



**WILLMOTT DIXON**

**SINCE 1852**

# OFFSITE CONSTRUCTION

**An Internal Guide**

November 2019



# INTRODUCTION

**As a product-focused business we are committed to continuing to evolve and move forward with new ideas and ways of working that solve our customers, our industry's, and our own challenges.**

One very present challenge is the ongoing skills and capacity crisis, where it has been estimated that for every one person joining our industry, five people leave - even against the backdrop of the lowest general levels of unemployment in recent history.

Over the next few years the skills shortage has the potential to create a huge pressure on our ability to deliver cost effective, quality products for our customers.

The Government has recognised this and is actively promoting offsite construction as it seeks to drive reduced costs, increase a greater level of standardisation and benefit the economy through improved productivity levels.

In response, we have a positive opportunity to drive an increased rate of change, reducing on-site labour through the increased use of pre-manufactured components. This will enable us to take advantage of the efficiency, quality and sustainability benefits that standardisation and digital construction can bring.

There is an increasing level of discussion around offsite, and how this may transform our industry. This guide is intended to help inform our approach and to steadily increase our use of offsite.

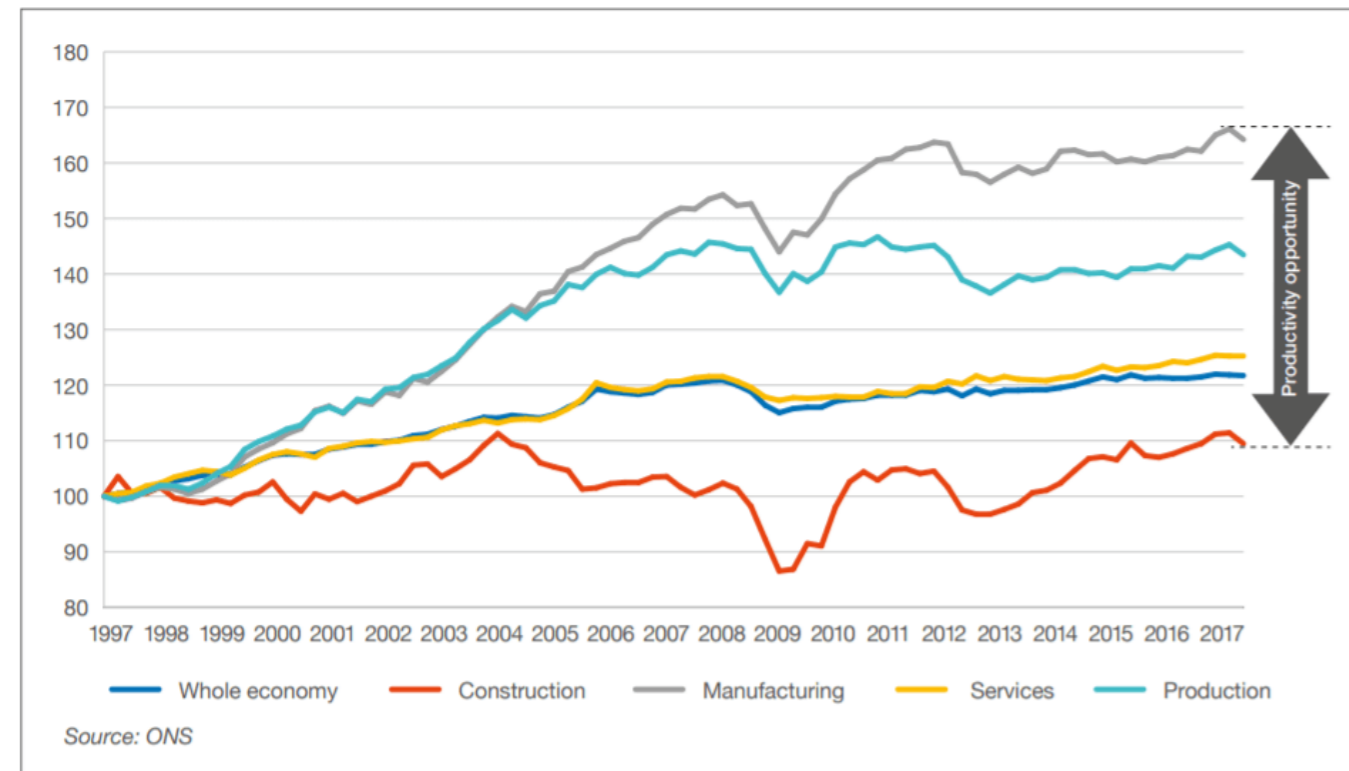
**For more details, or to discuss further, please contact the National Product Team.**



# WHY OFFSITE?

The productivity of our industry has failed to keep pace with that of most other industries. In the additional context of a declining labour resource we must respond to drive more output per person.

Offsite can be a significant solution to achieve this.



