



**National
Construction
Code**



Handbook



Performance Solution Process



abcb.gov.au

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Preface

The Inter-Government Agreement (IGA) that governs the Australian Building Codes Board (ABCB) places a strong emphasis on reducing reliance on regulation, including consideration of non-regulatory alternatives such as non-mandatory handbooks and protocols.

This handbook is one of a series produced by the ABCB. The series of handbooks is being developed in response to comments and concerns expressed by government, industry and the community that relate to the built environment. Handbooks expand on areas of existing regulation or relate to topics which have, for a variety of reasons, been deemed inappropriate for regulation. They provide non-mandatory advice and guidance.

Development of Performance Solutions has until recently been largely unregulated. Outside of fire safety design, little guidance material to understand the importance of the Performance Solution development process has been available to assist practitioners. This handbook has been developed in response to government and industry requests for guidance specifically on the application of the requirements introduced into the National Construction Code (NCC) with Amendment 1 of NCC 2019, specifically clause A2.2(4).

It will assist a range of stakeholders with the application of the performance-based NCC, as well as understanding the relationship between the NCC and respective state and territory legislative systems. Typically, legislative systems require compliance with the NCC for construction of new buildings and new work to be undertaken on existing buildings.

This handbook addresses issues in generic terms. It is not a document that sets out approaches that may be taken in dealing with specific issues. It is expected that this handbook will be used to develop solutions relevant to specific situations in accordance with the generic principles and criteria contained herein.

Acknowledgements

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REMINDER

This handbook is not mandatory or regulatory in nature and 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 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 Background

The National Construction Code (NCC) is a performance-based code containing mandatory Performance Requirements for the construction of buildings. A building, plumbing or drainage solution will comply with the NCC if it satisfies the Performance Requirements. This document provides guidance for practitioners seeking to develop a Performance Solution, particularly the process required to conform with A2.2(4) of the NCC.

1.1 Scope

This handbook assists NCC users in understanding and developing Performance Solutions. It will be of interest to all parties who are involved in selecting or assessing elements of buildings that must comply with the NCC. The handbook is structured to provide the reader with an understanding of important NCC terms and terminology used in the Performance Solution process and then expands each step in this process.

Separate examples are available at the ABCB website (abcb.gov.au).

1.2 Using this document

General information about complying with the NCC and responsibilities for building and plumbing regulation are provided in Appendix A of this document.

Acronyms and symbols used in this document are provided in Appendix B.

The term appropriate authority is used throughout this handbook. It is an NCC defined term meaning the relevant authority with the statutory responsibility to determine the particular matter. In general, this will be a building surveyor in respect to the Building Code of Australia (BCA), a plumbing authority in respect of the Plumbing Code of Australia (PCA) or may be a government entity with authority.

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

NCC extracts

Examples

Alerts

Reminders

2 Introduction

2.1 Legislation governing the NCC

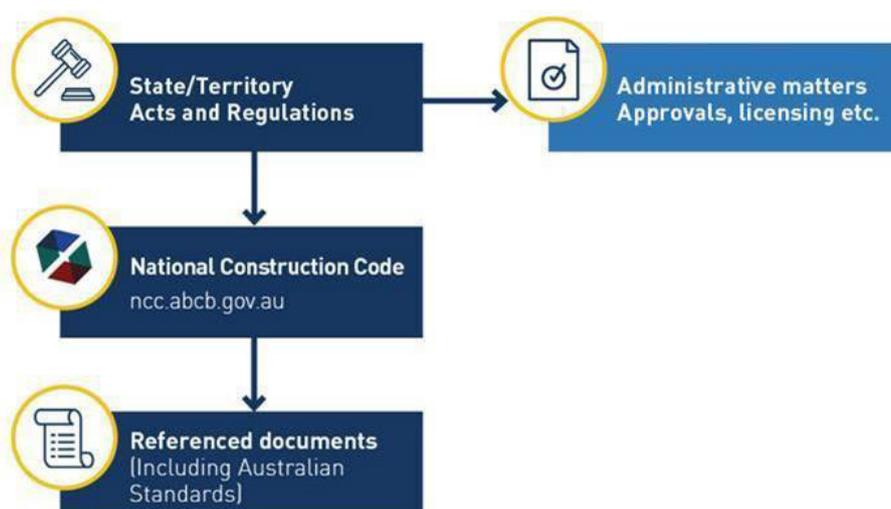
The Governing Requirements are mandatory in all Australian jurisdictions, typically via a regulatory reference to the entire NCC, which obliges compliance with the NCC inclusive of the Governing Requirements. State and territory legislation typically includes a requirement that the design and construction of new buildings, as well as new work on existing buildings, must comply with the NCC.

Electronic access to respective legislation is available via the websites in Table 1 and Figure 1 shows the relationship of legislation, administrative matters and the NCC.

Table 1 Website links for state and territory legislation governing building work

State/Territory	Website link
Australian Capital Territory (ACT)	legislation.act.gov.au
New South Wales (NSW)	legislation.nsw.gov.au
Northern Territory (NT)	legislation.nt.gov.au
Queensland (Qld)	legislation.qld.gov.au
South Australia (SA)	legislation.sa.gov.au
Victoria (Vic)	legislation.vic.gov.au
Tasmania (Tas)	legislation.tas.gov.au
Western Australia (WA)	legislation.wa.gov.au

Figure 1 NCC regulatory framework



2.2 NCC compliance

The NCC Governing Requirements in Section A/Section 1¹, set out how to conform with the NCC requirements. NCC Part A2, Compliance with the NCC, includes clause A2.0, which describes the mandatory parts of the NCC. Clause A2.1 describes the means by which compliance with the Performance Requirements can be demonstrated.

