# Modern Methods of Construction

NBCO
National Building Control Office

## Welcome


| Time | Topic | Speaker |
|---|---|---|
| 09:00 – 9:30 | Registration of delegates | |
| | **Morning Session** | |
| Morning Chairperson | Mairead Phelan – Head of National Building Control and Market Surveillance Office | |
| 09.30 – 10.00 | Welcome to Modern Methods of Construction – Building Control | Mairéad Phelan - NBC&MSO |
| 10:05 – 10.35 | Methods of Construction – Overview | Éadaoin Ní Fhearghail - DHLGH |
| 10.35 – 10.50 | Short Interval | |
| 10.50 – 11.20 | Case Studies Timber Frame: Ballyogan Operational and Maintenance Depot, and Toronto and Region Conservation Authority Headquarters Project | Merrit Bucholz & Diane Harrington – Bucholz McEvoy Architects |
| 11.25 – 11.50 | NSAI – MMC Agrément Certification updates | Martin Searson - NSAI |
| 11:55 – 12.25 | Design and production of 2D & 3D MMC systems/projects | Paddy Mahon - Framespace |
| 12:30 – 13:00 | Best Practice approach for Building Control to check compliance for MMC building | John Sweeney – Meath County Council |
| 13.05 – 13:30 | Q&A | |
| 13:30 – 14:30 | Lunch | |
| | **Afternoon Session** | |
| Afternoon Chairperson | Ronan Glynn – Pillar Head, MRIAI, NBCO&MSO | |
| 14:30 – 15:00 | Delivery of MMC Projects for large scale developments | Jason Van Hout – Glenveagh |
| 15.05 – 15.35 | Case Study -Precast Concrete Wall Panels MMC - Tallaght Development | James Matthews - Coadys |
| 15.40 – 16:10 | 3D printed Concrete building: Case study Louth County Council | Conor King – Louth County Council |
| 16:15 – 16.45 | Q&A and Round Table Discussion | |

https://app.sli.do
Modern Methods of Construction

https://app.sli.do/event/vZL7Gx9cwH15QC6EpuLfeD

COADY ARCHITECTS
Comhairle Contae Lú Louth County Council
NSAI
FRAMESPACE
Glenveagh
bucholzmcevoy ARCHITECTS
comhairle chontae na mí meath county council
An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachta Department of Housing, Local Government and Heritage

# NBCO

National Building Control Office

northern & western region

southern region

eastern & midlands region

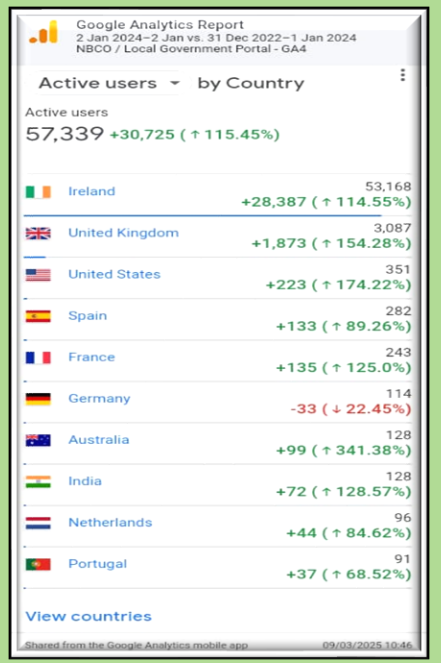
INSPECTIONS EDUCATION MARKET COMPLIANCE IS-BCMS
TRAINING SURVEILLANCE SUPPORT

***Mairéad Phelan***

*An Oifig Náisiúnta um Rialú Foirgníochta agus Faireachas Margaidh*

**NATIONAL BUILDING CONTROL AND MARKET SURVEILLANCE OFFICE**




Shared Service of the 31 Building Control & Market Surveillance Authorities

# Compliance (Administration/Design/Construction/Maintenance)

**Building Regulations**
**Health, Safety & Welfare of People**
**in or about Buildings**



All Methods of Construction Welcome

Design & Construction

Administration

DURABILITY!

- ***"BASIC REQUIREMENTS FOR CONSTRUCTION WORKS*** *Construction works as a whole and in their separate parts must be fit for their intended use, taking into account in particular the health and safety of persons involved throughout the life cycle of the works. Subject to normal maintenance, construction works must satisfy these basic requirements for construction works for an economically reasonable working life. ",*

1. **Mechanical resistance and stability**
2. **Fire safety**
3. **Hygiene, health and the environment**
4. **Safety and accessibility in use**
5. **Protection against noise**
6. **Energy economy and heat retention**
7. **Sustainable use of natural resources**

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60 years

Agrément Certs
60 Years!!!

# Materials & Workmanship Part D

***Materials and workmanship***

***D1 All works to which these Regulations apply shall be carried out with proper materials and in a workmanlike manner.***

***D3*** *In this Part, "**proper materials" means materials which are fit for the use for which they are intended and for the conditions in which they are to be used**, and includes materials which:*

(a) bear a CE Marking in accordance with the provisions of the Construction Products Regulation;

(b) comply with an appropriate harmonised standard or European Technical Assessment in accordance with the provisions of the Construction Products Regulation; or

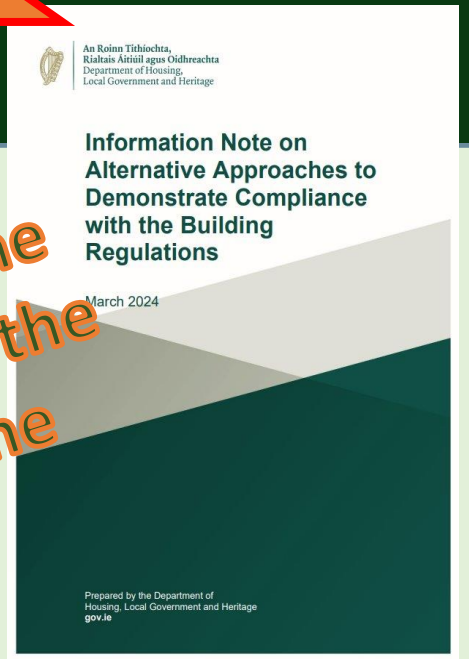
(c) comply with an appropriate Irish Standard, Irish Agrément Certificate or with an alternative national technical specification of any State which is a contracting party to the Agreement on the European Economic Area, which provides in use an equivalent level of safety and suitability

**1.1 of Technical Guidance Document D - Materials and Workmanship including**: -

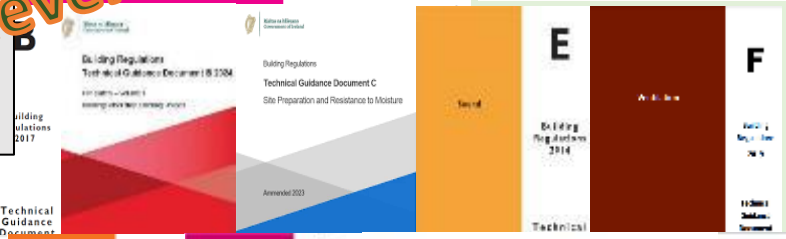
a. **Independent certification** schemes by approved bodies (NAB) e.g. (NSAI)... such certification schemes may be in addition to, but not conflict with, CE marking;

b. **Tests and calculations carried out by an accredited laboratory** showing that the material is capable of performing the function for which it is intended.

c. **Performance in use,** i.e. that the material can be shown by experience, such as its use in a substantially similar way in an existing building, to be capable of enabling the building to satisfy the relevant functional requirements of the Building Regulations.









Where alternative approaches are being considered, the local building control authority should be consulted at the earliest possible opportunity, to seek advice from the authority on the proposed development.

60 years

Agrément Certs
60 Years!!!

Office

# Materials & Workmanship Part D-

## Construction Producrts/MaterialsProtection Strategy to ensure fit for use

***Materials and workmanship***

***D1 All works to which these Regulations apply shall be carried out with proper materials and in a workmanlike manner.***

***D3*** *In this Part, "**proper materials" means materials which are fit for the use for which they are intended and for the conditions in which they are to be used**, and includes materials which:*


- **Damage to Materials/construction Products to be used in Construction Is Real**
- **Timber, sheet goods, roof trusses, and wall panels get left out in the rain, snow, and muck, leading to moisture-related issues, such as warping and Mold.**
- **Rain and snow also cause the breakdown of adhesives, causing wood-based panel products to swell and delaminate.**
- **Schedule materials deliveries as close as possible to the time those materials are placed in the building & NOT sitting out in the.**
- **Keep the materials under cover—in all weather—with plastic sheeting until you need them.**
- **Temporary Site Storage –protect construction materials**

Site storage involves the provision of adequate space, protection and control for materials, components and equipment that are to be used in works or a building.

60 years

Agrément Certs
60 Years!!!

