National Research Council Canada
Conseil national de recherches Canada

Associate Committee on the National Building Code

Canadian Housing Code 1990

PLEASE MAIL THIS CARD TODAY

The Canadian Housing Code 1990 is subject to periodic review, which results in amendments being published from time to time. Also, the **NBC/NFC News** contains explanatory articles and comments on the contents of the National Building Code and the National Fire Code, together with an announcement of the Code changes and the schedule of any seminars held across the country to discuss these changes.

To receive your free copy of the Canadian Housing Code amendments and the **NBC/NFC News**, we ask that you complete this card and return it immediately.

Name _____

_____

Address _____

_____

_____

_____

Area of Work (please check box)

- ☐ Architect
- ☐ Engineer
- ☐ Builder
- ☐ Contractor
- ☐ Other _____

- ☐ Owner/Developer
- ☐ Manufacturer
- ☐ Student/Educator
- ☐ Government employee

Specialization _____

Fix
stamp
here

The Secretary
Associate Committee on the National Building Code
National Research Council
Ottawa, Ontario
K1A 0R6

Canadian Housing Code 1990

Issued by the
Associate Committee on the National Building Code
National Research Council of Canada

First Edition 1990

ISSN 1180–3770

NRCC No. 30623

Printed in Canada

Table of Contents

Preface

The Canadian Housing Code is a new addition to the family of Code documents published under the auspices of the Associate Committee on the National Building Code. Its purpose is to assist members of the building industry to identify the requirements that apply to houses, and thereby simplify the application of the NBC. It is provided as a service to those concerned only with house construction: detached, semi-detached and row houses that have no attic or crawl space in common with other houses. Such construction does not entail shared egress facilities, such as public corridors and exit stairways, or shared service facilities, such as service shafts and service rooms. Restricting the scope of this Code to houses greatly simplifies the requirements for fire protection.

The requirements for detached, semi-detached and row houses in this document are identical to those in the National Building Code (Parts 1, 2 and 9). The numbering and wording in the Canadian Housing Code are the same as in the National Building Code, with few exceptions. A requirement that has been altered to restrict its scope to houses is identified by an asterisk. Requirements in the National Building Code that do not apply to houses have been deleted, but no change has been made to the numbering used in the NBC, nor to the intent of the requirement.

In most cases, where a reference is made in Parts 1, 2 and 9 to another Part of the Code, the appropriate portions of the referenced requirements are reproduced immediately after the reference. These are shown with a border to distinguish them from the requirements in Parts 1, 2 and 9. Generally, the referenced requirements are brief. In the case of Section 9.33, however, the reference to Part 6 for heating installations is extensive, covering several pages. In a few cases, the references to other parts of the Code (such as the structural design requirements in Part 4) are so extensive and involved as to make the reproduction of such material impracticable.

Where a reference is made in Parts 1, 2 or 9 to Appendix material, this material is also reproduced immediately following the reference to it and identified by an enclosing border. Where referenced requirements from other Parts of the Code in turn refer to additional Appendix material, the latter is brought together with the requirement as well, and identified by a border within the border. In a few cases, the Appendix material for Part 9 is so extensive that its inclusion within Part 9 would overwhelm the requirements. Such material is retained as a separate Appendix.

Metric Conversion. All values in the Code are given in metric units. A conversion table of imperial equivalents for the most common units used in building design and construction is located at the end of the document.

Public Comment and Inquiries. Comments and inquiries on the use of this Code and suggestions for its improvement are welcomed and should be submitted to: The Secretary, Associate Committee on the National Building Code, National Research Council of Canada, Ottawa, Ontario K1A 0R6.

Revisions to the Canadian Housing Code will be identical to those in the National Building Code and will not be circulated separately for public comment and review.

Related Documents The National Research Council of Canada publishes other code-related documents that are of interest to code users.

National Building Code of Canada 1990 A model set of technical requirements designed to establish a standard of safety for the construction of buildings, including extensions or alterations, the evaluation of buildings undergoing a change of occupancy and upgrading of buildings to remove an unacceptable hazard.

National Fire Code of Canada 1990 A model set of technical requirements designed to provide an acceptable level of fire protection and fire prevention within a community.

Canadian Plumbing Code 1990 Contains detailed requirements for the design and installation of plumbing systems in buildings.

Canadian Farm Building Code 1990 A model set of minimum requirements affecting human health, fire safety and structural sufficiency for farm buildings.

Supplement to the National Building Code 1990 Provides explanatory material on climatic loads, fire-performance ratings and measures for fire safety in high buildings, as well as commentaries on the structural design requirements of Part 4 of the Code.

Measures for Energy Conservation in New Buildings 1983 A set of minimum requirements that provide the basis for improving the energy use characteristics of new buildings.

Commentary on Part 3 (Use and Occupancy) of the National Building Code 1990 Discusses the overall arrangement and the basic concepts and terminology of Part 3, and provides examples to illustrate and explain the more complicated requirements in that Part.

Commentary on Part 9 (Housing and Small Buildings) of the National Building Code 1990 (NEW) Describes the principles behind many of the requirements of Part 9 and some of the historical background where this will assist users in understanding the objectives of certain provisions.

ACNBC Policies and Procedures 1990 Contains the terms of reference and operating procedures of the ACNBC and its standing committees, a statement on the supporting role of the Institute for Research in Construction of NRC and the membership matrices for the various standing committees.

Ce document est également publié en français.

Associate Committee on the National Building Code and Standing Committees

Associate Committee on the National Building Code

J. Longworth *(Chairman)*
J.F. Berndt[2] *(Deputy Chairman)*
R.W. Anderson
O.D. Beck
D.J. Boehmer
R. Booth[1]
K.W. Butler
J.N. Cardoulis[1]
H.E. Carr
S. Cumming
G.S. Dunlop
V.C. Fenton
S.G. Frost
B. Garceau
F. Henderson[1]
D. Hodgson
R.M. Horrocks
J.C. Hurlburt
G. Lévasseur
E.I. Lexier
L. Lithgow
R.P. Lynch[1]
E.I. Mackie
P. Masson[1]
W.M. Maudsley[1]
D.O. Monsen
J.R. Myles
F.L. Nicholson
F.-X. Perreault
J. Perrow
L. Pringle[1]
R. Sider[1]
M. Stein
A.D. Thompson
A.M. Thorimbert
J.E. Turnbull
E.Y. Uzumeri
H. Vokey

R.J. Desserud[2]
R.H. Dunn[3]
R.A. Hewett[2]
R.A. Kearney[3]
M. Walsh[2]

[1] Term completed during preparation of the 1990 Code
[2] IRC staff who provided assistance to the Committee
[3] IRC staff whose involvement with the Committee ended during the preparation of the 1990 Code.

Standing Committee on Fire Protection

F.-X. Perreault *(Chairman)*
A.J.M. Aikman[1]
H.K. Bowers
J.C. Clark
F.G. Clarke
T.J. Dunfield
J. Frewen-Lord[1]
E.H. Geres
R.S. Hallé
L.G. Hamre
G. Harvey
H.H. Hicks
F.P. Higginson
C.L. Kimball
T.K. Lenahan
G.P. Lockhart
J.W. Marshall
W.G. Nichols
R.R. Philippe
M. Rayburn
R. Sider

A.J.M. Aikman[2]
J.F. Berndt[3]
R.B. Chauhan[2]
M. Galbreath[3]
G.C. Gosselin[2]
H.W. Nichol[2]

Standing Committee on Occupancy

D.J. Boehmer *(Chairman)*
D.E.R. Anderson
C. Czarnecki
W.S. Drummond
C.T. Fillingham
J.-C. Labelle
A.E. Larden
R.L. Maki[1]
L.S. Morrison
J.-P. Perreault
G. Sereda
C. Simard
C.A. Skakun
W.T. Sproule
G.C. Waddell[1]
R.T. Wayment
E.K. Zorn[1]

A.J.M. Aikman[2]
J.F. Berndt[3]
R.B. Chauhan[2]
M. Galbreath[3]
G.C. Gosselin[3]
A.K. Kim[2]
H.W. Nichol[2]

Standing Committee on Barrier-Free Design

H.E. Carr *(Chairman)*
E.E. Bailey
J. Beatie
S. Brink
E.J. de Grey
J. Duperré
R.A. Elton
P. Falta
H.L. Frank
J.E. Hooper
R. Keith
G.F. Maguire
W.G.R. Partridge
L. Pringle
W. Schmid
G.C. Simpson

J.R. Champagne[2]
A.T. Hansen[3]
L.P. Saint-Martin[2]
J.K. Summers[2]

Standing Committee on Structural Design

V.C. Fenton *(Chairman)*
L.D. Baikie
R.L. Booth[1]
W.G. Campbell[1]
A.G. Davenport
B. deV. Batchelor
G.A. Dring
T.A. Eldridge
M.J. Frye
R. Gagné
M.I. Gilmor[1]
R. Halsall
D.J.L. Kennedy
L.C. King
E. Lerner
J.G. MacGregor
B. Manasc[1]
C. Marsh
A.M. McCrea
M.J. Newark
W. Noseworthy
R.F. Riffell
J.K. Ritchie
R. Schuster
R.V. Switzer
S.M. Uzumeri
G.L. Walt[1]

D.E. Allen[2]
D. A. Lutes[2]

Standing Committee on Heating, Ventilating and Air-Conditioning

O.D. Beck *(Chairman)*
G.F. Anderson
H.M. Chorney
S.K. Cryer
P.R. French
D.A. Hill
D.W. Johnson
J.O. Klein
R.E. Kuster
S. Levine
W.G. Mitchell
K.W. Newbert
J.W. Powers[1]
R.J. Scally
J.U. Tessier
T. Tyne
F. Vaculik

S. Barakat[2]
R. J. Desserud[2]
J. C. Haysom[2]
J. K. Summers[2]

Standing Committee on Plumbing Services

A.D. Thompson *(Chairman)*
W.C. Angevine
J.L.H. Batiste[1]
K.A. Bavis[1]
D.P. Carritt[1]
M.J. Cook
J. Cooney
L.J. Corkery
F.H. Edgecombe
A. Gendron
H. Gillis[1]
C.A. Hainer[1]
F. Holland
A.A. Knapp
B. Lagueux
H.C. Martin
D.S. McDonald
W.L. McNamara
J. Okabe[1]
T.A. Pegg[1]
J. Riley
R. Scott[1]
D. Walker
W.A. Wallace

D. A. Lutes[2]

---

[1] Term completed during preparation of the 1990 Code

[2] IRC staff who provided assistance to the Committee

[3] IRC staff whose involvement with the Committee ended during the preparation of the 1990 Code.

Standing Committee on Housing and Small Buildings

E.I. Lexier *(Chairman)*
R.A. Etherington
T.A. Hale
D. Hammond[4]
K. Harris
G. Harvey
J.-C. Havard
E.D. Jones
O.I. Luciw
A.W. McIntyre
B. Nantel
A.W. Nytepchuk
W.J. Phillips
V.A. Presseau
W. Purchase
G.D. Shortreed
P.L. Southwell
J. Timusk
A.L. Treppel
D.C. Verge
G.L. Walt
J.S. Yamashita

R.P. Bowen[2]
R. J. Desserud[2]
A.T. Hansen[3]
J. C. Haysom[2]
L. P. Saint-Martin[2]

Standing Committee on Fire Performance Ratings

E.Y. Uzumeri *(Chairman)*
J.R. Bateman
H.J. Campbell
D.B. Grant[4]
H.A. Grisack
F.P. Higginson
H. Jabbour
H.A. Locke
W.M. Maudsley[1]
R.J. McGrath
P. Mercier-Gouin[1]
J. Rocheleau[1]
G.D. Shortreed
D.C. Stringer
J.U. Tessier
C.R. Thomson
L.W. Vaughan

R.B. Chauhan[2]
G.C. Gosselin[3]
T.T. Lie[2]
R. A. Kearney[2]
J.J. Shaver[3]

NBC/NFC French Technical Verification Committee

F.-X. Perreault *(Chairman)*
R. Ashley [1]
G. Bessens
G. Harvey
S. Larivière
H.C. Nguyen [1]
G. Paré
J.-P. Perreault
I. Wagner

D. Chaput [3]
L. Pellerin [3]
L.P. Saint-Martin[2]
J. Wathier [2]

---

[1] Term completed during preparation of the 1990 Code

[2] IRC staff who provided assistance to the Committee

[3] IRC staff whose involvement with the Committee ended during the preparation of the 1990 Code.

[4] Deceased.

Part 1
Scope and Definitions

Part 1
Scope and Definitions

Section 1.1 General

1.1.1. Administration

1.1.1.1. This Code shall be administered in conformance with the appropriate provincial or municipal regulations or, in the absence of such regulations, in conformance with the ACNBC Administrative Requirements for Use with the National Building Code 1985.

1.1.2 Scope

1.1.2.1. This Code applies to the design, construction and *occupancy* of new *buildings*, and the *alteration*, reconstruction, demolition, removal, relocation and *occupancy* of existing *buildings*. (See Appendix A.)

** **1.1.2.2.**

(1) This Code applies to the construction of detached, semi-detached and row houses, together with their ancillary private *storage garages*, provided such houses

(a) have no shared egress facilities,
(b) have no *dwelling unit* above or below them,
(c) have no shared *service spaces* such as attics, crawl spaces, service shafts or *service rooms*,
(d) are self-contained with respect to heating and ventilation,
(e) have a *building area* not greater than 600 m^2, and
(f) have a *building height* of not more than 3 *storeys*.

(2) Houses other than those described in Sentence (1) shall conform to the National Building Code of Canada 1990.

1.1.3. Definitions of Words and Phrases

1.1.3.1. Definitions of words and phrases used in this Code that are not included in the list of definitions in this Part shall have the meanings which are commonly assigned to them in the context in which they are used in this Code, taking into account the specialized use of terms with the various trades and professions to which the terminology applies.

1.1.3.2. The words and terms in italics in this Code have the following meanings:

Access to exit means that part of a *means of egress* within a *floor area* that provides access to an *exit* serving the *floor area*.

Allowable bearing pressure (as applying to *foundations*) means the maximum pressure that may be safely applied to a *soil* or *rock* by the *foundation unit* considered in design under expected loading and subsurface conditions.

Alteration means a change or extension to any matter or thing or to any *occupancy* regulated by this Code.

Appliance means a device to convert fuel into energy and includes all components, controls, wiring and piping required to be part of the device by the applicable standard referred to in this Code.

---

* Requirement modified to apply to houses only.

** Article 1.1.2.2. is for the purpose of this document and does not appear in Part 1 of the National Building Code.

Attic or roof space means the space between the roof and the ceiling of the top *storey* or between a dwarf wall and a sloping roof.

Authority having jurisdiction means the governmental body responsible for the enforcement of any part of this Code or the official or agency designated by that body to exercise such a function.

Basement means a *storey* or *storeys* of a *building* located below the *first storey*.

Boiler means an *appliance* intended to supply hot water or steam for space heating, processing or power purposes.

Breeching means a *flue pipe* or chamber for receiving *flue* gases from one or more *flue* connections and for discharging these gases through a single *flue* connection.

Building means any structure used or intended for supporting or sheltering any use or *occupancy*.

Building area means the greatest horizontal area of a *building* above *grade* within the outside surface of exterior walls or within the outside surface of exterior walls and the centre line of *firewalls*.

Building height (in *storeys*) means the number of *storeys* contained between the roof and the floor of the *first storey*.

Chimney means a primarily vertical shaft enclosing not less than one *flue* for conducting *flue* gases to the outdoors.

Chimney liner means a conduit containing a *chimney flue* used as a lining of a *masonry or concrete chimney*.

Closure means a device or assembly for closing an opening through a *fire separation* or an exterior wall, such as a door, a shutter, wired glass, or glass block, and includes all components such as hardware, closing devices, frames and anchors.

Combustible means that a material fails to meet the acceptance criteria of CAN4-S114, "Standard Method of Test for Determination of Non-Combustibility in Building Materials."

Combustible construction means that type of construction that does not meet the requirements for *non-combustible construction*.

Dead load means the weight of all permanent structural and nonstructural components of a *building*.

Designer means the person responsible for the design.

Dwelling unit means a *suite* operated as a housekeeping unit, used or intended to be used as a domicile by one or more persons and usually containing cooking, eating, living, sleeping and sanitary facilities.

Exhaust duct means a duct through which air is conveyed from a room or space to the outdoors.

Exit means that part of a *means of egress*, including doorways, that leads from the *floor area* it serves, to a separate *building*, an open public thoroughfare, or an exterior open space protected from fire exposure from the *building* and having access to an open public thoroughfare. (See Appendix A.)

A-1.1.3.2. Exit. Exits include doors or doorways leading directly into an exit stair or directly to the outside. In the case of an exit leading to a separate building, exits also include vestibules, walkways, bridges and balconies.*Exposing building face* means that part of the exterior wall of a *building* which faces one direction and is located between ground level and the ceiling of its top *storey*, or where a *building* is divided into *fire compartments*, the exterior wall of a *fire compartment* which faces one direction.

Exterior cladding means those components of a *building* which are exposed to the outdoor environment and are intended to provide protection against wind, water or vapour.

Factory-built chimney means a *chimney* consisting entirely of factory-made parts, each designed to be assembled with the other without requiring fabrication on site.

Fire compartment means an enclosed space in a *building* that is separated from all other parts of the *building* by enclosing construction providing a *fire separation* having a required *fire-resistance rating*.

Fire-resistance rating means the time in hours or fraction thereof that a material or assembly of materials will withstand the passage of flame and the transmission of heat when exposed to fire under specified conditions of test and performance criteria, or as determined by extension or interpretation of information derived therefrom as prescribed in this Code.

Fire separation means a construction assembly that acts as a barrier against the spread of fire. (See Appendix A.)

A-1.1.3.2. Fire Separation. A fire separation may or may not have a fire-resistance rating.

Firewall means a type of *fire separation* of *noncombustible construction* which subdivides a *building* or separates adjoining *buildings* to resist the spread of fire and which has a *fire-resistance rating* as prescribed in this Code and has structural stability to remain intact under fire conditions for the required fire-rated time.

First storey means the uppermost *storey* having its floor level not more than 2 m above *grade*.

Flame-spread rating means an index or classification indicating the extent of spread-of-flame on the surface of a material or an assembly of materials as determined in a standard fire test as prescribed in this Code.

Floor area means the space on any *storey* of a *building* between exterior walls and required *firewalls*, including the space occupied by interior walls and *partitions*, but not including *exits*, *vertical service spaces*, and their enclosing assemblies.

Flue means an enclosed passageway for conveying *flue* gases.

Flue collar means the portion of a fuel-fired *appliance* designed for the attachment of the *flue pipe* or *breeching*.

Flue pipe means the pipe connecting the *flue collar* of an *appliance* to a *chimney*.

Forced-air furnace means a *furnace* equipped with a fan that provides the primary means for the circulation of air.

Foundation means a system or arrangement of *foundation units* through which the loads from a *building* are transferred to supporting *soil* or *rock*.

Furnace means a *space-heating appliance* using warm air as the heating medium and usually having provision for the attachment of ducts.

Gas vent means that portion of a venting system designed to convey vent gases to the outdoors from the *vent connector* of a gas-fired *appliance* or directly from the *appliance* when a *vent connector* is not used.

Grade (as applying to the determination of *building height*) means the lowest of the average levels of finished ground adjoining each exterior wall of a *building*, except that localized depressions such as for vehicle or pedestrian entrances need not be considered in the determination of average levels of finished ground. (See *First storey*.)

Guard means a protective barrier around openings in floors or at the open sides of stairs, landings, balconies, *mezzanines*, galleries, raised *walkways* or other locations to prevent accidental falls from one level to another. Such barrier may or may not have openings through it.

Horizontal service space means a space such as an attic, duct, ceiling, roof or crawl space oriented essentially in a horizontal plane, concealed and generally inaccessible, through which *building* service facilities such as pipes, ducts and wiring may pass.

Limiting distance means the distance from an *exposing building face* to a property line, the centre line of a *street*, lane or public thoroughfare, or to an imaginary line between 2 *buildings* or *fire compartments* on the same property, measured at right angles to the *exposing building face*.

Live load means the load other than *dead load* to be assumed in the design of the structural members of a *building*. It includes loads resulting from snow, rain, wind, earthquake and those due to *occupancy*.

Loadbearing (as applying to a building element) means subjected to or designed to carry loads in addition to its own *dead load*, excepting a wall element subjected only to wind or earthquake loads in addition to its own *dead load*.

Masonry or concrete chimney means a *chimney* of brick, stone, concrete or masonry units constructed on site.

Means of egress means a continuous path of travel provided for the escape of persons from any point in a *building* or contained open space to a separate *building*, an open public thoroughfare, or an exterior open space protected from fire exposure from the *building* and having access to an open public thoroughfare. *Means of egress* includes *exits* and *access to exits*.

Mezzanine means an intermediate floor assembly between the floor and ceiling of any room or *storey* and includes an interior balcony.

Noncombustible means that a material meets the acceptance criteria of CAN4-S114, "Standard Method of Test for Determination of Non-Combustibility in Building Materials."

Noncombustible construction means that type of construction in which a degree of fire safety is attained by the use of *noncombustible* materials for structural members and other building assemblies.

Occupancy means the use or intended use of a *building* or part thereof for the shelter or support of persons, animals or property.

Partition means an interior wall 1 *storey* or part-*storey* in height that is not *loadbearing*.

Party wall means a wall jointly owned and jointly used by 2 parties under easement agreement or by right in law, and erected at or upon a line separating 2 parcels of land each of which is, or is capable of being, a separate real-estate entity.

Plenum means a chamber forming part of an air duct system.

Plumbing system means a drainage system, a venting system and a water system or parts thereof.

Private sewage disposal system means a privately owned plant for the treatment and disposal of sewage (such as a septic tank with an absorption field).

Range means a cooking *appliance* equipped with a cooking surface and one or more ovens.

Return duct means a duct for conveying air from a space being heated, ventilated or air-conditioned back to the heating, ventilating or air-conditioning *appliance*.

Service room means a room provided in a *building* to contain equipment associated with *building* services. (See Appendix A.)

A-1.1.3.2. Service Room. Typical examples of service rooms include boiler rooms, furnace rooms, incinerator rooms, garbage handling rooms, and rooms to accommodate air-conditioning or heating appliances, pumps, compressors and electrical equipment. Rooms such as elevator machine rooms and common laundry rooms are not considered to be service rooms.

Service space means space provided in a *building* to facilitate or conceal the installation of *building* service facilities such as chutes, ducts, pipes, shafts or wires.

Service water heater means a device for heating water for plumbing services.

Smoke alarm means a combined *smoke detector* and audible alarm device designed to sound an alarm within the room or *suite* in which it is located upon the detection of smoke within that room or *suite*.

Space heater means a *space-heating appliance* for heating the room or space within which it is located, without the use of ducts.

Space-heating appliance means an *appliance* intended for the supplying of heat to a room or space directly, such as a *space heater*, fireplace or *unit heater*, or to rooms or spaces of a *building* through a heating system such as a central *furnace* or *boiler*.

Sprinklered (as applying to a *building* or part thereof) means that the *building* or part thereof is equipped with a system of automatic sprinklers.

Storage garage means a *building* or part thereof intended for the storage or parking of motor vehicles and which contains no provision for the repair or servicing of such vehicles.

Storey means that portion of a *building* which is situated between the top of any floor and the top of the floor next above it, and if there is no floor above it, that portion between the top of such floor and the ceiling above it.

Stove means an *appliance* intended for cooking and space heating.

Street means any highway, road, boulevard, square or other improved thoroughfare 9 m or more in width, which has been dedicated or deeded for public use, and is accessible to fire department vehicles and equipment.

Suite means a single room or series of rooms of complementary use, operated under a single tenancy, and includes *dwelling units*, individual guest rooms in motels, hotels, boarding houses, rooming houses and dormitories as well as individual stores and individual or complementary rooms for *business and personal services occupancies*. (See Appendix A.)

* **A-1.1.3.2. Suite.** Tenancy in the context of the term "suite" applies to both rental and ownership tenure. In a condominium arrangement, for example, dwelling units are considered separate suites even though they are individually owned.

Supply duct means a duct for conveying air from a heating, ventilating or air-conditioning *appliance* to a space to be heated, ventilated or air-conditioned.

Unprotected opening (as applying to *exposing building face*) means a doorway, window or opening other than one equipped with a *closure* having the required *fire-protection rating*, or any part of a wall forming part of the *exposing building face* that has a *fire-resistance rating* less than required for the *exposing building face*.

Vent connector (as applying to heating or cooling systems) means the part of a venting system that conducts the *flue* gases or vent gases from the *flue collar* of a gas *appliance* to the *chimney* or *gas vent*, and may include a draft control device.

1.1.4. Abbreviations

1.1.4.1. Abbreviations of Proper Names.

The abbreviations of proper names in this Code shall have the meanings assigned to them in this Article. The appropriate addresses are shown in brackets following the name.

ACNBC ..... Associate Committee on the National Building Code (National Research Council of Canada, Ottawa, Ontario K1A 0R6)

ASHRAE ..... American Society of Heating, Refrigerating and Air-Conditioning Engineers (1791 Tullie Circle N.E., Atlanta, Georgia 30329 U.S.A.)

ASTM ..... American Society for Testing and Materials (1916 Race Street, Philadelphia, Pennsylvania 19103 U.S.A.)

CAN ..... National Standard of Canada designation (The number or name following the CAN designation represents the agency under whose auspices the standard is issued. CAN1 designates CGA, CAN2 designates CGSB, CAN3 designates CSA, and CAN4 designates ULC.)

CGA ..... Canadian Gas Association (55 Scarsdale Road, Don Mills, Ontario M3B 2R3)

CGSB ..... Canadian General Standards Board (Ottawa, Ontario K1A 1G6)

CLA ..... Canadian Lumbermen's Association (27 Goulburn Avenue, Ottawa, Ontario K1N 8C7)

CSA ..... Canadian Standards Association (178 Rexdale Blvd., Rexdale, Ontario M9W 1R3)

HI ..... Hydronics Institute (35 Russo Place, Berkeley Heights, New Jersey 07922 U.S.A.)

HRAI ..... Heating, Refrigerating and Air-Conditioning Institute of Canada (5468 Dundas Street West, Islington, Ontario M9B 6E3)

NBC ..... National Building Code of Canada (National Research Council of Canada, Ottawa, Ontario K1A 0R6)

NLGA ..... National Lumber Grades Authority (1460-1055 West Hastings Street, Vancouver, B.C. V6E 2G8)

SMACNA .... Sheet Metal and Air Conditioning Contractors National Association Inc. (8224 Old Courthouse Road, Vienna, Virginia 22180 U.S.A.)

ULC ..... Underwriters' Laboratories of Canada (7 Crouse Road, Scarborough, Ontario M1R 3A9)

WCLIB ..... West Coast Lumber Inspection Bureau (6980 Southwest Varns Street, P.O.Box 23145, Portland, Oregon 97223 U.S.A.)

WWPA ..... Western Wood Products Association (1500 Yeon Building, Portland, Oregon 97204 U.S.A.)

1.1.4.2. Symbols and Other Abbreviations.

The symbols and other abbreviations in this Code shall have the meanings assigned to them in this Article.

cm	centimetre(s)
°	degree(s)
°C	degree(s) Celsius
diam	diameter
g	gram(s)
ga	gauge
h	hour(s)
Inc.	Incorporated
J	joule(s)
kg	kilogram(s)
kN	kilonewton(s)
kPa	kilopascal(s)
kW	kilowatt(s)
L	litre(s)
m	metre(s)
max.	maximum
min.	minimum
min	minute(s)
MJ	megajoule(s)
mm	millimetre(s)
MPa	megapascal(s)
N	newton
N/A	not applicable
ng	nanogram(s)
No.	number(s)
nom.	nominal
o.c.	on centre
s	second(s)
temp.	temperature
T&G	tongue and groove
W	watt(s)
wt	weight

Part 2
General Requirements

Part 2
General Requirements

Section 2.1 Application

2.1.4. Site Assembled and Factory-Built Buildings

2.1.4.1. This Code applies both to site assembled and factory made *buildings*.

2.1.6. Building Size Determination

* **2.1.6.1. Buildings Divided by Firewalls.** Where a *firewall* divides a *building*, each portion of the *building* so divided shall be considered as a separate *building*. (See Appendix A.)

A-2.1.6.1. This concept relates to the provisions directly regulated by this Code and does not apply to electrical service entrance requirements which are regulated by other documents.

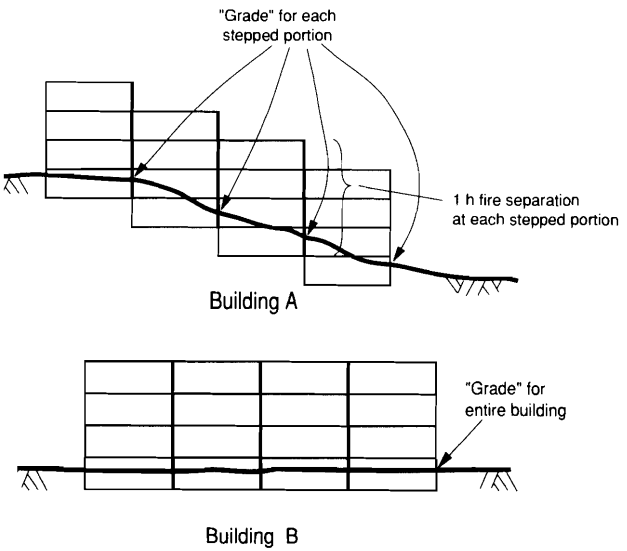
2.1.6.2. Buildings Divided by Vertical Fire Separations

(1) Except as permitted in Sentence (2), where portions of a *building* are completely separated by a vertical *fire separation* that has a *fire-resistance rating* of not less than 1 h and extends through all *storeys* and *service spaces* of the separated portions, each separated portion is permitted to be considered as a separate *building* for the purpose of determining *building height* provided

* (a) each separated portion is not more than 3 *storeys* in *building height* , and

(b) the unobstructed path of travel for the fire fighter from the nearest *street* to one entrance of each separated portion is not more than 45 m. (See Appendix A.)

A-2.1.6.2.(1) Buildings on Sloping Sites. Application of the definition of grade to stepped buildings on sloping sites often results in such buildings being designated as being greater than 3 storeys in building height even though there may be only 2 or 3 storeys at any one location. The diagrams below illustrate this application compared to a similar building on a flat site.



Under this Sentence, Building A can be considered as being 3 storeys in building height instead of 6 storeys in building height. Both Building A and

* Requirement modified to apply to houses only.

Building B are comparable with regard to fire safety and egress.

This relaxation applies to the determination of building height only. All other requirements continue to apply as appropriate.

Section 2.2 Climatic Data

2.2.1. General

2.2.1.1. Climatic Values

(1) The climatic values required for the design of *buildings* under this Code shall be in conformance with the values established by the *authority having jurisdiction* or, in the absence of such data, with Sentence (2) and the climatic values in Chapter 1 of the Supplement to the NBC 1990. (See Appendix A.)

A-2.2.1.1.(1) Data for municipalities not listed in the Supplement may be obtained by writing to: Head, Energy and Industrial Application Section, Canadian Climate Service, Environment Canada, 4905 Dufferin Street, Downsview, Ontario M3H 5T4.

(2) The outside winter design temperatures determined from Chapter 1 of the Supplement to the NBC 1990 shall be those listed for the January 2.5 per cent values. (See Appendix A.)

A-2.2.1.1.(2) The 2.5 per cent values stated in Sentence 2.2.1.1.(2) are the least restrictive temperatures that can be used. If a designer chooses to use the 1 per cent values given in Chapter 1 of the Supplement to the NBC 1990, they would be in excess of the Code minimums and would be considered acceptable.

2.2.1.2. Depth of Frost Penetration. Depth of frost penetration shall be established on the basis of local experience.

Section 2.3 Plans, Specifications and Calculations

2.3.1. General

2.3.1.1. Required Information. Sufficient information shall be provided to show that the proposed work will conform to this Code and whether or not it may affect adjacent property.

2.3.1.2. Required Plans. Plans shall be drawn to scale and shall indicate the nature and extent of the work or proposed *occupancy* in sufficient detail to establish that, when completed, the work and the proposed *occupancy* will conform to this Code.

2.3.2. Site Plans

2.3.2.1. Reference to Survey. Site plans shall be referenced to an up-to-date survey and, when required to prove compliance with this Code, a copy of the survey shall be provided.

2.3.2.2. Information Required on Site Plans

(1) Site plans shall show

(a) by dimensions from property lines, the location of the proposed *building*,

(b) the similarly dimensioned location of every other adjacent existing *building* on the property,

(c) existing and finished ground levels to an established datum at or adjacent to the site, and

(d) the access routes for fire fighting.

2.3.3. Fire Protection Components

2.3.3.1. Information Required for Fire Protection Components

(1) Information shall be submitted to show the major components of fire protection including

(a) the division of the *building* by *firewalls*,

(b) the *building area*,

(c) the degree of *fire separation*, *

(d) the source of information for *fire-resistance ratings* of elements of construction (to be indicated on large-scale sections),
(e) the location of *exits*, and
(f) fire detection, suppression and alarm systems.

Section 2.4 Materials, Appliances, Systems and Equipment

2.4.1. General

2.4.1.1. Characteristics of Materials, Appliances, Systems and Equipment. All materials, *appliances*, systems and equipment installed to meet the requirements of this Code shall possess the necessary characteristics to perform their intended functions when installed in a *building*.

2.4.1.2. Storage on the Building Site. All *building* materials, *appliances* and equipment on the *building* site shall be stored in such a way as to prevent deterioration or impairment of their essential properties.

2.4.1.3. Used Materials, Appliances and Equipment. Unless otherwise specified, used materials, *appliances* and equipment may be reused when they meet the requirements of this Code for new materials and are satisfactory for the intended use.

Section 2.5 Equivalents

2.5.1. General

2.5.1.1. Alternate Materials, Appliances, Systems and Equipment Permitted. The provisions of this Code are not intended to limit the appropriate use of materials, *appliances*, systems, equipment, methods of design or construction procedures not specifically described herein.

2.5.1.2. Evidence of Equivalent Performance. Any person desirous of providing an equivalent to satisfy one or more of the requirements of this Code shall submit sufficient evidence to demonstrate that the proposed equivalent will provide the level of performance required by this Code.

2.5.1.3. Equivalence Demonstrated by Past Performance, Test or Evaluation. Materials, *appliances*, systems, equipment, methods of design and construction procedures not specifically described herein, or which vary from the specific requirements in this Code, may be used if it can be shown that these alternatives are suitable on the basis of past performance, tests or evaluations.

2.5.3. Equivalent Test Standards

2.5.3.1. The results of tests based on test standards other than as described in this Code may be used provided such alternate test standards will provide comparable results.

Section 2.6 Review

2.6.5. Off-Site Review

2.6.5.1. Where a *building* or component of a *building* is assembled off the *building* site in such a manner that it cannot be reviewed on site, off-site reviews shall be provided to determine compliance with this Code.

Section 2.7 Referenced Documents

2.7.1. Application

2.7.1.1. The provisions of referenced documents in this Code apply only to the extent that they relate to *buildings*.

2.7.2. Conflicting Requirements

2.7.2.1. In the case of conflict between the provisions of this Code and those of a referenced document, the provisions of this Code shall govern.

2.7.3. Effective Date

2.7.3.1. Unless otherwise specified herein, the documents referenced in this Code shall include all amendments, revisions and supplements effective to 30 June 1989.

2.7.3.2. Where documents are referenced in this Code, they shall be the editions designated in Column 2 of Table 2.7.3.A.

Table 2.7.3.A.

Forming Part of Article 2.7.3.2.