A2.0 Compliance

Compliance with the NCC is achieved by complying with –

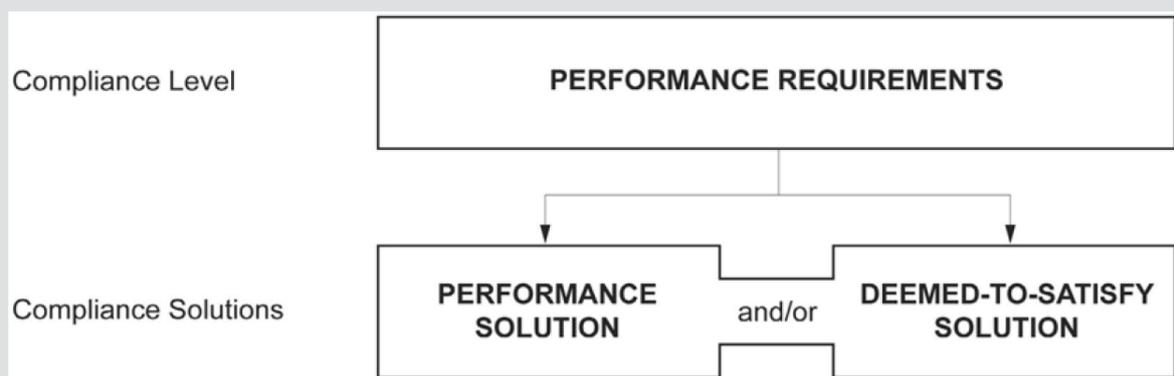
1. The Governing Requirements of the NCC; and
2. The *Performance Requirements*.

A2.1 Compliance with Performance Requirements

Performance Requirements are satisfied by one of the following, as shown in Figure 1:

1. A *Performance Solution*;
2. A *Deemed-to-Satisfy Solution*;
3. A combination of (1) and (2).

Figure 1: NCC compliance option structure



¹ The Governing Requirements are in Section A of NCC Volumes One and Three and Section 1 of NCC Volume Two.

A Performance Solution will typically comprise a unique means of complying with Performance Requirements. To facilitate assessment of Performance Solutions, NCC clause A2.2(2) requires that a Performance Solution must be assessed according to one or more of the NCC Assessment Methods.

A2.2 Performance Solution

1. ...
2. *A Performance Solution* must be shown to comply with the relevant *Performance Requirements* through one or a combination of the following *Assessment Methods*:
 - (a) Evidence of suitability in accordance with Part A5 that shows the use of a material, product, *plumbing* and *drainage product*, form of construction or design meets the relevant *Performance Requirements*.
 - (b) A *Verification Method* including the following:
 - (i) The *Verification Methods* provided in the NCC;
 - (ii) Other *Verification Methods*, accepted by the *appropriate authority* that show compliance with the relevant *Performance Requirements*.
 - (c) *Expert Judgement*.
 - (d) Comparison with the *Deemed-to-Satisfy Provisions*.
3. ...

The remaining clauses of A2.2, A2.2(3) and A2.2(4), set out what must be done where a Performance Requirement is intended to be satisfied entirely using a Performance Solution (i.e. without reference to a Deemed-to-Satisfy (DTS) Solution/s), and the steps that must be followed whenever a Performance Requirement is to be satisfied using a Performance Solution. The steps of A2.2(4) are the basis for this handbook.

To round out Part A2, clause A2.3 addresses assessment of DTS Solutions and clause A2.4 describes the approach when a combination of DTS and Performance Solutions are used.

Another key section of the Governing Requirements linked to preparing Performance Solutions is Part A5 Documentation of design and construction. This Part includes A5.1 Evidence of suitability, providing further information about this Assessment Method, which covers Volumes One, Two, and Three.

Part A5 describes requirements related to documentation of design and construction for various components of buildings, including additional requirements related to fire resistance (clause A5.4), fire hazard properties (clause A5.5) and resistance to the incipient spread of fire (clause A5.6). There are also requirements related to labelling of Aluminium Composite Panels (clause A5.7) that must be observed through documentation of design and construction.

Alert:

Plumbing and drainage products are subject to the requirements of the WaterMark Certification Scheme, with some listed exclusions. Demonstrating suitability for use of a product of a type subject to WaterMark certification by a means other than WaterMark (including a Performance Solution) is not permitted. For further details about requirements for plumbing and drainage products, and the WaterMark Certification Scheme, refer to Part A5.3 of the NCC and the WaterMark website (watermark.abcb.gov.au).

2.3 Evidence and documentation

There are various means used by design practitioners to identify and set out how the relevant requirements are to be addressed in the design process. For simpler partial performance-based proposals, a table, setting out which requirements are relevant and providing a short description of why they are, will likely be adequate. For more complex proposals, software, typically spreadsheets, are sometimes used.

In conjunction with documenting a design solution, a performance approach requires preparation of evidence of conformity with the Performance Requirements. This evidence may take many forms as set out at Part A5 of the NCC. A person designing or constructing in conformity with the DTS Provisions is to be taken to be complying with the Performance Requirement provided the documentation demonstrates conformity.

