TECHNICAL REPORT

ISO/TR 12910

First edition
2010-04-01

Light-frame timber construction — Comparison of four national design documents

Construction à ossature légère de bois — Comparaison de quatre documents nationaux pour la conception

Reference number
ISO/TR 12910:2010(E)

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Published in Switzerland

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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ISO/TR 12910 was prepared by Technical Committee ISO/TC 165, *Timber structures*.

Introduction

Light-frame timber construction is the dominant construction practice for housing and other types of buildings in some countries. In these countries, it has gained widespread acceptance due to its many benefits, including ease of construction, cost-effectiveness, adaptation to energy efficient buildings and proven performance. This Technical Report is intended to provide an overview of the common elements in existing national structural design documents on light-frame timber construction.

The comparison chart (see Annex A) is intended to assist in that process. This Technical Report draws attention to several common themes and identifies some differences in the documents reviewed.

Light-frame timber construction — Comparison of four national design documents

1 Scope

This Technical Report provides an introduction and synopsis of comparisons among the following four national design documents on light-frame timber (wood)[1)] construction:

a) AS 1684-1 (including AS 1684-1:1999/Amd.1:2002), AS 1684-2 and AS 1684-3;

b) the *Engineering guide for wood-frame construction*;

c) NZS 3604;

d) the *Wood Frame Construction Manual (WFCM) for One- and Two-Family Dwellings* (Chapter 1: General information, Chapter 2: Engineered design and Chapter 3: Prescriptive design).

Each of the four light-frame texts compared in this Technical Report is based on a national timber design standard that includes provisions for assemblies and systems, which go beyond single-member design methodology. Other jurisdictions also have similar design documents on light-frame timber construction. Although not all jurisdictions have design documents on light-frame timber construction, timber design standards typically address assemblies and systems (See 6.2).

2 Document design principles

2.1 Basic principles

AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* each comply with a national code, which defines the higher level building design principles and conditions that need to be met for light-frame timber buildings, including strength and serviceability criteria, specified loads and material design performance.

In general, AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* (design documents) share basic principles related to demonstrating how light-frame timber construction can comply with structural requirements, particularly how it can resist high-wind and/or seismic loading conditions and provide additional guidance concerning system design and construction methods.

At the same time, AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* do not all seek to have the same coverage or topics (see Clause 3). Some deal with housing only, others with housing and small buildings; a few with wood structural design only and others with other structural components or design aspects of the building. These differences complicate direct comparisons of the documents on a detailed level.

The following are some observations on general principles found.

1) The terms “wood” and “timber” are used interchangeably in this Technical Report.

2.2 Compliance through pre-engineered solutions

To demonstrate how to comply with national code requirements for light-frame wood construction, pre-engineered solutions and tables to accompany engineering design methods are included in AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual*. This approach can be more conservative in some cases, but can also facilitate design and regulatory checking, particularly in areas less familiar with the construction system.

The following are examples.

— AU: AS 1684-1, AS 1684-2 and AS 1684-3 cover design of timber-framed construction conforming to loading and performance requirements for Class 1 (housing or hostels) and Class 10 (non-habitable structures) buildings as defined by the national code; less conservative designs can be permitted by other building regulations or standards.

— CA: The *Engineering guide for wood-frame construction* covers a subset of the national code — Part 9 (Housing and small buildings). Part 9 typically permits less conservative measures for housing and small buildings, particularly for buildings subjected to significant lateral loading.

— NZ: NZS 3604 provides acceptable "non-specific" design solutions to the performance-based national code, including many detailed construction provisions.

— US: The *Wood Frame Construction Manual* is referenced in US national codes for design of wood-frame construction, particularly in higher wind and seismic conditions; other provisions permit less conservative conventional construction or engineered designs.

2.3 Design requirements matched to risk level

2.3.1 General

AS 1684-1, AS 1684-2 and AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* all, in one way or another, match design provisions to the type and intensity of loading as well as vulnerability of the building structure. This can in some cases lead to design discontinuities where special solutions are specified only for high- or low-risk areas, but also helps to provide a better fit to the scale of the problem.

2.3.2 Examples

— AU: Separate cyclonic and non-cyclonic documents deal with high- or low-risk cyclonic events. AS 1684-1, AS 1684-2 and AS 1684-3 increase requirements for higher risk areas, with up to half of racking force permitted to be resisted by nominal wall bracing; AS 1684-2 is published for simplified design in non-cyclonic areas.

— CA: Part C of the *Engineering guide for wood-frame construction* advises on applicability of solutions under lateral loading conditions, based on spacing and location of braced walls; national codes permit prescriptive construction that are more liberal than Part C of the *Engineering guide for wood-frame construction*.

— NZ: Prescriptive provisions include restrictions on bracing elements in terms of spacing, minimum capacity and location; if spacing of bracing lines not evenly distributed, spacing is reduced to coincide with a line of supporting members.

— US: Separate "prescriptive design" document in tabular format is based on engineering principles; national codes permit conventional construction in lower risk situations.

2.4 Relationship to engineering design

AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* share the objective of maintaining continuous load paths, but it is recognized that they cannot fully replace the design process. Common themes include agreement that not all aspects of the complete structure are fully addressed and conservative assumptions are made to present efficient design aids. The documents are intended to be used principally by engineers or other competent designers.

The following are examples.

— AU: Intended to provide building industry with design procedures and details for use in cyclonic and non-cyclonic areas; another simplified version (AS 1684-4) was published for non-designers.

— CA: Intended to be used in conjunction with competent engineering design, as well as to provide guidance to a wide range of the building community (e.g. builders, code officials).

— NZ: Intended to be used by a wide range of the building industry, while recognizing that due to national code requirements, users would be mainly fulfilling the role of a designer.

— US: Intended to be used in conjunction with competent engineering design, providing guidance and saving time for the design professional.

2.5 Evolving understanding of load-resistance interaction

There is widespread recognition of the complexity of load and resistance distribution and interaction in light-frame construction systems under gravity and lateral loading patterns. AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* include varying approaches to incorporating system action provisions and calibrating to the long performance history of these systems. These provisions are likely to evolve to include more advanced design tools as knowledge grows.

The following are examples.

— AU: Load distribution and strength-sharing effects are included in design methods for framing members, including rafter, studs and joists.

— CA: Design of rafters, studs, joists, headers and beams includes consideration of system action and strength sharing; shearwall design is a mechanics-based approach with additional consideration of shearwalls without hold-downs where sheathing is used to resist overturning and/or uplift.

— NZ: Nominal bracing systems are provided with prescribed bracing capacities; performance-based design (national code) permits use of alternative design solutions.

— US: Wall stud design includes system factors, load-sharing increase factors provided for joists, rafters and other members; shearwall design includes a mechanics-based approach for shearwalls with hold-downs with additional consideration of the empirical based perforated shearwall model (without hold-downs).

3 Coverage and limitations

3.1 General

The light-frame construction documents are limited in terms of building size, loads and other parameters. These limits are dictated largely by national codes, yet committees also make many decisions on what to include within the scope and limitations of light-frame construction documents.

3.2 Definition of light-frame construction

AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* all address small light-frame buildings constructed primarily of closely-spaced repetitive wood-framing members connected together in roof, wall and floor systems. Construction details are based on traditional domestic methods, and consequently, they differ to some extent on restrictions on building height, width, size and occupancy. The differences are less significant than common elements of structural design interest.

The following are examples.

— AU: Maximum building of two stories above substructure, maximum 8,5 m height; storey height up to 3,0 m, except up to 3,6 m where increased loads considered in design.

— CA: Building height not greater than three stories and maximum storey height not greater than 3,5 m.

— NZ: Timber-framed buildings up to three stories high, total height not more than 10 m.

— US: Building not more than three stories or a mean roof height of 10 m, maximum story height of 3,6 m for engineered design or 3,0 m for prescriptive design.

3.3 Prescriptive and performance-based approaches

Design documents are formulated on the basis of either prescriptive or performance-based designs, or combinations of both. Both approaches can take the form of pre-engineered solutions and it is sometimes difficult to disentangle them in a standard. In general, one would expect prescriptive measures to be more limited in application or more conservative than a fully engineered approach, but this is not always so.

The following are examples.

— AU: Bracing walls with minimum shear capacity require nominal fixing only and prescriptive fixings are provided for such cases; design criteria include system-based assumptions.

— CA: Mechanics-based lateral design method supplemented by tables; prescriptive bracing provisions, including consideration of non-structural elements included in Part C of the *Engeneering guide for wood-frame construction*.

— NZ: Prescriptive measures are based on tabulated bracing units equivalent to shear force (kN) per unit length or unit area; detailed provisions depend on building location and climatic data.

— US: Engineering lateral design method supplemented by prescriptive tables and specific framing details based on engineering assumptions and calculations.

3.4 Integration of national code provisions

National building codes vary from country to country and can include other sections related to light-frame construction, such as conventional construction provisions, loading and load factors, design principles and methods. On the other hand, national codes cannot cover all that is needed to fully address light-frame construction. Therefore, the documents either duplicate some of the national code provisions or make reference to them. Duplication is more complete, but can also lead to errors, revisions and national code interpretation questions.

The following are examples.

— AU: AS 1684-1, AS 1684-2 and AS 1684-3 include many prescriptive and engineering design and loading provisions, as well as reference to other documents forming part of the criteria for residential timber-framed construction to show conformance to national code requirements.

— CA: National code includes separate provisions for both fully-engineered and prescriptive design of wood buildings, therefore the *Engineering guide for wood-frame construction* includes selective provisions on loads and design assumptions to ensure understanding of which are applicable it.

— NZ: National code is a high-level performance-based document without specific provisions for light-frame construction, therefore NZ 3604 includes all aspects of design for these types of buildings, but does not include all load and design provisions.

— US: National codes include specific provisions for prescriptive braced walls which may be used for conventional construction, but these provisions are not included in the *Wood Frame Construction Manual*; the *Wood Frame Construction Manual* includes design provisions with reference to the national code for further load information.

3.5 Scope of structural design

Structural design of light-frame construction can include design of foundations, components, ancillary buildings, hybrid concrete-wood construction and other types of structures. Some of the documents include provisions for design aspects of these non-wood structures, while others are limited to the basic wood-frame construction system. AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* stress the need for load path continuity throughout the structure.

The following are examples.

— AU: AS 1684-1, AS 1684-2 and AS 1684-3 include detailed provisions for concrete foundations, piers, stumps, columns and slabs; AS 1684-1, AS 1684-2 and AS 1684-3 also includes building practice and procedures to assist in correct specification and construction procedures.

— CA: The *Engineering guide for wood-frame construction* does not cover specific foundation design, but includes forces and design provisions for attachment of walls to foundation and anchor bolt capacities; it also contains detailed prescriptive provisions for connecting braced walls to foundation.

— NZ: Includes detailed provisions for site requirements, foundations, expansive soils, slabs, piles, lintels, claddings, linings and ceilings; concrete masonry walls included as part of framing system; some design aspects covered by reference to other standards.

— US: Does not cover specific foundation design, but includes forces and connection design provisions for attachment of walls to foundation or crawl spaces, and anchor bolt capacities.

3.6 Beyond structural requirements, such as durability

Regulation of wood-frame construction does not end with structural requirements. Durability issues are of equal concern and can also be linked to structural issues resulting from high-wind and seismic events, e.g. corrosion, decay, mould and ventilation. Some of these documents are limited to structural design, while some cover other aspects of national code requirements.

The following are examples.

— AU: Includes durability provisions for timber, hardware, service conditions by reference to other standards and informative appendices on durability classes and timber properties.

— CA: Addresses structural requirements only; durability is outside scope, other than a general requirement to consider decay resistance in design of the structure.

— NZ: Includes section on durability covering timber, hardware, service conditions, claddings, underlay, sheathing, concrete, sealants and flashings; it does not include full details related to protection of the building envelope.

— US: Addresses structural requirements only; it is not applicable to durability.

4 Loads and load factors

4.1 General

Because loading is dictated largely by national codes, there are load differences between AS 1684-1, AS 1684-2, AS 1684-3, the Engineering guide for wood-frame construction, NZS 3604 and the Wood Frame Construction Manual. However, these differences are not so large as to change the nature of the light-frame construction system or the demands placed on the system.

4.2 Basic design framework and philosophy

All except the *Wood Frame Construction Manual* are based on factored load and resistance Limit states design format. While the *Wood Frame Construction Manual* is in unfactored or Working stress design format in accordance with general US practice, the referenced US wood design standard is available in dual (factored and unfactored) format. Another framework choice relates to decisions about design for load combinations, including the probability of simultaneous occurrence of maximum design loads.

The following are examples.

— AU: Loads and capacities based on Limit states design; calculations include consideration of various combinations and patterns of permanent and transient loads for single span, continuous and cantilevered spans.

— CA: Loads and capacities based on Limit states design; primary members designed for single spans under uniform loading with point loads as appropriate; reductions apply where multiple transient loads are considered together.

