Part 11

Modern Methods of Construction

Chapter

11.1

NHBC

MMC Systems: general requirements

This chapter provides guidance on meeting the Technical Requirements for certification, quality management, site management, installation, verification, and handover requirements for MMC systems used to form homes where the height of the top floor above ground does not exceed 18m. This chapter should be used in conjunction with Chapters 11.2 and 11.3.

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Introduction

This chapter gives guidance on meeting the Technical Requirements for certification, quality management, site management (handling, storage, and protection), structural design, structural design checking and certification, installation, verification, and handover requirements for MMC systems used to form homes where the height of the top floor above ground does not exceed 18m.

The guidance in this chapter is intended to outline the common general requirements applicable to MMC systems manufactured in a factory environment. This chapter should be used in conjunction with Chapter 11.2 Closed panel systems and Chapter 11.3 Volumetric systems, where further guidance is given relevant to the system type being employed.

Users of this chapter should also refer to Part 6 of the NHBC Standards, particularly Chapters 6.2 and 6.10 when either timber frame or light steel frame respectively are to be used.

'Modern Methods of Construction' is a collective term encompassing a wide range of system types, including off-site manufactured systems that cannot be inspected on site in a traditional manner due to high levels of offsite fabrication, innovative technologies and other non-conventional methods of construction that form the structure and envelop of the home. As such, methods of construction that are described in the preceding chapters of the NHBC Standards, such as open panel light steel and timber frame, and can be inspected on site during the build process are considered as conventional construction rather than MMC.

MMC types have been categorised and defined in the MHCLG Cross Industry Working Group 'MMC Definition Framework'. The definition framework identifies the following seven MMC categories:

Category 1	Pre-Manufacturing — 3D primary structural systems
Category 2	Pre-Manufacturing — 2D primary structural systems
Category 3	Pre-Manufacturing — Non-systemised structural components
Category 4	Pre-Manufacturing — Additive Manufacturing
Category 5	Pre-Manufacturing — Non-structural assemblies and sub-assemblies
Category 6	Traditional building product led site labour reduction/productivity improvements
Category 7	Site process led labour reduction/productivity improvements

The guidance in this Part will focus on systems that fall under Category 1 ie, volumetric systems, and Category 2 (closed panel only) ie, panelised in the definition framework:

Category 1 — 3D primary structural systems (volumetric)

Three-dimensional structural volumetric units fabricated offsite in a factory environment used to form all or part of the basic structure of a building. Volumetric units may incorporate varying degrees of offsite fabrication and finish, including internal and external linings, external claddings, windows and doors, internal finishes, concealed insulation, membranes, internal services, internal fixtures and fittings and fire-stopping.

Volumetric units can be used in varying configurations to form the entire structure of the home or be supported by surrounding construction. Units can be manufactured in varying structural forms and be formed from timber, concrete, steel or light gauge steel or a combination of those materials.

Category 2 — 2D primary structural systems (panelised)

Flat two-dimensional panelised units fabricated offsite in a factory environment used to form walls, floors, and roof structures. The category encompasses panelised units supplied as 'open' or 'closed' panel, however the scope of this Part only encompasses 'closed' panel systems. Definition of 'closed' panel systems is given in Chapter 11.2 Closed Panel.