Documents Referenced in the National Building Code of Canada 1990			
Issuing Agency	**Document Number**	**Title of Document**	**Code Reference**
ASTM	A123-84	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products	Table 9.20.16.A.
ASTM	A-153-82 (1987)	Zinc Coating (Hot-Dip) on Iron and Steel Hardware	Table 9.20.16.A.
ASTM	A525-87	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process	9.3.3.2.
ASTM	C4-62 (1986)	Clay Drain Tile	9.14.3.1.(1)
ASTM	C5-79(88)	Quicklime for Structural Purposes	9.20.3.1.(1)
ASTM	C27-84(88)	Classification of Fireclay and High-Alumina Refractory Brick	9.21.3.4.
ASTM	C126-86	Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units	9.20.2.1.(1)
ASTM	C207-79(88)	Hydrated Lime for Masonry Purposes	9.20.3.1.(1)
ASTM	C212-60 (1986)	Structural Clay Facing Tile	9.20.2.1.(1)
ASTM	C315-87 (1983)	Clay Flue Linings	9.21.3.3.(1)
ASTM	C411-82 (1987)	Hot-Surface Performance of High-Temperature Thermal Insulation	6.2.3.6.(3) 6.2.9.2.(2)
ASTM	C412M-83 (1988)	Concrete Drain Tile	9.14.3.1.(1)
ASTM	C444M-87	Perforated Concrete Pipe (Metric)	9.14.3.1.(1)
ASTM	C700-89	Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated	9.14.3.1.(1)
ASTM	C1002-88	Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases	9.24.1.4. 9.29.5.7.
ASTM	E90-87	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions	9.11.1.1.
ASTM	E336-84	Measurement of Airborne Sound Insulation in Buildings	9.11.1.1.
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
ASTM	E413-87	Classification for Rating Sound Insulation	9.11.1.1.
ASTM	F476-84	Test Methods for Security of Swinging Door Assemblies	9.6.6.10.
CGA	CAN/CGA-B149.1-M86	Natural Gas Installation Code	6.2.1.4.(1)
CGA	CAN/CGA-B149.2-M86	Propane Installation Code	6.2.1.4.(1)
CGSB	CAN/CGSB-7.1-M86	Cold Formed Steel Framing Components	9.24.1.2.
CGSB	CAN/CGSB-7.2-M86	Adjustable Metal Columns	9.17.3.4.
CGSB	10-GP-3Ma-1981	Refractory Mortar, Air Setting	9.21.3.4. 9.21.3.9.(1) 9.22.2.2.(1)
CGSB	CAN/CGSB-11.3-M87	Hardboard	9.27.10.1.(2) 9.29.7.1. 9.30.2.2.(1)
CGSB	CAN/CGSB-11.5-M87	Hardboard, Precoated, Factory Finished, for Exterior Cladding	9.27.10.1.(1)
CGSB	CAN2-12.1-M79	Glass, Safety, Tempered or Laminated	9.6.5.2.(2) 9.7.3.1.(1)
CGSB	CAN2-12.2-M76	Glass, Sheet, Flat, Clear	9.7.3.1.(1)
CGSB	CAN2-12.3-M76	Glass, Polished Plate or Float, Flat, Clear	9.7.3.1.(1)
CGSB	CAN2-12.4-M76	Glass, Heat Absorbing	9.7.3.1.(1)
CGSB	CAN2-12.8-M76	Insulating Glass Units	9.7.3.1.(1)
CGSB	CAN2-12.10-M76	Glass, Light and Heat Reflecting	9.7.3.1.(1)
CGSB	CAN2-12.11-M76	Glass, Wired, Safety	9.6.5.2.(2) 9.7.3.1.(1)
CGSB	CAN/CGSB-12.20-M89	Structural Design of Glass for Buildings	9.7.3.2.
CGSB	19-GP-5M-1976	Sealing Compound, One Component, Acrylic Base, Solvent Curing	9.27.4.2.(2)
GCSB	CAN/CGSB-19.13-M87	Sealing Compound, One-Component, Elastomeric, Chemical Curing	9.27.4.2.(2)
CGSB	19-GP-14M-1976	Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing	9.27.4.2.(2)
CGSB	19-GP-22M-1977	Sealing Compound, Mildew Resistant, for Tubs and Tile	9.29.10.5.
CGSB	CAN2-19.24-M80	Sealing Compound, Multi-Component, Chemical Curing	9.27.4.2.(2)
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
CGSB	CAN/CGSB-34.4-M89	Siding, Asbestos Cement, Shingles and Clapboards	9.27.8.1.(1)
CGSB	CAN/CGSB-34.5-M89	Sheets, Asbestos Cement, Corrugated	9.27.8.1.(1)
CGSB	CAN/CGSB-37.14-M87	Sheets, Asbestos Cement, Decorative	9.27.8.1.(1)
CGSB	CAN/CGSB-34.16-M89	Sheets, Asbestos Cement, Flat, Fully Compressed	9.27.8.1.(1)
CGSB	CAN/CGSB-34.17-M89	Sheets, Asbestos-Cement, Flat, Semicompressed	9.27.8.1.(1)
CGSB	CAN/CGSB-34.21-M89	Panels, Sandwich, Asbestos-Cement with Insulating Cores	9.27.8.1.(1)
CGSB	CAN/CGSB-34.22-M87	Pipe, Asbestos-Cement, Drain	9.14.3.1.(1)
CGSB	CAN/CGSB-37.2-M88	Asphalt Emulsified, Mineral Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings	9.13.2.1.(1)
CGSB	37-GP-3M-1976	Application of Emulsified Asphalts for Dampproofing or Waterproofing	9.13.1.3.(1)
CGSB	CAN/CGSB-37.4-M89	Cement, Lap, Cutback Asphalt, Fibrated, for Asphalt Roofing	9.26.2.1.(1)
CGSB	CAN/CGSB-37.5-M89	Cement, Plastic, Cutback Asphalt	9.26.2.1.(1)
CGSB	37-GP-6Ma-1983	Asphalt, Cutback, Unfilled, for Dampproofing	9.13.2.1.(1)
CGSB	CAN/CGSB-37.8-M88	Asphalt, Cutback, Filled, for Roof Coating	9.26.2.1.(1)
CGSB	37-GP-9Ma-1983	Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing	9.26.2.1.(1)
CGSB	37-GP-12Ma-1984	Application of Unfilled Cutback Asphalt for Dampproofing	9.13.1.3.(1)
CGSB	37-GP-16M-1976	Asphalt, Cutback, Filled, for Dampproofing and Waterproofing	9.13.2.1.(1)
CGSB	37-GP-18Ma-1985	Tar, Cutback, Unfilled, for Dampproofing	9.13.2.1.(1)
CGSB	37-GP-21M-1976	Tar, Cutback, Fibrated, for Roof Coating	9.26.2.1.(1)
CGSB	37-GP-22M-1976	Application of Unfilled Cutback Tar Foundation Coating for Dampproofing	9.13.1.3.(1)
CGSB	37-GP-50M-78	Asphalt, Rubberized, Hot Applied for Roofing and Waterproofing	9.26.2.1.(1)
CGSB	37-GP-51M-79	Application of Rubberized Asphalt, Hot Applied for Roofing and Waterproofing	9.26.15.1.
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
CGSB	37-GP-52M-84	Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric	9.26.2.1.(1)
CGSB	37-GP-54M-79	Roofing and Waterproofing Membrane, Sheet-Applied, Flexible, Polyvinyl Chloride	9.26.2.1.(1)
CGSB	37-GP-55M-79	Application of Sheet Applied Flexible Polyvinyl Chloride Roofing Membrane	9.26.16.1.
GGSB	37-GP-56M-80	Membrane, Modified,Bituminous, Prefabricated, and Reinforced for Roofing	9.26.2.1.(1)
CGSB	41-GP-6M-1976	Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced	9.26.2.1.(1)
CGSB	41-GP-24Ma-1983	Siding, Soffits and Fascia, Rigid Vinyl	9.27.13.1.
CGSB	41-GP-29Ma-1983	Tubing, Plastic, Corrugated, Drainage	9.14.3.1.(1)
CGSB	CAN/CGSB 51.20-M87	Thermal Insulation, Polystyrene, Boards and Pipe Covering	Table 9.23.16.A. 9.25.3.1.(1) 9.25.3.3.
CGSB	51-GP-21M-1978	Thermal Insulation, Urethane and Isocyanurate, Unfaced	Table 9.23.16.A. 9.25.3.1.(1)
CGSB	CAN/CGSB-51.25-M87	Thermal Insulation, Phenolic, Faced	Table 9.23.16.A. 9.25.3.1.(1)
CGSB	CAN/CGSB-51.26-M86	Thermal Insulation, Urethane and Isocyanurate, Boards, Faced	Table 9.23.16.A. 9.25.3.1.(1)
CGSB	51-GP-27M-1979	Thermal Insulation, Polystyrene, Loose Fill	9.25.3.1.(1)
CGSB	CAN2-51.32-M77	Sheathing, Membrane, Breather Type	9.20.13.10.(1) 9.23.17.1. 9.26.2.1.(1)
CGSB	CAN2-51.33-M80	Vapor Barrier, Sheet, for Use in Building Construction	9.25.3.5.(1)
CGSB	CAN/CGSB-51.34-M86	Vapour Barrier, Polyethylene Sheet for use in Building Construction	9.13.2.1.(1) 9.18.6.1.(3) 9.25.3.4.(2) 9.25.3.5.(1)
CGSB	51-GP-60M-1979	Thermal Insulation, Cellulose Fibre, Loose Fill	9.25.3.1.(1)
CGSB	CAN/CGSB-63.14-M89	Plastic Skylights	9.7.7.1. 9.7.7.2.
CGSB	CAN/CGSB-82.1-M89	Sliding Doors	9.6.4.2.
CGSB	CAN/CGSB-82.5-M88	Insulated Steel Doors	9.6.4.3.
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
CGSB	CAN/CGSB-82.6-M86	Doors, Mirrored Glass, Siding or Folding Wardrobe	9.6.5.3.
CGSB	CAN/CGSB-93.1-M85	Sheet, Aluminum Alloy, Prefinished, Residential	9.27.12.1.(4)
CGSB	93-GP-2Ma-1983	Siding, Soffits and Fascia, Aluminum, Prefinished, Residential	9.27.12.1.(3)
CGSB	93-GP-3M-1978	Sheet, Steel, Galvanized, Prefinished, Residential	9.27.12.1.(2)
CGSB	93-GP-4M-1978	Siding, Soffits and Fascia, Steel, Galvanized, Prefinished, Residential	9.27.12.1.(1)
CSA	CAN3-A5-M88	Portland Cements	9.3.1.2. 9.20.3.1.(1) 9.28.2.1.
CSA	CAN3-A8-M88	Masonry Cements	9.20.3.1.(1)
CSA	CAN3-A23.1-M77	Concrete Materials and Methods of Concrete Construction	9.3.1.3.(1) 9.3.1.4.
CSA	CAN3-A23.2-M77	Methods of Test for Concrete	9.3.1.8.(1)
CSA	CAN/CSA-A82.1-M87	Burned Clay Brick (Solid Masonry Units Made from Clay or Shale)	9.20.2.1.(1)
CSA	A82.3-M1978	Calcium Silicate (Sand-Lime) Building Brick	9.20.2.1.(1)
CSA	A82.4-M1978	Structural Clay Load-Bearing Wall Tile	9.20.2.1.(1)
CSA	A82.5-M1978	Structural Clay Non-Load-Bearing Tile	9.20.2.1.(1)
CSA	A82.22-M1977	Gypsum Plasters	9.20.3.1.(1)
CSA	A82.27-M1977	Gypsum Board Products	Table 9.23.16.A. 9.29.5.2.
CSA	A82.30-M1980	Interior Furring, Lathing and Gypsum Plastering	9.29.4.1.
CSA	A82.31-M1980	Gypsum Board Application	9.29.5.1.(2)
CSA	A82.56-M1976	Aggregate for Masonry Mortar	9.20.3.1.(1)
CSA	CAN3-A93-M82	Natural Airflow Ventilators for Buildings	9.19.1.1.(4)
CSA	A101-M1983	Thermal Insulation, Mineral Fibre, for Buildings	9.25.3.1.(1) Table 9.23.16.A.
CSA	A123.1-M1979	Asphalt Shingles Surfaced with Mineral Granules	9.26.2.1.(1)
CSA	A123.2-M1979	Asphalt Coated Roofing Sheets	9.26.2.1.(1)
CSA	A123.3-M1979	Asphalt or Tar Saturated Roofing Felt	9.26.2.1.(1)
CSA	A123.4-M1979	Bitumen for Use in Construction of Built-Up Roof Coverings and Dampproofing and Waterproofing Systems	9.13.2.1.(1) 9.26.2.1.(1)
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
CSA	A123.17-1963	Asphalt-Saturated Felted Glass-Fibre Mat for Use in Construction of Built-Up Roofs	9.26.2.1.(1)
CSA	CAN3-A123.51-M85	Asphalt Shingle Application on Roof Slopes 1:3 and Steeper	9.26.1.2.
CSA	CAN3-A123.52-M85	Asphalt Shingle Application on Roof Slopes 1:6 to less than 1:3	9.26.1.2.
CSA	CAN3-A165.1-M85	Concrete Masonry Units	9.15.2.2. 9.20.2.1.(1) 9.20.2.6.(1)
CSA	CAN3-A165.2-M85	Concrete Brick Masonry Units	9.20.2.1.(1)
CSA	CAN3-A165.3-M85	Prefaced Concrete Masonry Units	9.20.2.1.(1)
CSA	CAN3-A165.4-M85	Autoclaved Cellular Units	9.20.2.1.(1)
CSA	CAN/CSA-A247-M86	Insulating Fibreboard	9.23.15.6.(3) Table 9.23.16.A. 9.25.3.1.(1) 9.29.8.1.
CSA	CAN3-A266.1-M78	Air-Entraining Admixtures for Concrete	9.3.1.9.
CSA	CAN3-A266.2-M78	Chemical Admixtures for Concrete	9.3.1.9.
CSA	CAN3-A371-M84	Masonry Construction for Buildings	9.20.15.2.
CSA	CAN/CSA-A405-M87	Design and Construction of Masonry Fireplaces	9.21.3.5. 9.22.5.2.(2)
CSA	CAN3-A438-M84	Concrete Construction for Housing and Small Buildings	9.3.1.1.
CSA	CAN3-A440-M84	Windows	9.7.2.1. 9.7.6.1.
CSA	B51-M1986	Boiler, Pressure Vessel and Pressure Piping Code	6.2.1.4.(1)
CSA	B52-M1983	Mechanical Refrigeration Code	6.2.1.4.(1)
CSA	B111-1974	Wire Nails, Spikes and Staples	9.23.3.1. 9.26.2.2.(1) 9.29.5.6.
CSA	B139-1976	Installation Code for Oil Burning Equipment	6.2.1.4.(1)
CSA	CAN/CSA-B182.1-M87	Plastic Drain and Sewer Pipe and Pipe Fittings	9.14.3.1.(1)
CSA	B228.1-1968	Pipes, Ducts, and Fittings for Residential Type Air Conditioning Systems	6.2.4.2.(2)
CSA	CAN/CSA-B365-M87	Installation Code for Solid-Fuel Burning Appliances and Equipment	6.2.1.4.(1) 9.21.1.3.(2) 9.22.10.1. 9.33.1.2.
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
CSA	C22.1-1986	Canadian Electrical Code, Part 1	6.2.1.4.(1) 9.34.1.1.
CSA	C22.2 No. 0.3-M1985	Test Methods for Electrical Wires and Cables	3.1.4.3.(1)
CSA	C22.2 No.113-M1984	Fans and Ventilators	9.32.3.3.(2)
CSA	CAN/CSA-C444-M87	Installation Requirements for Heat Recovery Ventilators	6.2.1.7.
CSA	CAN/CSA-F280-M86	Determining the Required Capacity of Residential Space Heating Cooling Appliances	6.2.1.2.
CSA	CAN/CSA-G40.21-M87	Structural Quality Steels	9.23.4.2.(2)
CSA	CAN3-G401-M81	Corrugated Steel Pipe Products	9.14.3.1.(1)
CSA	CAN/CSA-O80.1-M89	Preservative Treatment of All Timber Products by Pressure Processes	9.3.2.9.(1)
CSA	CAN/CSA-O80.2-M89	Preservative Treatment of Lumber, Timber, Bridge Ties and Mine Ties by Pressure Processes	4.2.3.2. 9.3.2.9.(1)
CSA	CAN/CSA-O80.9-M1989	Preservative Treatment of Plywood by Pressure Processes	9.3.2.9.(1)
CSA	CAN/CSA-O80.15-M89	Preservative Treatment of Wood for Building Foundation Systems, Basements and Crawl Spaces by Pressure Processes	9.3.2.9.(1)
CSA	CAN3-O86-M84	Engineering Design in Wood	4.3.1.1.
CSA	CAN/CSA-O86.1-M89	Engineering Design in Wood – Limit States Design	4.3.1.1.
CSA	O115-M1982	Hardwood and Decorative Plywood	9.27.9.1. 9.30.2.2.(1)
CSA	O118.1-M88	Western Red Cedar Shingles and Shakes	9.26.2.1.(1) 9.27.7.1.(1)
CSA	O121-M1978	Douglas Fir Plywood	9.23.14.2.(1) 9.23.15.1.(1) Table 9.23.16.A. 9.27.9.1. 9.30.2.2.(1)
CSA	CAN/CSA-O122-M88	Structural Glued-Laminated Timber	9.23.4.3.(2)
CSA	O132.2-M1977	Wood Doors	9.6.4.1.(1)
CSA	O141-1970	Softwood Lumber	9.3.2.6.
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
CSA	O151- M1978	Canadian Softwood Plywood	9.23.14.2.(1) 9.23.15.1.(1) Table 9.23.16.A. 9.27.9.1. 9.30.2.2.(1)
CSA	O153-M1980	Poplar Plywood	9.23.14.2.(1) 9.23.15.1.(1) Table 9.23.16.A. 9.27.9.1. 9.30.2.2.(1)
CSA	CAN/CSA-O177-M89	Qualification Code for Manufacturers of Structural Glued-Laminated Timber	4.3.1.2.
CSA	CAN3-O188.1-M78	Interior Mat-Formed Wood Particleboard	9.23.14.2.(3) 9.29.9.1.(1) 9.30.2.2.(1)
CSA	CAN/CSA-O325.0-88	Construction Sheathing	9.23.14.2.(1) 9.23.15.1.(1) Table 9.23.16.B.
CSA	CAN3-O437.0-M85	Waferboard and Strandboard	9.23.14.2.(1) 9.23.15.1.(1) Table 9.23.16.A. 9.27.11.1. 9.29.9.1.(2) 9.30.2.2.(1)
CSA	CAN3-S304-M84	Masonry Design for Buildings	4.3.2.1.
CSA	S307-M1980	Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings	9.23.13.11.(9)
CSA	CAN3-S406-M83	Construction of Preserved Wood Foundations	9.15.1.3.(3)
NLGA	1987	Standard Grading Rules for Canadian Lumber	9.3.2.1. Table 9.3.2.A.
ULC	CAN4-S101-M82	Standard Methods of Fire Endurance Tests of Building Construction and Materials	3.1.7.1.(1)
ULC	CAN/ULC-S102-M88	Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies	3.1.12.1.(1)
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
ULC	CAN/ULC-S102.2-M88	Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies	3.1.12.1.(2)
ULC	CAN/ULC-S109-M87	Standard for Flame Tests of Flame-Resistant Fabrics and Films	6.2.3.4.(1) 6.2.3.5.
ULC	CAN/ULC S110-M86	Standard Methods of Test for Air Ducts	6.2.3.2.(2) 6.2.3.2.(4)
ULC	CAN4-S111-M80	Standard Method of Fire Tests for Air Filter Units	6.2.3.14.(1)
ULC	CAN4-S114-M80	Standard Method of Test for Determination of Non-Combustibility in Building Materials	1.1.3.2.
ULC	CAN4-S124-M85	Standard Method of Test for the Evaluation of Protective Coverings for Foamed Plastic	3.1.5.11.(2)
ULC	CAN/ULC-S610-M87	Standard for Factory-Built Fireplaces	9.22.8.1.
ULC	CAN/ULC-S629-M87	Standard for 650°C Factory-Built Chimneys	9.21.1.2.
ULC	CAN/ULC-S639-M87	Standard for Steel Liner Assemblies for Solid-Fuel Burning Masonry Fireplace	9.22.2.3.
Column 1	2	3	4

Part 9
Housing

Part 9
Housing

Section 9.1 General

For requirements covering safety measures at construction and demolition sites, see Part 8 of the National Building Code.

Section 9.2 Definitions

9.2.1. General

9.2.1.1. Words in italics are defined in Part 1.

Section 9.3 Materials, Systems and Equipment

9.3.1. Concrete

9.3.1.1. Concrete. Concrete shall be designed, mixed, placed, cured and tested in accordance with CAN3-A438, "Concrete Construction for Housing and Small Buildings."

9.3.1.2. Cement. Cement shall meet the requirements of CAN3-A5, "Portland Cements."

9.3.1.3. Concrete in Contact with Sulphate Soil

(1) Concrete in contact with sulphate *soil* deleterious to normal cement shall conform to the requirements in Section 16 of CAN3-A23.1, "Concrete Materials and Methods of Concrete Construction."

(2) Sulphate-resisting cement shall be used for concrete referred to in Sentence (1).

* Requirement modified to apply to houses only.

9.3.1.4. Aggregates. Aggregates shall consist of sand, gravel, crushed rock, crushed air-cooled blast furnace slag, expanded shale or expanded clay conforming to CAN3-A23.1, "Concrete Materials and Methods of Concrete Construction" and shall be clean, well-graded and free of injurious amounts of organic and other deleterious material.

9.3.1.5. Water. Water shall be clean and free of injurious amounts of oil, organic matter, sediment or any other deleterious material.

9.3.1.6. Compressive Strength. Unless specifically required elsewhere in this Part, the compressive strength of unreinforced concrete shall be not less than 15 MPa after 28 days. (See also Articles 9.3.1.7., 9.12.4.1., 9.15.4.1. and 9.18.6.1.)

9.3.1.7. Concrete for Garage and Carport Floors and Exterior Steps. When concrete is used for garage and carport floors and exterior steps, it shall have a minimum compressive strength of 20 MPa after 28 days and shall have air entrainment of 5 to 8 per cent.

9.3.1.8. Concrete Mixes

(1) The concrete mixes described in Table 9.3.1.A. shall be considered acceptable if the slump does not exceed 100 mm when measured according to the slump test described in CAN3-A23.2, "Methods of Test for Concrete."

(2) Aggregate for mixes referred to in Sentence (1) shall not exceed 50 mm in size.

9.3.1.9. Admixtures. Admixtures shall conform to CAN3-A266.1, "Air Entraining Admixtures for Concrete" or CAN3-A266.2, "Chemical Admixtures for Concrete," as applicable.

Table 9.3.1.A.
Forming Part of Sentence 9.3.1.8.(1)

Concrete Mixes (by volume)			
Concrete Strength, MPa	Cement, parts	Sand, parts	Coarse Aggregate, parts
15	1	2	4
	1	—	6, pit run gravel
20	1	1.75	3, up to 40 mm in size
	1	—	4.75 pit run gravel
Column 1	2	3	4

9.3.1.10. Reinforced Concrete. Reinforced concrete shall be designed to conform to the requirements of Part 4.

9.3.1.11. Cold Weather Requirements

(1) When the air temperature is below 5°C, concrete shall be kept at a temperature of not less than 10°C or more than 25°C while being mixed and placed, and maintained at a temperature of not less than 10°C for 72 h after placing.

(2) No frozen material or ice shall be used in concrete described in Sentence (1).

9.3.2. Lumber and Wood Products

9.3.2.1. Grade Marking. Lumber for joists, rafters, trusses and beams and for the uses listed in Table 9.3.2.A. shall be identified by a grade stamp to indicate its grade as determined by the NLGA "Standard Grading Rules for Canadian Lumber." (See Appendix A.)

Table 9.3.2.A.
Forming Part of Article 9.3.2.1.

Minimum Lumber Grades for Specific End Uses				
Use	Boards [1]			Framing
	Paragraph in the NLGA grading rules under which boards are graded			
	All Species		Eastern White Pine & Red Pine	All Species
	Para 113	Para 114	Para 118	
Stud wall framing (loadbearing members)	—	—	—	Standard Stud, No. 2
Stud wall framing (non-loadbearing members)	—	—	—	Stud, Utility, No. 3
Posts and beams less than 114 mm in thickness	—	—	—	Standard, No. 2
Posts and beams not less than 114 mm in thickness	—	—	—	Standard
Roof sheathing	No. 3 Common	Standard	No. 4 Common	—
Subflooring	No. 3 Common	Standard	No. 3 Common	—
Wall sheathing when required as a nailing base	No. 4 Common	Utility	No. 4	—
Wall sheathing not required as a nailing base	No. 5 Common	Economy	No. 5	—
Column 1	2	3	4	5

A-9.3.2.A. Lumber Grading. To identify board grades the paragraph number of the NLGA rules under which the lumber is graded must be shown in the grade mark. Paragraph 113 is equivalent to WWPA rules and paragraph 114 is equivalent to WCLIB rules. When graded in accordance with WWPA or WCLIB rules, the grade mark will not contain a paragraph number.

9.3.2.2. Lumber Grades. Except for joists, rafters, trusses and beams, visually graded lumber shall conform to the grades in Table 9.3.2.A. (See Article 9.23.4.1. for joists, rafters and beams and Article 9.23.13.11. for trusses).

9.3.2.3. Machine Stress Rated Lumber. Machine stress rated lumber shall conform to the requirements of Subsection 4.3.1.

4.3.1.1. Design Basis for Wood. *Buildings* and their structural members made of wood shall conform to CAN3-O86, "Engineering Design in Wood" or CAN/CSA-O86.1-M, "Engineering Design in Wood – Limit States Design."

4.3.1.2. Glued-Laminated Members. Glued-laminated members shall be fabricated in plants conforming to CAN/CSA O177-M, "Qualification Code for Manufacturers of Structural Glued-Laminated Timber."

9.3.2.4. Waferboard, Strandboard and Plywood Marking. Waferboard, strandboard and plywood used for roof sheathing, wall sheathing and subflooring shall be legibly identified on the face of the material indicating the manufacturer of the material, the standard to which it is produced and that the material is of an exterior type.

9.3.2.5. Moisture Content. Moisture content of lumber shall be not more than 19 per cent at the time of installation.

9.3.2.6. Lumber Dimensions. Lumber dimensions referred to in this Part are actual dimensions determined in conformance with CSA O141, "Softwood Lumber."

9.3.2.7. Panel Thickness Tolerances. The thicknesses specified in this Part for plywood, hardboard, particleboard, waferboard and strandboard shall be subject to the tolerances permitted in the standards referenced for these products unless specifically indicated herein.

9.3.2.8. Undersized Lumber. Joist, rafter, lintel and beam members up to 5 per cent less than the actual Canadian standard sizes may be used provided the allowable spans for the grade and species of lumber under consideration are reduced 5 per cent from those shown in the span tables for full size members. (See Appendix A.)

A-9.3.2.8. Non-Standard Lumber. The NLGA "Standard Grading Rules for Canadian Lumber" permit lumber to be dressed to sizes below the standard sizes (38 x 89, 38 x 140, 38 x 184, etc.) provided the grade stamp shows the reduced size. This Article permits the use of the span tables for such lumber provided the size indicated on the stamp is not less than 95 per cent of the corresponding standard size. Allowable spans in the tables must be reduced a full 5 per cent even if the undersize is less than the 5 per cent permitted.

9.3.2.9. Termite Resistance

(1) Where wood is pressure treated to resist termites, such treatment shall be in accordance with the requirements of

(a) CAN/CSA O80.1, "Preservative Treatment of All Timber Products by Pressure Processes,"

(b) CAN/CSA O80.2, "Preservative Treatment of Lumber, Timber, Bridge Ties and Mine Ties by Pressure Processes,"

(c) CAN/CSA O80.9, "Preservative Treatment of Plywood by Pressure Processes," or

(d) CAN/CSA O80.15, "Preservative Treatment of Wood for Building Foundation Systems, Basements and Crawl Spaces by Pressure Processes."

9.3.3. Metal

9.3.3.1. Sheet Metal Thickness. Minimum thicknesses for sheet metal material given in this Part refer to the actual minimum thicknesses measured at any point of the material, and in the case of galvanized steel, includes the thickness of the coating unless otherwise indicated.

9.3.3.2. Galvanized Sheet Metal. Where galvanized sheet metal is intended for use in locations exposed to the weather or as a flashing material, it shall have a zinc coating not less than the G90 coating designation in ASTM A525, "Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process."

Section 9.4 Structural Requirements

9.4.1. General

9.4.1.1. Structural Design

(1) Except as provided in Sentence (2), Sentence 9.23.4.1.(2) and Subsections 9.4.2. to 9.4.4., structural members and their connections shall be designed in conformance with Part 4.

(2) Where structural members and their connections conform to the requirements listed elsewhere in this Part, it shall be deemed that the structural design requirements have been met.

9.4.1.2. Post, Beam and Plank Construction. Except for columns described in Section 9.17 and beams described in Subsection 9.23.4., wood-frame post, beam and plank construction with the *loadbearing* framing members spaced more than 600 mm apart shall be designed in conformance with Subsection 4.3.1. (See Article 9.3.2.3.)

9.4.2. Snow Loads

9.4.2.1. Application. This Subsection applies to wood frame assemblies with clear spans not exceeding 12.20 m and members spaced not more than 600 mm apart.

9.4.2.2. Design Snow Loads

(1) Except as provided in Sentences (2) and (3), design snow loads shall be not less than calculated using the following formula:

$$S = C_b \cdot S_s + S_r$$

where

S = the design snow load,

C_b = the basic snow load roof factor, which is 0.5 where the entire width of a roof does not exceed 4.3 m and 0.6 for all other roofs,

S_s = the ground snow load listed in Chapter 1 of the Supplement to the NBC 1990, and

S_r = the associated rain load listed in Chapter 1 of the Supplement to the NBC 1990.

(2) In no case shall the design snow load be less than 1 kPa.

(3) Bow string, arch or semi-circular roof trusses having an unsupported span greater than 6 m shall be designed in conformance with the snow load requirements in Section 4.1.

9.4.2.3. Balconies. Residential balconies not used as passageways shall be designed to carry the design roof snow load or 1.9 kPa, whichever is greater.

9.4.3. Deflections

9.4.3.1. Deflections

(1) The maximum deflection of structural members shall conform to Table 9.4.3.A.

(2) *Dead loads* need not be considered in computing deflections referred to in Sentence (1).

9.4.4. Foundation Conditions

9.4.4.1. Allowable Bearing Pressures. Where footing sizes for *shallow foundations* are not determined in conformance with Section 9.15, footings may be designed using maximum *allowable bearing pressures* in Table 9.4.4.A.

9.4.4.2. Foundation Capacity in Weaker Soil and Rock

(1) Where a *soil* or *rock* within a distance equal to twice the footing width below the *bearing surface* has a lower *allowable bearing pressure* than that at the *bearing surface* as shown in Article 9.4.4.1., the design capacity of the *foundation* shall not be greater than would cause the weakest *soil* or *rock* to be stressed beyond its *allowable bearing pressure*.

(2) In calculating subsurface pressures referred to in Sentence (1), the loads from the footings shall be assumed to be distributed uniformly over a horizontal plane within a frustum extending downward from the footing at an angle of 60° to the horizontal.

9.4.4.3. High Water Table. Where a *foundation* bears on gravel, sand or silt, and the water table is within a distance below the *bearing surface* equal to

Table 9.4.3.A.
Forming Part of Sentence 9.4.3.1.(1)

Maximum Deflections		
Structural Members	Type of Ceiling Supported	Maximum Allowable Deflection Expressed as a Ratio of the Clear Span
Roof rafters, roof joists, roof beams and roof decking of plank and beam construction	No ceiling Other than plaster or gypsum board Plaster or gypsum board	1/180 1/240 1/360
Ceiling joists	Other than plaster or gypsum board Plaster or gypsum board	1/240 1/360
Floor beams, floor joists and floor decking of plank and beam construction for floor areas other than bedrooms in *dwelling units*	No ceiling Other than plaster or gypsum board Plaster or gypsum board	1/360 1/360 1/360
Floor beams, floor joists and floor decking of plank and beam construction for floor areas of bedrooms in *dwelling units*	No ceiling Other than plaster or gypsum board Plaster or gypsum board	1/240 1/240 1/360
Column 1	2	3

Table 9.4.4.A.
Forming Part of Article 9.4.4.1.

Allowable Bearing Pressure for Soil or Rock	
Type and Condition of Soil or Rock	Maximum *Allowable Bearing Pressure*, kPa
Dense or compact sand or gravel [1]	150
Loose sand or gravel [1]	50
Dense or compact silt [1]	100
Stiff clay [1]	150
Firm clay [1]	75
Soft clay [1]	40
Till	200
Clay shale	300
Sound rock	500
Column 1	2

Note to Table 9.4.4.A:
[1] See Appendix A.

A-9.4.4.A. Classification of Soils. Sand or gravel may be classified by means of a picket test in which a 38 mm by 38 mm picket bevelled at the end at 45° to a point is pushed into the soil. Such material is classified as "dense or compact" if a man of average weight cannot push the picket more than 200 mm into the soil and "loose" if the picket penetrates 200 mm or more.

Clay and silt may be classified as "stiff" if it is difficult to indent by thumb pressure, "firm" if it can be indented by moderate thumb pressure, "soft" if it can be easily penetrated by thumb pressure, where this test is carried out on undisturbed soil in the wall of a test pit.

the width of the *foundation*, the *allowable bearing pressure* shall be 50 per cent of that determined in Article 9.4.4.1.

9.4.4.4. Soil Movement. Where a *foundation* is located in an area in which *soil* movement caused by changes in *soil* moisture content is known to occur to the extent that it will cause significant damage to a *building*, measures shall be taken to minimize the effect of such movement on the *building*.

9.4.4.5. Retaining Walls. Walls shall be designed to resist the lateral pressure of the retained material.

9.4.4.6. Walls Supporting Drained Earth

(1) Walls supporting drained earth may be designed for pressure equivalent to that exerted by a fluid with a density of not less than 480 kg/m^3 and having a depth equal to that of the retained earth.

(2) Any surcharge shall be in addition to the equivalent fluid pressure specified in Sentence (1).

Section 9.5 Room and Space Dimensions

9.5.1. General

9.5.1.1. Application. Unless otherwise specifically indicated, this Section applies only to *dwelling units* that are intended for use on a continuing or year-round basis as the principal residence of the occupant.

9.5.1.2. Method of Measurement. Unless otherwise indicated herein, the areas, dimensions and heights of rooms or spaces shall be measured between finished wall surfaces and between finished floor and ceiling surfaces.

9.5.1.3. Floor Areas. Minimum floor areas specified in this Section do not include closets or built-in bedroom cabinets unless otherwise indicated.

9.5.1.4. Combination Rooms. Two or more areas are considered as a combination room if the dividing wall occupies less than 60 per cent of the separating plane.

9.5.1.5. Lesser Areas and Dimensions. Areas and dimensions of rooms and spaces may be less than required in this Section provided it can be shown that the rooms and spaces are adequate for their intended use, such as by the provision of built-in furniture to compensate for reduced sizes.

9.5.2. Ceiling Heights

9.5.2.1. Heights of Rooms or Spaces. Heights of rooms or spaces in *residential occupancies* shall conform to Table 9.5.2.A.

9.5.2.2. Mezzanines. The clear height above and below a *mezzanine* floor assembly shall be not less than 2.1 m. *

9.5.2.3. Storage Garages. The clear height in a *storage garage* shall be not less than 2 m.

9.5.3. Living Rooms or Spaces within Dwelling Units

9.5.3.1. Areas and Dimensions of Living Rooms and Spaces

(1) Living areas within *dwelling units*, either as separate rooms or in combination with other spaces, shall have an area not less than 13.5 m^2 and no dimension less than 3 m within the required area.

(2) Where the area of a living space is combined with a kitchen and dining area, the living area alone in a *dwelling unit* that contains sleeping accommodation for not more than 2 persons shall be not less than 11 m^2.

9.5.4. Dining Rooms or Spaces within Dwelling Units

9.5.4.1. Area of Dining Rooms or Spaces

(1) A dining space in combination with other space shall have an area not less than 3.25 m^2.

(2) Dining rooms not combined with other space shall have an area not less than 7 m^2.

9.5.4.2. Dimensions of Dining Rooms or Spaces

(1) Except as permitted in Sentence (2), a dining room or space combined with other space shall have no dimension less than 2.3 m within the

Table 9.5.2.A.
Forming Part of Article 9.5.2.1.

Room Heights	
Room or Space	Minimum Heights
Living room or space, dining room or space, kitchen or kitchen space	2.3 m over not less than 75 per cent of the required floor area with a clear height of 2.1 m at any point over the required area
Bedroom or bedroom space	2.3 m over not less than 50 per cent of the required floor area or 2.1 m over all of the required floor area. Any part of the floor having a clear height of less than 1.4 m shall not be considered in computing the required floor area.
Unfinished *basement* including laundry area therein	1.95 m under beams in laundry areas and in any location that would normally be used for passage to laundry and storage areas
Bathroom, water-closet room or laundry area above *grade*	2.1 m in any area where a person would normally be in a standing position
Passage, hall or main entrance vestibule and finished rooms not specifically mentioned above	2.1 m
Column 1	2

required area measured between wall faces or a wall face and a built-in cabinet or appliance.

(2) When a required dining area is provided in a kitchen or serves a *dwelling unit* that contains sleeping accommodation for not more than 2 persons, the minimum dimension of such space may be reduced to 1.7 m.

9.5.5. Kitchens within Dwelling Units

9.5.5.1. Kitchen areas within *dwelling units* either separate from or in combination with other spaces, shall have an area not less than 4.2 m^2 including the area occupied by the base cabinets, except that in *dwelling units* containing sleeping accommodation for not more than 2 persons, the minimum area shall be 3.7 m^2.

* 9.5.6. Bedrooms or Spaces

9.5.6.1. Area and Dimension of Bedrooms

(1) Except as provided in Articles 9.5.6.2. and 9.5.6.3., bedrooms in *dwelling units* shall have an area not less than 7 m^2 where built-in cabinets are not provided and not less than 6 m^2 where built-in cabinets are provided.

(2) The minimum dimension within the required area specified in Sentence (1) shall be 2 m.

9.5.6.2. Areas and Dimensions of Master Bedrooms

(1) Except as provided in Article 9.5.6.3., not less than one bedroom in every *dwelling unit* shall have an area not less than 9.8 m^2 where built-in cabinets are not provided and not less than 8.8 m^2 where built-in cabinets are provided.

(2) The minimum dimension within the required area specified in Sentence (1) shall be 2.7 m.

9.5.6.3. Areas and Dimensions of Combination Bedrooms. Bedroom spaces in combination with other spaces in *dwelling units* shall have an area not less than 4.2 m^2 and have no dimension less than 2 m within the required area..

9.5.7. Bathrooms and Water-Closet Rooms

9.5.7.1. In every *dwelling unit* an enclosed space of sufficient size shall be provided to accommodate a bathtub, water closet and lavatory.

9.5.8. Hallways

9.5.8.1. The width of a hallway within a *dwelling unit* shall be at least 860 mm, except that in *buildings* not more than 4.3 m wide the hallway width may be 710 mm where a second *exit* is provided near the end of the hallway farthest from the living area.

Section 9.6 Doors

9.6.1. General

9.6.1.1. This Section applies to doors, to glazed areas in doors and to sidelights for doors. (See also Sections 3.7, 9.9 and 9.10.)

9.6.2. Required Doors

9.6.2.1. A door shall be provided at each entrance to a *dwelling unit* and to each room containing a water closet within a *dwelling unit*.

9.6.3. Doorway Sizes

9.6.3.1. Doorway Opening Sizes. Except as provided in Articles 9.6.3.3. and 9.9.6.4., doorway openings within *dwelling units* shall be designed to accommodate not less than the door sizes in Table 9.6.3.A. for swing-type doors or folding doors.

9.6.3.3. Doors to Bathrooms. A doorway to not less than one bathroom as described in Article 9.5.7.1. shall accommodate a door not less than 760 mm wide.

9.6.4. Exterior Doors

9.6.4.1. Exterior Wood Doors

(1) Exterior wood doors shall conform to CSA O132.2, "Wood Doors."

(2) Each door described in Sentence (1) shall indicate legibly the name of the manufacturer, the standard to which it is produced and that it is of an exterior type.

Table 9.6.3.A.
Forming Part of Article 9.6.3.1.

Minimum Size of Doors		
At Entrance to:	Width mm	Height mm
Dwelling unit (required entrance) Vestibule or entrance hall	810	1 980
Stairs to a floor level that contains a finished space All doors in not less than one line of passage from the exterior to the *basement* Utility rooms	810	1 980
Walk-in closet	610	1 980
Bathroom, water-closet room, shower room [1]	610	1 980
Rooms located off hallways that are permitted to be 710 mm wide	610	1 980
Rooms not mentioned above, exterior balconies	760	1 980
Column 1	2	3

Note to Table 9.6.5.A.:
[1] See Article 9.6.3.3.

9.6.4.2. Sliding Doors. Sliding doors shall conform to CAN/CGSB 82.1-M, "Sliding Doors."

9.6.4.3. Insulated Steel Doors. Insulated steel doors shall conform to CAN/CGSB 82.5-M "Insulated Steel Doors."

9.6.5. Glass

9.6.5.1. Maximum Area of Glass. The maximum area of individual panes of glass for doors shall conform to Table 9.6.5.A.

9.6.5.2. Glass in Doors and Sidelights

(1) Glass in doors and in sidelights for doors shall conform to Sentence 9.7.3.1.(1).

* **(2)** Glass sidelights greater than 500 mm wide that could be mistaken for doors, glass in storm doors and glass in sliding doors within or at every entrance to a *dwelling unit* shall be safety glass of the laminated or tempered type conforming to CAN2-12.1, "Glass, Safety, Tempered or Laminated," or shall be of wired glass conforming to CAN2-12.11, "Glass, Wired, Safety."

* **(3)** Except as provided in Article 9.7.5.3., glass in entrance doors to *dwelling units*, other than the entrance doors described in Sentence (2), shall be safety glass or wired glass of the type described in Sentence (2) where the glass area exceeds 0.5 m^2 and extends to less than 900 mm from the bottom of the door.

9.6.5.3. Mirrored Glass Doors. Mirrored glass doors may be used only at the entrance to clothes closets and shall conform to the requirements of CAN/CGSB-82.6, "Doors, Mirrored Glass, Sliding or Folding Wardrobe." (See Appendix A.)

A-9.6.5.3. Mirrored Glass Doors. Standard CAN/CGSB-82.6 covers mirrored glass doors for use on reach-in closets. It specifies that such doors are not intended to be used for walk-in closets.

Table 9.6.5.A.
Forming Part of Article 9.6.5.1.

Maximum Glass Area for Doors, m^2 (1)						
	Type of Glass					
Glass Thickness mm	Annealed	Annealed Multiple-Glazed Factory-Sealed Units	Laminated	Wired	Heat Strength-ened	Fully Tempered
3	0.50	0.70	(2)	(2)	1.00	1.00
4	1.00	1.50	(2)	(2)	1.50	4.00
5	1.50	1.50	(2)	(2)	1.50	No limit
6	1.50	1.50	1.20	1.00	1.50	No limit
Column 1	2	3	4	5	6	7

Note to Table 9.6.5.A.:
(1) See Appendix A.
(2) Not generally available.

A-9.6.5.A. Glass in Doors. Maximum areas in Table 9.6.5.A. for other than fully tempered glazing are cut off at 1.50 m^2, as this would be the practical limit after which safety glass would be required by Sentence 9.6.5.2.(3).

9.6.5.5. Glass for Shower or Bathtub Enclosures. Glass other than safety glass shall not be used for a shower or bathtub enclosure.

9.6.5.6. Double Glazing

(1) Except where a separate storm door is provided, in *buildings* intended for use on a continuing basis during the winter months, exterior glass doors and glass in doors and adjacent sidelights separating heated space from unheated space or from the exterior shall be equipped with double glazing. (See Appendix A.)

A-9.7.1.5. Double Glazing. In a cold climate such as Canada's, windows which separate heated space from unheated space or the exterior must be at least double glazed to prevent the accumulation of significant amounts of condensation on the inside surface of the glazing. Although glazing materials are generally unharmed by such condensation, the water can run down and damage the materials in the window frame and in the wall below the window. Water accumulating in these materials can also lead to the growth of moulds.

Because of the potential for damage to the structure, this measure is required in any heated building, whether or not there is normally human occupancy.

(2) Metal frames for doors or glazing described in Sentence (1) shall incorporate a thermal break.

9.6.6. Resistance to Forced Entry

9.6.6.1. Application

(1) Except as permitted in Sentence (2), this Subsection applies to

(a) swinging entrance doors to *dwelling units*,
(b) swinging doors between *dwelling units* and attached garages or other ancillary spaces, and
(c) swinging doors which provide access directly or indirectly from a *storage garage* to a *dwelling unit*.

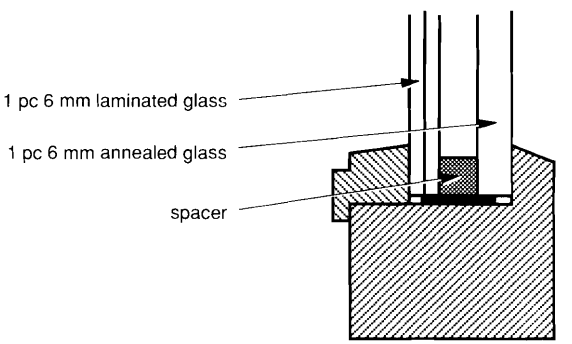
(2) Sentence (1) does not apply to exterior doors to garages and to other ancillary spaces. (See Appendix A.)

A-9.6.6.1. Glazing in Doors and Sidelights. There is no mandatory requirement that special glass be used in doors or sidelights, primarily because of cost. It is, however, a common method of forced entry to break glass in doors and sidelights to gain access to door hardware and unlock the door from the inside. Although insulated glass provides increased resistance over single glazing, the highest resistance is provided by laminated glass. Tempered glass, while stronger against static loads, is prone to shattering under high, concentrated impact loads.

Laminated glass is more expensive than annealed glass and must be used in greater thicknesses. The sketch shows an insulated sidelight made of one pane of laminated glass and one pane of annealed glass. This method reduces the cost premium that would result if both panes were laminated.

Consideration should be given to using laminated glazing in doors and accompanying sidelights regulated by Article 9.6.6.1., in windows located within 900 mm of locks in such doors, and in basement windows.

Underwriters' Laboratories of Canada have produced a document ULC Subject C972-1974, "Guide for the Investigation of Burglary Resisting Glazing Material," which provides a test procedure to evaluate the resistance of glazing to attacks by thieves. While it is principally intended for plate glass show windows, it may be of value for residential purposes.



Combined laminated/annealed glazing

9.6.6.2. Wood Doors

(1) Except as permitted in Article 9.6.6.10., wood doors as described in Sentence 9.6.6.1.(1). shall

(a) be solid core or stile and rail type,
(b) be not less than 45 mm thick, and
(c) if of the stile and rail panel type, have a panel thickness of not less than 19 mm, with a total panel area not more than half of the door area.

9.6.6.3. Deadbolt Lock. Except as permitted in Article 9.6.6.10., doors described in Sentence 9.6.6.1.(1) shall be provided with a deadbolt lock with a cylinder having not less than 5 pins and a bolt throw not less than 25 mm, protected with a solid or hardened free-turning ring or bevelled cylinder housing.

9.6.6.4. Double Doors. Except as permitted in Article 9.6.6.10., an inactive leaf in double doors used in locations specified in Sentence 9.6.6.1.(1) shall be provided with heavy duty bolts top and bottom having an engagement of not less than 15 mm.

9.6.6.5. Fastening of Hinges

(1) Except as permitted in Article 9.6.6.10., hinges for doors described in Sentence 9.6.6.1.(1) shall be fastened to wood doors with wood screws not less than 25 mm long and to wood frames with wood screws so that at least 2 screws per hinge penetrate not less than 30 mm into solid wood. (See Appendix A.)

A-9.6.6.5. Door Fasteners. The purpose of the requirement for 30 mm screw penetration into solid wood is to prevent the door from being dislodged from the jamb due to impact forces. It is not the intent to prohibit other types of hinges or strikeplates that are specially designed to provide equal or greater protection.

(2) Except as permitted in Article 9.6.6.10., hinges for doors described in Sentence 9.6.6.1.(1) shall be fastened to metal doors and metal frames with machine screws not smaller than No. 10 and not less than 10 mm long.

9.6.6.6. Fastening of Strikeplates

(1) Except as permitted in Article 9.6.6.10., strikeplates for doors described in Sentence 9.6.6.1.(1) shall be fastened to wood frames with wood screws that penetrate not less than 30 mm into solid wood. (See note to 9.6.6.5.(1).)

(2) Except as permitted in Article 9.6.6.10., strikeplates for doors described in Sentence 9.6.6.1.(1) shall be fastened to metal frames with machine screws not smaller than No. 10 and not less than 10 mm long.

9.6.6.7. Outward Swinging Doors. Except for storm or screen doors, doors described in Sentence 9.6.6.1.(1) which swing outward shall be provided with hinges or pins so that the doors cannot be removed when they are in the closed position. (See Appendix A.)

A-9.6.6.7. Hinged Doors. Methods of satisfying this Article include either using non-removable pin hinges or modifying standard hinges by screw fastening a metal pin in a screw hole in one half of the top and bottom hinges. When the door is closed, the projecting portion of the pin engages in the corresponding screw hole in the other half of the hinge and then, even if the hinge pin is taken out, the door cannot be removed.

9.6.6.8. Door Viewer. Main entrance doors to *dwelling units* shall be provided with a door viewer with a viewing angle of not less than 160°, unless transparent glazing is provided in the door or in a sidelight.

9.6.6.9. Solid Blocking. Solid blocking shall be provided on both sides at the lock height between the jambs for doors described in Sentence 9.6.6.1.(1) and the structural framing so that the jambs will resist spreading by force.

