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Calder, K.; Girault, M.; Beauchemin, C.; Adebar, P.; Chui, Y. H.; Kayll, D.; Robbins, A. P.; McFadden, J. B. W.; St-Onge, C.

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Summary of a Code Analysis of the National Building Code towards Performance-based Solutions

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Authors: K. Calder[1], M. Girault[1], C. Beauchemin[1],
P. Adebar[2],
Y.H. Chui[3],
D. Kayll[4],
A. P. Robbins[5], J. B. W. McFadden[5], and C. St-Onge[5]

[1] Senez Co.
[2] University of British Columbia
[3] University of Alberta
[4] Frontenac Building Science Inc.
[5] Construction Research Centre, National Research Council of Canada

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Executive Summary

This report provides a summary of the recommendations by the authors based on the results of a provision-by-provision analysis of select portions of the 2020 edition of the National Building Code of Canada (NBC 2020) [1]. The scope of the analysis was from the perspective of how the level of performance of Division B requirements may be clarified to better support the development and review of alternative solutions.

In alignment with the 2025-2030 code cycle work on the strategic priority of Performance-Based Solutions (PBS) [2] and draft mandate [3] of the National Model Code Committee on Performance-Based Solutions (NMCC-PBS) 2025-2030 code cycle, the analysis scope and subsequent recommendations for performance formulations of the requirements to be developed do not supplant the existing prescriptive requirements. That is, existing prescriptive requirements should remain and the new performance-based requirements would provide a parallel means of compliance for the acceptable solution requirement, within the current objective-based framework of the National Model Codes (NMCs).

The planning of this work occurred prior to the development of the scope of potential work for the National Model Codes 2025-2030 development cycle. Therefore, the efforts of the work summarized in this report were aligned as far as practical to help inform and accelerate the discussions on planning and initial work for 2025-2030 code cycle work on the strategic priority [2] of PBS. In addition, there may be some future-looking perspectives or aspects towards performance-based building and fire codes in Canada.

The following provides a high-level summary of select highlights from recommendations by the authors arising from the analyses of the three select areas of the NBC 2020 for clarification of performance targets, evaluation methods, and/or background rationale and assumptions used in the development of requirements that would improve the ease of development and review of alternative solutions.

Structural including Earthquake Design Related Key Requirements

Select key highlights of the recommendations for consideration (Section 4) include:

- Clarifying the performance objectives for buildings in different importance categories under different levels of earthquake hazard.
- Clarifying the quantitative performance targets (e.g., drift at the system level and damage at the components level) based on the performance of current existing SFRFs and expected performance targets.
- Providing a performance-based procedure for designs that are outside the scope of prescriptive requirements, including
    - An alternative seismic force resisting system (SFRS) that is not included in Table 4.1.8.9;
    - A building having an irregularity that is not included in Table 4.1.8.6.;
    - When two or more buildings are connected together;
    - Buildings on site with different soil conditions than assumed in the 6th Generation Seismic Hazard Model (CanadaSHM6).
- Clarifying the peer review requirements for performance-based design.
- Further clarifying performance-based requirements for seismic isolation and supplemental energy dissipation.

- Clarifying the assumptions and rationale and/or performance-based requirements for non-structural components and equipment.
- Transformation to performance-based standards and coordinating performance-based requirements in code and code referenced material design standards.
- Clarifying the rationale and engineering assumptions including loads underlying the prescriptive requirements on selected topics in Part 9.
- Clarifying the performance criteria (e.g., deflection and vibration) for span tables in Part 9 in coordination with code referenced standards (e.g., CSA O86).
- Clarifying the performance criteria for an alternative lateral load resisting system to demonstrate equivalent or better performance than the existing acceptable solutions in Part 9, i.e., light wood frame shear wall (braced wall panels).
- Clarifying the performance requirements in Part 9, where applicable, for topics such as adequate lateral support for columns and masonry walls, mortar mix, built-up beams and columns etc.
- Clarifying the limitations of Part 9 provisions for wood-frame construction in terms of whether "engineered components" includes prefabricated wood I-joist and Structural Composite lumber (SCL).

Fire Safety, Use and Egress, and Accessibility Related Key Recommendations

Select key highlights of the recommendations for consideration (Section 5) include:

- Clarification of the rationale and assumptions behind the requirements in general for all of the requirements in NBC Parts 3 and 9 related to fire safety, use and egress, and accessibility topics.
    - Revisit the content and update the current user's guide for Part 3 [4] that was last developed for the 1995 edition of the NBC, prior to the introduction of the alternative solution compliance path in the 2005 edition of the NBC [5].
- Consideration of the development of parallel high-level performance-based formulations of requirements was suggested to be as high as subsections for some areas.
- The development of parallel performance-based requirements was recommended for referenced test standards with prescriptive applications.
- While respecting the provision-by-provision analysis in the existing format, nearby provisions were grouped together for analysis, where appropriate; however, it was also noted that a broader collection of similar information may be beneficial to the clarity of the requirements and their application. Such consideration of the location of information may involve movement or reorganization of provisions and associated guidance. While this was generally noted for future considerations, the analysis and recommendations focused on the original scope.
    - For example, consideration of the risk characterization information that is scattered throughout Part 3 is recommended to be consolidated and included to facilitate the development of performance-based formulations of the requirements.
- A list of technical topics with detailed recommendations for clarification of performance target, evaluation method, and/or to expand on the current performance-based requirement.

- An overall recommendation is for fire safety, use and egress, and accessibility topics be considered for clarification for both Parts 3 and 9 applications at the same time, so that clarifications of the level of performance aspects, and/or rationale and assumptions are addressed in a holistic context.
    - In the context of a general assumption that the NBC Part 3 could provide the foundation for performance-based alternative solutions for Part 9 requirements, it is recommended that the rationale and assumptions for the Part 9 requirements could be clarified to include descriptions of the similarity or differences between Parts 3 and 9 that were used in the development of requirements.

Building Envelope, Energy Efficiency and Acoustic Related Key Recommendations

Select key issues (see Section 6) include:

Part 5 Environmental Separation

The majority of the provisions in Part 5 are *qualitative* in nature, as the overall performance intent is clearly identified but the method for calculating performance and confirming compliance is not provided.

The approach to develop further the performance-based provisions in Part 5 includes:

- Introduce a quantitative means for calculating environmental loads and their impacts on building materials, components, and assemblies, for provisions where requirements are of a qualitative nature, i.e., all Sections with the exception of 5.8. This would enable a consistent assessment against the resistance to deterioration compliance criteria for all proposed design solutions.
- Provide a quantitative approach for determining the acceptable level of resistance to deterioration in order to support consistent assessment of alternative solutions, since the means for assessment will be the same regardless of the solutions proposed. This would apply to all Sections except 5.8.
- Investigate the integration of a standardized, industry-accepted calculation methodology that provides criteria for the design and evaluation of assemblies and components. The objective is to provide consistent acceptable compliance criteria for developers and designers of materials, components, and assemblies to ensure they are fit for purpose and meet the objectives and functional statements of the Code.
- Consider using Section 5.8, Sound Transmission, as a reference format template for quantitative performance-based code provisions, as it provides both minimum performance-based requirements and methods for calculating design performance to demonstrate compliance.

Part 9 Housing and Small Buildings

In its current format, Part 9 uses many prescriptive solutions that have historical precedent for acceptable minimum levels of performance. However, the implicit performance of these prescriptive solutions is not well known. This means that innovation presented as alternative solutions to code compliance evaluators cannot be easily assessed to determine if they meet the minimum requirements of the applicable Code provisions.

In order to address this fundamental construct within Part 9, prescriptive provisions will need to be reviewed and the underlying performance criteria identified such that a “parallel performance path” can be developed to enable comparison of innovation to the prescriptive solutions.

The approach to develop performance-based provisions in Part 9 includes:

- Analyze the underlying performance criteria contained within the prescriptive solutions with the aim of identifying a clear minimum performance target for the provision, related to the objective and functional criteria for each provision;
- Consider using the NECB [33] format structure as a model to build parallel pathways to compliance;
- Clarify the significant number of undefined terms used in Part 9 that express a performance intent. This is needed to significantly improve the performance understanding of several provisions, establish more performance-based requirements and make demonstrating provision compliance achievable;
- Many provisions refer to “manufacturer’s installation instructions”. This creates an undefined performance gap that needs to be addressed by referencing installation standards instead;
- Include references to supplementary materials in the body of the Code where these materials provide the underlying performance intent; and
- For issues that are also addressed within Part 5, close coordination and cross referencing to Part 5 performance-based methodologies will improve harmonization.

This revision process will require careful planning and a rigorous framework over several code cycles. Prioritization of different aspects of Part 9 could be considered to allow for harmonization with other Parts of the Code. Given the breadth of the proposed recommendations, it may be advisable to first examine building products industries where innovative solutions are emerging (e.g., roofing, cladding, thermal insulation, sheathing membrane, fenestration, interior finishes), and in particular those industries developing innovative, low-GHG/carbon solutions, in order to identify priority areas of the Code where changes are needed.

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Purpose of Report

This report provides a summary of a provision-by-provision analysis of select portions of the 2020 edition of the National Building Code of Canada [1] from the perspective of how the level of performance of Division B requirements may be clarified to better support the development and review of alternative solutions. This work builds upon past efforts and was planned to support the initial discussions of the National Model Code Committee on Performance-Based Solutions (NMCC-PBS), to be launched during 2025.

While available information was used (see Section 1.1 for additional details), the efforts summarized here were started before the draft mandate [3] of the NMCC-PBS for the 2025-2030 code cycle was reviewed by the Canadian Board for Harmonized Construction Codes (CBHCC) or the draft workplan [6] was developed and refined. Furthermore, the preparation of this report was finalized before the launch of the NMCC-PBS in 2025. Therefore, while available information was used where possible to align work with the mandate of the NMCC-PBS for the 2025-2030 code cycle, caution is advised in the selection of sections of this report and the range of the perspective of the analysis used when considering this information in the context of the NMCC-PBS efforts.

Acknowledgements

The authors would like to acknowledge the funding support of the NRC Platform to Decarbonize the Construction Sector at Scale through the Construction Sector Digitalization and Productivity (CSDP) Challenge Program [7].

The authors would also like to acknowledge the support from Standards Council Canada (SCC) and CSA Group for providing access to code referenced standards during the analysis.

Warm appreciation is also extended to the expertise and support of Roger Pilkey and Hidaya Sekkal, of the Information Systems Unit within Codes Canada, who worked with the team to provide the National Model Codes (NMCs)-related analysis-inputs in a usable electronic format.

Furthermore, the planning and alignment, as far as practical, with the National Model Code Committee on Performance-Based Solutions (NMCC-PBS) would not have been possible without the ongoing collaboration with Codes Canada. We would like to extend particular thanks, for useful and timely guidance and advice, to Nick Gazo and Corey Carson, who are the Regulatory Solutions Technical Advisors to co-lead the NMCC-PBS, and Greg Fairthorne, as the Manager of the Regulatory Solutions team.

List of Acronyms

Acronym	Definition
CBHCC	Canadian Board for Harmonized Construction Codes
CCBFC	Canadian Commission on Building and Fire Codes
CSDP	Construction Sector Digitalization and Productivity
HCDS	Harmonized Code Development System
LCRF	Low-Carbon Regulatory Framework
NBC	National Building Code [of Canada]
NMCs	National Model Codes
NMCC	National Model Code Committee
NMS	[Canadian] National Master Construction Specification
NRC	National Research Council of Canada
PBR	Performance-based Regulations (a CSDP theme)
PBS	Performance-Based Solutions (a CBHCC approved strategic priority)
SSSB	Self-Service Storage Buildings (see NBC 2020, Division B Section 3.9 for context)

1. Introduction

This report provides a summary of a provision-by-provision code analysis performed for areas of the 2020 edition of the National Building Code of Canada (NBC) [1] that are most relevant to the application of low-carbon solutions to identify whether requirements were prescriptive-based or performance-based with the intent to map opportunities for clarification of the intended performance targets and/or assessment methods. The details of the analysis summarized in this report will provide a link between these results and current code requirements that could contribute to two major aspects:

- To support and accelerate initial discussions on the approved Canadian Board for Harmonized Construction Codes (CBHCC) strategic priority [2] of Performance-Based Solutions (PBS) and work planned for the 2025-2030 code cycle, as far as practical to align; and
- A mapping of the current requirements that could be used as a starting point to track the progress of future code changes towards performance-based formulation of provisions wherein the performance requirements can be adopted in future codes.

1.1 Rationale

The work in this report builds on a preliminary analysis of 2015 edition of the NBC [8] Part 3 fire and life safety [9] and Part 4 earthquake design [10] provisions that were conducted in 2020-2022 as part of recent work [11, 12, 13] to investigate the feasibility of developing and introducing performance-based codes in the Canadian context. In addition, more recent efforts included external engagement workshops [14] that were intended to add to the results of the preliminary analyses by collecting inputs from the construction sector on challenges and potential technical topics that could support the development and review of alternative solutions. While the details of the preliminary analyses provide an initial list of technical topics that could be used to inform the planning for next steps, the comments shared by participants at the workshops provided more general input on the direction, with some confirmation of topics. Therefore, a refinement of the analyses would be beneficial to help inform the detailed planning of next steps that would support the overall efforts towards performance-based codes within the context of the plans for the Harmonized Code Development System (HCDS) for the next code cycle and beyond. Therefore, this work has been aligned with the future plans of the HCDS as next steps, as far as was practical at the time of the development and preparation of this report. The extent of this alignment and items for consideration are summarized in this document.

1.2 Report Scope

This report provides a summary of the results from a provision-by-provision analysis of select portions of the 2020 edition [1] of the NBC from the perspective of how the level of performance of Division B requirements may be clarified to better support the development and review of alternative solutions.

The clarification is limited to the consideration of a potential performance-based formulation that could be added in parallel with the existing prescriptive requirement; and therefore, to support increased flexibility in the framework of the objective-based code while maintaining the prescriptive requirements that National Model Codes (NMCs) users are familiar with.

The scope of the analysis was limited to a review of acceptable solution provisions of the NBC 2020 [1] Division B of:

- Part 3 for fire protection, use and egress, and accessibility requirements

- Part 4 for structural including earthquake design requirements
- Part 5 for and environmental separation requirements; and
- Part 9 for:
    - fire protection, use and egress, and barrier-free requirements
    - structural including earthquake design requirements
    - building envelope, energy efficiency and acoustic design requirements

This work was initiated with the intention to share it with the National Model Code Committee on Performance-Based Solutions (NMCC-PBS); however, the mandate [3] for the NMCC-PBS for the 2025-2030 code cycle was in development at the start of this work. In addition, the draft workplan [6] for the code cycle was also in development. Available information, including the approved strategic priority [2] of PBS, was used in the planning and development of this effort, so that the information generated by this work would be useful to inform and accelerate initial discussions at the initial meetings of the NMCC-PBS, as far as practical. However, the scope of the information included within the analysis and this summary may be broader than the mandate of the NMCC-PBS for the 2025-2030 code cycle, and this additional scope is summarized herein to be available for future discussions as well. Therefore, while alignment was intended, care is cautioned in the selection and consideration of the analysis perspective for application to the NMCC-PBS mandate.

Additional context for background is provided in Section 2.

2. Background

A brief background is provided in this section for the:

- Funding context, with the *NRC Platform to Decarbonize the Construction Sector at Scale*, Construction Sector Digitalization and Productivity (CSDP) Challenge Program and Low-Carbon Regulatory Framework (LCRF) (Section 2.1);
- An overview of the current National Model Codes (NMCs) structure and history, including the introduction of objective-based codes as step towards a future performance-based code framework (Section 2.2); and
- A description of the Harmonized Code Development System (HCDS) context for the alignment between the work summarized in this report and the planning of the work in the 2025-2030 code cycle on the strategic priority of PBS (Section 2.3).

2.1 Overview of the NRC Platform to Decarbonize the Construction Sector at Scale

The *NRC Platform to Decarbonize the Construction Sector at Scale* [17] responds to commitments made in the 2020 Government of Canada Strengthened Climate Plan, which aims to reduce total greenhouse gas (GHG) emissions by 40 to 45% below 2005 levels by 2030 and achieve net-zero emissions by 2050.

The construction sector is a significant producer of emissions in Canada, with more than 16 million residential/commercial buildings currently in use, accounting for 18% of Canada's total emissions [15]. To meet national targets, a paradigm shift in the construction sector is needed to transform this sector into a low-carbon, competitive ecosystem and enable increased productivity. It is therefore critical to foster faster development and deployment of low-carbon solutions, including lower carbon materials, products, systems,

design and construction methodologies for new construction as well as existing buildings and infrastructure. Governments, academia, and industry all have critical roles to play: government through regulation; academia through innovative and practical solutions and training; and industry through co-development and early adoption of new solutions.

As a leading organization that provides scientific solutions for industry, with working experience on informing the development of construction codes and standards, the NRC is delivering the Platform to Decarbonize the Construction Sector at Scale. Over the seven-year program, the Platform seeks to address the challenge of decarbonizing the construction sector through a comprehensive plan comprised of three transformational strategic areas:

1. Advancing a low-carbon regulatory framework;
2. Solutions for a low-carbon built environment; and
3. Solutions to increase sector digitalization and productivity.

2.1.1 Overview of the CSDP Challenge Program

The Construction Sector Digitalization and Productivity (CSDP) Challenge Program [7] has been established to support the NRC Platform to Decarbonize the Construction Sector at Scale with the objective to improve the construction sector's productivity and help Canada reach its climate change targets by accelerating the development and deployment of innovative low-carbon solutions in the sector. The CSDP Challenge Program recognizes that digitalization can increase productivity in the construction sector and that performance-based design and building requirements help drive innovation. Therefore, the success of this CSDP Challenge Program is linked to the capacity of the regulatory system to evaluate and accept new innovative construction solutions.

The National Model Codes (NMCs) (that consist of the National Building Code, National Plumbing Code, National Fire Code, National Energy Code for Buildings, and National Farm Building Code), developed by the Canadian Board for Harmonized Construction Codes (CBHCC), contain objectives related to health, safety, the protection of buildings from fire and structural damage, accessibility, and the protection of the environment for building construction in Canada. These model codes are a collection of acceptable solutions to achieve at least a minimum level of performance for the construction of buildings and houses in the areas defined by the objectives and functional statements attributed to them. The objective-based framework of the NMCs supports flexibility to consider innovative solutions through proposed alternative solution compliance path. At the introduction of the objective-based codes, it was acknowledged that acceptable solutions retained a mixture of performance and prescriptive requirements [16], and in many cases the performance targets are not defined precisely by the acceptable solutions. That can create a challenge to the introduction and validation of new innovative solutions that vary from the acceptable solutions, which could benefit from the clarification of the minimum performance targets and/or evaluation methods. The alternative solution compliance approach worked well in the past when construction technology and social needs were changing slowly; however, a more agile approach is needed to meet today's challenges and to increase the rate of change. Shifting towards a performance-based formulation in codes and standards is a critical component of the CSDP Challenge Program as it will provide flexibility in the selection of products, materials, systems and design for more comprehensive solutions. It will also foster a faster adoption of innovative low-carbon solutions to help achieve the outcomes of the *NRC Platform to Decarbonize the Construction Sector at Scale*.

2.1.2 Overview of Low-Carbon Regulatory Framework

The Low-Carbon Regulatory Framework (LCRF) is another strategic research area of the *NRC Platform to Decarbonize the Construction Sector at Scale* [17]. The LCRF will work with stakeholders to develop new low carbon requirements and implement them through standards, specifications, guidelines and publications such as the Canadian National Master Construction Specification (NMS) and the NMCs through activities including:

- Supporting the development of new language for the 2025 and 2030 editions of the NMCs that will enable the regulation of operational and embodied GHG emissions, respectively;
- Developing a low carbon guideline that considers life-cycle GHG emissions in federally funded construction projects;
- Updating the NMS to include low carbon solutions;
- Supporting the development and implementation of performance-based options, clarifying current requirements in the NMCs; and
- Enabling the digitalization of the NMCs and the NMS.