Definitions for this chapter

Cavity	A space enclosed by elements of a building such as the space between the cladding system and the backing wall. The external wall cavity should be adequately drained, and ventilated where required.
Cavity barrier	A construction within a cavity, other than a smoke curtain, to perform either of the following functions: ● Close a cavity to stop smoke or flame entering ● Restrict the movement of smoke or flame within a cavity.
Factory installed	An element of the construction that is placed, positioned, fitted, or secured in, on or as part of the unit as part of the factory construction process.
Fire-stopping	A seal provided to close an imperfection of fit or design tolerance between elements or components, to restrict the spread of fire and smoke.
Hold Point	A point in the manufacturing or construction process beyond which work may not proceed until the required inspection and verification has been undertaken.
Installation Manual	Detailed installation guidance and information for the system compiled by the system manufacturer The Installation Manual describes general instructions for storage and transport of the system, and procedures for on-site assembly and installation.
MMC systems	Modern Methods of Construction is a collective term encompassing off-site manufactured systems that cannot be designed or be inspected on site in a traditional manner due to high levels of offsite fabrication, innovative technologies and other non-conventional methods of construction that form the structure and envelop of the home. As such, methods of construction that are described in the preceding chapters of the NHBC Standards and can be inspected on site during the build process are considered as conventional construction rather than MMC.
Manufacturer	The company which is responsible for the design and assembly of the MMC system.
Non-standard components	Components that are assembled as part of the system but vary for individual projects. These may be windows, doors or services that may be built into the system.
Robustness	A quality in a structure/structural system that describes its ability to accept a certain amount of damage without that structure suffering disproportionate failure. Robustness implies insensitivity to local failure.
Standard components	Components that are assembled as part of the system and are common to all projects.
Strong point	A structural element, frame or assembly oriented in a vertical plane that act to resist lateral loads supporting both horizontal and vertical stability systems together with façade (including wind posts, cladding rails, etc) and transfers the lateral actions through the assembly generally down to the foundation. Examples are reinforced concrete shear walls like lift cores or stair wells.
System	For the purposes of this chapter, this term refers to acceptable forms of either closed panel or volumetric MMC systems.
System Manual	Detailed technical information on the system compiled by the system manufacturer. The System Manual describes the system, the declared performance of the system and evidence to support the declared performance.
Unit	A prefabricated building element, manufactured offsite as a structural assembly in three-dimensional or flat panel format used as part of a system to form the superstructure of a building.
Volumetric	Three-dimensional structural units which are commonly stacked to form a building. Volumetric units may incorporate varying degrees of off-site fabrication and finish, including internal and external linings, external claddings, windows and doors, internal finishes, concealed insulation, membranes, internal services, internal fixtures and fittings and fire-stopping.