Offsite construction is not a new concept, it has been around in various forms for over a century and increased rapidly during the re-building after World War II due to a shortage in workforce and materials.

However due to technological improvements, economic demands, and changing mind-sets mean it is currently attracting an unprecedented wave of interest and investment.

If employed at scale it could give the industry a huge productivity boost.

# WHAT IS OFFSITE?

Offsite Manufacturing (OSM) - also referred to as Modern Methods of Construction (MMC) - is a term which covers the manufacture of parts of a building away from the actual construction site, with them being then subsequently transported to support a rapid and efficient on-site assembly. All our projects today contain varying degrees of offsite.

# OFFSITE CATEGORIES

Offsite covers a very broad range of products and components - all of which are aimed to reduce the amount of on-site labour required on a project.

For example a doorset is a form of offsite - installation typically takes less than an hour, compared to roughly six hours to install traditionally.

For consistency of reference this guide adopts the categories introduced in the Government's [MMC Definition Framework](#) (March 2019).

These define the broad spectrum of Modern Methods of Construction we are likely to utilise over the coming years.

We have expanded the background to each solution over the next few pages and indicated a sample of our relevant collective experience.

<h2>#</h2> <p>CATEGORY DEFINITION</p>	<h2>1</h2> <p>Pre-manufacturing (3D primary structural systems)</p>	<h2>2</h2> <p>Pre-manufacturing (2D primary structural systems)</p>	<h2>3</h2> <p>Pre-manufacturing components (non-systemised primary structure)</p>
<h2>4</h2> <p>Additive manufacturing (structural and non-structural)</p>	<h2>5</h2> <p>Pre-manufacturing (non structural assemblies &amp; sub-assemblies)</p>	<h2>6</h2> <p>Traditional building product led site labour reduction / productivity improvements</p>	<h2>7</h2> <p>Site process led site labour reduction / productivity / assurance improvements</p>

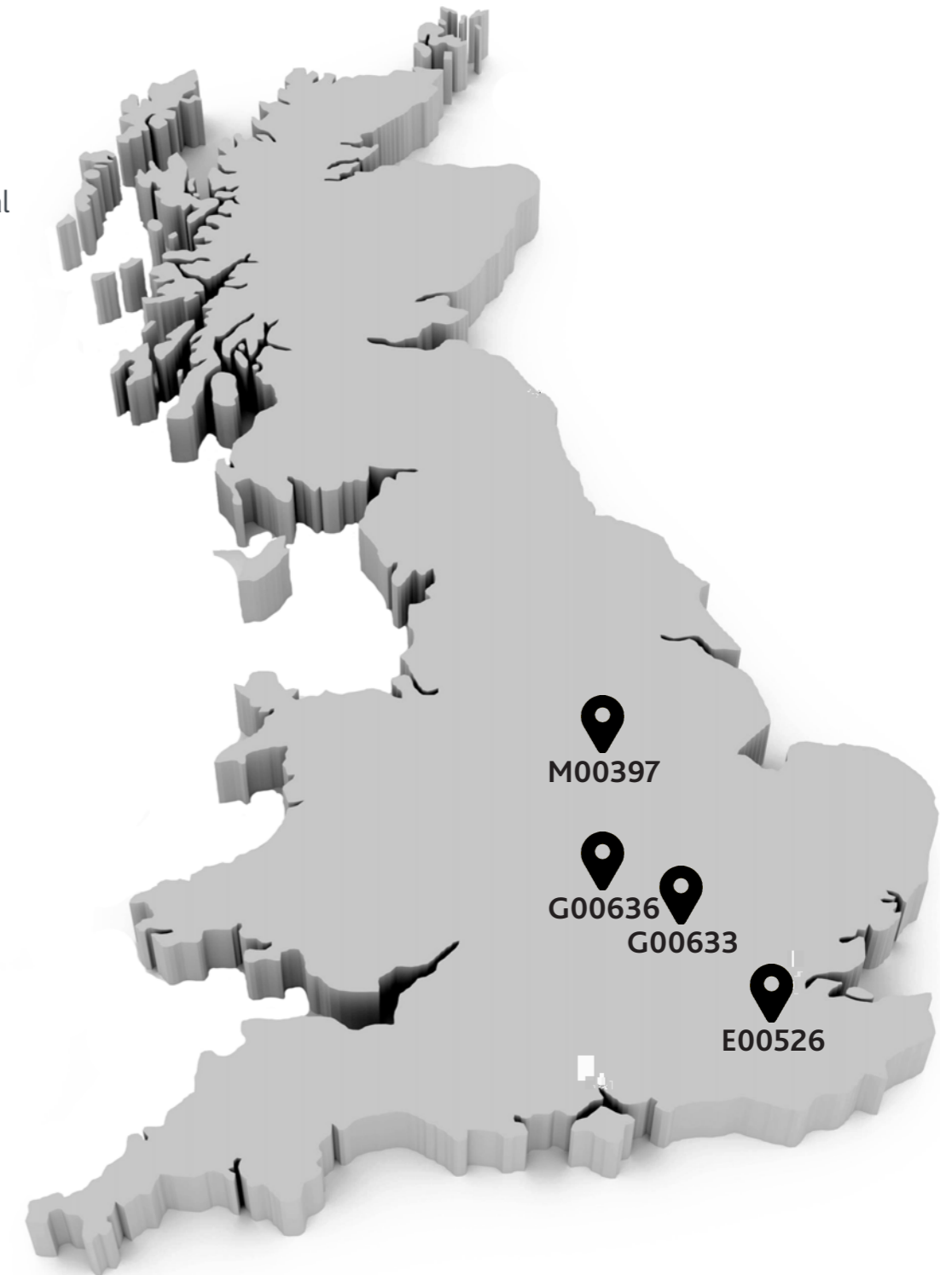
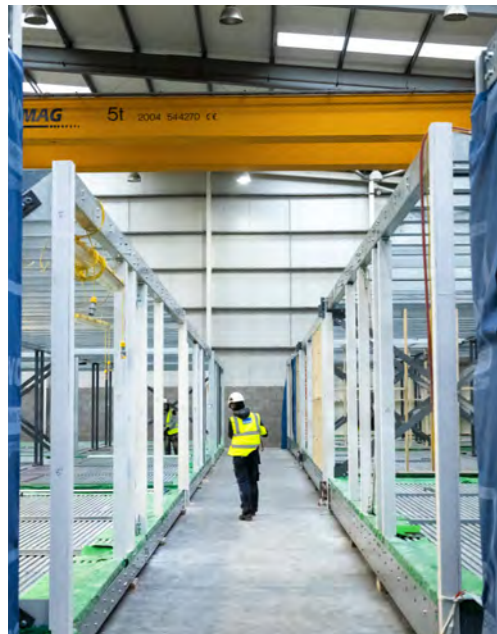
# CATEGORY 1

