchens installed as required. Each module is fully snagged and thoroughly cleaned before it is shrink-wrapped and sealed and ready for delivery.

During the loading phase, modules are labelled with data identifiers for part, unit type, end site location, and other data that can be scanned by both Modern Homes Ireland and the end client. They are then carefully loaded onto transportation units through a high-precision moving and craning process, ready for distribution. Modules are transported using a specialist distribution partner, who arranges permits or escorts from the factory to the development. Modules are connected on-site using specialist lifting mechanisms. Two full residential units, including sealed roofs, can be installed and connected in just one day, meaning that just 20% of the construction needs to happen on site.

The build system has achieved NSAI Agrément certification and the factory production control system achieved an EN1090-1:2009 certification. Some recent projects include Daneswell Place, which is a high-end private development of 35 units with a mix of 3 storey terraced 5-bed homes. Other projects include the Black House Social Housing development for Túath Housing. This is a 26 home development utilizing 4 different house type designs.

As of January 2019, Royal BAM Group's Irish operating company has acquired a non-controlling share in Modern Homes Ireland. This will allow Modern Homes Ireland access to BAM's modular expertise in the Netherlands, where BAM Modulair Bouwen en Ontwikkelen has state-of-the-art production facilities in Veenendaal to develop innovative elements for or newbuild and renovation projects.



Figure 1: Off site transport.

## Project Etopia

Project Etopia provides an all in one solution to house building at a faster rate than traditional construction with smart technology integration. Project Etopia adapts an Ecitech framework that combines energy, construction, and intelligent technologies to build the homes of the future. This involves looking at the most sustainable solutions across all three sectors and combining them while keeping a focus on the broader environment. It is the harmonising of these three key industries that ensure the end product is not only

modern today but for years to come. Their E-home range combines modern, open plan living with low or no energy bills and state of the art technology.

Project Etopia uses a pioneering, lightweight, high performing, structurally insulated panellised build system that is manufactured off-site and delivered on-site. These builds are extremely high performing and beyond passive in design (2 x passive). This is the world's first global ready, any weather, BDA Agrément approved, stock and store panelling system, designed and engineered in the United Kingdom.

Project Etopia intends to address current CO2 emission concerns by using build methods that dramatically reduce emissions. Furthermore, all of their homes incorporate the very latest in energy generation and storage technology, meaning that the carbon debt of their homes is paid off within 5 years. An example of this is Project Etopia's Corby site, which is a contemporary collection of 47 new Energy+ homes. These homes have an Environmental Performance Certification (EPC) calculations of up to 105(A)/100. To put this into context, the average UK home has an energy performance of 60 (D), and to be classed Green, a home would need 80 (D). Project Etopia is far outperforming this metric.

Further to this, their homes emit -0.7 tonnes of CO2, compared to traditional builds that emit 6 tonnes. This means over a 25 year mortgage period; there is a positive impact of 167 tonnes on the environment, equivalent to taking an average car off the road for 36 years. The homes also achieve ultra-high airtightness that far exceeds the requirements of Part L and P of the building regulations. Figure 2 provides an illustration of the Tellus E-Home from the Corby site.

Some of the OT devices installed within their homes include sensors, automated blinds, and smart appliances. These appliances enable the user to react to the environment and help conserve energy. The company is involved in areas of research and development that will examine how to use this

surplus energy to help build the community through smart solutions.



Figure 2: Project Etopia E-Home Tellus

## Studio Ayno

Studio Ayno explains that their volumetric buildings are entirely constructed within a factory environment that uses the same codes and standards as traditional buildings but delivered in about half the time. These are then brought together and sealed on-site, then becoming one integrated wall, floor, and roof assembly.

Studio Ayno outline that modular systems are a series of modularised steel frames manufactured off-site to a high degree of dimensional tolerance. The frames utilise bearing wall panels, with additional columns/beams to frame openings between rooms, window openings and to support heavy roof-mounted structure and plant items.

Some of the benefits to modular include projects being completed 30% - 50% sooner than traditional construction due to modular construction happening in parallel with foundation work, therefore reducing lead-in time. This also means earlier occupation and faster return on capital investment. The construction of materials off-site in a factory ensures more efficient use of materials. Surplus material and fall off can be captured and recycled back into the inventory for use on other projects.