11.1.1 Compliance

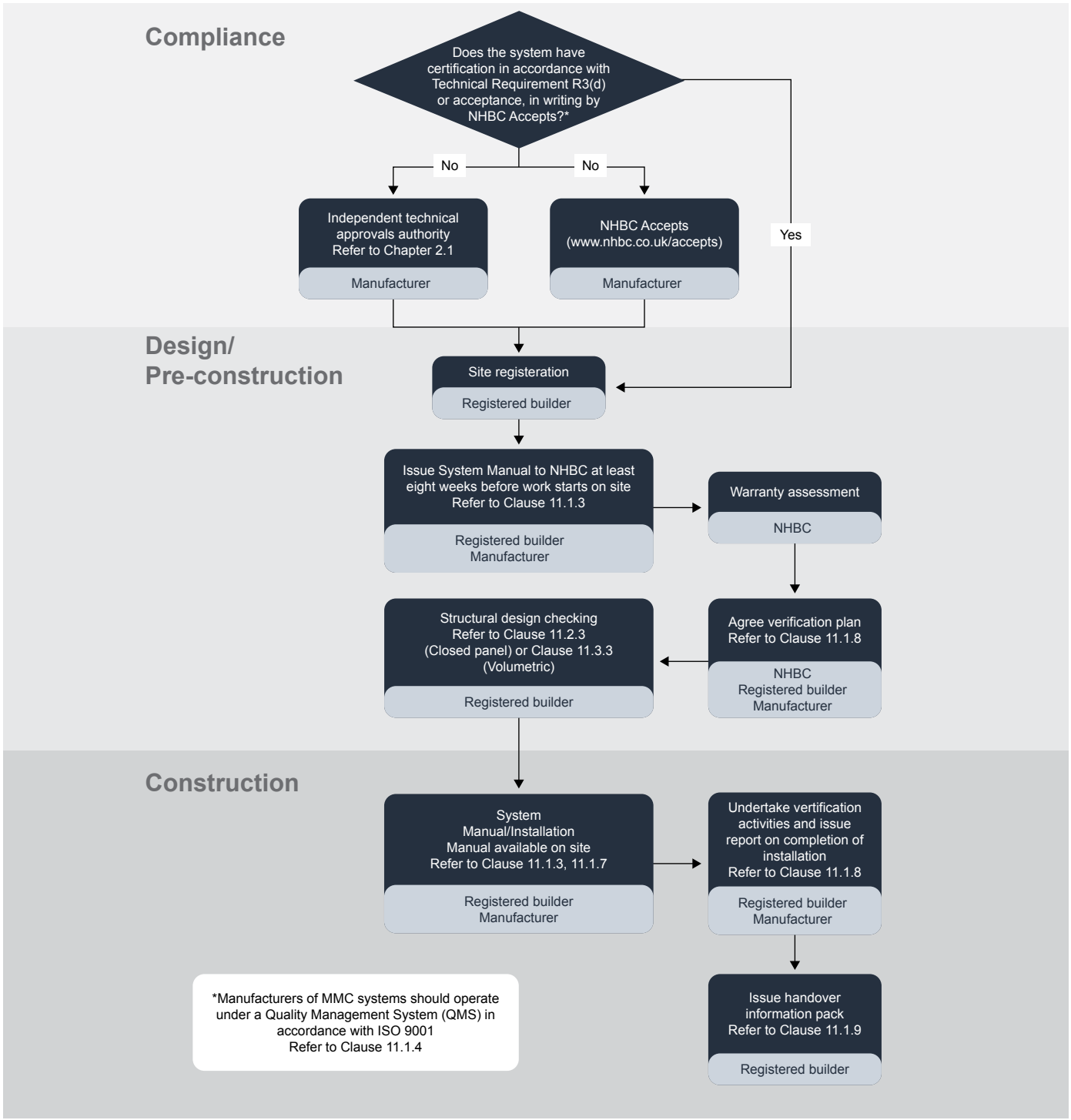
Also see: Chapter 2.1

MMC systems shall comply with the Technical Requirements.

MMC systems should comply with the guidance in this chapter. Further reference should be made to relevant chapters ie, Chapter 11.2 Closed panel or 11.3 Volumetric, appropriate to the MMC system type being used.

Early engagement with NHBC should be undertaken prior to use of MMC systems on projects.

Figure 1: MMC process



11.1.2 Certification

MMC systems shall be adequately certified as being suitable for their intended use.

MMC systems should have certification confirming satisfactory assessment, undertaken by an independent technical approvals authority, or acceptance in writing by NHBC Accepts.

The scope of certification by an independent technical approvals authority should include:

- inspection and surveillance of factory production
- strength and stability (including temporary loads)
- fire resistance including details of critical junctions between elements
- reaction to fire classification
- thermal performance
- acoustic performance
- system junctions and joints
- maintenance and repairability
- condensation risk
- resistance to weathering in use, including temporary resistance during transport and during construction
- regulatory compliance
- design considerations
- installation guidance and acceptable superstructure tolerances
- durability
- approval of installers.

Certification and system documentation should be:

- made available to NHBC before work begins on site, and
- used as a reference to ensure compliance.

Use of the system should be within the scope of the certification. Where relevant, certification should make reference to test evidence or documentation used to support or justify any declarations or conclusions made.

Standard components assessed as part of the system certification and performing critical functions should not be substituted or replaced unless agreed otherwise by NHBC.

11.1.3 System Manual

Designs and specifications, in the form of a System Manual, shall be produced in a clear and understandable format, include all relevant information, and be distributed to all appropriate personnel.

A System Manual and supporting design information should be issued to NHBC at least eight weeks in advance of the works starting on site, in accordance with NHBC rules. Further performance issues may be considered at the discretion of NHBC, and further information requested. If in doubt, consult NHBC Standards, Innovation and Research (**technicalsupport@nhbc.co.uk**).

The System Manual should contain the information described in Table 1 as relevant for the system.

Table 1: Items included in the System Manual

Topic	Description
System Details	• manufacturer name • system name • document revision number • issue date
Scope and limits of application	• description of the system and scope of offsite manufactured elements • intended use and limits of application or exclusions (geographic/environmental, storey height, dimensions, building type and shape, etc) • confirmation of parties, who have responsibility for the design and coordination of the system, certification of the system quality assurance and who has overall responsibility for the delivery of the home
Standard detail drawings	• schedule of standard detail drawings
Material specifications	• specifications and relevant third-party certificates for all key materials and standard components critical to the performance of the system
Durability	• demonstration of adequate durability of components and assemblies in accordance with Technical Requirement R3 • specification of fixings, including corrosion protection • temporary weather protection design and method

