

# Modern Methods of Construction: A Study of Upfront Carbon

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Bright ideas.  
Sustainable change.

# Why?

- Lack of evidence or comparison between MMC and typical construction techniques
- Growing desire for the use of MMC, typically in government-backed projects (Construction Playbook)

## Modern methods of construction: a study of upfront embodied carbon

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### Introduction

In response to growing environmental concerns and net-zero goals, the construction industry is increasingly recognising the need for sustainable practices. Modern methods of construction (MMC) have emerged as a promising approach to achieve sustainability in this field, and the UK government's *Construction Playbook* recognises that off-site manufacturing can deliver solutions with lower greenhouse gas emissions than traditional construction methods'. Indeed, MMC takes precedence over embodied carbon calculation in the Playbook, with 'MMC' mentioned 27 times more than 'embodied carbon'.

MMC encompasses a range of – often innovative – construction techniques and materials that provide alternative approaches to traditional building methods (see article by Nigel Ostone on page 28 for a description of MMC categories). However, despite a widely held belief that MMC reduces upfront embodied carbon compared with conventional practices, as evidenced by a survey conducted as part of the study discussed in this article, its effectiveness in doing so is not fully understood and case studies are sparse.

This article aims to bridge the knowledge gap by conducting a comparative analysis of MMC and 'typical' construction practices, specifically focusing on the impact on the upfront embodied carbon for the structural systems of MMC. Real-life projects utilising MMC have been studied,

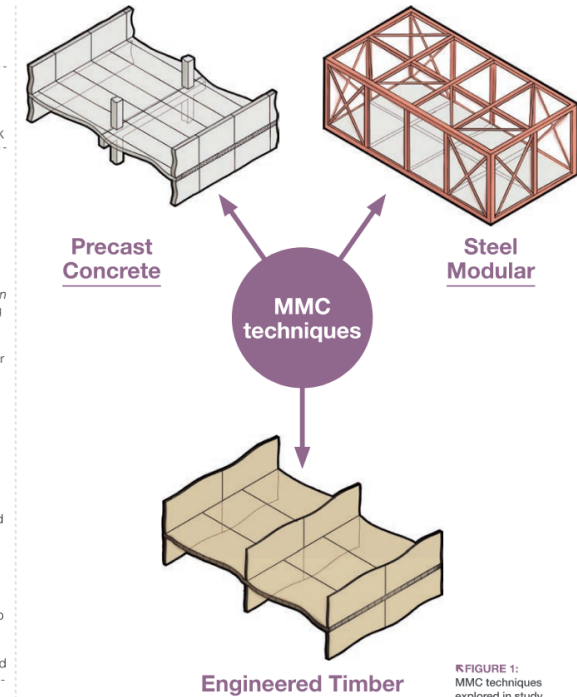
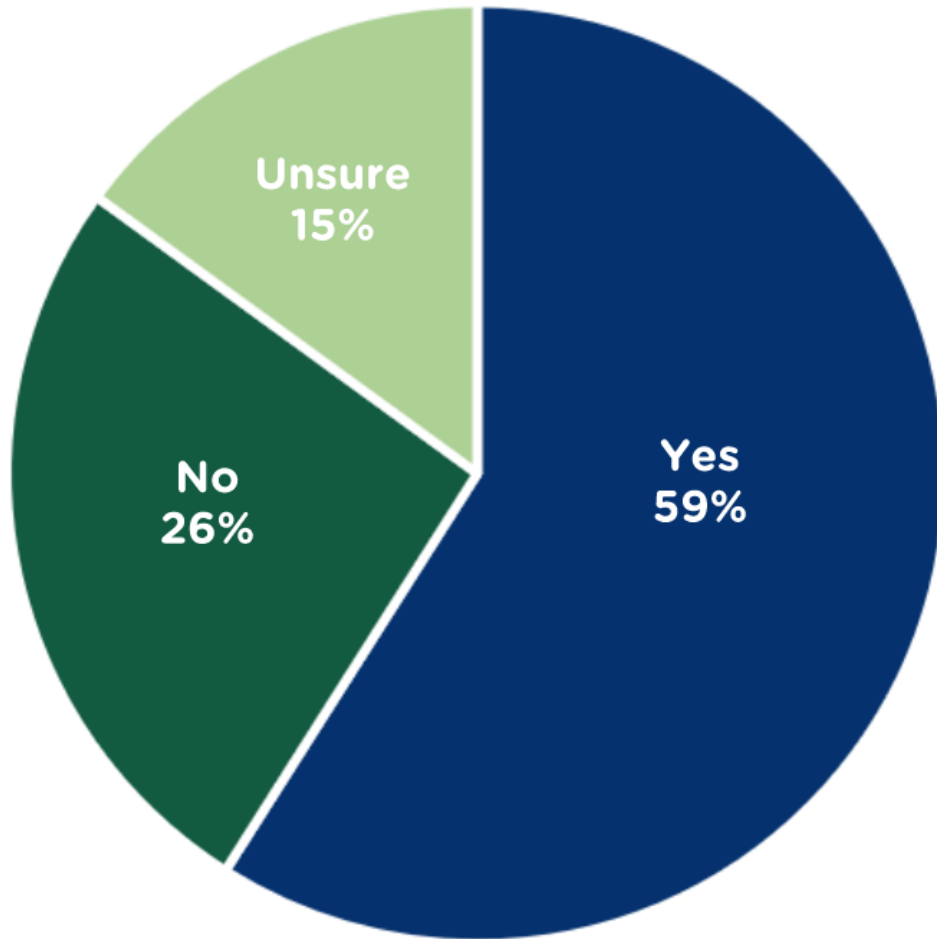