2.4 Complexity of the project or solution

Complexity may relate to a whole project or a specific solution. Value and size alone are not reliable indicators of complexity. Instead complexity can be thought of as a

higher potential for interaction between competing design elements. Thus relatively simple projects may require a complex Performance Solution and a relatively complex project may be addressed with a simple Performance Solution. Context for each Performance Solution is therefore important and will need to be clearly communicated during the process and ultimately reflected within the final Performance Solution report.

Once the broad goals of the project are established, it will be possible to determine the most appropriate process to develop the scope of design that accommodates these goals. Additional stakeholder identification and decisions about the timing of engagement of stakeholders in the process may stem from this knowledge. Early stakeholder engagement is beneficial for all Performance Solutions, especially those with greater complexity as more time may be needed to resolve competing design requirements.

Complexity impacts the process of developing a solution because of a number of factors including:

- the number of Performance Requirements that are to be met using a Performance Solution (i.e. potential interaction between competing design elements (e.g. energy vs fire));
- the extent to which the client brief establishes acceptance criteria that exceed minimum compliance requirements (e.g. In a hospital with a MRI machine on an upper level floor slab requires stringent vibration resistance of the supporting floor slab, which has implications for the location of services suspended from the underside of the slab impacting energy efficiency, acoustic separation and fire resistance for the surrounding structural elements);
- the use of the building and characteristics of the proposed building;
- the use of novel materials, construction methods;
- other unique or new design considerations; and
- the characteristics of the proposed location of the project (i.e. bushfire hazard, storm surge, or geology).

The process for development of the Performance Solution will not vary with project complexity. However, what will vary with complexity, is the extent of information to verify NCC compliance and the involvement of relevant stakeholders.

2.5 Professional practice

Performance Solution development essentially involves establishing a bespoke set of technical requirements for a specific project that, if followed, will address the Performance Requirements of the NCC and any additional requirements of the client. Therefore, the performance-based NCC provides a designer with an almost unbounded approach to preparing a comprehensive scope of work for a new building in conjunction with relevant stakeholders.

Some state and territory legislation empowers certain practitioners to develop and/or approve Performance Solutions. Irrespective of controls about who can undertake this process, the practitioners involved have a professional responsibility for ensuring that appropriately skilled and experienced persons are engaged and participate as stakeholders in the process.

Prior to commencing the process, consideration should be given to the extent of stakeholder consultation needed to produce a successful outcome. This is because the Performance Requirements of the NCC address all aspects of design and construction, such as structural design, fire safety, access and egress, plumbing, drainage, ventilation, lighting and energy efficiency. With an increasing number and complexity of Performance Solutions applicable in a building design, together with the need to identify interrelationships between requirements of different parts of the NCC, it may not be feasible for an individual practitioner to understand whether a particular solution complies with all relevant Performance Requirements.

Depending on the required Performance Solution, it may be appropriate to engage a BCA/PCA consultant, to assist stakeholders to understand the compliance requirements and opportunities for design output, including how issues might be resolved. The BCA/PCA consultant would complement the appropriate authority who is there to provide advice about compliance requirements for design approaches contemplated rather than advice on how to solve compliance matters.

It is important that the integrity of the statutory role of the appropriate authority is not compromised by design practitioners seeking solution advice, as this gives rise to a conflict of interest when undertaking the statutory assessment of the design solution.

2.6 Ethics

In general, state and territory legislation requires that the appropriate authority exercises their duties within a code of conduct. The principles captured by a number of these requirements are relevant to all construction professionals and are of key importance in the use of Performance Solutions. These are:

- acting in the public interest
- independence and
- competence.

2.6.1 Acting in the public interest

In undertaking their duties, an appropriate authority must exercise their discretionary powers in ways that safeguard the public interest. A construction professional's consideration of the interests of their clients and employers must not be contrary to the public interest.

2.6.2 Independence

In performing their professional duties, construction professionals involved in performance-based solutions must be objective, impartial and conduct themselves in accordance with the relevant requirements of state and territory legislation in managing any conflicts of interest.

2.6.3 Competence

A construction professional must not undertake professional work that they are not competent to perform.

3 The Performance Solution process

3.1 Introduction to the Performance Solution process

Clause A2.2(4) of the NCC describes the process for developing Performance Solutions:

- Prepare a brief
- Carry out analysis
- Evaluate results
- Prepare a final report.

A2.2 Performance Solution

1. ...
2. ...
3. ...
4. Where a *Performance Requirement* is proposed to be satisfied by a *Performance Solution*, the following steps must be undertaken:
 - (a) Prepare a *performance-based design brief* in consultation with relevant stakeholders.
 - (b) Carry out analysis, using one or more of the *Assessment Methods* listed in (2), as proposed by the *performance-based design brief*.
 - (c) Evaluate results from (b) against the acceptance criteria in the *performance-based design brief*.
 - (d) Prepare a final report that includes--
 - (i) all *Performance Requirements* and/or *Deemed-to-Satisfy Provisions* identified through A2.2(3) or A2.4(3) as applicable; and
 - (ii) identification of all *Assessment Methods* used; and
 - (iii) details of steps (a) to (c); and
 - (iv) confirmation that the *Performance Requirement* has been met; and
 - (v) details of conditions or limitations, if any exist, regarding the *Performance Solution*.