## Maintaining quality Cont tory i tion—a planned multi-faceted approach

- ***Proper Materials*** ,
  - *Design*
  - *Workmanship and*
  - *Materials*

  *Fit for use/purpose in the conditions, location..*

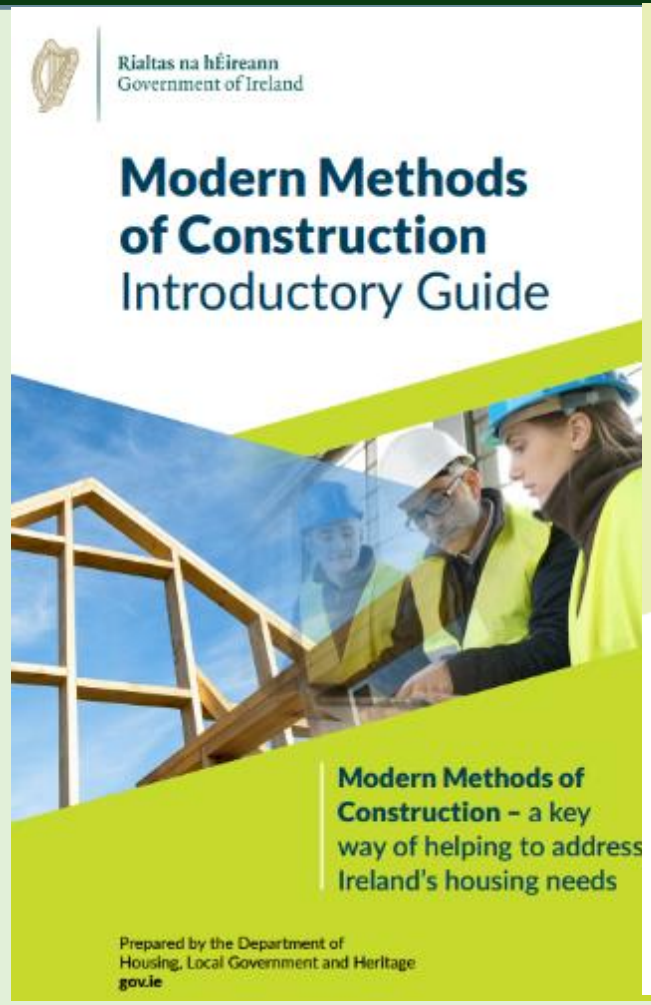
- ***People***
  - *Health*
  - *Safety and*
  - *Welfare*

- ***Planning***
  - *clear quality standards,*
  - *rigorous inspection procedures,*
  - *training staff,*
  - *continuously monitoring and*
  - *improving processes*

  *to ensure consistent quality throughout the supply chain*

# Modern Methods of Construction Introductory Guide

https://www.gov.ie/en/publication/e5e78-modern-methods-of-construction-introductory-guide/




## Introduction

This guide to Modern Methods of Construction (MMC) describes a range of innovative construction processes to deliver quality and compliant housing. This includes offsite construction techniques such as mass production and factory assembly as well as onsite innovations. Modern Methods of Construction will significantly help address Ireland's housing needs in line with Housing for All – the national strategy for housing.

**This guide has six parts as follows:**

1. **Modern Methods of Construction (MMC)**
2. **The main benefits of MMC**
3. **The seven categories of MMC – an at-a-glance view**
4. **The most commonly used categories of MMC for housing**
5. **Quality assurance (compliance and certification) – this part is mainly for industry readers**
6. **Initiatives to promote MMC in Ireland**

## 1 Modern Methods of Construction

Modern Methods of Construction is an industry term used to describe a range of manufacturing and innovative alternatives to traditional construction.

**MMC can:**

- **help boost productivity and efficiency of housing delivery, and**
- **increase the environmental sustainability of new housing delivery.**

## 2 Benefits of MMC

**There are many benefits of adopting Modern Methods of Construction more widely. These include:**

### Faster delivery of construction projects

MMC techniques can speed up the delivery of construction projects by between 20% and 60%. Both off and onsite activity can be improved. Many of the construction processes happen offsite in factory conditions where, for example, factors such as bad weather do not disrupt delivery times.

### High-quality homes

MMC promotes precision through digitalisation and strict quality-control processes. Creating construction components and units using factory-standard precision and consistency adds to the quality of structures. This means that they will achieve their intended performance and durability requirements of 60 years.

### Increased sustainability

MMC strengthens quality of construction such as improving air-tightness in homes. This improves the energy performance of homes and promotes higher Building Energy Ratings (BER) resulting in improved comfort, lower energy bills and reduced carbon emissions.

**MMC also helps to:**

- reduce manufacturing waste and energy, as well as reducing harmful emissions in transporting components,
- improve sustainability and circularity (most efficient use of materials), and
- reduce embodied carbon (which will help us meet our carbon-neutral goals as MCC can, for example, encourage the use of lower carbon-intensive materials).

### More affordable

MMC can reduce construction costs when they are combined with a steady supply of standardised designs. This can mean that new housing is more affordable for the purchaser or tenant.

### More diversity in the workforce

The indoor factory environment, with regular working hours and a consistent place of work is, attractive to a more diverse and localised workforce.

**Overall, greater use of MMC can boost productivity in the construction sector and open new opportunities for innovation.**

*Figure 1: MMC factory-controlled environment*

## 3 The seven categories of MMC – an at-a-glance view

**The seven categories of MMC are:**

| | |
|---|---|
| Category 1 | Pre-manufacturing – 3D primary structural systems (Volumetric) |
| Category 2 | Pre-manufacturing – 2D primary structural systems (Panelised) |
| Category 3 | Pre-manufacturing - non systemised primary structure |
| Category 4 | Additive manufacturing – (structural and non-structural) |
| Category 5 | Pre-manufacturing – non-structural assemblies and sub-assemblies, for example pods |
| Category 6 | Traditional building product-led site labour reduction and productivity improvements |
| Category 7 | Site process-led labour reduction/productivity assurance improvements (innovative processes and approaches) |


*Figure 2: Categories of MMC*

2 Pre-manufacturing (2D primary structural systems)

### Panelised components (category 2)

This MMC category uses flat panel units such as panelised walls, which can be made from a range of materials. They are made in factories and assembled onsite to produce a house or apartment.

Panelised components can include:

- **walls, roof and floors,**
- **insulation and linings, and**
- **cladding, windows, roofing and doors.**

They can be made from different materials such as:

- **Timber Frame**
- **Light Gauge Steel Frame (LGSF),**
- **Precast Concrete Panels and Structurally-Insulated Panels (SIPs), or**
- **Cross Laminated Timber (CLT).**

*Figure 4: Panelised unit'*

5 Pre-manufacturing (Non structural assemblies & sub-assemblies)

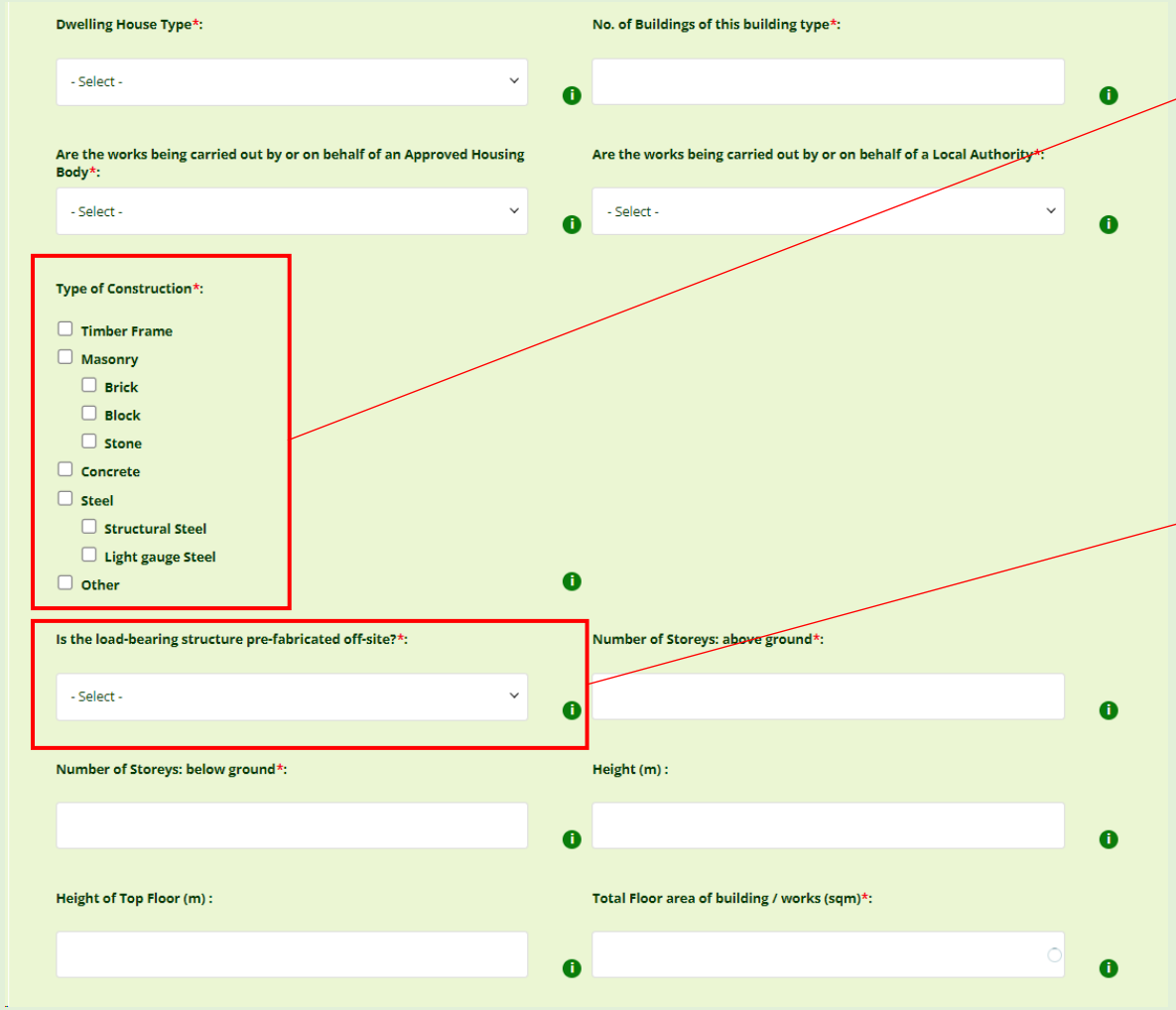
### Pre-manufacturing assemblies and sub-assemblies (category 5)

This applies to:

- **partition wall systems,**
- **weatherproofing or insulation roofing finish assemblies, and**
- **non-load-bearing volumetric assemblies known as 'pods', often used for kitchens and bathrooms.**

