The Potential, Requirements, and Limitations of BIM for Offsite Timber Construction

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ABSTRACT

Offsite Timber Construction has the potential to deliver important benefits for the housing sector, but there are obstacles that prevent a more widespread adoption. The advent of Building Information Modelling (BIM) has the potential to address many of these, improving the process and enhancing the end product. The paper identifies the key aspects of offsite timber construction in which BIM can play a significant role, and describes the immediate benefits that can be derived from applying BIM to those, with an emphasis on the UK market. The respective limitations are identified and discussed. The issue of financial viability is addressed and suggestions are made about how research and government initiatives can provide support for those. Finally, the need for a mid-term paradigm shift in BIM is identified, moving towards a more open and extensible strategy for construction that can respond to the expanded needs of Offsite Timber Construction.

Keywords: BIM, Collaboration, Modern Methods of Construction, Offsite, Timber

1. INTRODUCTION TO OFFSITE TIMBER CONSTRUCTION

The housing sector in the United Kingdom is experiencing an upward trend in housing prices mainly caused by the long term imbalance between housing demand and number of homes built (Barker, 2004). In order to mitigate this trend, the UK government has encouraged the use of Modern Methods of Construction (MMC) to produce a higher quantity and quality of houses (Egan, 1998) with a clear strategy for efficiency and elimination of waste (Cabinet Office, 2011). Furthermore, a shortage of traditional skill trades such as carpenters or bricklayers has been identified with a potential consequence in quality (CIOB, 2008).

Offsite construction can be defined as the fabrication and the assembly or pre-assembly of building, elements, components or modules
before transportation to the site the structure is to be located. Modern Methods of Construction is a broader term with an emphasis on the building product used; according to the Barker definition (2004) MMC aims to improve business efficiency, quality, customer satisfaction, environmental performance, sustainability and the predictability of delivery project on the scheduled timescale. Although it is possible to employ on-site manufactured MMC, the more controlled production flow process of the offsite environment is a catalyst for the implementation of continuous improvement strategies and the reduction of waste.

The use and need for offsite and MMC are not new; the Manning Cottage was exported from the UK around the world in the early 19th century as colonial expansion brought a housing and skills shortage. After the Second World War, British housing was mass produced in a manner reflecting the car industry known as “system build”, applying production theory. System build, although implemented with good intention, failed mainly as a result of being overly production-focused and not customer orientated, resulting in poor public perception and architectural apathy. System build was however a step in the evolutionary process to the agenda further progressed in 1998 to “rethink” construction (Egan, 1998) in order to reverse the degenerative cycle and satisfy the demand for housing driven primarily by demographic trends and rising incomes. This corresponded with approximately £1.1 billion UK government investment by the end of 2005 in MMC (National Audit Office, 2005).

While offsite construction and MMC can be applicable to all materials, timber systems present a particularly interesting option. Sustainability is a key theme of MMC and the advantages of timber in this area are well documented. Sustainable development is not limited to energy consumption or carbon emissions; it is also about ensuring a better quality of life for all of us now and for generations to come. It includes three broad components: social, environmental and economic often referred to as the ‘triple bottom line’ (Shelbourne et al., 2006). Timber systems, from sustainably managed forests, when appropriately designed and detailed, can meet stringent building envelope demands, reducing thermal conductivity and cold bridging.

Particularly, Scotland is recognized as a major hub of timber platform frame (TPF) assembly, most notably for housing, with 73% of all new build houses in Scotland being produced by this method via companies such as CCG (OSM), Stewart Milne Timber Systems (SMTS), Scotframe and Oregon Timber Frame (Figure 1). By the year 2016, Scottish construction will account for over 1/3 of the TPF industry in the UK and has the capability to supply closed panels systems that are internally lined, externally clad with windows, doors and service runs included. The current challenge is to scale its capacity and do so given the need for:

- Skills at primary (architect, planner, site supervisor, project manager, etc.), secondary (plumber, electrician, carpenter, etc.) and tertiary (general laborer, administrator, schedulers) levels with an emphasis on holistic skill sets and an improved understanding of project management, scheduling and planning requirements.
- Demonstrating and recouping the added value of offsite construction (quality assured, just in time strategies, environmental impact and building fabric performance) particularly given the need for continued investment in research and development. This will require the misconceptions of the public, clients, lenders and insurers to be addressed.
- Informed investment decisions for Offsite, given the higher levels of capital and technical approval costs, will require strong business leadership and operational management skills combined with technical skills and knowledge.

In recent years, the introduction from Europe of large-format solid timber elements has given the construction sector the possibility of new horizons due to its inherent versatility.
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