## 3D PRIMARY STRUCTURAL SYSTEMS

This category includes systemised approaches based on volumetric construction - involving the production of three-dimensional units in controlled factory conditions prior to final installation.

Volumetric units can be brought to final site in a variety of forms ranging from a basic structure only to one with all internal and external finishes and services installed, all ready for installation in four variants:

- A. Structural chassis only - not fitted out
- B. Structural chassis and internal fit out
- C. Structural chassis, fit out and external cladding / roofing complete
- D. Structural chassis and internal fit out - 'podded' room assemblies (structurally stacked bathrooms / kitchens etc.)



### RELEVANT EXPERIENCE

Project Ref	Project Name	Description	Supply Chain Partner
E00526	Ark Oval Primary Academy	School Extension	Yorkon
G00633	School Expansion 3 - LB Harrow	School Extension	Eco Modular
G00636	Bedford Borough Schools Programme	7 New Schools	Eco Modular
M00397	LCC SAP Programme 2017-19	Primary School	Ideal Building Systems

# CATEGORY 2

## 2D PRIMARY STRUCTURAL SYSTEMS

This category covers systemised approaches using flat panel units used for basic floor, wall and roof structures of varying materials which are produced in a factory environment and assembled at the final work face to produce a final three-dimensional structure.

- A. Basic framing only including walls, floors, stairs & roof
- B. Enhanced consolidation - insulation, internal linings etc.
- C. Further enhanced consolidation - insulation, linings, external cladding, roofing, doors, windows.



### RELEVANT EXPERIENCE

Project Ref	Project Name	Description	Supply Chain Partner
E00519	Kingston Uni - New Town House	Pre-Cast Frame	PCE
E00548	Sutton Secondary School	CLT	KLH
E00560	Village Hotel - Basingstoke	LGSF	Sigmat
G00654	Anna Freud	Timber Frame	Constructional Timber
G00662	Cotton End Primary School	Timber Frame	Robertson
K00218	Delamere Visitors Centre	CLT	B&K Structures
K00205	Simonsway	Timber Frame	Frame-Tech

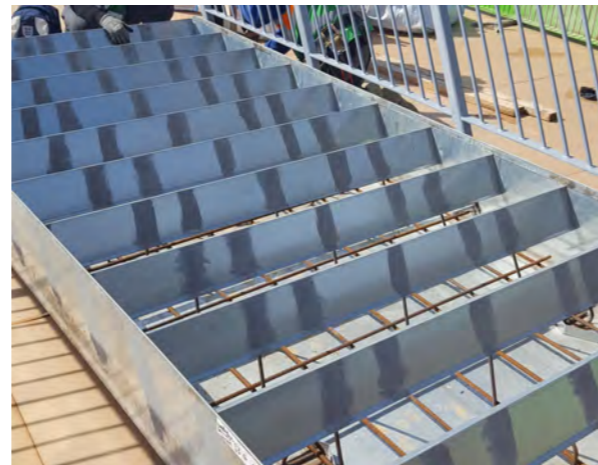
# CATEGORY 3

## PRE-MANUFACTURING COMPONENTS (non-systemised primary structures)

This category covers the use of pre-manufactured structural members made of framed or mass engineered timber, cold rolled or hot roofed steel or pre-cast concrete.

