NCC

Prefabricated, modular and offsite construction

Handbook

Australian Building Codes Board

Australian Government
Department of Industry, Science and Resources

Cooperative Research Centres Program

building 4.0 crc

Prefabricated, modular and offsite construction

Handbook

The Australian Building Codes Board

The Australian Building Codes Board (ABCB) is a standards writing body responsible for the National Construction Code (NCC), WaterMark and CodeMark Certification Schemes.

The ABCB is a joint initiative of all levels of government in Australia, together with the building and plumbing industry. Its mission is to oversee issues relating to health, safety, amenity, accessibility, and sustainability in building.

For more information visit the ABCB website.

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Preface

Modern methods of construction (MMC), including prefabricated and modular building technologies, have the potential to support the delivery of higher quality buildings by utilising newer methods of construction, often in an offsite environment, or onsite with advanced methods such as additive manufacturing like 3D printing concrete. They have the potential to increase productivity in the construction sector by producing buildings more efficiently, with greater speed and accuracy. The National Construction Code (NCC) provides the technical standard used for the regulation of all buildings in Australia as implemented in each state and territory.

The NCC standard of fit for purpose applies to all building technologies, systems, and products. Prefabrication and modular technologies were explicitly addressed in 2016 when prefabricated 'bathroom pods' were agreed to be accepted as WaterMarked certified products in all plumbing jurisdictions (states and territories). A range of other NCC requirements address building systems, and the performance-based code provides a pathway for innovative technologies to be implemented.

In March 2024, the Building Ministers acknowledged the significant potential of MMC to help address Australia's housing supply shortfall. Ministers emphasised the national target to construct 1.2 million new homes over the next 5 years. Ministers discussed the opportunities presented by recent developments in advanced manufacturing, supply chain and building techniques that could facilitate the delivery of more new homes by using MMC.

This handbook has been developed to increase the understanding and effectiveness of existing building standards and regulations at the direction of Ministers and to respond to government and industry requests for guidance on achieving NCC compliance in buildings that use MMC. It answers questions about determining evidence to support compliance and common NCC compliance risk areas.

ABCB handbooks expand on areas of existing regulation or relate to topics that are not regulated by the NCC. They provide advice and guidance.

The ABCB will continue to monitor this rapidly evolving space and respond as the industry develops.

Acknowledgements

The ABCB acknowledges the valuable contribution made by the Building 4.0 CRC on the scope and content of this handbook.

Contents

Reminder

This handbook is not mandatory or regulatory in nature. Compliance with it will not necessarily discharge a user's legal obligations. The handbook should only be read and used subject to, and in conjunction with, the general disclaimer at page i.

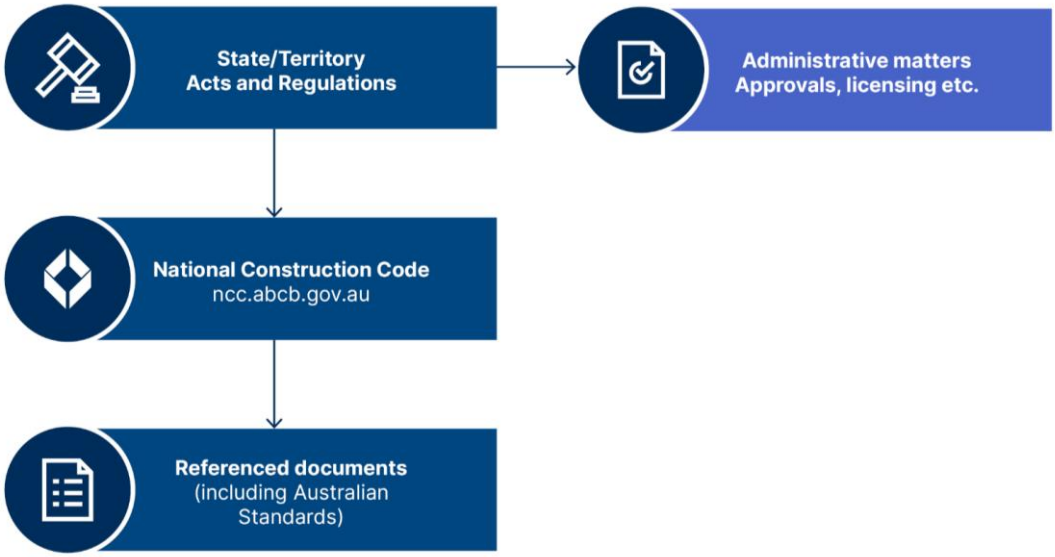
The handbook also needs to be read in conjunction with the NCC and the relevant legislation of the appropriate state or territory. It is written in generic terms and it is not intended that the content of the handbook counteract or conflict with the legislative requirements, any references in legal documents, any handbooks issued by the administration or any directives by the appropriate authority.

1 Introduction

1.1 Scope

Construction compliance is technically and legally complex. The NCC is just one component of the regulatory framework and comprises of 100s of pages and refers to 100s of referenced documents. The NCC sits within a regulatory framework administered by states and territories (Figure 1.1). It provides the primary set of technical design and construction provisions for buildings in Australia. This framework also interacts with other aspects including planning, practitioner registration and other legislative requirements.

Figure 1.1 NCC regulatory framework



This handbook focuses on the NCC and:

1. How to determine the evidence required to demonstrate NCC compliance and fitness for purpose through documentation. This supports the development of designs, the approvals process, and understanding the evidence that may be required during construction and at completion.
2. How to avoid common NCC compliance risks that affect MMC and other products. This supports recognition of risk areas so they may be effectively managed.

The handbook emphasis is on Deemed-to-Satisfy (DTS) compliance and is intended to support manufacturers, builders, plumbers, designers, appropriate authorities, and others in applying the NCC to residential buildings. While the focus of this handbook is residential buildings (i.e. NCC Class 1 and Class 2 buildings), the information will be relevant to all types of buildings. The handbook aligns with NCC 2022.

There are 2 main sections in this handbook. The first discusses how building and plumbing work is regulated and how to comply with the NCC. This includes a 4-step approach to determine the evidence to demonstrate DTS compliance and fitness for purpose as well as factors that influence how and where products and systems may be used. The second looks at a range of MMC and looks at how to avoid common compliance risks that may impact NCC compliance outcomes from the factory to site. Examples showing how to use the 4-step approach to demonstrate fitness for purpose and NCC compliance are provided in Appendix B.

The handbook addresses issues in generic terms and is not a document that sets out specific compliance advice for developing solutions to comply with the requirements in the NCC. It is expected that this handbook will guide readers to develop solutions relevant to specific situations in accordance with the generic principles and criteria contained herein.

What's not included:

The use of MMC may be influenced by a range of factors, such as insurance, finance, chain of responsibility, consumer, workplace health and safety and construction law. They may also be impacted by state and territory legislation covering planning, building and plumbing approvals, licensing, and mandatory inspections. These topics are outside the scope of this handbook.

The handbook also does not cover the end-to-end process of the use of MMC, the construction process more broadly, nor does it provide a how-to-construct or how-to-install manual for the thousands of products and MMC in use.

Appropriate authority: The relevant authority with the statutory responsibility to determine the particular matter.

1.2 Using this document

1.2.1 Appendices

This document contains 3 appendices, which are as follows:

- Appendix A contains a list of abbreviations and symbols used in this document.
- Appendix B contains examples showing how to use the 4-step process to demonstrate fitness for purpose and NCC compliance.
- Appendix C provides a list of references and further reading about NCC compliance and MMC.

1.2.2 Document styles

Different styles are used in this document. Examples of these styles are below.

NCC extracts[1]

Examples

Alerts or Reminders

1.3 Key messages

- The NCC has well-established evidence of suitability requirements for materials, products, plumbing products, forms of construction and design.
- The NCC is a performance-based code with flexibility in how to demonstrate compliance.
- Buildings using MMC, including prefabricated and modular buildings, are regulated in the same manner (except for plumbing products) as other construction products.
- Understanding how the NCC works, particularly compliance pathways, will assist in seeking approvals of buildings constructed using MMC including prefabricated and modular building products.
- There are 3 compliance pathways: DTS Solution, Performance Solution, or a combination of the two.
- The handbook includes a 4-step approach to assist determining the evidence to demonstrate fitness for purpose and NCC compliance.
- Fitness for purpose is supported by evidence of suitability and construction/installation in an appropriate manner.
- For some fire, energy efficiency and plumbing and drainage products, compliance must be determined in a particular way for DTS compliance.
- Volumetric MMC buildings will require documentation and evidence similar to a building constructed in-situ.
- There are important building and site-based factors that influence how and where a product or system is able to be used, for example use, scale, location.

[1] NCC extracts italicise defined terms as per the NCC. See Schedule 1 of the NCC for further information.

- Plumbing products are treated differently to building products, depending on whether the product is required to be WaterMark certified or not.
- Prefabricated plumbing modules may be considered a prefabricated plumbing installation, i.e. regulated work (in the same state or territory of the site of installation) or a purpose-built plumbing module, i.e. a product that is WaterMark certified (manufactured nationally or internationally).
- Factors that may impact a product or system's performance (and thus compliance) need to be managed through the design and construction process. These include handling, transport, storage, temporary works, interfaces between offsite and in-situ construction, design coordination, and site supervision.
- The NCC is one part of the compliance picture. There are other statutory requirements such as planning legislation, mandatory inspections, and licensing requirements to adhere to.