2.2 A Brief Overview of NMCs Structure and History

In brief, the current NMCs, including National Building Code, National Plumbing Code, National Fire Code, and National Energy Code for Buildings are objective-based codes, with the introduction of the objective-based framework starting in 2005 [5]. The objective-based codes provide two compliance options, namely to meet the acceptable solutions or to develop an alternative solution, that differs from the acceptable solutions but will perform “as well as” the applicable acceptable solutions.

The objective-based code format for the NMCs describes that most of the requirements in Division B are linked to three types of information:

- Objectives (normative information):
    - are entirely qualitative and are not intended to be used on their own in the design and approval processes.
- Functional statements (normative information):
    - are also entirely qualitative and are not intended to be used on their own in the design and approval processes.
- Intent statements [18] (informative information):
    - provide an explanation of how a specific requirement helps to achieve the attributed objectives and functional statements and are expressed in terms of risk avoidance and expected performance.
    - are for explanatory purposes and do not form a mandatory part of the Code provisions.

This information, with the acceptable solution requirements in Division B, is intended to facilitate the implementation of the NMCs with clarity of intent and to allow for flexibility in demonstrating code compliance. In addition, explanatory Notes in the Appendix at the end of each Part of the NMCs and user’s guide materials [19, 20, 21] (that are complementary publications in addition to the intent statements) provide additional informational content to help Code users understand and apply the provisions.

An alternative solution must meet at least the minimum level of performance required by the acceptable solutions for the areas described by the attributed objectives and functional statements. The descriptions of objectives, sub-objectives and functional statements are entirely qualitative; therefore, the applicable acceptable solution may provide the context for the intended level of performance. However, provisions may include prescriptive or performance-based targets, with values for these targets that are qualitative, quantitative, or a combination. In addition, the way to measure these values may or may not be defined. The associated intent statements may provide clarification of what a provision is intended to include or preclude; and therefore, they may assist the code user to establish a performance target for an acceptable solution. At the introduction of the objective-based code framework for the NMCs in 2005, it was acknowledged that acceptable solutions retained a mixture of performance and prescriptive requirements [14], and in many cases the performance targets are not defined precisely by the acceptable solutions. However, without a clearly quantified intended performance target and associated measurement method, it would be difficult to use a performance-based approach to evaluate a proposed design, which explains why other approaches are used, such as comparative or benchmark approaches [22, 23].

Furthermore, alternative solutions are considered code compliant only after approval by the authority having jurisdiction (AHJ) is achieved for the proposed solution for the project [24]. These solutions are developed, evaluated and reviewed to consider acceptance on a project-by-project basis. This case-by-case acceptance is not intended to provide a standard for compliance because of the focused and individual nature of this compliance approach. The onus to demonstrate compliance of an alternative solution lies with the builder, designer, building owner or their representative proposing the deviation from the acceptable solutions.

The introduction of an objective-based code was originally envisioned as a step or transition towards a performance-based code, which is based on specifying performance criteria as opposed to prescribing how each component is built to meet the requirements [25, 26]. A performance-based code can provide a framework for the evaluation of proposed designs to innovatively address the code in terms of systems, portions of buildings, or buildings, instead of a provision-by-provision approach of the details of compliance options [27]. Since the release of the 2005 edition of the NBC, little has changed to the overall structure of the code to make it more accepting of performance-based design. However, it has also been acknowledged that some parts of the codes might logically be left in prescriptive format, depending on the technical details and the community of code users [26]. Most code changes since then have focused on updating prescriptive provisions. Some code changes may have been used to consciously introduce or clarify acceptable solutions with better defined performance targets or improved quantification of the target.

2.3 Alignment with NMCC-PBS Mandate for the 2030 Code Cycle and Building on Previous Efforts

In preparation for the 2025-2030 code cycle, the CBHCC had approved a strategic priority [2] of PBS, and had started drafting and refining the mandate [3] and workplan [6] of the NMCC-PBS and the NMC Change Roadmap: Towards PBS [28].

The planning of this work occurred prior to the development of the scope of potential work for the National Model Codes 2025-2030 development cycle. Therefore, the work summarized in this report were aligned as far as practical to help inform and accelerate the discussions on planning for 2025-2030 code cycle work on the strategic priority [2] of PBS. In addition, there may be some future-looking perspectives or aspects towards performance-based building and fire codes in Canada.

The work summarized herein is intended to provide a starting point of a provision-by-provision review of areas of the 2020 edition of the NBC that could be shared with the NMCC. This information might be used to help identify topics to focus on, based on a starting map for where some level of clarification of a combination of performance target, assessment method, and/or rationale and assumptions behind the prescriptive requirements are recommended to support a performance-based formulation as a parallel option for compliance. These could then be considered to be added alongside the current acceptable solution that reflect the equivalent level of performance, with clear performance targets and evaluation methods. It is also noted that this report considered the review of acceptable solution provisions of a broader scope (Section 1.1) of provisions of the 2020 edition of the NBC compared to the draft mandate of the NMCC-PBS.

While the details of a potential future performance-based code framework for the NMCs would be decided through policy discussions within Harmonized Code Development System (HCDS); in general, performance-based codes and objective-based codes share many characteristics, but there are certain key differences [26]. Performance-based codes have performance requirements associated with the objectives; whereas the NMC objective-based code framework has levels of performance associated with the acceptable solutions. A performance-based code provides a framework for the evaluation of proposed designs to innovatively address the code in terms of systems, portions of buildings, or buildings [27], instead of a provision-by-provision approach of the NMCs objective-based codes.

Acknowledging a desire to support Code users' current applications of and familiarity with the NMCs in the objective-based framework, and the alignment, as far as possible considering the timing, with the scope of this planned 2025-2030 code cycle work [3, 6, 28] on the strategic priority [2] of PBS, it is highlighted that the recommendations for performance formulations of the requirements to be developed do not supplant the existing prescriptive requirements. It is also consistent with previous effort which calls for a gradual transition towards performance-based codes [26, 29, 14, 28]. Existing prescriptive requirements would remain and the new performance-based requirements would provide a parallel means of compliance for the acceptable solution, within the current objective-based framework of the NMCs. The scope and analysis approach follow this principle (Section 1.1 and 3).

3. Code Analysis Approach

The code analysis was performed on the following three areas of the 2020 edition [1] of the NBC:

- Part 3 and fire protection and egress related requirements in Part 9;
- Part 4 and structural including earthquake design related requirements in Part 9;
- Part 5 and environmental separation, acoustic, and energy related requirements in Part 9.

The information that was provided as input to the analysis was:

- NBC 2020 information:
    1. Part
    2. Subsection
    3. Subsection title
    4. Article
    5. Article title
    6. Sentence number
    7. Sentence text
    8. Functional statement and sub-objective
    9. Functional statement and sub-objective with associated intent statement [18]
    10. Appendix note

- NBC 2005 [5] information:
    11. Application statements, where applicable and mapped to the NBC 2020 provisions

The inputs numbered 1 to 6 above provide code references and allows for ease of sorting of the information. The smallest provision was considered at the sentence level, so clauses and sub-clauses were manually grouped based on the provision content. The input information numbered 7 to 11 provided the technical content that was analysed.

Each provision was initially analyzed for its type and structure. Type of provisions were characterized in three categories: i) scope; ii) risk characterization/load; or iii) solution in terms of core text or reference to a standard. The structure was identified as prescriptive, qualitative performance either actionable or non-actionable, quantitative performance either actionable or non-actionable. The focus of the analysis is recommended actions. The list of considerations for the analysis is included in Table 1.

For context, a short description of what is considered performance- and prescriptive-based formulation of acceptable solutions respectively is included here to help orientate the readers of the perspective used in the analysis.

Performance requirements focus on providing the performance targets and evaluation methods to evaluate the performance using analytical, or testing methods or in combination. This approach allows for greater flexibility in design and supports innovation, provided the intended performance of the proposed design can be demonstrated and validated. Examples include site-specific hazard assessments, nonlinear time-history analysis to demonstrate acceptable seismic behaviour, derivation of the design values of an alternative solution following the reliability-based principle, etc.

In comparison, prescriptive requirements focus on providing specific instructions on how a design should be done to achieve code compliance. These instructions could include specifying steps to be taken, detailed rules and/or use of specific materials, etc. Examples include R_dR_o factors and height limits for different seismic force resisting systems under different seismic zones, construction details such as fastener configurations, building size limits and construction type for fire safety requirements, exiting and egress (including exit design and maximum travel distance), etc.

It is also acknowledged that not all requirements should be written in a performance-based formulation. There may be specific reasons that some requirements were intentionally written prescriptively (e.g. specifying loads to be resisted).

The considerations (Table 1) were captured to help readers understand the perspective used when developing the recommendations. It is acknowledged that there is some subjectivity as to how “prescriptive” or “performance-based” a requirement might be, depending on the scale of provisions and comparison with other provisions.

This analysis was focused at the provision-by-provision level in the existing format, with nearby provisions grouped together for analysis, where appropriate; however, it was also noted that a broader collection of similar information may be beneficial to the clarity of the requirements and their application. This approach may involve movement or reorganization of provisions and associated guidance. While this was generally noted for future considerations, the analysis and recommendations in this report are focused on the provision level with comments indicating relevant requirements in other sections.

The key output from the analysis is the recommended action. A summary of the options for recommended actions is listed in Table 2. The recommended actions resulting from this analysis are intended to provide a starting point to support NMCC-PBS discussions and planning for topics in light of the drafted workplans [6]

for the 2025-2030 code cycle. And the comments section was used to capture additional insight, where possible.

Table 1 List of considerations used for analysis of information.

Consideration	Description
A. Type of provision	To identify the form of the information provided in each provision.
a. Scope	Describes the scope with signposts to the applicable provisions.
b. Risk characterization/ Load	Provides context, refining the scope for certain provisions or providing limits that should be applied (rather than the text describing a solution) or specifies loads to be resisted.
c. Solution i. Core text ii. Standard	To indicate whether the provision provides a solution as either: • Technical description for a solution (as i. “core text”), or • Reference to a standard (as ii “standard”).
B. Identified structure	To provide insight into the level of prescriptive or performance formulation of the technical solution in a provision.
a. Prescriptive	If the formulation of the technical solution is a prescriptive provision.
b. Performance i. Qualitative 1. Actionable 2. Non-Actionable ii. Quantitative 1. Actionable 2. Non-Actionable	If the formulation of the technical solution is a performance-based provision. Then whether the performance-based formulation is qualitative or quantitative, and if the requirement is actionable or not.
C. Recommended Action	A coded list of action options based on the analysis of each provision. A list of the coded options for recommended actions is included in Table 2.
D. Comments	An optional output, where notes from the analysis or additional context for the recommended action may be captured.

Table 2 List of options for recommended actions.

Coding	Recommended Action Options	Description
1	Leave as-is	Acknowledging that whether prescriptive or already having a performance-based formulation, there are provisions that would be recommended to leave as-is.
2	Leave as-is but standard is no longer available (or withdrawn) - update to new standard	The option to flag where a referenced standard has been withdrawn, so a review of alternative options would be recommended.
3	Performance-based requirements needed	Where the provision is prescriptive or performance-based but non-actionable, it would benefit from the clarification of the performance target and evaluation method.
4	Performance target need clarification	Where the provision would benefit from the clarification of the performance target.
5	Assessment method need clarification	Where the provision would benefit from the clarification of the evaluation method.
6	Rationale and assumptions behind the prescriptive requirements need clarification	Where the performance-based formulation of the provisions would benefit from the background or details of assumptions.
7	Expand further on the performance-based requirements	Where the provision is a combination of prescriptive and performance-based formulation, and would benefit from expanding further on the performance-based requirements.

This report provides a summary of the recommended actions that evolved from the results of the provision-by-provision analysis in the context of the NMCC-PBS 2025-2030 code cycle draft mandate [3]. Where a topic of interest is identified in this summary, it is recommended to refer to the analysis in excel format for more information.

Note that the recommendations for performance formulations of the requirements to be developed do not supplant the existing prescriptive requirements. Existing prescriptive requirements should remain and the new performance-based requirements would provide a parallel means of compliance for the acceptable solution. The recommended actions listed in Table 2 refer to whether an additional performance compliance path should be provided, and why and how the additional performance compliance path could be provided. Comments are also provided for the rationale of the recommended action and/or additional information.

The analysis goes beyond the scope of the CBHCC's approved strategic priority [2] on PBS for the 2025-2030 code cycle. Furthermore, not all identified topics would be possible to be worked on and/or completed during the 2025-2030 cycle. Therefore, the intent of the results of this analysis was to provide a starting point to inform and accelerate discussions by the NMCC-PBS to strategize a transition towards performance-based codes and to prioritize topics that can be worked on to support the workplan for the 2025-2030 code cycle.

4. Structural including Earthquake Design Requirements

4.1 Part 4

In total, 694 provisions were analyzed for the whole Part 4, among which 10% were identified where performance-based requirements could be clarified, added, or further developed. The summary of the code analysis for the seismic and structural design requirements is provided in Appendix A.

4.1.1 Earthquake design requirements

The CBHCC has identified the development of performance-based solutions, alongside prescriptive provisions, for the existing provisions relating to earthquake design, egress, and fire protection for the National Model Codes, a priority area for the 2030 cycle.

High-level summary of analysis

The current earthquake design requirements have four application paths:

1. A very simple procedure (current 4.1.8.1) that can be used only in regions of very low seismicity;
2. A simplified procedure for small and simple buildings meeting certain restrictions where the static analysis procedure is used with the design requirements; and,
3. A more general procedure where the dynamic analysis procedure is used with the design requirements.
4. A mostly performance-based procedure for seismic isolation and supplemental energy dissipation.

The current seismic design requirements are a mix of simple prescriptive requirements that have a limited scope of application and more general requirements that can be applied over a broader range of conditions. This mix of requirement types, plus the absence of clearly stated limitations of the design requirements, results in the prescriptive requirements sometimes being used beyond their limited scope.

A significant advantage of performance-based requirements is that they can be used over a broader range of conditions, i.e., they have much less limited scope compared to the simple prescriptive methods.

Some examples of where performance-based requirements would be particularly useful are:

- Design of a building with an innovative seismic force resisting system (SFRS) that is not codified (there are no known force modification factors Rd Ro).
- Design of a building that is very different, i.e., highly irregular building or a new type of irregularity.

- Design of a building on a site with different soil conditions than assumed in the 6th Generation Seismic Hazard Model (CanadaSHM6). Specific examples include a site with high impedance contrast or a site located above a significant sedimentary basin.

Suggestion

In total, 234 provisions were analyzed from Subsection 4.1.8 Earthquake Load and Effects, among which approximately 25% were identified as where performance-based requirements could be clarified, added, or further developed. Whether performance-based requirements should be clarified on a provision-by-provision basis, or where the prescriptive compliance path and the performance compliance path are provided in parallel at a higher level (like the structure of NBC 2020 Section 9.36 for energy efficiency), needs NMCC-PBS discussion. Suggestions for consideration are presented in Table 3 for the technical topics with indication of development work needed on a provision-by-provision basis, and are summarized in the following categories:

- Clarifying the performance objectives for buildings in different importance categories (normal importance, high importance, post-disaster buildings) under different level of earthquake event (2% in 50 years, 5% in 50 years and 10% in 50 years).
- Clarifying the quantitative performance targets (e.g., drift at the system level and damage at the components level) consistent with the performance of current existing SFRFs and expected performance targets. Damage at the components level may be more appropriately clarified in the corresponding material design standards.
- Providing a performance-based procedure for designs that are outside the scope of prescriptive requirements, including
    - An alternative seismic force resisting system that is not included in Table 4.1.8.9;
    - Unconventional form of building, i.e., unusual irregularity;
    - When two or more building are connected together;
    - Buildings on site with different soil conditions than assumed in the 6th Generation Seismic Hazard Model (CanadaSHM6).
- Clarifying the peer review requirements specifically needed for performance-based design.
- Further clarifying performance-based requirements for seismic isolation and supplemental energy dissipation.
- Clarifying the assumptions and rationale and/or performance-based requirements for non-structural components and equipment. A review of CSA S832 *Seismic risk reduction of operational and functional components (OFCs) of buildings* is recommended.

Table 3 Summary of recommendations by topic for performance-based requirements in Subsection 4.1.8.

Topic	Article	PB Requirements req' d (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Site properties	4.1.8.4	X					It is suggested to consider providing performance requirements for buildings on site with different soil conditions than

Topic	Article	PB Requirements req' d (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
							assumed in the 6th Generation Seismic Hazard Model.
Importance Factor	4.1.8.5	X					It is suggested to consider clarifying the performance objectives (life safety, immediate occupancy, or functional and operational) for normal importance, high importance, and post-disaster structures, and provide simple clear statements of the level of damage that is acceptable after a certain level of earthquake event. Suggest consider the PB requirements in combination with Sentences 4.1.8.10.(2) - (3), and 4.1.8.23.(2) – (6).
Structural configuration - irregularity	4.1.8.6	X					
R_dR_O factors and general restrictions	4.1.8.9	X					
Additional system restrictions	4.1.8.10	X					Suggest consider the PB requirements in combination with Sentences 4.1.8.5.(1), and 4.1.8.23.(2) – (3) for high importance and post-disaster buildings.
Dynamic analysis procedure	4.1.8.12	X					General procedure for NLDA needed for PBD. Suggest clarify peer review requirements for NLDA.
Structural separation	4.1.8.14	X					Suggest add PB requirements for connected buildings.
Foundation	4.1.8.16		X				Suggest clarify acceptable limits for increased displacement of the structure due to foundation movement.
Site stability	4.1.8.17		X				Suggest clarify acceptable levels of displacement or deformation.
Non-structural component	4.1.8.18	X	X	X	X		

Topic	Article	PB Requirements req' d (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
s and equipment							
Seismic isolation	4.1.8.19	X					
Seismic isolation design provisions	4.1.8.20					X	Suggest clarify the validation criteria by testing and testing protocol including number of specimens.
Supplemental energy dissipation	4.1.8.21	X				X	
Supplemental energy dissipation design considerations	4.1.8.22	X				X	Suggest clarify the validation criteria by testing and testing protocol including number of specimens.
Additional performance requirements	4.1.8.23	X					Suggest consider PBD requirements in combination with 4.1.8.5.(1) and 4.1.8.10.(2) – (3).

Appendix D provides suggested high-level grouping of performance-based earthquake design requirements.

Example requirements currently being used for performance-based seismic design in the U.S. can be found in LATBSDC "An Alternative Procedure for Seismic Analysis and Design of Tall Buildings" [30] and PEER "Guidelines for Performance-Based Seismic Design of Tall Buildings" [31].

4.1.2 Other than earthquake design

Structural design subsections other than earthquake design are beyond the scope of the NMCC-PBS priority for the NBC 2030. Selected suggestions based on provision-by-provision analysis are summarized in Table 4. NBC refers to material design standards for design requirements for structural materials (Section 4.3). The Standards Development Organizations and Technical Committees that are responsible for the material

design standards will need to produce the reference documents that provide guidance on material specific structural systems.

Table 4 Summary of recommendations and comments by topic for performance-based requirements in Part 4.