# Changes to Online Assessment

## Existing System

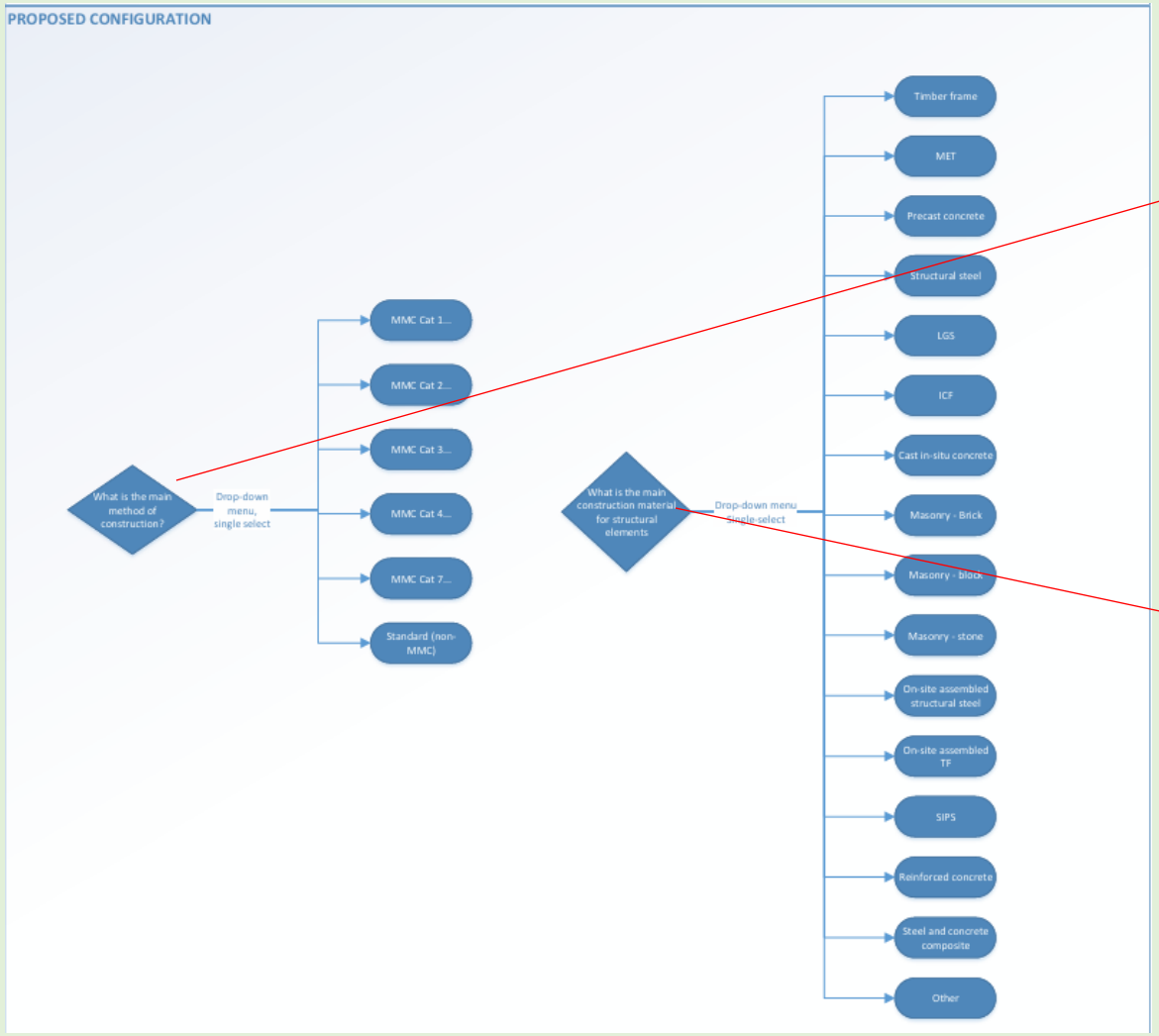



The type of construction used in the buildings of works. The existing system allowed for multiple types of construction within one building.

Load-Bearing Structures that arrive on site pre-fabricated, 3D modular for instance. The question was not well defined and could lead to errors.

# Changes to Online Assessment

## Proposed Improvements – 2 New Questions in the form of dropdown menus



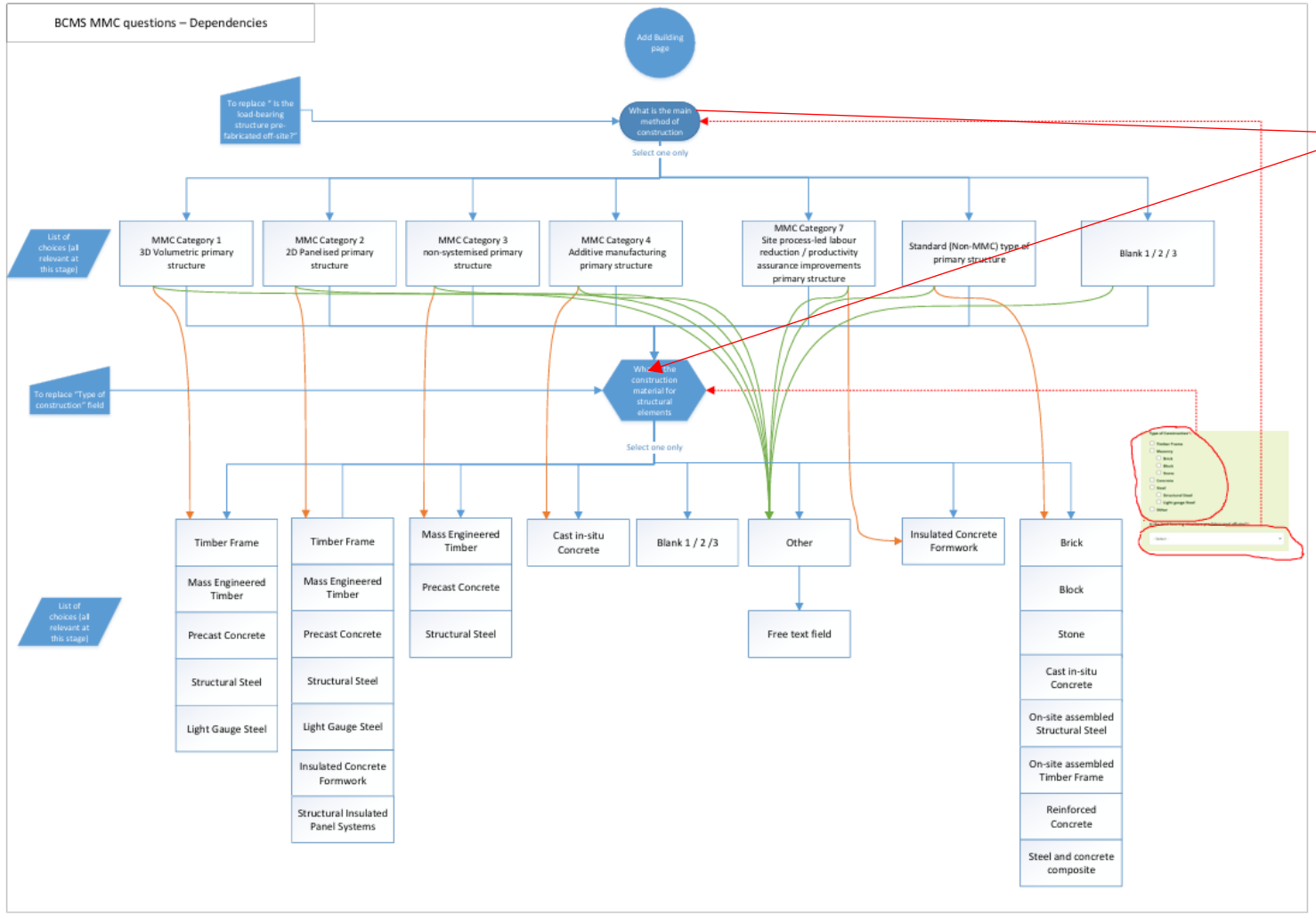

Main Method of Construction?
Selection available:

- Standard Construction (Non-MMC)
- MMC Category 1 3D Volumetric Primary Structure
- MMC Category 2 2D Panelised
- MMC Category 3 non systemised
- MMC Category 4 Additive manufacturing
- MMC Category 7 Site Process

Main material for Structural Elements?
List of 15 of the most common materials plus “other”

# Changes to Online Assessment

## Proposed Improvements – 2 New questions are linked




The Selection under
"What is the Main Method of Construction?"
Limits the fields in the "What is the main material for Structural Elements?"

