



postnote

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MODERN METHODS OF HOUSE BUILDING

Last week, the Government's Barker Review argued that a UK housing shortage is having widespread economic and social consequences.¹ Government estimates that by 2016 there will be 3 million new UK households. It recently published the Sustainable Communities Plan outlining a major new house building programme to help meet this growth. Government is encouraging modern methods of construction (MMC), which it says can achieve "a step change in the construction industry to produce the quantity and quality of housing we need".² Specifically, from 2004 a quarter of new publicly funded social housing must use MMC.

MMC primarily involves the manufacture of homes in factories, with potential benefits such as faster construction, fewer housing defects, and reductions in energy use and waste. This note describes the variety of MMC used by UK house builders and assesses the main costs and benefits. It then discusses issues including industry capacity and the quality of housing.

Background

History of MMC – prefabrication

Prefabricated housing has been used in the UK during periods of high demand, such as after the World Wars and during the slum clearances of the 1960s. In total about 1 million prefabricated homes were built during the 20th century, many of which were designed to be temporary. However, problems arose over the quality of building materials and poor workmanship, leading to negative public attitudes towards prefabrication. Nevertheless it has continued to be used in the UK for hospitals, hotels and schools, as well as for housing in other countries. MMC is a new term intended to reflect technical improvements in prefabrication, encompassing a range of on and off-site construction methods (see box).

What are Modern Methods of Construction?

Typically MMC involves the manufacture of house parts off-site in a specially designed factory. The two main products of MMC are:

- **Panels** – including ready-made walls, floors and roofs. These are transported to the site and assembled quickly, often within a day. Some panels have wiring and plumbing already inside them, making construction even faster.
- **Modules** – ready-made rooms, which can be pieced together to make a whole house or flat but are used most frequently for bathrooms or kitchens, where all the fittings are added in the factory. Also known as 'pods'.

MMC can also include innovative site-based methods, such as use of concrete moulds. A range of materials is used for MMC, the most common being wood, steel and concrete, although many houses built in the UK using MMC have a brick outer layer and so look like traditional houses.

Many of the benefits of using MMC for housing are as yet unproven or contentious. The issues section later in this paper covers each in more detail. However, Government and manufacturers suggest the main advantages of MMC are:

- **Economic** – MMC houses typically have fewer defects and can be built more quickly.
- **Environmental** – the houses can be more energy efficient, may involve less transport of materials, and produce less waste.
- **Social** – there may be fewer accidents and less impact on local residents during construction.

Current use of MMC

The majority of homes in the UK are still constructed using traditional 'brick and block' masonry. However, within the last few years there has been increased use of MMC for housing, driven by a range of factors including demands for faster construction and skills shortages. There is uncertainty about the amount of MMC housing

being built. A few large private house builders have recently invested in MMC factories so production will increase. It is estimated by the National House Building Council that about 10% of new UK homes are built using timber frames, and 5% using other MMC; equivalent to about 25,000 MMC homes per year. There are differences within the UK, most notably in Scotland, where timber frames have long been preferred, comprising around 60% of new housing. Other countries already make greater use of MMC than the UK (see box).

International use of MMC

In **Japan** 40% of new housing uses MMC. In other **European countries** there is also much greater use of MMC, particularly in **Scandinavia** and **Germany**. Indeed, some house building companies in Europe have started to export their houses to the UK; for example, one UK Housing Association is importing modules from Poland.

The reasons for greater use of MMC in these countries are uncertain, but suggestions have included:³

- in colder climates the building season is short due to bad weather – use of MMC allows quick construction.
- MMC building materials, such as timber, are more readily available.
- there is a greater tradition of self build housing. MMC appeals because faster construction reduces disruption to neighbours and allows earlier occupancy.
- there are cultural preferences for certain house styles, e.g. timber frame in Scandinavia.