Strength and stability	• structural design philosophy (including codes of practice referenced, test reports and identification of design aspects not covered by codes for which additional checks or assessment are required) • sample structural calculations for typical design • material strengths and/or grades (traceability) • section properties • loading • ultimate limit state • serviceability limit state • resistance to overturning • racking resistance • holding down • connections within the system • connections with other building elements • structural integrity • positions and sizes of holes through members • unit-to-unit connections (strength as well as accuracy) • unit-to-foundation connections • rigidity in transportation • lifting
Behaviour in relation to fire	• reaction to fire • resistance to fire including fire test reports, and supporting assessments where required, demonstrating compliance with Building Regulations • fire compartmentation design • design and specification of cavity barriers and fire-stopping
Resistance to moisture	• vapour permeability and moisture resistance of building fabric and suitable assessment of interstitial and surface condensation risk • watertightness of the building envelope including integrity and continuity of building membranes and weather resistant detailing at junctions and interfaces • resistance to moisture from the ground
Safety in use	• consideration of changes in levels • resistance to eccentric loads, including impact resistance
Resistance to the passage of sound	• sound insulation performance and design
Energy efficiency	• thermal resistance of building fabric including assessment of thermal bridging at typical junction and interface details • air permeability design
Coordination of services	• specification of factory installed services • method of testing and commissioning • method of access for site connections, inspection, and commissioning • allowance for tolerances of site connections to factory installed services
Quality of finish	• quality assurance process for achieving quality of finish in accordance with NHBC Standards
Evaluation of conformity	• evidence of Quality Management System (QMS) in accordance with ISO 9001:2015 • Factory Production Control (FPC) plan • non-conformity procedure • traceability and unit identification procedure • inspection and test plan • storage, transport, and installation procedures

11.1.4 Quality management

MMC systems shall be from a manufacturer operating under a quality management system acceptable to NHBC. Issues to be taken into account include:

1) **factory production control**
2) **traceability of components and manufactured units**
3) **storage.**

MMC systems must be supplied by a manufacturer who operates under a Quality Management System (QMS) which is certified by a UKAS accredited, independent certification body in accordance with the requirements of ISO 9001. The scope of the certified QMS should cover the following activities:

- design and development
- storage of goods and completed system units
- transportation
- externally provided products
- production controls
- identification and traceability
- site installation and handover.

Refer to Clause 11.1.9 for guidance on quality management of installation and handover.

11.1.4.1 Factory production controls

The manufacturer's Factory Production Control (FPC) plan should include:

- inspection and test plan, setting out the scope and frequency of inspection and testing of critical components
- description of controls between design and manufacture to demonstrate the accepted design is being produced
- traceability of all components used in the system
- process flow chart of activities, including change control mechanism
- process for identifying and resolving non-conformities
- hold points, evidence and method of inspection and documenting inspections.

Units formed from steel should be manufactured and installed in accordance with the relevant parts of BS EN 1090.

11.1.4.2 Traceability

MMC system units should be provided with a unique identifier in the form of an indelible Unit Identification Number (UIN), or unique digital marker containing a UIN affixed to the structure of the unit.

The indelible Unit Identification Number (UIN) should be accessible as far as practicable up to the point of handover. In addition:

- UINs or markers that can easily be damaged, dislodged or lost will not be acceptable
- digital markers should be of a type that can be easily read and accessed on site
- the location of UINs or markers should be indicated in the System Manual and Installation Manual
- as a minimum, the UIN should indicate the production number, unit descriptor (ie, unit type and variant), and date and place of manufacture.

The Unit Identification Number (UIN) should allow for traceability of all standard and non-standard components used to form the unit in accordance with the manufacturer's Quality Management System.

11.1.4.3 Storage

The manufacturer's Quality Management System (QMS) should provide suitable provision for long term storage of units at the manufacturing facility if required. Consideration should be given to:

- indoor, covered, or conditioned storage areas
- regular inspection of stored units
- records and tracking of storage duration
- exposure limits of protective materials.

Refer to Clause 11.1.5 for guidance on site storage requirements.

11.1.5 Site management (handling, storage, and protection)

Materials, products, and systems shall be handled, stored, and protected in a satisfactory manner to prevent damage, distortion, weathering, and degradation. Issues to be taken into account include:

1) **storage**
2) **temporary weather protection**
3) **protection from damage during storage, transportation, and installation.**

MMC systems should be:

- transported, lifted, handled, and stored in accordance with the manufacturer's recommendations, site installation manual and temporary weather protection method statement
- stored off the ground
- delivered in a sequence to avoid or minimise storage
- suitably protected against condensation, weathering and mechanical damage during storage, transport, and installation.