This handbook explains the steps in the process. The process is also summarised in the ABCB Guidance Document – Performance Solution Process available from the ABCB website (abcb.gov.au).

Developing a Performance Solution to satisfy the NCC Performance Requirements is an iterative process. When undertaking this process, elements may need to be reconsidered as analysis and results are evaluated and stakeholders engaged or re-engaged. Noting this, the process is also proportional to the scope of the solution being developed and is equally applicable to simple and more complex solutions.

NCC compliance is just one component of a project and the approaches taken to meeting the Performance Requirements may be influenced by a range of other project parameters such as legislative requirements and client needs. The Performance Solution process may need to reflect these wider project parameters, but the final report only needs to demonstrate that the relevant NCC Performance Requirements have been met.

Reminder

Practical scenarios applying this Performance Solution process are also available from the ABCB website to assist a better understanding of how to apply this process. A range of other tools, guidelines and templates have also been produced by state and territory regulatory authorities and industry associations.

3.2 Preparing a performance-based design brief

The development and approval of a Performance Solution can be a relatively simple process if it is initiated by the collaborative preparation of a performance-based design brief (also known as the brief or PBDB). Using this process can assist in developing a solution which satisfies the requirements of the NCC.

The purpose of the brief is to record the fundamental activities and outcomes of the performance-brief design process, as agreed by stakeholders. As a consequence, the design process can be commenced with a high degree of confidence that the design will be NCC compliant.

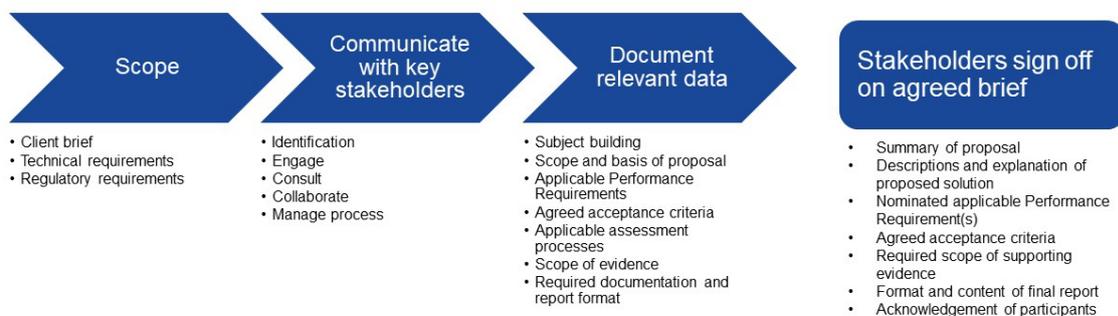
Typically the brief process is initiated by the designer. Broadly, the components in the process of development of a brief include:

- Scope proposed solution
- Communicate with stakeholders

- Document relevant data
- Stakeholders sign off on agreed brief.

Figure 2 illustrates each component in developing the brief.

Figure 2 Process of developing a performance-based design brief



Reminder

The level of detail required to complete the process articulated in Figure 2 is typically proportionate to the complexity of the Performance Solution being developed.

3.2.1 Scope

Scoping the proposed solution relates to defining the attributes or parameters of the proposal (e.g. building type and function, effective height, location). This will largely come from the client brief and will be informed by technical and regulatory requirements that apply to the proposal. These might be identified by the lead design practitioner or through stakeholders raising matters within their area of expertise. These may include fire authorities advising on operational parameters.

The parameters may evolve throughout the process of developing the brief, particularly for more complex designs. Adjustments may be made to ensure limitations and assumptions that arise through the process are captured and understood.

Evolving parameters may include: building classification; type of construction; occupancy and use characteristics; and effective height.

3.2.2 Communicate with key stakeholders

Consultation and active engagement with stakeholders is a fundamental component in the process of formulating an appropriate scope of work and consequently, the brief and all that flows from it.

Selection and engagement of the relevant stakeholders will often happen in conjunction with scoping the proposed solution. Identification of relevant stakeholders will stem from initial scoping of the attributes and parameters of the project and also the relevant parts of the building that are to be subject to a performance-based design approach. Within the proposed scope, the stakeholders can provide advice on appropriate acceptance criteria, NCC Assessment Methods (suitable for the acceptance criteria), potential risks and mitigation strategies.

As the design, assessment, and construction of any proposed work will normally involve more than one stakeholder, the process will require collaboration and negotiation to achieve a mutually acceptable performance-based outcome. Therefore, there needs to be a designated person to manage the brief process. The person responsible for brief process could be the lead designer, project manager, consultant building surveyor, engineer, or other specialist. The person should have an appropriate level of knowledge and experience commensurate with the specifics of the issue(s) to be addressed.

Consultation with an appropriate authority should be initiated as soon as possible to ensure the proposed acceptance criteria can be accepted in support of the approval process. However, the stage at which consultation is commenced is a decision for the person responsible for managing the brief process and may be influenced by the complexity of the project. Legislation may also dictate when this must occur.

The complexity of the project will influence:

- (a) the suitability of qualified and experienced individuals; and/or
- (b) the need for, and breadth of, stakeholder consultation.

A primary benefit of early consultation is that stakeholders, who will be required to contribute to decision making processes during the course of the project, have an opportunity to express their needs. This could be regarding preferred processes,

technical methodologies, and the scope of documentation to support future decision making.