Government policy

Housing demand and supply

The recent interest in MMC for house building is driven by a growth in the number of households in the UK: demand currently exceeds housing supply. The supply of new housing in the UK is currently about 175,000 dwellings per year, its lowest level since 1945. The number of households is predicted to rise by 3 million by 2016, on average 230,000 per year, driven primarily by changing lifestyles as more people live on their own. There is a particular shortage of affordable housing for key workers in south-east England. The Treasury's Barker Review warns of the consequences of poor housing supply in the UK, including fluctuations in the economy and affordability problems.

Government is keen to address the shortfall by encouraging more house building, and it is anticipated that dwellings built using MMC could play a role. The Sustainable Communities Plan identified four growth areas: the Thames Gateway, Milton Keynes, Ashford and Stansted-Cambridge.⁴ Approximately 200,000 houses will be built by 2016 in these areas, above those already planned. Parts of northern England, such as Oldham, are also identified for regeneration.

MMC policy

The Government believes MMC has economic, social and environmental benefits, and so has established initiatives to encourage its use, focusing on the social housing sector. From 2004 the Housing Corporation, the social housing regulator for England and Wales, will require a

quarter of new houses it funds to be built using MMC; equivalent to approximately 5,000 homes per year, or 3% of new UK housing. The Millennium Communities, overseen by the regeneration agency English Partnerships, are also using MMC (see box on p4). There is also an agreement between the Housing Corporation and English Partnerships to build 1,300 key workers' homes in south east England by 2005, of which half will be built using MMC.

Private house builders build almost 90% of new UK homes. However, Government influence on private sector house building is comparatively limited. The government and industry sponsored *Rethinking Construction* programme has been encouraging use of MMC through promoting best practice and providing information. There is also a part-Government funded project costing £1.5 million, called Promoting Off-site Production Applications (Prospa). Nevertheless, such initiatives are relatively modest, and Government has not so far provided direct incentives for private sector MMC, e.g. through planning policy or building regulations (see page 4).

Issues

While the Government is keen to encourage use of MMC for house building, research is still ongoing to assess its benefits. Issues arise over the cost of MMC; the industry capacity; its environmental benefits; the quality of such housing; public acceptance; and planning and building regulations. These questions are considered below.

Cost

Although some house builders argue that MMC is less expensive than traditional methods, industry sources indicate increased costs of around 7-10%. Reasons for the higher costs are difficult to discern because most project financial information is commercially confidential, and traditional masonry building costs vary widely too. It may be that the costs appear high because some benefits of using MMC, such as better quality housing and fewer accidents, are not obviously reflected in project accounts.

MMC housing is faster to build, reducing on-site construction time by up to 50%, and thus reducing labour costs. Quicker construction is an extra benefit for builders of apartments (because viewing often starts only once all flats are finished), and for Housing Associations, who receive rent earlier. However, it is less important for private house builders as they rarely sell all the properties on a new development at once.

An additional consideration is that the majority of factory overhead costs, e.g. labour, are fixed regardless of output. In contrast, site-based construction costs are only incurred if building is taking place. It is therefore less easy with MMC to respond to fluctuating demand.

Industry capacity

Industry capacity may be a barrier to increasing the number of houses built using MMC. Difficulties fall into two categories: a shortage of skills, and the factory capacity to manufacture parts.

Skills

There is a shortage of skilled labour in the UK construction industry, with over 80% of house builders reporting difficulties with recruitment. Using MMC to build house parts in factories, and faster on-site construction, means that fewer labourers are required. Factory workers with previous experience in other sectors, such as the car industry, can also be used.

However, there is uncertainty about the level of skills needed for MMC compared with masonry construction. MMC can require highly skilled labour for precise on-site assembly of factory-made house parts. Some of the problems with prefabricated housing built during the 20th century stemmed from poor skills, rather than defects with the housing materials. The Construction Industry Training Board (known as CITB ConstructionSkills), funded by industry and Government, is developing MMC training courses for the estimated 2,000 workers erecting MMC housing with no formal qualifications. Government has also suggested a need for training for other industry professionals, including surveyors, mortgage lenders, and planners, to ensure they are fully aware of MMC.