11.1.5.1 Storage

The storage of MMC systems should ensure:

- units are stored in accordance with the manufacturer's recommendations
- storage areas are clean and dry, level, and free from contaminants
- units are arranged and protected to prevent accumulation of trapped water
- units are arranged in sequence for erection, with markings visible and adequate access for lifting gear
- storage areas are suitably located, or protection provided to avoid staining and accidental damage by site traffic.

Packers or bearers placed under units should be located under stud positions or suitable bearing points in accordance with the manufacturer's recommendations.

Stacking

Where units are stacked on top of each other during storage, the storage area and bearing points should meet the required tolerances defined in the System Manual for foundations and be suitable packed and levelled to ensure no deformation of the structure. The System Manual should define:

- the maximum stacking height of units (ie the number of units that can be stacked on top of each other)
- method of temporary unit connections (for volumetric units) to ensure effective load transfer and resistance to sliding.

11.1.5.2 Temporary weather protection

The System Manual should include a moisture management plan to outline the design, method and controls for protecting the units from weather exposure and damage during storage, transport and installation. The plan should consider:

- details of any temporary openings that may be required in the protection layers (eg for lifting or installation/connection of units)
- continuity of temporary weather protection post installation
- method of sealing between units and around lifting/ connection points
- method and timing for removal of temporary weather protection materials (materials left in situ post installation should be assessed for condensation risk in the permanent design).

To minimise the effect of condensation or moisture trapped within the unit, consideration should be given to:

- choice of materials used as temporary weather protection (ie, vapour resistivity of membranes)
- periodic condition inspections
- use of desiccant products
- storage time limits
- providing drainage points to allow trapped water to escape.

The System Manual should include details about any relevant exposure time limits. Exposure time limits should consider:

- maximum duration for external storage, and
- maximum duration of exposure following installation until permanent claddings are installed.

The performance of gypsum plasterboard linings can be significantly affected by wetting. Factory installed gypsum linings showing signs of facing paper delamination or mould growth due to construction moisture during the storage, transport or installation phase should be removed and replaced in accordance with plasterboard manufacturers recommendations, and the supporting structure checked.

Closed panel systems
Where timber and light steel framed walls incorporate linings or opaque membranes to both internal and external faces there is a risk of moisture being trapped within the frame void during the storage or construction phase. Consideration should be given to providing means of drainage to the base of panels to allow trapped moisture to escape.

Volumetric systems
The tops of volumetric units should be designed with adequate falls to avoid the risk of standing water. Water should be directed away from unit joints and cavities. Suitable provision should be made to provide temporary drainage to discharge to rainwater outlets or be designed to shed water clear from the building façade.

Materials used for sealing between units or around lifting points and temporary openings should be suitable for use in cold and wet conditions and UV resistant suitable for the exposure period.

Floors
Consideration should be given to the location of water-resistant membranes in floors (eg to the undersides of floors), and care should be taken to avoid the risk of trapped moisture within the floor structure.

Timber
Moisture content readings of structural timber to closed systems (including: closed panel timber frame, volumetric systems formed entirely of timber or volumetric systems incorporating timber frame backing walls and floors) should be undertaken as part of system verification activities, further guidance can be found in Clause 11.1.10.

SIPs
Panel edge protection should be provided at the base of SIP panels susceptible to moisture damage to prevent wicking of moisture from the floor during construction. If a panel becomes saturated during construction, specialist advice should be sought.

11.1.5.3 Protection from damage

MMC systems should only be handled in accordance with the manufacturer's recommendations, lifting methods and handling positions should be clearly defined.

To minimise risk of damage from handling of units, consideration should be given to the following:

- handling of units should be planned and reduced to a minimum
- packing should be used to ensure that scaffolding does not damage units during installation where panels incorporate factory installed external finishes
- protection to permanently exposed surfaces, especially arrises and decorative features with timber strips, hessian, or polyethylene.

Practical steps should be taken to avoid the risk of damage and staining to units and finishes during construction.

Internal finishes and fitments
Appropriate protection should be provided to all internal finishes and factory installed fitments (including to doors, trim, balustrades, panelling, and other special features) to ensure they are not damaged. Factory installed sanitaryware and kitchens, including cupboards, doors, fittings, and worktops, should be suitably protected.