9.6.6.10. Alternate Test Procedure.

Doors, frames and hardware which conform to a security level of at least Grade 10 as described in the Annex to ASTM F476, "Standard Test Methods for Security of Swinging Door Assemblies," are not required to conform to Articles 9.6.6.2. to 9.6.6.6. (See Appendix A.)

A-9.6.6.10. Resistance of Doors to Forced Entry. This Article designates ASTM Standard F476, "Standard Test Methods for Security of Swinging Doors" as an alternate to compliance with the prescriptive requirements for doors

and hardware. The annex to the standard provides four security classifications, with acceptance criteria, depending on the type of building and the crime rate of the area in which it is located. The NBC has only specified Grade 10, the minimum level. The annex suggests the following guidelines be followed when selecting security levels for door assemblies:

Grade 10: This is the minimum security level and is quite adequate for single-family residential buildings located in stable, low-crime areas.

Grade 20: This is the low–medium security level and is designed to provide security for residential buildings located in average crime-rate areas and for apartments in both low and average crime-rate areas.

Grade 30: This is the medium–high security level and is designed to provide security for residential buildings located in higher than average crime-rate areas or for small commercial buildings in average or low crime-rate areas.

Grade 40: This is the high security level and is designed for small commercial buildings located in high crime-rate areas. This level could also be used for residential buildings having an exceptionally high incidence of semi-skilled burglary attacks.

All these grades satisfy the Code and can be considered for use where a higher level of security is desired or warranted.

Section 9.7 Windows and Skylights

9.7.1. General

9.7.1.1. Application. Windows shall conform to the requirements of this Section. (See also Sections 9.10 and 9.32 for fire protection and ventilation.)

*** 9.7.1.2. Minimum Window Areas**

(1) Except as required in Article 9.7.1.3., the minimum window glass area for roomsshall conform to Table 9.7.1.A.

(2) The unobstructed glass area of a door or skylight is considered equivalent to that of a window.

9.7.1.3. Bedroom Windows

(1) Except where a bedroom door provides access directly to the exterior, each bedroom shall have not less than one outside window openable from the inside without the use of tools or special knowledge.

(2) Windows referred to in Sentence (1) shall provide an unobstructed opening of not less than 380 mm in height and width and 0.35 m^2 in area. (See Article 9.7.1.4.)

9.7.1.4. Window Opening into a Window-Well

(1) Where a window required in Article 9.7.1.3. opens into a window-well, a clearance of not less than 550 mm shall be provided in front of the window.

(2) Where the sash of a window referred to in Sentence (1) swings towards the window-well, the operation of the sash shall not reduce the clearance in a manner that would restrict escape in an emergency.

9.7.1.5. Double Glazing or Storm Sash. In *buildings* intended for use on a continuing basis during the winter months, windows which separate heated space from unheated space or from the exterior shall be provided with storm sash or double glazing. (See note to 9.6.5.6.(1).)

9.7.2. Window Standards

9.7.2.1. Window Standard. Windows shall conform at least to the requirements for window ratings A1, B1 and C1 in CAN3–A440, "Windows." (See Appendix A.)

A-9.7.2.1. Windows. The CSA Standard CAN3-A440, "Windows," includes a window classification system that rates the assembly according to air leakage, water leakage and wind load resistance. The ratings, shown below, are marked on the window and indicate the level of performance that can be expected. Units can then be selected which are most appropriate for design conditions.

Air Leakage

A1 – intended for use primarily in low-rise residential (i.e. buildings of 3 storeys or less

Table 9.7.1.A.
Forming Part of Article 9.7.1.2.

Minimum Glass Areas for Rooms of Residential Occupancy		
	Unobstructed Glass Area	
Location	With No Electric Lighting	With Electric Lighting
Laundry, *basement* recreation room, unfinished *basement*	4 per cent of area served	Windows not required
Water-closet room	0.37 m^2	Windows not required
Kitchen, kitchen space, kitchen alcove	10 per cent of area served	Windows not required
Living rooms and dining rooms	10 per cent of area served	10 per cent of area served
Bedrooms and other finished rooms not mentioned above	5 per cent of area served (1)	5 per cent of area served (1)
Column 1	2	3

Note to Table 9.7.1.A.:
(1) See Article 9.7.1.3.

and having an area not exceeding 600 m^2), industrial, and light commercial use.

A2 – intended for use primarily in medium- to high-rise residential, institutional, and commercial use.

A3 – intended for use in high-performance institutional and commercial applications.

Water Leakage

B1 – moderate climatic conditions
B2 – severe climatic conditions
B3 – extreme climatic conditions

Wind Resistance

C1 – lowest wind load resistance
C2 – medium wind load resistance
C3 – highest wind load resistance

Article 9.7.2.1. has specified the lowest grades, since the NBC is a collection of minimum requirements only. Designers or builders should consider windows with higher ratings depending on the height of buildings, climatic conditions and occupancy classification.

9.7.3. Glass

9.7.3.1. Glass Standards

(1) Glass shall conform to
(a) CAN2-12.1, "Glass, Safety, Tempered or Laminated,"
(b) CAN2-12.2, "Glass, Sheet, Flat, Clear,"
(c) CAN2-12.3, "Glass, Polished Plate or Float, Flat, Clear,"
(d) CAN2-12.4, "Glass, Heat-Absorbing,"
(e) CAN2-12.8, "Insulating Glass Units,"
(f) CAN2-12.10, "Glass, Light and Heat Reflecting," or
(g) CAN2-12.11, "Glass, Wired, Safety."

9.7.3.2. Structural Design of Glass. Glass in windows shall be designed in conformance with CAN/CGSB-12.20-M, "Structural Design of Glass for Buildings." (See Appendix A.)

A-9.7.3.2. Maximum Glass Area. Subject to the restrictions noted, tables A-9.7.3.2.A. and A-9.7.3.2.B. may be used to select glass thickness for windows. These tables are based on Standard CAN/CGSB-12.20-M. In many cases, glass design based on these tables will be conservative due to conservative assumptions on which the tables are based. More exact design using the Standard directly could result in reduced glass thickness.

Table A-9.7.3.2.A.

Maximum Glass Area for Windows, m^2
In Areas for Which the "One in Ten" Wind Pressure (Q_{10})* Listed in the Supplement to the NBC is less than 0.40 kPa

Type of Glass	Glass Thickness, mm							
	2	3	4	5	6	8	10	12
Annealed	0.66	1.02	1.58	2.17	2.95	4.67	6.40	8.95
Factory-sealed IG Units	1.16	1.82	2.79	3.82	5.24	7.23	8.98	12.40
Heat strengthened or tempered	1.39	1.86	2.51	3.07	3.83	5.22	6.48	8.95
Wired	0.31	0.49	0.76	1.04	1.44	2.26	3.13	5.00

* The maximum hourly wind pressure with one chance in ten of being exceeded in any one year.

Table A-9.7.3.2.B.

Maximum Glass Area for Windows, m^2
In Areas for Which the "One in Ten" Wind Pressure (Q_{10})* Listed in the Supplement to the NBC is less than 0.60 kPa

Type of Glass	Glass Thickness, mm							
	2	3	4	5	6	8	10	12
Annealed	0.42	0.66	1.02	1.40	1.93	3.05	4.20	6.65
Factory-sealed IG Units	0.75	1.17	1.80	2.47	3.39	5.29	7.29	10.12
Heat strengthened	0.89	1.39	2.16	2.50	3.12	4.25	5.29	7.29
Tempered	1.13	1.52	2.05	2.50	3.12	4.25	5.29	7.29
Wired	0.20	0.32	0.50	0.68	0.95	1.50	2.06	3.32

* The maximum hourly wind pressure with one chance in ten of being exceeded in any one year.

Restrictions on use of Tables A-9.7.3.2.A. and A-9.7.3.2.B.

1. The tables apply to buildings which have essentially uniform distribution of openings, i.e. no large opening, such as a loading door.
2. The tables do not apply to buildings in exposed locations such as hilltops or the shores of large bodies of water.
3. The tables apply to buildings 12 m or less from grade to the uppermost roof.

9.7.4. Caulking and Glazing

9.7.4.1. Sealing Compound. Sealing compound used in the glazing of factory-sealed double-glazed units shall be compatible with the material used to edge seal the units.

9.7.4.2. Caulking Compound. Caulking shall be provided between window frames or trim and the exterior siding or masonry in conformance with Subsection 9.27.4.

9.7.6. Resistance to Forced Entry

9.7.6.1. In *dwelling units*, windows, any part of which is located within 2 m of adjacent ground level, shall conform to the requirements for resistance to forced entry as described in Clause 10.13 of CAN3-A440, "Windows." (See Appendix A.)

A-9.7.6.1. Resistance of Windows To Forced Entry. Although this Article only applies to windows within 2 m of adjacent ground level, certain house and site features, such as balconies or canopy roofs, allow for easy access to windows at higher elevations. Consideration should be given to specifying break-in resistant windows in such locations.

This Article does not apply to windows that do not serve the interior of the dwelling unit, such as windows to garages, sun rooms or greenhouses, provided connections between these spaces and the dwelling unit are secure.

9.7.7. Skylights

9.7.7.1. Plastic Skylights. Plastic skylights shall conform to CAN/CGSB 63.14-M, "Plastic Skylights."

9.7.7.2. Glass Skylights. Factory-built glass skylights shall meet the performance requirements of CAN/CGSB 63.14-M.

Section 9.8 Stairs, Ramps, Handrails and Guards

9.8.1. Scope

9.8.1.1. Application. This Section applies to the design and construction of interior and exterior stairs, steps, ramps, railings and *guards*.

9.8.2. General

9.8.2.1. Uniform Treads and Risers. Treads and risers shall have uniform rise and run in any one flight.

9.8.3. Stair Dimensions

9.8.3.1. Rise and Run of Stairs *

(1) Interior stairs within *dwelling units* and exterior stairs serving *dwelling units* shall have a maximum rise of 200 mm, a minimum run of 210 mm and a minimum tread width of 235 mm.

9.8.3.2. Nosing or Backslope. Where the run of any stair is less than 250 mm, a nosing of not less than 25 mm shall be provided beyond the face of the riser, or an equivalent back slope on the risers shall be provided.

9.8.3.3. Stair Width

(2) At least one stairway between each floor level in a *dwelling unit* shall have a width between wall faces of not less than 860 mm.

9.8.3.4. Head Room. The head room measured * vertically from a line drawn through the outer edges of the nosings shall be not less than 1.95 m for stairs located in *dwelling units*.

9.8.4. Landings

9.8.4.1. Dimensions of Landings. Landings * shall be at least as wide and as long as the width of stairs in which they occur, except that the length of landing for exterior stairs need not exceed 900 mm.

9.8.4.2. Required Landings

(1) Where a door swings towards a stair, the full arc of its swing shall be over a landing.

(2) Except as provided in Sentence (3), a landing shall be provided at the top and bottom of each flight of interior stairs and where a doorway occurs in a stairway.

(3) Where a door at the top of a stair in a *dwelling unit* swings away from the stair, no landing is required between the doorway and the stairs.

(4) A landing shall be provided at the top of all exterior stairs, except that a landing may be omitted at a secondary entrance to a *building* containing a single *dwelling unit* provided the stair does not contain more than 3 risers.

9.8.4.3. Height between Landings. The vertical height between any landings shall not exceed 3.7 m.

* **9.8.4.4. Height over Landings.** The clear height over landings shall be not less than 1.95 m in *dwelling units*.

9.8.5. Curved Stairs and Winders

* **9.8.5.2. Curved Stairs not in Exits.** Except as permitted in Article 9.8.5.3., a curved stair shall have an average run of not less than 200 mm and a minimum run of 150 mm and shall have risers conforming to Article 9.8.3.1.

9.8.5.3. Winders

(1) Stairs within *dwelling units* may contain winders that converge to a centre point provided the winders turn through an angle of not more than 90° and individual treads turn through an angle of 30°.

(2) Only one set of winders described in Sentence (1) shall be permitted between floor levels.

9.8.6. Pedestrian Ramps

(See Section 3.7 for ramps for wheelchair access.)

* **9.8.6.2. Maximum Gradient**

(1) The gradient for pedestrian ramps shall be not more than 1 in 10.

9.8.6.3. Level Areas on Ramps

(1) Except as provided in Article 9.8.6.1., where a doorway or stairway opens onto the side of a ramp, there shall be a level area extending across the full width of the ramp and for a distance of not less than 300 mm on either side of the wall opening.

(2) Where a doorway or stairway opens onto * the end of a ramp, there shall be a level area extending across the full width of the ramp and along it for not less than 900 mm.

9.8.7. Handrails

9.8.7.1. Required Handrails

(1) Except as permitted in Sentences (2) and * (3), a handrail shall be provided on

(a) at least one side of stairs less than 1 100 mm in width, and

(b) two sides of stairs 1 100 mm in width or greater.

(2) Handrails are not required for stairs * within *dwelling units* having not more than 2 risers, or for exterior stairs having not more than 3 risers.

(3) Only one handrail is required on exterior * stairs having more than 3 risers.

9.8.7.5. Height of Handrails. Handrails on stairs and ramps shall be not less than 800 mm and not more than 920 mm in height, measured vertically from a line drawn through the outside edges of the stair nosing or from the surface of the ramp, except that handrails not meeting these requirements are permitted provided they are installed in addition to the required handrails.

9.8.7.6. Handrail Clearance. A clearance of not less than 40 mm shall be provided between each handrail and the wall to which it is fastened.

9.8.7.7. Obstructions. Handrails shall be constructed with no obstruction on or above them to break a handhold except where the handrail is interrupted by newels at changes in direction.

9.8.7.8. Handrail Projection. Handrails and stair stringers shall not project more than 100 mm into the required width of stairway.

9.8.7.10. Attachment of Handrails

(1) Handrails shall be attached to wood studs, wood blocking, steel studs or masonry at points spaced not more than 1.2 m apart.

(2) Attachment to wood studs and blocking required in Sentence (1) shall consist of not less than 2 wood screws at each point, penetrating not less than 32 mm into solid wood.

9.8.8. Guards

9.8.8.1. Required Guards

(1) Every exterior landing, porch and every balcony, *mezzanine*, gallery, raised *walkway* and roof to which access is provided for other than maintenance purposes, shall be protected by *guards* on all open sides where the difference in elevation between adjacent levels exceeds 600 mm.

(2) Every exterior stair with more than 6 risers shall be protected with *guards* on all open sides where the difference in elevation between the adjacent ground level and the stair exceeds 600 mm.

(3) When an interior stair has more than 2 risers, the sides of the stair and the landing or floor level around the stair well shall be enclosed by walls or be protected by *guards*, except that a stair to an unfinished *basement* in a *dwelling unit* may have one unprotected side. (See Appendix A.)

A-9.8.8.1. Loads on Guards. Guards should be constructed so as to be strong enough to provide protection from falling under normal use. Such guards may be accepted on the basis of experience or by structural design. Loading criteria for the structural design of guards can be found in Article 4.1.10.1.

9.8.8.2. Height of Guards

(1) Except as provided in Sentences (2) to (5), all *guards*, including those for balconies, shall be not less than 1 070 mm high.

* **(2)** *Guards* for porches, decks, landings and balconies which are not more than 1.8 m above the finished ground level are permitted to be a minimum of 900 mm high.

* **(4)** *Guards* for stairs shall be not less than 800 mm measured vertically above a line drawn through the outside edges of stair nosings, and not less than 900 mm above landings.

(5) All required *guards* within *dwelling units* other than those described in Sentence (4), shall be not less than 900 mm high.

9.8.8.4. Openings in Guards. Openings through a *guard* on a balcony shall be of a size as to prevent the passage of a spherical object having a diameter of 100 mm, unless it can be shown that the location and size of openings which exceed these limits do not represent a hazard. *

9.8.8.5. Design to Prevent Climbing. *Guards* around exterior balconies shall be designed so that no member, attachment or opening between 100 mm and 900 mm above the balcony floor will facilitate climbing. *

9.8.8.6. Guards for Ramps. *Guards* for ramps including vehicular ramps shall conform to the requirements for *guards* for stairs in Articles 9.8.8.2. and 9.8.8.4.

9.8.9. Construction

9.8.9.1. Exterior Concrete Stairs

(1) Exterior concrete stairs with more than 2 risers and 2 treads shall be

(a) supported on unit masonry or concrete walls or piers not less than 150 mm by 150 mm or shall be cantilevered from the main foundation wall;

(b) when cantilevered from the foundation wall, constructed and installed in conformance with Subsection 9.8.10.

(2) The depth below ground level for foundations for exterior steps shall conform to the requirements in Section 9.12.

9.8.9.2. Exterior Wood Steps. Exterior wood steps shall not be in direct contact with the ground unless suitably treated with a wood preservative.

9.8.9.3. Wooden Stair Stringers

(1) Wooden stair stringers shall

(a) have a minimum effective depth of 90 mm and an over-all depth of not less than 235 mm,

(b) be supported and secured top and bottom,

(c) be not less than 25 mm actual thickness if supported along their length and 38 mm actual thickness if unsupported along their length, and

* (d) except as permitted in Sentence (2), be spaced not more than 900 mm o.c.

* **(2)** Where risers support the front portion of the tread, the space between stringers shall be not more than 1 200 mm.

9.8.9.4. Thickness of Treads. Lumber or plywood treads for stairs within *dwelling units* shall be not less than 25 mm actual thickness, except that if open risers are used, and the distance between stringers exceeds 750 mm, the treads shall be not less than 38 mm actual thickness.

9.8.9.5. Finish for Treads and Landings

(1) The finish for treads and landings of interior stairs in *dwelling units*, other than stairs to unfinished *basements*, shall consist of hardwood, vertical grain softwood, resilient flooring or other material providing equivalent performance.

* **(2)** Treads and landings of exterior stairs and ramps, shall have a slip-resistant finish or be provided with slip-resistant strips which extend not more than 1 mm above the surface.

9.8.10. Cantilevered Precast Concrete Steps

9.8.10.1. Design. Exterior concrete steps and their anchorage system that are cantilevered from a foundation wall shall be designed and installed to support the loads to which they may be subjected.

9.8.10.2. Anchorage. Cantilevered concrete steps in Article 9.8.10.1. shall be anchored to concrete foundation walls not less than 200 mm thick.

9.8.10.3. Prevention of Damage Due to Frost. Suitable precautions shall be taken during backfilling and grading operations to ensure that subsequent freezing of the soil will not cause uplift forces on the underside of cantilevered concrete steps to the extent that the steps or the walls to which they are attached will be damaged.

Section 9.9 Means of Egress

9.9.1. Scope

9.9.2. General

9.9.2.2. Types of Exits. *Exits* may consist of doorways, ramps and stairways. *

9.9.2.4. Elevators, Slide Escapes and Windows. Elevators, slide escapes or windows shall not be considered as part of a required *means of egress*.

9.9.4.6. Openings Near Exit Doors. Where an exterior *exit* door in one *fire compartment* is within 3 m horizontally of an *unprotected opening* in another *fire compartment* and the exterior walls of these *fire compartments* intersect at an exterior angle of less than 135°, the opening shall be protected with wired glass in fixed steel frames or glass block conforming to Articles 9.10.13.5. and 9.10.13.7.

9.9.6. Doors in a Means of Egress

9.9.6.5. Direction of Door Swing

(2) Every required *exit* door shall swing on its vertical axis. *

(4) *Exit* doors serving a *storage garage* or doors serving other accessory *buildings* where there is no danger to life safety, need not conform to Sentence (2). *

9.9.6.8. Door Opening Mechanism. *Exit* doors shall be openable from the inside without requiring keys, special devices or specialized knowledge of the door opening mechanism. *

9.9.9. Egress from Dwelling Units

9.9.9.1. Travel Limit to Exits or Egress Doors

(1) Except as provided in Sentences (2) and (3), every *dwelling unit* containing more than 1 *storey* shall have a sufficient number of *exit* doors so that it shall not be necessary to travel up or down more than 1 *storey* to reach a level served by *

(b) an *exit* doorway not more than 1.5 m above adjacent ground level.

* **(2)** The travel limit from a floor level in a *dwelling unit* to an *exit* door may exceed 1 *storey* where that floor level is served by an openable window providing an unobstructed opening of not less than 1 m in height and 0.55 m in width, located so that the sill is not more than 1 m above the floor and not more than 7 m above adjacent ground level.

* **(3)** The travel limit from a floor level in a *dwelling unit* to an *exit* door may exceed 1 *storey* where that floor level has direct access to a balcony.

Section 9.10 Fire Protection

9.10.1. General

9.10.1.2. Sloped Roofs. For the purposes of this Section, roofs with slopes of 60° or more to the horizontal and which are adjacent to a room or space intended for *occupancy* shall be considered as a wall.

9.10.3. Ratings

9.10.3.1. Fire-Resistance and Fire-Protection Ratings. Where a *fire-resistance rating* or a *fire-protection rating* is required in this Section for an element of a *building*, such rating shall be determined in conformance with Chapter 2 of the Supplement to the NBC 1990, with the test methods described in Part 3 or with A-9.10.3.1. in Appendix A.

* **3.1.7.1. Determination of Ratings**

(1) Where a material, assembly of materials or a structural member is required to have a *fire-resistance rating*, the rating shall be determined on the basis of the results of tests conducted in conformance with CAN4-S101-M, "Standard Methods of Fire Endurance Tests of Building Construction and Materials."

9.10.3.2. Flame-Spread Ratings

(1) Where a *flame-spread rating* is required in this Section for an element of a *building*, such rating shall be determined in accordance with the test methods described in Part 3, or in accordance with Chapter 2 of the Supplement to the NBC 1990.

3.1.12.1. Determination of Ratings *

(1) Except as provided in Sentence (2), the *flame-spread rating* and smoke developed classification of a material, assembly of materials or structural member shall be determined on the basis of not less than 3 tests conducted in conformance with CAN/ULC-S102-M, "Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies."

(2) The *flame-spread rating* and smoke developed classification of a material or assembly of materials shall be determined on the basis of not less than 3 tests conducted in conformance with CAN/ULC-S102.2-M, "Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies," where the material or assembly of materials

(a) is designed for use in a relatively horizontal position with only its top surface exposed to air,

(b) cannot be tested in conformance with Sentence (1) without the use of supporting material that is not representative of the intended installation, or

(c) is thermoplastic.

(2) Unless the *flame-spread rating* is referred to herein as a "surface *flame-spread rating*," it shall apply to any surface of the element being considered that would be exposed by cutting through it as well as to the exposed surface of the element.

9.10.3.3. Fire Exposure

(2) Exterior walls shall be rated for exposure * to fire from inside the *building*.

(3) *Firewalls* and interior vertical *fire separations* required to have *fire-resistance ratings* shall be rated for exposure to fire on each side.

9.10.4. Building Size Determination

9.10.4.1. Mezzanines not Considered as Stories

(1) *Mezzanines* shall not be considered as *storeys* for the purpose of determining *building height* where the aggregate area of *mezzanine* floors does not exceed 10 per cent of the *floor area* of the *storey* in which they are located.

(2) *Mezzanines* shall not be considered as *storeys* for the purpose of determining *building height* where they occupy an aggregate area of less than 40 per cent of the *floor area* of the *storey* in which they are located provided the space above the *mezzanine* floors and the floor below them have no visual obstructions more than 1 070 mm above such floors. (See A-3.2.1.1.(3) in Appendix A.)

* **A-3.2.1.1.(3) Building Height.** Where mezzanines are located at the same level but in different portions of a building, it is the intent of this Sentence that the aggregate area of all such mezzanines be used in relation to the area of the storey in which they are located. For example, mezzanines in *dwelling units* are visually obstructed by interior partitions or fire separations between *dwelling units*, thus, the requirement in Sentence 9.10.4.1.(2) does not apply.

Where the aggregate area of a mezzanine, consisting of a number of mezzanines in separate *dwelling units*, exceeds 10 per cent of the area of the storey in which it is located, that mezzanine is considered as an additional storey in the determination of building height.

9.10.5. Permitted Openings in Wall Membranes

9.10.5.1. Permitted Openings in Wall Membranes

* **(1)** Except as permitted in Sentence (2), a membrane forming part of an assembly required to have a *fire-resistance rating* shall not be pierced by openings into the assembly unless the assembly has been tested and rated for such openings.

(2) A wall membrane forming part of an * assembly required to have a *fire-resistance rating* may be pierced by openings for electrical and similar service outlet boxes provided such outlet boxes are tightly fitted.

(3) Where boxes referred to in Sentence (2) are located on both sides of walls required to provide a *fire-resistance rating*, they shall be offset where necessary to maintain the integrity of the *fire separation*.

9.10.7. Protection of Steel Members

9.10.7.1. Except as permitted in Article 3.2.2.3., structural steel members used in construction required to have a *fire-resistance rating* shall be protected to provide the required *fire-resistance rating*.

3.2.2.3. Exceptions to Structural Fire Protection *

(1) Fire protection is not required for

(a) steel lintels over openings not more than 2 m wide in *loadbearing* walls and not more than 3 m wide in non-*loadbearing* walls,

(b) steel lintels over openings greater than those in Clause (a) provided such lintels are supported at intervals of not more than 2 m by structural members with the required *fire-resistance rating*,

(c) the bottom flanges of shelf angles and plates that are not a part of the structural frame,

(e) steel members of stairways which are not a part of the structural frame of a *building*,

(f) steel members of porches, exterior balconies, cornices and other similar appurtenances provided they are outside an exterior wall of a *building*, and

(g) *loadbearing* steel or concrete members wholly or partially outside of a *building* face in *buildings*, provided such members are not less than 1 m away from any *unprotected opening* in an exterior wall, or shielded from heat radiation in the event of a fire within a *building* by construction that will provide the same

degree of protection that would be necessary if the member was located inside the *building*, with the protection extending on either side of the member a distance equal to the projection of the member from the face of the wall.

9.10.9. Fire Separations between Rooms and Spaces within Buildings

* **9.10.9.2. Continuous Barrier.** A wall assembly required to be a *fire separation* shall be constructed as a continuous barrier against the spread of fire. (See A-3.1.8.1.(1)(a) in Appendix A.)

A-3.1.8.1.(1)(a) Fire Separation Continuity. The continuity of a fire separation where it abuts against another fire separation, a floor, a ceiling or an exterior wall assembly is maintained by filling all openings at the juncture of the assemblies with a material that will ensure the integrity of the fire separation at that location.

9.10.9.6. Service Equipment Penetrating a Fire Separation

* **(1)** Piping, tubing, wiring, conduit, electrical outlet boxes and other similar service equipment that penetrate a required *fire separation* shall be tightly fitted or fire stopped to maintain the integrity of the separation. (See Appendix A.)

* **A-9.10.9.6.(1) Penetration of Fire-Rated Assemblies by Service Equipment.** This Article is intended to ensure that the integrity of fire-rated assemblies is maintained where they are penetrated by various types of service equipment.

It is assumed that this requirement is satisfied by the use of generic fire stop materials such as mineral wool, gypsum plaster or Portland cement mortar.

(2) Except as provided in Sentences (3) to (8), pipes, ducts, electrical outlet boxes, totally enclosed raceways or other similar service equipment that partly or wholly penetrate an assembly required to have a *fire-resistance rating* shall be *noncombustible* unless the assembly has been tested incorporating such equipment.

(3) Electrical wires or similar wiring enclosed in *noncombustible* totally enclosed raceways may partly or wholly penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (2).

(4) Electrical wires or cables, single or grouped, with *combustible* insulation or jacketing that is not totally enclosed in raceways of *noncombustible* material, may partly or wholly penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (2) provided the overall diameter of the wiring is not more than 25 mm.

(6) *Combustible* outlet boxes are permitted in an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (2) provided the opening through the membrane into the box does not exceed 160 cm^2.

(7) *Combustible* water distribution piping that has an outside diameter not more than 30 mm is permitted to partly or wholly penetrate a vertical *fire separation* that is required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (2) provided the piping is sealed in conformance with Article 3.1.9.1.

3.1.9.1. Fire Stopping of Service Penetrations *

(1) Piping that penetrates a membrane forming part of an assembly required to have a *fire-resistance rating*, or a *fire separation*, shall be

(b) sealed by a fire stop system that, when subjected to the fire test method in CAN4-S115-M, "Standard Method of Fire Tests of Firestop Systems," has an F rating not less than the *fire-protection rating* required for *closures* in the *fire separation*. (See A-9.10.9.6.(1) in Appendix A.) (See also Article 3.1.9.4. for penetrations involving *combustible* drain, waste and vent piping.)

(8) *Combustible* sprinkler piping is permitted to penetrate a *fire separation* provided the *fire compartments* on each side of the *fire separation* are *sprinklered*.

9.10.9.7. Combustible Drain, Waste and Vent Piping

* **(1)** Except as permitted in Sentences (2) to (5), *combustible* piping shall not be used in any part of a drain, waste and vent piping system where any part of that system partly or wholly penetrates a *fire separation* required to have a *fire-resistance rating* or penetrates a membrane that forms part of an assembly required to have a *fire-resistance rating*.

(2) *Combustible* drain, waste and vent piping not located in a vertical shaft is permitted to penetrate a *fire separation* required to have a *fire-resistance rating* or a membrane that forms part of an assembly required to have a *fire-resistance rating* provided the piping is sealed at the penetration by a firestop system that has an F rating not less than the *fire-resistance rating* required for the *fire separation*.

(3) The rating referred to in Sentence (2) shall be based on CAN4–S115, "Standard Method of Fire Tests for Firestop Systems" with a pressure differential of 50 Pa between the exposed and unexposed sides, with the higher pressure on the exposed side.

(5) *Combustible* drain, waste and vent piping is permitted on one side of a vertical *fire separation* provided it is not located in a vertical shaft.

9.10.9.8. Collapse of Combustible Construction. *Combustible construction* that abuts on or is supported by a *noncombustible fire separation* shall be constructed so that its collapse under fire conditions will not cause collapse of the *fire separation*.

9.10.9.9. Reduction in Thickness of Fire Separation by Beams and Joists. Beams and joists framed into a masonry or concrete *fire separation* shall not reduce the thickness of the *fire separation* to less than 100 mm of masonry or concrete.

9.10.9.10. Concealed Spaces above Fire Separations

* **(1)** A *horizontal service space* or other concealed space located above a required vertical *fire separation* shall be divided at the *fire separation* by an equivalent *fire separation* within the space.

9.10.9.14. Separation of Residential Suites

* **(1)** Except as provided in Sentence (3), *dwelling units* shall be separated from adjacent *dwelling units* by a *fire separation* having a *fire-resistance rating* of not less than 45 min.

(3) *Dwelling units* that contain 2 or more *storeys* including *basements* shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* of not less than 1 h. *

9.10.9.16. Separation of Storage Garages

(2) Except as permitted in Sentence (3), *storage garages* shall be separated from other *occupancies* by a *fire separation* of not less than 1 h. *

(3) Where a *storage garage* serves only the *dwelling unit* to which it is attached or built in, it shall be considered as part of that *dwelling unit* and the *fire separation* required in Sentence (2) need not be provided between the garage and the *dwelling unit* where

(a) the construction between the garage and the *dwelling unit* provides an effective barrier to gas and exhaust fumes, and

(b) every door between the garage and the *dwelling unit* conforms to Article 9.10.13.15.

(See Appendix A.)

A-9.10.9.16.(3) Separation Between Dwelling Units and Garages. The gas-tight barrier between a dwelling unit and an attached garage is intended to provide reasonable protection from carbon monoxide and gasoline fumes entering the dwelling unit. Construction assemblies incorporating a vapour barrier will perform adequately with respect to gas tightness provided reasonable care is exercised where the wall or ceiling is pierced by service assemblies. Where a garage is open to the adjacent attic space above the dwelling unit it serves, a gas-tight barrier in the dwelling unit ceiling will also provide protection. Unit masonry walls forming the separation between a dwelling unit and an adjacent garage should be provided with two coats of sealer or plaster or covered with gypsum wallboard on the side of the wall exposed to the garage.

9.10.11. Firewalls

9.10.11.1. Required Firewalls. Except as provided in Article 9.10.11.2., a *party wall* on a property line shall be constructed as a *firewall*.

9.10.11.2. Firewalls Not Required

* **(1)** A *party wall* on a property line between *dwelling units* need not be constructed as a *firewall* provided it is constructed as a *fire separation* having not less than a 1 h *fire-resistance rating*.

(2) The wall described in Sentence (1) shall provide continuous protection from the top of the footings to the underside of the roof deck.

(3) Any space between the top of the wall described in Sentence (1) and the roof deck shall be tightly sealed by caulking with mineral wool or *noncombustible* material.

9.10.11.3. Construction of Firewalls. Where *firewalls* are used, the requirements in Subsection 3.1.10. shall apply.

* 3.1.10. Firewalls

3.1.10.1. Prevention of Firewall Collapse

(1) Except as permitted in Sentence (2), where structural framing members are connected to or supported on a *firewall* and such members have *fire-resistance ratings* less than that required for the *firewall*, the connections and supports for such members shall be designed so that the collapse of the framing members during a fire will not cause the collapse of the *firewall*.

(2) Sentence (1) does not apply when a *firewall* consists of two separate wall assemblies each tied to its respective *building* frame but not to each other provided each wall assembly is constructed as a *fire separation* having one half of the *fire-resistance rating* required for the *firewall* in Sentence (2) and designed so that the collapse of one wall assembly will not cause collapse of the other.

(4) Piping, ducts and totally enclosed *noncombustible* raceways shall be installed so that their collapse will not cause collapse of the *firewall*.

3.1.10.2. Rating of Firewalls

(2) Every required *firewall* shall be constructed as a *fire separation* of *noncombustible construction* having a *fire-resistance rating* of not less than 2 h.

(3) The required *fire-resistance rating* of every *firewall* shall be provided by masonry or concrete.

3.1.10.3. Continuity of Firewalls

(1) Every *firewall* shall extend from the ground continuously through all *storeys* of a *building* or *buildings* so separated.

3.1.10.4. Parapets

(1) Except as provided in Sentence (2) , every *firewall* shall extend above the roof surface to form a parapet not less than 150 mm high.

(2) Where a *firewall* separates 2 *buildings* with roofs at different elevations, the *firewall* need not extend above the upper roof surface to form a parapet where the difference in elevation between the roofs so separated is more than 3 m.

3.1.10.6. Exposure Protection for Adjacent Walls. Where the external walls of 2 *buildings* meet at a *firewall* at an angle of 135° or less, the requirements of Article 3.2.3.14. shall apply.

3.1.10.7. Combustible Projections

(1) *Combustible* material shall not extend across the end of a *firewall*.

(2) When *buildings* are separated by a *firewall*, *combustible* projections on the exterior of one *building*, such as balconies, platforms, canopies, eave projections and stairs, that extend outward beyond the end of the *firewall*, shall not be permitted within 2.4 m of *combustible* projections and window or door openings of the adjacent *building*.

9.10.12. Prevention of Fire Spread at Exterior Walls

9.10.12.3. Location of Skylights. Where a wall in a *building* is exposed to a fire hazard from an adjoining roof of a separate unsprinklered *fire compartment* in the same *building*, the roof shall contain no skylights within a horizontal distance of 5 m of the windows in the exposed wall.

9.10.12.4. Exterior Walls Meeting at an Angle

(1) Except as provided in Article 9.10.14.14., where exterior walls of a *building* meet at an external *

angle of 135° or less, the horizontal distance from an opening in one wall to an opening in the other wall shall be not less than 1.2 m, where the openings are in different *fire compartments*.

(2) The exterior wall of each *fire compartment* referred to in Sentence (1) within the 1.2 m distance, shall have a *fire-resistance rating* not less than that required for the interior vertical *fire separation* between the compartment and the remainder of the *building*.

9.10.13. Closures

9.10.13.5. Wired Glass as a Closure

(1) Wired glass conforming to Article 9.7.3.1. which has not been tested in accordance with Article 9.10.3.1. is permitted as a *closure* in a vertical *fire separation* required to have a *fire-resistance rating* of not more than 1 h provided such glass is not less than 6 mm thick and is mounted in conformance with Sentence (2).

(2) Wired glass described in Sentence (1) shall be mounted in fixed steel frames having a metal thickness of not less than 1.35 mm and providing a glazing stop of not less than 20 mm on each side of the glass.

(3) Individual panes of glass described in Sentence (1) shall not exceed 0.84 m^2 in area or 1.4 m in height or width, and the area of glass not structurally supported by mullions shall not exceed 7.5 m^2.

9.10.13.7. Glass Block as a Closure.

Glass block that has not been tested in accordance with Article 9.10.3.1. is permitted as a *closure* in a *fire separation* required to have a *fire-resistance rating* of not more than 1 h. (See Article 9.20.9.6.)

9.10.13.15. Doors between Garages and Dwelling Units

(1) A door between an attached or built-in garage and a *dwelling unit* shall be tight fitting and weather-stripped to provide an effective barrier against the passage of gas and exhaust fumes and shall be fitted with a self-closing device.

(2) A doorway between an attached or built-in garage and a *dwelling unit* shall not be located in a room intended for sleeping.

9.10.13.16. Door Stops. Where a door is installed so that it may damage the integrity of a *fire separation* if its swing is unrestricted, door stops shall be installed to prevent such damage.

9.10.14. Spatial Separations between Buildings

9.10.14.1. Maximum Percentage of Unprotected Openings. Except as provided in Articles 9.10.14.3. to 9.10.14.8., the maximum percentage of *unprotected openings* in an *exposing building face* shall conform to Table 9.10.14.A. or to Subsection 3.2.3., whichever is the least restrictive for the *occupancy* being considered.

Table 9.10.14.A.
Forming Part of Article 9.10.14.1.

Maximum Percentage of Unprotected Openings in Exterior Walls													
	Maximum Area of *Exposing Building Face*, m^2	*Limiting distance*, m											
		Less than 1.2	1.2	1.5	2.0	4.0	6.0	8.0	10.0	12.0	16.0	20.0	25.0
	30	0	7	9	12	39	88	100	—	—	—	—	—
	40	0	7	8	11	32	69	100	—	—	—	—	—
	50	0	7	8	10	28	57	100	—	—	—	—	—
	100	0	7	8	9	18	34	56	84	100	—	—	—
	Over 100	0	7	7	8	12	19	28	40	55	92	100	—
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14

* **9.10.14.2. Area of Exposing Building Face.** The area of an *exposing building face* shall be calculated as the total area of exterior wall of each *dwelling unit* facing in one direction on any side of a *building* measured from the finished ground level to the uppermost ceiling.

9.10.14.3. Inadequate Fire Fighting Facilities. Where there is no fire department or where a fire department is not organized, trained and equipped to meet the needs of the community, the *limiting distance* determined from Article 9.10.14.1. or required in Articles 9.10.14.12. and 9.10.14.14. shall be doubled.

* **9.10.14.4. Alternate Method of Determining Limiting Distance.** The *limiting distance* shown in Table 9.10.14.A. may be reduced provided it is not less than the square root of the aggregate area of *unprotected openings* in an *exposing building face.*

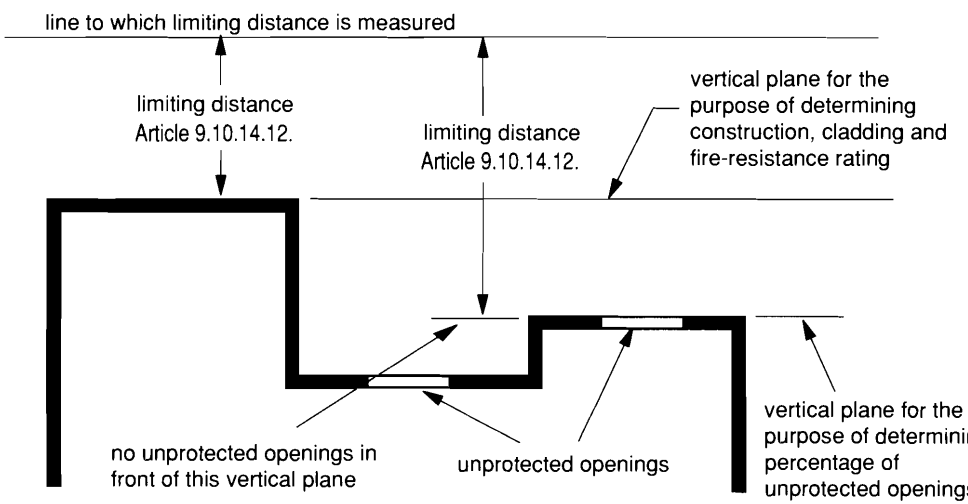
* **9.10.14.5. Openings in Walls Having a Limiting Distance Less Than 1.2 m.** Openings in a wall having a *limiting distance* of less than 1.2 m shall be protected by *closures*, of other than wired glass or glass block, having a *fire protection rating* of at least 20 minutes.

9.10.14.6. Allowance for Sprinklers and Wired Glass or Glass Block. The maximum area of *unprotected openings* may be doubled where the *building* is *sprinklered*, or where the *unprotected openings* are glazed with wired glass in steel frames or glass blocks as described in Articles 9.10.13.5. and 9.10.13.7. (See A-3.2.3.11. in Appendix A.)

* **A-3.2.3.11. Increased Openings Permitted.** The maximum area of unprotected openings in an exposing building face can be quadrupled if both sprinklers and protective glazing described in 9.10.14.6. are used.

9.10.14.8. Percentage of Unprotected Openings for Irregular-Shaped Buildings. For the purpose of using Table 9.10.14.A. to determine the actual percentage of *unprotected openings* permitted in an exterior wall, the location of the *exposing building face* is permitted to be taken at a vertical plane located so that there are no *unprotected openings* between the vertical plane and the line to which the *limiting distance* is measured. (See A-3.2.3.1.(4) in Appendix A.)

* **A-3.2.3.1.(4) Spatial Separation Design.** It is intended that Article 9.10.14.12. be used first to establish the basic requirements for the exterior wall in terms of fire-resistance rating, type of construction and type of cladding. The percentage of unprotected openings determined from the application of Article 9.10.14.12. would be unnecessarily restrictive if the actual unprotected openings occur in a plane that is set back from the front of the building face.



A-3.2.3.1.(4)

Article 9.10.14.8. applies to the calculation of the allowable percentage of unprotected openings based upon projection onto a plane that is in front of all unprotected openings. The application of these two Articles is shown in the diagram on page 53. The multiplying effect of Article 9.10.14.6. would be applied, if applicable, to the area of unprotected openings derived from Article 9.10.14.8.

* 9.10.14.12. Exposing Building Face of Houses

(1) The *exposing building face* shall have a *fire-resistance rating* of not less than 45 min where the *limiting distance* is less than 1.2 m, and when the *limiting distance* is less than 0.6 m, the *exposing building face* is clad with *noncombustible* material.

(2) Window openings in the *exposing building face* referred to in Sentence (1) shall not be permitted if the *limiting distance* is less than 1.2 m and shall be limited in conformance with the requirements for *unprotected openings* in Article 9.10.14.1. where the *limiting distance* is 1.2 m or greater.