FIGURE 1: MMC techniques explored in study

**Do you believe that MMC reduces the embodied carbon in structure?**



# Industry Survey

- LinkedIn poll with 218 responses asking the question 'Do you believe that MMC reduces the embodied carbon in structures?'
- Focused analysis on 40 individuals across all aspects of the construction industry

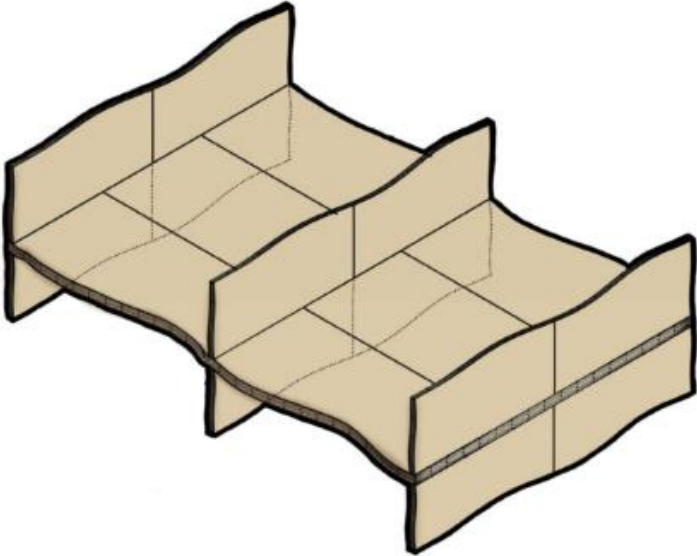
## What's currently happening?

Fewer than 20% of projects have MMC in their design brief  
(73% of responses)

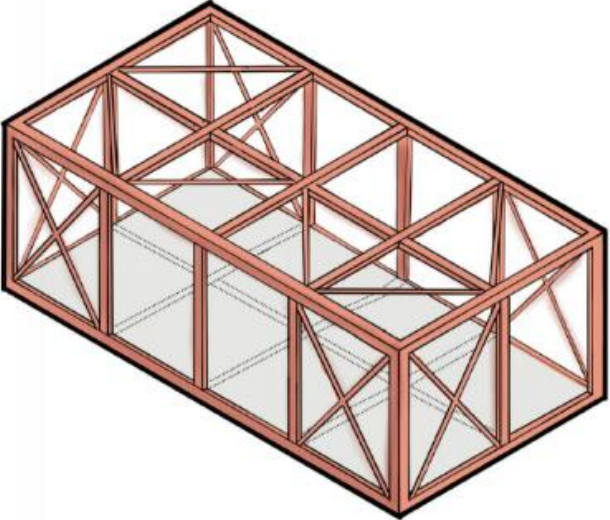
Although...

Over 20% of projects are utilising MMC for their main structure  
(65% of responses)

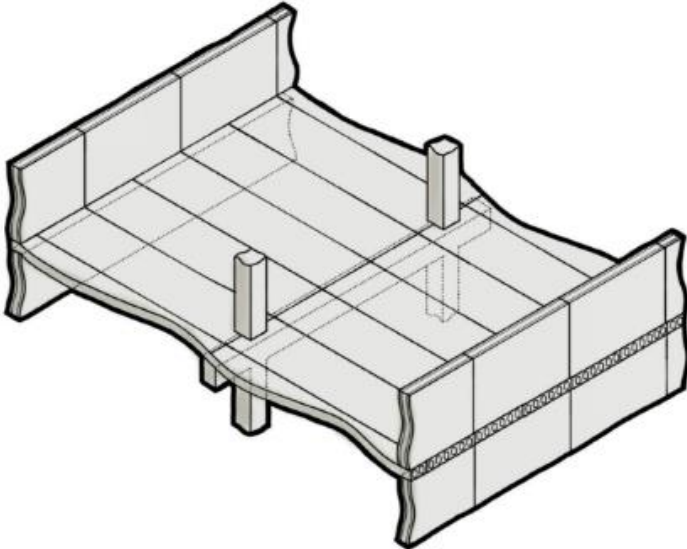
# What is the most sustainable MMC technique?