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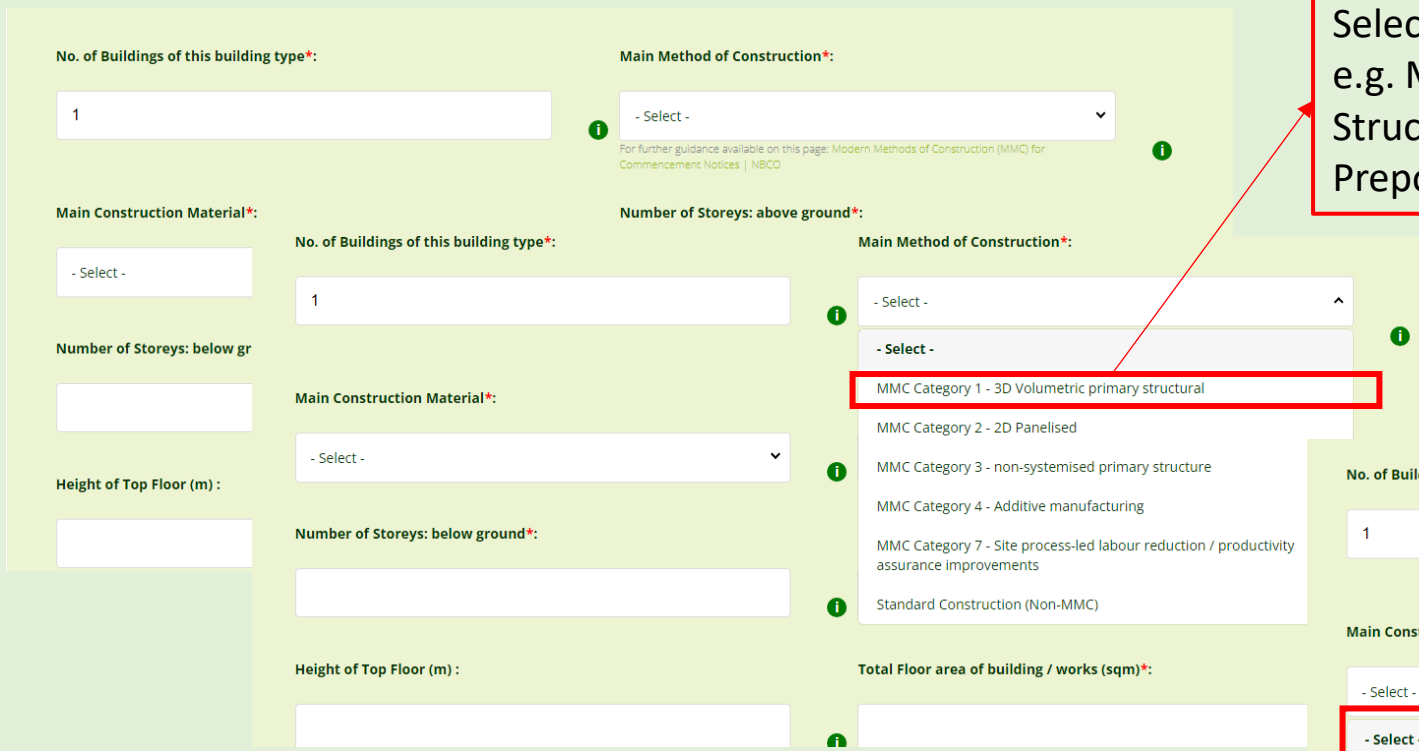
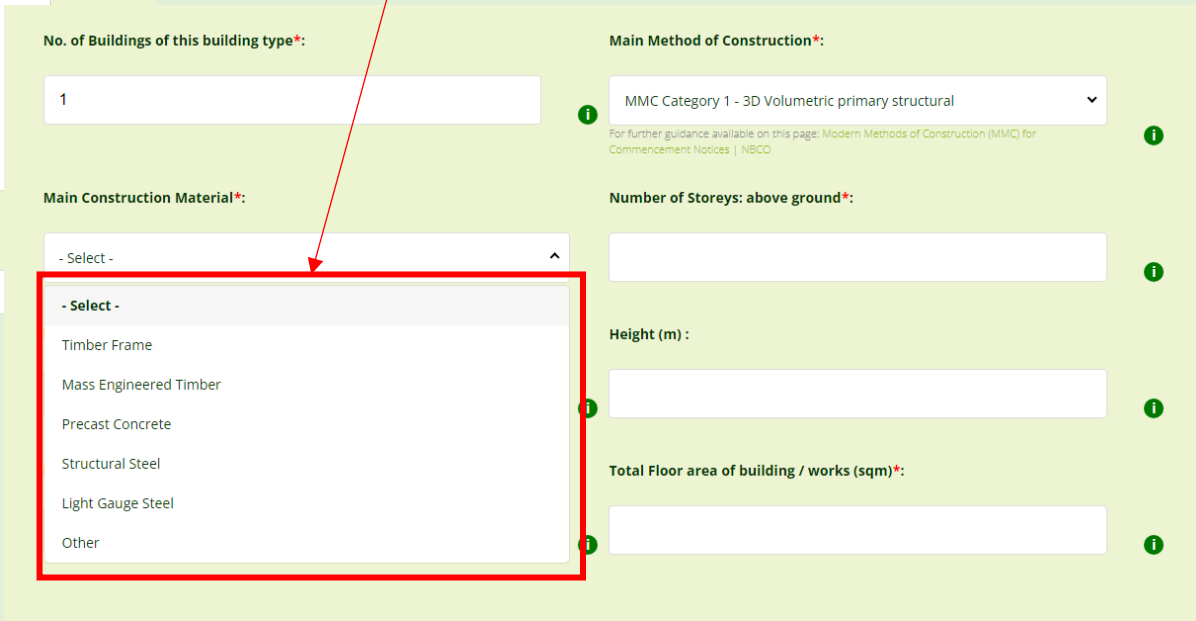
# Changes to Online Assessment

## Proposed Improvements –dropdown menus

Selecting a “Main Method of Construction”
e.g. MMC Category 1 - 3D Volumetric primary Structure
Prepopulates the “Main Construction Material”



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# Changes to Online Assessment

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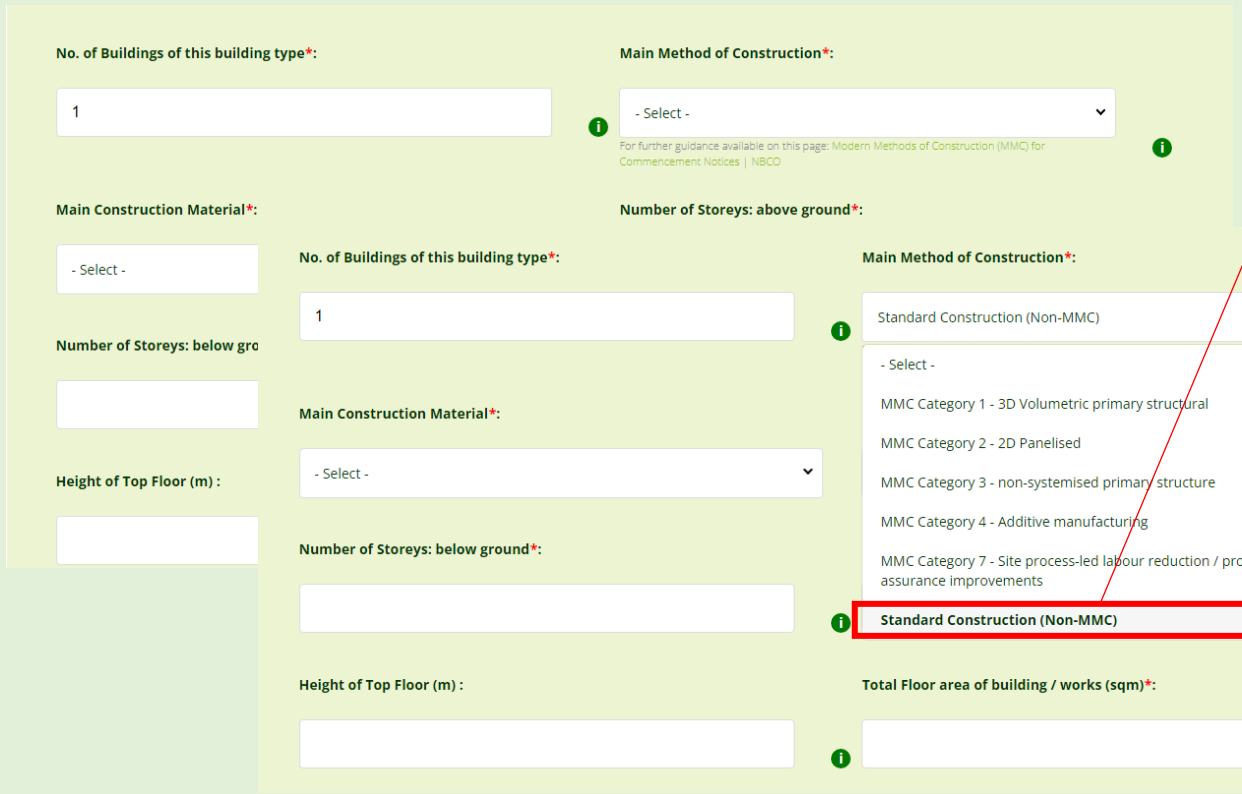
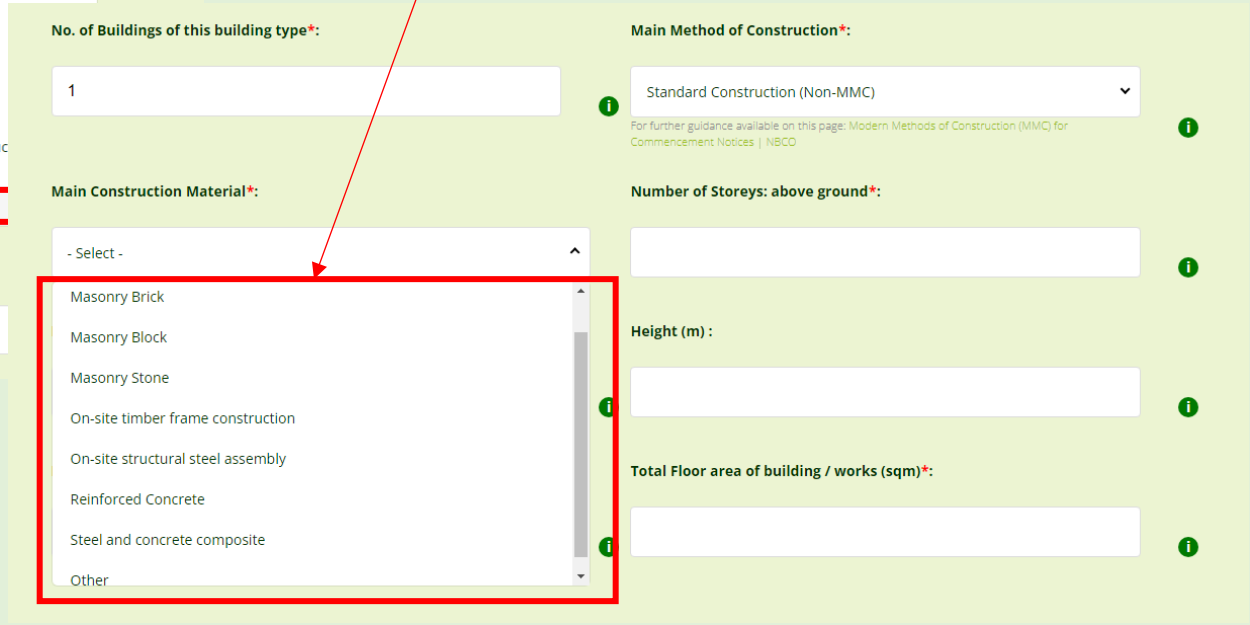


