

# Modern construction methods and sustainable built environment



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The term Modern Methods of Construction (MMC) generally refers to off-site and prefabricated construction. Over recent years the use of MMC has increased within the construction industry as Construction Company's look to develop quicker, cheaper and more sustainable construction techniques than that of traditional methods.

Sustainable Technology has been incorporated into construction to preserve the environment for future generations. The term Sustainable Development was first mentioned in 1987 in 'The Brundtland Report' as, "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This got individuals thinking of ways to reduce the carbon footprint of buildings by reducing waste and increasing their energy efficiency.

MMC has been influenced by the Latham Report (1994), "Constructing the Team" and The Egan report (1998), "Rethinking Construction". Both reports criticised the UK construction industry's poor performance and proposed a series of changes that were necessary to improve the performance of the construction industry. The Latham report looked at innovative ways to streamline the construction process and drive down construction costs. The Egan report highlighted the need to move towards sustainable construction with the emphasis on prefabrication and offsite assembly. (Ross, Cartwright, Novakovic, 2007).

MMC is now a primary method of construction for many construction companies due to the combination of skills shortages, new regulations, specific building needs and affordability. This has created an environment

where traditional methods of construction are no longer the only suitable option to consider. (Kelsey, 2005)

Through this research and adding to the existing knowledge already out there, it is anticipated to find out whether or not a sustainable environment can be achieved through MMC by comparing the advantages it brings over traditional methods of construction.

## **Aim**

The main aim of this research is to examine and discuss whether or not Modern Methods of Construction achieve a sustainable environment.

## **Objectives**

A number of objectives have been set in order to meet the aim. These are as follows:

- To investigate how big a role MMC plays in achieving a sustainable built environment
- To investigate the different methods of modern construction currently being undertaken in the construction industry
- To Identify and discuss the advantages and disadvantages of MMC
- To establish if MMC provides better value for money than traditional methods of construction
- To establish how the industry perceives MMC

## **Outline Methodology of the Research**

To achieve the aim of the research I will be using mainly qualitative research. This will involve researching literature regarding Modern Methods

of Construction from various journals books and websites. I will collect data by conducting personal structured interviews with a variety of different professionals within the construction industry to gain an insight into how MMC is perceived. The information collected will be analysed and be presented in tables and bar charts so it is can easily be understood. I will then analyse my findings and a come to a conclusion.

## **Chapter 2 – Literature Review**

### **2.1 Introduction**

This chapter will give a broad overview of the literature associated with MMC. Fundamental aspects of MMC will be researched including an insight into the current methods being used within the UK today. This chapter will also compare MMC with traditional construction methods and how it is perceived by the construction industry, which will be reinforced through an investigation of a project that incorporated a MMC into its build.

### **2.2 History of MMC**

MMC is a term used to describe a number of construction methods that differ from traditional methods of construction. Other meanings of the term include off-site construction, factory built and prefabrication. (Ross, Cartwright, Novakovic, 2007).

Off-site construction has been around for many years and can be traced back to the 19th century where it was first used in the Crimean War in the form of prefabricated timber houses and huts due to inadequate hospital provisions (Gibb, 1999). Gibb defines off-site fabrication as, “ whole buildings that are prefabricated and pre-assembled remote from their final destination and

installed in place with only the minimum of onsite work needed before they are fit for use.”(Gibb, 1999).

It wasn't until after the First World War in 1917 that the UK government introduced prefabricated housing to meet the demand for housing. This off site approach was seen as an alternative to traditional brick and block construction to help cope with the shortage of skilled labour and materials at this time (Ross, 2002). Between 1918 and 1939 various new methods of building homes had been developed that were based on the traditional methods of brick and block. Over this 21 year period 4.5 million homes were built however only 5% were constructed using what was considered at this time as new methods of construction (Taylor 2006).

It wasn't until the end of the Second World War that prefabricated housing really took off in the UK as traditional methods of constructing could not meet the demand for emergency housing. Taylor noted in 2006 that, “ the emphasis was to supplement traditional building operations with methods of construction using industrial capacity outside of the building industry” (Taylor, 2006). This approach of industrialised building methods was aimed at addressing skills shortages, to improve production, reduce costs and improve the quality of the final product. The “ industrialisation” was aimed at replacing houses destroyed by the war but also to complete the slum clearance programme started in the 1930s. It was these influences that pushed the industry to consider off-site construction again and resulted in various types of steel, timber and concrete systems being developed. This continued into the 1980s where prefabricated housing was dominated by timber frame systems and new technologies (Taylor, 2006).  
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Since then there has been a steady shift towards off-site construction as clients demand a better quality product, faster delivery and at reasonable cost (Gibb, 1999). However there is a stigma attached with factory based construction as people generally associate this method with the post war era where homes were built as a temporary measure to ease the housing crisis. Off-site construction is not just used for building homes it is also nowadays commonly used in the residential, health and educational sectors.

Since 2005 more and more key clients and construction firms are now choosing to use MMC on their projects with it now accounting for 10% of the construction market. Richard Odgen chairman of BuildOffsite believes offsite will continue to grow within the construction industry and predicts that by 2020 it will have gained 20% of the construction market (Wright, 2010). This is partly due to Private and public sector clients and major construction firms starting to see the benefits of MMC at keeping costs down and delivering projects within shorter timescales.