2 MMC, systems and products – Compliance with the NCC

In this chapter we take a close look at NCC compliance for buildings constructed using various construction methods. This includes buildings constructed using MMC. The chapter starts by outlining the role of the states and territories in regulating building and plumbing work and explains how the NCC is adopted into law. Minimum mandatory requirements and compliance pathways are described along with evidence of suitability and fitness for purpose. A 4-step approach to demonstrate DTS compliance and fitness for purpose is provided. The important distinction between a plumbing and building product is explained as well as the factors affecting how and where a product or system may be used.

What are modern methods of construction (MMC)?

'MMC refers to the wide variety of construction methods that are different to traditional onsite construction. This includes prefabrication, off-site manufacturing, and methods that produce modular or volumetric dwellings, as well as new technologies such as 3D printing, robotics, and artificial intelligence (AI).

MMC is not a singular approach, rather a collection of 'methods' to plan, design, and build within the constantly evolving workforce, supply chain and advanced technological landscape'[2]

2.1 Responsibilities for regulation of building and plumbing in Australia

State and territory governments are responsible for regulation of building, plumbing, and development/planning in their respective state or territory.

The NCC is a joint initiative of the Australian Government and the state and territory governments and is produced and maintained by the ABCB. The NCC provides a uniform set of technical provisions for the design and construction of buildings and other structures and plumbing and drainage systems throughout Australia. It allows for variations in climate and geological or geographic conditions.

The NCC is given legal effect by building and plumbing regulatory legislation in each state and territory. This legislation consists of an Act of Parliament and subordinate legislation (e.g. Building Regulations) which empowers the regulation of certain aspects of buildings and structures and contains the administrative provisions necessary to give effect to the legislation. Each state's and territory's legislation adopts the NCC subject to the variation or deletion of some

[2] Land and Housing Corporation, NSW Government (n.d.)

of its provisions, or the addition of extra provisions. These variations, deletions and additions are generally signposted within the relevant section of the NCC and located within appendices to the NCC. Notwithstanding this, any provision of the NCC may be overridden by, or subject to, state or territory legislation. The NCC must therefore be read in conjunction with that legislation.

Matters outside the NCC:

- State, territory and council planning

Each state and territory has its own planning frameworks. These include state and territory level and council level laws and regulations. Planning law and planning requirements are additional to NCC compliance requirements.

- Building approvals

State and territory building and plumbing legislation mandates approvals processes for building and plumbing work.

- Mandatory inspections

State and territory building and plumbing legislation mandates staged inspections of building and plumbing work. These stages have evolved based on on-site construction and represent a minimum requirement.

- Licensing

Each state and territory has its own regulatory framework for licensing requirements for various trades and activities.

- Mobile tiny homes and temporary structures

These may be subject to different planning requirements as compared to permanent buildings.

2.2 Demonstrating compliance with the NCC

The NCC Governing Requirements detail the rules and instructions for complying with the NCC. The NCC Performance Requirements prescribe the minimum necessary technical requirements for buildings, building elements, and plumbing and drainage systems.

Compliance with the NCC is achieved by complying with the NCC Governing Requirements and relevant Performance Requirements. There are 3 options to demonstrate compliance with the Performance Requirements:

- a DTS Solution
- a Performance Solution, or
- a combination of a Performance Solution and a DTS Solution.

A DTS Solution uses specified, or codified, ways of meeting the Performance Requirements. These are included in the NCC as DTS Provisions. If a DTS Solution is used, it is automatically considered to meet the Performance Requirements. DTS Solutions will sometimes make use of NCC referenced documents such as Australian Standards.

A Performance Solution is another method of complying with the Performance Requirements. A Performance Solution allows for non-DTS designs or methods of building - or part of it – provided it meets the relevant Performance Requirements. Performance Solutions may be used for a whole building or plumbing/drainage system, a specific element, or a small component such as the choice of material.

Alert

Demonstrating NCC compliance for buildings and plumbing systems utilising MMC (including prefabricated and modular buildings) is the same as for other buildings and plumbing installations.

There are steps that must be followed to show that a Performance Solution meets the relevant Performance Requirement(s). These are outlined in Part A2 of the Governing Requirements. For more information refer to the ABCB Performance Solution Process handbook .

A combination of Performance and DTS Solutions commonly arises where only part of a design meets the DTS requirements. Any minor deviation from the DTS Provisions will require a Performance Solution.

All compliance options may be assessed using one or a combination of NCC Assessment Methods, as appropriate. These include:

- Evidence of suitability
- Expert Judgement
- Verification Methods
- Comparison with DTS Provisions.

The following provides a brief overview of these Assessment Methods.

Evidence of suitability provisions are intended to demonstrate the fitness for purpose of materials, products, forms of construction, and designs, to ensure compliance with the NCC requirements. Evidence of suitability is discussed in further detail in Section 2.3.

Expert judgement is defined in the NCC as follows:

> '*The judgement of an expert who has the qualifications and experience to determine whether a Performance or DTS Solution complies with the Performance Requirements.'*

Each situation is different, so the capability of the expert to make appropriate judgements needs to be individually assessed on a project-by-project basis. The level of qualification and

experience may differ depending on the complexity of the proposal and the relevant regulatory requirements.

Verification Method is defined in the NCC as follows:

> *'A test, inspection, calculation, or other method that determines whether a Performance Solution complies with the relevant Performance Requirements.'*

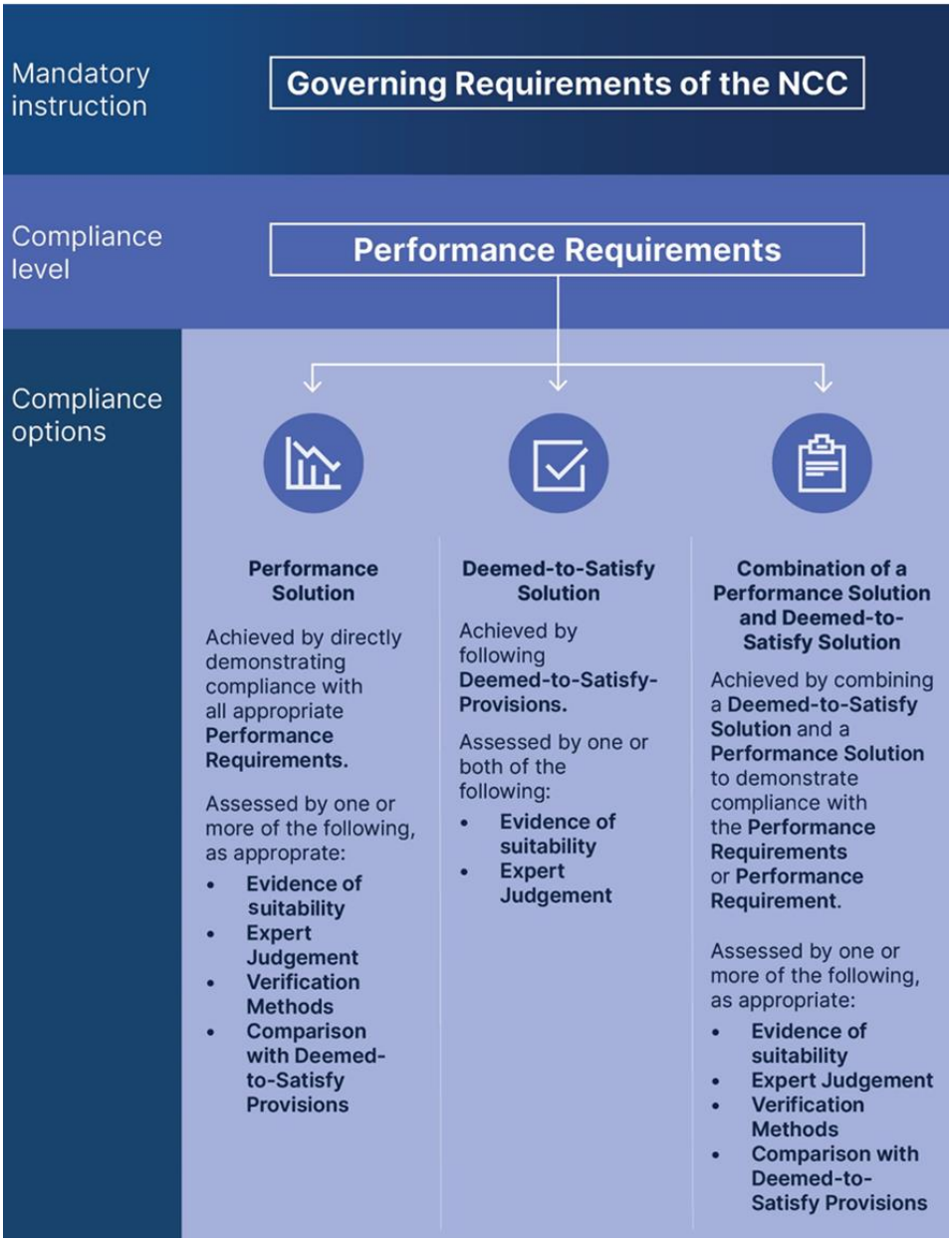
Comparison with DTS Provisions is for use with Performance Solutions only. It involves a comparative analysis demonstrating that a Performance Solution is at least equivalent to a solution that complies with the corresponding DTS Provision(s).