Factories

There are currently over 30 house building factories in the UK (see box below). A recent survey found there is current industry capacity to produce over 30,000 MMC homes per year.⁵ Therefore existing factory capacity should be sufficient to produce about 17% of new UK housing, based on a current building rate of 175,000 homes per year. Production could be increased by implementing more factory shifts.

Westbury Homes' Space4 Factory

The house builder **Westbury Homes** opened its *Space4* housing factory near Birmingham in 2001. The factory can produce up to 6,000 houses per year, although current output is only about one third of capacity. Timber frame panels are built in the factory on a production line and then erected on site by trained contractors. Such panels comprise a layer of insulation sandwiched by wood, and have been used for house building in the United States since the 1950s. Westbury usually use a brick outer layer for their *Space4* houses, hence they look like a traditionally built house. The factory employs about 100 people, mostly from a manufacturing background.

It costs over £10 million to build an MMC factory and train staff. To make this investment, companies need to be certain of long-term demand for MMC housing. Government support for MMC in the social housing sector, and its major house building programme, has therefore reduced this investment risk.

Environmental benefits

The Government is promoting the environmental benefits of MMC, as are many of the manufacturers. Research conducted by the Building Research Establishment (BRE) found MMC homes to be more energy efficient, but there was no significant evidence of waste and transport reductions.⁶ Evaluating the environmental benefits of a

new MMC housing development is complex because it is difficult to attribute outcomes solely to the use of MMC (see for example the box on p4 about the Millennium Communities).

Energy savings

Houses built using MMC typically require less energy to heat because of increased levels of insulation fitted in the walls and roof, and also less air leakage from the building. One of the reasons house builders are interested in MMC is because they anticipate that the energy requirements of the UK building regulations will soon become more stringent. The 2003 Energy White Paper committed the Government to implementing new energy related building regulations by 2005.

Waste

Construction and demolition waste comprises 25% of UK waste. The amount of waste produced using MMC is likely to be reduced because factory materials can be ordered to exact specifications, and there is a lower risk of on-site spoilage, e.g. through wet weather. However, there is little research confirming such reductions.

Transport

Building homes in factories may reduce the total number of trips to a building site. This is of growing importance as more house building takes place on 'brownfield' sites in inner-city areas. Little detailed analysis has been conducted to date on transport benefits, but they are likely to vary considerably depending on the distance between the building site and the factory.

Quality and accreditation

The number of defects in traditionally built homes in the UK is considerable, with house builders allocating up to £2,000 per house to rectify problems. Greater use of factory production can reduce defects because there is less risk of weather damage during construction, and materials can more easily be standardised and tested.

However, if there is belatedly found to be a problem with a particular MMC then this would have been replicated in many homes, because they are mass produced. Housing is built to last a minimum of 60 years, so problems could go unnoticed for some time. For this reason building insurers, mortgage lenders, and surveyors are cautious about greater use of MMC. For example, some insurers are worried about the resilience of MMC to flooding. In contrast, the risks of traditional site-based masonry construction are well known because the method has been used for a long time.

Accreditation systems to test the performance of housing products are operated by the British Board of Agrément⁷ and BRE Certification. But the process can take over a year and cost up to £100,000, meaning that not all companies apply. Six housing MMC have been granted accreditation so far, with three more in the pipeline. If houses are built using unaccredited methods then it can be difficult to gain buildings insurance, and hence a

mortgage. Some manufacturers argue that Government should offer grants to assist with accreditation.

The Council of Mortgage Lenders suggests that the Housing Corporation should make it mandatory to use accredited methods when building social housing. The Housing Corporation is reluctant to do so because it believes the decision about which MMC to use should be taken by individual Housing Associations. Also, with the 25% MMC target commencing in 2004, there are concerns that there would be insufficient industry capacity if Housing Associations were limited to using accredited manufacturers. Government and industry bodies are in preliminary discussions about options for a 'fast-track' accreditation scheme.