Key stakeholders commonly involved in Performance Solutions include:

- building owner (or owner's representative)
- project manager
- builder/plumber
- design practitioners
- hydraulic designers
- engineers
- appropriate authority
- specialists.

Alert:

It is crucial that the appropriate authority is not asked to provide design advice. It is a conflict of interest for those with regulatory responsibility to assess aspects of a design that they have contributed to the development of.

3.2.3 Document relevant data

The inputs and negotiations of stakeholders should document relevant data. Documentation is the final component in preparing the brief. This is where all the agreements made through the process are set out, in addition to any known limitations or assumptions that underpin the agreements made. The specific acceptance criteria including compliance benchmarks that were agreed and the methods of demonstrating conformity with them must be clearly documented. Any and all risks that are to be managed must also be clearly set out.

The brief should also set out who has responsibility for provision of agreed evidence, undertaking assessment, testing, modelling etc., and confirming acceptance criteria have been satisfied.

Documenting relevant data is a process that brings together information on:

- Subject building

- Scope and basis of proposal
- Applicable Performance Requirements
- Agreed acceptance criteria
- Applicable assessment processes
- Scope of evidence
- Required documentation and report format

The subject building and scope have been described earlier in this handbook. Other data to be documented are described below.

3.2.3.1 Determining applicable Performance Requirements

A2.2(3) requires that when a Performance Requirement is entirely satisfied by a Performance Solution, it must identify the relevant Performance Requirement.

A2.2 Performance Solution

1. ...
2. ...
3. Where a *Performance Requirement* is satisfied entirely by a *Performance Solution*, in order to comply with (1) the following method must be used to determine the *Performance Requirement* or *Performance Requirements* relevant to the *Performance Solution*:
 - (a) Identify the relevant *Performance Requirements* from the Section or Part to which the *Performance Solution* applies.
 - (b) Identify *Performance Requirements* from other Sections or Parts that are relevant to any aspects of the *Performance Solution* proposed or that are affected by the application of the *Performance Solution*.
4. ...

3.2.3.2 Acceptance criteria

Acceptance criteria are the cornerstone of developing a Performance Solution and need to be established to ensure the relevant Performance Requirements are met for the particular project given the occupancy and use characteristics of the building. For unquantified Performance Requirements, an approach to derive and agree acceptance criteria may be:

- What is being measured or needs to be demonstrated?

- Is there a metric to describe it?
- What is an acceptable level for the metric?

Practitioners often refer to the DTS Provisions to benchmark whether or not the Performance Requirements have been met for a given design. The 'performance' of the proposed design can be compared against the benchmark provided by a design satisfying the DTS Provisions to assess the difference and the potential impacts on the building, part of building and its occupants. Performance Solution documentation should identify and quantify these impacts and show how the proposed design addresses them and any mitigations or limitations proposed.

Another approach that may be useful is to apply a what, where, why, how, and when approach to tease out the specifics of the matters to be addressed in the Performance Solution to determine appropriate acceptance criteria.

- What is affected and where?
Is the whole building, part of building, facility, component, material, ground floor, basement, etc. affected?
- How and why is the building, part of building, facility, component, material, etc. affected?
- Who is affected, how and why?
Does the issue affect all users or specific user group (number, mobility and other characteristics of occupants)? If so, how does it affect them? And why?
- Does the issue apply all the time or only some of the time (i.e. when is the specific issue important?)

The acceptance criteria should identify all relevant parameters in order to determine the applicable NCC compliance pathways, measurable outcomes, methods of analysis, and NCC Assessment Methods. During this process, matters outside the scope of the NCC may need to be addressed as well.

Where possible, acceptance criteria should be quantified as they stand greater scrutiny and can be more readily evaluated and validated. All evidence supporting conformity with acceptance criteria should be clear and may include evidence to support any opinion provided in support of a qualitative acceptance criteria. This may include obtaining details of the qualifications of persons providing evidence of suitability particularly where A5.2(1)(e) is used and/or peer review for validation.

Fundamental to the success of the Performance Solution process is that there is general agreement amongst the stakeholders on the acceptance criteria for the proposal. It is essential to have the agreement of the appropriate authority for the project. Without their agreement at this stage, the completed design documentation including the performance proposal will not be accepted and subsequently will not be approved for construction.

Assumptions and limitations of the acceptance criteria, NCC Assessment Methods and analytical approaches and methods need to be clearly identified in the brief and Performance Solution report.

3.2.3.3 Assessment processes

Assessment processes, including the NCC Assessment Methods for the agreed acceptance criteria should also be generally agreed by stakeholders. Suitability of the NCC Assessment Methods is informed by many factors including the type of criteria, stakeholder engagement, timing, resources and also the availability of information. Selection of the NCC Assessment Methods will also be guided by the mix of Performance and DTS Solutions applicable to the proposal. It is key to ensure the appropriate authority agrees with the decisions made.

The NCC Assessment Methods for Performance Solutions (A2.2(2)) are:

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

3.2.3.4 Final report criteria

Identifying what documentation is required as evidence of NCC compliance and the required Performance Solution report format also forms part of the brief.

3.2.4 An agreed brief

The final element of the brief is the endorsement of stakeholders verifying that each understands the brief and accepts its content.