25%



38%



5%

What needs to happen next?

100%

...agree there needs to be further research into MMC  
to inform decision makers

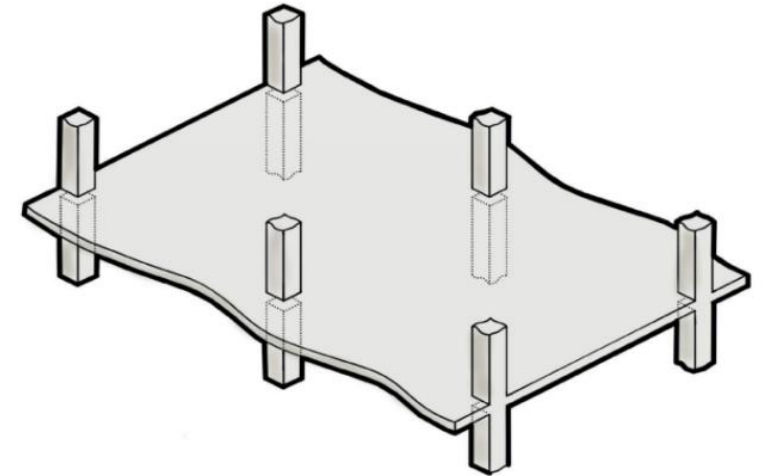
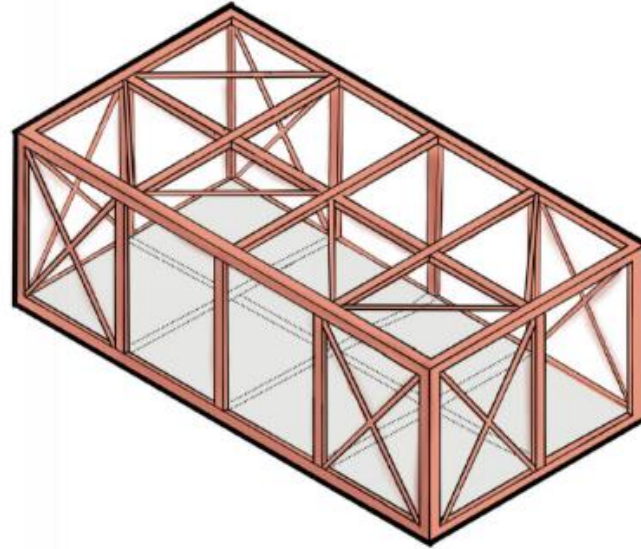
# Modular vs. In-situ RC

Calculation considered:

- Steel Columns
- Steel Beams
- Composite floor
- Bracing Elements

Did not include:

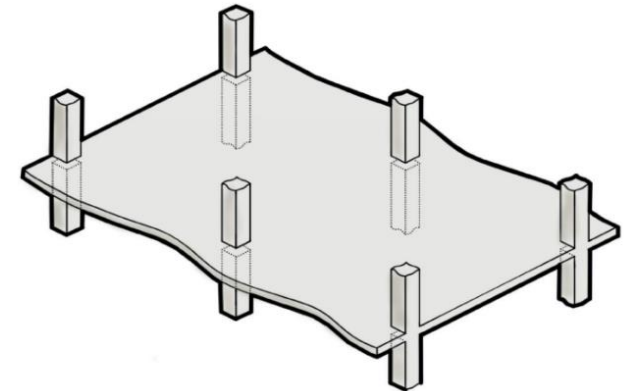
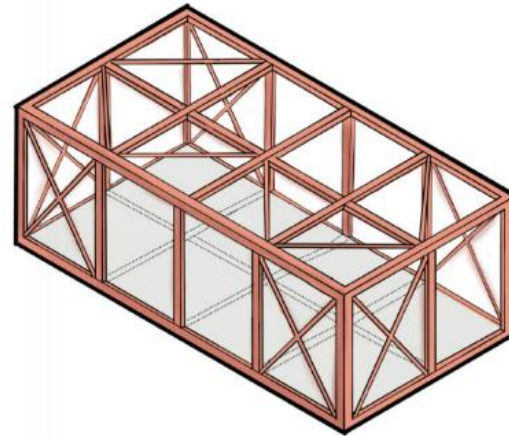
- Concrete core (assumed to be the same for RC in-situ)
- Finished
- Services