A figure showing the hierarchy of the NCC, its compliance options and relevant Assessment Methods is provided in Figure 2.1. It should be read in conjunction with the NCC.

Note that for the DTS compliance pathway only evidence of suitability and expert judgement NCC Assessment Methods may be used.

In the context of MMCs, the evidence of suitability NCC Assessment Method provides a comprehensive basis to understand the level of evidence to support compliance. For this reason, the next sections use it as a basis to explain the kinds of evidence to demonstrate compliance.

Figure 2.1 Demonstrating compliance with the NCC



2.3 Evidence of suitability

Part A5 of the Governing Requirements contains the documentation of design and construction provisions. This Part explains the evidence needed to show that the NCC requirements are met, and the solution is 'fit for purpose'. It details separate requirements for the Building Code of Australia (BCA) and Plumbing Code of Australia (PCA). Some examples of evidence to be prepared and retained are certificates, reports, calculations and any other documents or information. More information on these may be found in the ABCB Evidence of suitability handbook.

Clause A5G1(1) requires:

> '*…a building or plumbing installation must be constructed using materials, products, plumbing products, forms of construction and designs fit for their intended purpose to achieve the relevant requirements of the NCC.'*

For the purposes of A5G1(1), fitness for purpose is demonstrated if it is:

- Supported by evidence of suitability in accordance with A5G2, and A5G3 or A5G4 as appropriate, and
- Constructed or installed in an appropriate manner.

A5G2 requires evidence to be appropriate to the use of the material, product, plumbing product, forms of construction and design and to be submitted as a complete copy of the original certificate, report, or document.

A5G3 represents the minimum level of documentary evidence for the BCA and A5G4 represents the minimum level of documentary evidence for the PCA.

An overview and approach to demonstrating compliance and fitness for purpose is shown in Figure 2.3 (in Section 2.4).

Alert

For evidence of suitability 'design' may refer to engineering design, architectural design, hydraulic design, as well as product and material design.

2.3.1 Evidence of suitability in Volumes One and Two (BCA)

For NCC Volumes One and Two, the form of evidence that may be used, are explained in A5G3. A5G3 represents the minimum level of documentary evidence needed to show that material, product, form of construction, or design meets the relevant NCC requirements.

The evidence can be required by an appropriate authority, a party to a construction contract or a person certifying compliance with the NCC. For some fire and energy requirements, compliance must be determined in a particular way for DTS compliance. This is summarised in Figure 2.3 (in Section 2.4).

Note that if documentary evidence is used to demonstrate compliance for specific energy efficiency provisions or certain plumbing and drainage product requirements, A5G3 cannot be used. In this case, evidence of suitability for specific requirements must be in accordance with A5G4(1) to A5G4(5) and A5G9.

A5G5, A5G6 and A5G7 require that certain properties of specific building elements, components and assemblies be determined in ways specified in the NCC. These provisions will often require that a test be undertaken by an Accredited Testing Laboratory (ATL). In these circumstances it

may be appropriate that the report issued by the ATL be issued as evidence of suitability. Nevertheless, this doesn't prevent use of other forms of evidence, such as a CodeMark certificate.

2.3.2 Evidence of suitability in Volume Three (PCA)

For NCC Volume Three, the forms of evidence that may be used, are explained in A5G4, and depending on whether the evidence applies to a product [A5G4(1) to A5G4(5)] or to a design or system [A5G4(6)].

Note, the requirements of A5G4 apply to all plumbing product designs or systems. For example, if a product is in contact with drinking water, A5G4(6) cannot be used to show evidence of suitability and A5G4(1) requirements will apply instead.

DTS for plumbing products – not performance!

For most plumbing products (and materials) the only acceptable evidence of suitability is a WaterMark licence issued in accordance with the WaterMark Scheme Rules [A5G4(1)]. This means that whilst the installation of plumbing products may use a DTS or performance or combined approach, the verification of suitability for use of most plumbing products is not permitted under a performance approach.

For more information, refer A5G4(1) to A5G4(5) and the Explanatory Information: What is WaterMark?

Lead Free WaterMark

From 1 May 2026, the requirements of A5G4(2) will apply to a plumbing product that contains copper alloy and is intended for use in contact with drinking water. These products will require a Lead Free WaterMark licence, issued in accordance with the WaterMark Scheme Rules as evidence of suitability.

For more information, refer A5G4(2) and the Notes, Applications, Exemptions and Explanatory Information.

2.3.3 Types of evidence for BCA and PCA compliance

Figure 2.2 shows the types of evidence that may be used to demonstrate compliance with the BCA, the PCA or both. For more information on different types of evidence of suitability, see the ABCB Evidence of suitability handbook .

Figure 2.2 NCC Evidence of suitability framework – Volume One and Two and Three

2.3.4 Constructed or installed in an appropriate manner

The verification of construction and installation of materials, products, plumbing products, forms of construction or designs is typically the responsibility of the appropriate authority. The appropriate authority will carry out inspections in line with their state and territory legislation and any additional client instructions. Mandatory inspections typically occur at key stages before important parts of the construction/installation are concealed, for example, a footing and slab inspection or a frame inspection.

State and territory mandatory inspections are outside the scope of this handbook, however the role of inspections to verify compliance and fitness for purpose will be included within the examples later.

2.4 4-step approach to demonstrate DTS compliance and fitness for purpose

Bringing this together, there are 4 steps to establish the evidence suitable to demonstrate DTS compliance and fitness for purpose of a material, product, plumbing product, form of construction or design, see Figure 2.3.

Firstly, it is essential to identify the specific Performance Requirements and DTS Provisions that apply. This should involve consideration of where and how they are being used. A detailed BCA and PCA checklist is useful to identify all relevant Performance Requirements and DTS Provisions. A BCA and/or PCA consultant can assist in this task.

Alert

While not all building materials and products are mandated to comply with the NCC, they may be subject to other Australian, state or territory legislation as well as contractual obligations specifying specific requirements or materials or the like.

Secondly, it is important to understand what types of evidence of suitability may to be used. For the BCA, the types of evidence that may be used, are detailed in A5G3, and for PCA, they are outlined in A5G4. Note that the BCA and PCA have specific requirements to determine DTS compliance for aspects of fire, energy efficiency and plumbing. These must be adhered to.

Thirdly, for all other NCC requirements, the types of evidence must be relevant to the requirements and consider the risk associated with the use of the material, product, plumbing product, form of construction or design. For example, if NCC conformance is discovered by a test, an appropriate form of evidence may be a report from an ATL.

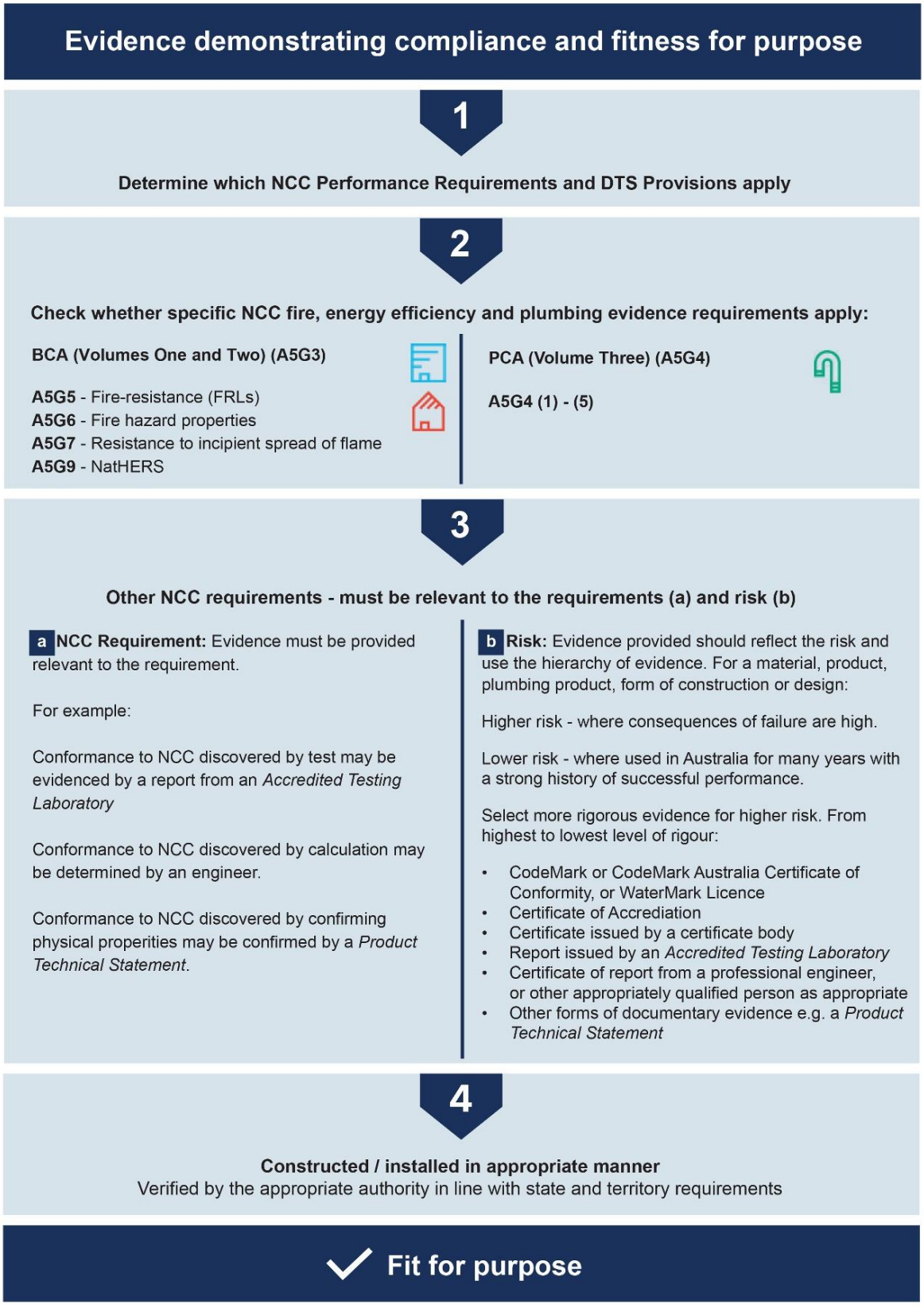
Risk considerations are also crucial. From the hierarchy of evidence, more rigorous evidence is appropriate for higher risk products and forms of construction, while less rigorous evidence can be used for lower risks. For more information, see the ABCB Evidence of suitability handbook.