11.1.6 Structural design

MMC systems shall be designed to support and transfer loads to foundations safely and without undue movement and shall have adequate resistance to all imposed loads. Issues to be taken into account include:

1) **compliance with relevant standards**
2) **stability or resistance to lateral load**
3) **structural robustness.**

11.1.6.1 Compliance with relevant standards

All load bearing elements should be designed to comply with relevant standards:

Basis of structural and geotechnical design	BS EN 1990 and relevant NA
Actions on structures	BS EN 1991, all parts and relevant NAs to these parts
Material codes	BS EN 1992 — EN 1999. Eurocodes for all materials and their relevant NAs
Low-rise building structures	BS 8103 (all parts)
Medium rise building structures of over three storeys high	Designed by an engineer in accordance with Technical Requirement R5
Structural robustness and mitigation of disproportionate collapse in buildings	BS EN 1991, all parts and relevant NAs to these parts Building Regulations — eg AD A in England & Wales IStructE's publication of Practical guide to structural robustness

11.1.6.2 Stability/resistance to lateral load

MMC systems forming homes or buildings containing homes shall be adequately designed to ensure that all loads are safely transferred to the foundations, without undue movement/distortion or impairing the health and safety of the building occupiers.

Whatever the system of resistance to lateral loads (ie, single material or hybrid system) that is being deployed for stability purposes, they should be demonstrated as being fit for purpose and within acceptable deflection limits for the type of structure and cladding used.

Effective connections of MMC modules or panels to any structural framing or strong point(s) used should be adequately provided and should be visible or inspectable. Where such connections are to be covered up in their final state, the installation is to be inspected and verified in accordance with the system verification plan (see Clause 11.1.10).

Manufacturing and erection tolerances should be clearly stated and allowed for in the design.

11.1.6.3 Structural robustness

MMC systems forming homes or buildings containing homes shall be adequately designed to ensure that the building is sufficiently robust to reduce the sensitivity of the building to disproportionate collapse in the event of an accident. This requirement will be considered met when the building is sufficiently robust to sustain a limited extent of damage or failure, depending on the consequence class of the building, without collapse. Further guidance can be found in The Institution of Structural Engineers publication 'Structural robustness and disproportionate collapse in buildings'.

11.1.7 Structural design checking and certification

MMC systems shall be adequately designed, checked and certified. The design of the MMC superstructure forming home(s) shall be adequately checked by an NHBC registered certifier.

Homes made from MMC systems to form the superstructure require certification confirming that the design of each house or apartment block has been satisfactorily checked by an NHBC registered MMC certifier.

MMC certifiers should:

- be listed on NHBC's list of MMC certifiers
- be a suitably qualified civil or structural engineer with a minimum of three years' experience in the use a particular MMC system or in the main components of the MMC system
- not be the designer of the MMC system or from the same firm as the designer of the MMC system
- complete and sign a certificate confirming assessment of structural adequacy for each specific project
- provide the registered builder with the completed and signed certificate to cover the different house(s) or apartment block(s).

The registered builder should ensure that the completed MMC certificate is available on site for inspection and a copy sent to the NHBC project manager.

Contact NHBC Standards, Innovation and Research via **operationssupport@nhbc.co.uk**

- if you require contact details of MMC certifiers, or
- to apply to become a MMC certifier.

11.1.8 Temporary stability, robustness, and integrity

MMC systems shall be sufficiently rigid to resist the forces imposed during transport, lifting and installation.

MMC systems should be sufficiently rigid to resist the forces imposed during transport, lifting and installation and prevent loosening of factory installed fire-resistant linings, claddings, cavity barriers and fire-stopping.

They should be provided with:

- designated anchorage or lifting points for lifting and securing during transport and installation
- suitable straps and/or frames to hold units safely in position during transport without undue movement
- temporary support or bracing to prevent excessive distortion and damage to the structure and finishes during transport and installation for units incorporating large openings.

Details of anchorage or lifting points and any temporary supports and their positioning should be included in the system Installation Manual and supporting drawings.

Consideration should be given to the design of racks and other equipment for large panels for transport with allowance made for the flexing of transport platforms.