— NZ: Loads and capacities based on Limit states design; national code requires compliance but does not stipulate how to comply; intent of NZS 3604 is to provide acceptable “non-specific” pre-engineered solutions; some design capacities are referenced to test results.

— US: Loads and capacities based on Working stress design, although multi-level load combination factors based on factored load approach; primary members designed for single spans under uniform or unbalanced (snow) loading with point loads as appropriate.

4.3 Load comparisons

Comparison of load levels in AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* is not straightforward because of the many load and resistance adjustments forming part of the design methods in different countries. In some cases, cross-boundary comparisons are misleading due to offsetting load and resistance modifications. National committees make many different decisions about how to characterize loads, e.g. return period, statistical parameters and modification factors.

The following are examples.

— AU: Permanent and transient loads are listed as specified loads along with associated load factors; loads are modified by additional load distribution factors depending on construction variables.

— CA: Live loads, F_{L}, snow loads, F_{snow}, rain loads, F_{rain}, wind loads, F_{wind}, earthquake loads and dead loads, F_{D}, are listed as specified loads, along with associated load factors; wind load calculations involve many additional gust factors.

— NZ: Live loads, F_{L}, are listed in the standard without identified modification factors and adjustments.

— US: Live, snow, wind, earthquake loads and dead loads are specified; loads are based on unfactored Working stress design, and wind calculations involve many additional load modifications.

5 Material specifications

5.1 General

AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* address material specifications and resistances for standard and non-standard products, including engineered wood and connections.

5.2 Product standards

Each document includes domestic material references and specifications accepted by the authority having jurisdiction. While these references tend to be limited to national standards and other documents, there is some provision for acceptance of other specifications as needed.

The following are examples.

— AU: References to applicable standards and supplements; alternative seasoned and unseasoned timber sizes also provided.

— CA: References to applicable material and design standards provided.

— NZ: Materials limited to two species, specific sizes and grades; other specifications require alternative solutions.

— US: References to applicable material and design standards provided.

5.3 Proprietary wood products

Proprietary wood products, such as I-joists and structural composite lumber, expand wood-frame construction through increased spans or load-carrying capacities. AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* have sought to integrate these products as much as possible, although their proprietary nature makes it impossible to include complete design information.

The following are examples.

— AU: Proprietary engineered wood product use subject to approval of building authority and manufacturer's recommendations.

— CA: Proprietary engineered wood product use in accordance with QA programme supervised by independent third party certification organization and as stated in the manufacturer's report.

— NZ: Proprietary products subject to approval of authorities, with testing standards referenced for evaluating proprietary products.

— US: Proprietary engineered wood product use according to the national code and the manufacturer's report.

6 Member design

6.1 General

In accordance with the relevant national code, members are designed to meet specific strength and serviceability limits. At the same time, AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* are useful in helping set those limits because performance levels are complex and calculated or prescribed solutions are only approximations of actual performance. Light-frame wood systems have a long performance history that is also considered in developing AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual*. Calculations, partial calculations or prescriptive determinations of roof, floor and wall provisions are included.

6.2 Member vs. system design

AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* are based on a national material design standard that covers design of wood or timber members and their connections, including provisions for structural components or systems which go beyond single member design methodology, adding greater efficiency or accuracy to specified end uses. System design is typically referenced to other standard documents, based on full-sized tests, models or historical experience or a combination of these.

The following are examples.

— AU: Design criteria include system-based assumptions to recognize the interaction between structural and other elements of the construction assembly; any changes to materials or methods can invalidate these assumptions.

— CA: Design criteria for framing members include system action, strength sharing and special short-term load duration; built-up members also have system factors.

— NZ: Design criteria include bracing system capacities which are based on test results.

— US: Design criteria for framing members include factors for composite action and load sharing.

— Other jurisdictions also have design standards which address timber assemblies and systems. For example EN 1995-1-1 and EN 1995-1-2 include design provisions for trusses, shearwalls, diaphragms and system design.

6.3 Roofs

Roof design is typically simplified for light-frame construction, taking into account the complexity of roof shapes and systems. As a result, AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* do not always require consideration of roof live or snow load patterns and can permit reduced gravity loads. Roof trusses tend to have more complete engineering solutions than rafter systems, but can also be calibrated up to limits of span and building size. Wind uplift on roofs is a different matter (see Clause 7).

The following are examples.

— AU: Roof members designed as sloped bending member under uniform and point live loads, coupled or uncoupled with ceiling joists; deflection calculated on basis of span along axis.

— CA: Roof members designed as sloped bending member under gravity and wind loads, F_{wind}, supported at top and bottom or as rafter connected to ridge board at top and ceiling joist at bottom; deflection on horizontal projection.

— NZ: Roof members designed to resist vertical wind and roofing loads, with rafters either coupled with ceilings or supported by ridge beam.

— US: Roof members designed as sloped bending member under gravity and wind loads, supported at top and bottom or as roof rafter connected to ridge board at top and ceiling joist at bottom; deflection on horizontal projection.

6.4 Walls

For light-frame walls up to 3 m in height, stud design tends to be governed more by practical constraints, such as the spacing of interior lining attachment, rather than by structural requirements. Where they are engineered, wall studs are designed to resist axial and lateral loads, alone or in combination. Where open spaces or vaulted ceilings require taller studs, special tables or designs are provided.

The following are examples.

— AU: Wall studs designed for axial forces from supported floors or roofs, as well as for horizontal bending loads.

— CA: Wall studs designed for bending, axial and axial-bending cases; bending-axial design has lower wind pressure coefficients than bending design alone.

— NZ: Wall studs designed to resist vertical loads as well as to resist horizontal loads separately.

— US: Wall studs designed for bending, axial and axial-bending cases; bending-axial design has lower wind pressure coefficients than bending design alone.

6.5 Floors

Floor design solutions are based on National performance criteria, and serviceability criteria—more than strength criteria — typically limit joist spans. Proprietary engineered wood members provide acceptable alternative solutions, but can also achieve longer spans and involve special design considerations, therefore member design and documentation in accordance with specified procedures and reports are required.

The following are examples.

— AU: Floor joists designed as bending members under permanent, transient and point loading: single span, continuous or cantilevered spans; serviceability includes deflection and dynamic criteria.

— CA: Floor joists designed for gravity loads and, in the case of diaphragms, designed for lateral loads; serviceability criteria include deflection and vibration performance.

— NZ: Floor joists pre-engineered for tabulated spans and loads.

— US: Floor joists designed for gravity loads and, in the case of diaphragms, designed for lateral loads; serviceability criteria includes deflection performance.

7 Lateral load systems design

7.1 General

Most questions about structural performance of light-frame construction systems arise from lateral load design, including shear, uplift and overturning. This is a topic of interest to national code bodies and an active area of research, so it's not surprising that the various documents provide different solutions. Each committee has had to decide whether lateral load resistance provisions were to be calculated, partially calculated or determined prescriptively in specific cases.

7.2 Linking lateral design to analysis models

In general, structural analysis methodology is not the principal subject of AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 or the *Wood Frame Construction Manual*. Nevertheless, design of the lateral load system can be predicated on assumptions about structural models in accordance with codes or general practice, and it is not always possible to separate analysis from design.

The following are examples.

- AU: Diaphragms transfer horizontal loads to braced cross walls; net uplift reduced at bottom plate level based on the assumption that the house acts as a box.
- CA: Roof and floors act as flexible diaphragms to transfer lateral forces to wall systems, disregarding contribution of non-structural elements, redundancy and load sharing.
- NZ: Pre-engineered design of foundation, wall, roof and floor systems based on evenly distributed loading and bracing assumptions; wings or blocks designed as if the wing or block were a separate building.
- US: Lateral design based on assumption of “box-like” structure of roughly rectangular shape, relatively uniform shear resistance and enclosed against wind pressures.

7.3 Load action assumptions

Lateral design emphasizes the need for continuity in load paths through the structure and its connections. At the same time, AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* all include decisions about whether loads in different directions should be assumed to act together or independently, taking into account the complex and variable nature of load distribution in these structures.

The following are examples.

- AU: Forces from horizontal loads are transferred to braced cross walls for each floor level considered separately; vertical loads (including uplift) are designed separately.
- CA: Forces between roof framing and walls caused by wind uplift, diaphragm shear, and wind on the face of the building are assumed to act independently.
- NZ: Wall and roof systems designed separately for vertical and horizontal loads; bracing forces determined separately for the level within the building being considered.
- US: Forces between roof framing and walls caused by wind uplift, shear and face loading are assumed to act independently.

7.4 Uplift design

The most serious failures observed in high-wind areas often result from uplift deficiencies, either at roof-to-wall, wall-to-wall or wall-to-foundation connections. In general, complete solutions are provided to address these critical interfaces.

The following are examples.

- AU: Roof members tied to supports (walls, floors and foundations) to resist uplift forces minus factored gravity loads including partial dead load and the permanent component of live load resisting uplift.
- CA: Roof members tied to supports (walls, floors and foundations) to resist uplift loads minus partial dead load; special design required for buildings in higher wind load areas; otherwise, prescriptive details can be used.
- NZ: Uplift fixings provided prescriptively for low, medium, high and very high wind zones.
- US: Roof members tied to resist uplift loads minus partial dead load, with load path provided by either a continuous connector or series of connections between roof, walls, floors and foundation.

7.5 Racking and overturning design

Racking design is addressed in different ways ranging from complete shearwall design to nominal wall bracing details. Nominal bracing solutions are typically limited in application to protect structural integrity in higher-risk situations.

The following are examples.

- AU: All bracing walls fixed to floor, ceiling or roof frame with connections of equal shear capacity to bracing capacity of wall.
- CA: Hold-down overturning resistance in accordance with shearwall design, sized to resist required overturning and uplift forces.
- NZ: Wall bracing and prescriptive fixing details to floor and foundation.
- US: Hold-downs to provide both uplift and overturning resistance in accordance with design of shearwalls, including capacity of stories located above.

7.6 Building plan irregularities

Wood-frame construction has a wide range of plan arrangements, including L-shaped and other irregular layouts. Since AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* are all based on “box-like” design approaches, they typically include provisions to show how these design irregularities affect basic assumptions.

The following are examples.

- AU: Bracing walls under offset eaves connected to diaphragms are limited to 20 % of total bracing.
- CA: Shearwall segments in the same shearwall not offset more than 1,2 m.
- NZ: Any wings or blocks that are part of bracing system not offset more than 6 m from rest of building.
- US: Offsets in a shearwall line within a storey not more than 1,2 m.

7.7 Wall openings

Wood-frame construction has a wide range of layouts, including interior halls and exterior openings. Since all of the documents are based on “box-like” design approaches, they include provisions to show how location and size of openings affect basic assumptions.

The following are examples.

- AU: Includes design revisions to address larger spans, wider openings and bigger rooms; identifies need for structural diaphragm ceiling where openings in external walls preclude bracing.
- CA: Includes requirement for design around wall openings; draws attention to vulnerability of large openings in lower stories; in prescriptive design, braced wall openings are limited at corners.
- NZ: Limits openings in foundation and external walls prescriptively.
- US: Includes requirement for continuous load path to be made around openings, with the exception that the perforated shearwall model is accepted on the basis of laboratory tests.

7.8 Elevation irregularities

Wood-frame construction has a wide range of elevation arrangements, including split levels, short “knee” walls, and other irregular designs. Since AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame constructio*n, NZS 3604 and the *Wood Frame Construction Manual* are all based on “box-like” design approaches, they include provisions to show how discontinuities in elevation affect basic assumptions.

The following are examples.

— AU: Design rules provided for a two-storey or split level building; wall offsets not more than 1,5 times floor member depth.

— CA: Shearwall segment offset not more than 4 times floor member depth or 1,2 m (whichever is the smaller); special provisions on the use of kneewalls and split-level buildings.

— NZ: Any building with discontinuous floor levels is required to have an internal bracing line below the location of the discontinuity.

— US: Shearwall segments not offset by more than floor member depth, except when the load path is designed and detailed; non-load bearing shearwalls offset up to 4 times floor member depth.

8 Connection design

8.1 General

Connection design provisions are incorporated in the sections on roof, wall, floor systems and lateral building design. Like member design, connection design can be calculated, partially calculated or prescriptive.

8.2 Fastener schedules

Wood-frame construction is often site-built, and nailing schedules are a common part of standardization of the system. Nail capacities can range widely due to variables such as nail and wood materials, construction tolerances, and site conditions. Nail schedules can be prescriptive and limited in application, based on experience or checked against design capacities.

The following are examples.

— AU: Prescriptive nominal fixings are provided for specific applications; beyond these cases, design tables are provided.

— CA: Roof, wall and floor system connections for lateral loading designed; other connections provided in accordance with prescriptive national code provisions.

— NZ: Prescriptive nailing schedule (hand- or power-driven nails) given in tables for floor framing members and wall framing members.

— US: Connections between roof, ceiling, wall and floor assemblies designed to transfer lateral forces; other connections are provided in accordance with prescriptive national code nailing schedules.