# Changes to Online Assessment

## Proposed Improvements – Resource Page

**No. of Buildings of this building type*:**

1

**Main Method of Construction*:**

- Select -

For further guidance available on this page: Modern Methods of Construction (MMC) for Commencement Notices | NBCO

Link under Main Method of Construction brings you a resource page

**Standard Construction (Non MMC)**

Standard Construction (Non MMC) - Cavity wall construction with blockwork inner leaf

Standard Construction (Non MMC) - Reinforced Concrete main structural elements

**Modern Methods of Construction Category 1 -3D Volumetric Primary Structure**

MMC Cat 1 - 3D Structural Unit

MMC Cat 1 Unit being craned into Position

**Modern Methods of Construction Category 2- 2D Panelised**

MMC Cat 2 - 2D Structural Panel with insulation and external cladding

MMC Cat 2 - 2D Light Gauge Steel (LGS) panel

**Modern Methods of Construction Category 3 - non systemised primary structure**

MMC Category 3 - Glulam primary structure

**Modern Methods of Construction Category 4- Additive Manufacturing**

MMC Category 4 - Ground floor in-situ concrete walls being "printed"

**Modern Method of Construction Category 4**

This MMC Category uses remote, site based or final workforce based 3D printing of parts of buildings through various material based on digital design and manufacturing techniques

**Main Construction Material for MMC Category 4**

- Cast In-situ Concrete

If a novel form of MMC Category 4 is being used please select other and enter in the details.

**Modern Methods of Construction Category 7 - Innovative site process and approaches**

MMC Cat 7 - Insulated Concrete Formwork (ICF) External Structural walls

**Modern Methods of Construction Category 7**

This category of MMC uses innovative construction techniques that improve on site processes.

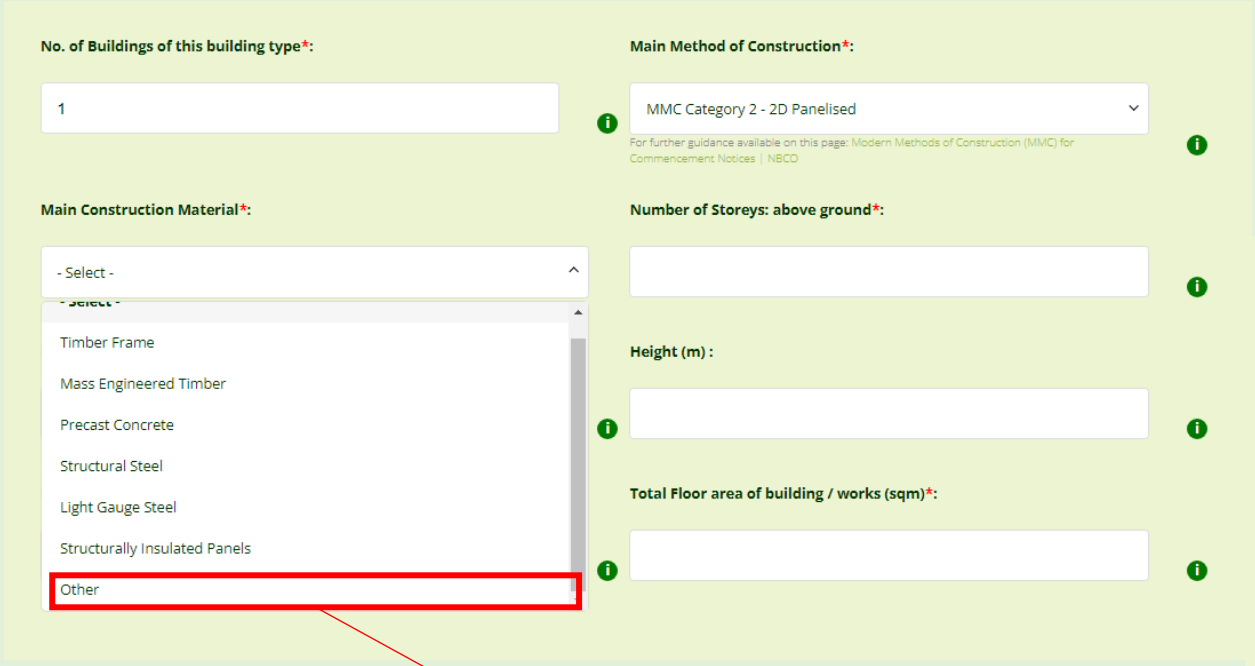
**Main Construction Material for MMC Category 7**

The most common form of MMC Cat 7 is Insulated Concrete Formwork (ICF).

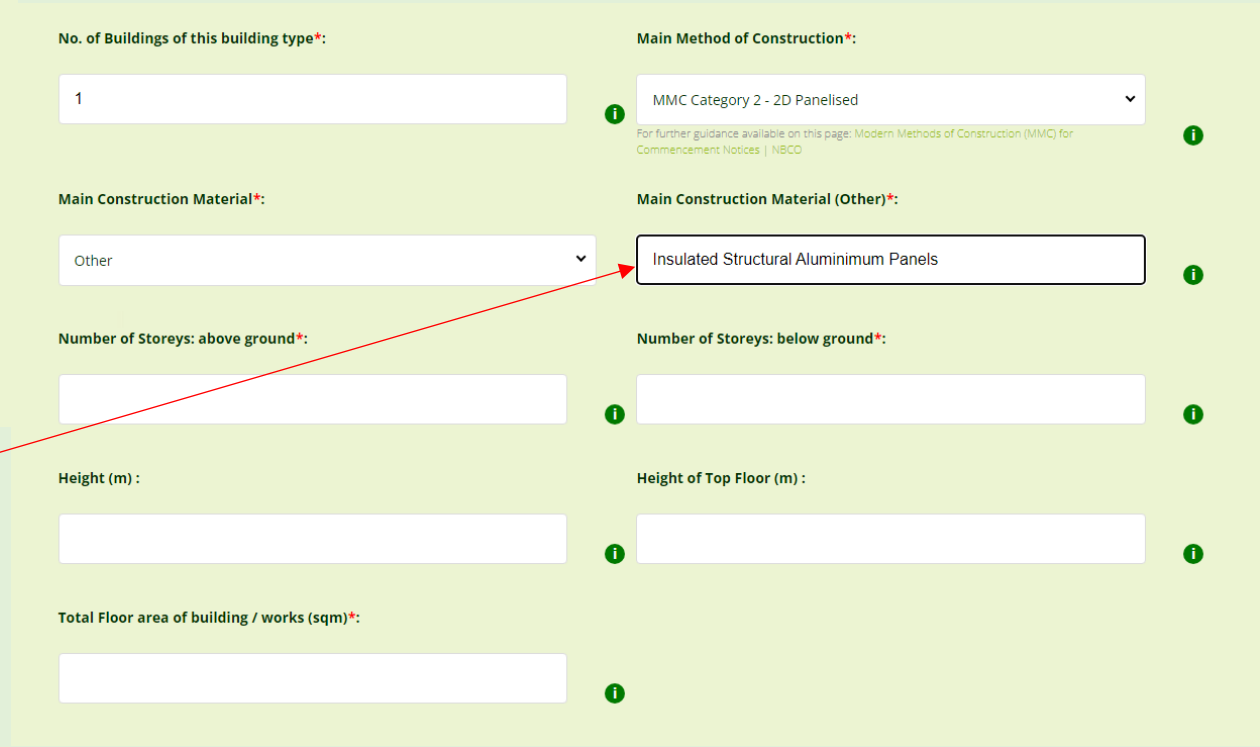
If a novel form of MMC Category 7 is being used please select other and enter in the details.