11.1.9 Installation

MMC systems shall be installed in accordance with the manufacturer's recommendations and provide satisfactory performance. Installation instructions, in the form of an Installation Manual, shall be produced in a clear and understandable format, include all relevant information, and be distributed to all appropriate personnel. Issues to be taken into account include:

1) **competence of installers**
2) **preparation**
3) **design, manufacture and erection tolerances**
4) **structural connections**
5) **sealing of joints and temporary openings.**

A set of clear installation instructions should be submitted to NHBC, distributed to appropriate personnel, and made available on site in the form of a system Installation Manual and relevant accompanying drawings, detailing the assembly and installation of the system as appropriate. These instructions should cover factory and site assembly as required.

The system Installation Manual should:

- be supported with site-specific information, including drawings, or detailed fixing specifications
- be used as a reference to ensure compliance
- be current and specific to the system variant/type.

The system Installation Manual should contain the information described in Table 2 as relevant for the system.

Table 2: Items included in the Installation Manual

Topic	Description
Roles and responsibilities	• site process and responsibilities of key personnel • competence requirements for installers • duty holders for verification in accordance with the verification plan • key inspection stages and hold points in accordance with the verification plan — ie, hold points, checklists, provision and/or taking of photographic records
Scope and limits of application	• overview of the system including a description of key components and/or assemblies • confirmation of limits of application
Storage	• process for site storage and correct maintenance and removal of any temporary protection • method of providing adequate ventilation • requirement for periodic condition surveys
Tolerances	• clear description of tolerances for substructure (including square/dimensional/straightness & level) • clear description of dimensional tolerances for units and erection • clear description of tolerances for unit junctions and interfaces including cladding finishes
Pre-installation checks	• inspection and verification procedure for condition of units prior to and following delivery to site • tolerance survey of the substructure • dimensional survey of units pre-installation
Installation procedure	• sequence of erection • method of connecting to foundations • process and detail of structural connections — with a reference to either type, size, centres, quantity, specification of fixings and reference to bolts requiring specific torques (if standard) or reference to drawings for all module connections, panel joints, etc or where this information can be found on site • temporary bracing requirements (if applicable) • checks and verification procedures associated with cavity barriers and fire-stopping • method and verification for the sealing and completion of junctions between units • method and verification procedure for sealing of temporary roofing membranes including temporary openings and lifting points and adequate drainage provision • detail about removal of temporary protection (unless included in the design as part of the system) • tolerance survey of installed units (level/plumb/deviation)
Services	• method for connection of building services such that fire protection and damp proofing are not compromised • method for making good of service connection access points in the structure • method for commissioning of services
Non-conformities	• remedial action procedure for damaged or non-conforming units

11.1.9.1 Competence of installers

Installation of MMC systems should be carried out by trained and competent installers. Specialist installers should understand storage and handling procedures, tolerances, and installation methods relevant to the system type, and have been provided with all product technical data sheets and installation guidance documentation.

Systems should be installed by operatives who:

- are competent
- are familiar with the system being installed
- are registered or hold a current and valid certificate confirming that they have been trained by the system manufacturer, supplier, or installer.

11.1.9.2 Preparation

A pre-installation survey of both the foundations and surrounding construction should be undertaken to ensure compliance with the product specification requirements prior to installation of units.

Volumetric systems

A pre-installation survey of service entry points and pop-ups (eg below ground drainage) should be undertaken prior to installation of units to ensure they align.

11.1.9.3 Design, manufacture and erection tolerances

MMC systems should be installed, within reasonable tolerances, in accordance with the design and as defined in the system Installation Manual.

Units should be checked to ensure that they are dimensionally accurate and not deformed in shape before erection commences.

Closed panel systems
Timber frame walls should be installed in accordance with the relevant tolerances in Clause 6.2.4.

Light steel frame walls should be installed in accordance with the relevant tolerances in Clause 6.10.10.

SIPs should be installed in accordance with the System Manual and certification requirements.

11.1.9.4 Structural connections

MMC unit connections should be installed in accordance with the design.

The supporting structure may have local deviations in level along its length or at individual base plate locations, and packing will be required to achieve the required tolerances and to provide for effective load transfer. The type and extent of packing should be in accordance with the System Manual.

Volumetric systems
Connection plates and brackets should not be drilled, cut, or welded unless required by the design.

11.1.9.5 Sealing of joints

Only the materials and method specified in the design should be used for sealing of joints between units and temporary openings. Tapes, sealants, and membranes should be installed in accordance with manufacturer's instructions.

Before joints between units or temporary openings are sealed, installers should ensure:

- all cavities are dry
- insulation is complete
- all surfaces are clean and dry
- cavity barriers and fire-stops have been installed.