9.10.14.13. Combustible Projections.

Except for *buildings* containing 1 or 2 *dwelling units* only, *combustible* projections on the exterior of a wall that are more than 1 m above ground level, such as balconies, platforms, canopies, eave projections and stairs, and that could expose an adjacent *building* to fire spread, shall not be permitted within 1.2 m of a property line or the centreline of a *public way*, or within 2.4 m of a *combustible* projection on another *building* on the same property.

9.10.14.14. Detached Garage Serving One Dwelling Unit

*

(1) Except as required in Article 9.10.14.3., the *exposing building face* of a detached garage shall have a *fire-resistance rating* of not less than 45 min, except that no *fire-resistance rating* is required where the *limiting distance* is 0.6 m or greater.

(2) The *exterior cladding* of detached garages described in Sentence (1) is not required to be *noncombustible* regardless of the *limiting distance*.

(3) The percentage of window openings permitted in the *exposing building face* of detached garages described in Sentence (1) shall conform to the requirements for *unprotected openings* in Article 9.10.14.1.

(4) Where a detached garage serves only one *dwelling unit* and is located on the same property as that *dwelling unit*, then the requirements for *limiting distance* shall not apply between the garage and the *dwelling unit*.

9.10.15. Fire Stops

9.10.15.1. Required Fire Stops in Concealed Spaces

(1) Concealed spaces in interior walls, ceilings and crawl spaces shall be separated by fire stops from concealed spaces in exterior walls and *attic or roof spaces*.

(2) Fire stops shall be provided at all interconnections between concealed vertical and horizontal spaces in interior coved ceilings, drop ceilings and soffits where the exposed construction materials within the concealed spaces have a surface *flame-spread rating* greater than 25.

(3) Fire stops shall be provided at the top and bottom of each run of stairs where they pass through a floor containing concealed space in which the exposed construction materials within the space have a surface *flame-spread rating* greater than 25.

(4) Every concealed space created by a ceiling, roof space or unoccupied attic space shall be separated by fire stops into compartments of not more than 300 m^2 in area where such space contains exposed construction materials having a surface *flame-spread rating* greater than 25. *

(5) No dimension of the concealed space described in Sentence (4) shall exceed 20 m.

(6) Concealed spaces in mansard or gambrel style roofs, exterior cornices, balconies and canopies of *combustible construction* in which the exposed construction materials within the space have a surface *flame-spread rating* exceeding 25 shall have vertical fire stops at intervals of not more than 20 m and at points where such concealed spaces extend across the ends of required vertical *fire separations*.

9.10.15.2. Required Fire Stops in Wall Assemblies

(1) Except as permitted in Sentences (2) and (3), fire stops shall be provided to block off concealed

spaces within wall assemblies, including spaces created by furring, at each floor level, and at each ceiling level where the ceiling contributes to part of the required *fire-resistance rating*, and at other locations within the wall, so that the distance between fire stops does not exceed 20 m horizontally and 3 m vertically.

(2) Fire stops required in Sentence (1) are not required provided the exposed construction materials within the wall space, including insulation, but not including wiring, piping or similar services, have a *flame-spread rating* of not more than 25.

(3) Fire stops required in Sentence (1) are not required provided the wall space is filled with insulation.

* **9.10.15.3. Fire Stop Materials.** Fire stops shall be constructed of not less than 0.38 mm sheet steel, 6 mm asbestos board, 12.7 mm gypsum wallboard, 12.5 mm plywood, waferboard or strandboard, with joints having continuous support, 2 layers of 19 mm lumber with joints staggered, or 38 mm lumber.

9.10.15.4. Penetration of Fire Stops. Where fire stops are pierced by pipes, ducts or other elements, the effectiveness of the fire stops shall be maintained around such elements.

9.10.16. Flame Spread Limits

9.10.16.1. Flame Spread Rating of Interior Surfaces

(1) Except as otherwise provided in this Subsection, the exposed surface of every interior wall and ceiling, including skylights and glazing, shall have a surface *flame-spread rating* of not more than 150.

(2) Except as permitted in Sentence (3), doors need not conform to Article 9.10.16.1. provided they have a surface *flame-spread rating* of not more than 200.

(3) Doors within *dwelling units* need not conform to Sentences (1) and (2).

9.10.16.10. Protection of Foamed Plastics

(1) Foamed plastics which form part of a wall or ceiling assembly in *combustible construction* shall be protected from adjacent space in the *building*, other than adjacent concealed spaces within *attic and roof spaces*, crawl spaces, and wall assemblies, by

(a) one of the interior finishes described in Subsections 9.29.4. to 9.29.9., or

(c) any thermal barrier that meets the requirements of Clause 3.1.5.11.(2)(e).

(e) any thermal barrier that meets the requirements of classification B when tested in conformance with CAN4-S124-M, "Standard Method of Test for the Evaluation of Protective Coverings for Foamed Plastic." (See Appendix A.)

A-3.1.5.11.(2)(e) Foamed Plastic Insulation Protection. The standard fire exposure temperature in CAN4-S101-M, "Standard Methods of Fire Endurance Tests of Building Construction and Materials" is the same as in CAN4-S124-M, "Standard Method of Test for the Evaluation of Protective Coverings for Foamed Plastic." A thermal barrier that when tested in conformance with CAN4-S101-M will not exceed an average temperature rise of 140°C on the unexposed face of the thermal barrier after a period of 10 min satisfies this requirement.

9.10.16.11. Walls and Ceilings in Bathrooms. The interior finish of walls and ceilings in bathrooms within *suites* of *residential occupancy* shall have a surface *flame-spread rating* of not more than 200.

9.10.16.12. Coverings or Linings of Ducts. Where a covering or a lining is used with a duct, such lining or covering shall have a *flame-spread rating* conforming to Part 6. (See Section 9.33.)

9.10.18. Smoke Alarms

9.10.18.1. Required Smoke Alarms. *

Smoke alarms conforming to CAN/ULC-S531, "Standard for Smoke Alarms" shall be installed in each *dwelling unit*.

9.10.18.2. Location of Smoke Alarms

(1) *Smoke alarms* within *dwelling units* shall be installed between each sleeping area and the remainder of the *dwelling unit*; and where the sleeping areas are served by hallways, the *smoke alarms* shall be installed in the hallway.

(2) *Smoke alarms* required in Article 9.10.18.1. and Sentence (1) shall be installed on or near the ceiling.

9.10.18.3. Power Supply

(1) *Smoke alarms* shall be installed by permanent connections to an electrical circuit and shall have no disconnect switch between the overcurrent device and the *smoke alarm*.

(2) Where the *building* is not supplied with electrical power, *smoke alarms* are permitted to be battery operated.

9.10.18.4. Interconnection of Smoke Alarms. Where more than one *smoke alarm* is required in a *dwelling unit*, the *smoke alarms* shall be wired so that the activation of one alarm will cause all alarms within the *dwelling unit* to sound.

9.10.18.5. Instructions for Maintenance and Care. Where instructions are necessary to describe the maintenance and care required for *smoke alarms* to ensure continuing satisfactory performance, they shall be posted in a location where they will be readily available to the occupants for reference.

9.10.19. Fire Fighting

9.10.19.3. Fire Department Access to Buildings

(1) Access for fire department equipment shall be provided to each *building* by means of a *street*, private roadway or yard. (See A-3.2.5.7.(1) in Appendix A.)

A-3.2.5.7.(1) Fire Department Access Route. The design and construction of fire department access routes involve the consideration of many variables, some of which are specified in the requirements in the Code. All these variables should be considered in relation to the type and size of fire department vehicles available in the municipality or area where the building will be constructed. It is appropriate, therefore, that the local fire department be consulted prior to the design and construction of access routes.

(2) Where access to a *building* as required in Sentence (1) is provided by means of a roadway or yard, the design and location of such roadway or yard shall take into account connection with public thoroughfares, weight of fire fighting equipment, width of roadway, radius of curves, overhead clearance, location of fire hydrants, location of fire department connections and vehicular parking.

Section 9.11 Sound Control

9.11.1. Sound Transmission Class Rating (Airborne Sound)

9.11.1.1. Determination of Sound Transmission Class Ratings. Sound transmission class ratings shall be determined in accordance with ASTM E413, "Classification for Rating Sound Insulation," using results from measurements in accordance with ASTM E90, "Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions" or ASTM E336, "Measurement of Airborne Sound Insulation in Buildings." (See Appendix A.)

9.11.2. Required Sound Control Locations (Airborne Sound)

9.11.2.1. Minimum Sound Transmission Class Ratings *

(1) Every *dwelling unit* shall be separated from every other *dwelling unit* by a construction providing a sound transmission class rating of at least 50, measured in accordance with Subsection 9.11.1. or listed in A-9.10.3.1. in Appendix A.

Section 9.12 Excavation

9.12.1. General

9.12.1.1. Removal of Topsoil and Organic Matter

(1) The topsoil and vegetable matter in all unexcavated areas under a *building* shall be removed.

(2) In localities where termites are known to occur, all stumps, roots and other wood debris shall

be removed from the *soil* to a depth of not less than 300 mm in unexcavated areas under a *building*.

(3) The bottom of every *excavation* shall be free of all organic material.

9.12.1.2. Standing Water. *Excavations* shall be kept free of standing water.

9.12.1.3. Protection from Freezing. The bottom of *excavations* shall be kept from freezing throughout the entire construction period.

9.12.2. Depth

9.12.2.1. Excavation to Undisturbed Soil. *Excavations* for *foundations* shall extend to undisturbed soil.

9.12.2.2. Minimum Depth of Foundations

(1) Except as provided in Sentences (4) and (5), the minimum depth of *foundations* below finished ground level shall conform to Table 9.12.2.A.

(2) The minimum depth of *foundations* for exterior concrete steps with more than 2 risers shall conform to Sentences (1) to (5).

(3) Concrete steps with 1 and 2 risers are permitted to be laid on ground level.

(4) The *foundation* depths required in Sentence (1) are permitted to be decreased where experience with local *soil* conditions shows that lesser depths are satisfactory, or where the *foundation* is designed for lesser depths.

Table 9.12.2.A.
Forming Part of Sentence 9.12.2.2.(1)

Minimum Depths of Foundation				
Type of *Soil*	*Foundation* Containing Heated *Basement* or Crawl Space		*Foundation* Containing no Heated Space	
	Good *Soil* Drainage to not less than the Depth of Frost Penetration	Poor *Soil* Drainage	Good *Soil* Drainage to not less than the Depth of Frost Penetration	Poor *Soil* Drainage
Rock	No limit	No limit	No limit	No limit
Coarse grained *soils*	No limit	No limit	No limit	Below the depth of frost penetration
Silt	No limit	No limit	Below the depth of frost penetration	Below the depth of frost penetration
Clay or *soils* not clearly defined [1]	1.2 m	1.2 m	1.2 m but not less than the depth of frost penetration	1.2 m but not less than the depth of frost penetration
Column 1	2	3	4	5

Note to Table 9.12.2.A.:
[1] See Appendix A.

A-9.12.2.A. Minimum Depths of Foundations. The requirements for clay soils or soils not clearly defined are intended to apply to those soils that are subject to significant volume changes with changes in moisture content.

(5) The *foundation* depths required in Sentence (1) do not apply to *foundations* for *buildings* of other than masonry or masonry veneer construction

(a) whose superstructure will not be damaged by differential *soil* movement caused by *frost action*, or

(b) used as accessory *buildings* of not more than 1 *storey* in *building height* and not more than 50 m² in *building area*.

9.12.3. Backfill

9.12.3.1. Placement of Backfill. Backfill shall be placed to avoid damaging the *foundation* wall, the drainage tile, externally applied thermal insulation and waterproofing of the wall.

9.12.3.2. Grading of Backfill. Backfill shall be graded to prevent drainage towards the *foundation* after settling.

9.12.3.3. Deleterious Debris and Boulders. Backfill within 600 mm of the *foundation* shall be free of deleterious debris and boulders larger than 250 mm diam.

9.12.4. Trenches beneath Footings

9.12.4.1. The *soil* in trenches beneath footings for sewers and watermains shall be compacted by tamping up to the level of the footing base, or shall be filled with concrete having a strength not less than 10 MPa to support the footing.

Section 9.13 Waterproofing and Dampproofing

(See Appendix A.)

9.13.1. General

9.13.1.1. Required Waterproofing

(1) Where hydrostatic pressure occurs, floors on ground and exterior surfaces of walls below ground level shall be waterproofed.

(2) Roofs of underground structures shall be waterproofed to prevent the entry of water into the structure.

9.13.1.2. Required Dampproofing

(1) Where hydrostatic pressure does not occur and the exterior finished ground level is at a higher elevation than the ground level inside the *foundation* walls, exterior surfaces of *foundation* walls below ground level shall be dampproofed.

(2) Except in garages and unenclosed portions of *buildings*, concrete slabs-on-ground shall be dampproofed. (See A-9.13 in Appendix A.)

9.13.1.3. Standards for Application

(1) The method of application of all bituminous waterproofing and dampproofing materials shall conform to

(a) CGSB 37-GP-3M, "Application of Emulsified Asphalts for Dampproofing or Waterproofing,"

(b) CGSB 37-GP-12Ma, "Application of Unfilled Cutback Asphalt for Dampproofing," or

(c) CGSB 37-GP-22M, "Application of Unfilled Cutback Tar Foundation Coating for Dampproofing."

9.13.2. Material

9.13.2.1. Material Standards

(1) Materials used for dampproofing or waterproofing shall conform to

(a) CAN/CGSB-37.2-M, "Asphalt, Emulsified, Mineral Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings,"

(b) CGSB 37-GP-6Ma, "Asphalt, Cutback, Unfilled, for Dampproofing,"

(c) CGSB 37-GP-16M, "Asphalt, Cutback, Filled, for Dampproofing and Waterproofing,"

(d) CGSB 37-GP-18Ma, "Tar, Cutback, Unfilled, for Dampproofing,"

(e) CSA A123.4, "Bitumen for Use in Construction of Built-Up Roof Coverings and Dampproofing and Waterproofing Systems," or

(f) CAN2-51.34-M, "Vapour Barrier, Polyethylene Sheet, for Use in Building Construction."

9.13.3. Waterproofing of Walls

9.13.3.1. Preparation of Surface

(1) Unit masonry walls to be waterproofed shall be parged on exterior surfaces below ground level with not less than 6 mm of mortar conforming to Section 9.20.

(2) Concrete walls to be waterproofed shall have all holes and recesses resulting from removal of form ties sealed with mortar or waterproofing material.

9.13.3.2. Application of Waterproofing Membranes. Concrete or unit masonry walls to be waterproofed shall be covered with not less than 2 layers of bitumen-saturated membrane, with each layer being cemented in place with bitumen and coated over-all with a heavy coating of bitumen.

9.13.4. Waterproofing of Floors

9.13.4.1. *Basement* floors to be waterproofed shall have a system of membrane waterproofing provided between 2 layers of concrete, each of which shall be not less than 75 mm thick, with the floor membrane mopped to the wall membrane to form a complete seal.

9.13.5. Dampproofing of Walls

9.13.5.1. Preparation of Surface

(1) Unit masonry walls to be dampproofed shall be parged on the exterior face below ground level with not less than 6 mm of mortar conforming to Section 9.20, and shall be coved over the footing when the first course of block is laid.

(2) Concrete walls to be dampproofed shall have holes and recesses resulting from the removal of form ties sealed with cement mortar or dampproofing material.

9.13.5.2. Application of Dampproofing Material. Bituminous or other dampproofing material shall be applied over the parging or concrete below ground level.

9.13.5.3. Interior Dampproofing of Walls

(1) Where a separate interior cladding is applied to a concrete or unit masonry wall which is in contact with the *soil*, or where wood members are applied to such walls for the installation of insulation or finish, the interior surface of the *foundation* wall below ground level shall be dampproofed.

(2) The dampproofing required in Sentence (1) shall extend from the *basement* floor and shall terminate at ground level and no membrane shall be applied above ground level between the insulation and the *foundation* wall.

9.13.5.4. Barrier to Soil Gas and Water Vapour. Masonry walls which are to be dampproofed and which are not dampproofed on their interior surface as required in Sentence 9.13.5.3.(1) shall include a course of masonry units without voids or be sealed with flashing material extending across the full width of the masonry at or below the level of the adjoining floor slab or, in the absence of a floor slab, the level of the ground cover required in Article 9.18.6.1. (See A-9.13 in Appendix A.)

9.13.6. Dampproofing and Sealing of Slabs

9.13.6.1. Location of Dampproofing. When slabs are dampproofed, the dampproofing shall be installed below the slab, except that where a separate floor is provided over the slab, the dampproofing may be applied to the top of the slab.

9.13.6.2. Dampproofing below the Slab

(1) When installed below the slab, dampproofing shall consist of polyethylene not less than 0.15 mm thick.

(2) Joints in dampproofing described in Sentence (1) shall be lapped not less than 300 mm.

9.13.6.3. Dampproofing above the Slab. When installed above the slab, dampproofing shall consist of not less than 2 mopped-on coats of bitumen, 0.05 mm polyethylene or other material providing equivalent performance.

9.13.6.4. Perimeter Seal. The slab shall be sealed around its perimeter to the inner surfaces of adjacent walls using flexible sealant. (See A-9.13 in Appendix A.)

9.13.6.5. Seal of Penetrations. All penetrations of the slab by pipes or other objects shall be sealed against water vapour and soil gas leakage. (See A-9.13 in Appendix A.)

9.13.6.6. Seal of Drain Penetrations. All penetrations of the surface of the concrete slab which are required to drain water from the slab surface shall be sealed in a manner which prevents the upward flow of water vapour and *soil* gas without preventing the downward flow of liquid water. (See A-9.13 in Appendix A.)

Section 9.14 Drainage

9.14.1. Scope

9.14.1.1. Application. This Section applies to subsurface drainage and to surface drainage.

9.14.1.2. Crawl Spaces. Drainage for crawl spaces shall conform to Section 9.18.

9.14.1.3. Floor Slabs. Drainage requirements beneath floor slabs shall conform to Section 9.16.

9.14.2. General

9.14.2.1. Foundation Wall Drainage

(1) Unless it can be shown to be unnecessary, the bottom of every exterior *foundation* wall shall be drained by drainage tile or pipe laid around the exterior of the *foundation* in conformance with Subsection 9.14.3. or by a layer of gravel or crushed *rock* in conformance with Subsection 9.14.4.

(2) Where mineral fibre insulation or crushed *rock* backfill is provided adjacent to the exterior surface of a foundation wall, it shall extend to the footing level to facilitate drainage of ground water to the *foundation* drainage system. (See Appendix A.)

A-9.14.2.1.(2) Insulation Applied to the Exterior of Foundation Walls. In addition to the prevention of heat loss, some types of mineral fibre insulation, such as rigid glass fibre, are installed on the exterior of basement walls for the purpose of moisture control. This is sometimes used instead of crushed rock as a drainage layer between the basement wall and the surrounding soil in order to facilitate the drainage of soil moisture. Water drained by this drainage layer must be carried away from the foundation by the footing drains or the granular drainage layer in order to prevent it from developing hydro–static pressure against the wall. Provision must be made to permit the drainage of this water either by extending the insulation or crushed rock to the drain or by the installation of granular material connecting the two. The installation of such drainage layer does not eliminate the need for normal waterproofing or damproofing of walls as specified in Section 9.13.

9.14.3. Drainage Tile and Pipe

9.14.3.1. Material Standards

(1) Drain tile and drain pipe for foundation drainage shall conform to

(a) ASTM C4, "Clay Drain Tile,"
(b) ASTM C412-M, "Concrete Drain Tile,"
(c) ASTM C444-M, "Perforated Concrete Pipe Metric,"
(d) ASTM C700, "Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated,"
(e) CAN/CGSB-34.22-M, "Pipe, Asbestos Cement, Drain,"
(f) CGSB 41-GP-29Ma, "Tubing, Plastic, Corrugated, Drainage,"
(g) CSA B182.1, "Plastic Drain and Sewer Pipe and Pipe Fittings," or
(h) CAN3-G401, "Corrugated Steel Pipe Products."

9.14.3.2. Minimum Size. Drain tile or pipe used for *foundation* drainage shall be not less than 100 mm in diam.

9.14.3.3. Installation

(1) Drain tile or pipe shall be laid on undisturbed or well-compacted *soil* so that the top of the tile or pipe is below the bottom of the floor slab or crawl space.

(2) Drain tile or pipe with butt joints shall be laid with 6 mm to 10 mm open joints.

(3) The top half of joints referred to in Sentence (2) shall be covered with sheathing paper, 0.10 mm polyethylene or No. 15 asphalt or tar-saturated felt.

(4) The top and sides of drain pipe or tile shall be covered with not less than 150 mm of crushed stone or other coarse clean granular material containing not more than 10 per cent of material that will pass a 4 mm sieve.

9.14.4. Granular Drainage Layer

9.14.4.1. Type of Granular Material. Granular material used to drain the bottom of a *foundation* shall consist of a continuous layer of crushed stone or other coarse clean granular material containing not more than 10 per cent of material that will pass a 4 mm sieve.

9.14.4.2. Installation. Granular material described in Article 9.14.4.1. shall be laid on undisturbed or compacted *soil* to a minimum depth of not less than 125 mm beneath the *building* and extend not less than 300 mm beyond the outside edge of the footings.

9.14.4.3. Grading. The bottom of an excavation drained by a granular layer shall be graded so that the entire area described in Article 9.14.4.2. is drained to a sump conforming to Article 9.14.5.2.

9.14.4.4. Wet Site Conditions. Where because of wet site conditions *soil* becomes mixed with the granular drainage material, sufficient additional granular material shall be provided so that the top 125 mm are kept free of *soil*.

9.14.5. Drainage Disposal

9.14.5.1. Drainage Disposal. *Foundation* drains shall drain to a sewer, drainage ditch or dry well.

9.14.5.2. Sump Pits

(1) Where a sump pit is provided, it shall be not less than 750 mm deep, 0.25 m^2 in area and be provided with a cover.

(2) Where gravity drainage is not practical, an automatic sump pump shall be provided to discharge the water from the sump pit described in Sentence (1) into a sewer, drainage ditch or dry well.

9.14.5.3. Dry Wells

(1) Dry wells may be used only when located in areas where the natural *groundwater level* is below the bottom of the dry well.

(2) Dry wells shall be not less than 5 m from the *building foundation* and located so that drainage is away from the *building*.

9.14.6. Surface Drainage

9.14.6.1. Surface Drainage. The *building* shall be located or the *building* site graded so that water will not accumulate at or near the *building*.

9.14.6.2. Drainage away from Wells or Septic Disposal Beds. Surface drainage shall be directed away from the location of a water supply well or septic tank disposal bed.

9.14.6.3. Catch Basin. Where runoff water from a driveway is likely to accumulate or enter a garage, a catch basin shall be installed to provide adequate drainage.

9.14.6.4. Downspouts. Where downspouts are provided and are not connected to a sewer, provisions shall be made to prevent *soil* erosion.

Section 9.15 Footings and Foundations

9.15.1. Scope

9.15.1.1. Application

(1) Except as provided in Articles 9.15.1.2. and 9.15.1.3., this Section applies to concrete or unit masonry *foundation* walls and concrete footings on *soils* with an *allowable bearing pressure* of 75 kPa or greater for *buildings* of wood frame or masonry construction. (See Appendix A.)

A-9.15.1.1.(1) Installation of Mobile Homes. CSA has prepared a standard entitled CAN3-Z240.10.1, "Recommended Practice for the Site Preparation, Foundation and Anchorage of

Mobile Homes." This document is intended to provide guidance to inspectors, installers and owners of mobile homes and includes information on site preparation, foundations, anchorage and skirting.

(2) *Foundations* for applications other than as described in Sentence (1) shall be designed in accordance with Section 9.4.

9.15.1.2. Permafrost. *Buildings* erected on permafrost shall have *foundations* designed by a designer competent in this field in accordance with the appropriate requirements of Part 4.

9.15.1.3. Wood Frame Foundations

(1) *Foundations* of wood frame construction are permitted to be used provided they conform to Sentence (2) or (3).

(2) Except as provided in Sentence (3), wood frame *foundations* shall be designed in conformance with Part 4.

(3) Wood frame *foundations* need not conform to Sentence (2) provided such *foundations*, including their lateral supports, conform to CAN3-S406, "Construction of Preserved Wood Foundations."

(4) The *foundation* referred to in Sentence (3) shall be supported on *soil* having an *allowable bearing pressure* of not less than 75 kPa and shall not be subjected to loads that exceed those determined from the design assumptions listed in Clause 1.1.2. of the Standard. (See Appendix A.)

A-9.15.1.3.(4) Preserved Wood Foundations – Design Assumptions. Tabular data and figures in CAN3-S406, "Construction of Preserved Wood Foundations" are based upon the general principles provided in CAN3-O86, "Code for Engineering Design in Wood" with the following assumptions:

(1) soil bearing capacity: 75 kPa or more,
(2) clear spans for floors: 5 000 mm or less,
(3) floor loadings: 1.9 kPa for first floor and suspended floor, and 1.4 kPa for second storey floor,
(4) foundation wall heights: 2 400 mm for slab floor foundation, 3 000 mm for suspended wood floor foundation,
(5) top of granular layer to top of suspended wood floor: 600 mm,
(6) lateral load from soil pressure: equivalent to fluid pressure of 4.7 kPa per metre of depth,
(7) ground snow load: 3 kPa,
(8) basic snow load coefficient: 0.6,
(9) roof loads are carried to the exterior wall,
(10) dead loads:

roof	0.50 kPa,
floor	0.47 kPa,
wall (with siding)	0.32 kPa,
wall (with masonary veneer)	1.94 kPa,
foundation wall	0.27 kPa,
partitions	0.20 kPa.

9.15.2. General

9.15.2.1. Concrete. Concrete shall conform to Section 9.3.

9.15.2.2. Concrete Block. Concrete block shall be *loadbearing* type conforming to CAN3-A165.1, "Concrete Masonry Units" and shall have a compressive strength over the gross area of the block of not less than 7.5 MPa for hollow units and 12.5 MPa for solid units.

9.15.2.3. Unit Masonry Construction. Mortar, mortar joints, corbelling and protection for unit masonry shall conform to Section 9.20.

9.15.2.4. Pier Type Foundations

(1) Where pier type *foundations* are used, the piers shall be designed to support the applied loads from the superstructure.

(2) Where piers are used as a *foundation* system in a *building* of 1 *storey* in *building height*, the piers shall be installed to support the principal framing members and shall be spaced not more than 3.5 m apart along the framing, unless the piers and their footings are designed for larger spacings.

(3) The height of piers described in Sentence (2) shall not exceed 3 times their least dimension at the base of the pier.

(4) Where concrete block is used for piers described in Sentence (2), they shall be laid with cores placed vertically, and when the width of the *building* is 4.3 m or less, placed with their longest dimension at right angles to the longest dimension of the *building*.

9.15.3. Footings

9.15.3.1. Footings Required. Footings shall be provided under walls, pilasters, columns, piers, fireplaces and *chimneys* that bear on *soil* or *rock*, except that footings may be omitted under piers or monolithic concrete walls if the safe *loadbearing* capacity of the *soil* or *rock* is not exceeded.

9.15.3.2. Support of Footings. Footings shall rest on undisturbed *soil*, *rock* or compacted granular *fill*.

9.15.3.3. Footing Sizes

* **(1)** Except as provided in Sentences (2) to (6), the minimum footing size shall be as shown in Table 9.15.3.A. provided the length of supported joists does not exceed 4.9 m.

* **(2)** Where the length of the supported joists exceeds 4.9 m, footings shall be designed in accordance with Section 4.2.

(3) The strip footing sizes for exterior walls shown in Column 2 of Table 9.15.3.A. shall be increased by 65 mm for each *storey* of masonry veneer over wood frame construction supported by the *foundation* wall.

Table 9.15.3.A.
Forming Part of Article 9.15.3.3.

Minimum Footing Sizes			
No. of Floors Supported	Minimum Width of Strip Footings, mm		Minimum Footing Area for Columns Spaced 3 m o.c.,[1] m^2
	Supporting Exterior Walls	Supporting Interior Walls	
1	250[2]	200[3]	0.4
2	350[2]	350[3]	0.75
3	450[2]	500[3]	1.0
Column 1	2	3	4

Notes to Table 9.15.3.A.:
[1] See Sentence 9.15.3.3.(6)
[2] See Sentence 9.15.3.3.(3) and (4)
[3] See Sentence 9.15.3.3.(5)

(4) The strip footing sizes for exterior walls shown in Column 2 of Table 9.15.3.A. shall be increased by 130 mm for each *storey* of masonry construction supported by the *foundation* wall.

(5) The minimum strip footing sizes for interior walls shown in Column 3 of Table 9.15.3.A. shall be increased by 100 mm for each *storey* of masonry construction supported by the footing.

(6) The footing area for column spacings other than shown in Table 9.15.3.A. shall be adjusted in proportion to the distance between columns.

9.15.3.4. High Water Table. Where a *foundation* rests on gravel, sand or silt in which the water table level is less than the width of the footings below the bearing surface, the footing width shall be not less than twice the width required by Article 9.15.3.3.

9.15.3.5. Non-Loadbearing Walls. Footings for interior non-*loadbearing* masonry walls shall be not less than 200 mm wide for walls up to 5.5 m high and shall be increased by 100 mm for each additional 2.7 m of height.

9.15.3.6. Thickness. Footings shall be not less than 100 mm thick except when greater thicknesses are required because of the projection of the footing beyond the supported element.

9.15.3.7. Footing Projection. The projection of an unreinforced footing beyond the supported element shall be not greater than the thickness of the footing.

9.15.3.8. Step Footings. When step footings are used, the vertical rise between horizontal portions shall not exceed 600 mm. The horizontal distance between risers shall not be less than 600 mm.

9.15.4. Foundation Walls

9.15.4.1. Foundation Wall Thickness. Where average stable *soils* are encountered, the thickness of *foundation* walls subject to lateral earth pressure shall conform to Table 9.15.4.A. for walls not exceeding 2.5 m in unsupported height.

9.15.4.2. Lateral Support

(1) For the purposes of Article 9.15.4.1., *foundation* walls shall be considered laterally supported at the top if such walls support solid masonry

Table 9.15.4.A.
Forming Part of Article 9.15.4.1.

Thickness of Foundation Walls			
Type of *Foundation* Wall	Minimum Wall Thickness, mm	Maximum Height of Finish Grade Above *Basement* Floor or Inside Grade	
		Foundation Wall Laterally Unsupported at the Top, (1) m	*Foundation* Wall Laterally Supported at the Top, (1) m
Solid concrete (15 MPa min. strength)	150	0.80	1.50
	200	1.20	2.15
	250	1.40	2.30
	300	1.50	2.30
Solid concrete (20 MPa min. strength)	150	0.80	1.80
	200	1.20	2.30
	250	1.40	2.30
	300	1.50	2.30
Unit masonry	140	0.60	0.80
	190	0.90	1.20
	240	1.20	1.80
	290	1.40	2.20
Column 1	2	3	4

Note to Table 9.15.4.A.:
(1) See Article 9.15.4.2.

superstructure or if the floor joists are embedded in the top of the *foundation* walls.

(2) *Foundation* walls shall also be considered to be supported at the top if the floor system is anchored to the top of the *foundation* walls with anchor bolts, in which case the joists may run either parallel or perpendicular to the *foundation* wall.

(3) When a *foundation* wall contains an opening more than 1.2 m long or contains openings in more than 25 per cent of its length, that portion of the wall beneath such openings shall be considered laterally unsupported, unless the wall around the opening is reinforced to withstand the earth pressure.

(4) When the length of solid wall between windows is less than the average length of the windows, the combined length of such windows shall be considered as a single opening for the purposes of Sentence (3).

9.15.4.3. Extension above Ground Level.

Exterior *foundation* walls shall extend not less than 150 mm above finished ground level.

9.15.4.4. Reduction in Thickness

(1) Where the top of a *foundation* wall is reduced in thickness to permit the installation of floor joists, the reduced section shall be not more than 350 mm high and not less than 90 mm thick.

(2) Where the top of a *foundation* wall is reduced in thickness to permit the installation of a masonry exterior facing, the reduced section shall be not less than 90 mm thick and tied to the facing material with metal ties conforming to Article 9.20.9.4.(3) spaced not more than 200 mm o.c. vertically and 900 mm o.c. horizontally.

(3) The space between wall and facing described in Sentence (2) shall be filled with mortar.

9.15.4.5. Corbelling.

Corbelling of *foundation* walls supporting cavity walls shall conform to Article 9.20.12.2.

9.15.4.6. Crack Control Joints

(1) Crack control joints shall be provided in *foundation* walls more than 25 m long at intervals of not more than 15 m.

(2) Joints required in Sentence (1) shall be designed to resist moisture penetration and shall be keyed to prevent relative displacement of the wall portions adjacent to the joint.

9.15.4.7. Interior Masonry Walls.

Interior masonry *foundation* walls not subject to lateral earth pressure shall conform to Section 9.20.

9.15.5. Joist and Beam Support

9.15.5.1. Support of Floor Joists

(1) Except as permitted in Sentence (2), *foundation* walls of hollow unit masonry supporting floor joists shall be capped with not less than 50 mm of solid masonry or concrete, or have the top course filled with mortar or concrete.

(2) Capping required in Sentence (1) is permitted to be omitted in localities where termites are not known to occur, when the joists are supported on a wood plate not less than 38 mm by

89 mm where the siding overlaps the *foundation* wall not less than 12 mm.

9.15.5.2. Support of Beams

(1) Not less than 190 mm depth of solid masonry shall be provided beneath beams supported on masonry.

(2) Where the beam referred to in Sentence (1) is supported below the top of the *foundation* walls, the ends of such beams shall be protected from the weather.

9.15.5.3. Pilasters

(1) Pilasters shall be provided under beams that frame into 140 mm unit masonry *foundation* walls.

(2) Pilasters required in Sentence (1) shall be not less than 90 mm by 290 mm and shall be bonded or tied into the wall.

(3) The top 200 mm of pilasters required in Sentence (1) shall be solid.

9.15.6. Parging and Finishing

9.15.6.1. Foundation Walls below Ground. Concrete block *foundation* walls shall be parged on the exterior face below ground level as required in Section 9.13.

9.15.6.2. Foundation Walls above Ground. Exterior surfaces of concrete block *foundation* walls above ground level shall have tooled joints, or shall be rendered, parged or otherwise suitably finished.

9.15.6.3. Form Ties. All form ties shall be removed at least flush with the concrete surface.

Section 9.16 Slabs-On-Ground

9.16.1. Scope

9.16.1.1. Application. This Section applies to concrete slabs supported on ground or on granular fill which do not provide structural support for the superstructure.

9.16.1.2. Structural Floor Slabs. Floor slabs that support loads from the superstructure shall be designed in conformance with Part 4.

9.16.1.3. Dampproofing and Waterproofing. Dampproofing and waterproofing shall conform to Section 9.13.

9.16.2. Granular Material beneath Slabs

9.16.2.1. Except for slabs in garages, not less than 100 mm of coarse clean granular material containing not more than 10 per cent of material that will pass a 4 mm sieve shall be placed beneath slabs in *dwelling units*. (See Appendix A.)

9.16.3. Drainage

9.16.3.1. Prevention of Water Accumulation. Except as provided in Article 9.16.3.2. or where it can be shown to be unnecessary, the accumulation of water underneath a slab-on-ground shall be prevented by grading or drainage.

9.16.3.2. Hydrostatic Pressure. Where *ground water levels* may cause hydrostatic pressure beneath the slab, the slab shall be designed to resist such pressures.

9.16.3.3. Floor Drains. When floor drains are installed (see Section 9.31), the floor surface shall be sloped so that no water can accumulate.

9.16.4. Concrete

9.16.4.1. Surface Finish

(1) The finished surface of concrete floor slabs shall be trowelled smooth and even.

(2) Dry cement shall not be added to the floor surfaces to absorb surplus water.

9.16.4.2. Topping Course

(1) When a topping course is provided for a concrete floor slab, it shall consist of 1 part cement to 2.5 parts clean, well graded sand by volume, with a water/cement ratio approximately equal to that of the base slab.

(2) When concrete topping is provided, it shall not be less than 20 mm thick.

9.16.4.3. Thickness. Concrete slabs shall not be less than 75 mm thick exclusive of concrete topping.

9.16.4.4. Bond Break. A bond-breaking material shall be placed between the slab and footings or *rock*.

Section 9.17 Columns

9.17.1. Scope

9.17.1.1. Application

* **(1)** This Section applies to columns used to support carport roofs (see Section 9.35), and beams carrying loads from not more than 2 wood-frame floors where the length of joists carried by such beams does not exceed 5 m.

9.17.2. General

9.17.2.1. Location. Columns shall be centrally located on a footing conforming to Section 9.15.

9.17.2.2. Fastening. Columns shall be securely fastened to the supported member to prevent lateral movement.

9.17.3. Steel Columns

9.17.3.1. Size and Thickness

(1) Except as permitted in Sentence (2), steel pipe columns shall have an outside diameter of not less than 73 mm and a wall thickness of not less than 4.76 mm.

(2) Columns of sizes other than as specified in Sentence (1) may be used where the *loadbearing* capacities are shown to be adequate.

9.17.3.2. End Bearing Plates

(1) Except as permitted in Sentence (2), steel columns shall be fitted with not less than 100 mm by 100 mm by 6.35 mm thick steel plates at each end, and where the column supports a wooden beam, the top plate shall extend across the full width of the beam.

(2) The top plate required in Sentence (1) may be omitted where a column supports a steel beam and provision is made for the attachment of the column to the beam.

9.17.3.3. Paint. Steel columns shall be treated on the outside surface with not less than one coat of rust-inhibitive paint.

9.17.3.4. Adjustable Steel Columns. Adjustable steel columns shall conform to CAN/CGSB 7.2-M, "Adjustable Metal Columns."

9.17.4. Wood Columns

9.17.4.1. Column Sizes

(1) The width or diameter of a wood column shall be not less than the width of the supported member.

(2) Except as provided in Article 9.35.4.2., columns shall be not less than 184 mm for round columns and 140 mm by 140 mm for rectangular columns, unless calculations are provided to show that lesser sizes are adequate.

9.17.4.2. Materials

(1) Wood columns shall be either solid, glued-laminated or built-up.

(2) Built-up columns shall consist of not less than 38 mm thick full-length members bolted together with not less than 9.52 mm diam bolts spaced not more than 450 mm o.c., or nailed together with not less than 76 mm nails spaced not more than 300 mm o.c.

(3) Glued-laminated columns shall conform to Section 4.3. (See 9.3.2.3.)

9.17.4.3. Columns in Contact with Concrete. Wood columns shall be separated from concrete in contact with the ground by 0.05 mm polyethylene film or Type S roll roofing.

9.17.5. Unit Masonry Columns

9.17.5.1. Materials. Unit masonry columns shall be built of *loadbearing* masonry units.

9.17.5.2. Sizes. Unit masonry columns shall be not less than 290 mm by 290 mm or 240 mm by 380 mm in size.

9.17.6. Solid Concrete Columns

9.17.6.1. Materials. Concrete shall conform to Section 9.3.

9.17.6.2. Sizes. Concrete columns shall be not less than 200 mm by 200 mm for rectangular columns and 230 mm diam for circular columns.

Section 9.18 Crawl Spaces

9.18.1. General

9.18.1.1. Application. This Section applies to crawl spaces whose exterior walls have less than 25 per cent of their total area above exterior ground level open to the outdoors.

9.18.1.2. Foundations. *Foundations* enclosing crawl spaces shall conform to Section 9.15.

9.18.1.3. Insulation. Insulation shall conform to Section 9.25.

9.18.1.4. Heating. Heating of crawl spaces shall conform to Section 9.33.

9.18.2. Access

9.18.2.1. Access Openings

* **(1)** An access opening of not less than 500 mm by 700 mm shall be provided to each crawl space where the crawl space serves a single *dwelling unit*.

(2) Access openings shall be fitted with a door or hatch, except when the access opening into the crawl space is from the adjacent *basement* and provides ventilation to the crawl space.

9.18.3. Ventilation

9.18.3.1. General. Crawl spaces shall be ventilated by natural or mechanical means.

9.18.3.2. Natural Ventilation. Except as otherwise permitted in Article 9.18.3.5., natural ventilation for crawl spaces shall be provided to the outside air by not less than 0.1 m^2 of unobstructed vent area for every 50 m^2 of floor area.

9.18.3.3. Design of Vents. Vents for crawl spaces shall be designed to prevent the entry of snow, rain and insects, and shall be provided with tight-fitting covers to prevent air leakage in winter if the crawl space is heated.

9.18.3.4. Distribution of Vents. Vents for crawl spaces shall be uniformly distributed on opposite sides of the *building*.

9.18.3.5. Ventilation to the Outside Not Required. Ventilation to the outside air is not required when the crawl space is used as a warm-air *plenum*, or if the crawl space is vented to an adjacent *basement* with an opening conforming to Article 9.18.3.2.

9.18.4. Clearance

9.18.4.1. Ground Clearance. The ground level in a crawl space shall be not less than 300 mm below the level of all joists and beams, except that in localities where termites are known to occur, the clearance shall be not less than 450 mm, unless the joists are pressure treated with a chemical that is toxic to termites.

9.18.4.2. Access Way to Services. Where equipment requiring service such as plumbing cleanouts, traps and burners is located in crawl spaces, an access way with a height and width of not less than 600 mm shall be provided from the access door to the equipment and for a distance of 900 mm on the side or sides of the equipment to be serviced.

9.18.5. Drainage

9.18.5.1. Drainage

(1) Unless *groundwater levels* and site conditions are such that water will not accumulate in the crawl space, the crawl space floor and access trenches shall be sloped to drain to a sewer, ditch or dry well.

(2) Drains shall conform to Section 9.14.

9.18.6. Ground Cover

9.18.6.1. Materials and Installation

(1) Except as required in Sentence (3), a ground cover consisting of not less than 50 mm of asphalt, 10 MPa Portland cement concrete, Type S

roll roofing or 0.10 mm polyethylene shall be provided in every crawl space.

(2) Joints in sheet-type ground cover required in Sentence (1) shall be lapped not less than 100 mm and weighted down.

(3) Where a crawl space serves a *dwelling unit* and is not vented to the outside air, a ground cover consisting of not less than 0.15 mm polyethylene sheet conforming to CAN2-51.34-M, "Vapour Barrier, Polyethylene Sheet, for Use in Building Construction" shall be provided in every crawl space.

(4) Joints in the ground cover required in Sentence (3) shall be lapped not less than 300 mm and weighted down.
(See A-9.13 in Appendix A.)

9.18.7. Fire Protection

9.18.7.1. Crawl Spaces as Warm Air Plenums

(1) Crawl spaces used as warm-air *plenums* in *buildings* of *residential occupancy* shall be restricted to 1-*storey* portions of *dwelling units*.

(2) Enclosing material in crawl spaces described in Sentence (1) including insulation shall have a surface *flame-spread rating* not greater than 150.

(3) *Combustible* ground cover in crawl spaces described in Sentence (1) shall be covered with *noncombustible* material or have *noncombustible* receptacles beneath the register openings.