Topic	Article	Update standard (2)	PB Requirements req'd (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both & Comments
Structural Loads and Procedures - General	4.1.1							This section has mostly qualitative actionable performance-based requirements. It also has references to Standards and scope statements.
Specified Loads and Effects	4.1.2							This section has definitions, and very few requirements.
Limit States Design	4.1.3		X				X	Suggest consider clarifying a method to derive resistance factors to achieve a clarified target reliability index for all structural materials and components. (4.1.3.2.(1)) Regarding deflection requirements, suggest consider clarifying the performance targets for occupants' comfort and operational performance objectives under service wind load, such as peak acceleration limits for occupants' comfort performance objective. (4.1.3.5)
Dead loads	4.1.4							This section has definitions, some statements with simplified prescriptive requirements, as well as many qualitative actionable performance-based requirements.
Live Loads Due to Use and Occupancy	4.1.5							This section primarily defines the loads (risk characterization). There are some statements with simplified prescriptive requirements, as well as many qualitative actionable performance-based requirements. It is not

Topic	Article	Update standard (2)	PB Requirements req'd (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both & Comments
								expected to have performance-based requirements being developed in place of these requirements in the near future. Suggest consider clarifying how to determine transitory portion and sustained portion of the live load.
Loads Due to Snow and Rain	4.1.6				X			This section defines loads (risk characterization). It is almost entirely prescriptive requirements. It is not expected to have performance-based requirements being developed in place of these requirements in the near future. Regarding accumulation factor for snow load, suggest consider adding an Annex Note that links to the Structural Commentary which provides guidance on how to determine the accumulation factor for shapes not addressed in the Code. (4.1.6.2.(9))
Wind load	4.1.7						X	This section defines loads (risk characterization), and is almost entirely prescriptive requirements. Work has begun in the United States to develop performance-based requirements for wind design, primarily for tall buildings. It may be possible to have some very limited performance-based requirements for wind design in NBC in the near future. See comment on 4.1.3. Regarding dynamic procedure, suggest validate/provide damping

Topic	Article	Update standard (2)	PB Requirements req'd (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both & Comments
								ratio in gust effect factor calculation for other material systems that are recently allowed in high rise buildings such as mass timber. (4.1.7.8.(4))
Earthquake load and effects	4.1.8	X	x	X	X	X	X	See Table 3
Materials used in foundations	4.2.3		X					Regarding steel piles, suggest consider clarifying performance requirements for alternative materials not listed in the Code, as well as what is considered adequate protection against corrosion, reference to standards for galvanized steel, and/or sacrificial thickness based on corrosion rate? (4.2.3.8, 4.2.3.10)
Deep foundations	4.2.7							Suggest consider clarifying the criteria for adequate lateral support. Simply being in contact may not be considered as adequate lateral support such as soft soil or liquefaction-prone soils. (4.2.7.2)
Wood	4.3.1							Work is to be coordinated with CSA on performance-based standard.
Plain and reinforced Masonry	4.3.2							Work is to be coordinated with CSA on performance-based standard.
Plain, reinforced and pre-stressed concrete	4.3.3							Work is to be coordinated with CSA on performance-based standard.
Steel	4.3.4							Work is to be coordinated with CSA on performance-based standard.
Aluminum	4.3.5							Work is to be coordinated with CSA on performance-based standard.

4.2 Part 9 – Structural including Earthquake Design related Requirements

4.2.1 High-level summary of analysis

In total, 1140 provisions were analyzed for structural including earthquake design related requirements in Part 9, among which approximately 15% were identified where performance-based requirements could be clarified, added, or further developed. The summary of the code analysis for the structural including earthquake design requirements is provided in Appendix A. Part 9 requirements are mostly prescriptive which are practical for houses and small buildings. However, addition of performance compliance path would support the use of innovative products/systems in Part 9 applications which will contribute to affordable housing particularly when there is supply chain issues. In general, there is always the option of performing an engineered design in accordance with Part 4 but using the Part 9 loads. Selected suggestions based on provision-by-provision analysis are summarized in Table 5, and can be categorized in the following categories:

Clarifying the rationale and engineering assumptions including loads underlying the prescriptive requirements. Depending on what can be achieved for this code cycle, in many cases, clarification of assumptions and rationale behind the prescriptive requirements would be a useful first step towards development of performance requirements, and would benefit the design and review of alternative solutions. Topics include those where pre-engineered solutions are provided, such as footings, foundation walls, studs size and spacing, fastener schedule, anchorage, earthquake reinforcement for masonry walls, span tables for lintels supporting masonry veneer, span tables for lintels in ICF walls, etc. Clarification of rationale and assumption would support the development and review of alternative solutions such as innovative fasteners and connectors and innovative masonry walls. It will also address the concern when the provisions are extrapolated/applied where the assumptions are not valid, such as where the loads are exceeded.

Clarifying the performance criteria (e.g., deflection and vibration) for span tables in Part 9 in coordination with code referenced standards (e.g., CSA O86). This will support the development of pre-engineered solutions for I-joists and Structural Composite Lumber in Part 9 applications.

Clarifying the performance criteria for an alternative lateral load resisting system to demonstrate equivalent or better performance than the existing acceptable solutions. For example, the acceptable solution for the lateral load resisting system in wood construction is a conventional wood frame shear wall (braced wall panels). Many innovative systems have been used as the lateral load resisting systems, such as wood sheathing with SCL studs, insulated sheathing and Structural Insulated Panels (SIPs) which are currently following the alternative solution pathway. The clarification of equivalency criteria to conventional wood frame shear wall will support the development and review of alternative solutions. Other examples include the minimum performance level provided by the acceptable solutions of subflooring and roof sheathing, and masonry walls using alternative ties that are as strong and durable.

Clarifying the performance requirements, where applicable, for topics such as adequate lateral support for columns, and masonry walls, mortar mix, built-up beams and columns.

Clarifying the limitations of Part 9 provisions for wood-frame construction. Suggest consider Article 9.23.1.1 in combination with Article 9.3.2.1 whether “engineered components” includes prefabricated wood I-joist and Structural Composite lumber (SCL). Wood I-joist and SCL have been used in Part 9 buildings for decades.

4.2.2 Suggestions

In alignment with the mandate of PBS strategic priority for the 2025-2030 code cycle, the following earthquake design related topics (highlighted in green in Table 5) are suggested for consideration:

- Clarifying the performance criteria for demonstrating equivalency to conventional wood frame shear wall (braced wall panels);
- Clarifying the rationale and engineering assumptions including loads and/or performance requirements for earthquake reinforcement of masonry walls (Subsections 9.20.1 and 9.20.15);
- Clarifying the rationale and engineering assumptions including loads and/or performance requirements for nailing to framing schedule and fasteners for sheathing and subflooring, which are part of, or transferring loads to the lateral load resisting system.

Table 5 Summary of recommendations and comments by topic for performance-based requirements in Part 9 structural including earthquake design requirements.

Topic	Article	Update standard (2)	PB Requirements req'd (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Concrete	9.3.1.			X		X		Clarification of rationale and assumptions behind the prescriptive requirements for concrete mixes and air entrainment. (9.3.1.6., 9.3.1.7.)
Lumber and wood products	9.3.2.						X	Suggest consider adding Engineered Wood Products such as wood I-joist and Structural Composite Lumber. (9.3.2.1.)
Deflections	9.4.3.						X	Suggest consider reviewing the deflection limits in light of changes in 5.4.2 in CSA O86-24.
Foundation conditions (geotechnical)	9.4.4.		X			X		Suggest consider clarifying i) the background of pressure distribution angle (9.4.4.2.); and ii) limit for soil movement (9.4.4.4.).
Backfill	9.12.3.			X				
Foundations (materials and design)	9.15.2.					X		Rationale and assumptions behind the pier-type foundations. (9.15.2.3.)
Footings	9.15.3.			X		X		Suggest consider clarifying the engineering assumptions including loads behind the prescriptive requirements for minimum footing sizes and adjustments. (9.15.3.4., 9.15.3.5., 9.15.3.6.)

Topic	Article	Update standard (2)	PB Requirements req' d (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Foundation walls	9.15.4.		X	X		X		Suggest consider clarifying i) the engineering assumptions including loads behind the prescriptive requirements (9.15.4.2., 9.15.4.5.); ii) criteria to be considered laterally supported (9.15.4.3., 9.15.4.4.); and iii) criteria for crack control joints (9.15.4.9.).
Hydrostatic pressure – floor-on-ground	9.16.3.		X					
Concrete floors-on-ground	9.16.4.			X				
Columns - general	9.17.2.			X				Suggest consider clarifying the connection stiffness requirement to the supported member in terms of maximum lateral differential movement allowed, and criteria for lateral support. (9.17.2.2.)
Steel columns	9.17.3.	X						The standard for adjustable steel columns needs updating as it still uses allowable stress design. (9.17.3.4.)
Wood columns	9.17.4.		X					Suggest consider clarifying the performance requirements for built-up columns using alternative fasteners, e.g., requirements for connections so that loads can be sufficiently transferred between plies and the built-up column will deflect as a unit, or refer to Part 4. (9.17.4.2.)
Unit masonry columns	9.17.5.					X		
Solid concrete columns	9.17.6.					X		
Masonry walls - Earthquake reinforcement	9.20.1					X		Suggest consider clarifying the engineering assumptions including loads behind the prescriptive requirements for earthquake reinforcement in combination with 9.20.15. (9.20.1.2.)
Masonry units	9.20.2.		X					

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Topic	Article	Update standard (2)	PB Requirements req' d (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Mortar	9.20.3		X					Suggest consider adding performance requirements to allow for low carbon masonry mortar mix. (9.20.3.2.)
Masonry support	9.20.5.					X		Suggest consider clarifying the engineering assumptions including loads and deflection requirements used in the development of maximum allowable spans. (9.20.5.2.)
Thickness and height of masonry walls	9.20.6.			X				
Support of loads	9.20.8.					X		
Bonding and tying	9.20.9.		X					Suggest consider adding performance requirements for masonry walls using alternative ties that are as strong and durable. (9.20.9.4.) Suggest consider clarifying the engineering assumptions including loads used in development of the prescriptive requirements for ties for masonry veneer. (9.20.9.5.)
Lateral support	9.20.10.		X					Suggest consider adding performance requirements for what constitutes adequate lateral support.
Anchorage of roofs, floors and intersecting walls	9.20.11.	X	X	X		X		Suggest consider clarifying i) the equivalency criteria for alternative anchors and ties (9.20.11.1., 9.20.11.2.); and ii) engineering assumptions including loads behind prescriptive anchoring requirements (9.20.11.3., 9.20.11.4.).
Reinforcement for earthquake resistance	9.20.15.					X		Suggest consider clarifying the engineering assumptions including loads behind the prescriptive requirements for earthquake reinforcement in combination with 9.20.1.
Above-ground flat insulating concrete form walls	9.20.17.					X		Suggest consider clarifying the engineering assumptions including loads and criteria in developing the span tables for lintels, and anchor bolts.

Topic	Article	Update standard (2)	PB Requirements req' d (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Masonry and concrete chimney construction	9.21.4.						X	
Wood-frame construction - limitations	9.23.1.						X	Suggest consider clarifying whether "engineered components" includes I-joist and Structural Composite lumber in combination with Article 9.3.2.1. Wood I-joist and Structural Composite Lumber have been used in Part 9 buildings for decades.
Fasteners and connectors	9.23.3.		X			X	X	Suggest consider clarifying the engineering assumptions including loads resisted behind the prescriptive nailing to framing schedule. Suggest consider clarifying the performance requirements for fasteners for sheathing or subflooring (9.23.3.4.).
Maximum spans	9.23.4.				X	X	X	Suggest coordinate performance requirements in the code and code referenced standards (CSA O86) (9.23.4.2.). Suggest consider clarifying the engineering assumptions including loads used in development of the prescriptive requirements for steel beams (9.23.4.3.). Suggest consider clarifying the method to reduce span when heavier materials are used (9.23.4.4, 9.23.4.5).
Anchorage	9.23.6.			X			X	Some requirements are revised in NBC 2025 (9.23.6.1.). Suggest consider clarifying how much uplift and lateral movement are considered acceptable for anchorage of columns and posts (9.23.6.2.).
Beams to support floors	9.23.8							Suggest consider clarifying the performance requirements for built-up beams to allow for built-up beams made of Structural Composite Lumber such as LVL (9.23.8.3.).

Topic	Article	Update standard (2)	PB Requirements req' d (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Floor joists	9.23.9.			X				
Wall studs	9.23.10					X		Suggest consider clarifying the engineering assumptions including loads used in development of the prescriptive requirements for studs size and spacing, which will avoid some heavy cladding or roofing materials being used exceeds the studs load carrying capacity.
Framing over openings	9.23.12.				X			Suggest coordinate performance requirements in the code and code referenced standards (CSA O86).
Bracing to resist lateral loads	9.23.13.					X	X	Suggest consider clarifying performance criteria for innovative lateral load resisting systems to demonstrate equivalent or better performance than the conventional wood frame shearwall (braced wall panels).
Roof and ceiling framing	9.23.14.					X		
Subflooring	9.23.15.		X					Suggest consider clarifying the performance requirements for subflooring, or minimum performance level provided by the acceptable solutions, in terms of resistance under uniform load, concentrated load and impact load, as well as deflection. (9.23.15.1.)
Roof sheathing	9.23.16.		X					Suggest consider clarifying the performance requirements for roof sheathing, or minimum performance level provided by the acceptable solutions, in terms of lateral loads, wind pressure, as well as deflection. (9.23.16.1.)
Slope of roofed surfaces	9.26.3.			X	X			Suggest consider clarifying qualitative statements.
Attachment of cladding	9.27.5.				X	X		
Lumber siding	9.27.6.			X				
Gypsum board finish	9.29.5.		X				X	

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Topic	Article	Update standard (2)	PB Requirements req'd (3)	Targets (4)	Method (5)	Rationale & Assumption (6)	Expand on PB requirements (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Particleboard, OSB or waferboard finish	9.29.9.					X		

5. Fire Safety, Use and Egress, and Accessibility Related Review Insights

Insights and recommendations based on the NBC Parts 3 and 9 provision-by-provision analysis that considers the description of the strategic priority [2] of PBS and was intended to align with the draft mandate [3] of the NMCC-PBS 2025-2030 code cycle are summarized in this section.

A summary of the results of the analysis is provided in the follow sections, starting with themes arising in both NBC Parts 3 and 9, then for topics in Parts 3 and 9 in the following two sections respectively.

A visual summary of the code analysis for the fire safety, use and egress, and accessibility related requirements is provided in Appendix B, with detail provided for Part 3 (Table 14 and Table 15) and for Part 9 (**Error! Reference source not found.**).

5.1 Common Themes for Parts 3 and 9

The following summarizes recommendations that arose from the consideration of the provision-by-provision analysis results for NBC Parts 3 and 9, where existing requirements could be clarified by developing performance formulations of the requirements without supplanting the existing prescriptive requirements (as described in Section 3).

Parallel performance-based formulation added to existing prescriptive requirements

Within the scope and limitations of this analysis, where potentially practical, grouping of provisions would be recommended, with performance-based formulations being provided for the highest level of the grouping, where possible (i.e., at the clause-, sentence-, article-, subsection-, or section-level). Furthermore, a reorganization or restructuring of the existing prescriptive requirement could also be beneficial for clarity. Some general recommendations are included e.g., based on the observation of the locations of provisions that describe risk characterization, as discussed in a theme below and in Sections 5.2 and 5.3), but this is limited since it was not within the scope of this analysis.

Clarification of the rationale and assumptions behind the requirements

Rationale and assumptions that were used in the development of current requirements are not part of the normative information of the NMCs, this information may be found in the informative materials of the explanatory Notes in the Appendix at the end of each Part and the user's guide associated with each Part. While the detail of the user's guides was not part of this analysis, it was noted that the rationale and assumptions are rarely included in the informational materials. The application of the acceptable solutions is typically the focus of the guidance included. Therefore, without a performance-based formulation of a requirement explicitly included in Division B, information to support the ease of the development and review of an alternative solution has not typically been included. Therefore, a general recommendation was raised for all of the requirements in NBC Parts 3 and 9 for the clarification of the rationale and assumptions behind the prescriptive requirements. That is, Code 6 of Table 2 is recommended to apply to all of NBC Parts 3 and 9 requirements. The details of related supplementary materials are included in the respective following sections for NBC Parts 3 and 9.

Subsections for parallel high-level performance-based formulations

Some subsections were recommended to be considered for the development of a high-level performance-based formulation in parallel with the existing primarily prescriptive requirements at the subsection level. The details of which subsections are listed in the respective following sections for NBC Parts 3 and 9.

Parallel performance-based requirements for referenced test standards with prescriptive applications

While some referenced test standards may provide a "performance" option, most are prescriptive in terms of their application to construction. Therefore, the recommendation is that these should remain; however, the prescriptive nature of their reference and content should be considered in the development of parallel performance-based requirements. Note that planning and development of such work would be recommended to be coordinated with standard development organizations.

Information in Division A with risk characterization information

The information contained in NBC 2020 Division A Article 1.3.3.4. on building size determination is recommended to be moved to Division B to support consistent location of risk characterization information. (See also Risk characterization information in Section 3.)

5.2 Part 3 – Fire Safety, Use and Egress, and Accessibility

Clarification of the rationale and assumptions behind the requirements

Building on the common theme introduction, a general recommendation was raised for all of the requirements in NBC Part 3 for the clarification of the rationale and assumptions behind the prescriptive requirements. While appendix notes within the NBC have been updated with proposed changes, this recommendation also acknowledges the current state of the supplementary materials for the *User's Guide – NBC 1995 Fire Protection, Occupant Safety and Accessibility (Part 3)* [21] would benefit from revision and updating to reflect the code changes since the preparation of this current version in 1996 and to summarize the background for the development of requirements and guidance information that would be useful for the development and review of alternative solutions, that was introduced as a new code compliance path in the 2005 edition [5]of the NBC.

Risk characterization information

During the analysis it was noted that elements of "risk characterization" (A. Type of provision, B. risk characterization/ Load in Table 1) are scattered throughout Part 3 and included the definitions of words and phrases (Division A, Subsection 1.4.1.). Such risk characterization includes and is not limited to how to classify buildings based on use and occupancy to then determine what code requirements apply, what is included or not in certain classifications in addition to the descriptions for defined terms, additional qualitative and quantitative details of presence, maximum or minimum sizes, capacities or limits of elements of various hazards, etc. Examples of such elements may include a building required to be of noncombustible construction, a maximum permitted building height, limited to storage with fixed installation, type and maximum amount of materials permitted to be stored, etc. In particular, it was noted that Subsection 3.1.2. is almost all risk characterization information rather than containing direct solutions.

While restructuring the provisions is beyond the scope of this analysis (see Section 3), this risk characterization information is recommended to be included to facilitate the development of performance-based formulation of the requirements. While associated with applicable provisions within the current framework, at least a working consolidation of the risk characterization information would be suggested to help address clear and consist application when working towards the clarification of existing provisions, with clear indication of how these apply to each provision (e.g., if consistent or there are variations). An appropriate structure for where to locate this type of information within the NBC is suggested to be considered in conjunction with broader goals of a future transition towards performance-based codes.

Subsections for parallel high-level performance-based formulations

Building on the common theme introduction, while reviewing the information provision-by-provision, the highest level of code structure was generally considered where a performance path might be located in parallel with current acceptable solutions. For example, this might be at a sentence, article, sub-section or section level. For comparison, the parallel performance and prescriptive paths for the tiered energy requirements in NBC 2020 are located at the subsection level (see NBC 2020 Part 9 Subsections 9.36.7. and 9.36.8). Based on the results of the review, NBC Part 3 subsections that are recommended to be considered for the development of a high-level performance-based formulation in parallel with the existing primarily prescriptive requirements are:

- For the consideration of construction type:
  - Subsection 3.1.4. for combustible construction;
  - Subsection 3.1.5. for noncombustible construction;
  - Subsection 3.1.6. for encapsulated mass timber construction; and
- Subsection 3.2.3. for spatial separation and exposure protection.

Attributions for building size and construction relative to occupancy in Subsection 3.2.2.

Considering the current framework of the NBC, for existing requirements in Subsection 3.2.2., for building size and construction relative to occupancy, the development of Objectives, Functional Statements and Intent Statements attributed to the height and area limits are recommended.

A selection of technical topics with recommendations for level of performance clarifications

Recommendations to clarify the performance target, evaluation method or to expand on current performance-based requirements are suggested for the technical topics listed in Table 6.

Table 6 Summary of recommendations by topic for clarification of the performance target, evaluation method or to expand on current performance-based requirements.