Lastly, compliance and fitness for purpose is determined by the material, product, plumbing product, form of construction or design, being constructed or installed in an appropriate manner. In Part A5, NCC Explanatory information states that A5G1 suitability relates to the quality of work and materials needed to construct a building to meet the NCC requirements. This means that:

- All people involved with construction must work skilfully in accordance with good trade practice; and
- All materials must be of a quality to fulfil their function/s within the building.

See Appendix B for examples of using the four-step approach to determine the evidence appropriate to demonstrate DTS compliance and fitness for purpose.

Figure 2.3 4-step approach to determining the evidence necessary to demonstrate DTS compliance and fitness for purpose of materials, products, plumbing products, forms of construction or designs



Alert

Remember that determining the appropriate form of documentary evidence to be used, and obtaining that evidence, is only part of achieving compliance with the NCC. Having appropriate documentary evidence for a specific component is of no relevance if a different, non-conforming component or product is procured and installed.

An important part of thinking about MMC, prefabrication and modular technologies is to acknowledge that they may range from seemingly ‘simple’ products that utilise efficient manufacturing techniques to a more complex assembly or a volumetric product.

Some products will be subject to straightforward NCC requirements and require relatively simple evidence to demonstrate compliance. However, complex products, including volumetric forms of construction may be subject to multiple NCC requirements and require extensive documentation to demonstrate compliance.

Determining evidence appropriate for volumetric MMC

Volumetric MMC buildings will require documentation and evidence similar to a building constructed in-situ.

Remember – the amount and type of evidence appropriate is proportionate to the complexity of the form of construction.

2.5 Plumbing products

Building products and plumbing products are treated differently under the NCC, depending on whether the product is required to be WaterMark certified or not.

Governing Requirements for plumbing products – not performance!

For most plumbing products (and materials) the only acceptable evidence of suitability is a WaterMark licence issued in accordance with the WaterMark Scheme Rules. This means that whilst the installation of plumbing products may use a DTS or performance or combined approach, a performance approach is not permitted for demonstrating the suitability of use for most plumbing products.

For more information, refer A5G4(1) to A5G4(5) and the Explanatory Information: What is WaterMark?

Lead Free WaterMark

From 1 May 2026, the requirements of A5G4(2) will apply to a plumbing product that contains copper alloy and is intended for use in contact with drinking water. These products will require a Lead Free WaterMark licence, issued in accordance with the WaterMark Scheme Rules as evidence of suitability.

For more information, refer A5G4(2) and the Notes, Applications, Exemptions and Explanatory Information.

Prefabricated plumbing modules may be considered a prefabricated plumbing installation, i.e. regulated work (in the same state or territory of the site of installation) or a purpose-built plumbing module, i.e. a product that is WaterMark certified (manufactured nationally or internationally). When manufacturing or building a bathroom within one jurisdiction, if the bathroom is intended to move interstate, or is being imported, the jurisdictions are only required to accept a WaterMark product. The jurisdictions do not have to accept regulated work undertaken in another jurisdiction.

Prefabricated plumbing modules

On 27 October 2016, the ABCB ('the Board') made a decision that prefabricated bathroom modules (also known as a 'bathroom pods') will be accepted in all plumbing jurisdictions (state or territory) as either:

a. **a purpose-built bathroom module** – which is a product, as defined in the NCC 2016, Volume Three, the PCA, listed in the WaterMark Certification Scheme, that is WaterMark certified to the applicable product specification(s) and subsequently installed by a licensed plumbing practitioner. The product, comprising integral components, may be assembled, or manufactured in any off-site location, nationally or internationally; or

b. a **prefabricated plumbing installation** – which is regulated work, involving the interconnection of component products, that is undertaken or approved by a licensed plumbing practitioner and subsequently installed by a licensed plumbing practitioner. The regulated work must be undertaken in the same jurisdiction as that having authority at the site of installation, in accordance with the legislated requirements for regulated work in that jurisdiction and will not be required to be WaterMark certified as a product.

In addition, the Board agreed that other similar prefabricated plumbing modules, such as prefabricated kitchen modules, will be treated the same way, notwithstanding any need for making appropriate amendments to the applicable product specification(s).

If the product comes with a WaterMark licence from the manufacturer, you need to ensure it is installed by a licensed practitioner, in accordance with the scope of use of the product and the installation requirements of the PCA, to comply with the NCC.

For further information refer to Notice of Direction 2016/4.0 Prefabricated plumbing modules.

Alert

Prefabricated bathroom pods, like bathrooms constructed in-situ, consist of multiple components carried out by multiple trades. Each component must comply with NCC requirements.

Complex products will necessitate a more comprehensive package of documentary evidence to support fitness for purpose and NCC compliance. For example, by way of a CodeMark certificate and WaterMark licences for integral component plumbing products covered by the WaterMark Certification Scheme.

Determine where the bathroom pod will be installed, and whether it is to be regulated work or a plumbing product.

2.6 NCC factors that influence how and where a product is used

There are important NCC factors that influence how and where products may be used. A product for a particular use or location will not necessarily be suited to another use or location. For any product, a detailed NCC compliance checklist should be worked through to identify site and location factors that will affect NCC compliance. The following factors influence the Performance Requirements and DTS Provisions. This list is not exhaustive!

2.6.1 Building classification

The NCC assigns buildings a classification based on their function and use. Different building classifications have different risks, and the NCC requirements may differ to reflect those risks. The classification of a building will affect its design and directly influences which Performance Requirements apply. For more information refer to the ABCB Understanding the NCC: Building Classifications.

2.6.2 Rise in storeys

The rise in storeys of a building generally means the number of storeys above natural ground level and any storeys in the roof space. Calculating rise in storeys relates to the risk of fire spreading to, or from adjoining property and the risk to occupants. It affects egress requirements and influences the type of fire-resisting construction. It also impacts building services including fire-fighting water services. Rise in storeys is used with the building's classification to determine the type of fire resisting construction.

2.6.3 Climate zone

Australia has a varied climate, leading to different locations around the country having different insulation as well as heating and cooling requirements. Climate is considered differently in different parts of the NCC. To account for these differences the energy efficiency DTS Provisions vary from location to location and for simplicity, locations with approximately similar climates have been combined into 8 climate zones.

Note that the climatic zone map for damp and weatherproofing is different as it has a different purpose. It is based on relative humidity.

Climate zone map for thermal design and climatic zone map based on relative humidity are available in the NCC.

2.6.4 Bushfire construction requirements

A designated bushfire prone area is defined in the NCC as land which has been designated under a power of legislation as being subject, or likely to be subject, to bushfires. Construction in bushfire prone areas is required to have specific design requirements based on risk.

The DTS Provisions (such as G5D2 and H7D4) draw on the referenced Australian Standard AS 3959:2018 Construction of Buildings in bushfire-prone areas and the National Association of Steel-Framed Housing Inc (NASH) Standard for steel-framed construction (2021). There are also Verification Methods, such as G5V1 and H7V2, that may be used to develop a Performance Solution.

2.6.5 Site (soil) classification

To avoid damage to a building, another characteristic of the site that must be considered in the design of a building is the soil the building will be built on, particularly for footing and slab design.

The DTS Provisions in Volume Two require that the foundation where the footings and slabs will be located must be classified in accordance with the Australian Standard AS 2870 Residential slabs and footings and provides a general description of foundation (soil) types. The provisions cannot be used for sites classified as E or P, for extremely reactive clay sites or soft soils, respectively.

2.6.6 Cyclonic areas

Cyclonic areas are those determined as being in wind region C and D in accordance with the Australian/ New Zealand Standard AS/NZS 1170.2 Structural design actions – Wind actions. Specification 4, Design of buildings in cyclonic areas, contains the requirements of metal roof cladding for the buildings in cyclonic areas in cyclonic areas. There are additional cyclone-related provisions in the NCC referenced document AS 1684 Part 3 Residential timber-framed construction – cyclonic areas.