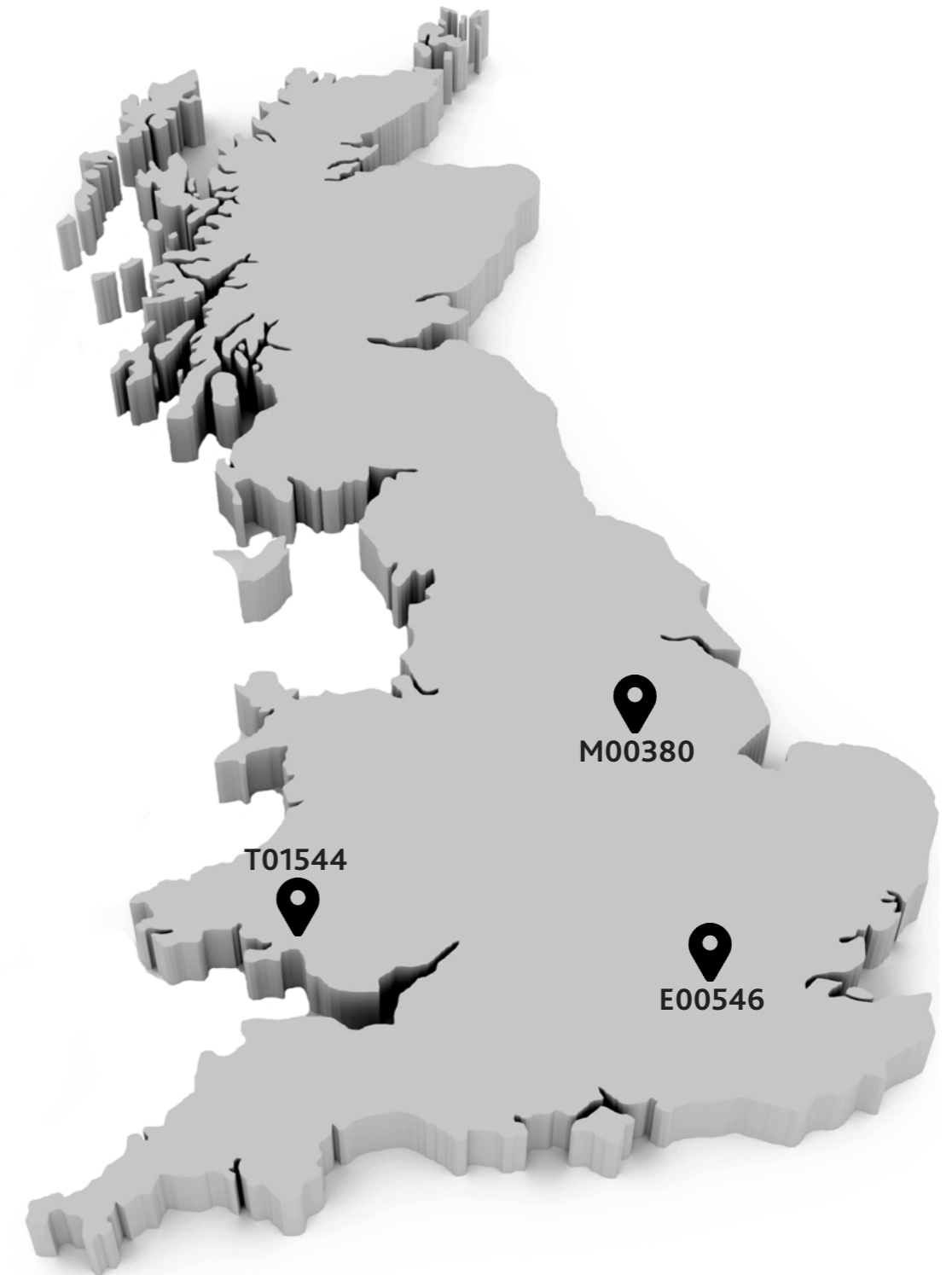
Members can include load bearing beams, columns, walls, core structures and slabs that are not substantially in-situ work face constructed and are not part of a systemised design. This category, although focused on superstructure elements, also includes sub-structure elements such as pre-fabricated ring beams, pile caps, driven piles and screw piles.