8.3 Proprietary connections

Proprietary fasteners and hardware, such as framing anchors and hold-downs, have been developed for wood frame construction, particularly to address high-wind and seismic forces. AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* sought to integrate these connection types as much as possible, although their proprietary nature makes it difficult to include specific design information.

The following are examples.

— AU: Proprietary connectors specified in some locations to ensure load continuity; fabricated components permitted in accordance with national code authorities and manufacturers.

— CA: Framing anchors or hangers specified in some locations to ensure load continuity, in some cases with minimum load capacities, determined in accordance with national code and appropriate reports.

— NZ: Proprietary fixings specified in some locations to ensure load continuity, provided they meet minimum load capacities under referenced test standards, in accordance with the national code system of appraisal and accreditation for such products.

— US: Hangers or framing anchors specified in locations in lieu of direct bearing; capacities in accordance with national code and manufacturer's reports.

9 Other

9.1 Miscellaneous

Wood- or timber-framed construction includes many possible construction features, some of which are difficult to include in engineering design documents. Each document includes some miscellaneous features.

The following are examples.

— AU: Includes provisions for various roof types, including hip and valley rafters, cantilevered floors, design of balconies and decks more than 1 m above ground.

— CA: Includes provisions for gable, hip and valley rafter designs, raised ceiling joist ties and cantilevered floors.

— NZ: Includes provisions for various roof types, including hip and valley rafters, cantilevered floors, verandah or attached carport post and beam designs.

— US: Includes provisions for gable, hip and valley rafter designs, raised ceiling joist ties, roof I-joist rafters and cantilevered floors.

9.2 Definitions of terminology

AS 1684-1, AS 1684-2, AS 1684-3, the *Engineering guide for wood-frame construction*, NZS 3604 and the *Wood Frame Construction Manual* all have significant shared terminology. Each country, however, has some distinctive terms that can confuse those not familiar with them. The most obvious one is the use of “wood” in Canada/US vs. “timber” elsewhere.

The following are examples.

a) Blocking: wood member which provides edge support for framing (CA, US).

b) Drag strut: diaphragm or shearwall boundary element parallel to applied load to collect and transfer diaphragm shear forces to vertical force-resisting elements (CA, US).

c) Dragon ties: member fixed diagonally across top plates at the corner of a building, in the absence of a diaphragm, to support against wind loads, act as ceiling bracing and prevent walls from spreading.

d) Dwang or noggin: short member fixed between framing members (AU, NZ).

e) Hold-down: a connection used in a shearwall, connected to chords, designed to resist overturning.

f) Purlin or batten: horizontal member laid to span across rafters or trusses and to which the roof cladding is attached (AU, NZ).

g) Sarking: boarding or sheet material secured to rafters, trusses or purlins, which can also serve as the ceiling lining (NZ).

h) Shearwall: wood-framed wall system designed to resist lateral forces parallel to the plane of the wall. A shearwall can also resist vertical loads and can consist of one or more shearwall segments in the plane of the wall (CA, US).

i) Sheathing: the structural covering used directly over framing such as joists, studs and rafters, which transfers loads to the framing members (CA, US).

j) Strutting beam: structural beam spanning between loadbearing walls from which underpurlins can be strutted (AU, NZ).

k) Underpurlin: horizontal member laid underneath rafters, supporting rafters at intermediate points along their length (AU, NZ).

Annex A
(informative)

Comparison chart

Table A.1 — Comparison chart of light-frame timber construction design documents

Provision	*Engineering guide for wood-frame construction* (Canada) EN = Engineered PR = Prescriptive	*Wood Frame Construction Manual* (US) EN = Engineered PR = Prescriptive	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) CA= Cyclonic areas NC= Non-cyclonic	NZ 3604 (New Zealand)	Reference
1 Scope and limitations					
1.1 General	Primary system of repetitive wood members spaced not more than 0,6 m apart for joists, rafters, trusses and studs NOTE Construction defined as a subset of the National Building Code of Canada's Part 9 (Housing and small buildings), subject to lateral loading.	Wood-frame construction with floor, wall and roof spacing not greater than 0,6 mm for joists, rafters, trusses and studs NOTE Construction as defined and referenced in the US International Residential Code.	Houses of traditional timber framing system, with member spacing up to 0,6 m, except up to 1,2 m for light roofs, and up to 0,9 m for floors depending on flooring type NOTE AS 1684 (all parts) also includes framing details that are typically found in North American building codes.	Timber-framed structures not requiring specific engineering design with members spaced up to 0,6 m, except up to 1,2 m for light roofs or 0,9 m for heavy roofs NOTE NZS 3604 is intended to provide acceptable solutions to performance-based New Zealand Building Code.	CAN: 1.1, Section C US: 1.1.1, 2.1.3 AUST: DC1.4.1 NZ: Foreword, tables
1.2 Model assumption	Roof and floors act as diaphragms to transfer lateral forces to wall systems, disregarding contribution of non-structural elements, redundancy and load sharing (EN); supplemented by tables and prescriptive Code provisions (PR) that include some of these other contributions	Lateral design based on assumption of “box-like” structure of roughly rectangular shape, relatively uniform shear resistance and enclosed against wind pressures (EN); supplemented by prescriptive (PR) tables and provisions based on simplified conservative assumptions and calculations	Building shape essentially rectangular or combination of rectangular elements; Diaphragms transfer horizontal loads to braced cross walls, each floor level considered separately; building assumed to be enclosed beneath the lower floor; Design criteria include several system-based assumptions	Pre-engineered design of foundation, wall, roof and floor systems based on evenly distributed loading and bracing assumptions; with dragon ties and/or diaphragms to be provided as required; Building with wings or blocks designed as if the wing or block is a separate building	CAN: Foreword, Supplementary guidelines US: Commentary AUST: DC1.4.4, DC6.1.3, NC/CA1.4.3, 8.3 NZ: 1.1.2, 5.1
1.3 Building dimensions: height	Building height not greater than three stories, with maximum story height not greater than 3,5 m	Building not more than three stories or a mean roof height of 10 m, with maximum story height of 3,6 m for EN design or 3,0 m for PR design	Maximum building of two stories above substructure, for maximum height of 8,5 m; storey height up to 3,0 m or 3,6 m where specially designed	Timber-framed buildings up to three stories high; total height not more than 10 m	CAN: 1.2 US: 1.1.3.1 AUST: DC1.4.2, NC/CA1.4.2 NZ: Objective (1), 1.1.2

Table A.1 (*continued*)

Provision	***Engineering guide for wood-frame construction*** **(Canada)** **EN = Engineered** **PR = Prescriptive**	***Wood Frame Construction Manual*** **(US)** **EN = Engineered** **PR = Prescriptive**	**AS 1684-1, AS 1684-2 and AS 1684-3 (Australia)** **CA= Cyclonic areas** **NC= Non-cyclonic**	**NZ 3604 (New Zealand)**	**Reference**
1.4 Building dimensions: width, length and area	Overall building area not greater than 600 m^2, with clear spans on horizontal projection not more than 12,2 m	Building length or width not greater than 24,4 m, aspect ratio not less than 1:4 or greater than 4:1	Overall width at any section not greater than 16 m; height-to-width ratio for structure not greater than 1,0	Unlimited floor area for one- or two-storey timber buildings; for other two- to three-storey buildings, not greater than 300 m^2	CAN: 1.2.1, 1.3.1 US: 1.1.3.1, 2.1.3 AUST: DC1.4.2, DC5 NZ: 1.1.2, Table 2.1
1.5 Roof configuration	Roof slope not greater than 45°; Max. clear span = 12,2 m or in cases with arch roofs clear span limit is 6 m; Diaphragms are to be rectangular except for maximum 1,2 m offset	Roof slope not greater than 45°; attic is considered a storey where slope > 1:2 (PR); Max. rafter span = 7,9 m, max. truss span = 17,7 m; roof diaphragm aspect ratio not greater than 4:1(EN) or limited prescriptively (PR)	Roof pitch not greater than 35°; Max. span = 16 m (building width), but less if roof has nominal framing and fixing only; Diaphragm aspect ratio not greater than 4:1; Detailed information on roof area supported	Slope of any roof plane not greater than 6°; Max. roof span = 12 m; Roofs with slope less than 3° or flat roofs with access require special design; ceiling diaphragm not more than 2 times width	CAN: 1.3.2, 1.3.3, 9.1.6 US: 1.1.3.4-1.1.3.3, 2.1.3.4, Table 3.16A AUST: DC1.4.2; NC/CA2.6 NZ: 1.1.2, Fig. 1.3, 10, 13
1.6 Floor configuration	Floor joist span not greater than 12,2 m; Diaphragms are to be rectangular, with a maximum 1,2 m offset	Floor joist span not greater than 7,9 m; Floor diaphragm aspect ratio up to 4:1 (EN) or prescriptive (PR); maximum 1,2 m offset	Floor joist spans limited by span tables; Diaphragm aspect ratio not greater than 4:1; Detailed information on floor area supported	Floor diaphragm to cover entire floor area; One-storey diaphragm aspect ratio up to 2,5:1; two-storey diaphragm aspect ratio up to 2:1	CAN: 1.3, 9.1.6 US: 1.1.3.2-3, 2.1.3.2 AUST: NC/CA2.6 NZ: Fig. 7.9
1.7 Wall configuration	Wall height not greater than 5,5 m; Shearwall aspect ratio limited to 3,5:1; For braced walls, see 4A.2	Wall height not greater than 6,1 m (EN); For prescriptive design, all loadbearing studs are limited to 3,0 m (PR); Shearwall aspect ratio limited to 3,5:1 (EN) or prescriptive limits (PR)	Maximum wall height is 3 m (floor to ceiling measured at external walls), except higher for gable or skillion walls; provisions may be made for walls up to 3,6 m, if design is modified	Top storey or single floor loadbearing studs not greater than 4,8 m; Other loadbearing studs not greater than 3 m; foundation walls not greater than 2 m	CAN: TabWall3, Wall6 US: 2.1.3, Tabble 3.17D AUST: 1.4.6 NZ: Fig. 1.1

Table A.1 (*continued*)

Provision	*Engineering guide for wood-frame construction* (Canada) EN = Engineered PR = Prescriptive	*Wood Frame Construction Manual* (US) EN = Engineered PR = Prescriptive	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) CA= Cyclonic areas NC= Non-cyclonic	NZ 3604 (New Zealand)	Reference
1.8 Occupancy limitations	Residential, office, retail and limited low-hazard industrial buildings; not applicable to post-hazard buildings	One- and two-family dwellings	Housing occupancy	Domestic dwellings, most residential and some commercial and other buildings, other than those of high value or social importance, or needing specific designs	CAN: 1.4 US: 1.1.1 AUST: DC1.4.1 NZ: Objective (1), Table 1.1
2 Loads, load factors, assumptions					
2.1 General	Continuous load path to be provided at top and bottom of walls, and between shearwalls and foundation (EN) or, in more limited cases, following prescriptive tables based on engineering principles (PR)	Continuous load path to be provided from roof, wall and floor systems to the foundation (EN) or, in more limited cases, following prescriptive tables based on engineering principles (PR)	Roof loads transferred through the frame to the foundation by the most direct route, noting that path cannot always be vertical or direct; all framing to be designed and joined to ensure performance under worst load combinations	Prescriptive details (PR) provided to ensure continuity of members and fixings, including foundations, framing and blocking, to resist demand of vertical and horizontal loading; additional tables (EN) for heavier loading	CAN: 7.5.2, 10.1.4; Supplement, Tables US: 2.1.2; 3 AUST: NC/CA1.6, 1.7 NZ: various, 14, 15
2.2 Gravity live loads, F_L	Roof snow loads not greater than 3,0 kPa for PR design (Code) or approx. 4,0 kPa for EN design, with roof live load not less than 1 kPa; Floor live loads not greater than 2,4 kPa and not less than 1,9 kPa; Attic live load = 0,5 kPa (typical); Code reductions included to reflect low probability of simultaneous load combinations	Ground snow loads not greater than 3,35 kPa, and roof live load not less than 1 kPa; Floor live loads not greater than 1,9 kPa and not less than 1,4 kPa; Attic live load 0,5 kPa or 1,0 kPa (with storage); Load combination reductions for loads from multiple levels as per ASCE standard on loads, based on LRFD approach	Roof live load includes occasional point load on roof or ceiling = 1,1 kN; Snow load disregarded as not critical in design; Permanent floor live load component = 0,5 kPa, transient F_L = 1,5 kPa; and partial F_L = 0,75 kPa; this is disregarded for floor areas < 10 m^2; In substructures, roof F_L up to 0,25 kPa disregarded and total F_L reduced by 50 %	Design snow load not greater than 1 kPa; Live load for roofs with access designed as per adjoining floors; Domestic floor loads of 1,5 kPa; 3,0 kPa for educational, institutional and some residential floors; 2,0 kPa for external uses, i.e. decks; Top floor in three-storey building no greater than 1,5 kPa; seismic design for floor loads ⩽ 2 kPa	CAN: 1.5, 5.2.1.2, Code US: 1.1.2, 2.3.1.1, Commentary AUST: DC1.4.9.2, 1.4.9.4; NC/CA3.6 NZ: 1.1.2, Table 1.2