Alert:

Typically a brief should include:

- a summary of the proposal, including for example
 - building type and function
 - effective height
 - location of the building
- a descriptions and explanation of the proposed solution
- nominated applicable Performance Requirement(s)
- agreed acceptance criteria
- required scope of supporting evidence
- format and content of the final report
- acknowledgement of participants.

Relevant state and territory variations may also guide the content and format of design documentation inclusive of Performance Solutions and care needs to be taken to ensure compliance with these.

3.3 Carry out analysis

Analysis, assessment and verification are different activities within the Performance Solution process as illustrated by the definitions of these words.

Analysis

(n) 1. Separation of something into its basic parts in order to discover its nature, meaning etc.

Assessment

1. the action or an instance of making a judgment about something: the act of assessing something

Verify

(v.t) 1.To prove (something) to be true; confirm; substantiate.

It is important to ensure that adequate analysis has been carried out prior to making an assessment and prior to verifying NCC compliance.

Analysis is different to assessment, but what can be confusing is that some (but not all) NCC Assessment Methods, contain analysis. Each Performance Solution is likely to be unique and will require a specific analysis relevant to its complexity. Analytical assessment should be completed as agreed in the brief and compared to the agreed acceptance criteria and reflect any limitations, assumptions and identified risks.

A better understanding of analysis can assist formulation of compliant Performance Solutions. The analysis concepts and principles in the International Fire Engineering Guidelines (IFEG) (ABCB 2005) provides a useful description of a range of analysis techniques that may be applied broadly to Performance Solutions. The following sections, Sections 3.3.1 to 3.3.4, contains extracts from IFEG with minor adaptations.

3.3.1 Comparative or absolute approach

3.3.1.1 Comparative approach

A comparative approach aims to determine whether the Performance Solution is equivalent to (or better than) the DTS or prescriptive design. The comparative approach is often referred to as an “equivalence” approach.

For more guidance on comparative analysis, see the Handbook: Fire Safety Verification Method (ABCB, 2020)

3.3.1.2 Absolute approach

When an evaluation is carried out on an absolute basis, the results of the analysis of the trial design are matched, using the agreed acceptance criteria, against the objectives or Performance Requirements without comparison to DTS or prescriptive or “benchmark” designs.

3.3.2 Deterministic or probabilistic approach

3.3.2.1 Deterministic approach

Deterministic methods are based on physical relationships derived from scientific theories and empirical results. Characteristically, for a given set of initial boundary conditions, a deterministic methodology will always produce the same outcome. They do not, however, indicate the probability of that outcome being realised.

Deterministic methods are the most commonly used as they are better developed, less complex and less demanding on data and analysis than a probabilistic method.

3.3.2.2 Probabilistic approach

These methods generally assign reliabilities to the performance of the various fire protection measures and assign frequencies of occurrence of events. They may analyse and combine several different scenarios. This use of multiple scenarios and their combination through probabilistic techniques is a key feature of some of the methods.

Probabilistic methods generally require much statistical data which are not always readily available and because of their complexity, may involve time-consuming calculations. Furthermore, their validity may be more difficult to demonstrate because detailed examination of statistics and many experiments may be necessary.

3.3.3 Qualitative or quantitative approach

3.3.3.1 Qualitative approach

In the minority of cases, qualitative analysis may be agreed and be sufficient for the consideration of a single non-compliance issue. The basis (logic) on which this approach is used should be documented with appropriate references.

A “Delphi” approach may also be appropriate in certain circumstances, i.e. where a group of suitably expert professionals reach consensus agreement regarding the suitability of a particular solution.

3.3.3.2 Quantitative approach

In the majority of cases, the more complex solutions will require a quantitative approach. This entails the use of one or more of the many analysis methods available. The quantitative methods will often be supported by additional qualitative arguments.

If a quantitative approach has been selected for the analysis, suitable methods need to be chosen. These analysis methods will reflect decisions made with respect to approaches adopted (comparative or absolute, deterministic or probabilistic). There are many forms of analysis methods including:

- formulas, equations and hand calculations
- spread sheet calculations
- statistical studies
- experiments with physical scale models
- full-scale experimental tests (such as fire tests or trial evacuations of real buildings)
- computer simulation or modelling.

The methods chosen should:

- be well documented (especially their limitations and assumptions) either in the literature or by the appropriate qualified person.
- be well validated.
- be suitable for the task.
- generate outputs that can be compared with the acceptance criteria agreed for the analysis.
- have clearly defined limitations and assumptions that are well documented.

3.3.4 Sensitivity, redundancy and uncertainty studies

Depending on the type and complexity of the analyses, sensitivity, redundancy and uncertainty studies may be required. These should be identified in the brief. For more information about such studies and examples, refer to the IFEG (ABCB 2005).

3.3.4.1 Sensitivity studies

Sensitivity studies measure the impact on the results of analyses of changing one or more key input values (singly or in combination) especially if there is some doubt about their quantification. The brief should state the nature and extent of the sensitivity studies that will be undertaken.

3.3.4.2 Redundancy studies

Redundancy studies are similar to sensitivity studies but examine the redundant measures of a trial design that essentially fulfil the same function. The brief should state the nature and extent of the redundancy studies that will be undertaken. In particular, designers should not expect each redundant component will deliver exactly the same performance, but designers should look for single points of failure and what systems will be available to provide backup to such a failure.