# Modular vs. In-situ RC

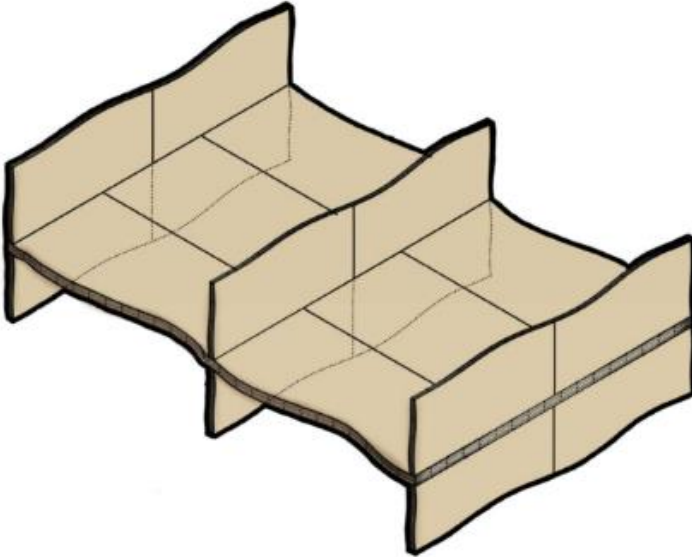
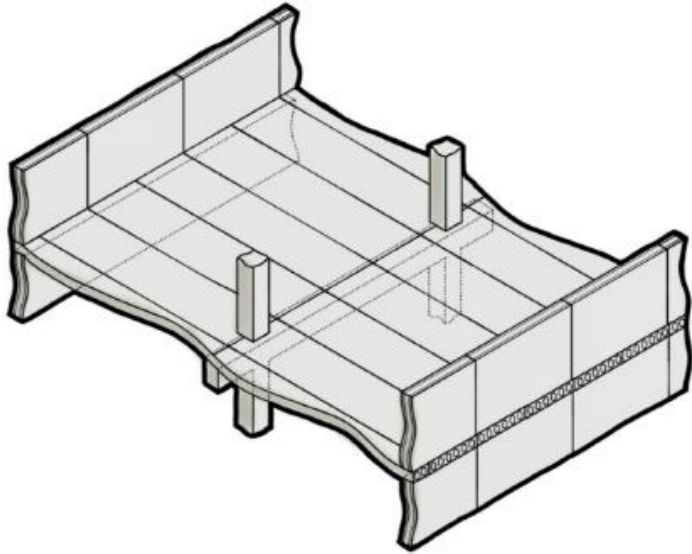
- Significant difference in A1-A3 emissions (product stage – cradle to gate)
- Increased emissions in transportation (A4)
- Savings found in the emissions associated with waste (A5.3)

Construction Technique	Embodied Carbon (kgCO <sub>2</sub> e/m <sup>2</sup> )			
	A1-A3	A4	A5.3	A1-A5.3
In-situ RC	128	6	8	142
Steel Modular	277	15	3	295





# What about the other techniques?



Construction Technique	Embodied Carbon (kgCO <sub>2</sub> e/m <sup>2</sup> )			
	A1-A3	A4	A5.3	A1-A5.3
In-situ RC	125	5	8	<b>138</b>
Pre-cast Concrete	131	15	4	<b>150</b>

Construction Technique	Embodied Carbon (kgCO <sub>2</sub> e/m <sup>2</sup> )			
	A1-A3	A4	A5.3	A1-A5.3
In-situ RC	136	6	9	<b>151</b>
CLT	81	27	4	<b>112</b>

# Where could we see carbon reductions?

- Fully fitted modular developments vs. fully fitted typical construction
- The reuse of modules at the end of life (module D)
- Highly repeatable structures to improve efficiency, such as:
  - Schools and other education facilities
  - Healthcare
  - Housing
  - Government assets
- Lifting systems that don't add excess material to the final structure, or reusable lifting bracing
- Waste reductions may start to produce a larger proportion of carbon values

# How we aim to take this research further...

- Understand the carbon impact of fully fitted modules, when compared to our typical construction approach
- Compare data and literature on the production efficiency of modular construction and waste data
- Develop this study with more case studies, including:
  - Education
  - Healthcare
  - Infrastructure
- Explore the carbon potential of other modular structures, outside of steel
- Review transport emissions, both A2 and A4 emissions, associated with modular

# Let's collaborate!

Drop me an email or connect on LinkedIn

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