Public attitudes

There are industry concerns about the public acceptability of MMC housing. A survey of MMC manufacturers identified lack of market demand and public perception as the two most important limitations on expansion.⁵ Industry concerns reflect public opinion: in a 2001 MORI poll, 69% of respondents felt a brick built home would fetch a better price.⁸ Negative attitudes towards MMC may stem from highly publicised problems with historical use of prefabricated housing. There are also concerns that if more innovative MMC is used exclusively for social housing the distinctive design may mean residents are stigmatised. However, all but one tenant of a new social housing MMC development in London said they would be willing to buy a similar home. Also, because most UK MMC developments are made to look like traditional brick houses, potential occupants may be unaware of the construction method.

Planning

The planning system has an important indirect influence on the MMC market because of its role in determining the supply of land for house building. Government planning policy is laid down in Planning Policy Guidance (PPG), one of which (PPG3) is about housing. PPG3 covers issues such as housing density, but use of MMC is not currently mentioned, and planning guidance would not generally cover such details about construction type.

Building Regulations

The UK building regulations do not specify building materials or construction method, but instead set minimum performance standards. Proposed changes to the building regulations covering energy efficiency, broadband access and structural integrity are forthcoming. These changes may make it cheaper and easier for MMC to meet the regulations compared with traditional masonry construction.

Health and safety

The construction industry is one of the most dangerous for workers, with about 100 deaths per year in the UK. MMC could improve safety because there is a reduced risk of accidents in a controlled factory environment, and less time is spent on the construction site. The Health

and Safety Executive, who regulate construction safety, are encouraging the use of MMC.

The Millennium Communities

Greenwich Millennium Village (GMV), the first of seven Millennium Communities, is being built using a combination of traditional on-site methods and factory produced components such as bathroom 'pods' and cladding panels. Work on the development, which comprises around 1,400 flats and houses mainly for private sale, started in 1999.

GMV has stringent environmental and financial targets set against industry benchmarks. Construction costs need to be reduced by 30% by completion of the development: so far costs have been reduced by approximately 10%. GMV has to date largely met its environmental targets: waste has been reduced by 56%, and energy use over the lifetime of the development will be reduced by 65%. It is difficult, however, to attribute these improvements solely to the use of MMC. For example, reductions in waste have been achieved largely through changing on-site practices, and the energy target has been met mainly through using an efficient local combined heat and power (CHP) generator.

Overview

- Use of MMC for house building has some advantages compared with traditional methods, such as increased speed of construction and fewer defects.
- There may be disadvantages to MMC, including higher immediate costs, poor public acceptability, and inflexibility of factories in responding to fluctuating demand.
- Robust accreditation procedures to certify the durability of MMC housing, and staff training to ensure high quality construction, will be important if Government targets for use of MMC are to be met.

Endnotes

- 1 *Barker Review of Housing Supply: Securing our Future Housing Needs*, Interim Report, December 2003, published by HM Treasury.
- 2 *Government Response to ODPM Select Committee Report on Planning for Sustainable Communities in the South East*, July 2003.
- 3 *Homing in on Excellence*, The Housing Forum, 2002.
- 4 *Sustainable Communities: Building for the Future*, ODPM, February 2003.
- 5 Imperial College London Innovation Studies Centre research for the Housing Forum - see www.thehousingforum.org.uk.
- 6 *Assessing the Sustainability of Prefabricated Construction Techniques*, BRE, 2003 - see www.projects.bre.co.uk.
- 7 The British Board of Agrément test construction products and provide independent certification.
- 8 *Attitudes Towards House Construction*, MORI poll, 2001, commissioned by the Traditional Housing Bureau.

POST is an office of both Houses of Parliament, charged with providing independent and balanced analysis of public policy issues that have a basis in science and technology. POST is grateful to Heather Lovell for her work in preparing this briefing, and to the ESRC for funding her Fellowship at POST.

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