According to Nadim, Goulding (2008) off-site construction aims, “ to improve business efficiency, quality, customer satisfaction, environmental performance, sustainability and the predictability of delivery timescales”.

### **2.3 Types of Off-Site Construction**

There are many different types of MMC currently being used within the UK however MMC only accounts for a small percentage of the overall value of the UK construction sector. This is due to the industries reluctance to adopt new innovative building techniques as new technologies usually require new ways of working and thinking (Nadim, Goulding, 2008). Many people who are

currently involved in the off-site sector believe the time is right for the clients, designers and contractors who have ignored it in the past to now accept off-site construction and realise its benefits (OSM, JUL 2010).

Ogden has spent the last 10 years campaigning to change the industries perception of offsite and he now believes the UK is “ on the cusp of change” he says, “ We have been here many times before in a cycle where offsite has come up higher on the agenda, been discussed and then gone away again,” Ogden says. “ But I think this time will be different. In fact, I don’t just think, I know.” Change needs to be adopted in order to meet the fierce housing targets and lessons can be learned from other countries like Japan where offsite construction is a mainstream construction method (wright, 2010).

Ogden believes, “ the pressure to meet sustainability and carbon efficient/ neutral codes, will force firms to take offsite seriously”. These new codes introduced around the world are aimed at preserving resources and achieving a more sustainable built environment. Ogden goes onto to say, “ I am sure that carbon efficiency codes will soon become law. It is not hard to see that using products that have been made in a controlled environment will do a better job at meeting standards.” (Wright, 2010).

The government is planning to spend vast amounts of money on new schools and hospitals in the forthcoming years. Peter Bonfield, Managing Director of BRE’s Construction Division, says: “ Off-site construction is ideal for the health and education sectors because you can fully fit out an operating theatre or school room in the factory. Then, during the school holidays, you could add new classrooms without affecting the operation of the school, or

extend a hospital wing without disrupting the existing wards.” (OSM JUL, 2010) this demonstrates the benefits of off-site construction on delivering major construction projects.

The different methods of construction include:

### **2.3.1 Volumetric Construction**

Volumetric construction is also known as modular construction and involves the production of three dimensional units within a factory (Figure 2). Once completed the units are transported to site and stacked onto the foundation to form the structure (Figure 3).

All internal finishes, services and furnishings are completed in the factory therefore only a small amount of work has to be completed on site (Gibb 1999). Depending on the design specifications of the units some external finishes can also be installed in the factory and the small amount of work that is required on site is to make good joints between units (Ross, 2005).

Volumetric construction is considered to be most effective when used to construct hotels, student accommodation, fast food restaurants and hospitals where the construction of each floor is continually repeated as the NHBC states, “ Volumetric construction is most efficient when used for large numbers of identical units” (NHBC, 2007). Gibb (1999) also notes it can be used to construct highly serviced areas in buildings such as toilets/ washrooms, kitchens, plant rooms, building services and lifts (Gibb, 1999). The method has only recently been adopted by house builders where a typical house consists of four units and a roof.



Units can be constructed by almost any material however the most commonly used materials are steel, timber and concrete. Units are generally the same size due to transport limitations as noted by Ross (2005), “ usually less than 4m in width and, although unit lengths of 16m are possible, lengths within range of 8-12m are more typical”. This is to ensure the safe transportation of units to site without being damaged.

### **2. 3. 2 Panellised Systems**

This method of construction involves building flat panel units within a factory and assembling them on site to create the buildings structure. The two main types of panel that are used are ‘ open’ or ‘ closed’. An open panel system generally comprises of a metal or timber frame that is constructed in the factory then delivered to site where the insulation, services, windows and internal finishes are installed (Figure 4). A closed panel system differs from an open panel system as it can also be made from concrete and normally has windows, services, internal finishes and external finishes fitted in the factory before delivery to site (Figure 5) (NHBC, 2006).

### **2. 3. 3 Hybrid Construction**

This method of construction combines panellised and volumetric methods that are constructed in a factory and transported to site. Hybrid can also be referred to as ‘ pods’ and used for highly serviced areas such as kitchens and bathrooms within offices, hotels and student accommodation (Gibb, Pendlebury, 2006). The pods are delivered to site with all services and fittings in place ready to be installed (Figure 5). This reduces the level of trades needed compared with other components of the building. The Hybrid

approach brings flexibility to the development and reduces the uniformity of design (Taylor, Fisher, Wamuziri, 2009).

#### **2.3.4 Sub-assemblies and components**

This method covers items that are not commonly considered as off-site manufacturing but applies

Sub-assemblies or components that have been innovatively factory fabricated. Ross (2005) defines this method as, “ items that are not full ‘ systems’, but which use factory made components either within manufactured structures or within otherwise traditionally built structures”. However traditional components such as windows and doors do not constitute modern methods of construction as they are usually used in all types of construction (NHBC, 2007). The main categories sub-assemblies and components fall under are floor and roof construction, pre-fabricated foundations, wiring looms and prefabricated plumbing (Figure 6).