Is Prefabrication the Future of Construction?

by Matthew Stewart

A Thought Piece

TODD

Is Prefabrication the Future of Construction?

A Case Study looking at Royal Wharf Residential Development, London and the use of off-site prefabricated construction technologies.

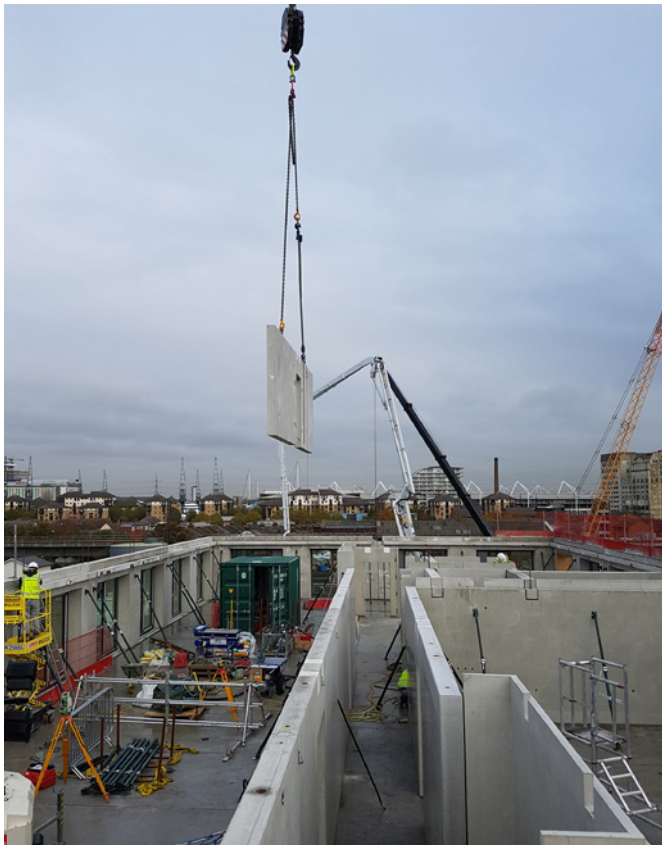
Prefabrication and off-site construction is currently one of the most widely discussed topics within the construction industry. Hailed by some, as the future of construction in GB & Ireland, it is seen as one of the industries answers to 'playing it's part' in the response to tackle climate change and reduce it's carbon footprint.

Prefabrication is not a new concept to the construction industry and has been utilised in different forms for decades. The term 'Prefabricated' is used to describe a multitude of building and fabrication methods by which units or components are manufactured off-site and then relocated to the construction site for final assembly or integration into the building.

At TODD, we have seen a trend towards prefabrication and modular construction in several sectors including residential, education, commercial and leisure. With a growing shortage of skilled workers and skilled trades personnel within the construction sector, the labour costs associated with traditional construction methods are gradually increasing and reinforcing the trend for Clients and Principal Contactors to consider the advantages and benefits of prefabricated and unitised approaches.

While prefabricated and modular building techniques have been around for many years, their prevalence is increasing due to the advancement of technology and the increasing accessibility to digital technology and software systems both in the design and construction stages. Adopting Building Information Modelling (BIM) as a design platform tool has become the 'new industry normal' and is changing the way designers create buildings. This digital and computer-driven process whereby the construction team build complete virtual models of their buildings is drawing parallels to other industry sectors such as product design, automotive and manufacturing. These product manufacturing sectors drive cohesive, integrated and innovative technology-based solutions to increase efficiency, quality and reduce energy usage and material wastage. Lessons learned from these other sectors are increasingly being utilised in the construction industry and gaining momentum through use of decentralised high tech offsite construction.

There are several ***advantages*** to a prefabricated approach worth considering:



Sustainability and Climate Change

North American philanthropists Bill Gates recently announced the release of his new book, "How to Avoid a Climate Disaster" (Feb 2021). Engaging in the climate discussion he said, 'buildings will be the most difficult innovation challenge of the climate crisis.' (The Independent, 20th October 2020). He wrote, "It's inspiring to see so much passion these days for dealing with climate change, and to know that the world has set some ambitious goals for solving it. What we need now are practical plans to reach those goals." The Microsoft founder and tech giant believes that technology can unlock solutions to this climate emergency challenge and insists "without innovation, there is no way."