Topic	Sub-section	Requirements (3)	Target(s) (4)	Method(s) (5)	Expand (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Classification of buildings by major occupancy	3.1.2.					Building on the current industrial occupancies defined based on a quantified combustible content, it is suggested to clarify other major occupancies utilizing the same type of quantified characterization as part of the definition.
Combustible construction	3.1.4.	x		x		Suggestion for high-level performance-based formulation at the subsection level.
Noncombustible construction	3.1.5.	x				Suggestion for high-level performance-based formulation at the subsection level.

Topic	Sub-section	Requirements (3)	Target(s) (4)	Method(s) (5)	Expand (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Encapsulated mass timber construction	3.1.6.	x				Suggestion for high-level performance-based formulation at the subsection level.
Fire separations and closures	3.1.8.	x		x		
Firewalls	3.1.10.	x		x		
Fire blocks in concealed spaces	3.1.11.	x		x		
Interior finish	3.1.13.	x			x	
Roof assemblies	3.1.14.	x				
Roof covering	3.1.15.	x				
Occupant load	3.1.17.	x				
General building fire safety	3.2.1.	x				
Building size and construction relative to occupancy	3.2.2.	x				
Spatial separation and exposure protection	3.2.3.					Suggestion for high-level performance-based formulation in parallel with the existing primarily prescriptive requirements at the subsection level.
Fire alarm and detection systems	3.2.4	x		x	x	

Topic	Sub-section	Requirements (3)	Target(s) (4)	Method(s) (5)	Expand (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Provisions for firefighting	3.2.5		x	x	x	
Additional Requirements for high buildings	3.2.6		x	x	x	
Mezzanines and openings through floor assemblies	3.2.8			x		
All floor areas	3.3.1		x	x	x	
Assembly occupancy	3.3.2	x		x		
Care, treatment or detention occupancies	3.3.3	x				
Residential occupancy	3.3.4	x		x		
Industrial occupancy	3.3.5	x		x		
Design of hazardous areas	3.3.6	x	x	x		
General exits	3.4.1			x		
Number and location of exists from floor areas	3.4.2			x		
Exit signs	3.4.5			x		
Types of exit facilities	3.4.6		x	x		

Topic	Sub-section	Requirements (3)	Target(s) (4)	Method(s) (5)	Expand (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
Fire escapes	3.4.7		x			
Dimensions and signs	3.5.4			x		
Service rooms	3.6.2			x		
Vertical service spaces and service facilities	3.6.3		x	x		
Horizontal service spaces and facilities	3.6.4			x	x	
Air duct and plenum systems	3.6.5			x	x	
Height of rooms	3.7.1			x		
Plumbing facilities	3.7.2.			x	x	
Design for accessibility	3.8.3.			x		
General requirements for self-service storage buildings (SSSB)	3.9.1.	x				
Building fire safety for SSSB	3.9.2.	x				

Topic	Sub-section	Requirements (3)	Target(s) (4)	Method(s) (5)	Expand (7)	Short Description of Selected Suggestions in Addition to Clarification of Targets, Methods or Both
SSSB floor areas	3.9.3.	x				

Considering past efforts, the results from this analysis compare well to the prior preliminary analysis results and topics raised in the previous workshops [14] considering that analysis grouped clarification of performance-based formulation, targets, methods and rationale and assumptions together, and this analysis provides more detail between three of these aspects: performance-based formulation, targets, and methods.

5.3 Part 9 – Use, Egress and Fire Safety Review

Clarification of the rationale and assumptions behind the requirements

Building on the common themes (of Section 5.1) and similar to the Part 3 recommendations (of Section 5.2), the clarification of the rationale and assumptions behind the prescriptive requirements is recommended for all of the requirements in Part 9. The rationale and assumptions could be shared in the informational materials of the explanatory Notes in the Appendix at the end of the Part and the complementary publication, the Illustrated User's Guide [20], supports users' understanding and application of the provisions. While it is acknowledged in this Guide that "… [i]t is expected that the majority of code users will primarily follow the acceptable solutions…", the recommendation poses to enrich this informational material to better support the development and review of alternative solutions with summaries of the background for the development of the requirements and assumptions, including the differences and similarities that were considered or assumed compared to Part 3 use, egress and fire safety topics. It is also noted that an updated version of the User's Guide for NBC Part 3 to include background information for the development of requirements, along with the differences in the assumptions and approach to the requirements for similar topics in Part 3 compared to Part 9 would also provide support for the improved ease of development and review of alternative solutions to address compliance for Part 9 designs.

Subsections for parallel high-level performance-based formulations

Building on the common theme introduction, based on the results of the review, NBC Part 9 subsections that are recommended to be considered for the development of a high-level performance-based formulation in parallel with the existing primarily prescriptive requirements are:

- Subsection 9 10.14. for spatial separation between buildings; and
- Subsection 9.10.15. for spatial separation between houses.

A selection of technical topics with recommendations for level of performance clarifications

Recommendations to clarify the performance target, evaluation method or to expand on current performance-based requirements are suggested for the following technical topics:

- Performance targets for clarification:

    - In Section 9.8.:
        - Subsection 9.8.8. for the current qualitative effective performance of a guard within dwelling units and houses with a secondary suite
        - Subsection 9.8.10. for:
            - Design loads for exterior concrete steps
            - No uplift forces from freezing of the soil on cantilevered precast concrete steps
- Evaluation methods for clarification:
    - Subsection 9.8.9. for wooden stair stingers to be supported and secured at top and bottom
    - Subsection 9.9.11. for exit signs to be visible on approach
- Expand further on performance-based requirements:
    - Subsection 9.21.1. the smoke- and flame-tight construction of chimney or flue pipe walls

It is also highlighted that there is a link assumed between the fire safety, use and egress, accessibility requirements in Parts 3 and 9. That is, if the rationale and assumptions are clarified for all of the fire safety, use and egress requirements in Parts 3 and 9, these would include the assumed similarities and differences that have been used in the development of requirements. Then Part 3 normative and informational content would provide a basis for performance-based alternative solutions for Part 9 requirements considering the assumptions of the similarities and differences. Therefore, it is also recommended that fire safety, use and egress, and accessibility topics be considered for both Part 3 and 9 applications at the same time, so that clarifications of the performance target, evaluation method, and/or rationale and assumptions are worked on at the same time, including the similarities and differences assumed, in a holistic context.

5.4 Summary

In summary, the results of the analysis and recommendations raised for consideration align well with past efforts [9, 13, 14, 28], while providing refinement that will support and accelerate discussions on selecting, planning, and executing next steps.

6. Building Envelope, Energy Efficiency, and Acoustic Requirements

6.1 Scope of the Review

The provisions of Part 9 *Housing and Small Buildings* of interest to this segment of the analysis are those contained in Sections 9.7., 9.11. to 9.14., 9.16., 9.18., 9.19., 9.25. to 9.30. and 9.36. All of the provisions of Part 5 *Environmental Separation* have been taken into account in the analysis.

The *Illustrated User's Guide - NBC 2015* [32] and several standards incorporated by reference in the Code were consulted in addition to the information provided as input to the analysis approach described in Section 3 of this report, during the provision-by-provision review of NBC Parts 5 and 9. The analysis then focused on recommending actions for each provision on the basis of options no. 1 to 7 presented in Table 2.

For each provision examined, details of the results (findings) of the code analysis are presented in Appendix D (Part 5) and Appendix E (Part 9), which also include comments explaining the reasoning behind the proposed recommended actions. In other cases, the comments provide background on the specific issues raised. These documents will enable readers to better understand the overall structure of the review, and the decisions taken throughout. Finally, we have highlighted the key findings of the analysis below, and made a few suggestions.

An overview of the recommended actions proposed for Parts 5 and 9 is presented below, together with statistics on the percentage of provisions, classified by Code Section, allocated to each recommended action. A more detailed breakdown of the statistics is available in Appendix C.

6.2 Part 5 – Environmental Separation

Division B, Part 5 *Environmental Separation* was originally created as a performance-based Code approach. The provisions focus on performance objectives related to resistance to deterioration and structural loads as these topics directly impact the Objective and Functional Statements related to structural safety and occupant health & safety.

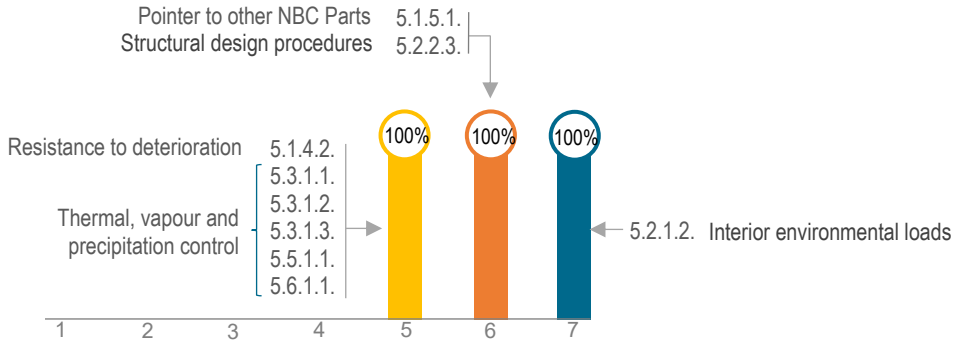
A summary of the key Articles in Part 5 that were identified with Actions (see Table 7) for change to the provision (not Action No. 1 leave as-is) is provided in Table 8. The frequency that a particular Action was identified for the Sentences and Clauses in each Article is identified. Note that Table 5 only identifies Articles where the frequency of a specific Recommended Action (at Sentence and Clause level) is either 100% of the provisions or between 50% and 99%. These items were more clearly impacted by the need for change. See Appendix C for the broader analysis of all Part 5 Articles. A total of 200 provisions were examined.

Table 7 List of recommended action items (see Table 2 for details)

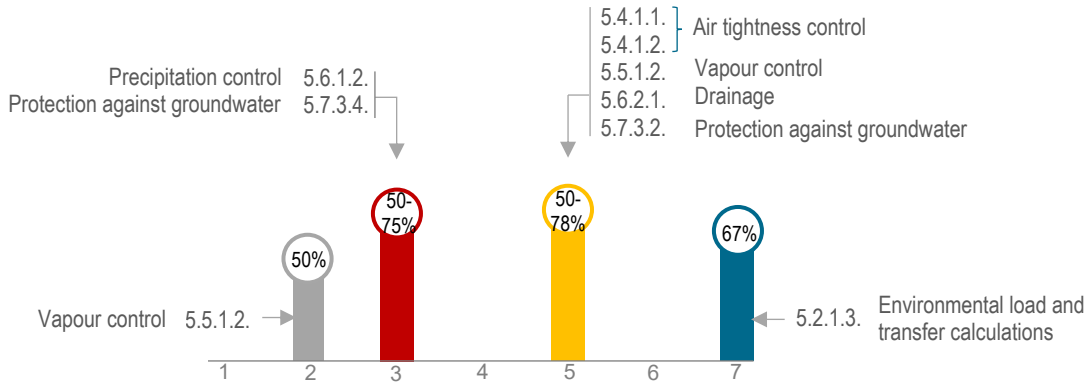
Coding	Recommended Action Description
1	Leave as-is
2	Leave as-is but standard is no longer available (or withdrawn) - update to new standard
3	Performance-based requirements needed
4	Performance target need clarification
5	Assessment method need clarification
6	Rationale and assumptions behind the prescriptive requirements need clarification
7	Expand further on the performance-based requirements

Table 8 Selected articles needing action in Part 5 with frequency of 50% or higher

Frequency of 100% of the Recommended Action in each Article



Frequency of 50-99% of the Recommended Action in each Article



The project identified that the majority of the provisions in Part 5 are *qualitative* in nature, as the overall performance intent is clearly identified but the method for calculating performance and confirming compliance is not provided. This resulted in a need for an Assessment Methodology to be clarified (Action No. 5). An industry accepted standard methodology for analyzing and developing solutions that meet the specific provisions and associated Objective and Functional Statements is not provided in Part 5 of the Code. This leaves the method for analyzing and demonstrating compliance up to the designer to chose. Currently, demonstration of failure to comply with the minimum provisions of Part 5 can only be identified after the constructed building has failed due to premature structural deterioration and/or exposure of occupants to harmful soil gases and mold.

There are some provisions related to identification of loads and methods for calculating the impact of these loads that are *quantitative* in nature, e.g., wind loads and acoustic requirements, but the majority of the provisions for Sections 5.3 Heat Transfer, 5.4 Air Leakage, 5.5 Vapour Diffusion, 5.6 Precipitation, and 5.7 Surface and Ground Water do not provide a quantifiable method for calculating the loads and their impacts related to resistance to deterioration, structural stability, and human health[1].

Section 5.8 *Sound Transmission* is an exception to this *qualitative* limitation. The acoustic provisions were developed and implemented in the 2015 edition of the NBC and were based upon research into *quantitative* performance-based calculation methodologies developed by NRC. This Section provides both performance-based minimum requirements and a method for calculating the design's performance to demonstrate compliance. This Section provides a strong model for *quantitative* performance-based Code preparation.

6.3 Part 9 – Building Envelope, Energy Efficiency, and Sound Transmission

The title of the Code Sections under review correspond to technical subjects that deal with the construction of the building envelope and interior assemblies that can be identified as:

- an intended function controlling the environmental loads (e.g., heat transfer, air leakage and condensation control, drainage, dampproofing, waterproofing and gas control, and sound transmission),
- an area in the building (e.g., roof spaces, crawl spaces and excavation), or
- a specific system (e.g., cladding, roofing, flooring and stucco).

While the titles of these Sections suggest that the provisions would be structured following different approaches, they are framed for the most part, following similar principles. They are material, component or system specific, which constitute a prescriptive requirement that comes with additional requirements either prescriptive and/or performance-based to form a complete acceptable solution in the context of the Code objectives. These provisions being fundamentally prescriptive, are often considered as the preferable Code compliance path for conventional construction since it is in most cases, a straightforward path. However, the prescriptive-based provisions are challenging for specifiers and builders requesting the use of an alternative solution.

[1] Of interest to this project is the current 2030 Code cycle strategic priority for addressing resistance to deterioration in Part 5 of the NBC. The National Model Code Committee on Climate Change Adaptation has a mandate to address the need for quantitative performance-based solutions for resistance to deterioration to address how adaptation to climate change can be quantitatively analyzed and designed.

The exception to this general structure is within Section 9.36. *Energy Efficiency*, since three parallel compliance routes are presented; i) prescriptive path, ii) performance path, and iii) compliance with the National Energy Code for Buildings (NECB).

The limitations created in Part 9's prescriptive provision approach relate to how alternative solutions and industry product innovation can be demonstrated to meet the equivalent of the respective prescriptive requirements. The existing prescriptive provisions do not provide a clearly stated minimum performance target for the provision, which therefore makes it difficult to prove that alternative and/or innovative options provide the same performance intent. This stifles innovation since it is not known what performance criteria are intended.

Demonstrating Code compliance of an alternative solution require submitting a Code Analysis for the Authorities Having Jurisdiction's (AHJ) approval. Per stated in Subsection 2.3.1., Alternative Solutions in Division C of the NBC 2020*, "...a Code analysis must outline the analytical methods and rationales used to determine that a proposed alternative solution will achieve at least the level of performance required by Clause 1.2.2.(1)(b) of Division A."* In addition, *"...information concerning any special maintenance or operational requirements that are necessary for the alternative solution to achieve compliance with the Code..."* must be provided to the AHJ.

When developing a Code analysis for Code compliance, applicable objectives, functional statements and acceptable solution(s) must be identified. This first step can be easily achieved as the information is explicitly available in the Code. Problems arise when the acceptable solution of the Code does not provide a clear understanding of the performance target requirements and evaluation methods. If it is not available or unclear, it may be necessary to test the Code's prescriptive solution to establish the Code's minimum (target) performance level, which is time-consuming and costly from the manufacturer's perspective in seeking Canadian marketplace acceptance of their innovative product. Interpretating the minimum level of performance in the absence of clear Code insight information, can bring its own set of challenges.

With these parameters in mind, it was noted during the provision-by-provision review of the Code that clarification should be recommended for the following high-level topics in order to support a performance-based approach facilitating code compliance for alternative solutions.

Performance-based requirements needed

Although the reviewed Sections include a combination of prescriptive and performance-based requirements, a majority of the provisions are prescriptive throughout Part 9 (with the exception of Sections 9.7., 9.11. and 9.36.).

Prescriptive solutions consist of specific materials (e.g., polyethylene membrane, stucco, metal flashing, fiberboard) with dimensional characteristics (where applicable), described in the main text of the Code or referenced in material standards. These standards may include performance-based requirements, but as the scope of the standard is usually limited to a specific type of material (e.g., spray-applied polyurethane foam, polyethylene membrane, vinyl siding), the performance-based requirements and criteria of the standards may not be applicable to the evaluation of innovative products.

Requirements relating to installation instructions are also part of the solutions, but they are also essentially prescriptive as they refer to specific dimensions and design requirements. Several provisions refer to the "manufacturer's installation instructions", creating a "minimum target" that cannot be quantitatively defined since each manufacturer will have differing installation criteria for products to be used to provide the same function. Therefore, a consistent alternative solution cannot be developed, given that these solutions will vary from manufacturer to manufacturer.

Over 35% of the 1,377 provisions examined in Part 9 were prescriptive provisions requiring performance-based requirements (action no. 3). At Section level, this percentage ranged from 10% to 79%.

Clarification on performance-based requirements target and assessment methods

At least a third of the Code Sections include performance expectations that are, in most cases, general when stated at the beginning of the Section (e.g., 9.7.3.1., 9.25.3.1.), and relatively more specific when stated later in the Section. They can be combined with prescriptive requirements at the Article level. The intent of the expectation is defined using the fundamental principles of the building envelope (e.g., “minimize condensation”, “ensure comfortable conditions”), which are not consistently defined criteria.

While it's easy to understand the intent, there is no clear performance target that would enable the users to correctly understand the level of performance sought for the provision. For example, the principle of “minimize condensation” raises the question of how to determine the level of deterioration that would be considered acceptable or unacceptable. How do we determine the maximum acceptable level of condensation? The point at which deterioration of moisture-sensitive materials begins, e.g., fungal growth or corrosion, should be used as critical criteria along with the means for analyzing the rates and risks of deterioration. The concern is that identifying performance required to meet the objective and functional statements can only be achieved by performing a formal analysis of the resistance to deterioration of the design. These types of provisions are performance-based by nature but may be unworkable due to the lack of clarity of the performance objective and the accepted methodology for conducting the analysis.

In addition, vaguely defined terms, e.g., “avoid damage”, “plant material”, “control vermin”, have been observed in performance-based provisions. These terms should be defined in the context of the Code to make them consistently specific for interpretation regardless of Code user.

In summary, the related problems were of a different nature: i) the vague terms used; ii) the difficulty of demonstrating compliance, given that performance assessment can only be carried out after construction; iii) the intent (fundamental principle) is generally clearly defined, but there is no precise test method or performance target; and iv) the difficulty of assessing that there is no failure after a prefabricated building has been transported.

Clarification on performance objectives requiring quantitative definition and/or quantitative values, corresponding to action no. 4, is found in around 11% of all provisions. This percentage varies from 1% to 41% at Section level.

Topics of particular interest

- Provisions on the “second plane of protection” would require clarification of the rationale and assumption behind the prescriptive requirements. If one of the objectives is to protect the primary structure from deterioration due to moisture/wetting, what are the requirements if the exterior sheathing can be used as a bracing element to resist lateral loads due to wind and earthquake? Shouldn't the exterior sheathing for bracing also be protected by two layers of sheathing membrane to reduce the risk of compromising the structural integrity of the wall, rather than one layer of this protection being allowed to be removed as currently stated? This provision needs to be clarified in terms of intent and the means of demonstrating the achievement of that intent to support the development and assessment of alternative solutions.