2.6.7 Coastal corrosive proximity

Due to Australian extensive coastline and diverse climate conditions, the NCC mandates specific requirements for buildings and structures located within severe corrosion environment. These requirements are designed to extend the life span of structures, reducing the maintenance costs, and ensure durability and safety. Compliance includes the use of corrosion resistant materials and application of protective coatings for steel and metal component.

2.6.8 Flood hazard area

A site that is designated as a flood hazard area means the site includes land lower than the flood hazard level as determined by an appropriate authority, for example, a local council authority. The NCC provides technical requirements for building if local government and planning regulations deem the building to be in a flood hazard area.

2.6.9 State and territory variations

Although the NCC is a national code, in some instances it is necessary for a state or territory to vary or apply additional requirements specific to their jurisdiction. Typically, these variations, additions or deletions override the requirements contained within the NCC.

Any provision of the NCC may be overridden by, or subject to, state or territory legislation. The NCC must therefore be read in conjunction with that legislation. Any queries on such matters

should be referred to the state or territory authority responsible for building and plumbing regulatory matters.

Where a requirement or provision of the NCC is subject to a state or territory variation, addition, or deletion, a reference to the appropriate provision in the applicable state or territory appendix is included with that requirement or provision.

Variations and additions are generally to address matters such as:

- geographic and climatic variations
- consistency with policies of the jurisdiction
- issues specific to individual jurisdictions.

Knowing the applicable version of the NCC, and whether any transitions, variations or additions apply, is critical to achieve compliance.

2.7 Early engagement and obtaining appropriate advice

Construction compliance is technically and legally complex. When using MMC, it is recommended to:

1. Engage early with the regulatory framework to understand not just NCC requirements, but other statutory requirements in your jurisdiction (state, territory, council). This will assist understanding relevant requirements such as planning, building and plumbing approvals, mandatory inspections, and licensing.
2. Take appropriate advice. This may include designers, architects, engineers, builders, plumbers, appropriate authorities, and BCA and PCA consultants.

Alert

Product manufacturers should seek advice from BCA and PCA consultants to determine their product(s) compliance with the NCC, including any limitations on their use.

3 Factors influencing compliance outcomes of MMC

In this chapter we look at some common MMC and discuss factors that may affect NCC compliance outcomes, especially during construction and installation. These factors ideally should be considered at the start of the design of a product or system, through its manufacture and subsequent use in a building, including at the relevant stage of the design and/or construction process. Any, or all, of these factors have the potential to affect NCC compliance of a product or system. The lists that follow are not exhaustive!

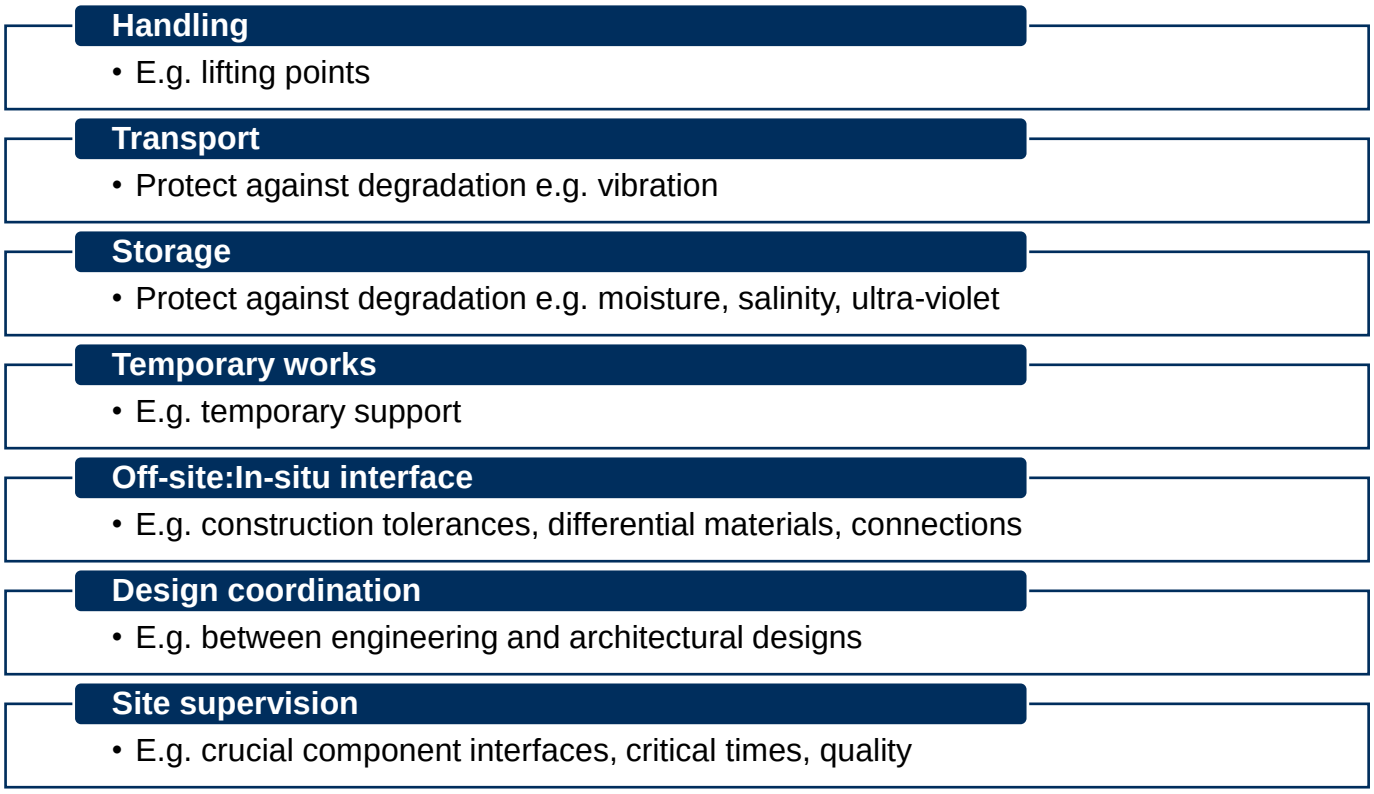
3.1 Factors affecting compliance outcomes – from factory to site

Demonstrating compliance with the NCC is more than the building approval providing documentary evidence that a manufactured product complies. As described in Chapter 2, fitness for purpose also includes proper construction and installation. For products, they need to be handled, transported, and stored. They may require temporary works. There will be interfaces between off-site and in-situ construction, design coordination between engineering and architectural design, and of course, site supervision of crucial interfaces at critical times, see Figure 3.1. (Note, this does not represent the end-to-end process of using products in building and plumbing work).

Design coordination

Depending on how a project is procured, design coordination may overlap with construction activities and in response to variations.

Figure 3.1 Factors to be considered during construction/installation to ensure a product is fit for purpose and NCC compliant



3.2 Precast concrete

Prefabricated concrete construction is perhaps the most tested and used MMC in today's construction industry. Componentised concrete systems are used in multiple classes of buildings and structures, from buildings to bridges, tunnels, or anything in between.

Common application of concrete components is guided by custom fabrication in known manufacturing or concrete production environments to well-tested engineering principles. Appropriate authorities have the benefit, of well-defined reference codes for the formation of elements and what is required within them to achieve compliance.

An important consideration is the interface between in-situ and precast construction components. The focus of compliance and inspection should be on the connections and their relevant performance criteria. This may include dimensional tolerances, management of gaps, continuity of fire separation, thermal insulation, sound insulation, allowance for differential movement and so on.

Design coordination is crucial, as is adequate site supervision. The inspection and certification of these connections must occur at the relevant stages of installation into the building or structure.

3.3 Timber based systems

There are a variety of timber-based systems, providing off-site engineered products, including composite timber products, cross-laminated timber (CLT) and post and plate.

Cross-laminated timber (CLT) framed buildings are used in Australia and overseas. Whilst there are no codes or standards for the application of CLT panels into the form of a building, they are consistently used for speed of onsite installation and dimensional accuracy. Such systems fall outside of Australian Standard AS 1684 Residential timber-framed construction for timber framing but are usually engineered to demonstrate compliance. Often, manufacturers of CLT will have span tables unique to their product for engineers to work with to meet engineering requirements. The use of CLT will therefore require a Performance Solution as it does not meet the DTS Solution that utilises NCC referenced document AS 1684.

The CLT system will have important interfaces to other parts of the construction including connections to external walls, windows, roofs, floors, foundations, and lift cores. These interfaces have the potential to affect other NCC requirements such as fire, sound, and energy efficiency. Therefore, in addition to the structural aspects, the Performance Solution must also cover any other affected Performance Requirements. For further information refer to the ABCB Performance Solution Process handbook.

Post-and-plate refers to the combination of different mass timber manufactured elements that can be brought together to form a building's superstructure. Where engineering or design flexibility calls for it, CLT panels can be combined with glulam (glued laminated timber) or other timber to form more flexible design options.

Common interfaces of post and plate systems occur when the system is connected to disparate building components. These might include but are not limited to lift cores made of concrete, concrete foundations, windows, or external weatherproof building facades, including composite panels. As for use of CLT, a Performance Solution will be required for any non-DTS Solutions.

Interface issues with post and plate systems often arise due to construction tolerance between offsite and onsite products which may impact the performance of the combined products to meet the NCC Performance Requirements. Ideally, the architectural and engineering design should include mitigation strategies for common site tolerances and connections of disparate materials. Site supervision is required at crucial interfaces and critical times.