Modular construction is also better for projects where affordability and controlled cost is of primary concern. Once additional expenses, such as transportation are taken into account, if implemented correctly, modular should still be a more cost-efficient way to create value in the long term. The prefabrication of the bulk of a building in an off-site facility means that the construction process is much less vulnerable to delays due to poor weather conditions, facilitating a more predictable schedule.

The use of precise fabrication tools such as CAD/CAM and the ability to automate processes allow for a high level of control and consistency. This is important when it comes to the installation of high tech components, such as fire and security systems. Labour productivity is also increased when using an off-site approach as a more consistent crew, and a more controlled workflow will be less prone to disruption. Workers are also not exposed to hazards of extreme weather and other construction site dangers such as those related to noise and air quality, making for a safer site.

Some recent projects Studio Ayno have worked on include the CitizenM Tower Hill, which is a 370 modular room hotel. Other projects include the Marriott in Edinburgh, which is a fully modular hotel solution with innovations including no scaffolding as perimeter fencing is used along the edging.

## Reliance Interiors

Reliance Interiors work hand in hand with their clients to establish a team concept on every project they undertake from beginning to end and believe their success and consistent growth is attributed to this philosophy. Some of their services include load and non-load bearing metal framing systems, panelised wall systems, metal roof truss systems, metal composite deck systems, etc.

Reliance Interiors have now moved into the BIM space and have hired their first BIM Manager. With this, the new BIM Manager expects to bring knowledge of BIM from their existing jobs into their

new role. This includes using the model to be proactive by producing Request for Information (RFI) before the job moves into construction. The further federation and coordination of the model with other trade models enable a quick responses to the RFIs and immediate solutions.

The BIM model has been used to assist with procurement, especially in relation to materials. This ensures a steady workflow for material orders are in place, resulting in a just in time delivery framework. The ordering of correctly quantified materials ensures there is less waste and fewer trips to the cut station concerning the framing members. Further to this, the location and adequate labelling of materials will mean easier installation for workers. The model is used to produce fabrication drawings, which means that both managerial and trades personnel spend less time trying to understand drawings due to the extensive detailing and 3D images exported from the model. Improvements in safety are gained by using the BIM information to produce elements in a more controlled manufacturing environment. .

The panels are transferred to sites via trucks and installed using an LULL, which is designed to be used for the lifting and transportation of materials, its an all terrain forklift. As most of the structures are only 1-3 storeys high, it does not make financial sense to have a crane permanently on-site.

Some of the challenges include interoperability issues between the different trades. Other problems include poor-quality of models or trades, not accounting for sufficient openings between objects. Moving forward, one of the roles for the BIM Manager will be the integration of the trade professionals with mobile technologies concerning using the model for information.

## Conclusion

The Irish Construction Industry faces a period of uncertainty with a return to pre-Covid-19 shutdown levels potentially taking some time. This has resulted in the Irish Construction Sector now facing a period

of reflection where most businesses will need to re-engineer their business model to respond to this new crisis. The MMC discussed in this paper can offer a viable solution to some parts of the sector. Further to this, if ambitious targets set out in Governmental Reports such as *Project 2040* and *Rebuilding Ireland Action Plan for Housing and Homelessness* are to be achieved, then MMC will need to become a fundamental part of the construction sector.

## Acknowledgments

Michael Keohane (Modern Homes Ireland), Rosanna Lawn (Project Etopia), James Walsh (Studio Ayna) and James Hillegas (Reliance Interiors)

## References

1. Global Construction Review (2020) Covid-19 sees Irish construction industry "collapse", available at .< <http://www.globalconstructionreview.com/news/covid-19-sees-irish-construction-industry-collapse/>>/
2. Archdaily (2020) A Closer Look at the Chinese Hospitals Built to Control the COVID-19 pandemic available at< <https://www.archdaily.com/937579/a-closer-look-at-the-chinese-hospitals-built-to-control-the-covid-19-pandemic>

## Case Study prepared by

Dr. Barry McAuley (CitA/TU Dublin) and Dr. Alan Hore (CitA/ TU Dublin)

**Published:** April 2020