Table A.1 (*continued*)

Provision	*Engineering guide for wood-frame construction* (Canada) **EN = Engineered** **PR = Prescriptive**	*Wood Frame Construction Manual* (US) **EN = Engineered** **PR = Prescriptive**	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) **CA= Cyclonic areas** **NC= Non-cyclonic**	NZ 3604 (New Zealand)	Reference
2.3 Gravity dead loads, F_D	Floor F_D = 0,5 kPa; partition loads, F_P, and concentrated loads included for non-residential cases; Roof F_D = 0,5 kPa; Ceiling F_D = 0,3 kPa or total attic load of 0,35 kPa where access is limited	Floor F_D = 0,5 kPa (typical) or 1,0 kPa (flooring); Roof F_D = 0,5 kPa or 1,0 kPa (roofing type); Ceiling F_D = 0,5 kPa or 1,0 kPa (accessibility); Wall F_D = 0,5 kPa	Dead loads, F_D, based on standard allowances for mass of roof, wall and floor constructions; for floors, F_D = 0,4 kPa; tile roofs = 0,9 kPa, sheet roofs = 0,4 kPa; total wall load = 0,4 kPa	Mass of materials: Roof = 0,2 kPa (light) or 0,6 kPa (heavy), including cladding and sarking; Wall = 0,3 kPa (light) or 0,8 kPa (medium) or 2 kPa (heavy) for cladding mass	CAN: 4.2.1.2, 4.2.13, Table Load 1, Code US: Table 2.7-2.8, 2.12-2.13, 2.14-2.15, Code AUST: DC1.4.9.1, DC3.1, NC/CA3.6.4.2 NZ: definitions
2.4 Snow load, F_{snow}, factors, assumptions	Snow load factor = 1,5 and F_D factor = 1,25; Roof snow load, F_{snow} = 0,55 times ground snow load plus specified rain load, F_{rain}, as per Building Code	Working stress design (no load factors); Roof snow load is approximately 1,2 times ground snow load, using unbalanced snow loads	Snow load may be disregarded up to 0,2 kPa; supplementary span tables provided	Snow load disregarded for roof design, except in supplementary tables provided for roofs in snow load areas	CAN: 4.1.2, 4.2.2.1 US: Table 2.14-2.15 AUST: DC1.4.9.4 NZ: 10.1
2.5 Floor load factors, assumptions	Live load factor = 1,5 and F_D factor = 1,25	Working stress design (no load factors)	Live load factor = 1,5 (or 1,25 for permanent live load component) and F_D factor = 1,25	See other documents	CAN: 4.1.2, Code US: Code AUST: DC Table 4.1.3 NZ: not available

Table A.1 (*continued*)

Provision	***Engineering guide for wood-frame construction*** **(Canada)** **EN = Engineered** **PR = Prescriptive**	***Wood Frame Construction Manual*** **(US)** **EN = Engineered** **PR = Prescriptive**	**AS 1684-1, AS 1684-2 and AS 1684-3 (Australia)** **CA= Cyclonic areas** **NC= Non-cyclonic**	**NZ 3604 (New Zealand)**	**Reference**
2.6 Wind loads, F_{wind}	Specified wind pressure not greater than 0,9 kPa for EN design or 0,6 kPa for PR design, on a 50-year return hourly basis; Wind load, F_{wind}, factor = 1,4 and F_D factor = 1,25 or 0,9 depending on effect, Gust factors typically for suburban areas; Higher gust factors used for components, cladding and studs under bending loads; lower factors are used for main wind-resisting members and for walls under combined axial-bending loading	Maximum windspeed of about 65 m/s (3 s gust basis), equivalent to 50-year return period hourly pressure of approximately 1,25 kPa; Gust factors typically for urban or suburban areas, with alternative tables for open areas; Higher gust factors used for components, cladding and studs under bending loads; lower factors are used for main wind-resisting members and for walls under combined axial-bending loading	Freestream wind gust pressures not greater than 2,2 kPa (NC) or 3,3 kPa (CA) comparison with other wind loads not available; F_{wind} factor = 1,0, and F_D factor = 1,25 or 0,8 depending on effect; peak wind gust pressure coefficients vary widely depending on member type and force direction; different factors for main spans, overhangs; Directional factor of 0,8 used where effect arises from pressure on two or more surfaces	Building wind zone is low, medium, high or very high, depending on region, roughness of terrain, topographic class and exposure; wind loads expressed as Bracing Units or BUs (equivalent to 20 kN) per m of length, based on winds up to 50 m/s and pressures up to 1,6 kPa; Typical residential areas designed as sheltered urban terrain; edge roof areas up to 1,5 times higher loads than in main roof area; Specific engineering design required where outside standard's scope	CAN: 4.1.2, 4.3.3, Fig. C1, Code, Supplement US: 1.1.2, Table 2.4, Table C1.1, Commentary AUST: DC Table 2.12-2.1.3, DC5.2.2 NZ: 1.1.2; Table 5.1, 5.2, Table 5.5-5.7, 10.2 NOTE There are a variety of factors used to develop wind loads that vary from country to country. It is difficult to compare wind load magnitudes amongst different countries.
2.7 Seismic loads	Seismic spectral response acceleration not greater than 1,2 g for EN design; Earthquake load factor = 1,0 and F_D factor = 1,0; Flexible diaphragm assumption permitted; Design for torsion exempted except for three-sided structures	Seismic design categories A to D for EN design; Spectral response acceleration not greater than 1,17 g; Flexible diaphragm assumption permitted; Torsion design not included for typical wood construction	Earthquake loads disregarded as not critical in design	Seismic loads expressed as Bracing Units or BUs (equivalent to 20 kN) per square metre of floor area	CAN: 4.1.2, 4.4, Fig. C1, Code US: 1.1.2, Table 2.5C AUST: DC1.4.9.5 NZ: Table 5.8-5.10

Table A.1 (*continued*)

Provision	*Engineering guide for wood-frame construction* (Canada) EN = Engineered PR = Prescriptive	*Wood Frame Construction Manual* (US) EN = Engineered PR = Prescriptive	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) CA= Cyclonic areas NC= Non-cyclonic	NZ 3604 (New Zealand)	Reference
2.8 Weight for seismic and wind uplift design	Seismic weight = construction F_D + F_P + 0,25 × F_{snow} + F_{stor} (F_{stor} is the storage load); For wind, F_D × 0,9 for uplift design + 0,5 L + 0,5 S	Seismic weight = roof dead load + 0,2 times flat roof snow load where F_{snow} > 1,4 kPa + factored weight from walls and floors; For wind, F_D × 0,6 for uplift design	Seismic N.A.; For wind, factored gravity loads due to 0,8 times dead load and permanent component of live load resisting uplift	See other documents	CAN: 4.1.2, 4.4.4, Code US: Table 2.5C, Code AUST: DC5 NZ: Not available
2.9 Other loads	Balconies and decks designed for greater of snow or floor loads	Balconies and decks to be designed in accordance with applicable building Code	Balconies or decks above ground by 1 m or more designed for higher gravity loading	Decks above ground by 3 m designed for higher gravity loads; lateral bracing details given	CAN: 4.3.2 US: Code AUST: DC1.4.9.2 NZ: 5.2.8, 7.4

Table A.1 (*continued*)

Provision	***Engineering guide for wood-frame construction*** **(Canada)** **EN = Engineered** **PR = Prescriptive**	***Wood Frame Construction Manual*** **(US)** **EN = Engineered** **PR = Prescriptive**	**AS 1684-1, AS 1684-2 and AS 1684-3 (Australia)** **CA= Cyclonic areas** **NC= Non-cyclonic**	**NZ 3604 (New Zealand)**	**Reference**
3A Member design: General requirements					
3A.1 Primary member	Bending and shear design to resist gravity and wind loads; Deflection = Span/360 under live loading for floor joists, roof joists supporting ceilings or wall studs supporting brick; span/180 or 240 for other cases; Vibration criteria part of floor joist design; Axial, bending and combined bending-axial design of studs, and for the special case of roof rafters not tied at bottom to resist thrust; For framing members including rafter, studs, joists, design includes system action, strength sharing, and special short-term load duration	Bending and shear design to resist gravity and wind loads; Deflection = Span/360 (typical) or alternatively span/480 under live loading for floor joists; span/180 or span/240 for roof framing; Axial, bending and combined bending-axial design of studs, and for the special case of roof rafters not tied at bottom to resist thrust; For wall studs, design includes increase factors based on consideration of system action; Load-sharing increase factors provided for joists, rafters and other members	Bending and shear design to resist gravity and wind loads; Deflection limits depend on specific cases, and are based on total loads using special load duration, other factors; In general, span/300 (typical) for permanent loads or span/250 for live loads or span/150 for wind loads (typical); For floor joists, design includes consideration of dynamic behaviour; For studs, max. deflection of 20 mm; for framing members including rafter, studs and joists, design includes consideration of load distribution and strength sharing	Primary members designed as bending members to resist vertical and horizontal loads	CAN: 3.4, 5.1, 6.1, 7.1, 5.4.2 US: 2.1.3.2, Table 2.7 to 2.15 AUST: DC1.4.10-1.4.11 NZ: details not available

Table A.1 (*continued*)

	Provision	***Engineering guide for wood-frame construction*** **(Canada)** **EN = Engineered** **PR = Prescriptive**	***Wood Frame Construction Manual*** **(US)** **EN = Engineered** **PR = Prescriptive**	**AS 1684-1, AS 1684-2 and AS 1684-3 (Australia)** **CA= Cyclonic areas** **NC= Non-cyclonic**	**NZ 3604 (New Zealand)**	**Reference**
3A.2	Secondary member	Sheathing design to resist gravity loads, wind suction; diaphragm or shear design to resist shear requirements; Deflection = Same as for primary members, except wall sheathing; Wind load coefficients higher for sheathing	Sheathing design to resist gravity loads, wind suction; diaphragm or shear design to resist shear requirements; Wind load coefficients higher for sheathing and cladding components	Roof battens, panels to resist gravity loads, wind suction where applicable; Sheeting requirements for racking resistance vary for cyclonic (CA) and non-cyclonic (NC) areas	Sheet panel, flooring, and roofing supports designed to resist imposed loads where applicable; additional details provided on weather protection of building envelope	CAN: 5.2, 6.2, 7.2, 9.2, 10.2 US: 2.2-2.5, Table 2A-2B, Commentary AUST: DC2.1, 7, 8 NZ: 7.2, 10.2, 11
3A.3	Material specifications	References provided to applicable material and design standards	References provided to applicable material and design standards	References to applicable standards, supplements; alternative seasoned and unseasoned timber sizes also provided	Materials limited to two species, specific sizes and grades; other specifications require alternative solutions	CAN: 1.6 US: 1.2 AUST: DC1.2, NC/CA1.14 NZ: 2.3
3A.4	Proprietary components	Proprietary engineered wood product used in accordance with QA programme supervised by independent third-party certification organization; designed and installed in accordance with code and manufacturer	Proprietary engineered wood product used in accordance with Code and manufacturer's report (EN); no provisions in prescriptive part (PR)	Proprietary engineered wood product used subject to approval of building authority and manufac-turer's recommendations	Proprietary products subject to approval of the Building Consent Authority; testing standards referenced for evaluating proprietary products or fasteners, or minimum capacities are identified as required	CAN: Supplement US: 2.1 AUST: NC/CA1.12 NZ: 6, 7, 10, 11, 15, 18

Table A.1 (*continued*)

Provision	*Engineering guide for wood-frame construction* (Canada) EN = Engineered PR = Prescriptive	*Wood Frame Construction Manual* (US) EN = Engineered PR = Prescriptive	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) CA= Cyclonic areas NC= Non-cyclonic	NZ 3604 (New Zealand)	Reference
3B Member design: Roofs					
3B.1 Roof members (rafters, roof joists)	Sloped bending member supported at top and bottom or as roof rafter connected to ridge board at top and ceiling joist at bottom; Deflection calculated on horizontal projection of framing member; End bearing not less than 38 mm; Rafter details provided	Sloped bending member supported at top and bottom or as roof rafter connected to ridge board at top and ceiling joist at bottom; Deflection calculated on horizontal projection of framing member; Rafters bear directly on beams, ledgers or walls; Rafter details provided; Rafter overhang not more than 0,6 m or one-third of rafter span; End restraint provided for deeper rafters (>3:1)	Sloped bending member under uniform and point live load; coupled or uncoupled with ceiling; single span with or without overhangs, or continuous span; Deflection calculated on basis of span along axis; Load distribution factors depending on roof type; Bearing not less than 30 mm at ends, 60 mm at continuous support; Rafter details provided; Underpurlins used in rafter systems to minimize weak axis sag; Rafter overhang limited to deflection of 10 mm; Birdsmouth ends designed for combined bending and shear	Rafters or trusses to resist vertical wind and roofing loads; coupled with ceiling joists or supported at ridge; Where roof slope is no more than 25°, wind bracing designed on basis of horizontal projection without overhang or eaves; Rafter bearing not less than 32 mm; Rafter details provided	CAN: 5.3, 5.4 US: Table 2.14-2.15, 2.5.1, 2.1.3.4 AUST: DC2.2-2.3, NC/CA1.10, NC/CA7 NZ: 10.1, 10.2, 5.2.7
3B.2 Hip and valley rafters	Hip and valley rafters designed for bending, except that where roof members are designed to resist thrust at eaves, hip beams may be selected to be not less than 50 mm deeper than the supported hip jack rafters	Hip and valley jack rafters designed as bending members; Hip and valley beams designed for bending	Hip and valley rafters supported by struts or by underpurlins, using prescri-ptive sizing and fastening provisions	Valley rafter designs are pre-engineered, and hip rafters are prescriptive; Bracing details provided for hip or valley rafters	CAN: 5.7, Table Roof 10, Building Code US: 2.5.1, Table 2.17 AUST: DC2.2-2.3, NC/CA2, NC/CA7.2, NC/CA Table 7.6 NZ: 10.1, 10.2, 10.3