- A. Driven / screw piling
- B. Pre-fabricated pile caps / ring beams
- C. Columns / shear walls / beams
- D. Floor slabs
- E. Integrated columns, beams and floor slabs
- F. Staircases
- G. Pre-assembled roof structure - Trusses / spandrel



### RELEVANT EXPERIENCE

Project Ref	Project Name	Description	Supply Chain Partner
E00546	Woodmansterne Secondary	Pre-Cast Columns	Southern Concrete
E00546	Woodmansterne Secondary	Pre-fab Staircases	Stairmaster
M00380	LCC SAP Programme 2016-2017	Driven PC Piles	M&D Foundations
T01544	Computational Foundy	Pre-Cast Wall Panels	Sterling Services

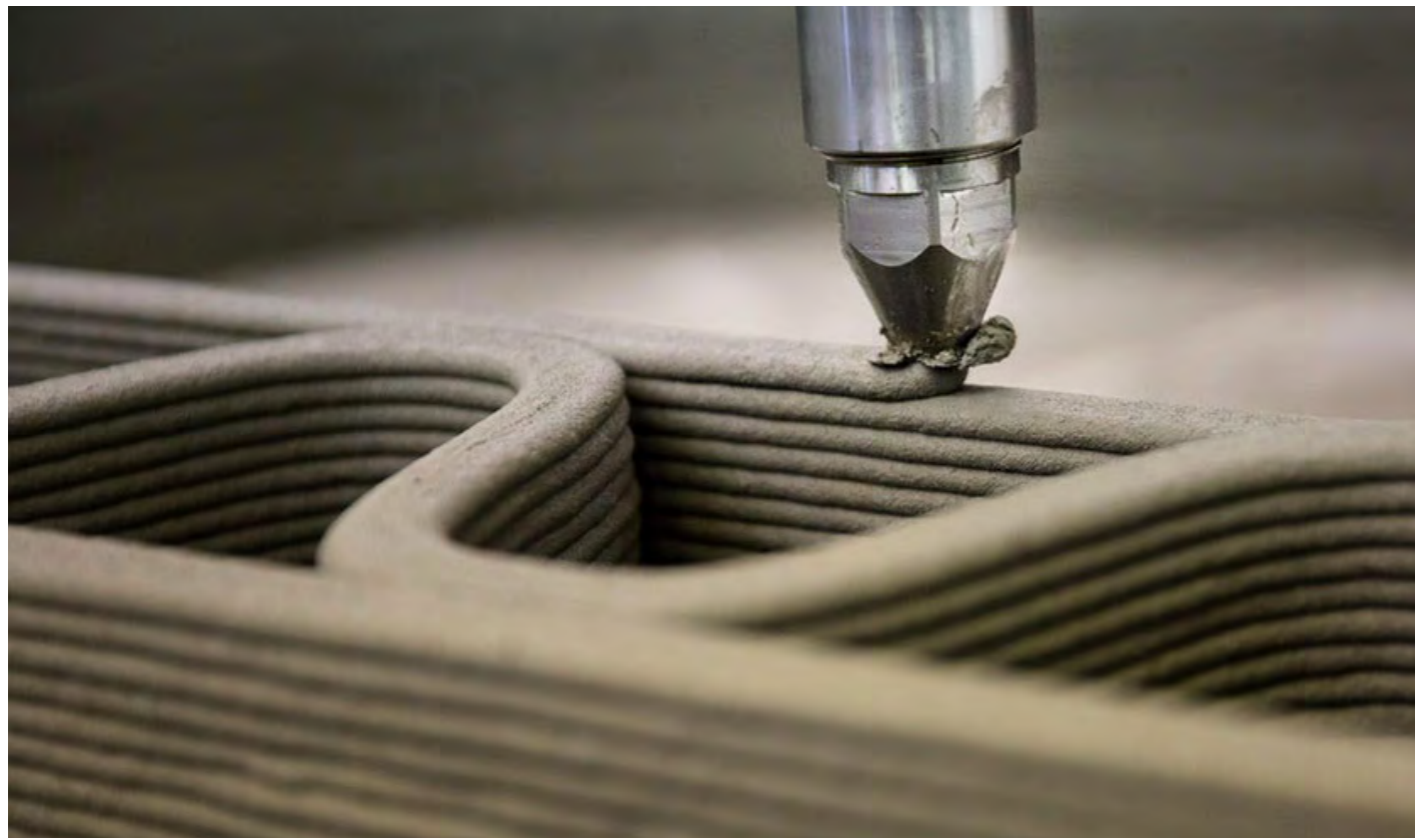


# CATEGORY 4

## ADDITIVE MANUFACTURING (Structural and Non-Structural)

This category covers remote, site-based or final work-face based printing of parts of buildings through various materials based on digital design and manufacturing techniques.

- A. Substantive structural forms / components
- B. Non-structural components



We have seen big changes in many other industries, from the way we access books and music, to the way other industries have embraced manufacturing to drive technological change and refine their product and service to their customers.

There is an ever increasing encroachment of this into the activities of the construction industry.