Section 9.19 Roof Spaces

9.19.1. Ventilation

9.19.1.1. Required Ventilation

(1) Except as provided in Article 9.19.1.2., every roof space or attic above an insulated ceiling shall be ventilated with openings to the exterior to provide unobstructed vent area of not less than 1/300 of the insulated ceiling area.

(2) Vents required in Sentence (1) may be roof type, eave type, gable-end type or any combination thereof, and shall be uniformly distributed on opposite sides of the *building*.

(3) Vents required in Sentence (1) shall be designed to prevent the entry of rain, snow and insects.

(4) The unobstructed vent area required in Sentence (1) shall be determined in conformance with CAN3-A93, "Natural Airflow Ventilators for Buildings."

9.19.1.2. Low Slope Roofs

(1) Where insulation is placed below the roof sheathing in roofs having a slope of less than 1 in 6 or in roofs that are constructed with roof joists, the unobstructed vent area shall be not less than 1/150 of the insulated ceiling area.

(2) Vents described in Sentence (1) shall be uniformly distributed to ventilate each roof space.

9.19.1.3. Cross Purlins

(1) Except as provided in Sentence (2), cross purlins not less than 38 mm by 38 mm shall be applied to the top of the roof joists where the roof does not incorporate an attic space, and the top of the insulation shall be not less than 25 mm below the top of the roof joists.

(2) Cross purlins required by Sentence (1) may be omitted where the roof slope is 1 in 6 or greater provided the roof framing members run in the same direction as the roof slope and a clearance of not less than 75 mm is maintained between the underside of the roof sheathing and the top of the insulation throughout the length of the roof joist.

(3) Vents in roofs described in Sentence (2) shall be distributed so that approximately 50 per cent of the required vent area is located near the lower part of the roof and approximately 50 per cent of the required vent area is near the ridge.

9.19.1.4. Obstruction by Insulation. Ceiling insulation shall be installed in a manner which will not restrict a free flow of air through roof vents or through any portion of the roof space or attic.

9.19.1.5. Mansard or Gambrel Roof

(1) The lower portion of a mansard or gambrel style roof need not be ventilated.

(2) The upper portion of roofs described in Sentence (1) shall be ventilated in conformance with the requirements in Articles 9.19.1.1. to 9.19.1.4., except that not less than 50 per cent of the required

vent opening shall be provided near the junction of the upper and lower portions.

9.19.2. Access

9.19.2.1. Access

* **(1)** Every attic space more than 600 mm in height at the highest point shall be provided with an access stair or shall have a hatchway of not less than 500 mm by 700 mm.

(2) Hatchways to attic spaces shall be fitted with doors or covers.

Section 9.20 Above-Grade Masonry

9.20.1. Scope

9.20.1.1. Application

(1) This Section applies to unreinforced masonry and masonry veneer in which the wall height above the foundation wall does not exceed 11 m, and in which the roof or floor system above the *first storey* is not of concrete construction.

(2) For *buildings* other than described in Sentence (1), or where the masonry is designed on the basis of design loads and allowable stresses, Subsection 4.3.2. shall apply.

4.3.2.1. Design Basis for Plain and Reinforced Masonry. Buildings and their structural members made of plain and reinforced masonry shall conform to CAN3-S304-M, "Masonry Design for Buildings."

9.20.1.3. Earthquake Reinforcement

(1) In velocity- or acceleration-related seismic zones of 4 or greater, *loadbearing* elements of masonry *buildings* more than 1 *storey* in *building height* shall be reinforced with not less than the minimum amount of reinforcement required in Subsection 9.20.15.

(2) In velocity- or acceleration-related seismic zones of 2 and 3, *loadbearing* elements of masonry *buildings* 3 *storeys* in *building height* shall be reinforced with not less than the minimum amount of reinforcement required in Subsection 9.20.15. (See Apendix A.)

A-9.20.1.3.(1) Seismic Zones. Information on seismic zones for various localities can be found in Chapter 1 of the Supplement to the National Building Code 1990.

9.20.2. Masonry Units

9.20.2.1. Masonry Unit Standards

(1) Masonry units shall comply with

(a) CAN/CSA-A82.1, "Burned Clay Brick (Solid Masonry Units Made from Clay or Shale),"

(b) CSA A82.3, "Calcium Silicate (Sand-Lime) Building Brick,"

(c) CSA A82.4, "Structural Clay Load-Bearing Wall Tile,"

(d) CSA A82.5, "Structural Clay Non-Load-Bearing Tile,"

(e) CAN3-A165.1, "Concrete Masonry Units,"

(f) CAN3-A165.2, "Concrete Brick Masonry Units,"

(g) CAN3-A165.3, "Prefaced Concrete Masonry Units,"

(h) CAN3-A165.4, "Autoclaved Cellular Units,"

(i) ASTM C126, "Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units," or

(j) ASTM C212, "Structural Clay Facing Tile."

9.20.2.2. Used Brick. Used bricks shall be free of old mortar, soot or other surface coating and shall conform to Article 9.20.2.1.

9.20.2.3. Glass Blocks. Glass blocks shall not be used as *loadbearing* units or in the construction of fireplaces or *chimneys*.

9.20.2.4. Foamed Concrete. Masonry made with foamed concrete shall not be used in contact with the soil or exposed to the weather.

9.20.2.5. Stone. Stone shall be sound and durable.

9.20.2.6. Concrete Units Exposed to the Weather

(1) *Loadbearing* concrete units or non-*loadbearing* concrete units exposed to the weather shall have

weight and water absorption characteristics conforming to the Classes A, B or C, described in CAN3-A165.1, "Concrete Masonry Units."

(2) Where cellular concrete blocks are used in situations described in Sentence (1), allowance shall be made in the design for the shrinkage characteristics of the units to be used.

9.20.2.7. Compressive Strength. The compressive strength of masonry units shall conform to Table 9.20.2.A.

Table 9.20.2.A.
Forming Part of Article 9.20.2.7.

Compressive Strength of Masonry		
Type of Unit	Minimum Compressive Strength over Net Area, MPa	
	Exposed to Weather	Not Exposed to Weather
Solid or hollow concrete block	15	10
Solid *loadbearing* cellular units	Not permitted	5
Solid non-*loadbearing* cellular units	Not permitted	2
Column 1	2	3

9.20.3. Mortar

9.20.3.1. Mortar Materials

(1) Cementitious materials and aggregates for mortar shall comply with

(a) CAN3-A5, "Portland Cements,"
(b) CAN3-A8, "Masonry Cement,"
(c) CSA A82.22, "Gypsum Plasters,"
(d) CSA A82.56, "Aggregate for Masonry Mortar,"
(e) ASTM C5, "Quicklime for Structural Purposes," or
(f) ASTM C207, "Hydrated Lime for Masonry Purposes."

(2) Water and aggregate shall be clean and free of significant amounts of deleterious materials.

(3) Lime used in mortar shall be hydrated.

(4) If lime putty is used in mortar, it shall be made by slaking quicklime in water for not less than 24 h or soaking hydrated lime in water for not less than 12 h.

9.20.3.2. Mortar Mixes

(1) Except as provided in Sentences (3) and (4), mortar mixes shall conform to Table 9.20.3.A.

(2) Mortar containing portland cement shall not be used later than 2.5 h after mixing.

(3) Mortar for sand-lime brick and concrete brick may consist of 1 part of masonry cement to not less than 3 or not more than 3.5 parts of aggregate by volume in addition to those mixes permitted in Table 9.20.3.A.

(4) Mortar for glass block shall consist of 1 part portland cement, 1 part hydrated lime to not more than 4 parts aggregate by volume.

9.20.4. Mortar Joints

9.20.4.1. Thickness

(1) Maximum average joint thickness shall be 12 mm.

(2) Maximum thickness of an individual joint shall be 20 mm.

9.20.4.2. Solid Masonry Units. Solid masonry units shall be laid will full head and bed joints.

9.20.4.3. Hollow Masonry Units. Hollow masonry units shall be laid with mortar applied to head and bed joints of both inner and outer face shells.

9.20.5. Masonry Support

9.20.5.1. Masonry Support

(1) All masonry shall be supported on masonry, concrete or steel, except that masonry veneer walls may be supported on *foundations* of wood frame constructed in conformance with Sentence 9.15.1.3.(3).

(2) Every masonry wall shall be at least as thick as the wall it supports, except as otherwise permitted in Article 9.20.12.2.

Table 9.20.3.A.
Forming Part of Article 9.20.3.2.

Mortar Mix Proportions (by volume)				
Permissible Use of Mortar	Portland Cement	Masonry Cement	Lime	Aggregate
All locations but not for use with sand-lime or concrete brick	1/2 to 1 1	1 —	— 1/4 to 1/2	
All locations except *foundation* walls and piers, but not for use with sand-lime or concrete brick	— 1	1 —	— 1/2 to 1 1/4	
All locations except *loadbearing* walls of hollow units, parapet walls and *chimneys*	1	—	1 1/4 to 2 1/2	Not less than 2 1/4 and not more than 3 times the sum of the volumes of the cement and the lime
All non-*loadbearing* interior walls and all *loadbearing* walls of solid units, except *foundation* walls, parapet walls and *chimneys*	1 —	— —	2 1/4 to 4 1	
Column 1	2	3	4	5

Table 9.20.5.A.
Forming Part of Sentence 9.20.5.2.(2)

Maximum Allowable Spans for Steel Lintels Supporting Masonry Veneer, m					
Minimum Angle Size, mm			75 mm Brick	90 mm Brick	100 mm Stone
Vertical Leg	Horizontal Leg	Thickness			
90	75	6	2.55	—	—
90	90	6	2.59	2.47	2.30
100	90	6	2.79	2.66	2.48
125	90	8	3.47	3.31	3.08
125	90	10	3.64	3.48	3.24
Column 1	2	3	4	5	6

9.20.5.2. Lintels or Arches

(1) Masonry over openings shall be supported by steel, reinforced concrete or masonry lintels or arches designed to support the imposed load.

(2) Steel angle lintels supporting masonry veneer above openings shall conform to Table 9.20.5.A.

9.20.6. Thickness and Height

9.20.6.1. Thickness of Exterior Walls

(1) Masonry exterior walls, other than cavity walls, in 1-*storey buildings* and the top *storeys* of 2-*storey buildings* shall be not less than 140 mm thick provided the walls are not more than 2.8 m high at the eaves and 4.6 m high at the peaks of gable ends.

(2) The exterior walls of the bottom storeys of 2-*storey buildings* and walls of 3-*storey buildings* shall be not less than 190 mm thick.

(3) In exterior walls composed of more than one wythe, each wythe shall be not less than 90 mm thick.

9.20.6.2. Cavity Walls

(1) Cavity walls shall be made with not less than 90 mm wide units if the joints are raked and not less than 75 mm wide units if the joints are not raked.

(2) The width of a cavity in a cavity wall shall be not less than 50 mm nor greater than 150 mm.

(3) The minimum thickness of cavity walls above the supporting base shall be 230 mm for the top 7.6 m and 330 mm for the remaining portion, except that where 75 mm wide units are used, the wall height above the top of the foundation wall shall not exceed 6 m.

9.20.6.3. Thickness of Interior Walls

(1) The thickness of *loadbearing* interior walls shall be determined on the basis of Article 9.20.10.1.

(2) Interior non-*loadbearing* walls shall be not less than 65 mm thick. (See Article 9.20.10.1.)

9.20.6.4. Masonry Veneer Walls

(1) Masonry veneer resting on a bearing support shall be of solid units not less than 75 mm thick for wall heights up to 11 m.

(2) Veneer described in Sentence (1) over wood-frame walls shall have not less than a 25 mm air space behind the veneer.

(3) Masonry veneer less than 90 mm thick shall have unraked joints.

* **(4)** Masonry veneer individually supported by the back-up material shall conform to the appropriate requirements contained in Subsection 4.3.2. (See 9.20.1.1.(2).)

9.20.6.5. Parapet Walls

(1) The height of parapet walls above the adjacent roof surface shall be not more than 3 times the parapet wall thickness.

(2) Parapet walls shall be solid from the top of the parapet to not less than 300 mm below the adjacent roof level.

9.20.6.6. Facings. Limestone slab facings and * precast concrete panel facings shall conform to the appropriate requirements of Subsection 4.3.2. (See 9.20.1.1.(2).)

9.20.7. Chases and Recesses

9.20.7.1. Maximum Dimensions. Except as permitted in Sentence 9.20.7.2.(2) and Article 9.20.7.4., the depth of any chase or recess shall not exceed one third the thickness of the wall, and the horizontal projection of the chase or recess shall not exceed 500 mm.

9.20.7.2. Minimum Wall Thickness

(1) Except as permitted in Sentence (2) and Article 9.20.7.4., no chase or recess shall be constructed in any wall 190 mm or less in thickness.

(2) Recesses may be constructed in 190 mm walls provided they do not exceed 100 mm in depth and 750 mm in height, and the horizontal projection of the recess does not exceed 500 mm.

9.20.7.3. Separation of Chases or Recesses. Chases and recesses shall be not less than 4 times the wall thickness apart and not less than 600 mm away from any pilaster, cross wall, buttress or other vertical element providing required lateral support for the wall.

9.20.7.4. Non-Conforming Chases or Recesses. Chases or recesses that do not conform to the limits specified in Articles 9.20.7.1. to 9.20.7.3. shall be considered as openings, and any masonry supported above such a chase or recess shall be supported by a lintel or arch.

9.20.7.5. Chases or Recesses Cut into Walls. Chases and recesses shall not be cut into walls made with hollow units after the masonry units are in place.

9.20.8. Support of Loads

9.20.8.1. Capping of Hollow Masonry Walls

(1) Except as permitted in Sentence (2), *loadbearing* walls of hollow masonry units supporting

roof or floor framing members shall be capped with not less than 50 mm of solid masonry or have the top course filled with concrete.

(2) Capping required in Sentence (1) may be omitted where the roof framing is supported on a wood plate not less than 38 mm by 89 mm.

9.20.8.2. Cavity Walls Supporting Framing Members

(1) Floor joists supported on cavity walls shall be supported on solid units not less than 57 mm high.

(2) Floor joists described in Sentence (1) shall not project into the cavity.

(3) Roof and ceiling framing members bearing on cavity walls shall be supported on not less than 57 mm of solid masonry, bridging the full thickness of the wall, or a wood plate not less than 38 mm thick, bearing not less than 50 mm on each wythe.

9.20.8.3. Bearing of Beams and Joists

(1) The bearing area under beams and joists shall be sufficient to carry the supported load.

(2) In no case shall the minimum length of end bearing of beams supported on masonry be less than 90 mm.

(3) The length of end bearing of floor, roof or ceiling joists supported on masonry shall be not less than 40 mm.

9.20.8.4. Support of Beams and Columns

(1) Beams and columns supported on masonry walls shall be supported on pilasters where the thickness of the masonry wall or wythe is less than 190 mm.

(2) Not less than 190 mm depth of solid masonry or concrete shall be provided under the beam or column referred to in Sentence (1).

(3) Pilasters required in Sentence (1) shall be bonded or tied to masonry walls.

(4) Concrete pilasters required in Sentence (1) shall be not less than 50 mm by 300 mm.

(5) Unit masonry pilasters required in Sentence (1) shall be not less than 100 mm by 290 mm.

* **9.20.8.5. Distance to Edge of Supporting Members.** The distance from the face of a wall to the edge of a supporting member attached to the structure, such as a shelf angle or the flange of a beam, shall not exceed 30 mm, except as otherwise permitted in Subsection 4.3.2. (See Sentence 9.20.1.1.(2).)

9.20.9. Bonding and Tying

9.20.9.1. Joints to be Offset or Reinforced

(1) Vertical joints in adjacent masonry courses shall be offset unless each wythe of masonry is reinforced with the equivalent of not less than 2 corrosion-resistant steel bars of 3.76 mm diam placed in the horizontal joints at vertical intervals not exceeding 460 mm.

(2) Where joints in the reinforcing referred to in Sentence (1) occur, the bars shall be lapped not less than 150 mm.

9.20.9.2. Bonding or Ties. Masonry walls that consist of 2 or more wythes shall have the wythes bonded or tied together with masonry bonding units as described in Article 9.20.9.3. or with metal ties as described in Article 9.20.9.4.

9.20.9.3. Bonding with Masonry Units

(1) Where wythes are bonded together with masonry units, the bonding units shall comprise not less than 4 per cent of the wall surface area.

(2) Bonding units described in Sentence (1) shall be spaced not more than 600 mm vertically and horizontally in the case of brick masonry and 900 mm o.c. in the case of block or tile.

(3) Units described in Sentence (1) shall extend not less than 90 mm into adjacent wythes.

9.20.9.4. Bonding with Metal Ties

(1) Where 2 or more wythes are bonded together with metal ties of the individual rod type, the ties shall conform to the requirements in Sentences (2) to (7).

(2) Other metal bonding ties may be used where it can be shown that such ties provide walls that are at least as strong and as durable as those made with the individual rod type.

(3) Metal ties of the individual rod type shall be corrosion-resistant and shall have

(a) a minimum cross-sectional area of not less than 17.8 mm^2, and

(b) not less than a 50 mm portion bent at right angles at each end.

(4) Metal ties of the individual rod type shall
(a) extend from within 25 mm of the outer face of the wall to within 25 mm of the inner face of the wall,
(b) be completely embedded in mortar except for the portion exposed in cavity walls, and
(c) be staggered from course to course.

(5) Where 2 or more wythes in walls other than cavity walls are bonded together with metal ties of the individual rod type, the space between wythes shall be completely filled with mortar.

(6) Ties described in Sentence (5) shall be
(a) located within 300 mm of openings and spaced not more than 900 mm apart around openings, and
(b) spaced not more than 900 mm apart horizontally and 460 mm apart vertically at other locations.

(7) Where the inner and outer wythes of cavity walls are connected with individual wire ties, the ties shall be
(a) spaced not more than 600 mm apart horizontally within 100 mm of the bottom of each floor or roof assembly where the cavity extends below the assemblies,
(b) spaced not more than 900 mm apart within 300 mm of any openings, and
(c) spaced not more than 900 mm apart horizontally and 400 mm apart vertically at other locations.

9.20.9.5. Ties for Masonry Veneer

(1) Masonry veneer 75 mm or more in thickness and resting on a bearing support shall be tied to masonry back-up or to wood framing members with not less than 0.76-mm thick, 22-mm wide corrosion-resistant straps spaced in accordance with Table 9.20.9.A. and shaped to provide a key with the mortar.

* **(2)** Masonry veneer individually supported by masonry or wood-frame back-up shall be secured to the back-up in conformance with Subsection 4.3.2. (See 9.20.1.1.(2).)

Table 9.20.9.A.
Forming Part of Sentence 9.20.9.5.(1)

Veneer Tie Spacing	
Maximum Vertical Spacing, mm	Maximum Horizontal Spacing, mm
400 500 600	800 600 400
Column 1	2

9.20.9.6. Reinforcing for Glass Block

(1) Glass block shall have horizontal joint reinforcement of 2 corrosion-resistant bars of not less than 3.76 mm diam or expanded metal strips not less than 75 mm wide spaced at vertical intervals of not more than 600 mm for units 190 mm or less in height and in every horizontal joint for units higher than 190 mm.

(2) Reinforcement required in Sentence (1) shall be lapped not less than 150 mm.

9.20.10. Lateral Support

9.20.10.1. Lateral Support Required

(1) Masonry walls shall be supported at right angles to the wall by floor or roof construction or by intersecting masonry walls or buttresses.

(2) The maximum spacing of supports required in Sentence (1) shall be
(a) 20 times the wall thickness for all *loadbearing* walls and exterior non-*loadbearing* walls, and
(b) 36 times the wall thickness for interior non-*loadbearing* walls.

(3) In applying Sentence (2), the thickness of cavity walls shall be taken as two-thirds of the sum of the thicknesses of the wythes.

(4) Floor and roof constructions providing lateral support for walls as required in Sentence (1) shall be constructed to transfer lateral loads to walls or buttresses approximately at right angles to the laterally supported walls.

9.20.11. Anchorage of Roofs, Floors and Intersecting Walls

9.20.11.1. Anchorage of Floor or Roof Assemblies

(1) Where required to provide lateral support (see Subsection 9.20.10.), masonry walls shall be anchored to each floor or roof assembly at maximum intervals of 2 m, except that anchorage of floor joists not more than 1 m above *grade* may be omitted.

(2) Anchors required in Sentence (1) shall be corrosion-resistant and be not less than the equivalent of 40 mm by 4.76 mm thick steel straps.

(3) Anchors required in Sentence (1) shall be shaped to provide a mechanical key with the masonry and shall be securely fastened to the horizontal support to develop the full strength of the tie.

(4) When joists are parallel to the wall, anchors required in Sentence (1) shall extend across not less than 3 joists.

9.20.11.2. Anchorage of Intersecting Walls

(1) Where required to provide lateral support, intersecting walls shall be bonded or tied together.

(2) Fifty per cent of the adjacent masonry units in the intersecting wall referred to in Sentence (1) shall be embedded in the laterally supported wall, or corrosion-resistant metal ties equivalent to not less than 4.76 mm by 40 mm steel strapping shall be provided.

(3) Ties required in Sentence (1) shall be spaced not more than 800 mm o.c. vertically and shaped at both ends to provide sufficient mechanical key to develop the strength of the ties.

9.20.11.3. Wood Frame Walls Intersecting Masonry Walls

(1) Wood-frame walls shall be tied to intersecting masonry walls with not less than 4.76 mm diam corrosion-resistant steel rods spaced not more than 900 mm o.c. vertically.

(2) Ties required in Sentence (1) shall be anchored to the wood framing at one end and shaped to provide a mechanical key at the other end to develop the strength of the tie.

9.20.11.4. Wood Frame Roof Systems

(1) Except as permitted in Sentence (2), roof systems of wood-frame construction shall be tied to exterior walls by not less than 12.7 mm diam anchor bolts, spaced not more than 2.4 m apart, embedded not less than 90 mm into the masonry and fastened to a rafter plate of not less than 38 mm thick lumber.

(2) The roof system described in Sentence (1) is permitted to be anchored by nailing the wall furring strips to the side of the rafter plate.

9.20.11.5. Cornices, Sills and Trim. Cornices, sills or other trim of masonry material which project beyond the wall face shall have not less than 65 per cent of their mass, but not less than 90 mm, within the wall or shall be adequately anchored to the wall with corrosion-resistant anchors.

9.20.11.6. Anchor Bolts. Where anchor bolts are to be placed in the top of a pier, the pier shall be capped with concrete or reinforced masonry not less than 300 mm thick.

9.20.12. Corbelling

9.20.12.1. Corbelling

(1) All corbelling shall consist of solid units.

(2) The units referred to in Sentence (1) shall be corbelled so that the horizontal projection of any unit does not exceed 25 mm and the total projection does not exceed one third of the total wall thickness.

9.20.12.2. Corbelling for Cavity Walls

(1) Cavity walls of greater thickness than the foundation wall on which they rest shall not be corbelled but may project 25 mm over the outer face of the foundation wall disregarding parging.

(2) The unit masonry foundation wall referred to in Sentence (1) is permitted to be corbelled to meet flush with the inner face of a cavity wall provided the individual corbel does not exceed half the height or one third the width of the corbelled unit and the total corbel does not exceed one-third of the foundation wall thickness.

9.20.12.3. Corbelling for Masonry Veneer

(1) Masonry veneer resting on a bearing support shall not project more than 25 mm beyond the supporting base where the veneer is not less than 90 mm thick, and 12 mm beyond the supporting base where the veneer is less than 90 mm thick.

(2) In the case of rough stone veneer, the projection, measured as the average projection of the stone units, shall not exceed one-third the bed width beyond the supporting base.

9.20.13. Control of Rain Water Penetration

9.20.13.1. Materials for Exposed Flashing

(1) Exposed flashing shall consist of not less than 1.73 mm sheet lead, 0.33 mm galvanized steel, 0.36 mm copper, 0.46 mm zinc or 0.48 mm thick aluminum.

(2) Aluminum flashing in contact with masonry or concrete shall be effectively coated or separated from the masonry or concrete by an impervious membrane.

9.20.13.2. Materials for Concealed Flashing. Concealed flashing shall consist of not less than 1.73 mm sheet lead, 0.33 mm galvanized steel, 0.36 mm copper, 0.46 mm zinc, Type S roll roofing, 0.15 mm polyethylene or 0.05 mm copper or aluminum laminated to felt or kraft paper.

9.20.13.3. Fastening of Flashing. Fastening devices for flashing shall be corrosion-resistant and compatible with the flashing with respect to galvanic action.

9.20.13.4. Location of Flashing

(1) Flashing shall be installed in masonry and masonry veneer walls

(a) beneath jointed masonry window sills,
(b) over the back and top of parapet walls,
(c) over the heads of glass block panels,
(d) beneath weep holes, and
(e) over the heads of window or door openings in exterior walls when the vertical distance between the top of a window or door trim and the bottom edge of the eave exceeds one-quarter of the horizontal eave overhang.

9.20.13.5. Extension of Flashing. When installed beneath jointed masonry window sills or over the heads of openings, flashing shall extend from the front edge of the masonry up behind the sill or lintel.

9.20.13.6. Flashing for Weep Holes in Cavity Walls

(1) Flashing beneath weep holes in cavity walls shall

(a) be bedded not less than 25 mm in the inside wythe,
(b) extend to not less than 5 mm beyond the outer face of the supporting wall, and
(c) slope toward the outside wythe.

9.20.13.7. Flashing for Weep Holes in Veneer

(1) Flashing beneath weep holes in masonry veneer over wood-frame walls shall be installed so that it extends from a point not less than 5 mm beyond the outer face of the supporting wall to a point 150 mm up behind the sheathing paper.

(2) Flashing described in Sentence (1) is permitted to conform to the requirements for concealed flashing in Article 9.20.13.2.

9.20.13.8. Flashing Joints. Joints in flashing shall be made watertight.

9.20.13.9. Required Weep Holes. Weep holes spaced not more than 800 mm apart shall be provided at the bottom of the cavity in cavity wall and masonry veneer wall construction including the cavities above lintels over window and door openings required to be flashed in conformance with Article 9.20.13.4.

9.20.13.10. Protection of Interior Finish

(1) Except as provided in Sentence (3), where the interior finish of the exterior walls of a building is a type which may be damaged by moisture, exterior masonry walls, other than cavity walls or walls that are protected for their full height by a roof of a carport or porch, shall be covered on the interior surface with sheathing paper conforming to CAN2-

51.32, "Sheathing, Membrane, Breather Type," lapped not less than 100 mm at the joints.

(2) In situations described in Sentence (1), flashing shall be provided where water will accumulate, to lead it to the exterior.

(3) Where insulation that effectively limits the passage of water is applied by a waterproof adhesive or mortar directly to parged masonry, the requirements for sheathing paper in Sentence (1) do not apply. (See Appendix A.)

A-9.20.13.10.(3) Damproofing of Masonry Walls. The reason for installing sheathing paper behind masonry walls is to prevent rainwater from reaching the interior finish if it should leak past the masonry. The sheathing paper intercepts the rainwater and leads it to the bottom of the wall where the flashing directs it to the exterior via weep holes. If the insulation is a type that effectively resists the penetration of water, and is installed so that water will not collect behind it, then there is no need for sheathing paper. If water that runs down between the masonry and the insulation is able to leak out at the joints in the insulation, such insulation will not act as a substitute for sheathing paper. If water cannot leak through the joints in the insulation but collects in cavities between the masonry and insulation, subsequent freezing could damage the wall. Where sheathing paper is not used, therefore, the adhesive or mortar should be applied to form a continuous bond between the masonry and the insulation. If this is not practicable because of an irregular masonry surface, then sheathing paper is necessary. (See Article 9.25.5.2. for vapour barriers with foamed plastic insulation.)

9.20.13.11. Mortar Droppings. Cavity walls shall be constructed so that mortar droppings are prevented from forming a bridge to allow the passage of rain water across the cavity.

9.20.13.12. Caulking at Door and Window Frames. The junction of door and window frames with masonry shall be caulked in conformance with Subsection 9.27.4.

9.20.13.13. Drips beneath Window Sills. Where no flashing is installed beneath window sills, such sills shall be provided with a drip not less than 25 mm from the wall surface.

9.20.14. Protection

9.20.14.1. Laying Temperature of Mortar and Masonry

(1) Mortar and masonry shall be maintained at a temperature not below 5°C during installation and for not less than 48 h after installation.

(2) No frozen material shall be used in mortar mix.

9.20.14.2. Protection from Weather. The top surface of uncompleted masonry exposed to the weather shall be completely covered with a waterproofing material when construction is not in progress.

9.20.15. Reinforcement for Earthquake Resistance

9.20.15.1. Amount of Reinforcement. Where reinforcement is required in this Section, masonry walls shall be reinforced horizontally and vertically with steel having a total cross-sectional area of not less than 0.002 times the cross-sectional area of the wall, so that not less than one-third of the required steel area is installed either horizontally or vertically and the remainder in the other direction.

9.20.15.2. Installation Standard. Where reinforcement for masonry is required in this Section, it shall be installed in conformance with the requirements for reinforced masonry as contained in CAN3-A371, "Masonry Construction for Buildings."

9.20.16. Corrosion Resistance

9.20.16.1. Carbon steel connectors required to be corrosion-resistant shall be galvanized to at least the minimum standards in Table 9.20.16.A.

Table 9.20.16.A.
Forming Part of Article 9.20.16.1.

Minimum Requirements for Galvanizing		
Connector Material	ASTM Standard	Coating Class
Wire ties and continous reinforcing (hot-dipped galvanizing)	A153	Class B2 458 g/m^2
Hardware and bolts	A153	See A153
Strip, plate, bars and rolled sections (not less than 3.18 mm thick)	A123	610 g/m^2
Sheet (less than 3.18 mm thick)	A123	305 g/m^2 on material 0.76 mm thick [1]
Column 1	2	3

Note to Table 9.20.16.A.:

[1] ASTM A123 does not apply to metal less than 3.18 mm thick. Galvanizing coatings may be interpolated for thicknesses between 3.18 mm and 0.76 mm.

Section 9.21 Chimneys and Flues

9.21.1. General

* **9.21.1.1. Application.** Except when otherwise specifically stated herein, this Section applies to rectangular *chimneys* of brick masonry or concrete not more than 12 m in height and to *flue pipes* serving *appliances* regulated by Article 9.33.1.2.

9.21.1.2. Factory-Built Chimneys. *Factory-built chimneys* serving solid fuel-burning *appliances*, and their installation, shall conform to CAN/ULC-S629, "Standard for 650°C Factory-Built Chimneys." (See Appendix A.)

A-9.21.1.2. Factory-Built Chimneys. Under the provisions of Section 2.5, certain solid-fuel burning appliances may be connected to factory-built chimneys other than those specified in Article 9.21.1.2. if tests show that the use of such a chimney will provide an equivalent level of safety.

9.21.1.3. Chimneys, Gas Vents or Flue Pipes

(1) Except as provided in Sentence (2), *chimneys* (other than those described in Articles 9.21.1.1. and 9.21.1.2.), *gas vents* and *flue pipes* serving gas- oil- or solid-fuel burning *appliances* and associated equipment shall conform to Section 6.3. (The appropriate parts of Section 6.3 are reproduced in Section 9.33.)

(2) *Flue pipes* serving solid-fuel burning *stoves*, *ranges* and *space heaters* shall conform to the requirements of CAN3-B365, "Installation Code for Solid-Fuel Burning Appliances and Equipment."

9.21.1.4. Chimney or Flue Pipe Walls. The walls of any *chimney* or *flue pipe* shall be constructed to be smoke- and flame-tight.

9.21.2. Chimney Flues

9.21.2.1. Chimney Flue Limitation. A *chimney flue* serving a fireplace or incinerator shall not serve any other *appliance*.

9.21.2.2. Connections of More Than One Appliance

(1) Except as required in Article 9.21.2.1., 2 or more fuel-burning *appliances* may be connected to the same *chimney flue* provided adequate draft is maintained for the connected *appliances* and the connections are made as described in Sentences (2) and (3).

(2) Where 2 or more fuel-burning *appliances* are connected to the same *chimney flue*, the *appliances* must be located on the same *storey*.

(3) The connection referred to in Sentence (2) for a solid-fuel burning *appliance* shall be below connections for *appliances* burning other fuels.

9.21.2.3. Inclined Chimney Flues. *Chimney flues* shall not be inclined more than 45° to the vertical.

9.21.2.4. Size of Chimney Flues

(1) Except for *chimneys* serving fireplaces, the size of a *chimney flue* shall conform to the require-

ments of the *appliance* installation standards referenced in Sentence 6.2.1.4.(1) and Article 9.33.1.2. (Sentence 6.2.1.4.(1) is reproduced in Section 9.33.)

(2) Where a *chimney flue* serves only one *appliance*, the *flue* area shall be at least equal to that of the *flue pipe* connected to it.

9.21.2.5. Fireplace Chimneys. The minimum size of a *chimney flue* serving a masonry fireplace shall conform to Table 9.21.2.A. or Table 9.21.2.B.

9.21.2.6. Oval Chimney Flues. The width of an oval *chimney flue* shall be not less than two-thirds its breadth.

9.21.3. Chimney Lining

9.21.3.1. Lining Materials. Every *masonry or concrete chimney* shall have a lining of clay, concrete, firebrick or metal.

Table 9.21.2.A.
Forming Part of Article 9.21.2.5.

Diameter of Round Flues for Fireplace Chimneys, mm				
Maximum Fireplace Opening, m^2	*Chimney* Height, m			
	3.0	4.6	6.0	9.0
0.15	140	128	124	116
0.25	181	164	156	145
0.35	212	193	184	171
0.50	253	229	218	202
0.65	287	260	247	227
0.80	318	290	273	251
1.0	356	321	303	279
1.2	388	352	331	304
1.4	419	380	358	328
1.6	448	405	382	349
1.8	–	430	404	371
2.0	–	–	425	390
2.2	–	–	–	407
Column 1	2	3	4	5

Table 9.21.2.B.
Forming Part of Article 9.21.2.5.

Nominal Rectangular Flue Sizes for Fireplace Chimneys, mm				
Maximum Fireplace Opening, m^2	*Chimney* Height, m			
	3.0	4.6	6.0	9.0
0.15	200 × 200	200 × 200	200 × 200	200 × 200
0.25	200 × 300	200 × 200	200 × 200	200 × 200
0.35	200 × 300	200 × 300	200 × 300	200 × 200
0.50	300 × 300	300 × 300	300 × 300	200 × 300
0.65	300 × 400	300 × 300	300 × 300	300 × 300
0.80	400 × 400	300 × 400	300 × 400	300 × 300
1.0	400 × 400	400 × 400	300 × 400	300 × 400
1.2	—	400 × 400	400 × 400	300 × 400
1.4	—	—	400 × 400	400 × 400
1.6	—	—	—	400 × 400
1.8	—	—	—	—
2.0	—	—	—	—
2.2	—	—	—	—
Column 1	2	3	4	5

9.21.3.2. Joints in Chimney Liners

(1) Joints of *chimney liners* shall be sealed to provide a barrier to the passage of flue gases and condensate into the cavity between the liner and the surrounding masonry.

(2) Joints of clay, concrete or firebrick *chimney liners* shall be struck flush to provide a straight, smooth, aligned *chimney flue*.

9.21.3.3. Clay Liners

(1) Clay liners shall conform to ASTM C315, "Clay Flue Linings."

(2) Liners referred to in Sentence (1) shall be not less than 15.9 mm thick and shall be capable of resisting, without softening or cracking, a temperature of 1 100°C.

9.21.3.4. Firebrick Liners. Firebrick liners shall conform to ASTM C27, "Classification of Fireclay and High Alumina Refractory Brick" and shall be laid with high temperature cement mortar conforming to CGSB 10-GP-3Ma, "Refractory Mortar, Air Setting."

9.21.3.5. Concrete Liners. Concrete flue liners shall conform to Clause 4.2.6.4. of CAN/CSA-A405, "Design and Construction of Masonry Chimneys and Fireplaces."

9.21.3.6. Metal Liners

(1) Metal liners shall be constructed of not less than 0.3 mm thick stainless steel.

(2) Metal liners referred to in Sentence (1) shall only be used in *chimneys* serving gas-, or oil-burning *appliances*. (See Appendix A.)

A-9.21.3.6. Metal Chimney Liners. Under the provisions of Section 2.5, masonry chimneys with metal liners may be permitted to serve solid fuel-burning appliances if tests show that such liners will provide an equivalent level of safety.

9.21.3.7. Installation of Chimney Liners. *Chimney liners* shall be installed when the surrounding masonry or concrete is placed.

9.21.3.8. Spaces between Liners and Surrounding Masonry

(1) Spaces between the liner and surrounding masonry shall not be filled with mortar where the *chimney* walls are less than 190 mm thick.

(2) A space not less than 10 mm wide shall be left between a liner and the surrounding masonry.

9.21.3.9. Mortar for Chimney Liners

(1) *Chimney liners* used in *chimneys* for solid-fuel burning *appliances* shall be laid in a full bed of

(a) high temperature cement mortar conforming to CGSB 10-GP-3Ma, "Refractory Mortar, Air Setting," or

(b) mortar consisting of 1 part Portland cement to 3 parts sand by volume.

(2) *Chimney liners* used in *chimneys* for oil- or gas-burning *appliances* shall be laid in a full bed of mortar consisting of 1 part Portland cement to 3 parts sand by volume.

9.21.3.10. Extension of Chimney Liners. *Chimney liners* shall extend from a point not less than 200 mm below the lowest *flue pipe* connection to a point not less than 50 mm or more than 100 mm above the *chimney* cap.

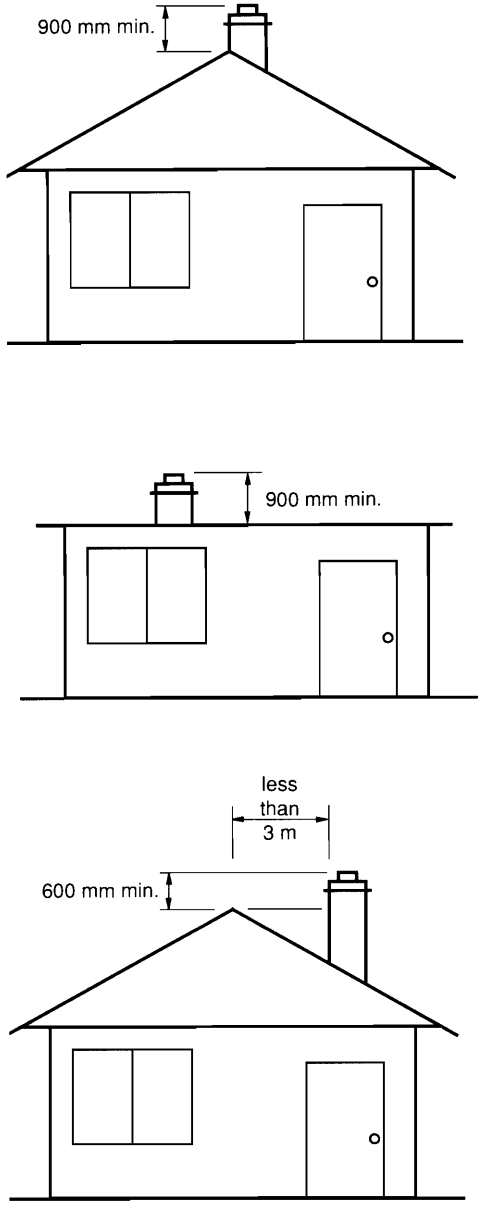
9.21.4. Masonry and Concrete Chimney Construction

9.21.4.1. Unit Masonry. Unit masonry shall conform to Section 9.20.

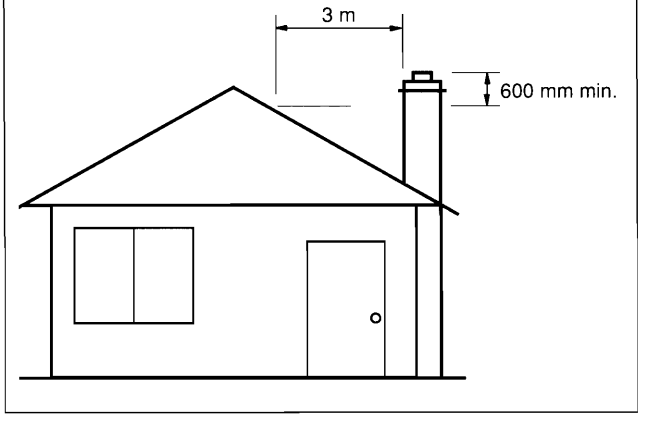
9.21.4.2. Concrete. Concrete shall conform to Section 9.3.

9.21.4.3. Footings. Footings for *masonry chimneys* and *concrete chimneys* shall conform to the requirements in Section 9.15.

9.21.4.4. Height of Chimney Flues. A *chimney flue* shall extend not less than 900 mm above the highest point at which the *chimney* comes in contact with the roof, and not less than 600 mm above the highest roof surface or structure within 3 m of the *chimney*. (See Appendix A.)



A-9.21.4.4. Location of Chimney Top.



9.21.4.5. Lateral Stability. *Chimneys* shall be braced when necessary to provide lateral stability. (See Appendix A.)

A-9.21.4.5. Lateral Support for Chimneys. The following information is from CAN/CSA-A405.

(1) Engineering calculations show that free-standing chimneys constructed with Type N mortar and with least dimension not less than 400 mm can extend to a height of 3.6 m.

(2) The number of flues contained within the same stack does not affect the height given in (1).

(3) The height shall be taken from the last point of lateral support for the chimney. For example,

(a) on frame construction of interior chimneys, the height measurement is taken from the bottom of the lowest flue liner;

(b) in solid or brick veneer construction, the height measurement is taken from the point where the chimney stack leaves the masonry which forms part of the exterior wall.

(4) Where a chimney is fastened to the house framing with metal anchors, in accordance with CSA Standard CAN3-A370 "Connectors for Masonry," it shall be considered to have adequate lateral support. The portion of the chimney stack above the roof shall be considered as free standing.

9.21.4.6. Chimney Caps

(1) The top of a *chimney* shall have a waterproof cap of reinforced concrete, masonry or metal.

(2) The cap required in Sentence (1) shall slope from the lining and be provided with a drip not less than 25 mm from the *chimney* wall.

(3) Cast-in-place concrete caps shall be separated from the *chimney liner* by a bond break and be sealed at that location.

(4) Jointed precast concrete or masonry *chimney* caps shall have flashing installed beneath the cap extending from the liner to the drip edge.

9.21.4.7. Cleanout. A cleanout opening with a metal frame and a tight-fitting metal door shall be installed near the base of the *chimney flue*.

9.21.4.8. Wall Thickness. The walls of a *masonry chimney* shall be built of solid units not less than 75 mm thick.

9.21.4.9. Separation of Flue Liners

(1) *Flue* liners in the same *chimney* shall be separated by not less than 75 mm of masonry or concrete exclusive of liners where clay liners are used, or 90 mm of firebrick where firebrick liners are used.

(2) *Flue* liners referred to in Sentence (1) shall be installed to prevent significant lateral movement.