Table A.1 (*continued*)

	Provision	*Engineering guide for wood-frame construction* (Canada) EN = Engineered PR = Prescriptive	*Wood Frame Construction Manual* (US) EN = Engineered PR = Prescriptive	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) CA= Cyclonic areas NC= Non-cyclonic	NZ 3604 (New Zealand)	Reference
3B.3	Ceiling joists	Ceiling joists designed as bending member, with axial load from rafter connection disregarded, except in the following case	Ceiling joists designed as bending member, with axial load from rafter connection disregarded, except in the following case	Ceiling joists designed as bending member, with axial load from rafter connection disregarded	Ceiling joist design provided for simple bending member	CAN: 5.4 US: 2.5.1.6 AUST: DC2.9 NZ: Table 10.4
3B.4	Ceiling joists, special cases	Where ceiling joists are raised above rafter ends, rafters are designed for increase in moment, shear and deflection; Ceiling joists are designed to resist rafter thrust; and lateral movement at top of wall limited to L/500	Where ceiling joists are raised above rafter ends, rafters are designed for increase in moment, shear and deflection; Ceiling joists are designed to resist rafter thrust	Where continuous batten is used on top edge mid-span of each joist, lateral restraint and load distribution factor is used; Hanging beams are used to support ceiling joists, underpurlins, struts, etc.	Designs and details provided for roof struts, underpurlins, hanging struts, etc.	CAN: 5.4.4, Table Roof 6 US: Table 2.14, Table 2.3 AUST: DC2.3 NZ: 10.2
3B.5	Roof trusses	References provided to truss design, bracing requirements, including some permanent bracing details	References provided to truss design, bracing requirements; notes on bearing and point loads; some details included	References provided to truss design; some bracing provisions; For trusses, fascia to share overhang loads to adjacent trusses	Reference made to truss design and construction standard, requirements including roof framing plan with bracing details	CAN: 5.8, Table Roof 11 US: 2.5.3, Fig. 2.16-2.18 AUST: NC/CA7 NZ: 10.2.2, 10.3
3B.6	Roof I-joists	Engineered product spans calculated using loads in *Engineering guide for wood-frame construction* and manufacturer's report	Engineered products in accordance with *Wood Frame Construction Manual* and additional specifications in manufacturer's report; Provisions for bridging, web stiffeners, supports	Fabricated components may be used where their design and use is in accordance with appropriate standards	Proprietary products subject to approval of the Building Consent Authority	CAN: 1.6.5, Table C2 US: 2.5.2, Fig. 2.10-2.11 AUST: NC1.12 NZ: 18

Table A.1 (*continued*)

Provision		***Engineering guide for wood-frame construction*** **(Canada)** **EN = Engineered** **PR = Prescriptive**	***Wood Frame Construction Manual*** **(US)** **EN = Engineered** **PR = Prescriptive**	**AS 1684-1, AS 1684-2 and AS 1684-3 (Australia)** **CA= Cyclonic areas** **NC= Non-cyclonic**	**NZ 3604 (New Zealand)**	**Reference**
3B.7	Roof ridge beams	Ridge beam designed for bending, shear and bearing; Deflection not more than span/360 or 15 mm; Provisions for built-up ridge beams and lintels include system increase factors for moment, shear and deflection resistance; Bearing length tables; Proprietary beams in accordance with manufacturer's tables	Ridge beam designed for bending, shear and bearing; Unbalanced snow design not required, so roof snow loads lower than for rafters; Deflection not more than L/240; Proprietary beams permitted in accordance with manufacturer's reports	Ridge beam designed for bending, shear and bearing; continuous span or single span with or without overhang; Deflection not more than L/300 for permanent loads, L/250 for live loads and L/150 for wind loads; overhang deflection limit = 10 mm; Provisions for load distribution and strength sharing in built-up beams	Ridge beam designs provided for wind load (low, medium, high, very high) and roof type (light, heavy); Verandah beam designs provided for wind loads	CAN: 5.6, Table Beam 1-Beam 4, Table Beam 9 US: Table 2.16, Commentary AUST: DC2.3 NZ: Table 10.6, Table 10.8
3B.8	Roof sheathing	Sheathing is designed to meet gravity load requirements or meet prescriptive code provisions for snow loads up to 2 kPa; it is in no case to be less than required for diaphragm shear resistance and is attached to resist wind suction loads	Sheathing designed to resist and transfer gravity and wind suction loads, and to resist required shear loads parallel and perpendicular to ridge	Battens designed for bending about weak axis and shear and for serviceability limits of span/300 for permanent loads and span/150 for transient loads	Prescriptive details given for roof battens, purlins or panel sheet covering	CAN: 5.2, 5.2.3 US: 2.5.4 AUST: DC2.1.2-2.1.3 NZ: 10.2-10.4
3B.9	Sheathing details	Panel orientation, edge support, joint staggering and gaps are specified; Lumber sheathing also specified	Sheathing continuous over two or more spans; edge support required for all panels > 9,5 mm or > 11 mm thickness on 600 mm spacing	Roof battens used on framing spaced 0,3 m (for tile roofs) to 1,2 m (for sheet roofs) apart; batten span continuous over two or more spans	Batten or purlin spacing varies with loads and roofing types	CAN: 5.2 US: 2.5.4 AUST: DC2.1.1 NZ: 10.2-10.4

Table A.1 (*continued*)

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3B.10 Roof Covering	Heavier dead loading for concrete tile roofing	Heavier dead loading for concrete tile roofing	Heavier dead loading, varying with batten spacing, for tile roofing	Heavier dead load for tiles; Roof cladding details provided	CAN: Code US: Code AUST: DC2.1.2.2 NZ: 11
3B.11 Additional roof details	Framing around openings to transfer all point loads; Overhangs included in gravity and wind uplift load calculations; Prescriptive limits on notching and boring of framing or as designed	Rake overhang not more than 0,6 m or one-half of purlin length; Framing around openings to transfer all point loads; Size limits on notching and bored holes	Prescriptive framing details provided, e.g. openings; Members or outriggers supporting verge overhangs to be fastened back to the structure	Prescriptive eave and gable verge overhang details provided; Tolerances given for: — deviations of 5 mm per 10 m length in plan or 10 mm max. deviation; — horizontal deviation of 5 mm per 10 m length or 10 mm max. deviation	CAN: Table Load 1, Table Load 15, Table Roof 10 US: 2.5.1 AUST: NC/CA 7.2 NZ: 10.2, Table 2.1

Table A.1 (*continued*)

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3C Member design: Walls					
3C.1 Wall members (studs, columns)	Single and built-up wall studs designed for — concentric axial loads — moment due to wind — combined bending-axial loads including secondary moment effects — wind uplift minus 0,9 times dead load — shearwall chord force — wind load deflection; Bending-axial design has lower wind pressure coefficients than for bending alone; interior loadbearing walls designed for gravity loads; columns are designed for gravity loads only, lateral loading is assumed to be resisted by shearwalls	Wall studs designed for — axial gravity loads — moment due to wind — wind uplift minus 0,6 times dead load Exterior loadbearing studs designed to resist uplift loads independent of gravity and face wind loads; Bending-axial design has lower wind pressure coefficients than for bending alone; Interior loadbearing walls designed for gravity loads; Built-up stud column tables provided	Wall studs designed for — tension or compression forces from supported floors or roofs — horizontal wall loads in bending — combined gravity loads, lateral wind loads and axial wind loads (acting in tension or compression) Vertical loads applied as axial point loads; Wind uplift minus 0,8 times dead load; Bending-axial design does not have lower wind pressure coefficients than for bending alone; Built-up studs designed for point loads around openings Posts designed for axial loads from supported roof and floors; posts do not replace studs in exterior walls and so are not designed for lateral loads	Wall system of each storey consists of: — system to resist vertical loads, — system to resist horizontal loads, — any other walls (non-loadbearing) All studs laterally supported by lining, cladding or metal hardware; Details provided for built-up studs; Prescriptive post design is provided for limited sizes and loading, and with fastenings designed for uplift loading	CAN: 7.1, 7.3, 8 US: 2.4.1, 2.4.2, Table 3.22F AUST: DC3.1-3.2; NC/CA6.3 NZ: 8.1, 8.5, 9

Table A.1 (*continued*)

	Provision	***Engineering guide for wood-frame construction*** **(Canada)** **EN = Engineered** **PR = Prescriptive**	***Wood Frame Construction Manual*** **(US)** **EN = Engineered** **PR = Prescriptive**	**AS 1684-1, AS 1684-2 and AS 1684-3 (Australia)** **CA= Cyclonic areas** **NC= Non-cyclonic**	**NZ 3604 (New Zealand)**	**Reference**
3C.2	Wall framing details	Wall studs are to be continuous between horizontal supports, except for specified fingerjoined products; Discontinuity in studs at gable endwalls is to be resisted by diaphragm action or wall bracing; Prescriptive Code limits on notching and boring of framing or design required	Wall studs are to be continuous between horizontal supports, including diaphragm assemblies and girders; end- or edge-glued lumber accepted through material standards; Size limits on notching and bored holes;	Wall studs to transfer loads to top and bottom wall supports; Detailed provisions for notching and holes; for notched studs, notches are assumed in either face of wall to a max. depth of 20 mm, with bending capacity = 0,6 times capacity of un-notched stud, and axial capacity based on net cross section at notch; other prescriptive wall details including nail specifications, blocking or nogging details	Wall framing tolerances include: — vertical deviation of 15 mm in two-storey building or 20 mm if higher; — deviation of 5 mm in loadbearing walls in alignment above/ below; — bow of 6 mm in studs, except 2 mm where corner studs meet; prescriptive provisions for holes or notching in studs and wall plates;	CAN: 7.3.2, , 11 US: 2.4.1, 2.4.2, 1.2.1 AUST: DC3.2, NC/CA2.3-2.5; NC/CA6.2 NZ: Table 2.1, 8.5
3C.3	Wall plates	Wall plates designed for — gravity load transfer — lateral load transfer — diaphragm chord and drag strut forces Wall plates not less than stud width, at least 38 mm thick, and top plate continuous through staggered double plate	Wall plates designed for bearing for gravity load; Wall studs are either aligned with joists, or band joists or blocking are designed to transfer point loads; top plates are lapped or tied at joints; bottom plate at least 38 mm thick and not less than stud width, bearing on foundation	Wall plates designed for — gravity load transfer, including point loads at openings — vertical wind loads; Assuming 3-span beams loaded by equally spaced point loads; Deflection limit of span/200 or 3 mm	Prescriptive provisions for framing directly over studs; special design provisions where — framing between studs, — lintels used, or — bracing is needed; Top plates supported by diaphragm or framing spaced not more than 2,5 m apart	CAN: 7.4.1-7.4.3 US: 2.4.1.2, 2.4.1.3 AUST: DC3.3, NC/CA6.2 NZ: 8.7

Table A.1 (*continued*)