A good understanding of the interfaces, design coordination, adequate site supervision and working closely with the appropriate authority can ensure compliant outcomes and mitigation of construction risks.

Alert

Timber products typically have specific transport, storage, protection, and assembly requirements as they are vulnerable to degradation and reduced performance. For example, mould, rot, dimensional variation, warping, etc.

3.4 Structural insulated panels (SIPs)

Structural insulated panels are typically sandwich panels with an insulation foam core and a bonded material on either side. Common examples of SIPs, have either an expanded polystyrene (EPS) or polyisocyanurate (PIR) core with a metal skin. Other systems have any range of cores, including EPS or graphene-filled EPS, and skins such as oriented strand board (OSB), magnesium oxide boards (MgO), or other materials.

Key factors relevant to SIPs include interface and compliance issues such as:

- Testing of the system and performance criteria of the panel and in combination to any other building element or material that it is connected to.
- Differential thermal movement compared to the material they are connecting to.
- Fire hazard properties.
- Acoustic performance.

With the appropriate documentary evidence, an SIP may utilise the DTS compliance pathway. This may include testing and certification to meet the relevant standards for structural, fire hazard properties, acoustic performance etc. to ensure they are suitable for the intended design application.

If the DTS Provisions are not met, a Performance Solution may be used to demonstrate that the Performance Requirements have been met. As with other products, if a SIPs interface affects other parts of the construction, the Performance Solution would be required to address the affected parts as well. For SIPs, this may include issues such as condensation, thermal bridging etc.

Other considerations for SIPs include storage, handling, and potential modification of panels to ensure integrity of the products such as:

- The materials should be covered and kept level to prevent damage particularly to the corners of the panels as such damages can make positioning of the panels difficult.
- Cutting of the panels may compromise the load bearing capacity leading to potential structural inadequacy. It may also affect their fire resistance properties.

3.5 Composite wall panels

Composite wall panels made offsite include the composite layers of structural elements combined with layers of insulation, cladding, windows, doors, and other components normal to a building. The level of finish or completion of the panel offsite depends on the system and the level of finish required.

Manufacturer verification of products needs to be considered. This would include providing evidence of suitability about NCC relevant Performance Requirements such as structural, fire, acoustics, energy efficiency, weather proofing etc. Incorporated windows and doors into a wall panel system will add other specific NCC requirements.

As shown in Appendix B, rating NCC compliance for products with multiple components, requires each part to be broken down into the relevant sub-components and appropriate evidence provided.

NCC checklists can be a useful tool to ensure all compliance requirements are met. Fitness for purpose and NCC compliance of an off-site manufactured wall system could comprise a range of test certificates, product data sheets, engineering calculations and so on. For tested wall systems with multiple compliance requirements, a CodeMark certificate may capture a broad range of evidence about the suitability of the product for use in different circumstances. A manufacturer can provide evidence of suitability for the off-site composite wall panels.

The alignment of composite wall panels to other structures, such as concrete floor, or roof structures may be problematic due to in-situ construction tolerances. As already stated, design coordination and site supervision are crucial to minimise potential problems.

For example, problems can arise when a concrete slab is poured to the dimensional tolerance limits set out by Australian Standards AS 2870 Residential slabs and footings and AS 3600 Concrete structures. The slab is NCC compliant, but a dimensionally accurate and square wall placed adjacent may:

- Create gaps that need to be weatherproofed.
- Need to be rectified at the slab-to-wall or wall-to-wall interface.
- Lead to lack of adequate fire protection.
- Lead to reduced acoustic performance.

As with any product, there will be manufacturer information on transport, handling, and storage to maintain the integrity of the product. Prior to installation, both on-site and off-site products and materials must be quality checked.

Transport of wall systems via road, rail or ship attracts relevant rules and regulations. These are outside the NCC. However, transport related movement, e.g. vibration may materially affect the performance of a product, e.g. loosening of fixings. Product design to resist vibration effects

should be documented and must be assessed as part of any product certification, manufacturer's instructions, and require pre-site installation quality checks as appropriate.

Temporary engineering of a product is important to ensure a product can be handled safely and not be damaged in transit. This may include lifting points to allow for moving from the off-site location to transport to site and then final positioning within the building. It might also include temporary support prior to final fixing.

3.6 Floor systems

Prefabricated floor systems can be anything from CLT panels (see Section 3.3) to composite timber, steel, or concrete floor panels, which comprise structure and a degree of finishing depending on the system. Finishes might include structural or non-structural layers of sheeting on top of a composite system and various other attributes normal to a floor. Typically, though, a floor system would be something made off site and lifted into place on site. Some considerations include:

- Dimensional accuracy of other building structures and positioning of them in the final form of a building. For example, in balloon construction, where a floor is placed in between two other walls, there will be a gap between the edge of the floor and the wall so that the floor can be installed. This gap needs to be designed to meet Performance Requirements for structural, fire, acoustic, etc.
- Where the floor system is an enclosed panel—i.e. there is skin on top and bottom that conceals components that would normally be inspected, the manufacturer would require to provide appropriate evidence for the concealed parts. Depending on how and where a product is used, such evidence could be in the form of test certificates from an ATL, engineering calculations, product technical statement, CodeMark certificate etc.
- When the floor system is installed onsite, other building elements might conceal onsite fixings in the assembly sequence. For example, a wall installed on top of the edge of a floor system might conceal the floor's visibility to another building element. Managing compliance will require design coordination, site supervision and verification of critical construction prior to concealment.
- Temporary engineering of structural floor systems involves not only lifting but also potential for temporary works whilst the floor system is being secured. Temporary works typically require engineering and a specific approval.

3.7 Roof systems

Prefabricated roof systems can be classified as any form of roof structure, with various degrees of finishing, which are made offsite for the purpose of transport, assembly, and installation to the building on site. Examples might include composite roof structures that have sheeting applied in the factory and require to be installed by relevant qualified tradespeople. Other examples of prefabricated roof systems might include panelised systems that are transported to site, lifted into position, with weatherproof membranes and sheeting installed onsite. Some considerations include:

- Potential for damage during transport, handling, storage, and installation, e.g. watertightness of joins, seams, materials, and components.
- Dimensional tolerances for the structural connection to other roof, and/or in-situ building components.
- Abutment with other elements and impacting other Performance Requirements. For example, the requirements for flashings, sealing, weather tightness etc.
- Temporary works may be required.
- Product to be engineered for lifting into place.

3.8 Volumetric prefabricated products and systems

Volumetric prefabricated products and systems are made offsite, transported to the construction site, and installed. They are more susceptible to transport, handling, and storage factors as they are large and usually limited by state and territory based transport (road, rail, or ship) laws and regulations. Volumetric products and systems typically comprise a range of components and sub-components, many of which are required to comply with the NCC. For these reasons, there are many factors that can impact the fitness for purpose and NCC compliance of volumetric products and systems.

Handling requires lifting points to be adequately engineered with supporting manufacturer instructions which should be followed. This includes from the factory, to transport, to site, to storage, and final placement.

The volumetric product or system will also require protection during handling and transport, e.g. from moisture, vibration, impact damage etc. The receipt of delivered volumetric products or systems should be subject to the same quality checks as other building products used in construction.

Factory and site storage requirements also need to be indicated by the manufacturer to ensure the product or system maintains its performance and is not degraded. This might include protection from moisture, storage temperature ranges, flammability risks etc.

For some volumetric products and systems, temporary works may be required, depending on the design and engineering. Temporary works are typically engineered and form part of the approvals process.

Upon installation, volumetric products and systems will interface with in-situ construction. Design coordination between engineering and architectural design can identify potential interface risks and include mitigation strategies to minimise those risks. This could include design to allow for dimensional tolerances, connections, critical interfaces such as those relating to fire separation etc. Design coordination can also identify whether there will be critical parts of the building concealed and to identify the need for additional compliance inspections, if necessary.

Site supervision also has an important role to play at crucial interfaces at critical times and to ensure products and systems are installed to the manufacturer's requirements. This is the same as other products used in building construction.

Whole building superstructures typically require to be transported in sections. On site assembly will include interfaces with the sub-structure as well as plumbing and drainage connections. Design coordination and site supervision of these connections and interfaces is essential.

It is entirely feasible for a volumetric product or system to comply with the DTS Provisions and to be provided with supporting evidence of suitability. There may be situations when a product or system meets some DTS Provisions and utilises a combination of Performance and DTS Solution or relies entirely on a Performance Solution. Where a Performance Solution is developed, understanding the interfaces with other parts of the building is important to ensure that any other affected Performance Requirements are addressed.

Alert

Best practice for concealed parts of in-situ construction:

- Manufacturing stage – Concealed parts of a product or system should have evidence provided demonstrating fitness for purpose and NCC compliance, e.g. CodeMark certificate.
- Installation stage – Concealed parts created by installing a product or system interfacing with in-situ construction, might be managed through design coordination and site supervision.

Use of a Performance Solution for a product or system provides the opportunity to document the appropriate evidence and verification required. This includes concealed parts within the product or system or as installed on site.