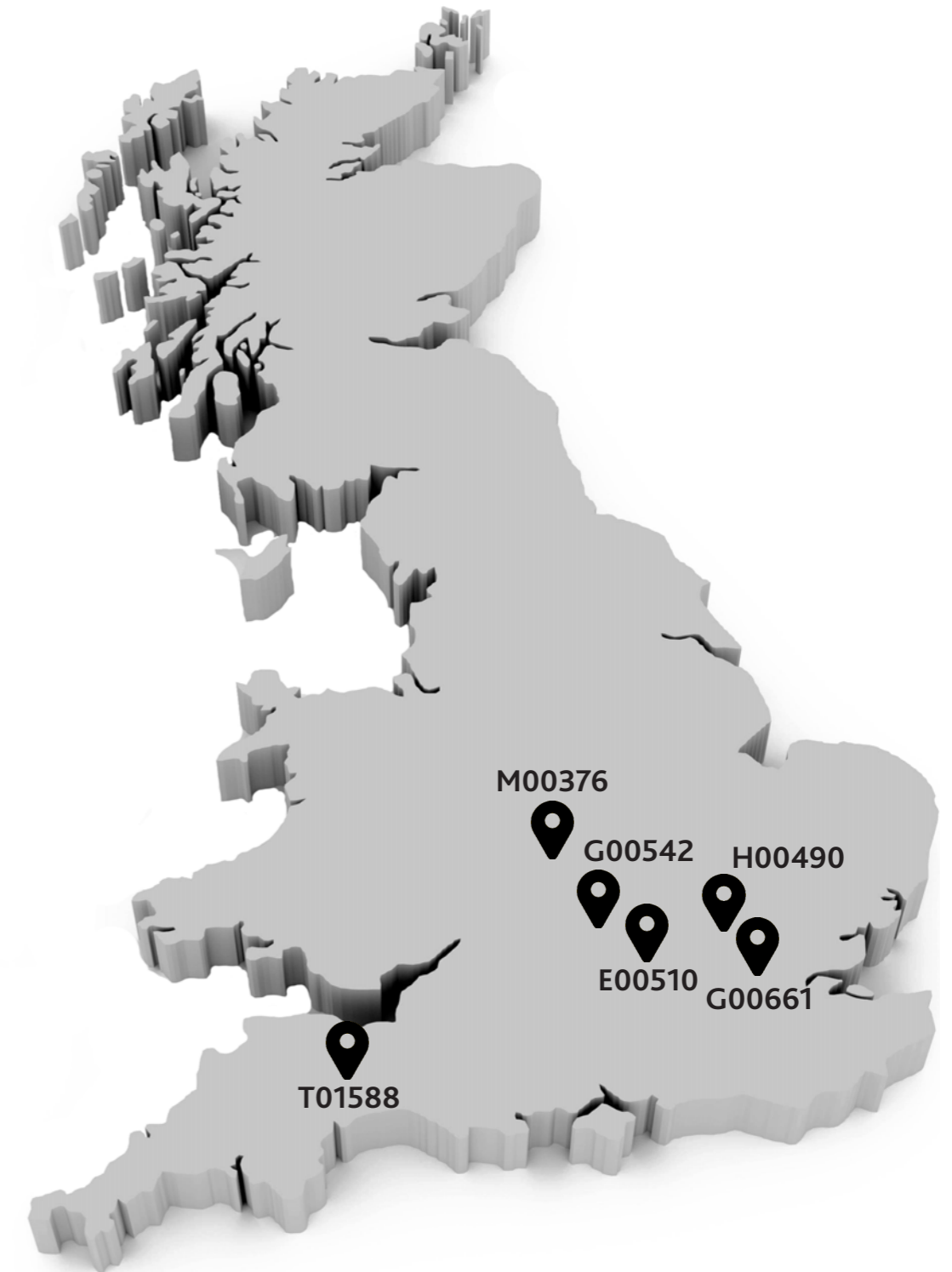
3D printing is a new concept for our industry - and as such should be approached with caution, and many of the associated technological and legal issues require further development and precedent.

# CATEGORY 5

## PRE-MANUFACTURING (Non-Structural Assemblies and Sub-Assemblies)

This category covers a series of different pre-manufacturing approaches that includes unitised non-structural walling systems.

It also covers roof cassettes or assemblies (where not part of a wider structural building system), non-load bearing mini-volumetric units for highly serviced and more repeatable areas such as kitchens and bathrooms, utility cupboards, risers, plant rooms as well as pre-formed wiring looms and mechanical engineering composites.