9.21.4.10. Flashing. Junctions with adjacent materials shall be adequately flashed to shed water.

9.21.5. Clearance from Combustible Construction

9.21.5.1. Clearance from Combustible Materials

(1) The clearance between *masonry or concrete chimneys* and *combustible* framing shall be not less than 50 mm for interior *chimneys* and 12 mm for exterior *chimneys*.

(2) A clearance of not less than 150 mm shall be provided between a cleanout opening and *combustible* material.

(3) Flooring shall have not less than a 12 mm clearance from *masonry or concrete chimneys*.

9.21.5.2. Sealing of Spaces. All spaces between *masonry or concrete chimneys* and *combustible* framing shall be sealed top or bottom with *noncombustible* material.

9.21.5.3. Support of Joists or Beams. Joists or beams may be supported on masonry walls which enclose *chimney flues* provided the *combustible* members are separated from the *flue* by not less than 290 mm of solid masonry.

Section 9.22 Fireplaces

9.22.1. General

9.22.1.1. Application. Except when otherwise specifically stated herein, this Section applies to masonry fireplaces constructed on-site.

9.22.1.2. Masonry and Concrete. Except as otherwise stated in this Section, unit masonry shall conform to Section 9.20 and concrete to Section 9.3.

9.22.1.3. Footings. Footings for masonry and concrete fireplaces shall conform to Section 9.15.

9.22.1.4. Combustion Air. Fireplaces, including factory-built fireplaces, shall have a supply of combustion air. (See Appendix A.)

A-9.22.1.4. Combustion Air for Fireplaces. The intent of this Article is to allow the fireplace to be operated without affecting, or being affected by, other appliances or exhaust equipment. For this to occur, the fireplace must be provided with a supply of combustion air dedicated to the fireplace only; an opening to the exterior should be provided at or near the fireplace opening. The opening of a window is not considered to be sufficient, as discomfort from drafts is likely to inhibit its use. Factory built fireplaces should have combustion air provided in accordance with manufacturers' installation instructions. In the case of site-built masonry fireplaces, this Article will be satisfied if the following procedures are followed:

(1) The combustion air in Article 9.22.1.4. is supplied by a duct having a minimum diameter of 100 mm or equivalent area.

(2) The air supply duct is noncombustible, corrosion–resistant and, where exposed to room air, insulated for its entire length with insulation having a thermal resistance value of RSI 1.41.
(3) The air supply outlet is located as close to the fireplace opening as possible.
(4) When the air supply outlet is placed inside the fire chamber, it is located at the front centre of the chamber hearth and is equipped with a noncombustible hood which when open will direct air away from the fire, and designed to prevent embers from entering the supply duct.
(5) The supply duct contains a damper that fits tightly when in the closed position and is located close to the outlet end.
(6) The damper is operable from the room containing the fireplace and the control mechanism clearly indicates the actual position of the damper.
(7) Any portion of the air supply duct within 1 m of its outlet in the fire chamber has a minimum 50 mm clearance from combustibles.
(8) The exterior air supply duct is protected against the entry of rain and direct wind and the inlet opening has an insect screen of corrosion–resistant material.
(9) The exterior air supply duct inlet is located to avoid being blocked by either snow or fallen leaves.

9.22.2. Fireplace Liners

9.22.2.1. Fireplace Liners. Except where a fireplace is equipped with a steel liner, every fireplace shall have a firebrick liner not less than 50 mm thick for the sides and back and not less than 25 mm thick for the floor.

9.22.2.2. Firebrick Liners

(1) Firebrick liners shall be laid with high temperature cement mortar conforming to CGSB 10-GP-3Ma, "Refractory Mortar, Air Setting."

(2) Joints between a firebrick liner and the adjacent back-up masonry shall be offset.

9.22.2.3. Steel Liners. Steel liners for fireplaces shall conform to CAN/ULC-S639M, "Standard for Steel Liner Assemblies for Solid-Fuel Burning Masonry Fireplaces," and shall be installed in accordance with the installation instructions required by that Standard.

9.22.3. Wall Thickness

9.22.3.1. Thickness of Walls

(1) Except as provided in Sentences (2) and (3), the back and sides of a fireplace shall be not less than 190 mm thick where a metal liner or a 50 mm thick firebrick liner is used, including the thickness of the masonry liner.

(2) Portions of the back exposed to the outside may be 140 mm thick.

(3) When a steel fireplace liner is used with an air circulating chamber surrounding the firebox, the back and sides of the fireplace shall consist of not less than 90 mm thickness of solid masonry units or 190 mm thickness of hollow masonry units.

9.22.4. Openings

9.22.4.1. Masonry above openings shall be supported by steel lintels conforming to Sentence 9.20.5.2.(2), reinforced concrete or a masonry arch.

9.22.5. Hearth

9.22.5.1. Hearth Extension

(1) Except as required in Sentence (2), fireplaces shall have a *noncombustible* hearth extending not less than 400 mm in front of the fireplace opening and not less than 200 mm beyond each side of the fireplace opening.

(2) Where the hearth floor is elevated more than 150 mm above the hearth extension, the width of the hearth extension shall be increased by
(a) 50 mm for an elevation above 150 mm and not more than 300 mm, and
(b) an additional 25 mm for every 50 mm in elevation above 300 mm.

9.22.5.2. Support of Hearth

(1) Except as permitted in Sentence (2), the hearth shall be supported on not less than a 140 mm thick trimmer arch of solid masonry units or not less than a 100 mm thick reinforced concrete trimmer.

(2) A hearth extension for a fireplace with an opening raised not less than 200 mm from a combustible floor is permitted to to be placed on that floor provided the requirements of Clauses 5.3.6.5. to 5.3.6.7. of CAN/CSA-A405, "Design and Construction of Masonry Chimneys and Fireplaces" are followed.

9.22.6. Damper

9.22.6.1. The throat of every fireplace shall be equipped with a metal damper sufficiently large to cover the full area of the throat opening.

9.22.7. Smoke Chamber

9.22.7.1. Slope of Smoke Chamber. The sides of the smoke chamber connecting a fireplace throat with a *flue* shall not be sloped at an angle greater than 45° to the vertical.

9.22.7.2. Wall Thickness. The thickness of masonry walls surrounding the smoke chamber shall be not less than 190 mm at the sides, front and back, except that the portions of the back exposed to the outside may be 140 mm thick.

9.22.8. Factory-Built Fireplaces

9.22.8.1. Factory-built fireplaces and their installation shall conform to CAN/ULC S610, "Standard for Factory-Built Fireplaces."

9.22.9. Clearance of Combustible Material

9.22.9.1. Clearance to the Fireplace Opening. *Combustible* material shall not be placed on or near the face of a fireplace within 150 mm of the fireplace opening, except that where the *combustible* material projects more than 38 mm out from the face of the fireplace above the opening, such material shall be not less than 300 mm above the top of the opening.

9.22.9.2. Metal Exposed to the Interior. Metal exposed to the interior of a fireplace such as the damper control mechanism shall have not less than a 50 mm clearance from any *combustible* material on the face of the fireplace where such metal penetrates through the face of the fireplace.

9.22.9.3. Clearance to Combustible Framing

(1) Not less than a 100 mm clearance shall be provided between the back and sides of a fireplace and *combustible* framing, except that a 50 mm clearance is permitted where the fireplace is located in an exterior wall.

(2) Not less than a 50 mm clearance shall be provided between the back and sides of the smoke chamber of a fireplace and *combustible* framing, except that a 25 mm clearance is permitted where the fireplace is located in an exterior wall.

9.22.9.4. Heat Circulating Duct Openings

(1) The clearance of *combustible* material above heat-circulating duct openings from those openings shall be not less than

(a) 300 mm where the *combustible* material projects not less than 38 mm from the face, and

(b) 150 mm where the projection is less than 38 mm.

9.22.10. Fireplace Inserts

9.22.10.1. The installation of fireplace inserts shall conform to CAN3-B365, "Installation Code for Solid-Fuel Burning Appliances and Equipment."

Section 9.23 Wood-Frame Construction

9.23.1. Scope

9.23.1.1. Application

(1) This Section applies to conventional wood-frame construction in which the framing members are spaced not more than 600 mm o.c.

9.23.1.2. Post, Beam and Plank Construction. Post, beam and plank construction and plank frame wall construction shall conform to Article 9.4.1.2.

9.23.2. General

9.23.2.1. Strength and Rigidity. All members shall be so framed, anchored, fastened, tied and braced to provide the necessary strength and rigidity.

9.23.2.2. Protection from Decay

(1) Ends of wood joists, beams and other members framing into masonry or concrete shall be treated to prevent decay where the bottom of the member is at or below ground level, or a 12 mm air space shall be provided at the end and sides of the member.

(2) Air spaces required in Sentence (1) shall not be blocked by insulation, vapour barriers or air barriers.

9.23.2.3. Protection from Dampness

(1) Except as permitted in Sentence (2), wood framing members that are not pressure treated with a wood preservative and which are supported on concrete in contact with the ground or fill shall be separated from the concrete by not less than 0.05 mm polyethylene film or Type S roll roofing.

(2) Dampproofing material referred to in Sentence (1) is not required where the wood member is at least 150 mm above the ground.

9.23.2.4. Lumber. Lumber shall conform to the appropriate requirements in Subsection 9.3.2.

9.23.3. Nails and Staples

9.23.3.1. Standard for Nails. Nails specified in this Section shall be common steel wire nails or common spiral nails, conforming to CSA B111, "Wire Nails, Spikes and Staples" unless otherwise indicated.

9.23.3.2. Length of Nails. All nails shall be long enough so that not less than half their length penetrates into the second member.

9.23.3.3. Prevention of Splitting. Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from the edges.

9.23.3.4. Nailing of Framing

(1) Except as provided in Sentence (2), nailing of framing shall conform to Table 9.23.3.A.

(2) Where the bottom wall plate or sole plate of an exterior wall is not nailed to joists or blocking in conformance with Table 9.23.3.A., the exterior wall may be fastened to the floor framing by

(a) having plywood, waferboard or strandboard sheathing extend down over floor framing and fastened to the floor framing by nails or staples conforming to Article 9.23.3.5., or

(b) tying the wall framing to the floor framing by 50 mm wide galvanized-metal strips of not less than 0.41 mm in thickness, spaced not more than 1.2 m apart, and fastened at each end with not less than two 63 mm nails.

9.23.3.5. Fasteners for Sheathing or Subflooring

(1) Fastening of sheathing and subflooring shall conform to Table 9.23.3.B.

(2) Staples shall not be less than 1.6 mm in diameter or thickness, with not less than a 9.5 mm crown driven with the crown parallel to framing.

(3) Roofing nails for the attachment of fibreboard or gypsum sheathing shall not be less than 3.2 mm in diameter with a minimum head diameter of 11.1 mm.

9.23.4. Allowable Spans

9.23.4.1. Spans for Joists, Rafters and Beams

(1) Except as required in Sentence (2), spans for wood joists, rafters and beams shall conform to the spans shown in Tables A-1 to A-9 for the uniform *live loads* shown in the tables. (See Appendix A.)

A-9.23.4.1.(1) Span Tables for Wood Joists and Rafters. In these span tables the term "rafter" refers to a sloping wood framing

Table 9.23.3.A.
Forming Part of Article 9.23.3.4.

Nailing for Framing		
Construction Detail	Minimum Length of Nails, mm	Minimum Number or Maximum Spacing of Nails
Floor joist to plate — toe nail	82	2
Wood or metal strapping to underside of floor joists	57	2
Cross bridging to joists	57	2 each end
Double header or trimmer joists	76	300 mm (o.c.)
Floor joist to stud (balloon construction)	76	2
Ledger strip to wood beam	82	2 per joist
Joist to joist splice (see also Table 9.23.13.A)	76	2 at each end
Tail joist to adjacent header joist	82	5
(end nailed) around openings	101	3
Each header joist to adjacent trimmer joist	82	5
(end nailed) around openings	101	3
Stud to wall plate (each end) toe nail	63	4
or end nail	82	2
Doubled studs at openings, or studs at walls or wall intersections and corners	76	750 mm (o.c.)
Doubled top wall plates	76	600 mm (o.c.)
Bottom wall plate or sole plate to joists or blocking (exterior walls) [1]	82	400 mm (o.c.)
Interior walls to framing or subflooring	82	600 mm (o.c.)
Horizontal member over openings in non-*loadbearing* walls — each end	82	2
Lintels to studs	82	2 at each end
Ceiling joist to plate — toe nail each end	82	2
Roof rafter, roof truss or roof joist to plate — toe nail	82	3
Rafter plate to each ceiling joist	101	2
Rafter to joist (with ridge supported)	76	3
Rafter to joist (with ridge unsupported)	76	see Table 9.23.13.A.
Gusset plate to each rafter at peak	57	4
Rafter to ridge board — toe nail	57	4
— end nail	82	3
Collar tie to rafter — each end	76	3
Collar tie lateral support to each collar tie	57	2
Jack rafter to hip or valley rafter	82	2
Roof strut to rafter	76	3
Roof strut to *loadbearing* wall — toe nail	82	2
38 mm x 140 mm or less plank decking to support	82	2
Plank decking wider than 38 mm x 140 mm to support	82	3
38 mm edge laid plank decking to support (toe nail)	76	1
38 mm edge laid plank to each other	76	450 mm (o.c.)
Column 1	2	3

Note to Table 9.23.3.A.:
[1] See Sentence 9.23.3.4.(2)

member which supports the roof sheathing and encloses an attic space but does not support a ceiling. The term "roof joist" refers to a horizontal or sloping wood framing member that supports the roof sheathing and the ceiling finish but does not enclose an attic space.

Where rafters or roof joists are intended for use in a locality having a higher design roof snow load than shown in the tables, the maximum member spacing may be calculated as the product of the member spacing and snow load shown in the span tables divided by the design snow load for the locality being considered. The following are examples of how this principle can be applied:

(1) For a 3.0 kPa design snow load, use spans for 1.5 kPa and 600 mm o.c. spacing but space

Table 9.23.3.B.
Forming Part of Article 9.23.3.5.

Fasteners for Sheathing and Subflooring

Element	Minimum Length of Fasteners for Sheathing and Subfloor Attachment, mm				Minimum Number or Maximum Spacing of Fastener
	Common or Spiral Nails	Ring Thread Nails	Roofing Nails	Staples	
Plywood, waferboard or strandboard up to 10 mm thick	51	45	N/A	38	150 mm (o.c.) along edges and 300 mm (o.c.) along intermediate supports
Plywood, waferboard or strandboard from 10 mm to 20 mm thick	51	45	N/A	51	
Plywood, waferboard or strandboard over 20 mm thick	57	51	N/A	N/A	
Fibreboard sheathing up to 13 mm thick	N/A	N/A	44	28	
Gypsum sheathing up to 13 mm thick	N/A	N/A	44	N/A	
Board lumber 184 mm or less wide	51	45	N/A	51	2 per support
Board lumber more than 184 mm wide	51	45	N/A	51	3 per support
Column 1	2	3	4	5	6

members 300 mm o.c., or use spans for 2.0 kPa and 600 mm o.c. spacing but space members 400 mm o.c.

(2) For a 3.5 kPa design snow load, use spans for 2.5 kPa and 600 mm o.c. spacing but space members 400 mm o.c.

(3) For a 4.0 kPa design snow load, use spans for 2.0 kPa and 600 mm o.c. spacing but space members 300 mm o.c.

The allowable spans in the span tables are measured from the face or edge of support to the face or edge of support.

In the case of sloping roof framing members, the spans are expressed in terms of the horizontal distance between supports rather than the length of the sloping member. The snow loads are also expressed in terms of the horizontal projection of the sloping roof. Spans for odd size lumber may be estimated by straight line interpolation in the tables.

These span tables may be used where members support a uniform live load only. Where the members are required to be designed to support a concentrated load, they must be designed in conformance with Subsection 4.3.1.

Supported joist length in Tables A-8 and A-9 means half the sum of the joist spans on both sides of the beam. For supported joist lengths between those shown in the tables, straight line interpolation may be used in determining the maximum beam span.

Spans for wood joists, rafters and beams which fall outside the scope of these tables, including those for U.S. species and individual species not marketed in the commercial species combinations described in the span tables, can be calculated in conformance with CAN3-O86, "Code for the Engineering Design of Wood."

(2) Spans for floor joists which are not selected from Tables A-1 and A-2 and which are required to be designed for the same loading conditions, shall not exceed the design requirements for uniform loading and vibration criteria. (See Appendix A.)

9.23.4.2. Steel Beams

(1) The spans for steel beams with laterally supported top flanges that support floors in 1- and 2-*storey* houses shall conform to Table 9.23.4.A. (See Appendix A.)

A-9.23.4.2.(1) Maximum Spans for Steel Beams Supporting Floors in Dwellings. A beam may be considered to be laterally supported if wood joists bear on its top flange at intervals of 600 mm or less over its entire length, if all the load being applied to this beam is transmitted through the joists and if 19 mm by 38 mm wood strips in contact with the top flange are nailed on both sides of the beam to the bottom of the joists supported. Other additional methods of positive lateral support are acceptable.

For supported joist lengths intermediate between those in the table, straightline interpolation may be used in determining the maximum beam span.

A-9.23.4.A. Spans for Steel Beams. The spans are based on the following assumptions:

(1) Simply supported beam spans

(2) Laterally supported top flange

(3) Yield strength 300 MPa

(4) Deflection limit L/360

(5) Live load = 1.9 kPa/1st floor, 1.4 kPa/2nd floor

(6) Dead load 1.5 kPa.

(2) Beams described in Sentence (1) shall at least meet the requirements for Grade 300 W steel in CAN/CSA-G40.21, "Structural Quality Steels."

9.23.4.3. Glued-Laminated Beams

(1) The spans for glued-laminated beams that support floors in 1- and 2-*storey* houses shall conform to Table 9.23.4.B.

(2) Beams described in Sentence (1) shall conform to 20 f-E stress grade in CSA O122, "Glued–Laminated Timber" and to Article 4.3.1.2.

9.23.4.5. Concrete Topping. Where a floor is required to support a concrete topping, the spans shown in Tables A-2 and A-3 or the spacing of the members shall be reduced to allow for the loads due to the topping. (See Appendix A.)

A-9.23.4.5. Concrete Topping. Spans given in Tables A-1 and A-2 were based on an assumed dead load for conventional wood frame floor construction. The addition of 50 mm of concrete topping can impose an additional dead load of about 0.8 to 1.2 kPa, depending on the density of the concrete. The spacing of joists in the span tables can be adjusted to allow for the increased load in accordance with the following example: for a topping dead load of 0.80 kPa on floor joists for living quarters, live load plus dead load becomes 2.7 kPa. Use spans for 1.9 kPa and 600 mm spacing but space members 400 mm apart.

Spans for floor joists in living quarters are based on a live load of 1.9 kPa. Spans for floor joists in bedrooms are based on a live load of 1.4 kPa.

Table 9.23.4.A.[1]
Forming Part of Sentence 9.23.4.2.(1)

Maximum Spans for Steel Beams Supporting Floors in Dwelling Units, m							
One *Storey* Supported							
	Supported Joist Length, m (Half the sum of joist spans on both sides of the beam)						
Section	2.4	3.0	3.6	4.2	4.8	5.4	6.0
W150 × 22	5.5	5.2	4.9	4.8	4.5	4.3	4.1
W200 × 21	6.5	6.2	5.7	5.3	5.0	4.7	4.5
W200 × 27	7.3	6.9	6.6	6.3	6.1	5.8	5.5
W200 × 31	7.8	7.4	7.1	6.8	6.6	6.4	6.1
W250 × 24	8.1	7.5	6.9	6.4	6.0	5.7	5.4
W250 × 33	9.2	8.7	8.3	8.0	7.6	7.2	6.9
W250 × 39	10.0	9.4	9.0	8.6	8.3	8.0	7.6
W310 × 31	10.4	9.6	8.8	8.2	7.7	7.3	7.0
W310 × 39	11.3	10.7	10.2	9.8	9.2	8.7	8.3
Two *Storeys* Supported							
W150 × 22	4.7	4.2	3.9	3.6	3.4	3.2	3.0
W200 × 21	5.2	4.7	4.3	4.0	3.7	3.5	3.4
W200 × 27	6.3	5.7	5.2	4.8	4.5	4.3	4.1
W200 × 31	6.9	6.2	5.7	5.3	5.0	4.7	4.5
W250 × 24	6.2	5.6	5.1	4.8	4.5	4.2	4.0
W250 × 33	7.9	7.1	6.5	6.0	5.7	5.4	5.1
W250 × 39	8.7	7.8	7.2	6.7	6.3	5.9	5.6
W310 × 31	8.0	7.2	6.6	6.1	5.8	5.4	5.2
W310 × 39	9.5	8.6	7.9	7.3	6.9	6.5	6.2
Column 1	2	3	4	5	6	7	8

Note to Table 9.23.4.A.:
[1] (See Appendix A.)

Table 9.23.4.B.
Forming Part of Sentence 9.23.4.3.(1)

Maximum Spans (m) for Glued-Laminated Floor Beams Supporting Floors in Dwellings [2, 3, 4]									
Number of *Storeys* Supported	Beam Width, mm	Supported Length, [1] m	Beam Depth, mm						
			228	266	304	342	380	418	456
1	80	2.4	4.32	5.04	5.76	6.48	7.20	7.92	8.64
		3.0	3.87	4.51	5.15	5.80	6.44	7.09	7.73
		3.6	3.53	4.12	4.70	5.29	5.88	6.47	7.06
		4.2	3.27	3.81	4.36	4.90	5.44	5.99	6.53
		4.8	3.06	3.57	4.07	4.58	5.09	5.60	6.11
1	130	2.4	5.51	6.43	7.35	8.26	9.18	10.10	11.02
		3.0	4.93	5.75	6.57	7.39	8.21	9.03	9.86
		3.6	4.50	5.25	6.00	6.75	7.50	8.25	9.00
		4.2	4.16	4.86	5.55	6.25	6.94	7.64	8.33
		4.8	3.90	4.54	5.19	5.84	6.49	7.14	7.79
2	80	2.4	3.28	3.83	4.37	4.92	5.47	6.01	6.56
		3.0	2.93	3.42	3.91	4.40	4.89	5.38	5.87
		3.6	2.68	3.12	3.57	4.02	4.46	4.91	5.36
		4.2	2.48	2.89	3.31	3.72	4.13	4.54	4.96
		4.8	2.32	2.71	3.09	3.48	3.86	4.25	4.64
2	130	2.4	4.18	4.88	5.57	6.27	6.97	7.66	8.36
		3.0	3.74	4.36	4.99	5.61	6.23	6.85	7.48
		3.6	3.41	3.98	4.55	5.12	5.69	6.26	6.83
		4.2	3.16	3.69	4.21	4.74	5.27	5.79	6.32
		4.8	2.96	3.45	3.94	4.43	4.93	5.42	5.91
Col. 1	2	3	4	5	6	7	8	9	10

Note to Table 9.23.4.B.:

(1) Supported length means half the sum of the joist spans on both sides of the beam.

(2) Spans are valid for any species covered by CSA O122-M, "Structural Glued-Laminated Timber."

(3) Spans are clear spans between supports.

(4) Provide minimum 89 mm of bearing.

9.23.4.6. Heavy Roofing Materials. Where a roof is required to support an additional uniform *dead load* from roofing materials other than as specified in Section 9.27, such as concrete or clay roofing tiles, spans for framing members in Tables A-3 to A-7, A-10 and A-11 or the spacing of the members shall be reduced to allow for the loads due to the roofing. (See 9.23.4.1.(1) and 9.23.4.5.)

9.23.5. Notching and Drilling

9.23.5.1. Holes Drilled in Framing Members. Holes drilled in roof, floor or ceiling framing members shall be not larger than one-quarter the depth of the member and shall be located not less than 50 mm from the edges, unless the depth of the member is increased by the size of the hole.

9.23.5.2. Notching of Framing Members. Floor, roof and ceiling framing members may be notched provided the notch is located on the top of the member within half the joist depth from the edge of bearing and is not deeper than one-third the joist depth, unless the depth of the member is increased by the size of the notch.

9.23.5.3. Wall Studs. Wall studs shall not be notched, drilled or otherwise damaged so that the undamaged portion of the stud is less than two-thirds the depth of the stud if the stud is *loadbearing* or 40 mm if the stud is non-*loadbearing*, unless the weakened studs are suitably reinforced.

9.23.5.4. Top Plates. Top plates in walls shall not be notched, drilled or otherwise weakened to reduce the undamaged width to less than 50 mm unless the weakened plates are suitably reinforced.

9.23.5.5. Roof Trusses. Roof truss members shall not be notched, drilled or otherwise weakened unless such notching or drilling is allowed for in the design of the truss.

9.23.6. Anchorage

9.23.6.1. Anchorage of Building Frames

(1) *Building* frames shall be anchored to the *foundation* unless a structural analysis of wind and earth pressures shows anchorage is not required.

(2) Except as provided in Article 9.23.6.3., anchorage shall be provided by embedding the ends of the first floor joists in concrete, or fastening the sill plate to the *foundation* with not less than 12.7-mm diam anchor bolts spaced not more than 2.4 m o.c.

(3) Anchor bolts referred to in Sentence (2) shall be fastened to the sill plate with nuts and washers and shall be embedded not less than 100 mm in the *foundation* and so designed that they may be tightened without withdrawing them from the *foundation*.

9.23.6.2. Anchorage of Columns and Posts. Exterior columns and posts shall be anchored to resist uplift and lateral movement.

9.23.6.3. Anchorage of Smaller Buildings

(1) *Buildings* not more than 4.3 m wide and not more than 1 *storey* in *building height* may be anchored by means of corrosion-resistant steel rods or cables of not less than 12.7 mm diam, attached to the *building* frame near each corner of the *building* in a manner that will develop the full strength of the rod or cable.

(2) Each rod or cable described in Sentence (1) shall be anchored to the ground by means of ground anchors having a withdrawal resistance of not less than 500 N for each metre of length of the *building*. (See 9.15.1.1.(1).)

9.23.7. Sill Plates

9.23.7.1. Size of Sill Plates. Where sill plates provide bearing for the floor system they shall be not less than 38 mm by 89 mm material.

9.23.7.2. Levelling of Sill Plates. Sill plates shall be levelled by setting them on a full bed of mortar, except that where the top of the *foundation* is level, they may be laid directly on the *foundation* provided the junction between the *foundation* and the sill plate is caulked or the sill plate is placed on a layer of mineral wool not less than 25 mm thick before being compressed. (See also 9.23.2.3.)

9.23.8. Beams to Support Floors

9.23.8.1. Bearing for Beams. Beams shall have even and level bearing and shall have not less than 89 mm length of bearing at end supports.

9.23.8.2. Priming of Steel Beams. Steel beams shall be shop primed.

9.23.8.3. Built-up Wood Beams

(1) Where a beam is made up of individual pieces of lumber that are nailed together, the individual members shall be 38 mm or greater in thickness and installed on edge.

(2) Except as permitted in Sentence (3), where individual members of a built-up beam are butted together to form a joint, the joint shall occur over a support.

(3) Where a beam is continuous over more than one span, individual members are permitted to be butted together to form a joint at or within 150 mm of the end quarter points of the clear spans, provided the quarter points are not those closest to the ends of the beam.

(4) Members joined at quarter points shall be continuous over adjacent supports.

(5) Joints in individual members of a beam that are located at or near the end quarter points shall not occur in adjacent members at the same quarter point and shall not reduce the effective beam width by more than half.

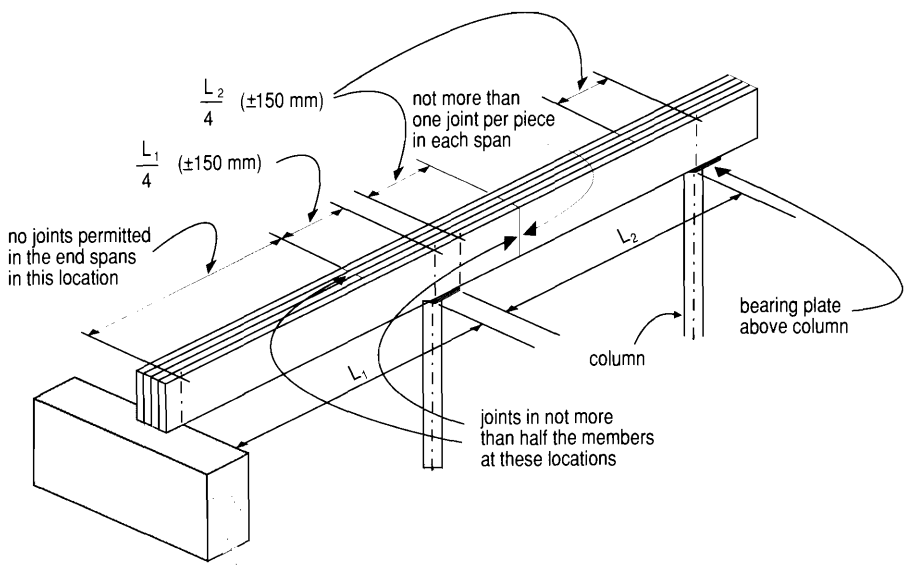
(6) Not more than one butt joint shall occur in any individual member of a built-up beam within any one span.

(7) Except as provided in Sentence (8), where 38 mm members are laid on edge to form a built-up beam, individual members shall be nailed together with a double row of nails not less than 89 mm in length, spaced not more than 450 mm apart in each row with the end nails located 100 mm to 150 mm from the end of each piece.

(8) Where 38 mm members in built-up wood beams are not nailed together as provided in Sentence (7), they shall be bolted together with not less than 12.7 mm diam bolts equipped with washers and spaced not more than 1.2 m o.c., with the end bolts located not more than 600 mm from the ends of the members.

(See Appendix A.)

A-9.23.8.3. Joint Location in Built-up Beams



9.23.9. Floor Joists

9.23.9.1. End Bearing for Joists

(1) Except when supported on ribbon boards, floor joists shall have not less than 38 mm length of end bearing.

(2) Ribbon boards referred to in Sentence (1) shall be not less than 19 mm by 89 mm lumber let into the studs.

9.23.9.2. Joists Supported by Beams

(1) Floor joists may be supported on the tops of beams or may be framed into the sides of beams.

(2) When framed into the side of a wood beam, joists referred to in Sentence (1) shall be supported on

(a) joist hangers or other acceptable mechanical connectors, or

(b) not less than 38 mm by 64 mm ledger strips nailed to the side of the beam, except that 38 mm by 38 mm ledger strips may be used provided each joist is nailed to the beam by not less than four 89 mm nails, in addition to the nailing for the ledger strip required in Table 9.23.3.A.

(3) When framed into the side of a steel beam, joists referred to in Sentence (1) shall be supported on the bottom flange of the beam or on not less than 38 mm by 38 mm lumber bolted to the web with not less than 6.3 mm diam bolts spaced not more than 600 mm apart.

(4) Joists referred to in Sentence (3) shall be spliced above the beam with not less than 38 mm by 38 mm lumber at least 600 mm long to support the flooring.

(5) Not less than a 12 mm space shall be provided between the splice required in Sentence (4) and the beam to allow for shrinkage of the wood joists.

9.23.9.3. Restraint of Joist Bottoms.

Except as provided in Sentence 9.23.9.4.(2), bottoms of floor joists shall be restrained from twisting at each end by toe-nailing to the supports, end-nailing to the header joists or by providing continuous strapping, blocking between the joists or cross-bridging near the supports.

9.23.9.4. Strapping and Bridging in Tables A1 and A2

(1) Except as permitted in Sentence (2), where strapping only is specified in Tables A-1 and A-2, it shall be

(a) not less than 19 mm by 64 mm, nailed to the underside of floor joists,

(b) located not more than 2 100 mm from each support or other rows of strapping, and

(c) fastened at each end to a sill or header.

(2) Strapping is not required if furring strips or a panel-type ceiling finish is attached directly to the joists.

(3) Where bridging is specified in Tables A-1 and A-2, it shall consist of not less than 19 mm by 64 mm or 38 mm by 38 mm cross bridging located not more than 2 100 mm from each support or other rows of bridging.

(4) Where bridging plus strapping is specified in Tables A-1 and A-2, it shall consist of

(a) bridging as described in Sentence (3), together with wood strapping as described in Sentence (1), or

(b) 38-mm solid blocking located not more than 2 100 mm from each support or other rows of bridging and securely fastened between the joists, together with wood strapping as defined in Sentence (1).

(See 9.23.4.1.(2).)

9.23.9.5. Header Joists

(1) Header joists around floor openings shall be doubled when they exceed 1.2 m in length.

(2) The size of header joists exceeding 3.2 m in length shall be determined by calculations.

9.23.9.6. Trimmer Joists

(1) Trimmer joists around floor openings shall be doubled when the length of the header joist exceeds 800 mm.

(2) When the header joist exceeds 2 m in length the size of the trimmer joists shall be determined by calculations.

9.23.9.7. Support of Tail and Header Joists. When tail joists and header joists are supported by the floor framing, they shall be supported by suitable joist hangers or nailing.

9.23.9.8. Support of Walls

(1) Non-*loadbearing* walls parallel to the floor joists shall be supported by joists beneath the wall or on blocking between the joists.

(2) Blocking referred to in Sentence (1) for the support of non-*loadbearing* walls shall be not less than 38 mm by 89 mm lumber, spaced not more than 1.2 m apart.

(3) Non-*loadbearing* interior walls at right angles to the floor joists are not restricted as to location.

(4) *Loadbearing* interior walls parallel to floor joists shall be supported by beams or walls of sufficient strength to transfer safely the design loads to the vertical supports.

(5) *Loadbearing* interior walls at right angles to floor joists shall be located not more than 900 mm from the joist support when the wall does not support a floor, and not more than 600 mm from the joist support when the wall supports one or more floors, unless the joist size is designed to support such loads.

9.23.9.9. Cantilevered Floor Joists

(1) Floor joists supporting roof loads shall not be cantilevered more than 400 mm beyond their supports where 38 mm by 184 mm joists are used and not more than 600 mm beyond their supports where 38 mm by 235 mm or larger joists are used.

(2) The cantilevered portions referred to in Sentence (1) shall not support floor loads from other *storeys* unless calculations are provided to show that the allowable design stresses of the cantilevered joists are not exceeded.

(3) Where cantilevered floor joists described in Sentences (1) and (2) are at right angles to the main floor joists, the tail joists in the cantilevered portion shall extend inward away from the cantilever support a distance equal to not less than 6 times the length of the cantilever, and end nailed to an interior doubled header joist in conformance with Table 9.23.3.A.

9.23.10. Wall Studs

9.23.10.1. Stud Size and Spacing. The size and spacing of studs shall conform to Table 9.23.10.A.

9.23.10.2. Lateral Support. *Loadbearing* studs shall be laterally supported by cladding or blocking.

9.23.10.3. Orientation of Studs

(1) Except as permitted in Sentences (2) and (3), all studs shall be placed at right angles to the wall face.

(2) Studs on the flat are permitted to be used in gable ends of roofs that contain only unfinished space or in non-*loadbearing* interior walls within the limits described in Article 9.23.10.1.

(3) Wall studs that support only a load from an attic not accessible by a stairway are permitted to be placed on the flat within the limits permitted in Article 9.23.10.1. provided

(a) the studs are clad on not less than one side with plywood, waferboard or strandboard sheathing fastened to the face of the studs with a structural adhesive, and

(b) the portion of the roof supported by the studs does not exceed 2.1 m in width.

9.23.10.4. Continuity of Studs. Wall studs shall be continuous for the full *storey* height except at openings and shall not be spliced except by finger-joining with a structural adhesive. (See Appendix A.)

A-9.23.10.4. Fingerjoined Lumber. The NLGA "Standard Grading Rules for Canadian Lumber," referenced in 9.3.2.1. refers to two special product standards, SPS-1, "Fingerjoined Structural Lumber," and SPS-3, "Fingerjoined Stud Lumber – Vertical Use Only," produced by NLGA. Material identified as conforming to these standards is considered to meet the requirements in this Article for joining with a structural adhesive. Lumber fingerjoined in accordance with SPS-3 should be used as a vertical end-loaded member in compression only, where sustained bending or tension-loading conditions are not present, and where the moisture content of the wood will not exceed 19 per cent. Fingerjoined lumber may not be visually regraded or remanufactured into a higher stress grade even if

Table 9.23.10.A.
Forming Part of Article 9.23.10.1.

Size and Spacing of Studs				
Type of Wall	Supported Loads (including *dead loads*)	Minimum Stud Size, mm	Maximum Stud Spacing, mm	Maximum Unsupported Height, m
Interior	No load	38 × 38 38 × 89 flat [1]	400 400	2.4 3.6
	Attic not accessible by a stairway	38 × 64 38 × 64 flat [1] 38 × 89 38 × 89 flat [1]	600 400 600 400	3.0 2.4 3.6 2.4
	Attic accessible by a stairway plus one floor Roof load plus one floor Attic not accessible by stairway plus 2 floors	38 × 89	400	3.6
	Roof load Attic accessible by a stairway Attic not accessible by a stairway plus one floor	38 × 89 38 × 64	600 400	3.6 2.4
	Attic accessible by a stairway plus 2 floors, or roof load plus 2 floors	38 × 89 64 × 89 38 × 140	300 400 400	3.6 3.6 4.2
	Attic accessible by a stairway plus 3 floors, or roof load plus 3 floors	38 × 140	300	4.2
Exterior	Roof with or without attic storage	38 × 64 38 × 89	400 600	2.4 3.0
	Roof with or without attic storage plus one floor	38 × 89 38 × 140	400 600	3.0 3.0
	Roof with or without attic storage plus 2 floors	38 × 89 64 × 89 38 × 140	300 400 400	3.0 3.0 3.6
	Roof with or without attic storage plus 3 floors	38 × 140	300	1.8
Column 1	2	3	4	5

Note to Table 9.23.10.A.:
[1] See Article 9.23.10.2.

the quality of the lumber containing fingerjoints would otherwise warrant such regrading.

9.23.10.5. Support for Cladding Materials

(1) Corners and intersections shall be designed to provide adequate support for the vertical edges of interior and *exterior cladding* materials, and in no instance shall exterior corners be framed with less than the equivalent of 2 studs.

(2) Where the vertical edges of interior cladding at wall intersections are supported at vertical intervals by blocking or other acceptable methods, the vertical distance between such supports shall not exceed the maximum distance between supports specified in Section 9.29.

9.23.10.6. Studs at Sides of Openings

(1) Except as provided in Sentence (2), studs shall be doubled on each side of openings so that the inner studs extend from the lintel to the bottom wall plate and the outer studs extend from the top wall plates to the bottom wall plate.

(2) Single studs may be used on either side of openings in non-*loadbearing* interior walls not required to have *fire-resistance ratings* provided the studs extend from the top wall plate to the bottom wall plate.

9.23.11. Wall Plates

9.23.11.1. Size of Wall Plates. Wall plates shall be not less than 38 mm thick and shall be the same width as the wall studs, except that in non-*loadbearing* walls and in *loadbearing* walls where the studs are located directly over framing members, the bottom wall plate may be 19 mm thick.

9.23.11.2. Bottom Wall Plates

(1) A bottom wall plate shall be provided in all cases.

(2) The bottom plate in exterior walls shall not project more than one-third the plate width over the support.

9.23.11.3. Top Plates

(1) Except as permitted in Sentences (2) to (4), no fewer than 2 top plates shall be provided in *loadbearing* walls.

(2) A single top plate may be used in a section of a *loadbearing* wall containing a lintel provided the top plate forms a tie across the lintel.

(3) A single top plate may be used in *loadbearing* walls where the concentrated loads from ceilings, floors and roofs are not more than 50 mm to one side of the supporting studs and in all non-*loadbearing* walls.

(4) The top plates may be omitted in a section of *loadbearing* wall containing a lintel provided the lintel is tied to the adjacent wall section with not less than 75 mm by 150 mm by 0.91 mm thick galvanized steel, or 19 mm by 89 mm by 300 mm wood splice nailed to each wall section with no fewer than three 63 mm nails.

9.23.11.4. Joints in Top Plates

(1) Joints in the top plates of *loadbearing* walls shall be staggered not less than one stud spacing.

(2) The top plates in *loadbearing* walls shall be lapped or otherwise suitably tied at corners and intersecting walls.

(3) Joints in single top plates used with *loadbearing* walls shall be suitably tied.

(4) Ties referred to in Sentences (2) and (3) shall be the equivalent of not less than 75 mm by 150 mm by 0.91 mm thick galvanized steel nailed to each wall with not less than three 63 mm nails.

9.23.12. Framing over Openings

9.23.12.1. Openings in Non-Loadbearing Walls

(1) Except as provided in Sentence (2), openings in non-*loadbearing* walls shall be framed with not less than 38 mm material the same width as the studs securely nailed to adjacent studs.

(2) Openings for doors in non-*loadbearing* walls required to be *fire separations* with a *fire-resistance rating* shall be framed with the equivalent of not less than two 38 mm thick members that are the same width as the wall plates.

9.23.12.2. Openings in Loadbearing Walls

(1) Openings in *loadbearing* walls shall be framed with lintels designed to carry the superimposed loads to adjacent studs.

(2) Except as provided in Sentence 9.23.12.3.(3), where 2 or more members are used in lintels, they shall be fastened together with not less than 82 mm nails in a double row, with nails not more than 450 mm apart in each row.

(3) Lintel members may be separated by filler pieces.

9.23.12.3. Lintel Spans and Sizes

(1) In *buildings* of *residential occupancy*, where the wall studs exceed 38 mm by 64 mm in size, and where the spans of supported joists do not exceed 4.9 m and the spans of trusses do not exceed 9.8 m, the spans for wood lintels shown in Table 9.23.12.A. may be used.

(2) Lintels referred to in Sentence (1) shall consist of a single piece of lumber 89 mm thick or 2 pieces of 38-mm thick lumber on edge.

(3) In *loadbearing* exterior and interior walls of 38-mm by 64-mm framing members, lintels shall consist of solid 64-mm thick members on edge or 38 mm thick and 19-mm thick members fastened together with not less than 63-mm nails in a double row, with nails not more than 450 mm apart in each row.

(4) Lintels referred to in Sentence (3) shall be not less than 50 mm greater in depth than those shown in Table 9.23.12.A. for the allowable spans, and shall not exceed 2.24 m in length.

(5) In *buildings* of *residential occupancy*, the spans shown in Table 9.23.12.B. for wood lintels supporting roof and ceiling loads and consisting of 3 or 4 pieces of 38-mm thick lumber on edge or glued-laminated timber, are permitted to be used.

9.23.13. Roof and Ceiling Framing

9.23.13.1. Continuity of Rafters and Joists.

Roof rafters and joists and ceiling joists shall be continuous or shall be spliced over vertical supports that extend to suitable bearing.

9.23.13.2. Framing around Openings.

Roof and ceiling framing members shall be doubled on each side of openings greater than 2 rafter or joist spacings wide.

9.23.13.3. End Bearing Length.

The length of end bearing of joists and rafters shall be not less than 38 mm.

