

# Briefing Paper: Embodied Carbon and Modern Methods of Construction (MMC)

The Institution of Structural Engineers  
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## Introduction

The Institution of Structural Engineers (IStructE) has extensive technical expertise and knowledge about [Modern Methods of Construction](#) (MMC).

This includes online resources such as webinars, articles and training to explain MMC and its use as an innovative construction method. MMC aims to increase efficiency, reduce waste, ensure consistent quality, and otherwise improve the construction process.

This briefing provides an overview of how MMC can be made more sustainable.

## What is MMC?

Modern methods of construction (MMC) is an umbrella term for a range of non-traditional construction processes encompassing off-site manufacture, modular, or

prefabricated construction. MMC is different from conventional construction by generally involving off-site fabrication of elements which are then installed in-situ, rather than being constructed on-site from scratch.

The aim of MMC is to increase quality and productivity by utilising manufacturing technology. Some estimates such as work by the [RIBA](#) predict that MMC is up to twice as productive as traditional methods, with subsequent reductions in cost, programme time and labour, and as such is growing in popularity across the construction industry.

The catch-all term of MMC has a wide range of meanings and applications. A Ministry of Housing, Communities & Local Government MMC working group produced a [seven-category framework](#), outlined in Figure 1 below. All seven categories can be used in any form of building. The more repetitious the building, the more it lends itself to assembly off-site.

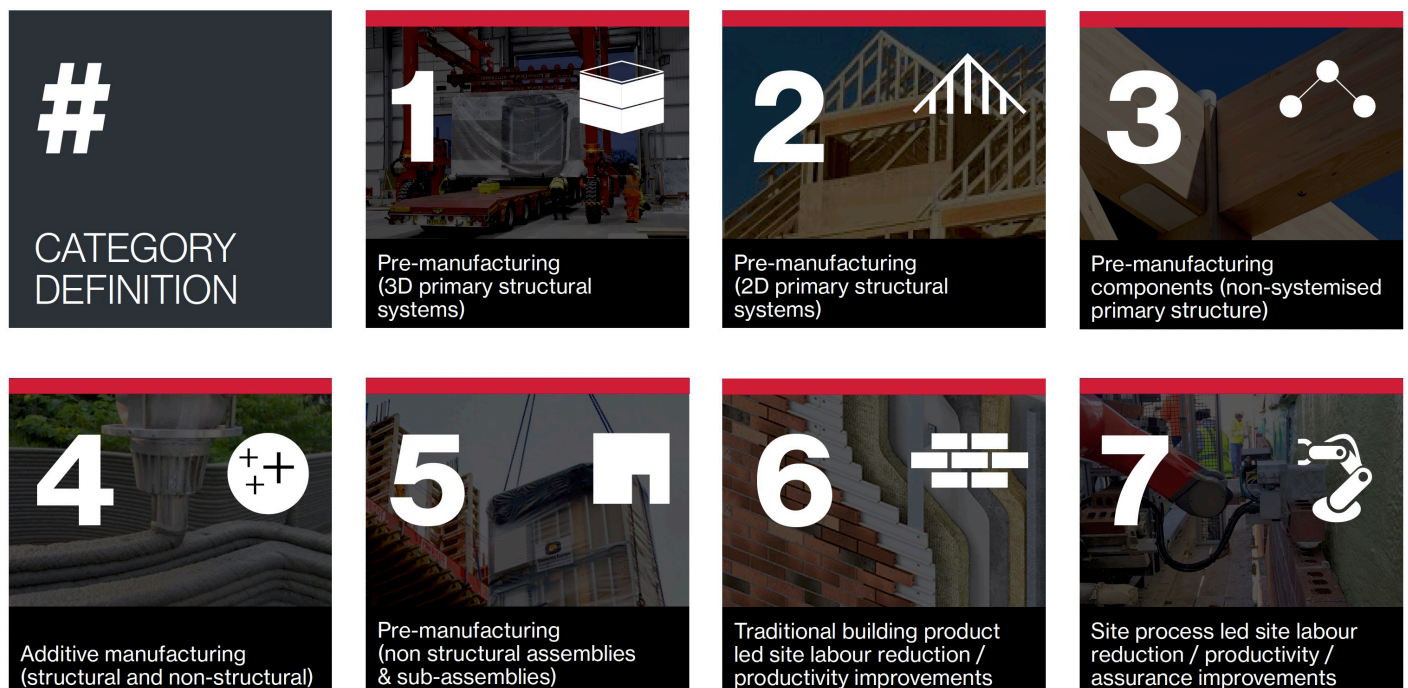


Figure 1: The seven categories of MMC

## Is MMC sustainable?

The simple answer is that **it depends**: on the type of MMC, the way the building is designed, the materials used, the construction requirements, the end use of the building, and so on.

Guidance published by CIRIA, entitled "[C792: Methodology for quantifying the benefits of offsite construction](#)" highlights some typically quoted benefits such as on carbon emissions, transport reduction and circularity benefits. However, the experiences shared with the IStructE by its members leading in the field of MMC show that there is more nuance to the situation than this.

Studies by IStructE Members at Ramboll, [available on our website](#), show that the embodied carbon emissions (those emitted through use of materials) related to MMC can be either higher or lower than traditional construction methods (see Figure 2). A similar study by engineers at Arup, [also published by the IStructE](#), argues the same. The Ramboll study showed one scenario where MMC could lead to a 25% reduction in embodied carbon emissions, and another where it could increase carbon by 100%.

This sensitivity is also true of wider environmental sustainability issues such as resource use, waste generation, and biodiversity loss.

Another example of such nuances is in [this paper published by IStructE](#) where the authors highlight that whilst MMC can reduce waste by as much as 90%, waste typically only contributes to one tenth of the total carbon impact of construction in the first place. This means that such levels of waste reduction only results in a 9% reduction in embodied carbon emissions.