3.3.4.3 Uncertainty studies

Uncertainty studies often follow or complement a sensitivity study. An uncertainty study determines how input data and uncertainties inherent in the methods used are reflected in the outputs of the analysis. Some indication of the uncertainties associated with the methods may be obtained by the use of a number of appropriate methods and comparing outputs. The uncertainties may be due to poor conceptualisation of the problem being investigated or to inadequate formulation of the conceptual or computational model used. Calculation and documentation errors may also lead to uncertainties. The brief team should determine whether an uncertainty study is appropriate for the analysis to be carried out.

As each process may require specific input and output information, it is essential that potential variables in the agreed method of evaluation are identified during the stakeholder consultation process and documented within the brief prior to commencing the activity.

3.3.5 Modelling and testing

Depending on the agreed analytical process(es), modelling or testing may have to be undertaken to assist in determining compliance.

Standards which set out how modelling or testing is undertaken should be observed once compatibility with the brief objectives has been established. Careful consideration must also be given to the ability of any testing body to provide an appropriate standard of confidence in the processes used and test data produced. Testing by an accredited testing body provides far greater certainty in the results than otherwise and may form a part of the agreed risk management strategy agreed by stakeholders within the brief.

Modelling is not as well-regulated as testing and as such careful consideration of this approach is required. The modelling inputs, modelling mode and other parameters must be available for review and independent verification, to support confidence in the outputs.

Alert:

Ultimately, agreed analytical processes may need to be reviewed if initial outcomes do not meet the agreed acceptance criteria.

3.4 Evaluate results

During the process of analysis, multiple trials or design scenarios may have been considered and analysed. The various evidence and design documents must be collated to allow the standard of conformity of the design to be properly evaluated, or assessed, against the acceptance criteria.

The evidence and design documents need to verify that the preferred design approach satisfies the agreed acceptance criteria, and in turn, meets the NCC Performance Requirements. The evaluation of results is therefore a critical component of the Performance Solution process.

The evaluation needs to take into account the agreed acceptance criteria for the analysis as set out in the brief. Further design iterations and analysis, modelling and/or testing may be required if the outcomes are not consistent with the agreed acceptance criteria.

3.5 Prepare a final report

3.5.1 Final Performance Solution report context

The final report is sometimes referred to as a Performance Solution report. Its prime purpose is to provide the means of verifying compliance with the NCC Performance Requirements. The appropriate authority will use the Performance Solution report for compliance assessment purposes.

Once a design proposal is approved, the final report can also support decision making processes during construction. It is an important tool providing information about the way that the building might perform during construction, not just in service. This can assist the construction team to understand important safety considerations for site personnel, the public and emergency services.

Post completion of construction, the final report can support consideration for authorisation of occupation, particularly through reference to identified inspection, hold and verification points. In addition to the final report identifying how the design conforms with the NCC, it will also provide a means of understanding how the construction is to be confirmed as conforming with the approved design and relevant regulatory, technical, and client specified requirements.

In service, the final report will also provide a valuable reference for building owners and occupants who are seeking to understand how the building will impact decisions about the provision of a safe workplace. It will also inform future plans to alter, re-purpose, or demolish the building and may set out specific maintenance or management requirements relevant to the particular solution.

3.5.2 Report preparation

The Performance Solution process may have considered a range of non-NCC matters, but the final report only needs to demonstrate that compliance with the NCC Performance Requirements outlined in the brief has been achieved. The content of a typical final report must comply with A2.2(4)(d) and may include:

- An overview of the brief, including:
 - Scope of the project

- Stakeholders
- Applicable NCC Performance Requirements and DTS Provisions
- NCC Assessment Method/s used
- Approaches to methods of analysis
- Any assumptions that were made
- Limitations
- Acceptance criteria agreed to by stakeholders
- Overview and outline of the analysis, modelling and/or testing carried out
 - Method of analysis used
 - Calculations and outcomes
 - The sensitivities, redundancies and uncertainty studies carried out
 - The results obtained and relevance to the brief
- Evaluation of results including:
 - Comparison of results with acceptance criteria
 - Any further sensitivity studies undertaken
 - Any expert judgement applied and its justification
- Conclusion
 - Specifications of the final design that are deemed to be acceptable
 - Confirmation that the NCC Performance Requirements/s were met
 - All limitations to the design and any conditions of use.

The conclusion of the final report must include key design decisions, assumptions and limitations that may affect future decisions for the building. For example, the inclusion/exclusion of sprinkler protection, design and working floor loads; smoke hazard management strategy etc.

3.5.3 Limitations and conditions

Conditions forming part of the final report are important and must be clearly communicated. Conditions may relate to specific design inclusions to be constructed, ongoing maintenance or management requirements, or post-occupancy requirements, such as a periodic inspection.

4 References

ABCB (Australian Building Codes Board) (2020) [Handbook: Fire Safety Verification Method](#) ABCB, accessed Jan 2021.

ABCB (Australian Building Codes Board) (2005) [International Fire Engineering Guidelines \(IFEG\)](#) ABCB, accessed Jan 2021.

ABCB (Australian Building Codes Board) (2019) [National Construction Code \(NCC\) Amendment 1 Complete Series](#) ABCB, accessed Jan 2021.

ABCB (Australian Building Codes Board) (2020) [Performance Solution process guidance document](#) ABCB, accessed Jan 2021.