### RELEVANT EXPERIENCE

Project Ref	Project Name	Description	Supply Chain Partner
E00510	Gatwick Diamond	Roof Plant Room	Constant Air Systems
G00542	Travelodge Aylesbury	Bathroom Pods	Walker Modular
G00661	Aberfeldy Estate	Plant Assemblies	KANE
H00490	Dudley House	Plant Assemblies	KANE
M00376	Warwick Sports Hub	Roof Plant Room	Derry Building Services
T01588	Bridgewater College	Bathroom Pods	Offsite Solutions



# CATEGORY 5

## PRE-MANUFACTURING (Non-Structural Assemblies and Sub-Assemblies)

This category includes conventional masonry site-constructed schemes. Conventional building products such as windows and doorsets - which might otherwise be part of the fabrication process in the other pre-manufacturing categories - should not be included as sub-assemblies or components in this category unless there is a further level of consolidation from traditional configurations.

Also excludes any structural base elements that composite assemblies are fixed to and which are to be included in categories 1-4. Any structure in this category is purely to support the sub-assembly in transit / install phase.

- E. Facade assemblies (non-structural) including glazing, solid cladding, metalwork
- F. Roof assemblies/ cassettes - pre-finished roof sections including structure to support own weight)
- G. In-unit M&E distribution assemblies
- H. Infrastructure M&E assemblies - vertical risers/ main distribution
- I. Infrastructure M&E assemblies - central plant & equipment
- J. Floor cassettes with horizontal services/ finishes added
- K. Partition cassettes - with horizontal & vertical services / finishes added
- L. Door-sets (pre-hung, finished with ironmongery)



### RELEVANT EXPERIENCE

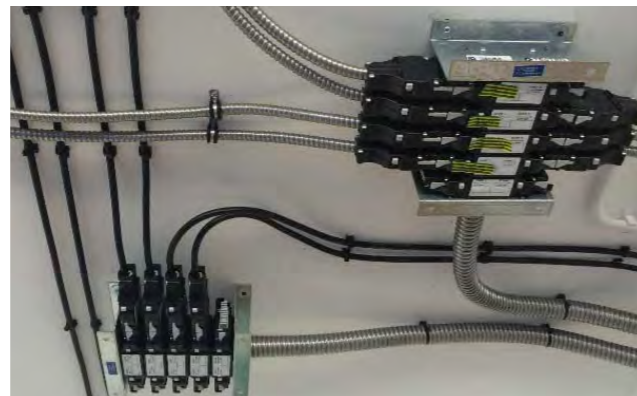
Project Ref	Project Name	Description	Supply Chain Partner
E00512	Dorset City Hotel	Unitised Cladding	Deepdale
G00645	Anglia Ruskin Medical Building	Roof Box	SD Samuels
G00652	Stansted Training Facility	Facade Panels	Eurobond Rockspan
G00663	Dulwich Health Centre	Hygienic Wall Kits	Trovex

# CATEGORY 6

## TRADITIONAL BUILDING PRODUCTS (Labour / Productivity Improvements)

This category traditional single building products manufactured in large format, pre-cut configurations or with easy jointing features to reduce site labour.

- A. Large format walling products - external walls
- B. Large format walling products - internal walls
- C. Large format roofing finishes
- D. Pre-sized and cut to measure traditional materials - component level systemisation
- E. Easy site install / jointing / interfacing features - brick slips, modular wiring, flexible pipework



### RELEVANT EXPERIENCE

Project Ref	Project Name	Description	Supply Chain Partner
G00650	Hertswood Academy	Corium Brick Slips	AVV Solutions
G00669	Tatling End, Gerrards Cross	Porotherm	AVV Solutions
P00061	Ashton Rise	H+H i-House	Roof Space

# CATEGORY 7

## SITE PROCESS (Labour / Productivity / Assurance Improvements)

This category is intended to encompass approaches utilising innovative site based construction techniques that harness site process improvements falling outside the five main pre-manufacturing categories 1-5 or materials innovation in category 6.

It also includes factory standard work-face encapsulation measures, lean construction techniques, physical and digital worker augmentation, work face robotics, exoskeletons and other wearables, drones, verification tools and adoption of new technology led plant and machinery.

- A. Site encapsulation measures - weatherproof and environmentally controlled enclosures
- B. Use of standardised or sacrificial temporary works - modular scaffold, tunnel form in-situ concrete.
- C. Use of BIM connected lean delivery surveying etc.) framework - digitally enabled work-flow planning.
- D. Site worker augmentation – visual (i.e. AR/VR)
- E. Site worker augmentation – physical (i.e. exoskeletons, assisted materials distribution etc.)
- F. Site worker productivity planning tools (GPS, wearables etc.)
- G. Site process robotics and drones (re-bar, masonry, plastering, decorating,
- H. Autonomous plant and equipment and drones (driver-less cranes, diggers etc.)
- I. Digital site verification tools (photogrammetry, site worker video, LIDAR scanning etc.)



### RELEVANT EXPERIENCE

Project Ref	Project Name	Description	Supply Chain Partner
Various	Various	Exoskeleton to reduce muscular skeletal injuries	
G00650	Hertswood Academy	Drone for calculating spoil volume	
G00663	Dulwich Health Centre	QR codes in various projects linked to VR	
K00201	Teeside University	Drones for surveys and progress reporting	

# KEY POINTS TO CONSIDER

We must always consider offsite, and only use where it provides tangible benefits.