3.9 Light gauge steel

The use of light gauge steel (LGS) in the formation of framed elements produced offsite has the potential to increase speed and accuracy. LGS is commonly used in framing for residential, commercial, and industrial buildings. Applications include wall or floor framing or roof trusses, but it is also used in non-load-bearing applications, such as non-load-bearing wall partitions. It is commonly used in the formation of prefabricated bathroom pods and the framing of them because of its speed of fabrication, strength, and dimensional stability. In different climates it is useful for construction in termite areas.

The formation of LGS into a building system involves roll-forming flat steel sheets into studs, trusses, and other framing members. The accuracy inherent to steel and the dimensional stability of it as a material mean that fabrication offsite can occur quickly and efficiently. Added to this is the reduction in waste, where framing members are fabricated to length as required. Some considerations include:

- Potential for damage during transport, handling, storage, and installation, e.g., protect from water and corrosion.
- Dimensional tolerances for connection to in-situ building construction.
- Abutment with other elements and impacting other Performance Requirements. For example, the requirements for acoustics, fire, and energy efficiency.
- Connections with other components to protect against bimetallic (galvanic) corrosion. Design coordination and site supervision to ensure correct fixings are used and/or protection at metal: metal interfaces.

3.10 Additive and subtractive manufacturing

Additive manufacturing and subtractive manufacturing offer ways to produce components and integrated assemblies for buildings. These 2 approaches sit within the broader term ‘prefabrication’ but are distinct in their integration with digital tools. To generate additive or subtractive outputs, digital models (e.g. three-dimensional 3D CAD) are used to represent precise geometry from which machining code can be derived. Computer numerical control (CNC) machines such as laser cutters, waterjet cutters, 3D printers, industrial robots and the like operate using input code to control the various parameters of a machining operation (e.g. material thickness, feed rate, locations, etc.).

Subtractive fabrication simply is the process of cutting components out of materials – to subtract a shape from a larger sheet material, for example. The products that are generated from subtractive fabrication will fall under compliance conditions of specific materials such as for timber, steel, plastics, and the like based on what those products are designed to achieve.

Additive manufacturing is more commonly known as 3D printing and involves the continual addition of a material or substrate from a printing or deposition head to form a larger whole. Additive manufacturing can be used to create non-structural parts or components from the very small to very large, and structural load-bearing elements. 3D printing or additive substrates can include various types of plastics, resins, and cementitious fluids that harden upon printing.

Additive manufacturing of load bearing building components using concrete-like mixtures is also referred to as contour crafting. This process is akin to creating conventional in-situ concrete walls without formwork, or core-filled block walls without the block. For off-site manufacture, handling, transportation and storage of the products and systems needs careful consideration, as previously described. Interface issues between additive or subtractive parts and in-situ construction will need to be designed. This may relate to connections, dimensional tolerances, and allowances for dissimilar materials.

Design coordination and site supervision will be crucial to maximise the potential of these MMC.

Appendices

Appendix A Abbreviations

Table A.1, contains abbreviations used in this document.

Table A.1 Abbreviations

Abbreviation	Meaning
ABCB	Australian Building Codes Board
AI	Artificial intelligence
AS	Australian Standard
AS/NZS	Joint Australian/New Zealand Standard
ATL	Accredited Testing Laboratory
BCA	Building Code of Australia
CAD	Computer-aided design
CLT	Cross Laminated Timber
CNC	Computer numerical control
CRC	Cooperative Research Centre
DTS	Deemed-to-Satisfy
EPS	Expanded Polystyrene
FRL	Fire Resistance Level
kN/m	Kilo Newton per metre
LGS	Light Gauge Steel
MgO	Magnesium oxide boards
MMC	Modern method of construction
NASH	National Association of Steel-Framed Housing Inc
NatHERS	Nationwide House Energy Rating Scheme
NCC	National Construction Code
OSB	Oriented Strand Board
SOU	Sole-occupancy unit
PCA	Plumbing Code of Australia
PIR	Polyisocyanurate
SIPs	Structural Insulated Panels

Appendix B Examples to determine the appropriate evidence to demonstrate fitness for purpose and NCC compliance

An important part of thinking about MMC, prefabrication and modular technologies is to acknowledge that they may range from seemingly ‘simple’ products that utilise efficient manufacturing techniques to a more complex assembly or a volumetric product. Some products will be subject to straightforward NCC requirements and require relatively simple evidence to demonstrate compliance. However, complex products, including volumetric forms of construction may be subject to multiple NCC requirements and require extensive documentation to demonstrate compliance.

In this Appendix, we look at how to use the 4-step framework to determine the appropriate evidence to demonstrate fitness for purpose and NCC compliance. The framework also assists in the identification of other NCC influencing factors and potential interfaces with other products and parts of a building. We start with a fire door assembly as this is a familiar product to step through the evidence framework.

B.1.1 Example 1 - Fire door assembly with FRL -/60/30

Step 1: Determine which NCC Performance Requirements and DTS Provisions apply.

How is the material, product, plumbing product, form of construction or design proposed to be used?

- To provide a pre-approved door set for inclusion in a fire separating wall.
- It is non-loadbearing.

Where is it being used?

Building classification and applicable NCC Volume(s):

- Apartment building (Class 2), Volume One.

Location within the building and its interfaces with other products or parts of the construction.

- To provide access into sole-occupancy units (SOUs) and common areas.
- Within internal corridor walls.

From these 2 questions, likely applicable Volume One Sections:

- A Governing Requirements

- C Fire resistance
- D Access and egress
- F Health and amenity
- G Ancillary provisions (Part G7 Livable housing design)

A detailed BCA checklist working through the Parts is recommended to identify all relevant Performance Requirements and DTS Provisions.

Step 2: Are there specific evidence requirements relating to fire, energy efficiency or plumbing?

Yes. Specific evidence is required to demonstrate compliance with fire resistance requirements (FRLs). These are found in Specification 1 and 2. Determination must be carried out by an ATL, the resultant test report is suitable evidence.

Step 3: For other NCC requirements evidence to be relevant to the requirement and reflect the risk.

Example: A door into a Class 2 SOU, is required to meet threshold and clear opening width provisions.

- Relevant evidence to this provision will demonstrate geometry and width of the door set. A drawing or technical product sheet would be sufficient.
- The risk of this provision is low, and a product data sheet or drawing would be sufficient.

Step 4: Construction and installation in an appropriate manner.

Has it been constructed in an appropriate manner?

- Yes, the product has been constructed in accordance with a process and to a specification that has been verified by testing.

Has it been installed in an appropriate manner?

- Installation to be as per manufacturer's specification, including fixings into wall, dimensional tolerances, and gaps.
- Visual inspection of installed product likely sufficient to confirm compliance.

Are there concealed parts of the product that would typically be inspected on site?

- No.
- Visual inspection of installed product likely sufficient to confirm compliance.

Fire-resistance level (FRL): The grading periods in minutes determined in accordance with Specifications 1 and 2, for the following criteria—

(a) structural adequacy; and

(b) integrity; and

(c) insulation,

and expressed in that order.

Notes

A dash means there is no requirement for that criterion. For example, 90/–/– means there is no requirement for an FRL for integrity and insulation, and –/–/– means there is no requirement for an FRL.

Fire wall: A wall with an appropriate resistance to the spread of fire that divides a storey or building into fire compartments.

Door set:

A complete assembly comprising—

(a) the door leaf or leaves including any glazing and other inbuilt features;

(b) the doorframe, if any, with its fixings to the wall and, for a sliding door set, with all guides and their respective fixings to the lintel, wall or sill;

(c) any fixed panel and its associated transom or mullion (including the methods of fixing) that is contained within the doorframe;

(d) all door hardware; and

(e) fixtures and fittings attached to the door leaf or doorframe.

B.1.2 Example 2 - Wall partition panel system

Step 1: Determine which NCC Performance Requirements and DTS Provisions apply.

How is the material, product, plumbing product, form of construction or design proposed to be used?

- Loadbearing partition.

Where is it being used?

Building classification and applicable NCC Volume(s):

- Single dwelling (Class 1a), Volume Two.

Location within the building and its interfaces with other products or parts of the construction.

- Entry corridor and central stairwell.

From these 2 questions, likely applicable Volume Two Sections:

- Section A Governing Requirements
- Part H1 Structure

A detailed BCA checklist working through the Parts is recommended to identify all relevant Performance Requirements and DTS Provisions.

Step 2: Are there specific evidence requirements relating to fire, energy efficiency or plumbing?

No.

Step 3: For other NCC requirements evidence to be relevant to the requirement and reflect the risk.

Example: Structural adequacy of partition:

- Relevant evidence to this provision will demonstrate conformance to structural calculations. Appropriate evidence would be determined by a report from an engineer.
- The risk of this provision is low/moderate and a report from a professional engineer would be appropriate.

Step 4: Construction and installation in an appropriate manner.

Has it been constructed in an appropriate manner?

- Yes, it has been constructed in accordance with a process and to a specification that has been verified by test.

Has it been installed in an appropriate manner?

- Installation to be as per manufacturer's specification regarding dimensional tolerances, and including fixings into adjoining walls, floors, and ceilings.
- Visual inspection of installed product likely sufficient to confirm compliance.

Are there concealed parts of the product that would typically be inspected on site?

- No.
- Visual inspection of installed product likely sufficient to confirm compliance.

Loadbearing: Intended to resist vertical forces additional to those due to its own weight.

Loadbearing wall: For the purposes of H1D4 and H2D3 of NCC Volume Two and Section 4 of the ABCB Housing Provisions, means any wall imposing on the footing a load greater than 10 kN/m.