9.23.13.4. Location and Attachment of Rafters

(1) Rafters shall be located directly opposite each other and tied together at the peak, or may be offset by their own thickness if nailed to a ridge board not less than 17.5 mm thick.

(2) Except as permitted in Sentence (3), framing members shall be connected by gusset plates or nailing at the peak in conformance with Table 9.23.3.A.

(3) Where the roof framing on opposite sides of the peak is assembled separately, such as in the case of factory-built houses, the roof framing on opposite sides may be fastened together with galvanized-steel strips not less than 200 mm by 75 mm by 0.41 mm thick spaced not more than 1.2 m apart and nailed at each end to the framing by not less than two 63 mm nails.

9.23.13.5. Shaping of Rafters.

Rafters shall be shaped at supports to provide even bearing surfaces and supported directly above the exterior walls.

9.23.13.6. Hip and Valley Rafters.

Hip and valley rafters shall be not less than 50 mm greater in depth than the common rafters and not less than 38 mm thick, actual dimension.

9.23.13.7. Intermediate Support for Rafters and Joists

(1) Ceiling joists and collar ties of not less than 38 mm by 89 mm lumber may be assumed to provide intermediate support to reduce the span for rafters and joists where the roof slope is 1 in 3 or greater.

(2) Collar ties referred to in Sentence (1) more than 2.4 m long shall be laterally supported near their centres by not less than 19 mm by 89 mm continuous members at right angles to the collar ties.

(3) Dwarf walls and struts are permitted to be used to provide intermediate support to reduce the span for rafters and joists.

Table 9.23.12.A.
Forming Part of Sentences 9.23.12.3.(1) and (4)

Wood Lintel Spans			
Location of Lintels	Supported Loads including *Dead Loads* and Ceiling	Depth of Lintels, mm	Maximum Allowable Spans, m
Interior walls	Limited attic storage	89 140 184 235 286	1.22 1.83 2.44 3.05 3.81
	Full attic storage or roof load or limited attic storage plus one floor	89 140 184 235 286	0.61 0.91 1.22 1.52 1.83
	Full attic storage plus one floor or roof load plus one floor or limited attic storage plus 2 or 3 floors	89 140 184 235 286	— 0.76 0.91 1.22 1.52
	Full attic storage plus 2 or 3 floors or roof load plus 2 or 3 floors	89 140 184 235 286	— 0.61 0.91 1.07 1.22
Exterior walls	Roof with or without attic storage	89 140 184 235 286	1.12 1.68 2.24 2.79 3.35
	Roof with or without attic storage plus one floor	89 140 184 235 286	0.56 1.40 1.96 2.24 2.51
	Roof with or without attic storage plus 2 or 3 floors	89 140 184 235 286	0.56 1.12 1.68 1.96 2.24
Column 1	2	3	4

Table 9.23.12.B.
Forming Part of Sentence 9.23.12.3.(5)

Built-Up Wood Lintels Supporting Roof and Ceiling Loads over Large Openings [4, 5]

Supported Length, m [1]	No. 1 and No.2 Header Span, m [2, 3]							Select Structural Header Span, m [2, 3]						
Live Load – 1.0 kPa	2.4	3.0	3.6	4.2	4.8	5.4	6.0	2.4	3.0	3.6	4.2	4.8	5.4	6.0
2.4	A	A	A	B	D	F	F	A	A	A	B	C	D	F
3.0	A	A	B	D	F	G*	G*	A	A	A	B	D	E	G*
3.6	A	B	C	D	F	G*	G*	A	A	A	C	D	F	G*
4.2	A	B	D	F	G*	G*	G*	A	A	B	C	E	F	G*
4.8	A	C	D	F	G*	G*	I*	A	A	B	D	F	G*	I*
	No. 1 and No.2 Header Span, m [2, 3]							Select Structural Header Span, m [2, 3]						
Live Load – 1.5 kPa	2.4	3.0	3.6	4.2	4.8	5.4	6.0	2.4	3.0	3.6	4.2	4.8	5.4	6.0
2.4	A	A	B	D	F	G*	I*	A	A	A	C	D	F	I*
3.0	A	B	D	F	G*	I*	J*	A	A	B	C	E	I*	J*
3.6	A	C	D	F	G*	I*	K*	A	A	B	D	F	I*	K*
4.2	B	D	F	G*	G*	I*	M*	A	A	C	D	F	I*	M*
4.8	B	D	F	G*	I*	K*	M*	A	B	D	F	I*	K*	M*
	No. 1 and No.2 Header Span, m [2, 3]							Select Structural Header Span, m [2, 3]						
Live Load – 2.0 kPa	2.4	3.0	3.6	4.2	4.8	5.4	6.0	2.4	3.0	3.6	4.2	4.8	5.4	6.0
2.4	A	A	C	D	F	I*	K*	A	A	B	C	E	I*	K*
3.0	A	B	D	F	G*	I*	M*	A	A	C	D	F	I*	M*
3.6	B	D	F	G*	I*	K*	M*	A	B	D	F	I*	K*	M*
4.2	B	D	G*	G*	I*	K*	P*	A	B	D	F	I*	K*	P*
4.8	C	F	G*	G*	I*	M*	P*	A	D	F	G*	I*	M*	P*
	No. 1 and No.2 Header Span, m [2, 3]							Select Structural Header Span, m [2, 3]						
Live Load – 2.5 kPa	2.4	3.0	3.6	4.2	4.8	5.4	6.0	2.4	3.0	3.6	4.2	4.8	5.4	6.0
2.4	A	C	E	G*	G*	I*	M*	A	A	C	D	F	I*	M*
3.0	B	D	F	G*	I*	K*	M*	A	B	D	F	I*	K*	M*
3.6	B	E	G*	G*	I*	M*	P*	A	B	D	F	I*	M*	P*
4.2	D	F	G*	G*	I*	M*	R*	B	D	F	G*	I*	M*	R*
4.8	D	G*	G*	I*	K*	P*	R*	B	D	F	I*	K*	P*	R*

Addendum to Table 9.23.12.B.:

(1) Supported length means half the span of trusses, roof joists or rafters supported by the header plus the length of the overhang beyond the lintel.
(2) Table valid for all major species groups (D Fir-L, Hem-Fir, S-P-F).
(3) Span are clear spans between supports. For total spans, add two bearing lengths.
(4) Provide minimum 89 mm of bearing.
(5) Any size in the Table may be substituted by any size of higher rank (A lowest, R highest).

Legend – Header Sizes

A = 3 – 38 × 184
B = 4 – 38 × 184
C = 3 – 38 × 235
D = 4 – 38 × 235
E = 3 – 38 × 286
F = 4 – 38 × 286

G* = 80 × 380
H* = 130 × 304
I* = 80 × 418
J* = 130 × 342
K* = 80 × 456
L* = 130 × 380
M* = 80 × 494

N* = 80 × 532
O* = 130 × 418
P* = 80 × 570
Q* = 130 × 456
R* = 80 × 608

*Glued-laminated 20 f-E grade

(4) When struts are used to provide intermediate support they shall be not less than 38 mm by 89 mm material extending from each rafter to a *loadbearing* wall at an angle of not less than 45° to the horizontal.

(5) When dwarf walls are used for rafter support, they shall be framed in the same manner as *loadbearing* walls and securely fastened top and bottom to the roof and ceiling framing to prevent over-all movement.

(6) Solid blocking shall be installed between floor joists beneath dwarf walls referred to in Sentence (5) that enclose finished rooms.

9.23.13.8. Ridge Support

(1) Except as provided in Sentence (3), the ridge of the roof shall be supported by a *loadbearing* wall extending from the ridge to suitable bearing or by a ridge beam of not less than 38 mm by 140 mm material.

(2) Ridge beams referred to in Sentence (1) shall be supported at intervals not exceeding 1.2 m by not less than 38 mm by 89 mm members extending vertically from the ridge to suitable bearing.

(3) When the roof slope is 1 in 3 or more, ridge support may be omitted provided the lower ends of the rafters are adequately tied to prevent outward movement.

(4) Ties required in Sentence (3) are permitted to consist of tie rods or ceiling joists forming a continuous tie for opposing rafters and nailed in accordance with Table 9.23.13.A.

(5) Ceiling joists referred to in Sentence (4) shall be fastened together with at least one more nail per joist splice than required for the rafter to joist connection shown in Table 9.23.13.A.

(6) Members referred to in Sentence (5) may be fastened together either directly or through a gusset plate.

9.23.13.9. Restraint of Joist Bottoms. Roof joists supporting a finished ceiling, other than plywood, waferboard or strandboard, shall be restrained from twisting along the bottom edges by means of furring, blocking, cross bridging or strapping conforming to Article 9.23.9.4.

9.23.13.10. Ceiling Joists Supporting Roof Load

(1) Except as permitted in Sentence (2), ceiling joists supporting part of the roof load from the rafters shall be not less than 25 mm greater in depth than required for ceiling joists not supporting part of the roof load.

(2) When the roof slope is 1 in 4 or less, the ceiling joist sizes referred to in Sentence (1) shall be determined from the span tables for roof joists.

9.23.13.11. Wood Roof Trusses

(1) Except for roof trusses constructed of Poplar, Eastern White Pine, Western White Pine, Red Pine, Western Red Cedar and Eastern White Cedar, the member sizes for Howe or Fink type wood roof trusses spaced not more than 600 mm o.c. which are to be supported at or near their ends may be determined in conformance with Tables A-10 and A-11 provided such trusses conform to the requirements of Sentences (3) to (7). (See Appendix A.)

A-9.23.13.11.(1) Span Tables for Wood Roof Trusses. In these Tables the term "Fink" truss refers to the common "W" type truss and the term "Howe" truss refers to the type which has a vertical member extending from its peak. Schematic drawings of the simplest version of each type are shown on the following page. Each type may have web members additional to those shown, in which case the distances between panel points can be decreased.

The span tables in the Appendix have been calculated for wood species equivalent in strength to Spruce-Pine-Fir, Douglas Fir-Larch or Hem-Fir. The spans are not appropriate for the weaker species, which are included in the northern species combination.

The spans are based on 600 mm o.c. truss spacing.

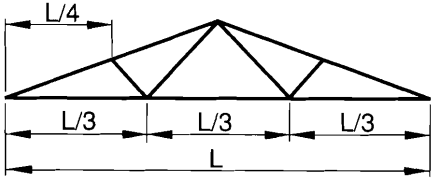
Where wood roof trusses are intended for use in a locality having a design roof snow load higher than shown in the tables, the maximum truss spacing may be adjusted to allow for the higher loading in the same manner as described for roof rafters and roof joists.

Table 9.23.13.A.
Forming Part of Sentences 9.23.13.8.(4) and (5)

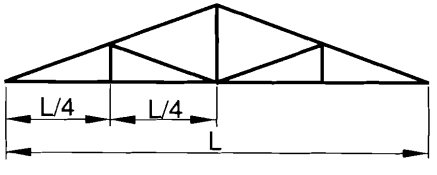
Rafter-to-Joist Nailing
(Minimum Number of Nails not less than 16 mm Long)
(Unsupported Ridge)

Roof Slope	Spacing, mm	Rafter Tied to Every Joist						Rafter Tied to Joist Every 1.2 m					
		Building Width up to 8 m			*Building* Width up to 9.8 m			*Building* Width up to 8 m			*Building* Width up to 9.8 m		
		Roof Snow Load, kPa											
		1.0 or less	1.5	2.0 or more	1.0 or less	1.5	2.0 or more	1.0 or less	1.5	2.0 or more	1.0 or less	1.5	2.0 or more
1 in 3	400	4	5	6	5	7	8	11	—	—	—	—	—
	600	6	8	9	8	—	—	11	—	—	—	—	—
1 in 2.4	400	4	4	5	5	6	7	7	10	—	9	—	—
	600	5	7	8	7	9	11	7	10	—	—	—	—
1 in 2	400	4	4	4	4	4	5	6	8	9	8	—	—
	600	4	5	6	5	7	8	6	8	9	8	—	—
1 in 1.71	400	4	4	4	4	4	4	5	7	8	7	9	11
	600	4	4	5	5	6	7	5	7	8	7	9	11
1 in 1.33	400	4	4	4	4	4	4	4	5	6	5	6	7
	600	4	4	4	4	4	5	4	5	6	5	6	7
1 in 1	400	4	4	4	4	4	4	4	4	4	4	4	5
	600	4	4	4	4	4	4	4	4	4	4	4	5
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14

Where wood roof trusses are to be used in an area where the design roof snow load falls between the values shown in the tables, the spans may be interpolated between the spans shown in the tables.
The truss spans in these tables are valid only where the design live load on the bottom member does not exceed 0.5 kPa of ceiling area. This applies to trusses in buildings whose attic spaces have limited access through an access hatch and not to attics that are accessible by stairways. The spans do not apply to trusses which may be subject to concentrated loads, such as those required to support hoisting equipment. In addition, the top members of the trusses must be constructed to prevent lateral buckling by the provision of roof sheathing or by other suitable bracing.



Fink truss



Howe truss

(2) The joint connections used in trusses described in Sentence (1) shall be designed in conformance with the requirements in Subsection 4.3.1. (See 9.3.2.3.)

(3) Where a roof truss described in Sentence (1) supports a ceiling, and the unsupported length of the bottom chord between the truss panel points exceeds 3.05 m, the bottom chord shall be not less than 38 mm by 114 mm in size.

(4) Where the unsupported length of the bottom chord described in Sentence (3) exceeds 3.66 m between the panel points, the bottom chord shall be not less than 38 mm by 140 mm in size.

(5) Where the length of compression web members in roof trusses described in Sentence (1) exceeds 1.83 m, such web members shall be provided with continuous bracing to prevent buckling.

(6) Bracing required in Sentence (5) shall consist of not less than 19 mm by 89 mm lumber nailed at right angles to the web members near their centres with at least two 63 mm nails for each member.

(7) Web members referred to in Sentence (5) shall be not less than 38 mm by 89 mm lumber of at least No. 2 grade.

(8) Roof trusses that are not designed in conformance with Sentence (1) shall

(a) be capable of supporting a total ceiling load (*dead load* plus *live load*) of 0.5 kPa plus two and two-thirds times the design roof load for 24 h, and

(b) not exceed the deflections shown in Table 9.23.13.B. when loaded with the ceiling load plus one and one-third times the design roof snow load for 1 h.

(9) Testing for lumber roof trusses referred to in Sentence (8) shall be in conformance with CSA S307, "Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings," except that the unsymmetrical loading requirement in Clause 7.7 of that standard shall not apply.

9.23.14. Subflooring

9.23.14.1. Subflooring Required. Subflooring shall be provided beneath finish flooring where the finish flooring does not have adequate strength to support the design loads (see Subsection 9.30.3.).

Table 9.23.13.B.
Forming Part of Sentence 9.23.13.11.(8)

Maximum Roof Truss Deflections		
Truss Span	Type of Ceiling	Maximum Deflection
4.3 m or less	Plaster or gypsum board	1/360 of the span
	Other than plaster or gypsum board	1/180 of the span
Over 4.3 m	Plaster or gypsum board	1/360 of the span
	Other than plaster or gypsum board	1/240 of the span
Column 1	2	3

9.23.14.2. Material Standards

(1) Wood-based panels for subfloors shall conform to

(a) CSA O121, "Douglas Fir Plywood,"

(b) CSA O151, "Canadian Softwood Plywood,"

(c) CSA O153, "Poplar Plywood,"

(d) CAN3-O437.0-M85, "Waferboard and Strandboard," or

(e) CAN/CSA O325.0, "Construction Sheathing."

(2) Particleboard subflooring may be used only where a *building* is constructed in a factory so that the subfloor will not be exposed to the weather.

(3) Subflooring described in Sentence (2) shall conform to grade N-1 or N-2 in CAN3-O188.1, "Interior Mat-Formed Wood Particleboard."

(4) Subflooring described in Sentence (2) shall have its upper surface and all edges treated to restrict water absorption where the subfloor is used in bathrooms, kitchens, laundry rooms or other areas subject to periodic wetting. (See Appendix A.)

A-9.23.14.2.(4) Water Absorption Test. A method for determining water absorption is de-

scribed in ASTM D1037, "Standard Methods of Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials." The treatment to reduce water absorption may be considered to be acceptable if a 300 mm x 300 mm sample when treated on all sides and edges does not increase in weight by more than 6 per cent when tested in the horizontal position.

9.23.14.3. Edge Support. Where the edges of panel-type subflooring are required to be supported (see Sentence 9.30.2.1.(2)), such support shall consist of tongue-and-groove panel edges or not less than 38 mm by 38 mm blocking securely nailed between framing members.

9.23.14.4. Direction of Installation

(1) Plywood subflooring shall be installed with the surface grain at right angles to the joists and with joints parallel to floor joists staggered.

(2) Waferboard and strandboard subflooring conforming to O-1 and O-2 grades in CAN3-O437.0 shall be installed with the direction of face orientation at right angles to the joists and with joints parallel to floor joists staggered. (See Appendix A.)

A-9.23.14.4.(2) Oriented Waferboard and Strandboard. The CSA Standard requires that Type O (aligned) panels be marked to show the grade and the direction of face alignment.

9.23.14.5. Subfloor Thickness or Rating

(1) Except as provided in Sentences (2) and (3), subfloors shall conform to either Table 9.23.14.A. or Table 9.23.14.B.

(2) Where the finished flooring consists of not less than 19-mm matched wood strip flooring laid at right angles to joists spaced not more than 600 mm o.c., subflooring shall be permitted to consist of not less than

(a) 12.5-mm thick plywood,
(b) 12.5-mm thick waferboard or strandboard conforming to O–2 grade, or
(c) 12.7-mm thick waferboard or strandboard conforming to grades R-1 or O-1.

Table 9.23.14.A.
Forming Part of Sentences 9.23.14.5.(1) and 9.23.15.6.(1)

Thickness of Subflooring, mm				
Maximum Spacing of Supports, mm	Plywood and O-2 Grade Waferboard and Strandboard	Waferboard and Strandboard, R-1 and O-1 Grades	Particle-board	Lumber
400 500 600	15.5 15.5 18.5	15.9 15.9 19.0	15.9 19.0 25.4	17.0 19.0 19.0
Column 1	2	3	4	5

Table 9.23.14.B
Forming Part of Sentences 9.23.14.5.(1) and 9.23.15.6.(1)

Rating for Subfloor When Applying CSA O325.0		
Maximum Spacing of Supports, mm	Panel Mark	
	Subfloor	Used with Panel-Type Underlay
400 500 600	1F16 1F20 1F24	2F16 2F20 2F24
Column 1	2	3

(3) Except where the flooring consists of ceramic tiles applied with adhesive, where a separate panel-type underlay or concrete topping is applied to a subfloor on joists spaced not more than 400 mm o.c., the subfloor may consist of not less than

(a) 12.5-mm thick plywood,
(b) 12.5-mm thick waferboard or strandboard conforming to O–2 grade, or
(c) 12.7-mm thick waferboard or strandboard conforming to grades R-1 or O-1.

(See Article 9.30.6.2.)

9.23.14.6. Annular Grooved Nails. When resilient flooring is applied directly to a waferboard and strandboard, particleboard or plywood subfloor, the subfloor shall be fastened to the supports with annular grooved nails.

9.23.14.7. Lumber Subflooring

(1) Lumber subflooring shall be laid at an angle of not less than 45° to the joists.

(2) Lumber subflooring shall be fully supported at the ends on solid bearing.

(3) Lumber for subflooring shall be of uniform thickness and not more than 184 mm wide.

9.23.15. Roof Sheathing

9.23.15.1. Material Standards

(1) Wood-based panels used for roof sheathing shall conform to the requirements of

(a) CSA O121, "Douglas Fir Plywood,"
(b) CSA O151, "Canadian Softwood Plywood,"
(c) CSA O153, "Poplar Plywood,"
(d) CAN3-O437.0-M85, "Waferboard and Strandboard," or
(e) CAN/CSA O325.0, "Construction Sheathing."

9.23.15.2. Direction of Installation

(1) Plywood roof sheathing shall be installed with the surface grain at right angles to the roof framing.

(2) Waferboard and strandboard roof sheathing conforming to O-1 and O-2 grades in CAN3-O437.0 shall be installed with the direction of face orientation at right angles to the roof framing members. (See 9.23.14.4.(2).)

9.23.15.3. Gap between Sheets. Waferboard and strandboard and plywood roof sheathing shall be installed with not less than a 2 mm gap between sheets.

9.23.15.4. Lumber Roof Sheathing. Lumber roof sheathing shall not be more than 286 mm wide and shall be applied so that all ends are supported with end joints staggered.

9.23.15.5. Edge Support. Where panel-type roof sheathing requires edge support, the support shall consist of metal H clips or not less than 38 mm by 38 mm blocking securely nailed between framing members.

9.23.15.6. Thickness or Rating

(1) The thickness or rating of roof sheathing on a flat roof used as a walking deck shall conform to either Table 9.23.14.A. or Table 9.23.14.B. for subfloors.

(2) The thickness or rating of roof sheathing on a roof not used as a walking deck shall conform to either Table 9.23.15.A. or Table 9.23.15.B.

(3) Asphalt-coated or asphalt-impregnated fibreboard not less than 11.1 mm thick conforming to CAN3-A247-M, "Insulating Fibreboard" may be used as a roof sheathing over supports spaced not more than 400 mm o.c. provided the roofing consists of a continuous sheet of galvanized steel of not less than 0.33 mm in thickness or a continuous sheet of aluminum of not less than 0.61 mm in thickness.

Table 9.23.15.A.
Forming Part of Sentence 9.23.15.6.(2)

Minimum Thickness of Roof Sheathing, mm					
Maximum Spacing of Supports, mm	Plywood and O-2 Grade Waferboard and Strandboard		Waferboard and Strandboard, R-1 and O-1 Grades		Lumber
	Edges Supported	Edges Unsupported	Edges Supported	Edges Unsupported	
300	7.5	7.5	9.5	9.5	17.0
400	7.5	9.5	9.5	11.1	17.0
600	9.5	12.5	11.1	12.7	19.0
Column 1	2	3	4	5	6

Table 9.23.15.B
Forming Part of Sentence 9.23.15.6.(2)

Rating for Roof Sheathing When Applying CSA O325.0		
Maximum Spacing of Supports, mm	Panel Mark	
	Edges Supported	Edges Unsupported
400 500 600	2R16 2R20 2R24	1R16 1R20 1R24
Column 1	2	3

(4) All edges of sheathing described in Sentence (3) shall be supported by blocking or framing.

9.23.16. Wall Sheathing

9.23.16.1. Required Sheathing. Exterior walls and gable ends shall be sheathed when the *exterior cladding* requires intermediate fastening between supports or if the *exterior cladding* requires solid backing.

9.23.16.2. Thickness, Rating and Material Standards. Where wall sheathing is required, it shall conform to either Table 9.23.16.A. or Table 9.23.16.B.

Table 9.23.16.B.
Forming Part of Article 9.23.16.2

Rating for Wall Sheathing When Applying CSA O325.0	
Maximum Spacing of Supports, mm	Panel Mark
400 500 600	W16 W20 W24
Column 1	2

9.23.16.3. Attachment of Siding to Sheathing. Gypsum sheathing, rigid insulation and fibreboard shall not be used for the attachment of siding materials.

9.23.16.4. Lumber Sheathing. Lumber wall sheathing shall be applied so that all ends are supported with end joints staggered.

9.23.16.5. Joints in Panel-Type Sheathing

(1) Panel-type sheathing board shall be applied so that vertical joints are staggered if the sheathing is applied horizontally.

(2) A gap of not less than 2 mm shall be left between sheets of plywood, waferboard, strandboard or fibreboard.

9.23.16.6. Mansard Style Roofs. Where the bottom portions of mansard style roofs are vented, the vertical framing members behind the sloping portions shall be considered on the same basis as exterior wall studs and shall conform to the appropriate requirements in Subsection 9.23.17.

9.23.17. Wall Sheathing Paper

9.23.17.1. Material Standard. Sheathing paper shall conform to CAN2-51.32, "Sheathing, Membrane, Breather Type."

9.23.17.2. Sheathing Paper beneath Stucco. Tar-saturated felts or papers shall not be used as a sheathing paper beneath stucco.

9.23.17.3. Sheathing Paper

(1) Except as provided in Sentences (3) and (6), not less than one layer of sheathing paper shall be applied beneath siding, stucco or masonry veneer.

(2) Sheathing paper required in Sentence (1) shall be applied so that joints are lapped not less than 100 mm, and if applied horizontally, the upper sheets shall overlap the lower sheets.

(3) Except as provided in Sentence (6), where no sheathing is used with masonry veneer or other siding, not less than 2 layers of sheathing paper shall be applied beneath the veneer or siding.

(4) All joints in the sheathing paper required in Sentence (3) shall occur over framing, and the paper shall be fastened to the framing with roofing nails or staples spaced not more than 150 mm along the edges of the outer layer of sheathing paper.

Table 9.23.16.A.
Forming Part of Article 9.23.16.2.

Wall Sheathing Thickness and Specifications			
Type of Sheathing	Minimum Thickness, mm [1]		Material Standards
	With Supports 400 mm o.c.	With Supports 600 mm o.c.	
Lumber	17.0	17.0	See Table 9.3.2.A.
Fibreboard (insulating)	9.5	11.1	CAN3-A247
Gypsum sheathing	9.5	12.7	CSA A82.27
Plywood (exterior type)	6.0	7.5	CSA O121 CSA O151 CSA O153
Waferboard and Strandboard Grade O-2	6.0	7.5	CAN3-O437.0
Waferboard and Strandboard Grades R-1 and O-1	6.35	7.9	CAN3-O437.0
Expanded polystyrene Types 1 and 2	38	38	CAN/CGSB-51.20M
Expanded polystyrene Types 3 and 4	25	25	CAN/CGSB 51.20M
Urethane and Isocyanurate Types 1, 2 and 4	38	38	CGSB 51-GP-21M
Urethane and Isocyanurate Type 3	25	25	CGSB 51-GP-21M
Urethane and Isocycanurate Types 1 and 2, faced	25	25	CAN/CGSB-51.26-M
Phenolic, faced	25	25	CAN/CGSB 51.25M
Rigid Board Mineral Fibre, Type 2	25	25	CSA A101
Column 1	2	3	4

Note to Table 9.23.16.A.:
[1] See also Sentences 9.27.5.1.(2) to (4).

(5) Wall sheathing may be used in lieu of one layer of sheathing paper required in Sentence (3), and the thickness need not conform to Table 9.23.16.A.

(6) Sheathing paper may be omitted beneath siding when the joints in the siding are formed to effectively prevent the passage of wind and rain in conformance with Sentences (7) or (9), as applicable.

(7) Siding consisting of sheets of plywood, hardboard, waferboard and strandboard or asbestos cement is considered to meet the requirements in Sentence (6) provided the siding is applied so that all edges are directly supported by framing and the vertical joints between adjacent sheets covered with battens or shiplapped or otherwise matched to provide weather tight joints.

(8) Vertical joints between sheets described in Sentence (7) shall be caulked.

(9) Metal siding consisting of sheets of metal is considered to meet the requirements of Sentence (6) where the joints between sheets are of the locked seam type. (See Appendix A.)

A-9.23.17.3.(9) Omission of Sheathing Paper Under Metal Siding. The purpose of sheathing paper is to prevent drafts and the entry of wind-driven rain into the wall cavity. Certain types of metal siding consisting of large sheets or panels will perform this function, eliminating the need for sheathing paper. This requirement applies to siding such as that commonly used on mobile homes but does not apply to metal siding installed in strips which is intended to simulate the appearance of lapped wood siding. Such material does not act as a substitute for sheathing paper since it incorporates provision for venting the wall cavity and has many joints.

9.23.18. Bracing (See Appendix A.)

A-9.23.18. Bracing. Traditionally, diagonal bracing has been provided at the corners of wood framed walls to provide resistance against wind racking forces. Laboratory tests have indicated, however, that the bracing that had been traditionally used contributed relatively little to the overall strength of the wall. Most of the racking resistance was in effect provided by the interior finish. Because of this, the requirements for bracing were deleted in the late 1950's. (See "Shear Resistance of Wood Frame Walls," by A.T. Hansen, Building Practice Note 61, Institute for Research in Construction, National Research Council, Ottawa.)

Where the interior is not finished, however, bracing is necessary if the siding itself or the sheathing does not provide the required racking strength. If panel type siding is used, or if the sheathing consists of plywood, waferboard, strandboard, gypsum board, diagonal lumber, or fibreboard sheathing, additional bracing is not considered necessary because of the wind bracing provided by these materials.

Where bracing is provided, it must be installed at roughly a 45° angle on each wall and in each storey, extending the full height of the storey. This type of bracing provides considerably greater resistance to wind forces than the traditional bracing that was found to be relatively ineffective.

The permission to omit bracing assumes typical house designs. Some houses may have reduced resistance to racking forces as a result of their configuration. These include tall narrow houses in exposed locations with large door or window openings located in the short sides. In such cases racking resistance can be improved by ensuring that paneled sections are placed adjacent to the openings.

The Code does not address the issue of bracing of the structure during construction. It is often necessary to provide temporary bracing until the interior finish or sheathing is installed, however, this is not a Code requirement.

9.23.18.1. Required Bracing

(1) Except as provided in Sentence (2), each exterior wall in each *storey* shall be braced with not less than one diagonal brace conforming to Article 9.23.18.2.

(2) Bracing is not required where walls have an interior finish conforming to the requirements of Section 9.29, or if the walls are clad with panel type siding, diagonal lumber or plywood, waferboard, strandboard, gypsum or fibreboard sheathing.

9.23.18.2. Material and Installation

(1) Where bracing is required, it shall consist of not less than 19 mm by 89 mm wood members applied to the studs at an angle of approximately 45° to the horizontal, extending the full height of the wall on each *storey*.

(2) Bracing described in Sentence (1) shall be nailed to each stud and wall plate by not less than two 63 mm nails.

Section 9.24 Sheet Steel Stud Wall Framing

9.24.1. General

9.24.1.1. Application

(1) This Section applies to sheet steel studs for use in non-*loadbearing* exterior and interior walls.

(2) Where *loadbearing* steel studs are used, they shall be designed in conformance with Part 4.

9.24.1.2. Material Standards. Steel studs and runners shall conform to CAN/CGSB-7.1-M, "Cold Formed Steel Framing Components."

9.24.1.3. Metal Thickness. Metal thickness specified in this Section shall be the minimum base steel thickness exclusive of coatings.

9.24.1.4. Screws. Screws for the application of cladding materials to steel studs, runners and furring channels shall conform to ASTM C1002, "Steel Drill Screws for the Application of Gypsum Board."

9.24.1.5. Cladding Required. Steel stud framing shall have cladding on both sides, fastened with screws spaced at the appropriate spacing described in Section 9.29, penetrating not less than 10 mm through the metal.

9.24.2. Size of Framing

9.24.2.1. Size and Spacing of Studs in Interior Walls. Except as required in Articles 9.24.2.3. and 9.24.2.4., the size and spacing of steel studs for non-*loadbearing* interior walls shall conform to Table 9.24.2.A.

Table 9.24.2.A.
Forming Part of Article 9.24.2.1.

Steel Studs for Non-Loadbearing Interior Walls		
Minimum Stud Size, mm	Maximum Stud Spacing, mm	Maximum Wall Height, m
30 × 40	400 600	3.0 2.7
30 × 63	400 600	4.0 3.6
30 × 91	400 600	5.2 4.9
Column 1	2	3

9.24.2.2. Thickness of Studs. Except as required in Article 9.24.2.4., steel studs in non-*loadbearing* interior walls shall have a metal thickness of not less than 0.46 mm.

9.24.2.3. Runners. Runners for interior and exterior non-*loadbearing* walls shall have a thickness of not less than the thickness of the corresponding studs and shall have not less than 30 mm flanges.

9.24.2.5. Size and Spacing of Studs in Exterior Walls. The size and spacing of non-*loadbearing* steel studs for exterior walls shall conform to Table 9.24.2.B.

9.24.3. Installation

9.24.3.1. Installation of Runners

(1) Runners shall be provided at the tops and bottoms of walls.

(2) Runners required in Sentence (1) shall be securely attached to the *building* at approximately 50 mm from the ends, and at intervals of not more than 600 mm o.c. for interior walls and 300 mm o.c. for exterior walls.

(3) Fasteners used for attachment described in Sentence (2) shall consist of the equivalent of 63 mm nails or 25 mm screws.

(4) Studs at openings and which are not full wall height shall be supported by a runner at the

Table 9.24.2.B.
Forming Part of Article 9.24.2.5.

Steel Studs for Non-Loadbearing Exterior Walls				
Minimum Stud Size, mm	Minimum Metal Thickness, mm	Maximum Stud Length, m		
		Spacing of Studs		
		300 mm (o.c.)	400 mm (o.c.)	600 mm (o.c.)
30 × 91	0.53	3.0	2.4	—
30 × 91	0.69	3.3	2.7	2.4
30 × 91	0.85	3.6	3.0	2.7
30 × 91	1.0	4.0	3.3	3.0
Column 1	2	3	4	5

ends of the studs, securely fastened to the full length studs at the sides of the opening.

9.24.3.2. Fire-Rated Walls

(1) Steel studs used in walls required to have a *fire-resistance rating* shall be installed so that there is not less than a 12 mm clearance between the top of the stud and the top of the runner to allow for expansion in the event of fire.

(2) Except as provided in Article 9.24.3.6., studs in walls referred to in Sentence (1) shall not be attached to the runners in a manner that will prevent such expansion.

9.24.3.3. Orientation of Studs. Steel studs shall be installed with webs at right angles to the wall face and, except at openings, shall be continuous for the full wall height.

9.24.3.4. Support for Cladding Materials. Corners and intersections of walls shall be constructed to provide support for the cladding materials.

9.24.3.5. Framing around Openings

(1) Studs shall be doubled on each side of every opening where such openings involve more than one stud space, and shall be tripled where the openings in exterior walls exceed 2.4 mm in width.

(2) Studs described in Sentence (1) shall be suitably fastened together to act as a single structural unit in resisting transverse loads.

9.24.3.6. Attachment of Studs to Runners

(1) Studs shall be attached to runners by screws, crimping, welding or other suitable methods around wall openings and elsewhere where necessary to keep the studs in alignment during construction.

(2) Where clearance for expansion is required in Article 9.24.3.2., such attachment required in Sentence (1) shall be applied between studs and bottom runners only.

Section 9.25 Thermal Insulation and Control of Condensation

(See Appendix A.)

A-9.25 Control of Condensation. The majority of moisture problems resulting from condensation of water vapour in walls and ceiling/attic spaces are caused by the leakage of moist interior heated air into these spaces rather than by the diffusion of water vapour through the building envelope.

Protection against such air leakage must be provided by a system of air-impermeable materials joined with leak free joints. Generally, air leakage protection can be provided by the use of air-impermeable sheet materials such as gypsum board or polyethylene of sufficient thickness. However, the integrity of the air barrier protection can be

compromised at the joints and here special care must be taken in the design and construction of an effective air barrier system.

Although this Section refers separately to vapour barrier protection and air barrier protection, these functions in a wall or ceiling assembly of conventional wood frame construction are often combined as a single membrane which acts as a barrier against moisture diffusion and the movement of interior air into insulated wall or roof cavities. Openings cut through this membrane, such as for electrical boxes, provide opportunities for air leakage into concealed spaces and special measures must be taken to make such openings as airtight as possible. Attention must also be paid to less obvious leakage paths, such as holes for electric wiring, plumbing installations, wall/ceiling/floor intersections and gaps created by shrinkage of framing members.

In some constructions the air barrier protection is provided by the interior finish, such as gypsum board, which is sealed to framing members and adjacent components by gaskets, caulking, tape or other methods to complete the air barrier protection. In such cases, special care in sealing joints in a separate vapour barrier is not critical. These techniques often use no separate vapour barrier but rely on appropriate paint coatings to give the interior finish sufficient resistance to water vapour diffusion that it can provide the required vapour barrier protection.

The wording in this Section allows for such innovative techniques, as well as the more traditional approach of using a continuous sheet, such as polyethylene, to act as an "air/vapour barrier."

Further information is available in "Moisture Problems in Houses," by A.T. Hansen, Canadian Building Digest 231, available from the Institute for Research in Construction, National Research Council of Canada, Ottawa K1A 0R6.

9.25.1. Scope

9.25.1.1. Application

(1) This Section applies to thermal insulation and measures to control condensation for *buildings* of *residential occupancy* intended for use on a continuing basis during the winter months.

(2) Insulation of heating and ventilating ducts shall conform to Sections 9.32 and 9.33.

9.25.2. General

9.25.2.1. Required Insulation. All walls, ceilings and floors separating heated space from unheated space, the exterior air or the exterior soil shall be provided with sufficient thermal insulation to prevent moisture condensation on their room side during the winter and to ensure comfortable conditions for the occupants.

9.25.2.2. Barrier to Air Leakage. Thermally insulated wall, ceiling and floor assemblies shall be constructed so as to provide a continuous barrier to leakage of air from the interior of the building into wall spaces, floor spaces or *attic or roof spaces*.

9.25.2.3. Barrier to Vapour Diffusion. Except as provided in Article 9.25.6.3., thermally insulated wall, ceiling and floor assemblies shall be constructed so as to provide a barrier to diffusion of water vapour from the interior into wall spaces, floor spaces or *attic or roof spaces*.

9.25.3. Materials

9.25.3.1. Insulation Material Standards

(1) Except as required in Sentence (2), thermal insulation shall conform to the requirements of

(a) CSA A101, "Thermal Insulation, Mineral Fibre, for Buildings,"
(b) CAN/CSA-A247-M, "Insulating Fibreboard,"
(c) CAN/CGSB 51.20-M, "Thermal Insulation, Polystyrene, Boards and Pipe Covering,"
(d) CGSB 51-GP-21M, "Thermal Insulation, Urethane and Isocyanurate, Unfaced,"
(e) CAN/CGSB-51.25-M, "Thermal Insulation, Phenolic, Faced,"
(f) CAN/CGSB-51.26-M, "Thermal Insulation, Urethane and Isocyanurate, Board, Faced,"
(g) CGSB 51-GP-27M, "Thermal Insulation, Polystyrene, Loose Fill," or
(h) CGSB 51-GP-60M, "Thermal Insulation, Cellulose Fibre, Loose Fill."

(2) The *flame-spread ratings* requirements contained in the standards listed in Sentence (1) shall not apply. (See Appendix A.)

A-9.25.3.1.(2) Flame-Spread Ratings of Insulating Materials. Part 9 has no requirements for flame-spread ratings of insulation materials since these are seldom exposed in parts of buildings where fires are likely to start. Certain of the insulating material standards referenced in 9.25.3.1.(1) do include flame-spread rating criteria. These are included either because the industry producing the product wishes to demonstrate that their product does not constitute a fire hazard or because the product is regulated by authorities other than building authorities (e.g., Hazardous Products Act). However, the Code cannot apply such requirements to some materials and not to others. Hence, these flame-spread rating requirements are excepted in referencing these standards.

9.25.3.2. Insulation in Contact with the Ground. Insulation in contact with the ground shall be inert to the action of soil and water and shall be such that its insulative properties are not significantly reduced by moisture.

9.25.3.3. Type 1 Polystyrene Insulation. Type 1 expanded polystyrene insulation as described in CAN/CGSB 51.20M "Thermal Insulation, Expanded Polystyrene" shall not be used in contact with the ground or as roof insulation applied above the roofing membrane.

9.25.3.4. Air Barrier Materials

(1) Air barrier protection shall possess the characteristics necessary to provide an effective barrier to air exfiltration under differential air pressure due to stack effect, mechanical systems or wind.

(2) Polyethylene sheet used to provide the air barrier protection required in 9.25.2.2., shall conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction."

9.25.3.5. Vapour Barrier Materials

(1) Membrane-type vapour barriers shall conform to the requirements of

(a) CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction," or

(b) CAN2-51.33-M, "Vapor Barrier, Sheet, for Use in Building Construction."

(2) Vapour barriers conforming to Clause (1)(b) shall be Type 1 when used where a high resistance to vapour movement is required, such as in wall constructions that incorporate *exterior cladding* or sheathing having a low water vapour permeance.

9.25.4. Installation of Thermal Insulation

9.25.4.1. General

(1) Insulation shall be installed so that there is a reasonably uniform insulating value over the entire face of the insulated area.

(2) Insulation shall be applied to the full width and length of the space between furring or framing.

9.25.4.2. Batt-Type Insulation. Batt-type insulation manufactured with no membrane on either face shall be installed so that at least one face is in full and continuous contact with cladding, sheathing or other air-impermeable membrane.

9.25.4.3. Loose-Fill Insulation

(1) Except as provided in Sentences (2) and (3), loose-fill insulation shall be used on horizontal surfaces only.

(2) Water repellent loose-fill insulation may be used between the outer and inner wythes of masonry cavity walls. (See Appendix A.)

A-9.25.4.3.(2) Loose-Fill Insulation in Masonry Walls. Typical masonry cavity wall construction techniques do not lend themselves to the prevention of entry of rainwater into the wall space. For this reason, loose-fill insulation used in such space must be of the water repellant type. A test for water–repellancy of loose-fill insulation suitable for installation in masonry cavity walls can be found in ASTM C516, "Specification for Vermiculite Loose Fill Insulation."

(3) Loose-fill insulation may be used in wood frame walls of existing *buildings*. (See Appendix A.)

A-9.25.4.3.(3) Loose-Fill Insulation in Existing Wood Frame Walls. The addition of insulation into exterior walls of existing wood frame buildings increases the likelihood of damage to framing and cladding components as a result of moisture accumulation. Many older homes were constructed with little or no regard for protection from vapour transmission or air leakage from the interior. Adding thermal insulation will substantially reduce the temperature of the siding or sheathing in winter months, possibly leading to condensation of moisture at this location.

Defects in exterior cladding, flashing and caulking could result in rain entering the wall cavity. This moisture, if retained by the added insulation, could initiate the process of decay.

Steps should be taken therefore, to minimize these effects prior to the retrofit of any insulation. Any openings in walls that could permit leakage of interior heated air into the wall cavity should be sealed. The inside surface should be coated with a low-permeability paint to reduce moisture transfer by diffusion. Finally, the exterior siding, flashing and caulking should be checked and repaired if necessary to prevent rain penetration.

(4) Where soffit venting is used, measures shall be taken to prevent loose-fill insulation from causing blockage of soffit vents.

9.25.4.4. Insulation in Crawl Spaces. Insulation on the interior of foundation walls enclosing a crawl space shall be applied so that there is not less than 50 mm clearance above the crawl space floor, if the insulation is of a type that may be damaged by water.

9.25.4.5. Insulation around Slabs-on-Grade. Insulation around concrete slabs-on-grade shall be located so that heat from the *building* is not restricted from reaching the ground beneath the perimeter, where exterior walls are not supported by footings extending below frost level.

9.25.4.6. Insulation Exposed to Weather. Where insulation is exposed to the weather and subject to mechanical damage, it shall be protected with not less than 6 mm asbestos-cement board, 6 mm preservative-treated plywood or 12 mm cement parging on wire lath applied to the exposed face and edge.