### MMC increases sustainability when it...

- leads to better standards of construction, reducing waste (e.g., through fewer errors).
- uses customisation to utilise materials more efficiently in the design (e.g., designing bespoke shaped lightweight structural beams).
- better integrates different aspects of the design (e.g., the façade playing a role in the structural stability of a building).
- enables more considered material specification (e.g., enabling the use of low-carbon alternatives).
- enables future deconstruction and reuse for short-life buildings (e.g., by providing accessible, reversible fixings).

### MMC decreases sustainability when it...

- leads to duplication of elements (e.g., at the interface between two or more panels/volumes that have been constructed).
- results in greater overall travel distances, or less efficient haulage arrangements (e.g., with a lot of 'fresh air' being transported).
- limits the potential use of low-carbon concrete (e.g., due to required factory speeds).
- requires additional materials for installation (e.g., extra cross-bracing to allow lifting into place).
- uses over-standardised designs (e.g., with the design of repeated systems based on a single worst-case loading requirement).

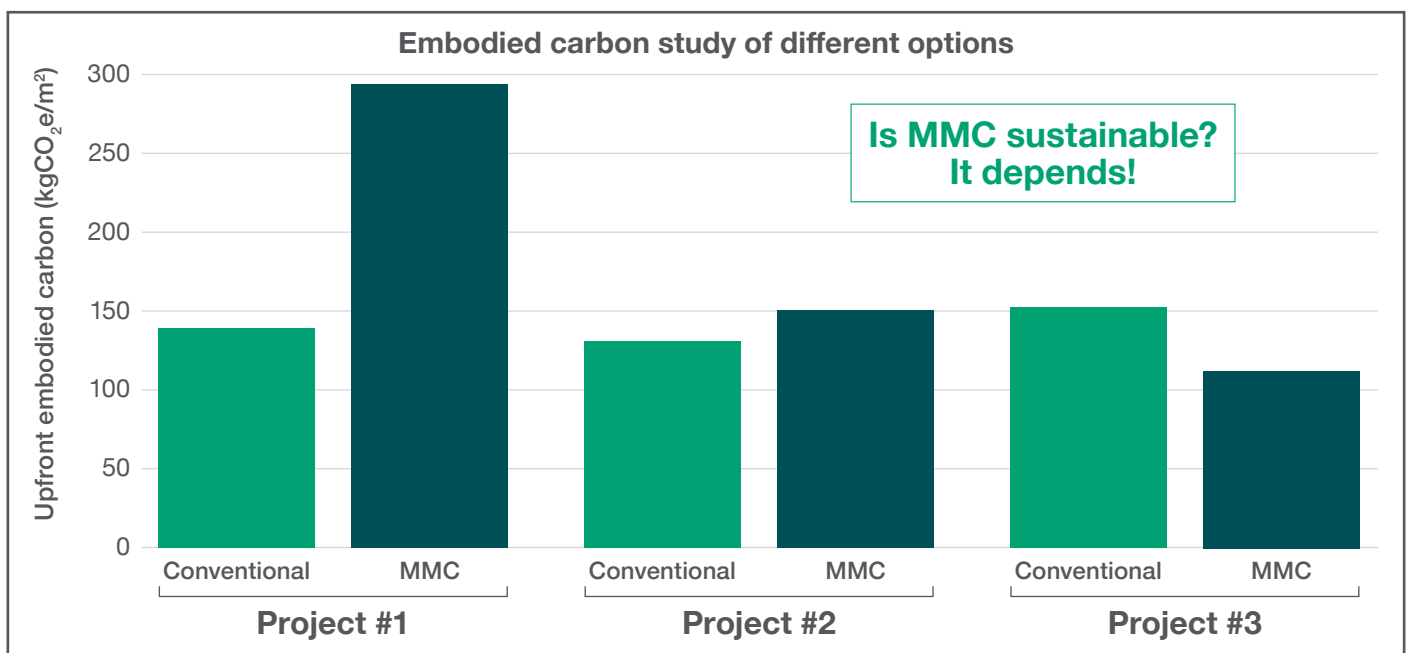


Figure 2: Ramboll studied three building projects, and compared conventional and MMC options for each, demonstrating that MMC does not always result in lower-carbon designs



Figure 3: Examples of MMC use in construction

## What policies would help MMC to be more sustainable?

Given that MMC can either increase or decrease the environmental impacts of a project, it is important to ensure that environmental issues such as embodied carbon emissions are considered from the earliest stages of design. This will lead to an increase in the number of design decisions resulting in more sustainable outcomes.

**IStructE** recommends the following policies to ensure that the sustainability opportunities presented by MMC are maximised on every project:

- By 2026: Mandate the measurement and reporting of whole-life carbon emissions for all projects with a gross internal area of more than 1000m<sup>2</sup> or that create more than 10 dwellings.
- By 2028: Introduce legal limits on the upfront embodied carbon emissions of such projects, with a view to future revision and tightening as required.

The two-step approach in the green box (left) follows precedent set by other parts of the world including the EU, several US states, and New Zealand.

IStructE has been leading a campaign that proposes an amendment to the Building Regulations, called [Part Z](#), which is supported by [more than 200 firms](#) from household names to SMEs. The proposed Part Z matches our recommendation in the green box (left), leading to the reporting and limiting of embodied carbon emissions, matching the way that operational energy use is currently regulated in the UK. This would bring the UK in line with our competitors overseas, and bringing investment and growth to suppliers of low-carbon materials and developers of low-carbon buildings.

Such updates to regulation could be passed using the proposed Future Homes and Buildings Standards, and should be embedded in the government-commissioned PAS 8700 “Modern methods of construction for new build residential properties”.

### For further information:

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