B.1.3 Example 3 – Bathroom pod

Step 1: Determine which NCC Performance Requirements and DTS Provisions apply.

How is the material, product, plumbing product, form of construction or design proposed to be used?

- To provide a pre-assembled, prefinished bathroom with floor, walls, door, and ceiling.
- Fitted with sanitary appliances, heated and cold-water supply and sanitary drainage pipework. Ready to connect to base build.
- Fitted with electrical power, lighting, and exhaust fan. Ready to connect to base-build.
- Fitted with vanity, mirror, and shower screen.
- Waterproofing of floor and walls completed.
- Floor waste installed. Ready to connect to base build.
- Relevant parts capable of being isolated for testing and maintenance.

Where is it being used?

Building classification and applicable NCC Volume(s):

- Apartment building (Class 2), Volumes One and Three.

Location within the building and its interfaces with other products or parts of the construction.

- Within each SOU as an internal room.
- Adjacent a common wall.
- Adjacent to a fire separating wall.
- Installed on a concrete floor.

From these 2 questions, likely applicable Volume One Sections:

- A Governing Requirements
- B Structure
- C Fire resistance
- D Access and egress
- F Health and amenity
- G Ancillary provisions

- J Energy efficiency

Volume Three Sections:

- A Governing Requirements
- B Water services
- C Sanitary plumbing and drainage
- D Excessive noise.

A detailed BCA and PCA checklist working through the Parts is recommended to identify all relevant Performance Requirements and DTS Provisions.

Steps 2 to 4
2. Are there specific evidence requirements relating to fire, energy efficiency or plumbing?
3. For other NCC requirements evidence to be relevant to the requirement and reflect the risk?
4. Construction and installation in an appropriate manner.

Given the complexity of this product, each aspect would need to be assessed separately to determine the necessary evidence to demonstrate DTS compliance and fitness for purpose.

Alert

Prefabricated bathroom pods, like bathrooms constructed in-situ, consist of multiple components carried out by multiple trades. Each component must comply with NCC requirements.

Complex products will require a more comprehensive package of documentary evidence to support fitness for purpose and NCC compliance. For example, by way of a CodeMark certificate and WaterMark licences for integral component plumbing products covered by the WaterMark scheme.

Determine where the bathroom pod will be installed, and then whether it is to be regulated work or a plumbing product.

Remember:

For compliance with the PCA – a prefabricated bathroom pod may be:

a. a **prefabricated plumbing installation** – which is regulated work, involving the interconnection of component products, that is undertaken or approved by a licensed plumbing practitioner and subsequently installed by a licensed plumbing practitioner. The regulated work must be undertaken in the same jurisdiction (state or territory) as that having authority at the site of installation, in accordance with the legislated requirements for regulated work in that jurisdiction and will not be required to be WaterMark certified as a product.

or

b. **a purpose-built bathroom module** – which is a product, as defined in the NCC 2016, Volume Three, the PCA, listed in the WaterMark Certification Scheme, that is WaterMark certified to the applicable product specification(s) and subsequently installed by a licensed plumbing practitioner. The product, comprising integral components, may be assembled, or manufactured in any off-site location, nationally or internationally.

For a WaterMark certified bathroom pod product:

A WaterMark licence for a bathroom pod product covers the PCA requirements only – it does not certify BCA requirements for its structure, electrical components, waterproofing, fire protection, etc. The plumbing product (bathroom pod), including any integral plumbing components, has been evaluated and certified to an applicable specification and authorised for use in a plumbing and drainage installation.

B.1.4 Example 4 – Heated water within a bathroom pod undertaken as regulated work (i.e. not a WaterMark certified plumbing product)

Step 1: Determine which NCC Performance Requirements and DTS Provisions apply.

How is the material, product, plumbing product, form of construction or design proposed to be used?

- Heated water provision to sanitary fittings. Ready to connect to base build.

Where is it being used?

Building classification and applicable NCC Volume(s):

- Apartment building (Class 2), Volumes One and Three.

Location within the building and its interfaces with other products or parts of the construction.

- Within each bathroom pod located in each SOU.

From these 2 questions, likely applicable Volume One Sections:

- A Governing Requirements
- F Health and amenity
- G Ancillary provisions (Part G7 Livable housing design)

Volume Three Sections:

- A Governing Requirements
- B Water services
- D Excessive noise.

A detailed BCA and PCA checklist working through the NCC is recommended to identify all relevant Performance Requirements and DTS Provisions.

Step 2: Are there specific evidence requirements relating to fire, energy efficiency or plumbing?

Yes. Specific evidence is required to demonstrate compliance with plumbing requirements. These are found in A5G4. They may include reports from ATLs, WaterMark Licences, certificate from a certification body.

Step 3: For other NCC requirements evidence to be relevant to the requirement and reflect the risk.

Example: Scald prevention in a Class 2 building.

- Relevant evidence to this provision will demonstrate meeting the technical requirements, i.e. ability to control temperature requires NCC conformance to be evidenced through a test. Therefore, relevant evidence would be a test certificate from an ATL.
- The risk related to this provision is high due to consequences of failure, i.e. scalding. A higher level of evidential rigour would be appropriate for higher risk.

A report from an ATL would reflect relevance and is higher on the evidence hierarchy and appropriate to the risk. In contrast, a product technical statement does not reflect the relevant provision (it is not demonstrating conformance through a test) and has lower rigour that does not reflect the risk.

Step 4: Construction and installation in an appropriate manner.

Has it been constructed in an appropriate manner?

- Yes, the heated water supply pipework and fittings within the pod have been constructed by a plumber licensed in the relevant state/territory, in accordance with the PCA referenced documents in the AS/NZS 3500 Plumbing and drainage series.
- Compliance demonstrated by a certificate from a professional engineer or other appropriately qualified person e.g. licensed plumber.

Has it been installed in an appropriate manner?

- Within the pod, yes.
- Installation of the pod (including the heated water component) to be as per manufacturer's specification and instructions.
- Installation of pod plumbing to be carried out by a licensed plumber.
- Compliance demonstrated by a certificate from a professional engineer or other appropriately qualified person e.g. licensed plumber.

Are there concealed parts of the product that would typically be inspected on site?

- Yes, however, offsite construction and installation has been completed by a licensed plumber with a certificate verifying compliance.
- Site installation of the pod heated water, i.e. connection to base build heated water supply, carried out by a licensed plumber with a certificate verifying compliance.

Heated water: Water that has been intentionally heated; normally referred to as hot water or warm water.

B.1.5 Example 5 – Waterproofing within a bathroom pod

Step 1: Determine which NCC Performance Requirements and DTS Provisions apply.

How is the material, product, plumbing product, form of construction or design proposed to be used?

- Waterproofing system of the bathroom pod.
- Waterproofing of floor and walls.
- Providing continuous waterproofing with drainage outlets.

Where is it being used?

Building classification and applicable NCC Volume(s):

- Apartment building (Class 2), Volume One.

Location within the building and its interfaces with other products or parts of the construction.

- Within each bathroom pod located in each SOU.
- Interface with waterproofed base build water supply and drainage pipework.

From these 2 questions, likely applicable Volume One Sections:

- A Governing Requirements
- F Health and amenity

A detailed BCA and PCA checklist working through the NCC is recommended to identify all relevant Performance Requirements and DTS Provisions.

Step 2: Are there specific evidence requirements relating to fire, energy efficiency or plumbing?

No

Step 3: For other NCC requirements evidence to be relevant to the requirement and reflect the risk.

Example: Waterproofing product suitability and compatibility with base build waterproofing:

- Relevant evidence for this provision relates to design, specification, and installation. Appropriately designed and specified waterproofing materials for the substrate and proposed finish e.g. tiles. Appropriate evidence may be a specification for the proposed design. For installation by an appropriately qualified person, a report or certificate from the appropriately qualified person would be adequate.

- The risk of this provision is moderate due to the prevalence of waterproofing defects in buildings generally and their concealed nature. Inspection prior to concealment and a report / certificate from an appropriately qualified person would be appropriate.

Step 4: Construction and installation in an appropriate manner.

Has it been constructed in an appropriate manner?

- Yes

Has it been installed in an appropriate manner?

- Within the pod, yes if installed by an appropriately qualified person; for example, a licensed waterproofer.
- Installation of the pod (including sanitary drainage pipework.) to be as per manufacturer's specification and instructions.

Are there concealed parts of the product that would typically be inspected on site?

- Yes, however, offsite construction and installation has been completed by an appropriately qualified person with a certificate verifying compliance.
- Site installation of the pod, i.e. in accordance with manufacturer's instructions, with visual checks for any damage to the product prior to installation on site.

Waterproofing – does it comply?

Waterproofing of wet areas is a challenging area for compliance assessment.

Waterproofing is typically inspected once installed and prior to finishes being applied. Even when waterproofing is inspected as an in-situ construction, there are no guarantees that the substrate was adequately prepared, that there are appropriate bond breakers, that the product is suitable for the tile adhesive, that the product is of the correct thickness, with adequate curing time between coats etc.

The visual inspection can only assess obvious superficial defects. Thus, in-situ applied waterproofing of wet areas is reliant on certification of the design specification and installation by an appropriately qualified person. This is like a waterproofed wet area constructed off site.

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