- In the context of calculating RSI values for energy efficiency purposes (see Sentence 9.36.2.2.(2)), the average temperature of 24°C required by the Code, for testing, may not be appropriate for innovative insulations as it may not lead to the lowest effective RSI value in use. Requiring a temperature-dependent thermal resistance curve might be more appropriate. The reference to insulation performance may need to be addressed in a broader context in both the NBC and NECB to take account of changing RSI values at different temperatures. This issue should be the subject of further discussion within the NMCC PBS, and/or a possible CCR.
- Although the intent of Sentence 9.25.2.3.(8) is clear, it does not seem possible to demonstrate compliance unless the failure is discovered by on-site dismantling of the wall systems.
- Some provisions refer to Part 5. These provisions are intended to provide an alternative method for demonstrating compliance with Code minimums without restricting Code users to the solutions provided in Part 9. However, since Part 5 has been identified in this project as requiring quantitative performance-based solutions, it is recommended that provisions referring to Part 5 be examined for applicability when changes to Part 5 are undertaken.
- Provisions for air-barrier systems need improvement to align with Part 5 of NBC 2020. It is recommended to consider the performance system approach outlined in Part 5 for air barrier assembly, rather than an air barrier materials approach within a prescriptive system design as defined in Part 9. It would be rational to align this with the requirements in Section 5.4, however this would also then require consideration of the quantitative means for analyzing acceptable air barrier assembly performance in the context of the Objectives and Functional Statements related to resistance to deterioration. An alternative to use Sentence 5.4.1.2.(1) referring to CAN/ULC-S742 Air Barrier Assemblies [34] or the method described in Sentence 5.4.1.2.(2) should be explored. Coordination of performance criteria between Part 5 and Part 9 will be important for consistency in application.
- 15 standards were identified as withdrawn (action no. 2).
- The scope of Section 9.29, Interior Wall and Ceiling Finishes, should be clarified. It is not clear whether all assemblies must be designed and constructed with interior finishes, and what minimum level of performance is expected.
- Among the various cladding solutions described in Part 9, Article 9.27.3.6. allows for faced sealed cladding with prescriptive details at panel joints. In the absence of clear expectations as to the applicability of such a system and level of performance, it is difficult to determine whether it can be selected as an acceptable solution applicable to an alternative solution whose compliance must be demonstrated. Clarification would be required for the following aspects: i) the level of performance and ii) limitations in terms of building type application (e.g., mobile-home, any building that meets Part 9).
- Propose a pointer to Part 4 for cases where floors-on-ground can be exposed to hydrostatic water pressure.
- Consider developing performance-based requirements for venting since CAN3-A93 Natural Airflow Ventilators for Buildings [35] seems to limit the solution to metal vents.
- Consider clarifying the performance target for metal stucco mesh and defining the minimum required galvanization.

Supplementary material

- There are cases, where the *Illustrated User's Guide – NBC 2015* clarifies installation details, but the guidance is not enforceable. Therefore, the suggestion is that the main text of the Code should be changed to include content currently in the Guide to make the installation details enforceable by an Authority Having Jurisdiction (see 9.27.7.5.(1)). In some cases, quantitative clarifications and definitions are necessary. It is recommended that this text be added to the Article to improve the provisions of the Code.
- There may be an appropriate reference document that could be added as an explanatory note. In addition to the *Illustrated User's Guide*, it is recommended to refer to potential guides from the CHBA or CMHC.
- The definition of localities with known termite infestation could be clarified by reference to the *Illustrated* User's *Guide* map.

Statistics on the recommended actions and provisions

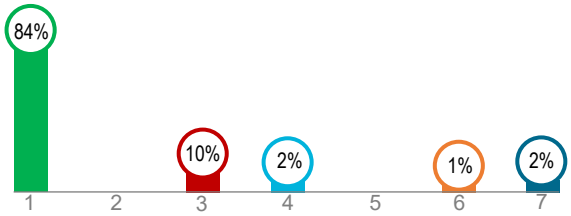
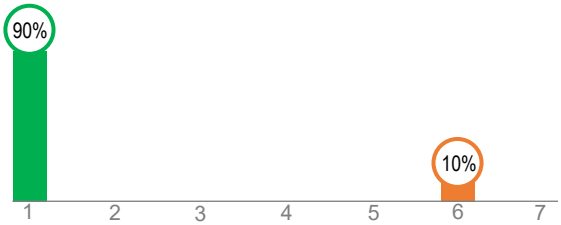
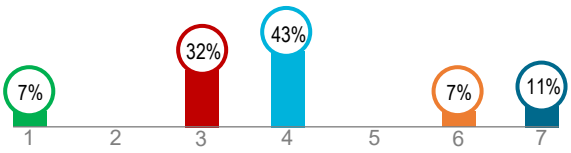
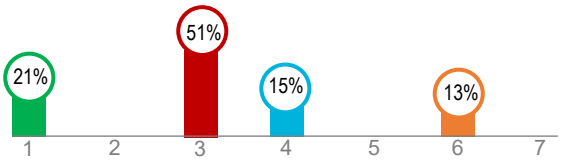
Table 10 provides a general summary of the percentage of provisions for which Actions no. 1 to 7 (see Table 9) were recommended by the Sections of the Code. The analysis is done at the Sentence and Clause level of the Sections of the Code that were reviewed. A total of 1377 provisions were examined. The detailed results of these activities are presented in the spreadsheet attached to Appendices D and E.

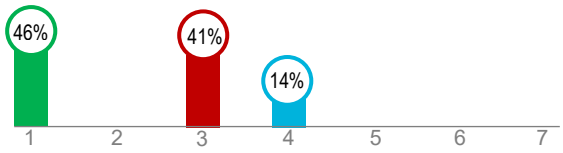
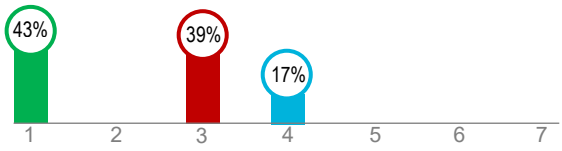
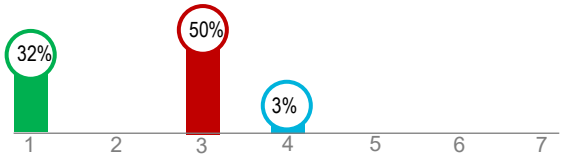
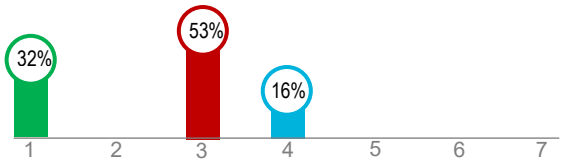
Note: Subsection 9.18.7. was not part of the review since it relates to fire protection. A subject-matter expert's review is recommended for Subsections 9.18.2.1., 9.18.4.1., 9.18.7.1. and 9.19.2.1.

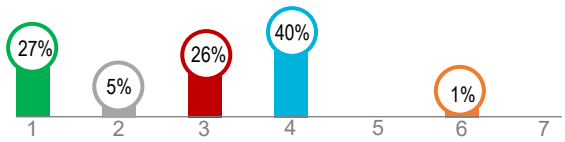
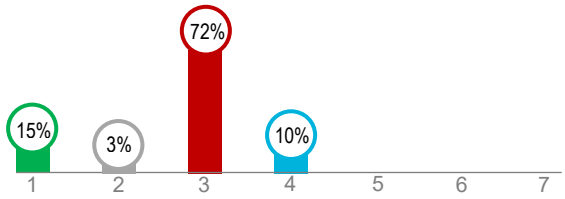
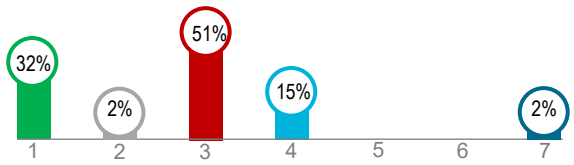
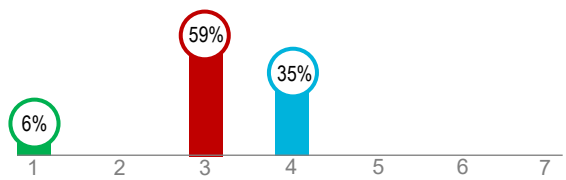
Table 9 List of recommended action items (see Table 2 for details)

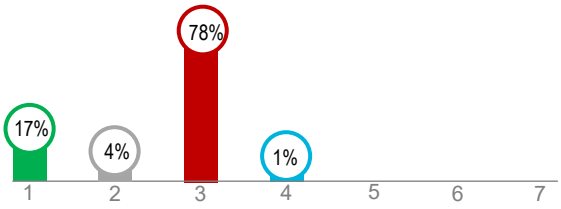
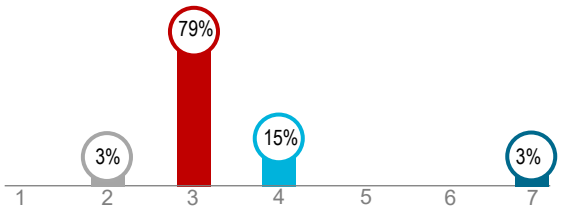
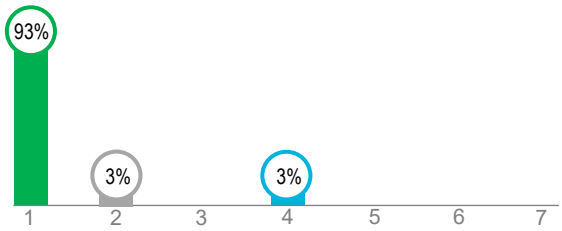
Coding	Recommended Action Description
1	Leave as-is
2	Leave as-is but standard is no longer available (or withdrawn) - update to new standard
3	Performance-based requirements needed
4	Performance target need clarification
5	Assessment method need clarification
6	Rationale and assumptions behind the prescriptive requirements need clarification
7	Expand further on the performance-based requirements

Table 10 Overview of statistics by Code Section (Part 9).

Frequency of the Recommended Action	Short Description of Selected Recommendations
Windows, Doors and Skylights (NBC 9.7.) 	Developing performance-based requirements is proposed for provisions, that: (i) are prescriptive, (ii) indicate only a high level of performance, (iii) refer to manufacturer's installation instructions, or (iv) refer to prescriptive installation instructions. Consider clarifying the provisions for which the performance objective is specified without quantitative values (e.g., “control of vermin”, “comfortable conditions”, “minimize condensation”). (81 provisions)
Sound Transmission (NBC 9.11.) 	This Section includes straight forward prescriptive and performance-based requirements with performance target and assessment methods. However, clarification is proposed, on the objectives and functional statements for Tables 9.10.3.1.-A and B and on the requirements for innovative adjoining construction options, i.e., those not shown in Table A-9.11.1.4-A. (20 provisions)
Excavation (NBC 9.12.) 	These provisions refer to a significant number of vaguely defined terms such as “vegetable matter”, “avoid damaging”, “deleterious debris”, “damping” and “prevent drainage” that need to be clarified to fully understand the level of performance sought. It is suggested that consideration be given to clarifying, by means of performance-based requirements, what the foundation depth requirements attempt to avoid (e.g., foundation movement and deformation). (28 provisions)
Dampproofing, Waterproofing and Soil Gas Control (NBC 9.13.) 	Consider developing performance-based requirements for surface preparation and application of material. Clarifying the rationale and assumption behind the multiple referenced material standards is proposed. Referring to installation standards rather than manufacturers' installation instructions would provide a minimum target in qualitative terms. Propose clarifying vaguely defined terms (e.g., “minimize the ingress of moisture”, “prevent the ingress of water”, “waterproofing”) to make clear what is the minimum level of performance. While the intent of the performance-based solution for the rough-in is clear, consider clarifying the performance target. (82 provisions)

Frequency of the Recommended Action	Short Description of Selected Recommendations
Drainage (NBC 9.14.) 	Subsurface and surface drainage solutions include very general requirements for which quantifiable requirements are suggested to be clarified. (37 provisions)
Floors on Ground (NBC 9.16.) 	Propose a pointer to Part 4 for cases where floors-on-ground can be exposed to hydrostatic pressure. Suggest clarifying the performance target for bond-breaking material between the slab and footing. (23 provisions)
Crawl Spaces (NBC 9.18.) 	Subsections 9.18.2., 9.18.4. and 9.18.7. require analysis by a fire and life safety subject matter expert. Propose adding performance-based requirements for the ventilation and ground cover material of crawl spaces. (29 provisions)
Roof Spaces (NBC 9.19.) 	Subsection 9.19.2., 9.18.4. and 9.18.7. may require analysis by a life safety subject matter expert. Consider developing performance-based requirements for venting since CAN3-A93 [35] seems to limit the solution to metal vents. (19 provisions)

Frequency of the Recommended Action	Short Description of Selected Recommendations
Heat Transfer, Air Leakage and Condensation Control (NBC 9.25.) 	The development of performance-based requirements or performance target is recommended for several provisions, since there is/are: (i) several material standards; (ii) vaguely defined terms; (iii) difficulty in demonstrating compliance, as the performance assessment can only be carried out after construction; (iv) no clear test method and performance target although the intent is usually clearly defined (fundamental principles); and (v) difficulty of assessing that there is no failure after the transport of factory-built building. Consider exploring performance-based requirements for air-barrier systems that would align with Part 5. Clarify the performance target for what is meant by “not result in high moisture generation.” Note: It is proposed that the requirements for loose-fill insulation permitted to be installed in existent buildings be moved in NBC Alterations to Existent Buildings of Part 9 Buildings. (84 provisions)
Roofing (NBC 9.26.) 	Consider developing performance-based solutions for the majority of provisions, as they mostly refer to prescriptive solutions in terms of materials and installation. For provisions that refer to vaguely defined terms (e.g., “effectively shed water”, “will not adversely affect”, “sufficient roofing nails”) consider clarifying the performance target to make the provisions workable. Clarify the level of performance of face sealed cladding and limitations in building applications. (155 provisions)
Cladding (NBC 9.27.) 	Consider clarifying the performance target of high-level fundamental principles for which there is no guidance on how to achieve the intent since several include vaguely defined terms (e.g., “minimize/prevent the ingress of precipitation”, “minimize the passage of rain and snow).” It is proposed to clarify the rational and assumption behind the prescriptive requirements of the second plane of protection and face sealed cladding provisions. There is a need to develop performance-based requirements for half of the provisions as these consist of a mixture of materials, systems, designs or installations that are prescriptive requirements. (186 provisions)
Stucco (NBC 9.28.) 	There is an overall need to develop performance-based requirements for half of the provisions as these consist of prescriptive installations requirements and prescriptive material characteristics (specifications). Consider clarifying the performance target for metal stucco mesh and defining minimum required galvanization. (49 provisions)

Frequency of the Recommended Action	Short Description of Selected Recommendations
Interior Wall and Ceiling Finishes (NBC 9.29.) 	Development of performance-based requirements is proposed for a significant portion of the Section as the majority of the provisions include prescriptive installation instructions and material characteristics. It is proposed to clarify the scope of the Section since it is not clear whether all assemblies must be designed and constructed with interior finishes, and what minimum level of performance is expected. (83 provisions)
Flooring (NBC 9.30.) 	Development of performance-based requirements is proposed for a significant portion of the Section as the majority include prescriptive installation instructions and material characteristics (type of material, dimension), and refer to material standards. (34 provisions)
Energy efficiency (NBC 9.36.) 	Consider exploring the need for a temperature-dependent thermal resistance curve since the average temperature of 24°C required by the Code may not be appropriate for innovative insulations as it may not lead to the lowest effective RSI value in use. It is proposed to clarify the performance target of the air barrier details and the required seal at ducts and plenums joints. (467 provisions)

7. Overall Summary and Next Steps

In summary, this report provides a summary of the results from a provision-by-provision analysis of select portions of the 2020 edition [1] of the National Building Code (NBC) from the perspective of how the level of performance of Division B requirements may be clarified to better support the development and review of alternative solutions. This summary could be used to inform and accelerate the discussions on planning for work towards more performance-based building codes in Canada.

The scope of the analysis was for the consideration of additional performance formulations of the requirements to be developed, so existing prescriptive requirements remain and the new performance-based requirements would provide a parallel means of compliance for the acceptable solution requirement, within the current objective-based framework of the National Model Codes (NMCs). This is in alignment with the draft mandate [3] of the National Mode Code Committee on Performance-Based Solutions (NMCC-PBS).

The following sections summarize the highlights from recommendations arising from the analyses of the three areas of the NBC.

7.1 Highlights of Recommendations Raised

A selection of key highlights of the recommendations that were raised following the provision-by-provision analysis are summarized in the following sections based on areas of the NMCs.

7.1.1 Structural including Earthquake Design Related Key Requirements

Highlights of the recommendations raised in Section 4 for consideration include:

- Clarifying the performance objectives for buildings in different importance categories (normal importance, high importance, post-disaster buildings) under different level of earthquake event (2% in 50 years, 5% in 50 years and 10% in 50 years).
- Clarifying the quantitative performance targets (e.g., drift at the system level and damage at the components level) based on the performance of current existing SFRFs and expected performance targets.
- Clarifying the performance-based procedure for designs that are outside the scope of prescriptive requirements, including
    - An alternative seismic force resisting system that is not included in Table 4.1.8.9;
    - A building having an irregularity that is not included in Table 4.1.8.6.;
    - When two or more buildings are connected together; and
    - Buildings on site with different soil conditions than assumed in the 6th Generation Seismic Hazard Model (CanadaSHM6).
- Clarifying the peer review requirements.
- Further clarifying performance-based requirements for seismic isolation and supplemental energy dissipation.
- Clarifying the assumptions and rationale and/or performance-based requirements for non-structural components and equipment. A review of CSA S832 *Seismic risk reduction of operational and functional components (OFCs) of buildings* is recommended.

- Transformation to performance-based standards and coordinating performance-based requirements in code and code referenced material design standards.
- Clarifying the rationale and engineering assumptions including loads underlying the prescriptive requirements in Part 9 (see Section 4.2.1 for details).
- Coordinating and clarifying the performance requirements in Part 9 (e.g., deflection and vibration) and code referenced standards (e.g., CSA O86).
- Clarifying the performance criteria for an alternative lateral load resisting system to demonstrate equivalent or better performance than the existing acceptable solutions in Part 9 (see Section 4.2.1 for details).
- Clarifying the performance requirements in Part 9, where applicable, for topics such as adequate lateral support for columns and masonry walls, mortar mix, built-up beams and columns etc.
- Clarifying the limitations of Part 9 provisions for wood-frame construction in terms of whether "engineered components" includes prefabricated wood I-joist and Structural Composite lumber (SCL).