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3C.4	Wall openings	Framing around openings designed for — gravity loads — wind uplift minus 0,9 times dead load — lateral out-of-plane load on the opening face — shearwall chord forces	Framing around exterior wall openings to include headers, supporting studs and window sill plates in accordance with lateral and gravity requirements	Framing and design around openings includes consid-eration of contribution of roof battens, wall plates, jack studs and trimmers; Load transferred to jamb studs on each side of lintels; Windowsill trimmer sizes vary for CA and NC areas	Details provided for trimming studs around openings, depending on — storey level, — opening width; Windowsill trimmer details provided;	CAN: 7.6.1 US: 2.4.1.4 AUST: DC3.4, NC/CA Table 6.3, NC/CA Table 6.3 NZ: 8.5, 8.6
3C.5	Headers or lintels	Deflection not more than span/360 or 15 mm; Provisions for built-up headers and lintels include system increase factors for moment, shear and deflection resistance; Bearing length tables; proprietary beams in accordance with manufacturer's tables	Headers designed for gravity and wind loads; Deflection not more than Span/240; Live load from roof need not be considered simultaneously with live loads from ceiling (PR); proprietary beams in accordance with manufacturer's reports	Lintels designed under gravity and vertical wind loads assuming spaced point loading; Deflection limits = L/300 or 10 mm for permanent loads, L/250 or 15 mm for live loads, L/360 or 10 mm for uniform live load alone, or L/200 for wind load; Provisions for load distribution and strength sharing in built-up beams	Lintel tables designed to support evenly distributed gravity loads from floors, walls, and roofs having a maximum pitch of 45°; Fastenings to ensure lintels are secured against uplift	CAN: 7.6.2 US: 2.4.1.4, Commentary AUST: DC3.4 NZ: 8.6
3C.6	Exterior non-loadbearing walls	Exterior non-loadbearing walls designed to resist lateral and uplift loads; Horizontal forces in discontinuous studs in gable end walls to be resisted by diaphragms or gable wall bracing	Exterior non-loadbearing walls designed to resist lateral, uplift and rake overhang uplift loads; Where diaphragms are used to brace gable endwalls, sheathing and fasteners are designed to resist shear forces	External walls laterally supported against wind loads; walls supporting ceiling joists, rafters or trusses deemed to have adequate support; Gable and verandah walls to be restrained at 3 m spacing by inter-secting walls, framing	External non-loadbearing walls designed to resist lateral wind forces	CAN: 7.3 US: 2.4 AUST: NC/CA6.2.5 NZ: Table 8.4

Table A.1 (*continued*)

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3C.7 Interior partitions	Non-loadbearing partitions help stiffen structure so building acts as a box rather than series of shearwalls; Nominal code requirements apply	Non-loadbearing studs designed to carry weight of applied finishes; Conventional code sizes applicable; Notching and boring provisions	Non-loadbearing walls fixed 10 mm below bottom chord; conventional code sizes applicable	Internal walls designed for, among other things, effects of varying air pressures within a building	CAN: Supplement, Code US: 2.4.3, Code AUST: NC/CA6.2.5, NC/CA6.3 NZ: 8.5.1.3
3C.8 Wall sheathing	Sheathing designed for resistance to external wind forces; in a shearwall, sheathing not less than required thickness; Deflection design not required unless it affects cladding serviceability	Sheathing designed to resist and transfer wind suction loads; in a shearwall, to resist shear loads in accordance with shearwall design; Max. spans and uniform loads provided	Tables provided for spacing of supports for lining or cladding	Sheathing as specified in end use standards; sheathing also has hygrothermal and durability provisions and is identified as a wind barrier	CAN: 7.2 US: 2.4.4, Table 2.4, Table 3A AUST: Supplements NZ: 11
3C.9 Sheathing details	In a shearwall, all sheathing edges are supported or a strength reduction factor is applied for unblocked shearwalls	All shearwall sheathing edges are supported; Max. spans and uniform lateral wind loads provided for wall sheathing	All lining edges supported; In some cases, fixing requirements can lead to thicker sheeting or lining requirements	Blocking requirements identified in appropriate sections	CAN: 7.2 US: 2.4.4, Table Sup 3A AUST: NC6.2-3 NZ: 5, 8
3C.10 Wall cladding	Sheathing used in all cases where cladding requires backing or attachment support	Sheathing and cladding attached to assure transfer of specified loads into framing members	Studs evenly spaced to suit fixing of cladding and lining; blocking suitable for proper fixing of cladding and lining	Cladding details provided; Bracing details for walls supporting masonry veneer	CAN: 7.2 US: 2.2.5 AUST: NC/CA6.2 NZ: 11, Table 5.8

Table A.1 (*continued*)

Provision	*Engineering guide for wood-frame construction* (Canada) EN = Engineered PR = Prescriptive	*Wood Frame Construction Manual* (US) EN = Engineered PR = Prescriptive	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) CA= Cyclonic areas NC= Non-cyclonic	NZ 3604 (New Zealand)	Reference
3D Member design: Floors					
3D.1 Floor members (joists, components)	Floor member designed for gravity loads, and in the case of diaphragms, designed for lateral loads; Serviceability criteria include deflection and vibration performance; bearing provisions; Strength design includes system factors	Floor member designed for gravity loads, and in the case of diaphragms, designed for lateral loads; Serviceability criteria includes deflection, bearing design	Floor member designed as bending member under gravity loads; for permanent, transient and point loading: single span, continuous, or cantilevered spans; Serviceability includes deflection and dynamic behaviour criteria; Bearing provisions; Design includes load distribution and strength sharing factors	Floor members pre-engineered for given spans and loads	CAN: 6.1 US: 2.3.1.1 AUST: DC4.1 NZ: 7.1
3D.2 Floor framing details	Joists supported by walls, lintels or beams, with minimum 38 mm bearing length; bottoms of joists restrained from twisting by nailing, strapping, blocking, bridging or hangers; Prescriptive Code limits on notching and boring of framing or design required	Joists bear on beams, girders, ledgers or walls, or are supported by hangers; End restraint provided at joist ends to resist about 33 N·m twisting moment; Lateral stability rules provided; Notching and boring provisions	Joists bear on beams, walls or bearers (headers) that support loads from wall as well as the floor; Minimum 30 mm bearing per joist; Lateral stability prescriptive rules; Cuts, holes and notches restricted in size and location	Joists bear on supports, with minimum bearing of 32 mm; Lateral stability provisions; Tolerances given for: — deviation of 5 mm per 10 m length in plan or 10 mm max. deviation; — horizontal deviation of 5 mm per 10 m length, max. deviation = 10 mm; prescriptive rules given for notches and holes	CAN: 6.3.2, 11 US: 2.3.1.2, 2.3.1.3, 2.3.1.4, 2.3.1.5, 2.3.1.1.1 AUST: NC/CA4.1-4.2 NZ: Table 2.1, 7.1

Table A.1 (*continued*)

	Provision	*Engineering guide for wood-frame construction* (Canada) EN = Engineered PR = Prescriptive	*Wood Frame Construction Manual* (US) EN = Engineered PR = Prescriptive	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) CA= Cyclonic areas NC= Non-cyclonic	NZ 3604 (New Zealand)	Reference
3D.3	Loadbearing and non-loadbearing walls	Joists are designed to support weight from a loadbearing wall, except where the wall is perpendicular to and within a joist depth, d, from the joist's support; weight from a non-loadbearing wall on joists or blocking may be disregarded	Joists are designed to support weight from a loadbearing wall, except where the wall is perpendicular to and within a joist depth, d, from the joist's support; weight from a non-loadbearing wall perpendicular to joists may be disregarded; setbacks of non-loadbearing shearwalls on lumber joists (PR) may be up to $4d$ under applicable conditions	Joist may be designed disregarding weight of a loadbearing wall supporting roof loads, where the wall is directly over a support or within 1,5 times d from support, as may other members under same conditions; Parallel walls may be supported on joists by considering roof loads; non-loadbearing wall loads disregarded	Loadbearing walls parallel to floor joists supported by two joists; Perpendicular loadbearing walls are to be not more than 200 mm from a supporting wall or bearer; Non-loadbearing walls with bracing elements are to be over a joist or blocking; if no bracing elements, within 150 mm of a joist	CAN: 6.3.2 US: 2.3.1.5, 3.1.3.2 AUST: NC/CA1.7, NC/CA 4.2.2.2, NC/CA4.3.2 NZ: 7.1.3
3D.3	Cantilevered floors	Lumber joists designed as bending members, including case with 0,9 times dead load alone on the non-cantilevered portion (EN); Prescriptive provisions (PR) in Code within building limits	Cantilevers supporting a loadbearing wall limited to joist depth, d, unless designed for the added weight (EN), or as per prescriptive exception (PR) for use in low snow load cases; Cantilevers supporting a non-loadbearing wall limited to span/4 under applicable conditions	Where joists support floor loads only, joists may cantilever up to 1/4 of span provided min. backspan is at least twice cantilever span; where loadbearing wall supported, cantilever up to 15 % of span provided backspan at least 4 times cantilever span	Cantilevers may support a wall up to 2,4 m high, but do not support a balcony deck of mass > 25 kg/m^2, or balcony balustrade of mass > 5,5 kg/m^2; Maximum cantilever spans provided; Wind bracing design for decks disregarded	CAN: 6.3.1.2, Code US: 2.3.1.6, 2.1.3.2c, 3.1.3.2 AUST: NC/CA4.3.2 NZ: 7.1.5, 5.2.8

Table A.1 (*continued*)

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3D.4	Floor openings	Openings limited in size to lesser of 3,5 m or one-half the floor width (EN); or 3×2 m (PR); Where openings within 0,6 m of exterior wall, floor assumed to not provide lateral support; Header and trimmer joists designed to transfer loads around openings	Framing around openings designed to transfer loads; Where openings within 0,6 m of exterior wall, the wall is framed with full height studs or a beam is used to resist gravity, lateral and uplift loads at that location	Prescriptive rules given for trimmers up to 3 m in length	Prescriptive rules given for framing around openings, including trimmer spans up to 2,4 m, and curtailed joist spans up to 3 m	CAN: 6.4 US: 2.3.1.7 AUST: NC/CA4.3.2.5 NZ: 7.1.6
3D.5	Wood I-joists	Wood I-joists designed to support weight from all loadbearing walls; Weight from a non-loadbearing wall on joists or blocking may be disregarded; additional restrictions in accordance with Code	Wood I-joists designed in accordance with manufacturer's report; additional restrictions on notching, boring, bearing, bridging, wall support and cantilevers	Fabricated components may be used where their design and use is in accordance with appropriate standards	Proprietary products subject to approval of the Building Consent Authority	CAN: 6.3.3 US: 2.3.2 AUST: NC/CA1.12 NZ: 18
3D.6	Floor beams or headers	Deflection not more than span/360 or 15 mm; Provisions for built-up headers and lintels include system increase factors for moment, shear and deflection resistance; Bearing length tables; Proprietary beams in accordance with manufacturer tables	Deflection not more than span/240; Beams designed to support imposed loads; Live load from roof need not be considered simultaneously with live loads from ceiling (PR)	Bearers designed to support imposed loads from floor and walls on single, continuous or cantilevered spans; Deflection not more than L/300 or 12 mm max. under total load, or L/360 or 9 mm under live load only; Where loadbearing wall is within 1,5 d from bearer support, roof loads may be disregarded	Tables provided for sizing floor bearers, including built-up members, to support imposed loads	CAN: 6.6 US: 3, Commentary AUST: DC4.2, NC/CA4.3.1 NZ: 6.12

Table A.1 (*continued*)

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3D.7 Floor sheathing	Max. spans and gravity uniform and point loads provided for floor sheathing	Max. spans and gravity uniform loads provided for floor sheathing	Detailed prescriptive sheathing and decking layout and nailing provisions	Max. spans provided for strip flooring and plywood under typical floor loads	CAN: 6.2.2 US: Table 2A AUST: NC/CA5 NZ: 7.2
3D.8 Rim boards	Rim boards to transfer all gravity and lateral loads	Floor framing, restraint against twisting to transfer all loads	Rim boards to carry imposed uniform and point loads	Continuous boundary joist to provide lateral support to joists, nailing	CAN: 6.3.1, 9.2.2, 10 US: 2.3.3.3, 2.3.5 AUST: NC/CA4.2 NZ: 7.1.2, Table 7.5
3D.9 Floor covering	Deflection under concrete-topped floor calculated using dead plus live load	Higher dead load is used to design floor joists and beams for heavier floors	For heavy floors, dead load increased up to 100 kg/m^2	Flooring sizes and supports depend on specified floor loads	CAN: 6.6.2.3 US: Table 2.7 AUST: DC Table 4.1.1 NZ: 7.2,14
4 Lateral load systems design					
4A Design requirements					
4A.1 Basis of design	Lateral building design based on static analysis of flexible diaphragms acting as bending members between shearwalls; Shearwall designed to resist the sum of the diaphragm reactions at top of shearwall plus cumulative forces from upper storey shearwalls	Shearwall design loads distributed to vertical elements of seismic force-resisting system based on relative lateral stiffness of the elements and the diaphragm; Shearwall segments designed to meet sum of shear loads collected by diaphragms above, for wind or seismic loads in both building directions	Racking force based on wind pressure and area of elevation; racking force divided by brace capacities to determine no. of braces required; Racking forces typically based on the assumption that the ground floor supporting structure is enclosed.	Prescriptive wind bracing demand based on location, building size and shape, and level within building; Prescriptive earthquake demand based on location, level, size, and roofing and cladding; Where a structural diaphragm is present, no internal bracing lines used within boundaries	CAN: 4.4.2, 4.4.3, 9.1.5, 10.1.1 US: 2.4.4, 2.1.2 AUST: NC/CA8 NZ: 5.1-5.3

Table A.1 (*continued*)