# Changes to Online Assessment

## Proposed Improvements – Construction Material - Other

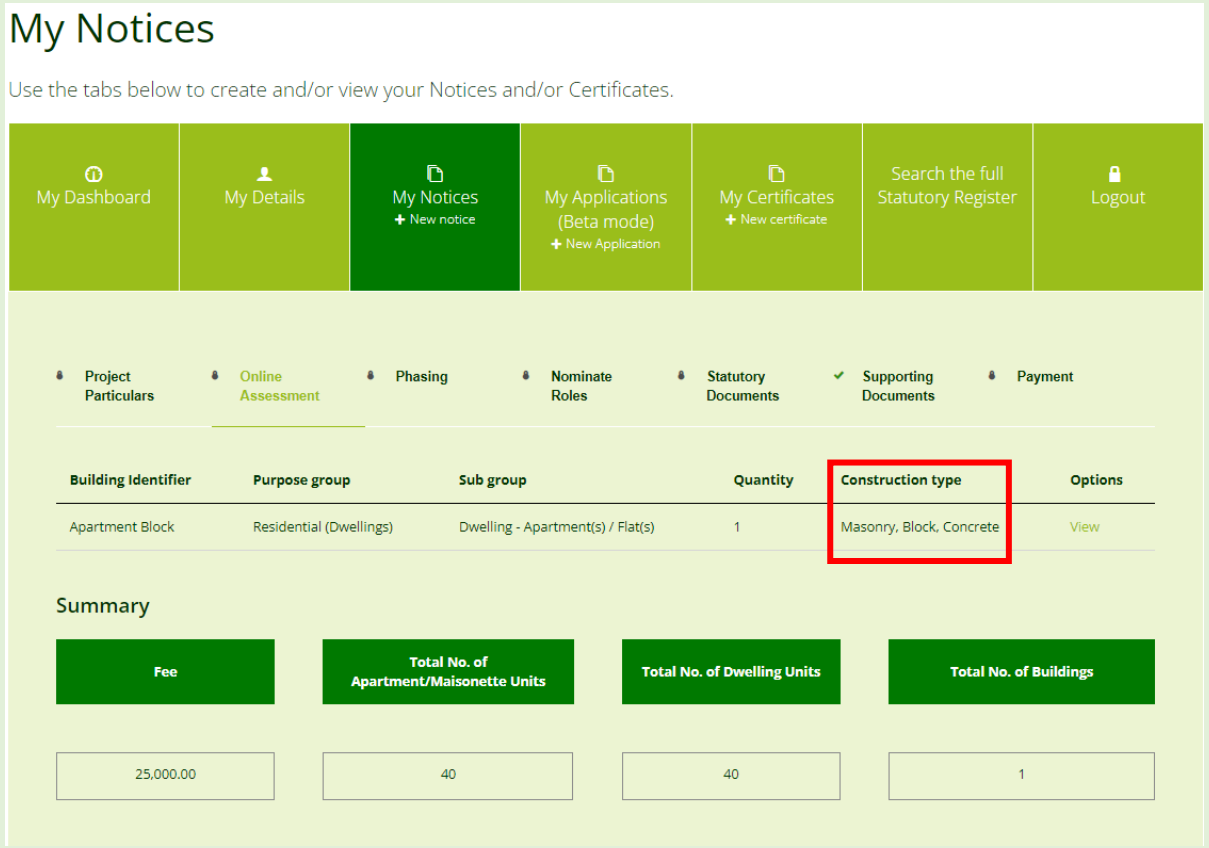


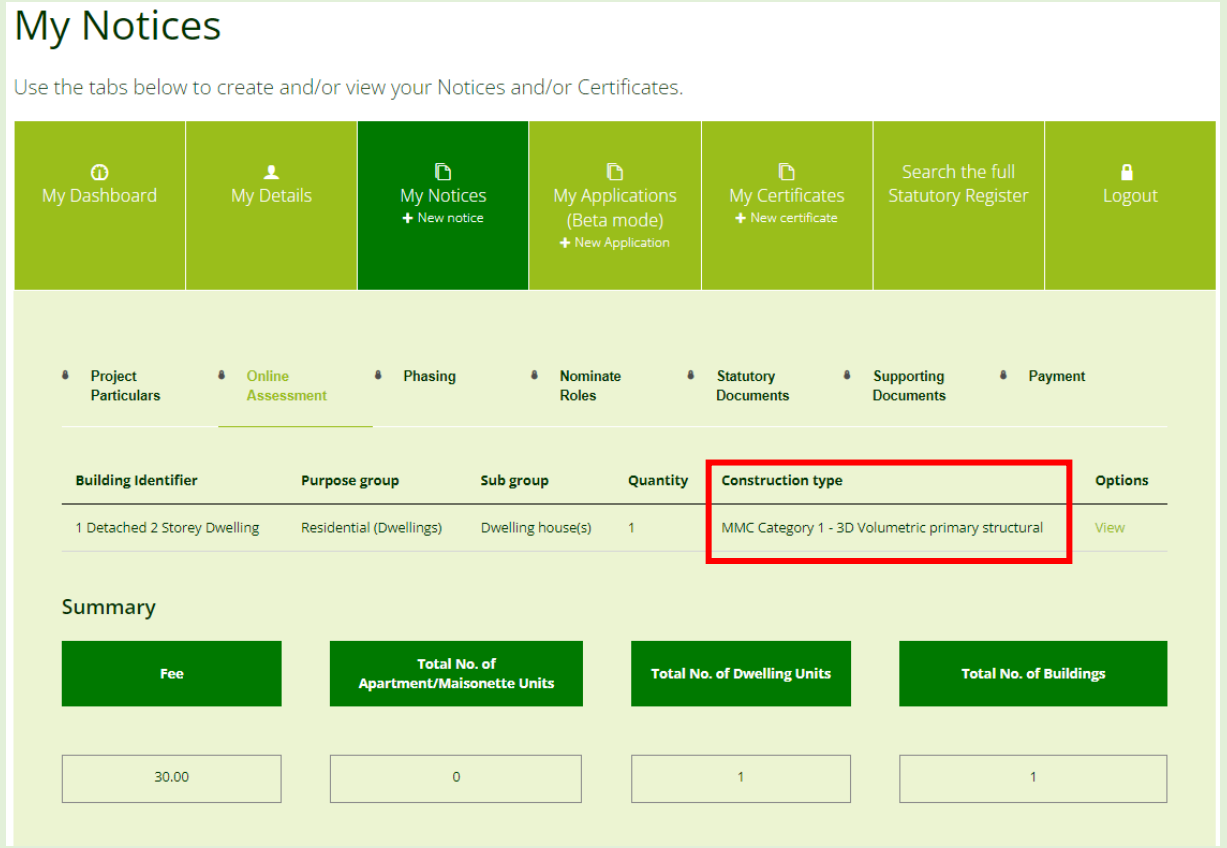

If “Other” is selected than a free Text box will appear to let the Notice Creator enter concise details of proposed Material



# Changes to Online Assessment

## Proposed Improvements – Legacy v Proposed Change



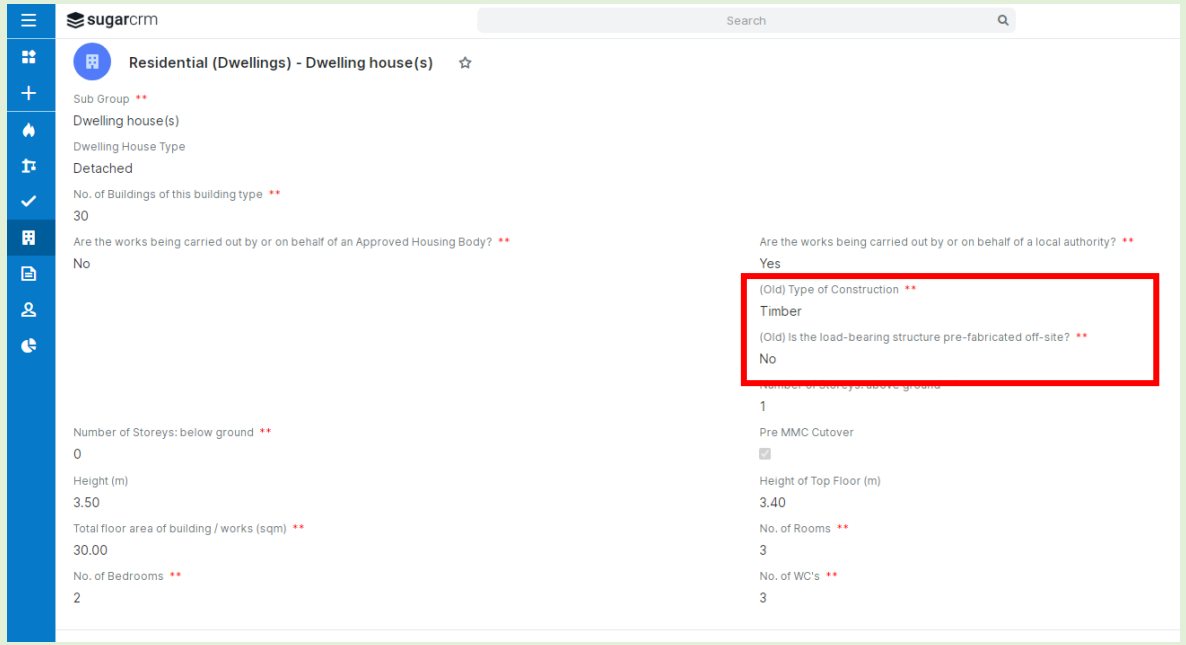



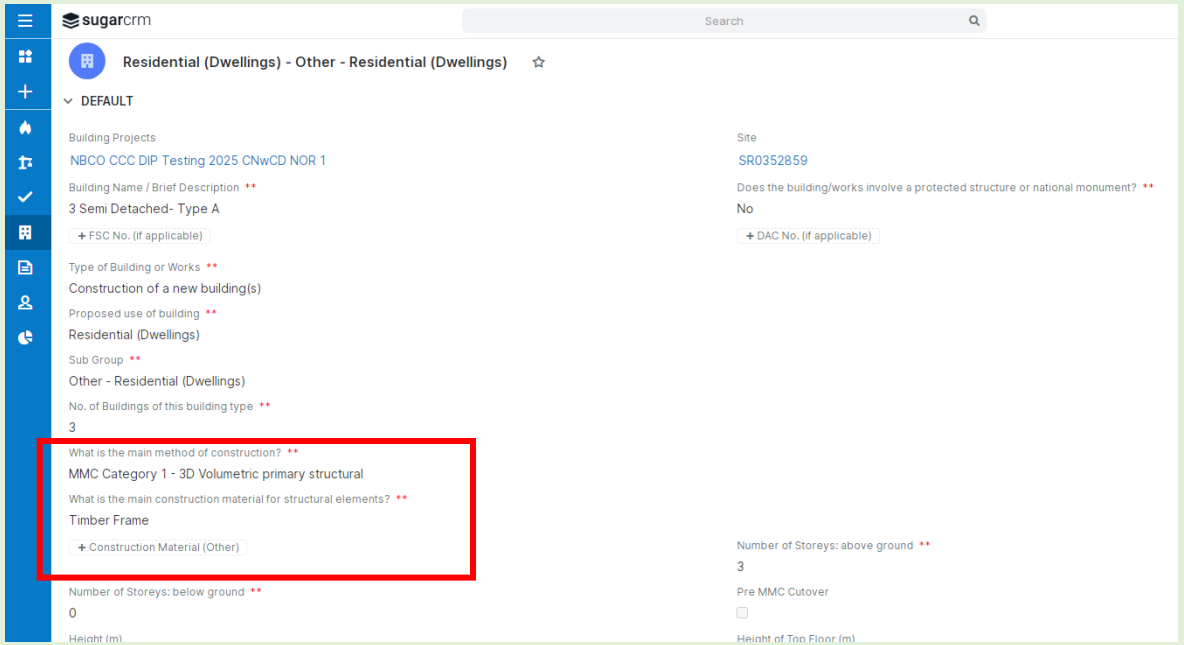

Legacy Projects will still display the (Legacy) "Construction Type" under Online-Assessment