7.1.2 Fire Safety, Use and Egress, and Accessibility Related Key Recommendations

Highlights of the recommendations raised for consideration in Section 5 for clarification of performance targets, evaluation methods, and/or background rationale and assumptions used in the development of requirements that would improve the ease of development and review of alternative solutions include:

- Common themes raised for both NBC Part 3 and 9 requirements:
    - Performance-based formulation of requirements added in parallel to existing prescriptive requirements is recognized for supporting:
        - A desire to support Code users' current applications of and familiarity with the NMCs in the objective-based framework;
        - Calls for a gradual transition towards performance-based codes [14, 25, 26, 28]; and
        - Alignment of the scope of the analysis summarized in this report with the strategic priority [2] of PBS.
    - Clarification of the rationale and assumptions behind the requirements in general for all of the requirements in NBC Parts 3 and 9 related to fire safety, use and egress topics.
    - Consideration of the development of parallel high-level performance-based formulations of requirements was suggested to be as high as subsections for some areas.
    - The development of parallel performance-based requirements was recommended for referenced test standards with prescriptive applications.
    - Suggestion of the movement of risk characterization information in NBC 2020 Division A Article 1.3.3.4. into Division B.
- Themes raised for recommendation for Part 3 fire safety, use and egress, and accessibility requirements:

- Clarification of the rationale and assumptions behind the requirements, particularly to revisit the content and update the current user's guide [21] for Part 3 that was last developed for the 1995 edition of the NBC, considering both technical changes incorporated in subsequent editions and the introduction of the objective-based framework with the alternative solution compliance path in the 2005 edition [5].
- Consideration of the risk characterization information that is scattered throughout Part 3 is recommended to be included in the development of performance-based formulation of the requirements.
- Development of parallel high-level performance-based formulations was recommended to be considered at the subsection level for:
  - construction type (including Subsection 3.1.4. for combustible construction; Subsection 3.1.5. for noncombustible construction; and Subsection 3.1.6. for encapsulated mass timber construction); and
  - spatial separation and exposure protection (Subsection 3.2.3.).
- Development of attributions for building size and construction relative to occupancy for the requirements in Subsection 3.2.2.
- A selection of technical topics with recommendations for clarification of performance target, evaluation method, and/or to expand on the current performance-based requirements (see Section 5.2 for details), including:
  - Occupancy definitions based on quantified combustible content;
  - Construction type;
  - Building size and construction;
  - Fire separations and closures;
  - Firewalls;
  - Fire blocks and concealed spaces;
  - Interior finishes;
  - Roof assemblies and coverings;
  - Fire alarm and detection systems;
  - Provisions for firefighting;
  - High building requirements;
  - Occupant load;
  - Requirements based on occupancy type for assembly, care, treatment or detention, residential and industrial occupancies;
  - Exit requirements;
  - Accessibility design;
  - Service rooms, spaces and facilities;
  - Height of rooms;

        - Plumbing facilities; and
        - Self-service storage building requirements.
- Themes raised for recommendation for Part 9 fire safety, use and egress requirements:
    - Clarification of the rationale and assumptions behind the requirements that would support an improved ease of development and review of alternatives solutions in the informational materials of the Notes in the Appendix at the end of the Part and the Illustrated User's Guide [20].
    - Development of parallel high-level performance-based formulation was recommended to be considered at the subsection level for
        - Spatial separation between:
            - Buildings (Subsection 9 10.14.); and
            - Houses (Subsection 9.10.15.).
    - A selection of technical topics with recommendations for clarification of performance target, evaluation method, and/or to expand on the current performance-based requirements, including:
        - Effective performance of a guard within dwelling units and houses with a secondary suite;
        - Design loads for exterior concrete steps;
        - No uplift forces from freezing of the soil on cantilevered precast concrete steps;
        - Evaluation of the performance of supported and secured wooden stair stingers; and
        - Evaluation of visibility performance of exit signs on approach.

These recommendations were raised for consideration in the context of a general assumption that the NBC Part 3 could provide the foundation for performance-based alternative solutions for Part 9 requirements, with the consideration that the rationale and assumptions for the Part 9 requirements would include a description of the similarity or differences between the development of Parts 3 and 9 requirements.

Thus, it is also recommended that fire safety, use and egress topics be considered for clarification for both Parts 3 and 9 applications at the same time, so that clarifications of the level of performance aspects, and/or rationale and assumptions are addressed in a holistic context.

Overall, it was noted that the recommendations suggested aligned with topics raised in past efforts, while providing more refinement to assist with discussions on next steps.

7.1.3 Building Envelope, Energy Efficiency, and Acoustic Related Key Recommendations

Highlights of the recommendations raised in Section 6 for consideration include:

Part 5 *Environmental Separation*

Part 5 is performance-based in intent. However, the performance-based solutions identified are largely *qualitative* in nature as an industry accepted standard methodology for analyzing risks and designing to

avoid them is not provided. This leaves a gap in the application of the Code provisions in a consistent manner across Canada.

- Modification to Part 5 to provide a quantitative method for calculating resistance to deterioration will provide the structure for identification of Code-compliant air leakage control, precipitation management, vapour diffusion control, and heat flow control solutions. The quantitative methodology must address the existing Objective and Functional Statements coupled to the provisions in Sections 5.1 and 5.2.
- It is noted that the acoustic provisions in Section 5.8 have both performance minimums and the methods for calculating a design's performance. This Section is a model for how quantitative, performance-based solutions can be provided within the NBC.

Part 9 *Housing and Small Buildings*

As for Part 9, many of the prescriptive provisions were identified to remain in place since these prescriptive solutions can provide a simplified and industry understood path to providing Code compliant buildings.

Prescriptive solutions were originally included in Part 9 since there was an industry understood successful method for building housing and small buildings that met the intent for these buildings to achieve an expected service life. The construction of housing had been developing slowly for hundreds of years and it was understood within the design and construction community "what worked". The provisions of the Code demonstrated that they provided the expected performance and service life through many years of previous experience. However, these provisions did not identify the underlying minimum specific performance levels related to the intent of the Article. They were simply "known to work". The only criteria used to evaluate their acceptability was that over many years of experience with the solution, the building appeared to have provided the overall service life expected.

While this worked well for repeated construction of similar buildings, this general performance experience does not provide suitable guidance on performance that can then be used to evaluate alternative and innovation solutions. This limits and inhibits the development of solutions that may meet the underlying Code intent while addressing additional policy objectives related to health & safety/accessibility, and energy efficiency.

To support these policy objectives, it will be necessary to consider adjustment to Part 9. For the purpose of this project, it has been assumed that the existing prescriptive provisions should remain in-place to allow continuity in Code interpretation and housing delivery. Therefore, it becomes necessary to develop a "parallel path" compliance approach, where the underlying performance criteria contained within the prescriptive solutions are identified and codified such that alternative solutions and current code acceptable solutions can be considered in an "apples to apples" comparison.

The development of Part 9 could mimic the structure of the NECB [33], where alternative compliance paths are provided such that compliance with Part 9 can be demonstrated either by meeting the prescriptive requirements or the performance requirements.

Options to explore for the development of this "parallel path" include:

A. Develop performance-based provisions within Part 9

In order to properly identify the specific performance criteria, the existing prescriptive requirements will need to be analyzed in the context of each Article's intent and the underlying performance criteria contained within the prescriptive solution. Coupled with this work would be the need to identify an

analysis/testing methodology for each criterion such that the performance of the proposed solution can be consistently identified.

This would be a significant project in terms of complexity, consistency, and coordination of the various industry interests. This work could be staged over multiple Code cycles, with priority potentially given to the Sections of Part 9 where Action No. 3 was identified for 50% or more of the Articles, Sentences and Clauses, dealing with topics such as;

- Dampproofing and waterproofing
- Crawl spaces and roof spaces
- Roofing
- Cladding
- Interior wall and finishes
- Flooring
- Stucco

B. Reference to Part 5

Coupled with this process in Option A would also be the option of meeting of the underlying objectives of Part 9 related to resistance to deterioration and acoustic performance by applying the requirements in Part 5. This approach would effectively support innovation once Part 5 is adjusted as noted above.

Other more specific Part 9 recommendations from the work delivered in this project include:

- Consider referring to standards for installation instead of manufacturers' installation instructions.

- The *Part 9 Illustrated User's Guide* [32] provides guidance on compliance with Part 9 provisions. However, it is not specifically referenced within Part 9 as a compliance expectation. If it were determined that this Guide was to represent Code compliance solutions, then it would need to be reviewed in the context of any new performance-based "parallel path" provisions and would also need to be kept current as industry innovation provides new solutions.

- Clarification of non-defined terms used throughout Part 9 that are performance objectives would significantly improve several provisions to achieve more performance-oriented requirements and make provisions workable. Examples are terms like "control of pests", "comfortable conditions", "minimize condensation", etc. While the underlying intent is generally understood, these terms do not provide a suitable baseline for comparing the performance of various solutions against a minimum standard of performance.

- In addition to the topics outlined in Option A, provisions for air-barrier systems need improvement to align with Part 5 of NBC 2020, with a focus on an overall air barrier system approach rather than air barrier materials. As mentioned in section 6.3 of this report, it would be rational to align this with the requirements in Section 5.4, however this would also then require consideration of the quantitative means for analyzing acceptable air barrier assembly performance in the context of the Objectives and Functional Statements related to resistance to deterioration.

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8. References

1. CCBFC and NRC, 2025, *National Building Code of Canada 2020, Volume 1, Second Printing, including revisions and errata released in March 2025, NRCC-CONST-56435E, Catalogue No. NR24-28/2020E-PDF*, Issued by the Canadian Commission on Building and Fire Codes and National Research Council of Canada, https://nrc-publications.canada.ca/eng/view/ft/?id=515340b5-f4e0-4798-be69-692e4ec423e8&dp=2&dsl=en
2. CBHCC, 2024, *Performance-based solutions, Strategic Priorities for 2030 Code Cycle*, as included as Agenda item 6 in the Agenda Package for the Canadian Board for Harmonized Construction Codes Public Meeting, January 25, 2024, Canadian Board for Harmonized Construction Codes.
3. CBFCC, 2024, *Terms of Reference for national Model Code Committee on Performance-Based Solutions, Draft*, as included as Agenda item 6 in the Agenda Package for the Canadian Board for Harmonized Construction Codes Public Meeting, October 3, 2024, Canadian Board for Harmonized Construction Codes.
4. CCBFC and NRC, 1996, *User's Guide – NBC 1995 Fire Protection, Occupant Safety and Accessibility (Part 3)*, Issued by the Canadian Commission on Building and Fire Codes (CCBFC), and National Research Council of Canada. https://nrc-publications.canada.ca/eng/view/ft/?id=f4c59aa5-16df-4b40-b9db-d6c65cae71de
5. CCBFC and NRC, 2005, *National Building Code of Canada 2005, Volume 1, Report number NRCC 47666, Third printing including revisions and errata released on December 1, 2007 and June 20, 2008*, Issued by the Canadian Commission on Building and Fire Codes (CCBFC), and National Research Council of Canada. https://nrc-publications.canada.ca/eng/view/ft/?id=2623b771-c768-4b67-a2df-0d5895011263&dsl=en
6. CBFCC, 2024, *Approval of the work plan for the 2030 Codes, Draft*, as included as Agenda item 6 in the Agenda Package for the Canadian Board for Harmonized Construction Codes Public Meeting, October 3, 2024, Canadian Board for Harmonized Construction Codes.
7. Government of Canada, 2024, *Construction Sector Digitalization and Productivity Challenge program*, https://nrc.canada.ca/en/research-development/research-collaboration/programs/construction-digitalization-productivity-challenge-program
8. CCBFC and NRC, 2015*, National Building Code of Canada 2015, Volume 1, NRCC 56190, Second printing, including revisions and errata released on September 28, 2018, Catalogue No. NR24-28/2015E*, Issued by the Canadian Commission on Building and Fire Codes and National Research Council of Canada, https://nrc-publications.canada.ca/eng/view/ft/?id=c8876272-9028-4358-9b42-6974ba258d99&dp=2&dsl=en
9. Robbins, A.P. and Laroche. A., 2024, *Research towards a Performance-Based Building Code – Preliminary Analysis NBC Part 3: Fire and Life Safety Provisions, NRC Research Report Catalogue No. NR24-123/2024E-PDF*, National Research Council Canada. https://nrc-publications.canada.ca/eng/view/ft/?id=97091b93-1fc5-4533-af2f-1f8595f28ca1
10. Singh, J. and Adebar, P., 2022, *Research Towards a Performance-Based Building Code for Earthquake Design in Canada: Including a review of international practice (United States and New Zealand), Catalogue No. NR24-107/2022E-PDF*, National Research Council Canada. https://publications.gc.ca/collections/collection_2022/cnrc-nrc/NR24-107-2022-eng.pdf
11. Bénichou, N., 2021, *Review of Performance-Based Fire Safety Regulations in Selected Countries: Australia, Catalogue No. NR24-110/2-2022E-PDF*, National Research Council of Canada, https://publications.gc.ca/collections/collection_2022/cnrc-nrc/NR24-110-2-2022-eng.pdf

12. Su, J., 2021, *Review of Performance-Based Fire Safety Regulations in Selected Countries: New Zealand, Report No.: A1-018529.1*, National Research Council of Canada, https://publications.gc.ca/collections/collection_2022/cnrc-nrc/NR24-110-1-2022-eng.pdf
13. Bwalya, A. et al., 2022, *Report on the Workshop on Research towards a Performance-Based Building Code, Report No: A1-020201-01*, National Research Council of Canada, https://nrc-publications.canada.ca/eng/view/ft/?id=c888db50-f652-4ec6-b45c-9f2f8b034445
14. Allin, B. et al., 2024, *Towards Performance-Based Building Construction Codes – Initial Stakeholder Consultation: Summary of Comments, Catalogue No. NR24-124/2024E-PDF*, National Research Council of Canada, https://nrc-publications.canada.ca/eng/view/ft/?id=875a1ffc-7e51-4d08-9345-f98bed2e82f0
15. Government of Canada, 2025, *The Canada Green Buildings Strategy: Transforming Canada's buildings sector for a net-zero and resilient future*, https://natural-resources.canada.ca/energy-efficiency/building-energy-efficiency/canada-green-buildings-strategy-transforming-canada-s-buildings-sector-net-zero-resilient-future
16. Archer, J. W. 2005. *Canada introduces "objective based" codes, NRCC-48205*, National Research Council Canada, https://nrc-publications.canada.ca/eng/view/accepted/?id=5b19d844-94cc-4273-ac77-1123737f3fd5
17. Government of Canada, 2025, *Platform to Decarbonize the Construction Sector at Scale*, https://nrc.canada.ca/en/research-development/research-collaboration/platform-decarbonize-construction-sector-scale
18. CCBFC and NRC, 2018, *Supplement to the NBC 2015: Intent Statements*, First release, Issued by the Canadian Commission on Building and Fire Codes and National Research Council Canada, https://nrc-publications.canada.ca/eng/view/ft/?id=c5502636-d398-451b-bcc9-61fc5eaed10a
19. CCBFC and NRC, 2025, *Structural Commentaries, User's Guide National Building Code of Canada, Part 4, Division B, NRCC-CONST-56529E, Catalogue No. NR24-28/1-2020E-PDF, First printing*, Issued by the Canadian Commission on Building and Fire Codes (CCBFC), and National Research Council of Canada, https://nrc-publications.canada.ca/eng/view/ft/?id=b9fddc27-86f2-496b-9aa4-b66c45164ba6
20. CCBFC and NRC, 2025, *Housing and Small Buildings, Illustrated user's guide National Building Code of Canada 2020, Part 9 of Division B, Third edition, NRCC-CONST-56683E*, Issued by the Canadian Commission on Building and Fire Codes and National Research Council of Canada, https://nrc-publications.canada.ca/eng/view/ft/?id=a7a505fa-519c-436b-a23b-6f418df87e6a
21. CCBFC and NRC, 1996, *User's Guide – NBC 1995 Fire Protection, Occupant Safety and Accessibility (Part 3)*, Issued by the Canadian Commission on Building and Fire Codes (CCBFC), and National Research Council of Canada. https://nrc-publications.canada.ca/eng/view/ft/?id=f4c59aa5-16df-4b40-b9db-d6c65cae71de
22. IFEG, 2005, *International Fire Engineering Guidelines*, Australian Building Codes Board, Department of Building and Housing (New Zealand), International Code Council (USA), and National Research Council (Canada).
23. Bergeron, D., 2008, R*esearch in support of performance-based solutions in the National Construction Codes of Canada, NRCC-50457*, 7th International Conference on Performance-Based Codes and Fire Safety Design Methods, Auckland, New Zealand, April 16-18, pp. 105-115.
24. Frye, J., Holland, F., Lawrie, R., McCullough, R., Murdoch, G. and Oleszkiewicz, I., *Recommended Documentation Requirements for Projects Using Alternative Solutions in the Context of Objective-Based Codes (Discussion Paper)*, Issued by the Canadian Commission on Building and Fire Codes, Canada, 1998. https://nrc.canada.ca/sites/default/files/2019-03/documentation_requirements.pdf

25. CCBFC, 1995, *Building the Future – The Strategic Plan of the Canadian Commission on Building and Fire Codes 1995-2000,* Issued by the Canadian Commission on Building and Fire Codes and National Research Council Canada.
26. Bergeron, D. 2004. *Canada's objective-based codes*, 5th International Conference on Performance-Based Codes and Fire Safety Design Methods. NRCC-42800. Luxembourg, October 6. https://nrc-publications.canada.ca/eng/view/accepted/?id=ad81d6f2-e76c-4eff-a428-de7e001d3527
27. Meacham, B.J. (Ed.), 2010, *Performance-Based Building Regulatory Systems - Principles and Experiences, A Report of the Inter-jurisdictional Regulatory Collaboration Committee*, prepared for the Inter-jurisdiction Regulatory Collaboration Committee.
28. CBHCC, 2024, *National Model Code Change Roadmap: Transition towards Performance-based Solutions, Draft, Version 2.1 (October 2023)*, as included as Agenda item 9 in the Agenda Package for the Canadian Board for Harmonized Construction Codes Public Meeting, January 25, 2024, Canadian Board for Harmonized Construction Codes.
29. CCBFC, 1995, *Building the Future – The Strategic Plan of the Canadian Commission on Building and Fire Codes 1995-2000*, Issued by the Canadian Commission on Building and Fire Codes and National Research Council Canada.
30. Los Angeles Tall Buildings Structural Design Council, 2024, *An Alternative Procedure for Seismic Analysis and Design of Tall Buildings - 2023 edition with 2024 supplements*. https://drive.google.com/file/d/1HLHg2z52b-Sl86jEkrQsARUCVAP4n2LF/view
31. Pacific Earthquake Engineering Centre, 2017, *Guidelines for Performance-Based Seismic Design of Tall Buildings, version 2.03*. https://peer.berkeley.edu/sites/default/files/tbi-working-group-led-by-co-chairs-ron-ha-burger-and-jack-moehle_10.9.17_withlinks.pdf
32. CCBFC and NRC, 2015 *Illustrated User's Guide, NBC 2015 Part 9 of Division B, Housing and Small Buildings, Second edition, NRCC-CONST-56249E*, Issued by the Canadian Commission on Building and Fire Codes and National Research Council of Canada. User's Guide – National Energy Code of Canada for Buildings 2015 - National Research Council Canada
33. CCBFC and NRC, *Energy, National Energy Code of Canada for Buildings 2020*, *Fifth Edition*, *NRCC-CONST-56438E*, Issued by the Canadian Commission on Building and Fire Codes and National Research Council of Canada. National Energy Code of Canada for Buildings 2020, second printing
34. Standards Council of Canada, *CAN/ULC-S742:2020, Standard for Air Barrier Assemblies – Specification*, *Second edition*, ULC Standards, Normes ULC.
35. CSA Standard, *CAN3-A93-M82, Natural Airflow Ventilators for Buildings, A National Standard of Canada, December 1982*, Issued by Canadian Standards Association.