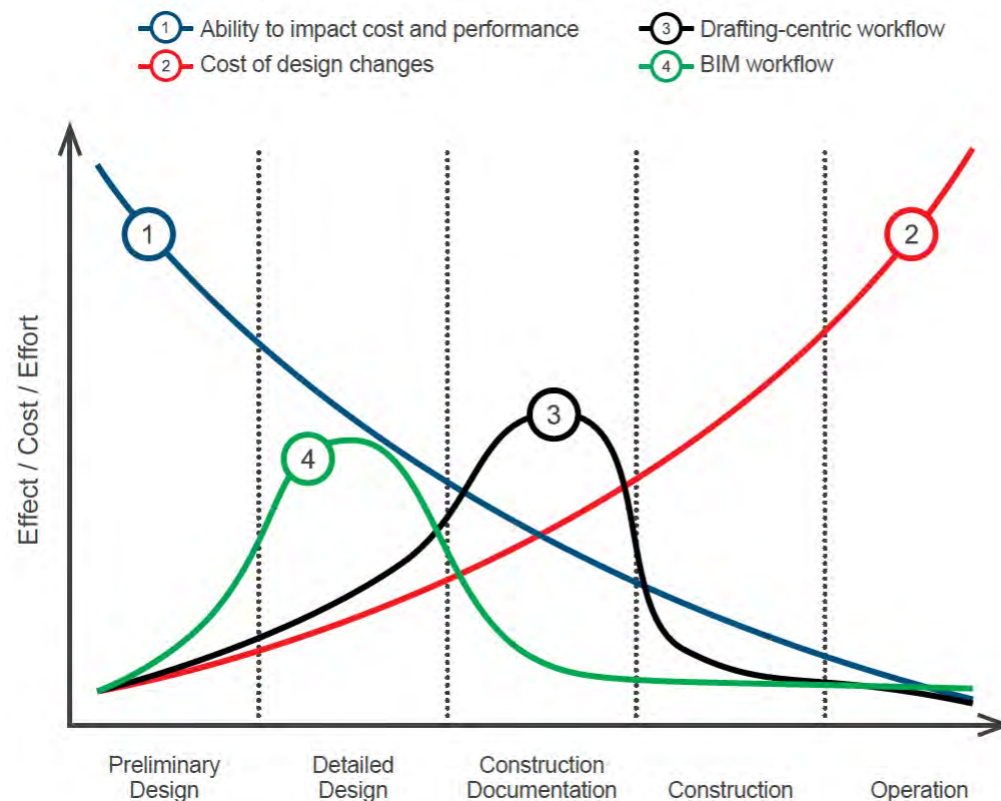
We should use MMC as opposed to traditional wherever it can be proven to add value - whether time, cost, quality, sustainability, etc. or a combination.

## OUR CUSTOMER

We must always put our customer first, and understand their approach, they may have strategic drivers to use offsite, equally they may have strong views on certain systems and components.

## ABILITY TO INFLUENCE

Rarely will a project be designed to suit offsite manufacture by coincidence, the earlier we can engage with our customers the more influence we can have on the form of construction and pre-manufactured components.



## SEEK OPPORTUNITIES TO STANDARDISE

Throughout the early stages of design we must continuously seek opportunities to standardise as many components as we can.

This includes, but is not limited to doorsets, staircases, columns, windows, risers, MEP cupboards, bathrooms, toilets, communal plant, corridor widths, balconies, etc.

## MANAGING OFFSITE QUALITY

We must not assume that just because something is made offsite that it will arrive defect free as lower skilled workers could be employed in offsite factories, coupled with less oversight from external inspectors such as LABC, NHBC or our own Build Managers.

We must visit offsite facilities and satisfy ourselves as to the quality control processes and carry out stage inspections. When using new building systems and components we should also seek to visit other projects in advance to familiarise ourselves with the product, its interfaces, protection, sequencing and programming implications. Relevant supply chain partners should also join any visit.

## CHALLENGE OUR SUPPLY CHAIN PARTNERS

We have a committed supply chain, but we need to pro-actively and positively challenge and support our supply chain partners to reduce on-site labour and increase productivity through innovation.

## DO WE NEED TO PAY FOR SPEED?

Our preference is to deliver projects as efficiently as possible, however we need to be mindful that in some sectors, such as private housing, it is likely that the build rate will need to closely match the expected sales rate to balance cashflow.

Equally greater proportions of offsite when managed well can deliver projects faster with greater certainty than traditional approaches.

This is particularly relevant for sectors including education, homes for rent, hotels and student accommodation where even paying a slight premium for speed can be offset against earlier returns or reduced program risk.



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