New Project will display the new "Main Method of Construction" under Online Assessment

# Changes to Online Assessment

## Proposed Improvements – Change to Sugar CRM – BCA's interface



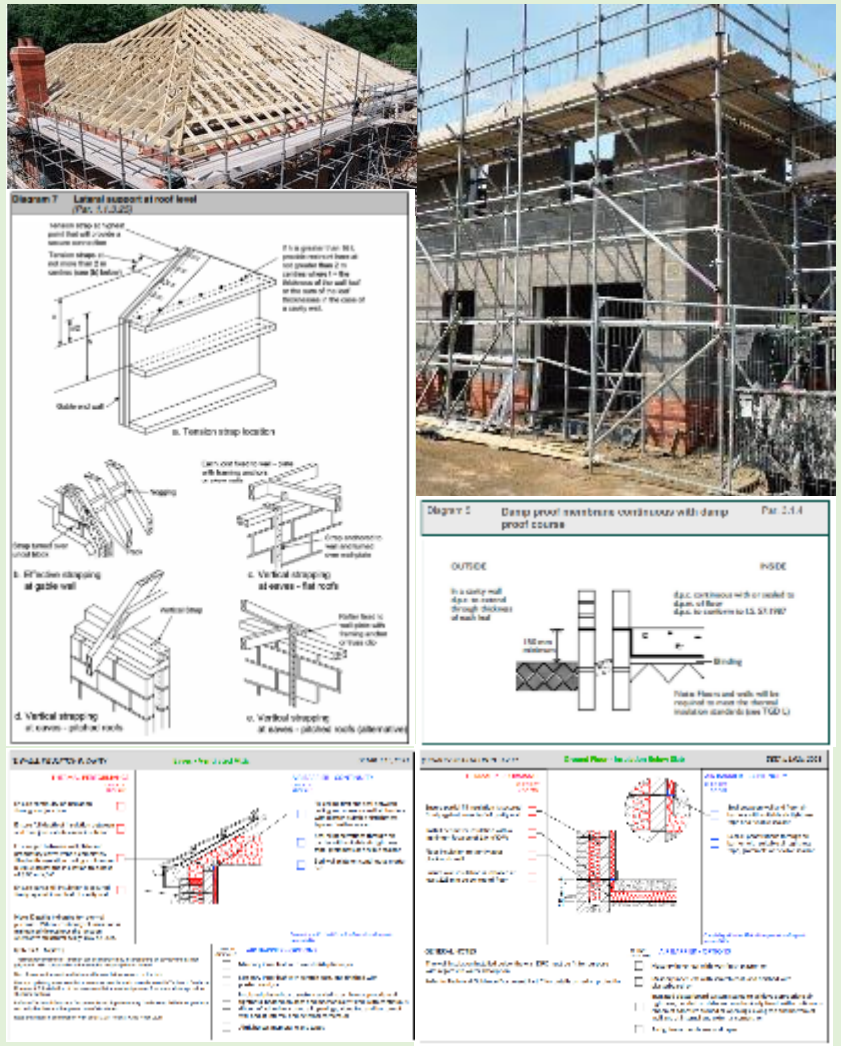

Legacy Projects will only display "(Legacy) Type of Construction" and "(Legacy) Is the load-bearing structure pre-fabricated off-site?" Under Online-Assessment

New projects will only display the 3 New fields:
"Main Method of Construction"
"Main Construction Material" and "Other" if applicable

# Standard Construction –Non MMC

## Standard Construction – Generally Masonry Construction – as described in TGDs for a non-complex building

- Check if building details are in accordance with TGDs, these are prima facie compliance
- Check if materials are accordance with Part D
- Check if material are properly stored
- Check works are progressing in workmanlike manner
- Check if details are in accordance with ACDs



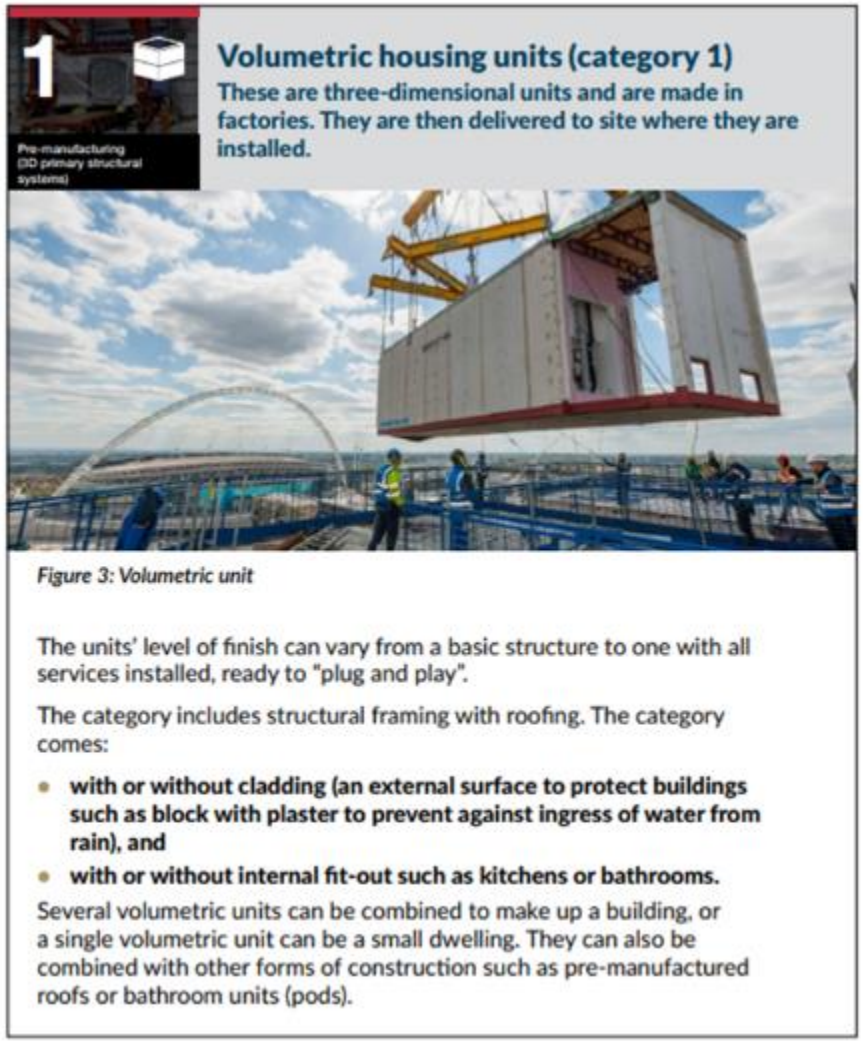
# MMC Category 1 -3D Volumetric Primary Structure

## Pre-manufacturing (3D primary structural systems)

## Can be stand alone units, individual apartments or rooms/combination of rooms.

***These are three-dimensional units consisting of floor, wall and roof panels, which are the primary structure of all or part of the building. The units are made in factories and transported to site.***

- Check on site protection (Part D)
- Check Agrément Cert
- Check Factory Inspection records
- Check interface with founds (Part C)
- Check sealing between units
- Check external envelope Walls, Roofs and Balcony junctions



# MMC Category 2- 2D Panelised (Flat-Pack!!)

- **Pre-manufacturing (2D primary structural systems)**
- ***These are two-dimensional flat panel units such as panelised walls, which are part of the primary structure of the building. They are made in factories and assembled on site, to produce a building.***
- Check Agrément Cert/IS 440 compliance for Timber Frame construction
- Check On-site Protection (Part D)
- Check Factory Inspection records
- Check interface with founds
- Check sealing between units; Fire Barriers
- Check external envelope Walls,
  Roofs and Balcony junctions