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Appendix A Summary of analysis results – Structural and earthquake design requirements

Table 11 Summary of analysis results for NBC 2020 Subsection 4.1.8, Earthquake Load and Effects, showing percentages of the total number of provisions allocated coded recommendations by article

Article	No. of provisions analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
4.1.8.1.	26	100%	0%	0%	0%	0%	0%	0%
4.1.8.2.	1	100%	0%	0%	0%	0%	0%	0%
4.1.8.3.	14	100%	0%	0%	0%	0%	0%	0%
4.1.8.4.	9	78%	11%	11%	0%	0%	0%	0%
4.1.8.5.	2	50%	0%	50%	0%	0%	0%	0%
4.1.8.6.	3	0%	33%	67%	0%	0%	0%	0%
4.1.8.7.	3	100%	0%	0%	0%	0%	0%	0%
4.1.8.8.	3	100%	0%	0%	0%	0%	0%	0%
4.1.8.9.	5	0%	0%	80%	0%	0%	0%	20%
4.1.8.10.	23	57%	0%	43%	0%	0%	0%	0%
4.1.8.11.	22	100%	0%	0%	0%	0%	0%	0%
4.1.8.12.	14	93%	0%	7%	0%	0%	0%	0%
4.1.8.13.	6	100%	0%	0%	0%	0%	0%	0%
4.1.8.14.	5	80%	0%	20%	0%	0%	0%	0%
4.1.8.15.	14	100%	0%	0%	0%	0%	0%	0%
4.1.8.16.	14	93%	0%	0%	7%	0%	0%	0%
4.1.8.17.	1	0%	0%	0%	100%	0%	0%	0%
4.1.8.18.	37	49%	0%	41%	5%	3%	3%	0%
4.1.8.19.	16	94%	0%	6%	0%	0%	0%	0%
4.1.8.20.	15	73%	0%	0%	0%	0%	0%	27%
4.1.8.21.	14	86%	0%	7%	0%	0%	0%	7%
4.1.8.22.	17	76%	0%	12%	0%	0%	0%	12%
4.1.8.23.	11	18%	0%	82%	0%	0%	0%	0%
Total	234	73%	1%	21%	2%	0.4%	0.4%	3%

Table 12 Summary of analysis results for NBC 2020 Part 4 Structural Design, showing percentages of the total number of provisions allocated coded recommendations by subsection

Subsection	No. of Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
4.1.1.	13	100%	0%	0%	0%	0%	0%	0%
4.1.2.	7	100%	0%	0%	0%	0%	0%	0%
4.1.3.	48	96%	0%	2%	0%	0%	0%	2%
4.1.4.	10	100%	0%	0%	0%	0%	0%	0%
4.1.5.	52	100%	0%	0%	0%	0%	0%	0%
4.1.6.	88	99%	0%	0%	0%	1%	0%	0%
4.1.7.	98	99%	0%	0%	0%	0%	0%	1%
4.1.8.	275	78%	1%	17%	1%	0%	0%	3%
4.2.1.	1	100%	0%	0%	0%	0%	0%	0%
4.2.2.	7	100%	0%	0%	0%	0%	0%	0%
4.2.3.	17	65%	0%	35%	0%	0%	0%	0%
4.2.4.	25	100%	0%	0%	0%	0%	0%	0%
4.2.5.	12	100%	0%	0%	0%	0%	0%	0%
4.2.6.	6	100%	0%	0%	0%	0%	0%	0%
4.2.7.	19	95%	0%	5%	0%	0%	0%	0%
4.2.8.	2	100%	0%	0%	0%	0%	0%	0%
4.3.1.	3	100%	0%	0%	0%	0%	0%	0%
4.3.2.	1	100%	0%	0%	0%	0%	0%	0%
4.3.3.	1	100%	0%	0%	0%	0%	0%	0%
4.3.4.	3	100%	0%	0%	0%	0%	0%	0%
4.3.5.	1	100%	0%	0%	0%	0%	0%	0%
4.3.6.	2	100%	0%	0%	0%	0%	0%	0%
4.4.1.	1	100%	0%	0%	0%	0%	0%	0%
4.4.2.	1	100%	0%	0%	0%	0%	0%	0%
4.4.3.	1	100%	0%	0%	0%	0%	0%	0%
Total	694	89%	0.3%	8.1%	0.6%	0.3%	0.1%	1.4%

Table 13 Summary of analysis results for NBC 2020 Part 9 structural including earthquake design related requirements, showing percentages of the total number of provisions allocated coded recommendations by subsection.

Subsection	No. of Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
9.1.1.	1	100%	0%	0%	0%	0%	0%	0%
9.1.2.	2	100%	0%	0%	0%	0%	0%	0%
9.2.1.	1	100%	0%	0%	0%	0%	0%	0%
9.3.1.	23	65%	0%	0%	9%	0%	26%	0%
9.3.2.	9	89%	0%	0%	0%	0%	0%	11%
9.3.3.	1	100%	0%	0%	0%	0%	0%	0%
9.4.1.	5	100%	0%	0%	0%	0%	0%	0%
9.4.2.	14	100%	0%	0%	0%	0%	0%	0%
9.4.3.	2	0%	0%	0%	0%	0%	0%	100%
9.4.4.	11	64%	0%	9%	18%	0%	9%	0%
9.6.1.	17	100%	0%	0%	0%	0%	0%	0%
9.12.1.	5	100%	0%	0%	0%	0%	0%	0%
9.12.2.	15	100%	0%	0%	0%	0%	0%	0%
9.12.3.	7	86%	0%	0%	14%	0%	0%	0%
9.12.4.	1	100%	0%	0%	0%	0%	0%	0%
9.15.1.	7	100%	0%	0%	0%	0%	0%	0%
9.15.2.	12	92%	0%	0%	0%	0%	8%	0%
9.15.3.	23	70%	0%	0%	4%	0%	26%	0%
9.15.4.	42	69%	0%	2%	10%	0%	19%	0%
9.15.5.	11	100%	0%	0%	0%	0%	0%	0%
9.15.6.	3	100%	0%	0%	0%	0%	0%	0%
9.16.1.	4	100%	0%	0%	0%	0%	0%	0%
9.16.2.	5	100%	0%	0%	0%	0%	0%	0%
9.16.2	2	100%	0%	0%	0%	0%	0%	0%
9.16.3.	4	75%	0%	25%	0%	0%	0%	0%
9.16.4.	1	0%	0%	0%	100%	0%	0%	0%
9.16.5.	1	100%	0%	0%	0%	0%	0%	0%
9.17.1.	4	100%	0%	0%	0%	0%	0%	0%
9.17.2.	6	50%	0%	0%	50%	0%	0%	0%
9.17.3.	7	86%	14%	0%	0%	0%	0%	0%
9.17.4.	7	71%	0%	29%	0%	0%	0%	0%
9.17.5.	3	33%	0%	0%	0%	0%	67%	0%
9.17.6.	2	50%	0%	0%	0%	0%	50%	0%
9.20.1.	5	60%	0%	0%	0%	0%	40%	0%

Subsection	No. of Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
9.20.2.	13	92%	0%	8%	0%	0%	0%	0%
9.20.3.	13	92%	0%	8%	0%	0%	0%	0%
9.20.4.	7	100%	0%	0%	0%	0%	0%	0%
9.20.5.	7	86%	0%	0%	0%	0%	14%	0%
9.20.6.	17	65%	0%	0%	35%	0%	0%	0%
9.20.7.	7	100%	0%	0%	0%	0%	0%	0%
9.20.8.	17	88%	0%	0%	0%	0%	12%	0%
9.20.9.	32	84%	0%	3%	0%	0%	13%	0%
9.20.10.	6	83%	0%	17%	0%	0%	0%	0%
9.20.11.	18	44%	6%	11%	11%	0%	28%	0%
9.20.12.	7	100%	0%	0%	0%	0%	0%	0%
9.20.13.	19	89%	0%	0%	11%	0%	0%	0%
9.20.14.	3	67%	33%	0%	0%	0%	0%	0%
9.20.15.	2	50%	0%	0%	0%	0%	50%	0%
9.20.16.	1	100%	0%	0%	0%	0%	0%	0%
9.20.17.	28	79%	0%	0%	0%	0%	21%	0%
9.21.1.	4	100%	0%	0%	0%	0%	0%	0%
9.21.3.	16	100%	0%	0%	0%	0%	0%	0%
9.21.4.	15	93%	0%	0%	0%	0%	0%	7%
9.22.1.	4	100%	0%	0%	0%	0%	0%	0%
9.22.5.	1	100%	0%	0%	0%	0%	0%	0%
9.23.1.	6	83%	0%	0%	0%	0%	0%	17%
9.23.2.	12	100%	0%	0%	0%	0%	0%	0%
9.23.3.	25	56%	0%	28%	0%	0%	8%	8%
9.23.4.	18	33%	0%	0%	0%	17%	22%	28%
9.23.5.	5	100%	0%	0%	0%	0%	0%	0%
9.23.6.	18	61%	0%	0%	17%	0%	0%	22%
9.23.7.	4	100%	0%	0%	0%	0%	0%	0%
9.23.8.	10	80%	0%	0%	20%	0%	0%	0%
9.23.9.	37	92%	0%	0%	8%	0%	0%	0%
9.23.10.	15	93%	0%	0%	0%	0%	7%	0%
9.23.11.	15	100%	0%	0%	0%	0%	0%	0%
9.23.12.	13	92%	0%	0%	0%	8%	0%	0%
9.23.13.	60	32%	0%	0%	0%	0%	27%	42%
9.23.14.	32	97%	0%	0%	0%	0%	3%	0%
9.23.15.	27	96%	0%	4%	0%	0%	0%	0%
9.23.16.	22	95%	0%	5%	0%	0%	0%	0%
9.23.17.	7	100%	0%	0%	0%	0%	0%	0%

Subsection	No. of Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
9.24.1.	8	100%	0%	0%	0%	0%	0%	0%
9.24.2.	4	100%	0%	0%	0%	0%	0%	0%
9.24.3.	9	100%	0%	0%	0%	0%	0%	0%
9.26.2.	8	100%	0%	0%	0%	0%	0%	0%
9.26.3.	7	29%	0%	0%	57%	14%	0%	0%
9.26.4.	13	100%	0%	0%	0%	0%	0%	0%
9.26.8.	8	100%	0%	0%	0%	0%	0%	0%
9.26.9.	1	100%	0%	0%	0%	0%	0%	0%
9.26.10.	2	100%	0%	0%	0%	0%	0%	0%
9.26.10	1	100%	0%	0%	0%	0%	0%	0%
9.26.11.	5	100%	0%	0%	0%	0%	0%	0%
9.26.12.	1	100%	0%	0%	0%	0%	0%	0%
9.26.13.	5	100%	0%	0%	0%	0%	0%	0%
9.26.14.	1	100%	0%	0%	0%	0%	0%	0%
9.26.17.	1	100%	0%	0%	0%	0%	0%	0%
9.27.1.	8	100%	0%	0%	0%	0%	0%	0%
9.27.3.	3	100%	0%	0%	0%	0%	0%	0%
9.27.5.	23	87%	0%	0%	0%	9%	4%	0%
9.27.6.	8	88%	0%	0%	13%	0%	0%	0%
9.27.7.	12	100%	0%	0%	0%	0%	0%	0%
9.27.8.	10	100%	0%	0%	0%	0%	0%	0%
9.27.9.	6	100%	0%	0%	0%	0%	0%	0%
9.27.10.	9	100%	0%	0%	0%	0%	0%	0%
9.27.11.	4	100%	0%	0%	0%	0%	0%	0%
9.27.12.	4	100%	0%	0%	0%	0%	0%	0%
9.27.13.	2	100%	0%	0%	0%	0%	0%	0%
9.27.14.	3	100%	0%	0%	0%	0%	0%	0%
9.28.1.	6	100%	0%	0%	0%	0%	0%	0%
9.28.2.	4	100%	0%	0%	0%	0%	0%	0%
9.28.3.	5	100%	0%	0%	0%	0%	0%	0%
9.28.4.	16	100%	0%	0%	0%	0%	0%	0%
9.28.5.	5	100%	0%	0%	0%	0%	0%	0%
9.28.6.	10	100%	0%	0%	0%	0%	0%	0%
9.29.3.	2	100%	0%	0%	0%	0%	0%	0%
9.29.4.	1	100%	0%	0%	0%	0%	0%	0%
9.29.5.	30	83%	0%	13%	0%	0%	0%	3%
9.29.6.	8	100%	0%	0%	0%	0%	0%	0%
9.29.7.	6	100%	0%	0%	0%	0%	0%	0%

Subsection	No. of Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
9.29.8.	6	100%	0%	0%	0%	0%	0%	0%
9.29.9.	15	93%	0%	0%	0%	0%	7%	0%
9.29.10.	8	100%	0%	0%	0%	0%	0%	0%
9.30.2.	13	100%	0%	0%	0%	0%	0%	0%
9.30.3.	3	100%	0%	0%	0%	0%	0%	0%
9.30.6.	1	100%	0%	0%	0%	0%	0%	0%
9.35.3.	6	100%	0%	0%	0%	0%	0%	0%
9.35.4.	3	100%	0%	0%	0%	0%	0%	0%
Total	1140	84%	0%	2%	3%	1%	6%	4%

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Appendix B Summary of analysis results – Use, fire safety, egress, and accessibility design requirements

Table 14 Summary of analysis results for NBC 2020 Part 3, use, fire safety, egress, and accessibility design requirements, showing percentages of the total number of provisions allocated coded recommendations by subsection.

Subsection	No. Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
3.1.1.	2	100%	0%	0%	0%	0%	0%	0%
3.1.2.	7	100%	0%	0%	0%	0%	0%	0%
3.1.3.	5	100%	0%	0%	0%	0%	0%	0%
3.1.4.	45	87%	4%	2%	0%	7%	0%	0%
3.1.5.	117	79%	13%	9%	0%	0%	0%	0%
3.1.6.	72	69%	0%	29%	0%	1%	0%	0%
3.1.7.	11	91%	9%	0%	0%	0%	0%	0%
3.1.8.	90	90%	0%	1%	0%	9%	0%	0%
3.1.9.	33	100%	0%	0%	0%	0%	0%	0%
3.1.10.	21	43%	0%	38%	0%	19%	0%	0%
3.1.11.	37	59%	3%	32%	0%	5%	0%	0%
3.1.12.	5	100%	0%	0%	0%	0%	0%	0%
3.1.13.	42	48%	0%	50%	0%	0%	0%	2%
3.1.14.	10	60%	0%	40%	0%	0%	0%	0%
3.1.15.	9	56%	0%	44%	0%	0%	0%	0%
3.1.16.	1	100%	0%	0%	0%	0%	0%	0%
3.1.17.	6	83%	0%	17%	0%	0%	0%	0%
3.2.1.	23	39%	0%	61%	0%	0%	0%	0%
3.2.2.	479	89%	0%	11%	0%	0%	0%	0%
3.2.3.	100	91%	6%	3%	0%	0%	0%	0%
3.2.4.	187	95%	0%	1%	0%	2%	0%	3%
3.2.5.	82	89%	0%	0%	6%	5%	0%	0%
3.2.6.	52	92%	0%	0%	0%	8%	0%	0%
3.2.7.	64	100%	0%	0%	0%	0%	0%	0%
3.2.8.	31	97%	0%	0%	0%	3%	0%	0%
3.2.9.	1	100%	0%	0%	0%	0%	0%	0%
3.3.1.	139	66%	0%	22%	1%	11%	0%	0%
3.3.2.	104	70%	0%	28%	0%	2%	0%	0%
3.3.3.	41	71%	0%	29%	0%	0%	0%	0%
3.3.4.	40	58%	0%	33%	0%	10%	0%	0%
3.3.5.	29	69%	0%	24%	0%	7%	0%	0%
3.3.6.	28	64%	0%	7%	4%	25%	0%	0%

Table 14 continued.

Subsection	No. Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
3.4.1.	20	95%	0%	0%	0%	5%	0%	0%
3.4.2.	33	97%	0%	0%	0%	3%	0%	0%
3.4.3.	23	100%	0%	0%	0%	0%	0%	0%
3.4.4.	26	100%	0%	0%	0%	0%	0%	0%
3.4.5.	15	93%	0%	0%	0%	7%	0%	0%
3.4.6.	162	90%	0%	1%	1%	8%	0%	0%
3.4.7.	21	95%	0%	0%	5%	0%	0%	0%
3.5.1.	2	100%	0%	0%	0%	0%	0%	0%
3.5.2.	5	100%	0%	0%	0%	0%	0%	0%
3.5.3.	7	100%	0%	0%	0%	0%	0%	0%
3.5.4.	4	75%	0%	0%	0%	25%	0%	0%
3.6.1.	7	100%	0%	0%	0%	0%	0%	0%
3.6.2.	32	97%	0%	0%	0%	3%	0%	0%
3.6.3.	32	91%	0%	0%	6%	3%	0%	0%
3.6.4.	12	75%	0%	0%	0%	17%	0%	8%
3.6.5.	52	94%	0%	0%	0%	4%	0%	2%
3.7.1.	2	50%	0%	0%	0%	50%	0%	0%
3.7.2.	37	92%	0%	0%	0%	5%	0%	3%
3.7.3.	2	100%	0%	0%	0%	0%	0%	0%
3.8.1.	2	100%	0%	0%	0%	0%	0%	0%
3.8.2.	67	100%	0%	0%	0%	0%	0%	0%
3.8.3.	180	98%	0%	0%	0%	2%	0%	0%
3.9.1.	9	89%	0%	11%	0%	0%	0%	0%
3.9.2.	6	83%	0%	17%	0%	0%	0%	0%
3.9.3.	8	63%	0%	38%	0%	0%	0%	0%
3.10.1.	1	100%	0%	0%	0%	0%	0%	0%
Total	**2680**	**85%**	**1.0%**	**9.6%**	**0.6%**	**3.5%**	**0.3%**	**0.6%**

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Table 15 Summary of analysis results for NBC 2020 Part 3, use, fire safety, egress, and accessibility design requirements, showing numbers of provisions allocated coded recommendations by subsection.

Subsection	No. Provisions Analyzed	Number of Provisions for each Coded Recommendation						
		1	2	3	4	5	6	7
3.1.1.	2	2	0	0	0	0	0	0
3.1.2.	7	7	0	0	0	0	0	0
3.1.3.	5	5	0	0	0	0	0	0
3.1.4.	45	39	2	1	0	3	0	0
3.1.5.	117	92	15	10	0	0	0	0
3.1.6.	72	50	0	21	0	1	0	0
3.1.7.	11	10	1	0	0	0	0	0
3.1.8.	90	81	0	1	0	8	0	0
3.1.9.	33	33	0	0	0	0	0	0
3.1.10.	21	9	0	8	0	4	0	0
3.1.11.	37	22	1	12	0	2	0	0
3.1.12.	5	5	0	0	0	0	0	0
3.1.13.	42	20	0	21	0	0	0	1
3.1.14.	10	6	0	4	0	0	0	0
3.1.15.	9	5	0	4	0	0	0	0
3.1.16.	1	1	0	0	0	0	0	0
3.1.17.	6	5	0	1	0	0	0	0
3.2.1.	23	9	0	14	0	0	0	0
3.2.2.	479	426	0	52	0	0	1	0
3.2.3.	100	91	6	3	0	0	0	0
3.2.4.	187	177	0	2	0	3	0	5
3.2.5.	82	73	0	0	5	4	0	0
3.2.6.	52	48	0	0	0	4	0	0
3.2.7.	64	64	0	0	0	0	0	0
3.2.8.	31	30	0	0	0	1	0	0
3.2.9.	1	1	0	0	0	0	0	0
3.3.1.	139	92	0	31	1	15	0	0
3.3.2.	104	73	0	29	0	2	0	0
3.3.3.	41	29	0	12	0	0	0	0
3.3.4.	40	23	0	13	0	4	0	0
3.3.5.	29	20	0	7	0	2	0	0
3.3.6.	28	18	0	2	1	7	0	0

Table 15 continued

Subsection	No. Provisions Analyzed	Number of Provisions for each Coded Recommendation						
		1	2	3	4	5	6	7
3.4.1.	20	19	0	0	0	1	0	0
3.4.2.	33	32	0	0	0	1	0	0
3.4.3.	23	23	0	0	0	0	0	0
3.4.4.	26	26	0	0	0	0	0	0
3.4.5.	15	14	0	0	0	1	0	0
3.4.6.	162	145	0	2	2	13	0	0
3.4.7.	21	20	0	0	1	0	0	0
3.5.1.	2	2	0	0	0	0	0	0
3.5.2.	5	5	0	0	0	0	0	0
3.5.3.	7	7	0	0	0	0	0	0
3.5.4.	4	3	0	0	0	1	0	0
3.6.1.	7	7	0	0	0	0	0	0
3.6.2.	32	31	0	0	0	1	0	0
3.6.3.	32	29	0	0	2	1	0	0
3.6.4.	12	9	0	0	0	2	0	1
3.6.5.	52	49	0	0	0	2	0	1
3.7.1.	2	1	0	0	0	1	0	0
3.7.2.	37	34	0	0	0	2	0	1
3.7.3.	2	2	0	0	0	0	0	0
3.8.1.	2	2	0	0	0	0	0	0
3.8.2.	67	67	0	0	0	0	0	0
3.8.3.	180	176	0	0	0	4	0	0
3.9.1.	9	8	0	1	0	0	0	0
3.9.2.	6	5	0	1	0	0	0	0
3.9.3.	8	5	0	3	0	0	0	0
3.10.1.	1	1	0	0	0	0	0	0
Total	**2680**	**2289**	**27**	**258**	**16**	**95**	**7**	**16**

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Table 16 Summary of analysis results for NBC 2020 Part 9, use, fire safety, egress, and accessibility design requirements, showing number of provisions allocated coded recommendations by section.