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4A.2 Prescriptive guidelines	Guidelines provided for construction, spacing and nailing for “braced walls,” to provide nominal resistance to moderate lateral loads in small, regular-shaped buildings (PR); Where the limitations on loads or building shape are exceeded, shearwall design is used (EN); Spacing and location of braced walls determines applicability of prescriptive solutions	Braced walls are not included in the *Wood Frame Construction Manual*, although building Codes include provisions for prescriptive braced walls that may be used for conventional construction in lieu of engineered shearwall design, as permitted by the Code authorities; Shear loads from wind are calculated based on aspect ratio limits (PR)	Up to 50 % of racking force may be resisted by nominal wall bracing, evenly distributed and at least 450 mm long; Nominal wall bracing includes shear panels using plywood, plaster-board, fibre cement, hardboard, nominally fixed to the floor and roof or ceiling frame	Bracing systems to be used with prescribed bracing capacities; Spacing of subfloor and wall bracing ⩽ 6 m, with minimum capacity and location; wall bracing located near corners and evenly spaced; If spacing of bracing lines not evenly distributed, spacing is reduced to coincide with line of bearers	CAN: Supplementary Guidelines (Part C) US: Code AUST: NC/CA8.3.6 NZ: 5.4-5.5, 10.3
4B Shearwalls					
4B.1 Shearwall design	For fully-restrained shearwalls with hold-downs at all openings, design is based on shear per unit length of full-height sheathed walls, and overturning design based on analysis of overturning and resisting moments in each segment	For fully-restrained shearwalls with hold-downs at all openings, design based on shear per unit length of full-height sheathed walls, and overturning design based on analysis of overturning and resisting moments in each segment (EN); Shearwall capacity increased by 40 % when resisting wind loading	Bracing required to meet product of wind pressure and area of elevation in both directions of a building	Bracing element capacities provided in bracing units (BUs), where 20 BUs = 1 kN per metre of wall length (wind design) or per m^2 of floor area (seismic) for lines parallel to exterior walls	CAN: 10.1.2 US: 2.4.4 AUST: NC/CA8 NZ: 5.4-5.5, 8.3

Table A.1 (*continued*)

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4B.2 Shearwall framing	Shearwalls include nailed shear panels using structural wood panels, gypsum board or diagonal lumber sheathing attached to min 38 mm framing; Panel edges bearing on and attached to framing (except as in 4B.9); Shear panel size at least 1 200 × 2 400 mm except near boundaries where up to two short panels not less than 300 mm may be used; Min nailing schedules provided; Special provisions for shearwalls using gypsum wallboard; Min 25 mm thick proprietary rim joists may be used, where appropriate	Shearwalls include nailed shear panels using structural wood panels, gypsum board or diagonal lumber sheathing attached to min 38 mm framing: All shearwall sheathing edges are supported; Shear panel sizes limited by aspect ratios; Nailing schedules provided; Shearwall lines oriented to resist loads in two orthogonal directions; band joists, blocking or other framing used to transfer roof, wall and floor loads from upper stories; Proprietary rim joists in accordance with manufacturer's report	Wall bracing includes sheet bracing or cross bracing (metal or wood) evenly distributed; All sheet edges are supported, with a minimum width = 0,9 m or 0,6 m where through-rods are used; For single or upper storey construction, bracing elements spaced not more than 9 m; for lower storey or subfloor, bracing wall spacing varies with wind loads (CA vs. NC), floor width; Prescriptive framing provisions for bracing of walls, subfloor to meet required racking forces; details include bracing to concrete piers, bracing of columns, bracing of unreinforced masonry; varies for higher cyclonic areas (CA);	For building supported on bracing lines, each exterior wall has a minimum bracing capacity, and walls shorter than 3 m are to be supported by interior bracing lines; Bracing lines up to 6 m from exterior walls or up to 5 m where low-strength material is used to line ceilings; Where building height is not greater than 1,7 times building width, a two-storey building may have same bracing systems as one-storey; for other buildings, continuous foundation wall attachment required; Provisions for braced walls set at angles to bracing lines; bracing lines in each storey need not coincide with those of the storey below	CAN: 10.1.3, 10.2.1, 10.2.2, 10.2.3 US: 2.1.3.3, 2.4.4.3, Table 3C AUST: NC/CA1.4.8, NC/CA8.3 NZ: 5.4, 5.5, 8.3

Table A.1 (*continued*)

Provision	*Engineering guide for wood-frame construction* (Canada) EN = Engineered PR = Prescriptive	*Wood Frame Construction Manual* (US) EN = Engineered PR = Prescriptive	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) CA= Cyclonic areas NC= Non-cyclonic	NZ 3604 (New Zealand)	Reference
4B.3 Elevation offset	Continuous load path may be assumed where: — shearwall segment offset < 4 times d or 1,2 m (whichever is less) — shearwall segments fully connected — full-depth blocking in joists below shearwalls — diaphragms continuous without openings — shear forces transferred to lower shearwall; Split levels, knee walls limited by guidelines (PR)	Shearwall segments not offset by more than d, except: — (EN) shearwall segments may be offset from storey below when the load path continuity is designed and detailed as per Code — (PR) non-loadbearing shearwalls on lumber joists may be up to $4d$, where applicable	Rules provided for determining load on a two-storey or split-level building	Any building with discontinuous floor levels to have an internal bracing line below the location of the discontinuity;	CAN: 10.1.5, Supplement US: 1.1.3.3b, 3.1.3 AUST: Fig. 8.2(B) NZ: 5.1.5
4B.4 Plan offset	Shearwall segments in the same shearwall not offset more than 1,2 m	Offsets in a shearwall line within a storey not more than 1,2 m; where more, design as separate structure or as inscribed rectangular structure	Offset bracing walls limited to 20 % of total bracing; complex shapes are to be considered individually or on the total area as a whole	Any wings or blocks that extend more than 6 m from rest of building are to provide sufficient bracing individually; parallel walls not more than 2 m apart can be treated as one wall	CAN: 10.1.6 US: 2.1.3 AUST: NC/CA8.3.3-8.3.6 NZ: 5.1.5; 5.5.6.2
4B.5 Drag struts	Drag struts are needed where shearwalls do not extend full depth of the diaphragm	No specific information on drag struts; load path to foundation required; chord splice details provided	Bracing walls used under eaves if suitably connected to overhangs; Crossed metal braces continue diaphragm action to the rafter overhangs	The first bracing line from an exterior wall may be up to 7,5 m where dragon ties provide support to an exterior wall; dragon details are provided	CAN: 10.1.7 US: Table 3.21 AUST: NC/CA8.3.6.8 NZ: 5.5.5, 8.3.3

Table A.1 (*continued*)

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4B.6	Shearwall segments	Shearwall resistance = sum of segment values; aspect ratio of segment not more than 3,5:1; Sheathing above and below openings not included in resistance; Loads distributed to segments based on relative shear strength	Shearwall segment aspect ratios not to exceed 3,5:1; shearwall resistance based on full-height segments; Loads distributed to vertical elements of seismic force-resisting system based on relative stiffness of elements and the diaphragm	Structural braced walls with framing and fixing details, some with full-length rods at each end of section, with given resistances; Sheet-braced walls to be at least 900 mm wide, continuous from top to bottom plates with same fixings for horizontal joints over noggings	Bracing units provided for construction type; where one type supports another type, the lower bracing capacity is used for the whole system	CAN: 10.2.4 US: Table 3.17 AUST: NC/CATable 8.18, 8.3.6 NZ: 5.4
4B.7	Segments without hold-downs	A mechanics-based method is used to determine shear and overturning in segments not having hold-downs around every opening, based on: (a) using nails in sheathing to resist overturning uplift rather than shear; and (b) transferring shear to segments as per relative strength; hold-downs used at shearwall ends	Perforated shearwall design method is used to reduce shear and hold-down capacities of segments without hold-downs at all openings, based on test results and analysis; Hold-downs are required to be used at ends of shearwalls and as required to develop shear capacity	Nominal wall bracing option provided in lieu of complete structural wall bracing system	Prescriptive bracing details provided for braced walls without diaphragms	CAN: 10.2.5 US: Table 3B, 2.2.4.1 AUST: NC/CATable 8.18 NZ: 5
4B.8	Segments with multiple layers	Shear capacity of panels on opposite side of wall may be summed, but if applied to same side of wall, only the inside panel capacity is used	Combinations of similar sheathing are permitted on shearwalls in accordance with tabulated values and notes	Shear capacity of plywood on opposite sides of wall may be combined	Not available	CAN: 10.2.6 US: 3.4.4.2, Table 3B AUST: NC/CA8.3.6.5 NZ: NA

Table A.1 (*continued*)

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4B.9 Unblocked shearwalls	Unblocked shearwalls may be designed with reduced capacity provided: — max. height of 2,4 m — horizontal sheathing — sheathing not designed to resist uplift forces	Unblocked shearwall design is applicable only to walls with gypsum board sheathing	Not available	Not available	CAN: 10.2.7 US: Table 3.17D AUST: NA NZ: NA
4B.10 Using shear panels to resist uplift	Shearwalls may be designed to use panel sheathing to resist uplift and shear: — dry service conditions — sheathing overlap of floor framing by not less than 50 mm — shrinkage gap left between stories — horizontal joints blocked — proper detailing and attachment — uplift forces reduce shear capacity	Not available	Not available	Not available	CAN: 10.2.8 US: NA AUST: NA NZ: NA

Table A.1 (*continued*)

Provision	*Engineering guide for wood-frame construction* (Canada) EN = Engineered PR = Prescriptive	*Wood Frame Construction Manual* (US) EN = Engineered PR = Prescriptive	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) CA= Cyclonic areas NC= Non-cyclonic	NZ 3604 (New Zealand)	Reference
4C Diaphragms					
4C.1 Diaphragm design	Diaphragms designed to — resist lateral shear — resist diaphragm chord and drag strut forces — transfer lateral forces	A continuous load path is to be provided to transfer all lateral and vertical loads from roof, wall and floor systems to the foundation (EN); Capacities for horizontal diaphragms provided; Diaphragm capacity increased by 40 % when resisting wind loading	Permanent bracing is applied to ensure roof, walls and floor can resist racking forces	Prescribed floor or ceiling diaphragms may be used with braced walls; For buildings with floor diaphragms, each exterior bracing line is required to have at least 50 % of the total required wind bracing, and 60 % of required seismic bracing	CAN: 9.1.2 US: 2.1.2, Table 2C AUST: NC/CA8 NZ: 5.4.2.3, 5.6,13

Table A.1 (*continued*)

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4C.2	Diaphragm framing	Diaphragms include structural wood shear panels or diagonal lumber sheathing attached to min 38 mm framing; panel edges bearing on and attached to framing; Shear panel size at least 1 200 × 2 400 mm except near boundaries where up to two short panels not less than 300 mm may be used; Min nailing schedules provided; Min 25 mm thick proprietary rim joists may be used, where appropriate	Framing and connections provided at panel edges to transfer lateral wind loads from exterior wall to floor diaphragm; diaphragm aspect ratio not greater than 4:1; Min nailing schedules provided; Designs provided for ceiling diaphragm for bracing gable end walls; Rim joists to be designed	Ceiling lining or decking attached directly to rafters, purlins, joists, trusses or battens to ensure integrity of the diaphragm	Diaphragm maximum length = 15 m, and in accordance with: — diaphragm length and width at right angles, — length ⩽ 2,5 mm (width) for one storey or ⩽ 2,0 mm (width) for two stories, — panel size 1 200 mm × 2 400 mm except near boundaries; ceiling sheets of at least 900 mm × 1 800 mm; — construction as specified in figures; Each edge of the diaphragm is connected to a wall having a minimum bracing capacity; Ceiling materials and nailing schedules; First floor of a three-storey diaphragm supported by reinforced masonry wall	CAN: 9.1.3, 9.2.2 US: 2.3.5, 2.1.3.2, 2.1.3.4 AUST: NC/CA7.3 NZ: 5.6, 7.3, 13

Table A.1 (*continued*)