APPENDICES



Appendix A Compliance with the NCC

A.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 an initiative of the Council of Australian Governments and is produced and maintained by the ABCB on behalf of the Australian Government and each state and territory government. 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 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.

A.2 Demonstrating compliance with the NCC

Compliance with the NCC is achieved by complying with the Governing Requirements of the NCC and relevant Performance Requirements.

The Governing Requirements are a set of governing rules outlining how the NCC must be used and the process that must be followed.

The Performance Requirements prescribe the minimum necessary requirements for buildings, building elements, and plumbing and drainage systems. They must be met to demonstrate compliance with the NCC.

Three options are available to demonstrate compliance with the Performance Requirements:

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

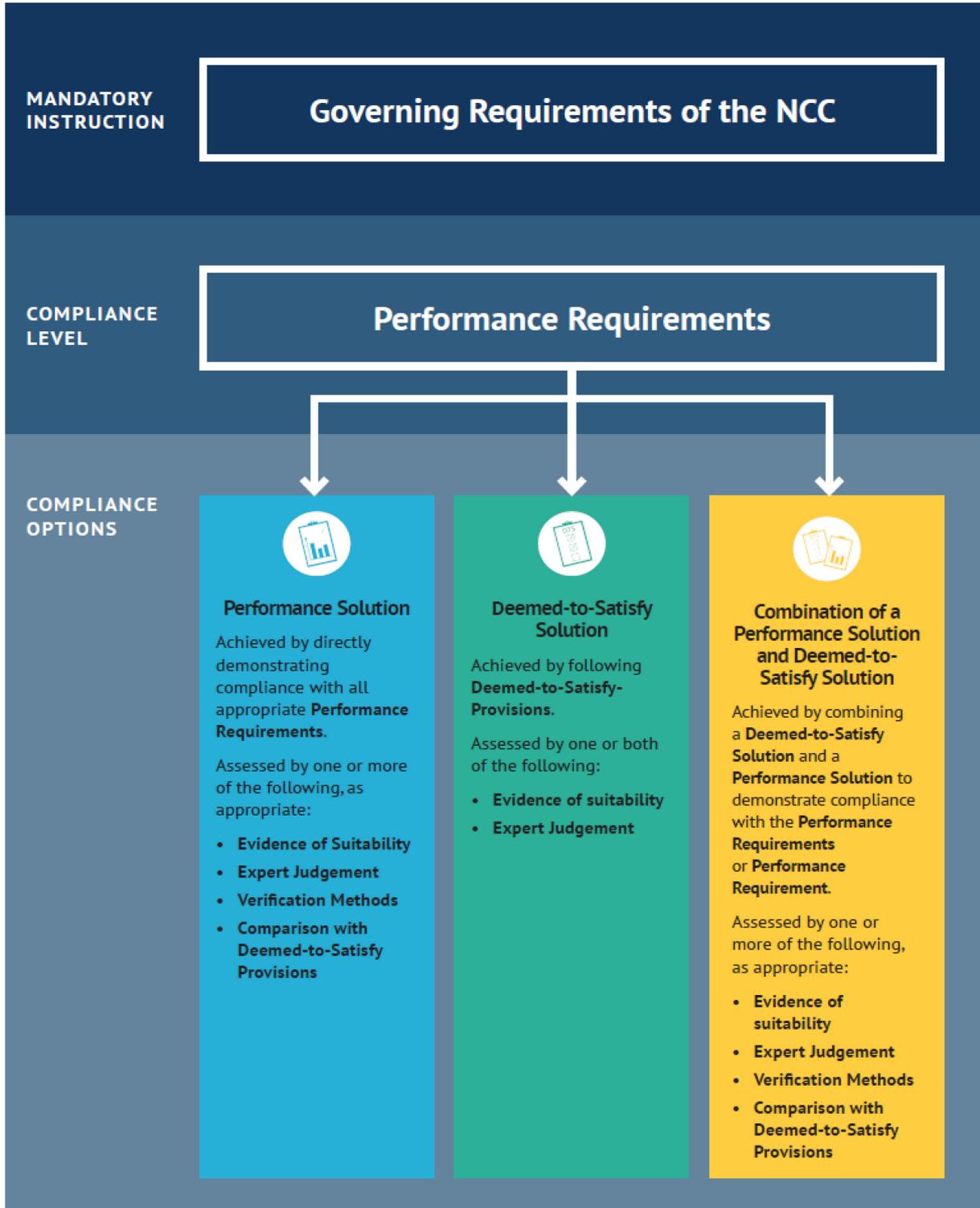
All compliance options must be assessed using one or a combination of the following Assessment Methods, as appropriate:

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

A figure showing hierarchy of the NCC and its compliance options is provided in Figure A.1. It should be read in conjunction with the NCC.

To access the NCC or for further general information regarding demonstrating compliance with the NCC visit the ABCB website (abcb.gov.au).

Figure A.1 Demonstrating compliance with the NCC



Appendix B Acronyms and symbols

The following table, Table B.1 contains acronyms and symbols used in this document.

Table B.1 Acronyms and symbols

Acronym/Symbol	Meaning
ABCB	Australian Building Codes Board
AIBS	Australian Institute of Building Surveyors
BCA	Building Code of Australia
DTS	Deemed-to-Satisfy
IFEG	International Fire Engineering Guidelines
IGA	Inter-government agreement
NCC	National Construction Code
PBDB	Performance-based design brief
PCA	Plumbing Code of Australia