Section	No. Provisions Analyzed	Number of Provisions for each Coded Recommendation						
		1	2	3	4	5	6	7
9.1.	1	1	0	0	0	0	0	0
9.5.	21	21	0	0	0	0	0	0
9.6.	19	19	0	0	0	0	0	0
9.7.	11	11	0	0	0	0	0	0
9.8.	178	174	0	0	3	1	0	0
9.9.	188	187	0	0	0	1	0	0
9.10.	478	478	0	0	0	0	0	0
9.16.	20	20	0	0	0	0	0	0
9.17.	18	18	0	0	0	0	0	0
9.20.	161	161	0	0	0	0	0	0
9.21.	53	52	0	0	0	0	0	1
9.22.	30	30	0	0	0	0	0	0
9.23.	312	312	0	0	0	0	0	0
9.24.	36	36	0	0	0	0	0	0
9.25.	20	20	0	0	0	0	0	0
9.26.	14	14	0	0	0	0	0	0
9.27.	1	1	0	0	0	0	0	0
9.28.	34	34	0	0	0	0	0	0
9.29.	83	83	0	0	0	0	0	0
9.30.	31	31	0	0	0	0	0	0
9.35.	9	9	0	0	0	0	0	0
9.37.	1	1	0	0	0	0	0	0
Total	**1719**	**1713**	**0**	**0**	**3**	**2**	**0**	**1**

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Appendix C Summary of analysis results – Building envelope, energy efficiency, and acoustic design requirements

Table 17 Summary of analysis results for NBC 2020 Part 5, building envelope, energy efficiency and acoustic design requirements, showing percentages of the total number of provisions allocated coded recommendations by article

Code Article	Percentage of Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
5.1.1.1.	100%	100%	0%	0%	0%	0%	0%	0%
5.1.2.1.	100%	100%	0%	0%	0%	0%	0%	0%
5.1.3.1.	100%	100%	0%	0%	0%	0%	0%	0%
5.1.4.1.	100%	8%	0%	0%	46%	38%	8%	0%
5.1.4.2.	100%	0%	0%	0%	0%	100%	0%	0%
5.1.5.1.	100%	0%	0%	0%	0%	0%	100%	0%
5.2.1.1.	100%	67%	0%	0%	0%	0%	0%	33%
5.2.1.2.	100%	0%	0%	0%	0%	0%	0%	100%
5.2.1.3.	100%	33%	0%	0%	0%	0%	0%	67%
5.2.2.1.	100%	86%	0%	0%	14%	0%	0%	0%
5.2.2.2.	100%	67%	0%	0%	17%	0%	17%	0%
5.2.2.3.	100%	0%	0%	0%	0%	0%	100%	0%
5.3.1.1.	100%	0%	0%	0%	0%	100%	0%	0%
5.3.1.2.	100%	0%	0%	0%	0%	100%	0%	0%
5.3.1.3.	100%	0%	0%	0%	0%	100%	0%	0%
5.4.1.1.	100%	22%	0%	0%	0%	78%	0%	0%
5.4.1.2.	100%	50%	0%	0%	0%	50%	0%	0%
5.5.1.1.	100%	0%	0%	0%	0%	100%	0%	0%
5.5.1.2.	100%	0%	50%	0%	0%	50%	0%	0%
5.6.1.1.	100%	0%	0%	0%	0%	100%	0%	0%
5.6.1.2.	100%	50%	0%	50%	0%	0%	0%	0%
5.6.2.1.	100%	40%	0%	0%	0%	60%	0%	0%

Table 17 continued

Code Article	Percentage of Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
5.6.2.2.	100%	80%	0%	0%	20%	0%	0%	0%
5.7.1.1.	100%	100%	0%	0%	0%	0%	0%	0%
5.7.1.2.	100%	67%	0%	0%	0%	33%	0%	0%
5.7.2.1.	100%	100%	0%	0%	0%	0%	0%	0%
5.7.2.2.	100%	100%	0%	0%	0%	0%	0%	0%
5.7.2.3.	100%	100%	0%	0%	0%	0%	0%	0%
5.7.3.1.	100%	100%	0%	0%	0%	0%	0%	0%
5.7.3.2.	100%	33%	0%	0%	0%	67%	0%	0%
5.7.3.3.	100%	100%	0%	0%	0%	0%	0%	0%
5.7.3.4.	100%	0%	0%	75%	0%	25%	0%	0%
5.8.1.1.	100%	100%	0%	0%	0%	0%	0%	0%
5.8.1.2.	100%	100%	0%	0%	0%	0%	0%	0%
5.8.1.3.	100%	100%	0%	0%	0%	0%	0%	0%
5.8.1.4.	100%	100%	0%	0%	0%	0%	0%	0%
5.8.1.5.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.1.1.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.2.1.	100%	75%	0%	0%	0%	0%	25%	0%
5.9.2.2.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.2.3.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.2.4.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.3.1.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.3.2.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.3.3.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.3.4.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.3.5.	100%	100%	0%	0%	0%	0%	0%	0%
5.9.4.1.	100%	100%	0%	0%	0%	0%	0%	0%
TOTAL	100%	**60%**	**1%**	**2%**	**5%**	**28%**	**3%**	**2%**

Table 18 Summary of analysis results for NBC 2020 Part 5, building envelope, energy efficiency and acoustic design requirements, showing number of provisions allocated coded recommendations by article.

Code Article	No. Provisions in Analysis	No. Provisions Analysed	Number of provisions for each Code recommendation						
			1	2	3	4	5	6	7
5.1.1.1.	2	2	2	0	0	0	0	0	0
5.1.2.1.	3	3	3	0	0	0	0	0	0
5.1.3.1.	1	1	1	0	0	0	0	0	0
5.1.4.1.	13	13	1	0	0	6	5	1	0
5.1.4.2.	5	5	0	0	0	0	5	0	0
5.1.5.1.	1	1	0	0	0	0	0	1	0
5.2.1.1.	3	3	2	0	0	0	0	0	1
5.2.1.2.	1	1	0	0	0	0	0	0	1
5.2.1.3.	3	3	1	0	0	0	0	0	2
5.2.2.1.	7	7	6	0	0	1	0	0	0
5.2.2.2.	6	6	4	0	0	1	0	1	0
5.2.2.3.	1	1	0	0	0	0	0	1	0
5.3.1.1.	4	4	0	0	0	0	4	0	0
5.3.1.2.	4	4	0	0	0	0	4	0	0
5.3.1.3.	2	2	0	0	0	0	2	0	0
5.4.1.1.	18	18	4	0	0	0	14	0	0
5.4.1.2.	6	6	3	0	0	0	3	0	0
5.5.1.1.	5	5	0	0	0	0	5	0	0
5.5.1.2.	4	4	0	2	0	0	2	0	0
5.6.1.1.	5	5	0	0	0	0	5	0	0
5.6.1.2.	2	2	1	0	1	0	0	0	0
5.6.2.1.	5	5	2	0	0	0	3	0	0
5.6.2.2.	5	5	4	0	0	1	0	0	0
5.7.1.1.	1	1	1	0	0	0	0	0	0
5.7.1.2.	3	3	2	0	0	0	1	0	0
5.7.2.1.	1	1	1	0	0	0	0	0	0
5.7.2.2.	2	2	2	0	0	0	0	0	0
5.7.2.3.	1	1	1	0	0	0	0	0	0
5.7.3.1.	1	1	1	0	0	0	0	0	0
5.7.3.2.	3	3	1	0	0	0	2	0	0
5.7.3.3.	3	3	3	0	0	0	0	0	0
5.7.3.4.	4	4	0	0	3	0	1	0	0
5.8.1.1.	3	3	3	0	0	0	0	0	0
5.8.1.2.	3	3	3	0	0	0	0	0	0
5.8.1.3.	4	4	4	0	0	0	0	0	0

Table 18 continued

Code Article	No. Provisions in Analysis	No. Provisions Analysed	Number of provisions for each Code recommendation						
			1	2	3	4	5	6	7
5.8.1.4.	11	11	11	0	0	0	0	0	0
5.8.1.5.	8	8	8	0	0	0	0	0	0
5.9.1.1.	3	3	3	0	0	0	0	0	0
5.9.2.1.	4	4	3	0	0	0	0	1	0
5.9.2.2.	4	4	4	0	0	0	0	0	0
5.9.2.3.	2	2	2	0	0	0	0	0	0
5.9.2.4.	4	4	4	0	0	0	0	0	0
5.9.3.1.	1	1	1	0	0	0	0	0	0
5.9.3.2.	1	1	1	0	0	0	0	0	0
5.9.3.3.	2	2	2	0	0	0	0	0	0
5.9.3.4.	11	11	11	0	0	0	0	0	0
5.9.3.5.	12	12	12	0	0	0	0	0	0
5.9.4.1.	2	2	2	0	0	0	0	0	0
TOTAL	200	**200**	**120**	**2**	**4**	**9**	**56**	**5**	**4**

Table 19 Summary of analysis results for NBC 2020 Part 9, building envelope, energy efficiency and acoustic design requirements, showing percentages of the total number of provisions allocated coded recommendations by section.

Code Section	Percentage of Provisions Analyzed	Percentage of Provisions Analyzed based on Coded Recommendations						
		1	2	3	4	5	6	7
9.7.	100%	84%	0%	10%	2%	0%	1%	2%
9.11.	100%	90%	0%	0%	0%	0%	10%	0%
9.12.	100%	7%	0%	32%	43%	0%	7%	11%
9.13.	100%	21%	0%	51%	15%	0%	13%	0%
9.14.	100%	46%	0%	41%	14%	0%	0%	0%
9.15.	0%	0%	0%	0%	0%	0%	0%	0%
9.16.	100%	43%	0%	39%	17%	0%	0%	0%
9.17.	0%	0%	0%	0%	0%	0%	0%	0%
9.18.	85%	32%	0%	50%	3%	0%	0%	0%
9.19.	100%	32%	0%	53%	16%	0%	0%	0%
9.20.	0%	0%	0%	0%	0%	0%	0%	0%
9.21.	0%	0%	0%	0%	0%	0%	0%	0%
9.22.	0%	0%	0%	0%	0%	0%	0%	0%
9.23.	0%	0%	0%	0%	0%	0%	0%	0%
9.24.	0%	0%	0%	0%	0%	0%	0%	0%
9.25.	100%	27%	5%	26%	40%	0%	1%	0%
9.26.	100%	15%	3%	72%	10%	0%	0%	0%
9.27.	100%	32%	2%	51%	15%	0%	0%	2%
9.28.	100%	6%	0%	59%	35%	0%	0%	0%
9.29.	100%	17%	4%	78%	1%	0%	0%	0%
9.30.	100%	0%	3%	79%	15%	0%	0%	3%
9.35.	0%	0%	0%	0%	0%	0%	0%	0%
9.36	100%	93%	0%	3%	3%	0%	0%	0%
TOTAL	67%	**51%**	**1%**	**34%**	**11%**	**0%**	**1%**	**0%**

Table 20 Summary of analysis results for NBC 2020 Part 9, building envelope, energy efficiency and acoustic design requirements, showing number of provisions allocated coded recommendations by section.

Code Section	No. Provisions in Analysis	No. Provisions Analysed	Number of provisions for each Code recommendation						
			1	2	3	4	5	6	7
9.7.	81	81	68	0	8	2	0	1	2
9.11.	20	20	18	0	0	0	0	2	0
9.12.	28	28	2	0	9	12	0	2	3
9.13.	82	82	17	0	42	12	0	11	0
9.14.	37	37	17	0	15	5	0	0	0
9.15.	99	0	0	0	0	0	0	0	0
9.16.	23	23	10	0	9	4	0	0	0
9.17.	29	0	0	0	0	0	0	0	0
9.18.	34	29	11	0	17	1	0	0	0
9.19.	19	19	6	0	10	3	0	0	0
9.20.	191	0	0	0	0	0	0	0	0
9.21.	38	0	0	0	0	0	0	0	0
9.22.	7	0	0	0	0	0	0	0	0
9.23.	278	0	0	0	0	0	0	0	0
9.24.	19	0	0	0	0	0	0	0	0
9.25.	84	84	23	4	22	34	0	1	0
9.26.	155	155	23	4	112	16	0	0	0
9.27.	186	186	59	3	94	27	0	0	3
9.28.	49	49	3	0	29	17	0	0	0
9.29.	83	83	14	3	65	1	0	0	0
9.30.	34	34	0	1	27	5	0	0	1
9.35.	3	0	0	0	0	0	0	0	0
9.36	468	467	435	0	15	16	1	0	0
TOTAL	2047	**1377**	**706**	**15**	**474**	**155**	**1**	**17**	**9**

Appendix D Towards Performance-Based Seismic Design Provisions for NBC

This section presents a potential high-level framework for the performance-based seismic design provisions in NBC, and provides some recommendations for details of what could be included in these provisions, including how some of the current content in NBC can be utilized. The information presented herein may provide some future-looking perspectives or aspects towards performance-based seismic design for buildings, which may be broader than the mandate of the NMCC-PBS for the 2025-2030 code cycle.

Performance-based seismic design is not likely to be used as an alternative to the simple prescriptive procedures for the following cases:

- regions of very low seismicity (current 4.1.8.1); and
- small and simple buildings meeting certain restrictions (4.1.8.7) where the static analysis procedure is used with the design requirements (4.1.8.11);

and therefore, that current content of NBC is not included in the following high-level framework.

1. Performance requirements

Start the performance requirements (e.g., related to Articles 4.1.8.5, 4.1.8.23) with simple clear statements of the acceptable level of damage to buildings in different importance categories after a certain level of ground shaking. Discussion at the NMCC-PBS would be required to clearly define these.

(a) Normal Importance Buildings

Performance requirements at Design Ground Motion (DGM):

Suggest clarify in the body of the Code that ‘Life Safety’ is the performance objective for Normal Importance buildings at 2% probability of exceedance in 50-year hazard level.

What is meant by “life safety performance” should be clearly defined, which may be different than defined elsewhere such as in the US (“safeguarding people during escape and rescue”). What are the acceptable levels of damage to structural and non-structural elements? Commentary J has some information on this.

Additional performance requirements at less intense but more frequent ground shaking:

Structural framing elements not considered part of SFRS in a subset of Normal Importance Buildings are required to behave elastically at the 10% probability of exceedance in 50-year hazard level (4.1.8.23.(4)).

(b) High Importance Buildings

Performance requirements at Design Ground Motion (DGM):

Define the intended performance of High Importance buildings at 2% probability of exceedance in 50-year hazard. What are the acceptable levels of damage to structural and non-structural elements? Commentary J has some information on this.

Additional performance requirements at less intense but more frequent ground shaking:

High Importance buildings are required to behave elastically at the 10% probability of exceedance in 50-year hazard level (4.1.8.23.(3)).

(c) Post-Disaster Buildings

Performance requirements at Design Ground Motion (DGM):

Define the intended performance of post-disaster buildings at 2% probability of exceedance in 50-year hazard. What are the acceptable levels of damage to structural and non-structural elements? Commentary J has some information on this.

Additional performance requirements at less intense but more frequent ground shaking:

Post-disaster buildings are required to behave elastically at the 5% probability of exceedance in 50-year hazard level (4.1.8.23.(2)).

(d) Site stability statement from 4.1.8.17.

(e) Potential for liquefaction of the soil from 4.1.8.16.(10).

2. Ground motion characterization

Group the following requirements for ground motion characterization:

- A complete definition of the ground motions at different hazard levels.
- Spectrum for linear dynamic analysis (LDA) (from 4.1.8.4)
- Selection and scaling of ground motions for nonlinear dynamic analysis (NLDA) (from Commentary J)
- Site response procedures to determine modification of hazard accounting for different soil profiles.
- Soil structure interaction considerations

3. Minimum design requirements

Begin with a clear definition of the capacity design requirements in general terms, such as classification of actions in SFRS elements – deformation-controlled action with reliable inelastic deformation capacity, or force-controlled action which needs to be capacity protected; as well as design consideration for those actions.

Summarize all minimum design requirements such as:

- General requirements from 4.1.8.3.(2) to (7)
- General requirements from 4.1.8.15 such as: (1), (5) to (10)
- Structural configuration (4.1.8.6) and corresponding system restrictions for irregularities (4.1.8.10)
- Foundation requirements from 4.1.8.16.(5), (10)
- Requirements for structural, non-structural elements and equipment: 4.1.8.18.

Summarize more specific requirements (here or elsewhere) such as:

- Seismic category specific foundation requirements, i.e., foundation requirements for SC3 and SC4 such as 4.1.8.16.(6) to (9);
- Material/system specific requirements such as 4.1.8.15.(2) to (4);
- Requirements for unusual irregular buildings (not within the scope of current NBC) to provide equivalent performance to common regular buildings (within the scope of NBC); these requirements need to be developed.

Clarify which minimum design requirements can be waived so long as it can be justified to the peer review panel following the peer review requirements, and which minimum design requirements cannot be waived.

4. Modelling and analysis requirements

Summarize all general modelling and analysis requirements such as:

- An expanded version of the brief statement from 4.1.8.3.(8)
- Dynamic analysis procedure (4.1.8.12)
- Analysis in orthogonal directions from 4.1.8.8
- Accidental torsion from 4.1.8.12.(4)
- Requirement to consider soil flexibility from 4.1.8.16.(1)
- Requirements for nonlinear dynamic analysis from Commentary J.

Summarizing more specific modelling and analysis requirements such as:

- For design of seismic isolation (4.1.8.19, 4.1.8.20)
- For design of supplemental energy dissipation (4.1.8.21, 4.1.8.22)
- Describe considerations for new systems where these is no experience with modelling and analysis

5. Life safety evaluation

Clarify the acceptance criteria for life safety evaluation. General requirements at the system level such as:

- Maximum drift (from 4.1.8.13);
- Residual drift;
- Separation (from 4.1.8.14);
- Maximum number of unacceptable responses from nonlinear dynamic analysis.

It is also suggested to clarify the acceptance criteria for immediate occupancy and functional performance levels.

Define System specific requirements such as:

- Deformation demands on deformation-controlled actions or elements within limits specified in reference document for the system;
- Force demands on force-controlled actions or elements within limits specified in reference document for the system.

Provide a framework/procedure to be used to establish the acceptance criteria for a new type of system, including the testing requirements, analysis requirements, and the special peer review requirements for these types of systems.

Requirements for unusual irregular buildings (not within the scope of current NBC) to provide equivalent performance to common regular buildings (within the scope of NBC).

6. Serviceability evaluation

Define acceptance criteria for immediate occupancy and functional performance objectives.

Define general requirements at the system level such as

- Maximum drift (from 4.1.8.13, 4.1.8.23);
- Residual drift;
- Maximum number of unacceptable responses from nonlinear dynamic analysis.

Define System specific requirements such as:

- Deformation demands on deformation-controlled actions or elements within limits specified in reference document for the system;
- Force demands on force-controlled actions or elements within limits specified in reference document for the system.

7. Peer review requirements

Define the scope of the peer review and procedures to qualify and select Peer Review panel members specifically for performance-based design.

Example requirements currently being used for performance-based seismic design in the U.S. can be found in LATBSDC “An Alternative Procedure for Seismic Analysis and Design of Tall Buildings” [30] and PEER “Guidelines for Performance-Based Seismic Design of Tall Buildings” [31].