11.1.10 Verification

Documentation shall be provided in a clear and understandable format to confirm that the system has been supplied and installed in accordance with the System Manual and the design.

In addition to system certification and structural design checking (see Clause 11.2.3 and 11.3.3), NHBC requires verification, comprising documentation in a clearly understandable format, to show that MMC systems have been manufactured, stored, transported, and installed:

- in accordance with the design
- in accordance with the Quality Management System (QMS)
- to an acceptable standard
- in accordance with the System Manual and manufacturers instructions
- in accordance with statutory requirements.

Verification plan
A verification plan should be provided to NHBC before construction works commence on site.

The verification plan should:

- name duty holders
- define competence and responsibilities of duty holders during the factory production and construction phase
- outline key inspection stages and hold points, covering pre-installation, installation, and post-installation phase checks
- refer to the System Manual and system Installation Manual.

Verification reports should clearly state which elements of the system have or have not been subject to inspection and verification. The report should also record where verification is based on photographic evidence or other information supplied by a third-party.

Systems are assigned risk categories according to the complexity of the system and installation, see Table 3.

Table 3: System risk categories

Risk category	System type
1	Closed panel (no factory installed external claddings) — See Chapter 11.2
2	Closed panel (factory installed external claddings) — See Chapter 11.2
3	Volumetric (houses up to 4 storeys) — See Chapter 11.3
4	Volumetric (apartment buildings and buildings above 4 storeys) — See Chapter 11.3

The verification reporting requirements will be appropriate for the risk category of the system. Inspection stages and verification requirements will vary according to the system but should consider activities listed in Table 4. The manufacturer should determine the verification activities appropriate to the system, and present these in the verification plan for submittal to, and agreement by NHBC.

Table 4: Verification stage activities

Verification inspection stage activities	Risk category			
	1	2	3	4
Storage				
● regular condition survey of units in storage	●	●	●	●
● suitability and condition of storage areas	●	●	●	●
Transport				
● secure fixing to transport or support in transport stillage	●	●	●	●
● adequate bracing of openings	●	●	●	●
● temporary weather protection	●	●	●	●
Pre-installation				
● recording of delivery dates for individual units	●	●	●	●
● damage/condition inspection of units	●	●	●	●
● visual inspection and moisture readings of structural timber elements (if applicable)	●	●	●	●
● dimensional, square, straightness and level check of substructure and surrounding construction	●	●	●	●
● dimensional and square check of panels	●	●	●	●
Installation				
● recording of installation dates for individual units	●	●	●	●
● unit to foundation connections	●	●	●	●
● unit to unit connections	●	●	●	●
● connections of secondary elements eg balconies (if applicable)	●	●	●	●
● unit to surrounding construction (eg building core, staircases, roof, etc) connections	●	●	●	●
● temporary/permanent weather sealing of unit junctions	●	●	●	●
● installation of cavity barriers and fire-stopping	●	●	●	●
● location referenced photographic records of concealed fire-stopping		●	●	●
● service connections			●	●
● third-party verification (if required)				●
Post-installation				
● visual inspection and moisture readings of structural timber elements (if applicable)	●	●	●	●
● survey of top of units (ie standing water)			●	●

For systems incorporating specialist materials or complex construction methods not covered by NHBC Standards that are critical to the structural stability of the building, NHBC may also require additional verification from an independent third-party engineer in accordance with Technical Requirement R5.

Suitable persons for the level of verification

The manufacturer of the system should specify the requirements for specialist installers and verifiers.

The manufacturer should clearly establish the roles and responsibilities of verifiers within the verification plan, recognising that installation teams may be responsible for providing information to support the overall verification strategy for the system (for example concealed fire-stopping and cavity barriers or tolerance surveys).

The registered builder's site team should be fully aware of the installation procedures and hold points for inspection.

11.1.11 Handover requirements

Clear information about the system and guidance on its future use or maintenance shall be provided to the homeowner.

A pack of handover information should be provided to the homeowner. The pack of information should be in a format intended for a non-technical user and include:

- user-friendly description of the building system
- method statement for the replacement of materials and components with a lesser durability that will require replacement during the lifetime of the home
- maintenance requirements
- product data sheets or relevant certification for key components that make up the building system
- contact details for the manufacturer.

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