It is estimated that the construction sector is responsible for 19% of global greenhouse gas (GHG) emissions. (NBS Statistic)

DEFRA Reported that in 2014 the UK generated 202.8 million tons of waste and the 59% of that number was made up of Construction, demolition and excavation waste. (NBS Statistic)

With regards to materials consumption, it is estimated that the construction industry in the UK accounts for approximately 55%, with buildings (including their operation) contributing 50% of total CO2 emissions. (NBS Statistic)

It is also estimated that 55% of the global industrial carbon emissions come from the manufacture and processing of five key materials: steel (25%), cement (19%), paper (4%), plastic and aluminium (3%). Of these materials, the construction industry is a primary consumer of cement and is responsible for consuming approximately 26% of aluminium, 50% of steel, and 25% of plastic. (NBS Statistic)

There is an immediate need for the construction industry to tackle these issues and embrace innovative technology-based solutions to reduce energy use, carbon emission and wastage.

Whilst innovations have been made to reduce energy usage and carbon emissions of building operationally, the industry needs to reduce the carbon impact of buildings themselves and develop more sustainable methods to construct buildings.

Off-site construction factories offer advantages of a controlled manufacturing process, whereby systems can be managed with the view to limit energy consumption or invest in energy-saving measures and green energy systems. Digital and computer-driven systems offer the advantage of precision, cutting materials precisely to reduce wastage through control and efficiencies.

Other management systems can monitor water usage and drive initiatives to offset carbon emissions and minimise the ecological footprint of the manufacturing process.

A prefabricated off-site approach enables building components and units to be manufactured in a controlled managed system whereby sustainability and environmental performance can be measured and managed responsibly.

Speed of Construction

As the old cliche says, 'time is money' and reduced construction time on site reduces project costs. Prefabricated approach offers the opportunity to 'speed up' the construction process and overall programme durations. Some specialist prefabrication manufactures have suggested that off-site approaches can be up to 50% faster than traditional construction.

Digital technologies can be utilised to reduce the delivery time through 24hr factories and automated techniques. Manufacturing of building components can happen in tandem with other site works and therefore not constrained to programme sequencing in traditional construction as well as programme risks associated with time lost due to weather of other unforeseen events.

For large scale projects, repetition and standardization of components can also lead to efficiencies and reduction of costs.

Prefabricated approaches can bring many time saving benefits to both the Contractor and the Client and in many cases, the cost associated with time saved often outweighs any cost premium over and above a traditional construction approach depending on market conditions.

Quality

Prefabricated construction is typically carried out in a controlled assembly line. These facilities are specifically designed and set up to manufacture the off-site components and are managed with thorough quality control checks and testing which would otherwise be more difficult to carry out if components were assembled directly at the jobsite.

Projects are not subject to limitations of geography or the location of construction skills in the vicinity of the jobsite. Prefabricated components are made in the same factory, on the same production lines by the same staff which bring the benefits of continuity of a skilled and trained workforce and associated quality control standards.

Site Safety

Prefabricated construction can bring some additional site safety benefits to a jobsite. Offsite components are made in a controlled environment with health and safety procedures. When fabrication is carried out off-site, less personnel are required at the job site to assembly the components.

Prefabricated components arrive on site as required. This can lead to cleaner, clutter free sites with less material storage and reduce risks of accidents.

The Future

Is the Prefabricated Construction the future of the Construction Industry? Is off-site construction the only sustainably managed future for the construction industry?

It is understandable to see the trend in Principal Contractors adopting new Modern Methods of Construction, notably off-site prefabrication. This is partially due to the increasing shortage of construction skills but also to take advantage of the benefits of improved efficiency, reducing construction time, improved quality as well as minimising the ecological impact.

The future growth of this construction approach within the industry will likely be influenced by the attitude of insurance companies, funders and property valuers. There have been a number of initiatives created to help remove the uncertainty around this type of construction particularly for valuation purposes. Schemes such as the 'Buildoffsite Property Assurance Scheme' (BOPAS) provide an accreditation for manufacturers to give confidence that the construction type is fit for purpose and will provide durability and longevity. Such schemes remove the risk to funders/lenders or the risk of mortgages being declined which in turn gives confidence to this part of the construction sector.