Provision		*Engineering guide for wood-frame construction* (Canada) **EN = Engineered** **PR = Prescriptive**	*Wood Frame Construction Manual* (US) **EN = Engineered** **PR = Prescriptive**	AS 1684-1, AS 1684-2 and AS 1684-3 (Australia) **CA= Cyclonic areas** **NC= Non-cyclonic**	NZ 3604 (New Zealand)	Reference
4C.3	Openings in diaphragms	Forces may be assumed to be transferred around openings < 3,5 m or one-half diaphragm width in size; Diaphragm chords next to openings designed to resist increased forces; Diaphragms having an opening within 0,6 m of exterior wall assumed not capable of resisting shear forces adjacent to the opening	Floor diaphragm openings not greater than 3,7 m or one-half of building dimension	Prescriptive provisions for openings in floors, ceilings	Prescriptive provisions for openings in floors, ceilings	CAN: 9.1.4 US: 2.1.3.2 AUST: 4.3, 7.2 NZ: NA
4C.4	Diaphragm edge support	Diaphragms rectangular with edges supported by shearwalls or drag struts over entire depth, except — where shearwall segments offset by less than 1,2 m, — three-sided structures (see 4C.5) — for diaphragms with openings within 600 m of the edge, where the effective depth of diaphragm is reduced in calculating resistance	Framing and connections provided at panel edges to transfer lateral wind loads from exterior wall to floor diaphragm	Bracing placed in exterior walls and where possible in corners; where bracing cannot be placed in exterior walls due to openings, a structural diaphragm ceiling may be used to transfer racking forces to bracing walls, or wall frames may be designed for portal action; Elevated floors require bracing	Roof bracing against horizontal loads not required where structural ceiling diaphragm is designed and attached to rafters or roof sheathed with wood panelling in accordance with design; Details provided for bracing edges of roofs; Floor joists braced around entire perimeter	CAN: 9.1.6, 9.2.1.2 US: 2.3.5 AUST: NC/CA8.3.5-6, NC/CA8.3.6.7 NZ: 10.3-10.4, 7.3

Table A.1 (*continued*)

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4C.5	Three-sided structures	One-storey structures may be built without shearwall on one side with reduced capacity where the depth normal to the open side is not more than 7,5 m or two-thirds diaphragm width	Not available	Not available	Not available	CAN: 9.1.7 US: NA AUST: NA NZ: NA
4C.6	Diaphragm vertical offset	Diaphragms may be considered continuous where vertical offset is not more than d, and framing members tied together effectively	Vertical floor offset not more than d, and framing members on each side of offset tied or lapped together to transfer shear in both directions	Where there is more than one floor level, each level considered separately for bracing requirement	Any building with discontinuous floor levels to have an internal bracing line below the location of the discontinuity	CAN: 9.2.4 US:2.1.3.2 AUST: 8.3.3 NZ: 5.1.5
4C.7	Diaphragm drag struts	Drag struts required where shearwalls do not extend full depth of diaphragm	No specific information on drag struts; load path to foundation required; chord splice detail provided	Where bracing cannot be placed in exterior walls due to openings, a structural diaphragm ceiling may be used to transfer racking forces to bracing walls or wall frames may be designed for portal action	Dragon ties may be used in lieu of ceiling diaphragm	CAN: 9.4 US: Table 3.21 AUST: NC/CA8.3.6.7 NZ: 8.3.3.1

Table A.1 (*continued*)

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5	**Connections**					
5A	**Lateral framing connections**					
5A.1	Basic member-to-member	Forces between roof framing and walls caused by wind uplift, diaphragm shear, and wind on the face of the building are assumed to act independently; Roof rafters connected to ceiling joists to resist rafter thrust; Roof, wall and floor system connections designed (EN); Other connections to resist gravity loads in accordance with prescriptive Code provisions (PR)	Forces caused by wind uplift, shear and face loading assumed to act independently; Connections between roof, ceiling, wall and floor assemblies to be designed to transfer lateral forces (EN); Other connections to resist gravity or lateral loads are provided in accordance with prescriptive Code provisions (PR)	Nominal and other bracing walls with capacity up to 1,5 kN/m require nominal fixing only, and prescriptive nominal fixings are provided for those cases; Additional fixing requirements specified; Beyond these cases, design tables provided	All parts of the building to be securely fastened and to meet fabrication tolerances, to resist all forces expected during construction or during the expected life of the building, and to ensure the whole building acts as a single structural entity; Rafters connected to joists to resist thrust; Prescriptive nailing schedule (hand or power driven nails) given in tables for floor framing members and wall framing members	CAN: 5.9.5, 6.5.3, 5.4.2, 1.1 US: 2.2, Commentary, Table 3.1 AUST: NC/CA8.3.6.9; NC/CA9.5 NZ: 2.4.1, Table 7.5, Table 8.19, Table 10.14
5A.2	Wall system to roof, floor or ceiling system	To resist wind forces on face of wall: — Roof tied to exterior walls; — Floor framing tied to exterior walls; — Studs tied to wall plates	Connections to transfer all plate-to-roof, plate-to-plate, plate-to-stud and plate-to-floor wind loads	Continuity of tie-down from roof sheeting to foundation, including uplift and shear forces; Bracing details vary for wind speed in CA or NC areas	Roof diagonal braces and hip bracing to walls provided prescriptively	CAN: 5.9.3, 6.5.1.1, 7.5.1 US: 2.2.1.1 AUST: NC/CA9.6, NC/CA8.3.7 NZ: 10.1
5A.3	Foundation to floor system	Connections to transfer loads from foundation wall in accordance with foundation design	Connections to transfer loads from foundation wall in accordance with foundation design	Fixings to transfer horizontal loads into braced columns, posts or stumps in the ground	Detailed foundation wall supports provisions	CAN: 6.5.1.2 US: 2.2.1.2 AUST: 8.3.5 NZ: 6.11, 7.1.4

Table A.1 (*continued*)

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5B Shear connections					
5B.1 Roof, floor or ceiling system to wall system	Roof and floor members connected to diaphragm chords to transfer shear forces; Roof and floor members connected to shearwalls, drag strut or foundation to transfer shear forces; Connection loads need not be considered in combination with other loads except as noted in 5B.3	Connections to transfer roof-to-wall, ceiling-to-wall, and floor-to-wall wind or seismic shear loads acting parallel or perpendicular to the roof ridge	Shear forces resisted at each level of house; In most cases, nominal fixing is adequate except for special provisions as noted below; For wind class N4 (NC) and for CA classes, special connections used to fix floor joists to walls, unless tiedowns provide the needed shear capacity; Otherwise, nominal fixing used	Detailed nailing schedules provided for framing of roof, floor, ceiling and wall systems	CAN: 9.5.1, 9.5.2, 9.5.4 US: 2.2.2.1 AUST: NC/CA9.7 NZ: 6, 7, 8, 9, 10
5B.2 Wall system to wall system	Connections are used to transfer the shear forces from upper shearwall to lower shearwall, except in cases where sheathing is used to transfer shear forces	Connections to transfer shear loads from a shearwall segment above another for wind or seismic loads acting parallel or perpendicular to the roof ridge	Nominal fixings used, supplemented by higher capacity tiedowns to resist uplift; Fixings for wall plates vary depending on windspeed in NC and CA areas	Detailed provisions for connecting wall plates together in walls with or without bracing elements; Details include 3 kN and 6 kN connections	CAN: 10.4.1, 10.4.2 US: 2.2.2.2 AUST: NC and CA9.2, NC/CA Table 9.19 NZ: 8.7
5B.3 Floor system to foundation	Shear force transferred to foundation using anchor bolts or other connections; where ground floor acts as a diaphragm, connections to transfer both diaphragm and shearwall forces	Connections to transfer shear loads from a floor system to foundation for wind or seismic loads acting parallel or perpendicular to ridge	For wind class N4 (NC) and for CA classes, special connections used to fix floor joists to bearers or walls, and bearers to supports, unless tiedowns provide needed shear capacity; Otherwise, nominal fixings used	Prescriptive nailing schedule provided for floor framing members	CAN: 10.4.3 US: 2.2.2.3 AUST: NC/CA 9.7 NZ: Table 7.5

Table A.1 (*continued*)

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5B.4 Wall system to foundation	Continuous load path from roof to foundation; Where ground floor acts as a diaphragm, connections to transfer both diaphragm and shearwall forces	Connections to transfer shear loads from a wall system to foundation for wind or seismic loads acting parallel or perpendicular to ridge	For wind class N4 and CA classes, bottom plates connected to concrete slab using hammered, fired, screwed or expansion masonry anchors at 0,9 m spacing; otherwise, nominal fixing used	Prescriptive nailing schedule for attachment to subfloor and foundation	CAN: 10.4.1, 10.4.3 US: 2.2.2.4 AUST: NC/CA9.7 NZ: 6
5C Wind uplift connections					
5C.1 General	Roof members tied to supports to resist uplift loads minus 0,9 F_D; Special uplift design for roof and wall framing connections in buildings in higher wind load areas (EN); otherwise, prescriptive details can be used (PR)	Total uplift load = uplift minus 0,6 × F_D; A continuous uplift load path is to be provided by either a continuous connector or series of connections between roof, walls, floors and foundation	Net uplift forces are the difference between ultimate uplift forces due to wind and factored gravity loads due to 0,8 times dead load and permanent component of live load resisting uplift; Net uplift = greater of net uplift pressure on roof or net resultant from overturning forces	Uplift fixings provided prescriptively for low, medium, high and very high wind zones	CAN: 5.9.2, Supplement US: Table 2.2A, 2.2.3 AUST: DC5.1, DC5.2.2 NZ: 8, 9, 10
5C.2 Roof system to foundation	Roof framing tied to supports; a continuous uplift load path is to be provided at top and bottom of walls	Connections to transfer uplift loads from roof system to foundation	Tie-downs to resist net uplift pressures at level where located, times the supported roof area; Uplift fixings for roof sheathing, battens, rafters, wall frame and floor frame vary for NC or CA areas; Net uplift at bottom plate level multiplied by 0,8 factor assuming house acts as a box	Details provided for: — fixing of top plates supporting roof members to wall studs or lintels; — lintel fastenings to secure against uplift; — rafter and truss fixings against uplift	CAN: 5.9.2, 7.5.2, Supplement US: 2.2.3.1 AUST: DC5.1.2, DC5.2.2, NC/CA 9, Table 7.4 NZ: 8.6, 8.7, 10.2

Table A.1 (*continued*)

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5D Overturning connections					
5D.1 General	Anchoring devices to maintain continuous load path to foundation, considering dead load with a factor of 0,9 for wind loads and 1,0 for earthquakes	Overturning resistance is to be provided, calculated using no more than 0,6 times the design dead load	Continuity of tiedown shall be provided from roof sheeting to the foundations, with due allowance for effects of gravity loads	Buildings with height of more than 1,7 times width are attached to continuous foundation wall around entire perimeter	CAN: 10.3.1 US: 2.2.4 AUST: NC/CA9.6 NZ: 5.4.3.2
5D.2 Hold-downs	Hold-down overturning resistance in accordance with shearwall design; sized to resist required overturning forces; provisions also given for shearwall segments without hold-downs	Hold-downs to provide overturning resistance in accordance with design of shearwalls; sized to resist the required hold-down tension capacity, where used to resist both uplift and overturning sized to resist the sum of the forces; provisions also for wall segments without hold-downs; prescriptive hold-down requirements based on wall height and shearwall capacity	All bracing walls fixed to floor, ceiling or roof frame with connections of equal shear capacity to bracing capacity of wall; Where overturning can contribute to uplift, uplift pressures at bottom plate or subfloor level are equivalent values assuming the uplift load width = one-half the building width	Prescriptive fixing details to floor and foundation	CAN: 10.3, 10.2.9.5, US: 2.2.4.1 AUST: DC5.1.2, NC/CA8.3.6.9-10 NZ: 6
5E Sheathing and cladding attachment					
5E.1 Roof sheathing	Roof sheathing fastened to resist wind suction loads and to provide required diaphragm resistance	Roof sheathing attached to resist wind suction loads and to provide the roof diaphragm capacity	Specific connection design required for uplift of roof battens or sheeting, depending on wind loads (NC or CA)	Nails passing through sheets > 10 mm to be at least 3 times the sheet material thickness, with pointside penetration no less than 45 mm nail length; Nailing schedules given	CAN: 5.2.3 US: 2.2.5.1, Table 2C AUST: NC/CA9.6 NZ: 2.4.4, 10, 13

Table A.1 (*continued*)

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5E.2 Wall sheathing	Wall sheathing fastened to resist wind suction loads, provide required shearwall resistance, and meet minimum Code requirements	Wall sheathing attached to resist wind suction loads and to provide the shearwall capacity	Sheeting fixing schedules provided in tables for bracing walls	Nails passing through sheets > 10 mm to be at least 3 times the sheet material thickness, with pointside penetration no less than 45 mm nail length; Nailing schedules given	CAN: 7.2.4 US: 2.2.5.2 AUST: NC/CA Table 8.18 NZ: 2.4.4, 8
5E.3 Floor sheathing	Subflooring fastened to provide required diaphragm resistance and meet minimum Code requirements	Floor sheathing attached to provide the floor diaphragm capacity	Subfloor fixing schedules provided	Nails passing through sheets > 10 mm to be at least 3 times the sheet material thickness, with pointside penetration no less than 45 mm nail length; Nailing schedules given	CAN: 6.2.4 US: 2.2.5.3 AUST: NC/CA5.5 NZ: 2.4.4, 7
5F Special connections					
5F.1 Ridge tie	Roof members connected at ridge to resist horizontal wind load component	Ridge connection to resist separation due to wind suction loads	Each pair of rafters tied together at ridge to resist loads	Rafters connected together prescriptively or with a strap to resist 6 kN load	CAN: 5.5.3 US: 2.2.6.1 AUST: NC/CA9.6 NZ: 10.2.1.3

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ICS 91.080.20

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