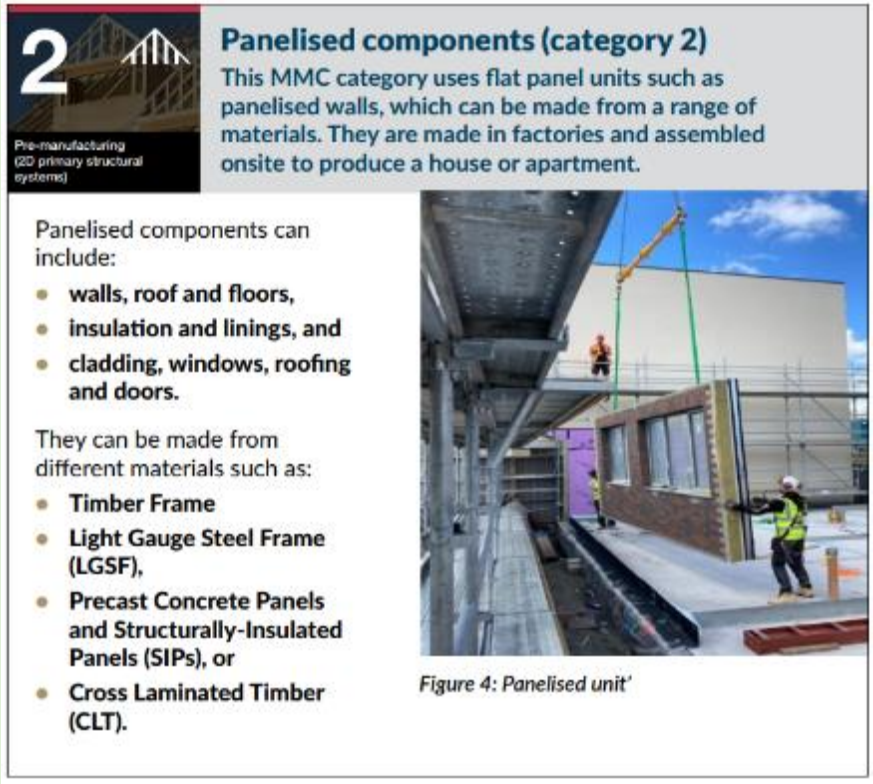


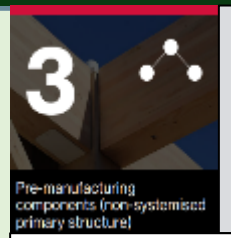
*Figure 4: Panelised unit'*

# MMC Category 3 - Non-Systemised Primary Structure

## *Pre-manufacturing components (non-systemised primary structure)*

***"These are two-dimensional components such as beams and posts, which form part of the primary structure of a building. They are made in factories and assembled on site to produce a building"***

- Check Agrément Cert/basis of compliance
- Check On-site Protection (Part D Materials?)
- Check Factory Inspection records
- Check interface with foundations (gap details)
- Check external envelope Walls, Roofs and Balcony junctions




**Pre-Manufacturing components (category 3)**
**This MMC Category uses pre-manufacturer structural members made of framed or mass engineered timber, cold rolled or hot rolled steel or pre-cast concrete**

Structural members
Can include:

- **Load Bearing Beams**
- **Columns**
- **Walls**
- **Core Structures**
- **Slabs**

They can be made
From different
materials such as:

- **Structural Steel**
- **Mass Engineered Timber**
- **Precast Concrete**

# MMC Category 4- Additive Manufacturing

## Additive manufacturing (structural and non-structural)

**3D printing**

**Additive manufacturing, also known as 3D printing, is a process that creates three-dimensional objects by adding material layer by layer.**

**MIT - Massachusetts Institute of Technology**

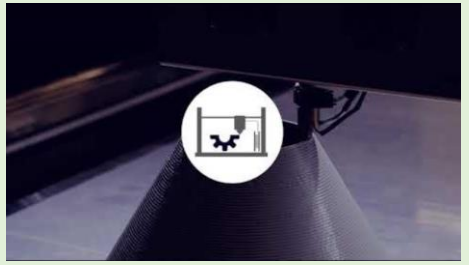
**https://youtu.be/_K1C_dkZK98**

- Check Agrément Cert/basis of compliance
- Check On-site Protection (Part D)
- Check interface with foundations
- Check installation of ancillary items; Cavity barriers, Fire Barriers
- Check dockets/slump test/cube tests for concrete


**Additive manufacturing (category 4)**
**This MMC Category uses remote, site based or final workforce based 3D printing of parts of buildings through various material based on digital design and manufacturing techniques**

Printed Elements can include:
- **Walls**
- **Internal Partitions**

They can be made from:
- **In-Situ Concrete**



# MMC Category 7- Site-Process led labour Reduction

## Site process led site labour reduction / productivity / assurance improvements

***"This includes innovative processes on the construction site such as insulated concrete formwork, which form part of the primary structure of the building."***

- Check Agrément Cert/basis of compliance
- Check horizontal damp proof course must be appropriate for the type of ICF system.
- Check joints between the windows and doors and the surrounding cladding system, sufficiently sealed and to Manufacturer's instructions.
- Check detailing and construction of any lean-to/flat roof abutments, parapets or balcony constructions to determine how water penetration will be prevented.


# Compliance

Completed Building or works must be in compliance with Parts A-M of the Second Schedule of the Buildings Regulations.

For novel approaches, outside the scope of the TGDs, compliance may be demonstrated by:

- Agrément Certification
- Drawings, Calculations and Testing that demonstrates compliance

Compliance with the Building Regulations must be considered holistically, not just on the performance of constituent parts.

Those involved in the design and construction of a building may be required to provide such evidence as is necessary to establish that the requirements of the Building Regulations are being complied with.

## 5 Compliance

**Modern Methods of Construction must be high quality.**

*Figure 7: Completed 2D panelised system using Timber Frame*

**All new buildings must comply with Irish Building Regulations and Building Control regulations. For new dwellings, all key elements must have a durability of at least 60 years.**

You will find more information about Building Regulations on the Department of Housing, Local Government and Heritage website. This website also contains information on regulations for the design and construction of a new building or an extension to an existing building:

https://www.gov.ie/en/publication/1d2af-building-regulations/

The Building Regulations (Part D) requires that all works should be carried out with proper materials and in a workmanlike manner.

'Proper materials' means materials which are fit for the use for which they are intended, and for the conditions in which they are to be used.

Follow the link below for full Building Regulations Technical Guidance Documents. They are available on the Department of Housing, Local Government and Heritage website:

https://www.gov.ie/en/collection/d9729-technical-guidance-documents/

# Compliance - MMC

### Agrément Certification of MMC

Innovative systems such as MMC must comply with the Building Regulations. The process of Agrément certification applies to those products and processes which do not fall within the scope of existing construction standards, either because they are innovative or because they deviate from established norms.

The National Standards Authority of Ireland (NSAI Agrément) assesses, specifies testing, and where appropriate, issues **Agrément certificates.** This certificate confirms that new building products, materials, techniques and equipment are safe and fit for purpose in accordance with the Irish Building Regulations and with the terms of the certificate.

### Certification

The NSAI offers certifications on the construction and sign-off stages for MMC products and building system installation compliance under building regulations.

https://www.nsai.ie/certification/agrement-certification/modern-methods-of-construction-certification/

NSAI also published the Agrément Guide for Modern Methods of Construction under the Housing For All plan, which can be viewed at the following link:

https://www.nsai.ie/images/uploads/certification-agrement/Guide_to_Agr%C3%A9ment_Certification_for_MMC.pdf

You can find a list of Agrément certified MMC systems here by selecting "Building Systems":

https://www.nsai.ie/certification/agrement-certification/search-agrements-certificates/

The system has not been assessed for use with timber frame or steel frame construction. The system can be used on NSAI Agrément certified ICF (Insulated Concrete Formwork) systems.

**4.5 DURABILITY**

Buildings based on the Amvic ICF System, when rendered using the Wetherby or other NSAI Agrément certified renders for use onto EPS, subject to maintenance, when constructed in accordance with the manufacturer's instructions and this Certificate, will have a minimum design life of at least 60 years in accordance with BS 7543:2015 *Guide to durability of buildings and building elements, products and components*.

External render systems can last in excess of 40 years in accordance with BS 7543:2015 subject to normal use, regular inspection and maintenance. It is important to note that the durability of the render system is entirely dependent on the correct installation of the product in accordance with its NSAI Agrément Certificate, the manufacturer's instructions, IS EN 13914-1:2016 *Design, preparation and application of external rendering and internal plastering – Part 1: External rendering* and ongoing care and maintenance as described in Section 4 of their NSAI Agrément Certificates. Critical details include rendering at window sills, raised features, junctions with eaves and verges, and the use of suitably designed overhangs and flashings. Reference should be made to IS EN 13914-1:2016 for general advice on design, in particular on the use of angle, stop and movement joint beads.

**4.6 MAINTENANCE**

The rendering/concrete in the wall panels is maintenance free. However, the coloured rendering may discolour with time. It is considered that periodic re-coating of the silicone top coat may be necessary every 18 to 20 years to improve the appearance. The external sealants

# Compliance - MMC

NSAI
Agrément

Remove forms at openings, cutting 25mm smaller to allow for adjustments. The inside of the opening is lined with 50mm x 150mm treated timber frame glued/screwed into position and propped/braced as required.

**2.4.5 Reinforcement Placement**

Horizontal reinforcement can be placed in different locations across the concrete fill void using the form tie/spacer toothed slots. Horizontal reinforcing bars for lintels must be located within the lintel as specified in the structural design, the minimum length of bar will be specified by the chartered structural engineer to ensure that adequate anchorage has been allowed for either side of an ope. Vertical reinforcement can then be secured to horizontal reinforcement at required centres using standard fixing methods. Bar lapping lengths as per I.S. EN 1992-1-1[7] should be adopted. The system requires that in plain walls horizontal reinforcement be provided in top and bottom courses of every wall lift. The reinforcement is checked to ensure there is adequate concrete cover for protection and that compaction can take place. The horizontal and vertical reinforcement shall be specified by the chartered structural engineer (see Section 3.1.1).

**2.4.6 Bracing**

The bracing system is installed following installation of the third or fourth course of forms. Temporary bracing and propping during construction is essential to maintain alignment and adequate lateral stability during concrete filling. The installer is responsible for ensuring the adequacy of all temporary bracing. As a minimum, the full height of the assembled formwork system must be supported 700mm from corners and along the length of each wall at maximum horizontal centres of 1.8m.

All lintels must be adequately supported until the concrete has attained its minimum working strength. On exposed sites or in adverse weather conditions further support may be necessary. Typically, the bracing and alignment systems are placed on one side of the formwork (usually the inside face) during construction, however for very long or walls greater than one storey height, bracing on two sides is recommended.