As the pace and demand for Modern Methods of Construction increase, which embrace efficiency, quality and importantly carbon neutral solutions, the key to the success of prefabricated solutions is a full- integrated approach between designers, manufactures and contractors as well as the confidence and 'buy-in' of clients to adopt these technologies and approaches and recognise the added value to a construction project.

TODD has been involved in a number of high-profile residential developments in the London Docklands which have utilised prefabricated off-site construction techniques. The Case study below describes how this technology has been used in the construction of Royal Wharf.

Royal Wharf, London

Royal Wharf is a Residential development located east of Canary Wharf in Central London with scenic views over the River Thames and adjacent to the Thames Barrier. The total development masterplan comprises over 3,300 homes along with retail, leisure and education amenities.

TODD were appointed to develop the design and to deliver 512no. apartments across 2 separate plots within the masterplan layout. Designated Plot 20 and Plot 24, the sites provide a mix of tenures from social affordable to private sales and PRS.

Plot 20 comprises of four individual blocks constructed over a basement and wrapped around a landscaped podium. Plot 24 comprises of three individual blocks wrapped around a central landscaped courtyard. The building elevations were designed with a vertical emphasis and articulated with brick recesses and considered detailing. The repetition and formal rhythm of the elevation openings was well suited to a prefabricated approach and enabled standardization of the panel arrangements.

A 'total prefab construction' approach was adopted. This consisted of an integrated system for both the structure of the building (floor slabs and internal walls) as well as the external envelope and façade.

Both plots were designed and detailed to utilise prefabricated concrete sandwich panels. These consisted of an inner concrete panel, an outer concrete panel onto which the facing brick was bonded, sandwiched between an insulated core. A concrete slab and frame was constructed to first floor level with external walls formed using 'traditional construction'. This created a base from which the remaining floors were built off using the Total Prefabricated system. Prefabricated units were used to form the façade, floors, party walls, stair and lift cores. The facade panels incorporated all architectural components such as ventilation grilles, windows and doors as well as the balcony supports. The balcony units were similarly prefabricated off-site and later fitted to the pre-prepared supports.

Delivery of this scheme required a high degree of 'front end' coordination. Utilising Building Information Modelling (BIM) and digital technologies, the complete building was created virtually which enabled the design to be to fully analysed and allowed for a 'clash detection' process to be carried out to ensure the prefabricated panels could be coordinated, manufactured and delivered to site in line with the delivery programme.

The use of prefabricated sandwich panels in a controlled off-site factory environment allowed for the integration of complex masonry details, including various bonds, feature courses and sawtooth patterns which would overwise be more difficult to achieve to a high quality and consistent standard using a tradition construction approach directly at the jobsite. The inclusion of the window systems within the panels at the prefabrication stage enabled a high-quality factory finish to be achieved on integrated metalwork.

Particular attention was paid to the interface details between the traditionally constructed ground levels and the prefabricated upper levels to ensure continuity of water and weather proofing, fire safety and acoustic attenuation measures.

The prefabricated panels were manufactured in the Netherlands before being transported by articulated lorry to the jobsite in London. Panels were assembled into position by site crane at a rate of one storey per week which significantly contributed to the fast delivery on this constraint project programme.

The off-site prefabricated approach has resulted in the speedy delivery of this project in Central London and the enabled a high-quality factory finish to be achieved.

Contact

Offices

London
18 Wells Street
Fitzrovia, London, W1T 3PG

T +44 (0)20 3146 9555
E info@toddarch.co.uk

Belfast
2nd Floor, Titanic House
6 Queens Road, Belfast, BT3 9DT

T +44 (0)28 9024 5587
E info@toddarch.co.uk

Dublin
The Old Barracks, 4A Lad Lane
Hagan's Court, Dublin 2, D02 T997

T +353 (0)1 6620 500
E info@toddarch.ie

Manchester
125 Deansgate
Manchester, M3 2BY

T +44 (0) 7485 315 354
E info@toddarch.co.uk

Directors

Paul Crowe
BA (Hons) DipArch RIBA MRIAI

Peter Minnis
BSc DipArch RIBA

Peter Moran
BSc (Hons) DipArch RIBA

Andrew Murray
BSc (Arch) BArch RIBA

Gary McConville
BSc (Hons) BArch RIBA MRIAI

Jim Mulholland
BSc (Hons) BArch RIBA

Daragh Coleman
BSc (Hons) BArch RIBA

Michael Edwards
FCCA