9.25.4.7. Mechanical Damage. Insulation located in areas where it may be subject to mechanical damage shall be protected by a covering such as gypsum board, plywood, particleboard, waferboard, strandboard or hardboard.

9.25.4.8. Factory-Built Buildings. Insulation in factory-built *buildings* shall be installed so that it will not become dislodged during transportation.

9.25.5. Installation of Air Barrier Systems

9.25.5.1. Joints in Air Barrier Protection

(1) Where the air barrier protection consists of an air-impermeable panel-type material, all joints shall be sealed to prevent air leakage.

(2) Where the air barrier protection is formed of flexible sheet material, all joints shall be

(a) sealed, or

(b) lapped not less than 100 mm and clamped, such as between framing members, furring or blocking and rigid panels.

9.25.5.2. Air Barrier Protection with Low Permeability. Where the air barrier protection consists of a material with a water vapour permeance less than the maximum permitted for Type 2 vapour barriers in Clause 9.25.3.5.(1)(b), it shall be installed in a location where the temperature will not be below the dew point of the interior air when the exterior temperature is 10°C above the 2.5 per cent January design temperature. (See Appendix A.)

A-9.25.5.2. Location of Low Permeance Air Barriers. Generally the location in a building assembly of the air barrier is not critical; it can restrict outward movement of indoor air whether it is located near the outer surface of the assembly, near the inner surface or at some intermediate location. However, if the material chosen to act as the air barrier also has the characteristics of a vapour barrier (i.e., low permeability to water vapour), its location must be chosen more carefully in order to avoid moisture problems. Any moisture

from the indoor air which diffuses through the inner layers of the assembly or is carried by air leakage through those layers is likely to be trapped at such an air barrier. This will not cause a problem if the air/vapour barrier is located where the temperature is above the dew point of the indoor air; the trapped water vapour will remain as vapour and no harm will be done. But if the air/vapour barrier is located where the temperature is below the dew point of the indoor air, the trapped water vapour will condense as liquid water or ice. If this temperature remains below the dew point for any length of time, significant moisture could accumulate.

Moisture which remains into warmer weather can allow the growth of decay organisms. Therefore 9.25.5.2. specifies that the temperature at such an air/vapour barrier be checked when the outdoor temperature is at a fairly low value. The January 2.5 per cent value is a temperature below which the temperature in an average January can be expected to go only 2.5 per cent of the hours in the month. Using this value would certainly be safe; however, modelling studies have indicated that moisture accumulation is unlikely to be significant if the location of the air/vapour barrier is based on exterior temperatures up to 10°C above this temperature. The method of carrying out this check is illustrated in the following example (see illustration next page):

Consider this wall on a house located in an area where the January 2.5 per cent temperature, as listed in the Supplement to the National Building Code, is –30°C. The designated air barrier is a material with low water vapour permeance (extruded polystyrene); therefore, the wall should be checked for compliance with 9.25.5.2., (i.e., the wall should be checked to ensure that the temperature at the location of the air/vapour barrier is above the dew point of the interior air when the outdoor temperature is –20°C).

Thus, in this example, the temperature at the location of the air/vapour barrier is below the dew point of the interior air and the design is not acceptable for use in this area. However, similar calculations would show that, if the extruded polystyrene were 100 mm thick, its surface temperature would be 4.7°C and the design would be acceptable in this area. Similarly, if the extruded polystyrene were 50 mm thick, the wall could be used in an area where the January 2.5 per cent temperature is –20°C.

9.25.5.3. Interior/Exterior Intersections. Where an interior wall meets an exterior wall, ceiling, floor or roof required to be provided with air barrier protection, the protection shall extend across the intersection.

9.25.5.4. Penetrations of Air Barrier Protection. Penetrations of the air barrier protection, such as those created by the installation of doors, windows, electrical wiring, electrical boxes, piping or ductwork, shall be sealed to maintain the integrity of the air barrier protection over the entire surface.

9.25.5.5. Access Hatches. Access hatches through surfaces requiring air barrier protection shall be weatherstripped around their perimeters to prevent air leakage.

9.25.5.6. Joints in Ductwork. Ductwork passing through unheated spaces shall have all joints taped or be otherwise sealed to ensure that the ducts are airtight throughout their length.

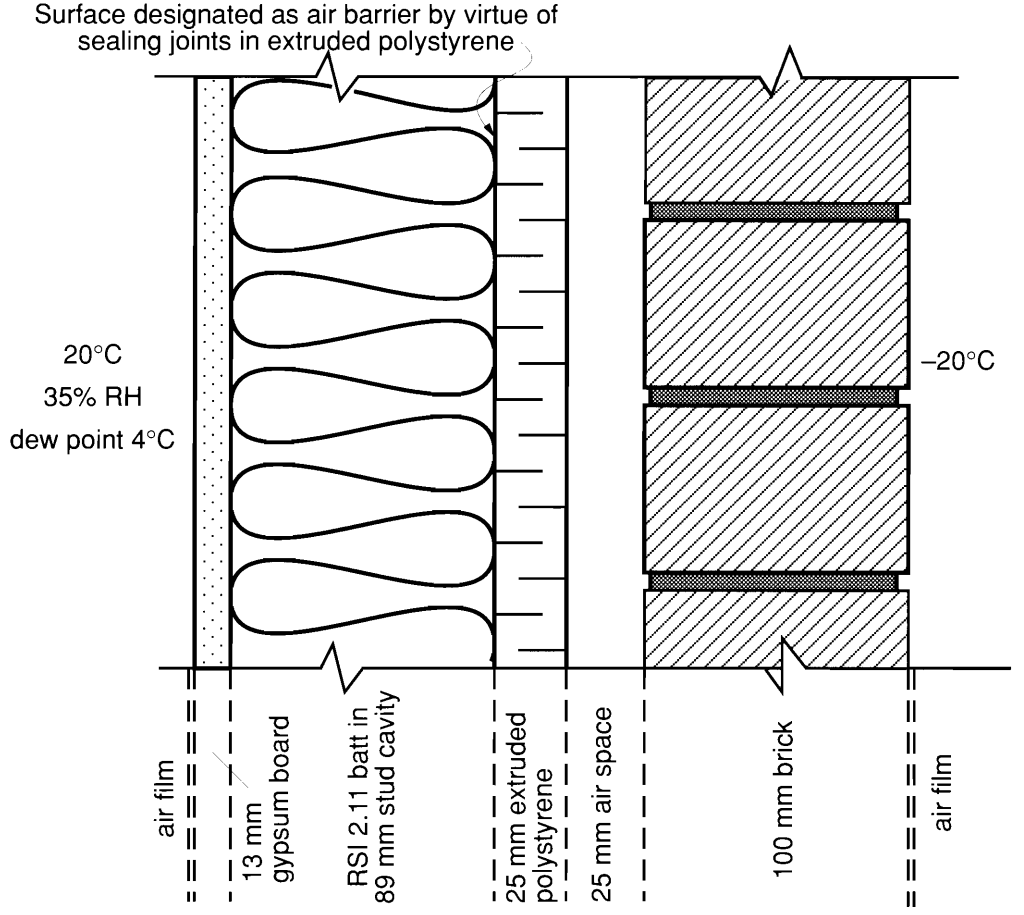
9.25.5.7. Clearances around Chimneys and Vents. Clearances between *chimneys* or *gas vents* and the surrounding construction which would permit air leakage from within the *building* into a wall or *attic or roof space* shall be sealed by *noncombustible* material to prevent such leakage.

9.25.5.8. Hollow Masonry Walls

(1) Masonry walls of hollow units which penetrate the ceiling shall be sealed at or near the ceiling adjacent to the roof space to prevent air within the voids from entering the *attic or roof space* by

(a) capping with masonry units without voids, or

(b) installation of flashing material extending across the full width of the masonry.



RSI value	0.12	0.08	2.11	0.87	0.17	0.07	0.03
RSI / (total RSI)	0.04	0.02	0.61	0.25	0.05	0.02	0.01
Temp. drop, K	1.60	0.80	24.40	10.00	2.00	0.80	0.40
Surf. Temp., °C	+20	+18.4	+17.6	–6.8	–16.8	–18.8	–19.6 –20

9.25.6. Installation of Vapour Barriers

9.25.6.1. General. Vapour barrier protection shall be installed to protect the entire surfaces of thermally insulated wall, ceiling and floor assemblies.

9.25.6.2. Location of Vapour Barriers. Vapour barrier protection shall be installed on the warm side of insulation.

A-9.25.6.2. Location of Vapour Barriers. Assemblies in which the vapour barrier is located partway through the insulation meet the intent of this Article provided it can be shown that the temperature of the vapour barrier will not fall below the dew point of the heated interior air.

9.25.6.3. Low Permeance Insulation

(1) Additional vapour barrier protection is not required with insulation when

(a) the insulation is of a type which, when installed, has a vapour permeance less than that required for vapour barriers in Article 9.25.3.5., or
(b) the insulation is foamed plastic insulation with a permeance rating of not more than 230 ng/Pa · s · m^2 and is installed in continuous contact with masonry or concrete walls.

(See Appendix A.)

A-9.25.6.3. Low Permeance Insulation. Where foamed plastic provides the resistance to water vapour specified in this Article, then no additional vapour barrier is necessary to reduce the rate of water vapour diffusion. Most serious problems resulting from moisture condensation, however, are the result of the leakage of moist air from inside the building into concealed wall spaces during colder weather. (See 9.25.) In most cases, vapour diffusion accounts for only a small fraction of the total moisture.

If the insulation is installed by spot applied adhesives, large areas of the wall can share common interconnected air spaces between the insulation and the masonry. These can allow openings in the interior finish (due to holes, cracks, electrical boxes and other discontinuities) to communicate with openings in the exterior masonry surface (e.g. from cracks, joints and weep holes). Any air pressure differential between the inside and outside due to wind effects, mechanical equipment or buoyancy of warm air (stack effect) can cause room air to leak into the cavity between the insulation and masonry and condense as water or eventually as ice. The stack effect increases with the height of the building and is greatest at the top of the building.

Insulation should therefore be installed in continuous contact with the masonry to eliminate the space between them. If this is impractical, the adhesive should be applied as a continuous band around the perimeter of the back side of the insulation to prevent spaces behind the insulation from communicating with each other. While this may not eliminate potential problems, it reduces the risk of an air leak in the interior finish affecting a large area of wall surface. (See Article 9.20.13.10. for dampproofing masonry walls insulated with foamed plastic.)

Section 9.26 Roofing

9.26.1. General

9.26.1.1. Purpose of Roofing. Roofs shall be protected with roofing, including flashing, installed to shed rain effectively and prevent water due to ice damming from entering the roof.

9.26.1.2. Alternate Installation Methods. Methods described in CAN3-A123.51, "Asphalt Shingle Application on Roof Slopes 1:3 and Steeper," or CAN3-A123.52, "Asphalt Shingle Application on Roof Slopes 1:6 to less than 1:3" are permitted to be used for asphalt shingle applications not described in this Section.

9.26.2. Roofing Materials

9.26.2.1. Material Standards

(1) Roofing materials shall conform to
(a) CAN/CGSB 37.4-M, "Cement, Lap, Cutback Asphalt, Fibrated, for Asphalt Roofing,"
(b) CAN/CGSB 37.5-M, "Cement, Plastic, Cutback Asphalt,"
(c) CAN/CGSB 37.8-M, "Asphalt, Cutback, Filled, for Roof Coating,"
(d) CGSB 37-GP-9Ma, "Primer, Asphalt for Asphalt Roofing, Dampproofing and Waterproofing,"
(e) CGSB 37-GP-21M, "Tar, Cutback, Fibrated, for Roof Coating,"
(f) CGSB 37-GP-50M, "Asphalt, Rubberized, Hot Applied for Roofing and Waterproofing,"
(g) CGSB 37-GP-52M, "Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric,"
(h) CGSB 37-GP-54M, "Roofing and Waterproofing Membrane, Sheet Applied, Flexible, Polyvinyl Chloride,"
(i) CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing,"
(j) CGSB 41-GP-6M, "Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced,"
(k) CAN2-51.32, "Sheathing, Membrane, Breather Type,"

(l) CSA A123.1, "Asphalt Shingles Surfaced with Mineral Granules,"
(m) CSA A123.2, "Asphalt Coated Roofing Sheets,"
(n) CSA A123.3, "Asphalt or Tar Saturated Roofing Felt,"
(o) CSA A123.4, "Bitumen for Use in Construction of Built-Up Roof Coverings and Dampproofing and Waterproofing Systems,"
(p) CSA A123.17, "Asphalt-Saturated Felted Glass-Fibre Mat for Use in Construction of Built-Up Roofs," or
(q) CSA-O118.1, "Western Red Cedar Shingles, and Shakes."

9.26.2.2. Nails

(1) Nails used for roofing shall be corrosion-resistant roofing or shingle nails conforming to CSA B111, "Wire Nails, Spikes and Staples."

(2) Nails shall have sufficient length to penetrate through, or 12 mm into, roof sheathing.

(3) Nails used with asphalt roofing shall have a head diameter of not less than 9.5 mm and a shank thickness of not less than 2.95 mm.

(4) Nails used with wood shingles or shakes shall have a head diameter of not less than 4.8 mm and a shank thickness of not less than 2.0 mm and shall be stainless steel, aluminum or hot-dipped galvanized. (See Appendix A.)

A-9.26.2.2.(4) Fasteners for Treated Shingles. Where shingles or shakes have been chemically treated with a preservative or a fire retardant, the fastener should be of a material known to be compatible with the chemicals used in the treatment.

9.26.2.3. Staples

(1) Staples used to apply asphalt or wood shingles shall be corrosion-resistant and shall be driven with the crown parallel to the eaves.

(2) Staples used with asphalt shingles shall be not less than 19 mm long, 1.6 mm diam or thickness, with not less than a 25 mm crown, except that an 11 mm crown may be used if the number of staples specified in Article 9.26.7.4. is increased by one-third.

(3) Staples used with wood shingles shall be not less than 29 mm long, 1.6 mm diam or thickness, with not less than a 9.5 mm crown and shall be stainless steel or aluminum. (See 9.26.2.2.(4).)

9.26.3. Roof Slope

9.26.3.1. Slope

(1) Except as provided in Sentences (2) and (3), the roof slopes on which roof coverings may be applied shall conform to Table 9.26.3.A.

(2) Asphalt and gravel or coal tar and gravel roofs may be constructed with lower slopes than required in Sentence (1) when effective drainage is provided by roof drains located at the lowest points on the roofs.

(3) Sheet metal roof cladding systems specifically designed for low-slope applications are permitted to be installed with lower slopes than required in Sentence (1).

9.26.4. Flashing at Intersections

9.26.4.1. Materials. Sheet metal flashing shall consist of not less than 1.73 mm thick sheet lead, 0.33 mm thick galvanized steel, 0.46 mm thick copper, 0.46 mm thick zinc or 0.48 mm thick aluminum.

9.26.4.2. Valley Flashing

(1) Where sloping surfaces of shingled roofs intersect to form a valley, the valley shall be flashed.

(2) Closed valleys shall not be used with rigid shingles on slopes of less than 1 in 1.2.

(3) Open valleys shall be flashed with not less than one layer of sheet metal not less than 600 mm wide, or 2 layers of roll roofing.

(4) The bottom layer of roofing required in Sentence (3) shall consist of not less than Type S smooth roll roofing or Type M mineral surface roll roofing (mineral surface down) not less than 457 mm wide, centred in the valley and fastened with nails spaced not more than 450 mm o.c. located 25 mm away from the edges.

(5) The top layer of roofing required in Sentence (3) shall consist of not less than Type M mineral surface roll roofing (mineral surface up), 914 mm wide, centred in the valley, applied over a 100 mm wide strip of cement along each edge of the

Table 9.26.3.A.
Forming Part of Sentence 9.26.3.1.(1)

Roofing Types and Slope Limits of Roofs		
Type of Roofing	Minimum Slope	Maximum Slope
Built-up Roofing		
Asphalt base (gravelled)	1 in 50 (1)	1 in 4
Asphalt base (without gravel)	1 in 25	1 in 2
Coal-tar base (gravelled)	1 in 50 (1)	1 in 25
Cold process	1 in 25	1 in 1.33
Asphalt Shingles		
Normal application	1 in 3	no limit
Low slope application	1 in 6	no limit
Roll Roofing		
Smooth and mineral surfaced	1 in 4	no limit
480 mm wide selvage asphalt roofing	1 in 6	no limit
Cold application felt	1 in 50	1 in 1.33
Wood Shingles	1 in 4	no limit
Handsplit Shakes	1 in 3	no limit
Asbestos-Cement Corrugated Sheets	1 in 4	no limit
Corrugated Metal Roofing	1 in 4	no limit
Sheet Metal Shingles	1 in 4	no limit
Slate Shingles	1 in 2	no limit
Clay Tile	1 in 2	no limit
Glass Fibre Reinforced Polyester Roofing Panels	1 in 4	no limit
Column 1	2	3

Note to Table 9.26.3.A.:
(1) See Sentences 9.26.3.1.(2) and (3).

bottom layer, and fastened with a sufficient number of nails to hold it in place until the shingles are applied.

9.26.4.3. Intersection of Shingle Roofs and Masonry

(1) The intersection of shingle roofs and masonry walls or *chimneys* shall be protected with flashing.

(2) Counter flashing required in Sentence (1) shall be embedded not less than 25 mm in the masonry and shall extend not less than 150 mm down the masonry and lap the lower flashing not less than 100 mm.

(3) Flashing along the slopes of a roof described in Sentence (1) shall be stepped so that there is not less than a 75 mm head lap in both the lower flashing and counter flashing.

(4) Where the roof described in Sentence (1) slopes upwards from the masonry, the flashing shall extend up the roof slope to a point equal in height to the flashing on the masonry, but not less than 1.5 times the shingle exposure.

9.26.4.4. Intersection of Shingle Roofs and Walls Other Than Masonry

(1) The intersection of shingle roofs and walls clad with other than masonry shall be protected with flashing.

(2) Flashing required in Sentence (1) shall be installed so that it extends up the wall not less than 75 mm behind the sheathing paper, and extends not less than 75 mm horizontally.

(3) Along the slope of the roof, the flashing required in Sentence (1) shall be stepped with not less than a 75 mm head lap.

9.26.4.5. Intersection of Built-Up Roofs and Masonry

(1) The intersection of built-up roofs with masonry walls or *chimneys* shall have a cant strip at the intersection, and a roofing membrane shall be mopped over the cant strip and not less than 150 mm up the wall.

(2) Counter flashing installed over the intersection referred to in Sentence (1) shall be embedded not less than 25 mm in the masonry, and shall be of sufficient length to extend down not less than 150 mm, lapping the membrane on the masonry not less than 100 mm.

9.26.4.6. Intersection of Built-Up Roofs and Walls other than Masonry

(1) The intersection of built-up roofs with walls clad with other than masonry shall have a cant strip at the intersection.

(2) The roofing membrane shall be mopped over the cant strip referred to in Sentence (1).

(3) Flashing plies shall extend not less than 150 mm up the wall referred to in Sentence (1) behind the sheathing paper.

9.26.4.7. Chimney Saddles

(1) Except as otherwise permitted in Sentence (5), *chimney* saddles shall be installed where the upper side of a *chimney* on a sloping roof is more than 750 mm wide.

(2) *Chimney* saddles shall be covered with sheet metal or roofing material of weight and quality equivalent to the roofing.

(3) Saddles shall be suitably flashed where they intersect the roof.

(4) The intersection of the saddle and the *chimney* shall be flashed and counterflashed as in Article 9.26.4.3.

(5) A *chimney* saddle need not be installed if the intersection between the *chimney* and roof is protected by sheet metal flashing that extends up the *chimney* to a height equal to not less than one sixth the width of the *chimney*, but not less than 150 mm, and up the roof slope to a point equal in height to the flashing on the *chimney*, but not less than 1.5 times the shingle exposure.

(6) Flashing described in Sentence (5) at the *chimney* shall be counterflashed as required by Article 9.26.4.3.

9.26.5. Eave Protection for Shingles and Shakes

9.26.5.1. Required Eave Protection

(1) Except as provided in Sentence (2), eave protection shall be provided on shingle, shake or tile roofs, extending from the edge of the roof a minimum of 900 mm up the roof slope to a line not less than 300 mm inside the inner face of the exterior wall.

(2) Eave protection is not required

(a) over unheated garages, carports and porches,

(b) where the roof overhang exceeds 900 mm measured along the roof slope from the edge of the roof to the inner face of the exterior wall,

(c) on roofs of asphalt shingles installed in accordance with Subsection 9.26.8.,

(d) on roofs with slopes of 1 in 1.5 or greater, or

(e) in regions with 3 500 or fewer degree-days.

9.26.5.2. Materials

(1) Eave protection shall be laid beneath the starter strip and shall consist of

(a) No. 15 asphalt-saturated felt laid in two plies lapped 480 mm and cemented together with lap cement,

(b) Type M or S roll roofing laid with not less than 100 mm head and end laps cemented together with lap cement,

(c) glass fibre or polyester fibre coated base sheets, or
(d) self-sealing composite membranes consisting of modified bituminous coated material.

9.26.6. Underlay beneath Shingles

9.26.6.1. Materials. When underlay is used beneath shingles, it shall be asphalt-saturated sheathing paper weighing not less than 0.195 kg/m^2 or No. 15 plain or perforated asphalt-saturated felt or 0.05 mm polyethylene, except that underlayment used beneath wood shingles shall be breather type.

9.26.6.2. Installation

(1) When used with shingles, underlay shall be installed parallel to the eaves with head and end lap of not less than 50 mm.

(2) The top edge of each strip of underlay referred to in Sentence (1) shall be fastened with sufficient roofing nails to hold it in place until the shingles are applied.

(3) The underlay referred to in Sentence (1) shall overlap the eave protection by not less than 100 mm. (See Article 9.26.10.2. for underlay beneath wood shakes.)

9.26.7. Asphalt Shingles on Slopes of 1 in 3 or Greater

9.26.7.1. Coverage. Coverage shall be not less than 2 thicknesses of shingle over the entire roof, disregarding cutouts.

9.26.7.2. Starter Strip

(1) A starter strip shall be installed along the lower edge of the roof so that it extends approximately 12 mm beyond the eaves and rake of the roof and fastened along the bottom edge with nails spaced not more than 300 mm o.c.

(2) Starter strips shall be not less than Type M mineral-surfaced roll roofing not less than 300 mm wide, or shingles of the same weight and quality as those used as a roof covering with tabs facing up the roof slope.

(3) Starter strips may be omitted where eave protection of not less than Type M mineral-surfaced roll roofing is provided.

9.26.7.3. Head Lap. Shingles shall have a head lap of not less than 50 mm.

9.26.7.4. Fasteners

(1) Shingles shall be fastened with no fewer than 4 nails or staples for 1 m wide shingles so that no nails or staples are exposed.

(2) Fasteners may be reduced for narrower shingles in proportion to the width of the shingle or when shingles incorporating interlocking devices are used.

(3) Fasteners referred to in Sentence (1) shall be located 25 mm to 40 mm from each end of each strip shingle with other fasteners equally spaced between them.

(4) Fasteners referred to in Sentence (1) shall be located not less than 12 mm above the tops of the cutouts.

9.26.7.5. Securing of Tabs. Shingle tabs shall be secured by a spot of plastic cement not exceeding 25 mm diam under the centre of each tab or by interlocking devices or self-sealing strips.

9.26.7.6. Hips and Ridges

(1) Shingles on hips and ridges shall be applied so they extend not less than 100 mm on either side of the hip or ridge, and shall be lapped not less than 150 mm.

(2) Shingles referred to in Sentence (1) shall be fastened with nails or staples on each side located not more than 25 mm from the edge and 25 mm above the butt of the overlying shingle.

9.26.7.7. Eave Protection. Eave protection shall conform to Subsection 9.26.5.

9.26.7.8. Flashing. Flashing shall conform to Subsection 9.26.4.

9.26.8. Asphalt Shingles on Slopes of less than 1 in 3

9.26.8.1. Coverage. Except for the first 2 courses, coverage shall be not less than 3 thicknesses of shingle over the entire roof, disregarding cutouts.

9.26.8.2. Starter Strip

(1) A starter strip shall be installed as in Article 9.26.7.2.

(2) Starter strips required in Sentence (1) shall be laid in a continuous band of cement not less than 200 mm wide.

9.26.8.3. Securing of Tabs. Shingle tabs shall be secured with cold application cement applied at the rate of not less than 0.5 L/m^2 of cemented area, or hot application asphalt applied at the rate of 1 kg/m^2 of cemented area.

9.26.8.4. Securing of Shingle Courses

(1) The first course of shingles shall be secured by a continuous band of cement along the eaves applied so that the width of the band equals the shingle exposure plus 100 mm and the band is located not less than 50 mm above the lower edge of the starter strip.

(2) The succeeding courses of shingles shall be secured by a continuous band of cement applied so that the width of the band equals the shingle exposure plus 50 mm.

(3) The band required in Sentence (2) shall be located not less than 25 mm nor more than 50 mm above the butt of the overlying course of shingles.

9.26.8.5. Hips and Ridges

(1) Shingles on hips and ridges shall be not less than 300 mm wide applied to provide triple coverage.

(2) Shingles referred to in Sentence (1) shall be cemented to the roof shingles and to each other with a coat of cement 25 mm from the edges of the shingles and fastened with nails or staples located 40 mm above the butt of the overlying shingle and 50 mm from each edge.

9.26.8.6. Flashing. Flashing shall conform to Subsection 9.26.4.

9.26.8.7. Fastening. Shingles shall be fastened in accordance with Article 9.26.7.4.

9.26.9. Wood Roof Shingles

9.26.9.1. Decking. Decking for wood shingled roofs may be continuous or spaced.

9.26.9.2. Grade. Shingles shall be not less than No. 2 grade.

9.26.9.3. Size. Wood shingles shall be not less than 400 mm long and not less than 75 mm nor more than 350 mm wide.

9.26.9.4. Spacing and Joints. Shingles shall be spaced approximately 6 mm apart and offset at the joints in adjacent courses not less than 40 mm so that joints in alternate courses are staggered.

9.26.9.5. Fastening. Shingles shall be fastened with 2 nails or staples located approximately 20 mm from the sides of the shingle and 40 mm above the exposure line.

9.26.9.6. Exposure. The exposure of wood roof shingles shall conform to Table 9.26.9.A.

9.26.9.7. Flashing. Flashing shall conform to Subsection 9.26.4.

Table 9.26.9.A.
Forming Part of Article 9.26.9.6.

Maximum Exposure of Wood Roof Shingles, mm						
Roof Slope	No. 1 Grade Length of Shingle			No. 2 Grade Length of Shingle		
	400 mm	450 mm	600 mm	400 mm	450 mm	600 mm
Less than 1 in 3	100	115	165	90	100	140
1 in 3	125	140	190	90	100	140
Over 1 in 3	125	140	190	100	115	165
Column 1	2	3	4	5	6	7

9.26.9.8. Eave Protection. Eave protection shall conform to Subsection 9.26.5.

9.26.10. Handsplit Roof Shakes

9.26.10.1. Size and Thickness. Shakes shall be not less than 450 mm long and not less than 100 mm nor more than 350 mm wide with a butt thickness of not more than 32 mm and not less than 9 mm.

9.26.10.2. Underlay

(1) Where eave protection is not provided, an underlay conforming to the requirements in Article 9.26.6.1. for wood shingles shall be laid as a strip not less than 900 mm wide along the eaves.

(2) A strip of material similar to that described in Sentence (1) not less than 450 mm wide shall be interlaid between each course of shakes with the bottom edge of the strip positioned above the butt line at a distance equal to double the exposure of the shakes.

(3) Interlaid strips referred to in Sentence (2) shall be lapped not less than 150 mm at hips and ridges in a manner that will prevent water from reaching the roof sheathing.

9.26.10.3. Spacing and Joints. Shakes shall be spaced 6 mm to 9 mm apart and offset at the joints in adjacent courses not less than 40 mm so that joints in alternate courses are staggered.

9.26.10.4. Fastening. Shakes shall be fastened with nails located approximately 20 mm from the sides of the shakes and 40 mm above the exposure line.

9.26.10.5. Exposure. The exposure of wood shakes shall not exceed 190 mm for shakes not less than 450 mm long and 250 mm for shakes not less than 600 mm long.

9.26.10.6. Flashing. Flashing shall conform to Subsection 9.26.4.

9.26.10.7. Eave Protection. Eave protection shall conform to Subsection 9.26.5.

9.26.11. Built-Up Roofs

9.26.11.1. Quantity of Materials. The quantities of bituminous materials used on built-up roofs shall conform to Table 9.26.11.A.

Table 9.26.11.A.
Forming Part of Article 9.26.11.1.

Quantities of Bitumen for Built-Up Roofs		
Type of Roof	Amount of Bitumen per Square Metre of Roof Surface	
	Mopping Coats between Layers	Flood Coat
Asphalt and aggregate	1 kg	3 kg
Coal-tar and aggregate	1.2 kg	3.6 kg
Cold process roofing	0.75 L cold process cement	2 L cold process top coating
Column 1	2	3

9.26.11.2. Coal-Tar and Asphalt Products. Coal-tar products and asphalt products shall not be used together in built-up roof construction.

9.26.11.3. Roof Felts. Bitumen roofing felts shall be not less than No. 15 felt.

9.26.11.4. Aggregate Surfacing

(1) Aggregate used for surfacing built-up roofs shall be clean, dry and durable and shall consist of particles of gravel, crushed stone or air-cooled blast furnace slag having a size of from 6 mm to 15 mm.

(2) The minimum amount of aggregate surfacing per square metre of roof surface shall be 15 kg gravel or crushed stone or 10 kg crushed slag.

9.26.11.5. Flashing. Flashing shall conform to Subsection 9.26.4.

9.26.11.6. Number of Layers. Built-up roofing shall consist of not less than 3 mopped-down layers of roofing felt flood coated with bitumen.

9.26.11.7. Installation of Layers

(1) In hot process applications each layer of bitumen-saturated felt shall be laid while the bitumen is hot, with each layer overlapping the previous one.

(2) The full width under each lap referred to in Sentence (1) shall be coated with bitumen so that in no place does felt touch felt.

(3) Felt shall be laid free of wrinkles and shall be rolled directly into the hot bitumen and broomed forward and outward from the centre to ensure complete adhesion.

9.26.11.8. Roofing over Wood-Based Sheathing

(1) Except as permitted in Sentence (2), built-up roofing applied over wood, plywood, waferboard or strandboard roof sheathing shall be laid over an additional base layer of felt laid dry over the entire roof deck with not less than a 50 mm headlap and a 50 mm sidelap between each sheet.

(2) Where plywood, waferboard or strandboard roof sheathing is used, the dry layer of felt required in Sentence (1) may be omitted when the joints are taped and the sheathing is primed with asphalt.

9.26.11.9. Attachment to Decking.

Roofing shall be securely attached to the decking or where insulation is applied above the deck, the insulation shall be securely attached to the deck before the first layer of felt is fastened to the insulation.

9.26.11.10. Cant Strips

(1) Except as permitted in Sentence (4), a cant strip shall be provided at the edges of roofs.

(2) No fewer than 2 plies of the roofing membrane shall be carried over the top of the cant strip.

(3) Flashing shall extend over the top of the cant strip and be shaped to form a drip.

(4) The cant strip required in Sentence (1) may be omitted where a gravel stop is provided at the edge of roofs.

(5) The roofing membranes shall be carried over the edge of the roof before the gravel stop is fastened and 2 plies of roofing membrane mopped to the top surface of the gravel stop referred to in Sentence (4) before the flood coat is applied.

(6) The gravel stop referred to in Sentence (4) shall extend over the edge of the roof to form a drip or shall be flashed so that the flashing extends over the edge to form a drip.

9.26.12. Selvage Roofing

9.26.12.1. Wide selvage asphalt roofing shall provide double coverage over the entire roof surface.

9.26.12.2. Plies of selvage roofing shall be cemented together to ensure a water tight joint.

9.26.13. Sheet Metal Roofing

9.26.13.1. Sheet metal roofing shall be not less than 0.33 mm thick galvanized steel, 0.46 mm thick copper, 0.46 mm thick zinc or 0.48 mm thick aluminum.

9.26.14. Glass Reinforced Polyester Roofing

9.26.14.1. Where glass reinforced polyester roofing panels are not supported by roof decking but span between spaced supports, the panels shall be designed to support the design roof load.

9.26.15. Hot Applied Rubberized Asphalt Roofing

9.26.15.1. Hot applied rubberized asphalt roofing shall be installed in accordance with CGSB 37-GP-51M, "Application of Rubberized Asphalt, Hot Applied, for Roofing and Waterproofing."

9.26.16. Polyvinyl Chloride Sheet Roofing

9.26.16.1. Polyvinyl chloride sheet applied roofing membrane shall be installed in accordance with CGSB 37-GP-55M, "Application of Sheet Applied Flexible Polyvinyl Chloride Roofing Membrane."

9.26.17. Downspouts and Roof Drains

9.26.17.1. Where downspouts are provided and are not connected to a sewer, extensions shall be provided to carry rainwater away from the *building* in a manner which will prevent soil erosion.

Section 9.27 Siding

9.27.1. Scope

9.27.1.1. Application. This Section applies to exterior wall coverings of lumber, wood shingles, shakes, asbestos-cement shingles and sheets, plywood, waferboard, hardboard, asphalt shingles, vinyl, aluminum and steel including trim, soffits and flashing.

9.27.1.2. Stucco and Masonry Veneer. Requirements for stucco shall conform to Section 9.28 and requirements for masonry veneer shall conform to Section 9.20.

9.27.1.3. Asphalt Shingles. Where asphalt shingles are used as siding, they shall conform to the requirements in Section 9.26 for asphalt roof shingles.

9.27.2. General

9.27.2.1. Required Siding. Exterior walls shall be protected with siding, including flashing, trim and other special purpose accessory pieces required for the siding system being used, to restrict the entry of rain and snow into the wall assembly.

9.27.2.2. Clearance from Ground. Not less than a 200 mm clearance shall be provided between the finished ground level and siding that is adversely affected by moisture such as wood, plywood, waferboard, strandboard and hardboard.

9.27.2.3. Clearance from Roof Surface. Not less than a 50 mm clearance shall be provided between a roof surface and siding that is adversely affected by moisture such as wood, plywood, waferboard and strandboard and hardboard.

9.27.2.4. Insulating Asphalt Siding. Insulating asphalt siding shall be ventilated by not less than a 10 mm air space behind the siding. (See Sentence 9.25.3.5.(2))

9.27.3. Flashing

9.27.3.1. Materials. Flashing shall consist of not less than 1.73 mm thick sheet lead, 0.33 mm thick galvanized steel, 0.46 mm thick copper, 0.46 mm thick zinc, 0.48 mm thick aluminum or 1.02 mm thick vinyl.

9.27.3.2. Installation

(1) Flashing shall be installed at every horizontal junction between 2 different exterior finishes, except where the upper finish overlaps the lower finish.

(2) Except as provided in Sentence (4), flashing shall be applied over exterior wall openings where the vertical distance from the bottom of the eave to the top of the trim is more than one-quarter of the horizontal overhang of the eave.

(3) Flashing shall be installed so that it extends upwards not less than 50 mm behind the sheathing paper and forms a drip on the outside edge.

(4) Where a window or exterior door is designed to be installed without head flashing, the exterior flange of the window or door frame shall be bedded into a non-hardening type caulking material and the exterior flange screwed down over the caulking material to the wall framing to form a waterproof joint.

9.27.4. Caulking

9.27.4.1. Required Caulking

(1) Caulking shall be provided where required to prevent the entry of water into the structure.

(2) Caulking shall be provided between masonry, siding or stucco and the adjacent door and window frames or trim, including sills unless such locations are completely protected from the entry of rain.

(3) Caulking shall be provided at vertical joints between different cladding materials unless the joint is suitably lapped or flashed to prevent the entry of rain. (See Articles 9.7.4.2., 9.20.13.12. and 9.28.1.5.)

9.27.4.2. Materials

(1) Caulking shall be of a non-hardening type suitable for exterior use, selected for its ability to resist the effects of weathering and shall be compatible with and adhere to the substrate to which it is applied.

(2) Caulking shall conform to

(a) CGSB 19-GP-5M, "Sealing Compound, One Component, Acrylic Base, Solvent Curing,"

(b) CAN/CGSB-19.13, "Sealing Compound, One Component, Elastomeric, Chemical Curing,"

(c) CGSB 19-GP-14M, "Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing," or

(d) CAN2-19.24, "Sealing Compound, Multi-Component, Chemical Curing."

9.27.5. Attachment of Siding

9.27.5.1. Attachment

(1) Except as permitted in Sentences (2) to (7), siding shall be nailed to the framing members, furring members or to blocking between the framing members.

(2) Vertical lumber and stucco lath or reinforcing may be attached to sheathing only where the sheathing consists of not less than 14.3 mm lumber, 12.5 mm plywood or 12.5 mm waferboard and strandboard.

(3) Vertically applied metal siding and wood shingles and shakes may be attached to the sheathing only where the sheathing consists of not less than 14.3 mm lumber, 7.5 mm plywood or 7.5 mm waferboard and strandboard.

(4) Asbestos-cement shingles may be attached to the sheathing only when the sheathing consists of not less than 14.3 mm lumber, 9.5 mm plywood or 9.5 mm waferboard and strandboard.

(5) Where wood shingles or shakes are applied to sheathing which is not suitable for attaching the shingles or shakes, the shingles or shakes may be attached to a wood lath not less than 38 mm by 9.5 mm thick securely nailed to the framing and applied as described in Article 9.27.7.5.

(6) Where asbestos-cement shingles are applied to sheathing that is not suitable for attaching the shingles, the shingles may be fastened to a wood lath not less than 89 mm by 9.5 mm thick securely nailed to the framing.

(7) Lath referred to in Sentence (6) shall be applied so that it overlaps the preceding shingle course by not less than 20 mm.

9.27.5.2. Blocking. Blocking for the attachment of siding shall be not less than 38 mm by 38 mm lumber securely nailed to the framing and spaced not more than 600 mm o.c.

9.27.5.3. Furring

(1) Except as permitted in Sentences 9.27.5.1.(5) and (6), furring for the attachment of siding shall be not less than 19 mm by 38 mm lumber when applied over sheathing.

(2) When applied without sheathing furring referred to in Sentence (1) shall be not less than 19 mm by 64 mm lumber on supports spaced not more than 400 mm o.c., and 19 mm by 89 mm on supports spaced not more than 600 mm o.c.

(3) Furring referred to in Sentence (1) shall be securely fastened to the framing and shall be spaced not more than 600 mm o.c.

9.27.5.4. Size and Spacing of Fasteners. Nail or staple size and spacing for the attachment of siding and trim shall conform to Table 9.27.5.A.

9.27.5.5. Fastener Materials. Nails or staples for the attachment of sidings and wood trim shall be corrosion-resistant and shall be compatible with the siding material.

9.27.5.6. Expansion and Contraction. Fasteners for metal or vinyl siding shall be positioned to permit expansion and contraction of the siding.

9.27.5.7. Penetration of Fasteners

(1) Fasteners for shakes and shingles shall penetrate through the nail-holding base or not less than 19 mm into the framing.

(2) Fasteners for siding other than that described in Sentence (1) shall penetrate through the nail-holding base or not less than 25 mm into the framing.

Table 9.27.5.A.
Forming Part of Article 9.27.5.4.

Attachment of Siding			
Type of Siding	Minimum Nail or Staple Length, mm	Minimum Number of Nails or Staples	Maximum Nail or Staple Spacing
Wood trim	51	—	600 mm (o.c.)
Lumber siding or horizontal siding made from sheet material	51	—	600 mm (o.c.)
Metal siding			600 mm (o.c.) (nailed to framing) 400 mm (o.c.) (nailed to sheathing only)
Handsplit wood shakes up to 200 mm in width	51	2	—
Handsplit wood shakes over 200 mm in width	51	3	—
Wood shingles and machine grooved shakes up to200 mm in width	32	2	—
Wood shingles and machine grooved shakes over 200 mm in width	32	3	—
Asbestos-cement shingles	32	2	—
Panel or sheet type siding up to 7 mm thick	38	—	150 mm (o.c.) along edges
Panel or sheet type siding more than 7 mm thick	51	—	300 mm (o.c.) along intermediate supports
Column 1	2	3	4

9.27.6. Lumber Siding

9.27.6.1. Materials. Lumber siding shall be sound, free of knot holes, loose knots, through checks or splits.

9.27.6.2. Thickness and Width

(1) Drop, rustic, novelty, lapped board and vertical wood siding shall be not less than 14.3 mm thick and not more than 286 mm wide.

(2) Bevel siding shall be not less than 5 mm thick at the top and 12 mm thick at the butt for sidings 184 mm or less in width, and 14.3 mm thick at the butt for sidings wider than 184 mm.

(3) Bevel siding shall be not more than 286 mm wide.

9.27.6.3. Joints

(1) Lumber siding shall prevent water from entering at the joints by the use of lapped or matched joints or by vertical wood battens.

(2) Siding shall overlap not less than 1 mm per 16 mm width of lumber, but not less than 9.5 mm for matched siding, 25 mm for lapped bevel siding or 12 mm for vertical battens.

9.27.7. Wood Shingles and Machine Grooved Shakes

9.27.7.1. Materials

(1) Shingles and shakes shall conform to CSA O118.1, "Western Red Cedar Shingles and Shakes."

(2) Shakes shall be not less than No. 1 grade and shingles not less than No. 2 grade, except that No. 3 grade may be used for undercoursing.

9.27.7.2. Width. Shingles and shakes shall be not less than 65 mm nor more than 350 mm wide.

9.27.7.3. Fasteners. Shingles or shakes shall be fastened with nails or staples located approximately 20 mm from each edge and not less than 25 mm above the exposure line for single-course applications, or approximately 50 mm above the butt for double-course applications.

9.27.7.4. Offsetting of Joints

(1) In single-course application, joints in succeeding courses shall be offset not less than 40 mm so that joints in any 2 of 3 consecutive courses are staggered.

(2) In double-course application, joints in the outer course shall be offset from joints in the under-course by not less than 40 mm, and joints in succeeding courses shall be offset not less than 40 mm.

9.27.7.5. Fastening to Lath

(1) When lath is used with double-course application (see Sentence 9.27.5.1.(5)), it shall be spaced according to the exposure and securely fastened to the framing.

(2) The butts of the under-course of the application referred to in Sentence (1) shall rest on the top edge of the lath.

(3) The outer course of the application referred to in Sentence (1) shall be fastened to the lath with nails of sufficient length to penetrate through the lath.

(4) The butts of the shingles or shakes shall be so located that they project not less than 12 mm below the bottom edge of the lath referred to in Sentence (1).

(5) If wood lath is not used, the butts of the under-course shingles or shakes of the application referred to in Sentence (1) shall be located 12 mm above the butts of the outer course.

9.27.7.6. Exposure and Thickness. The exposure and butt thickness of shingles and shakes shall conform to Table 9.27.7.A.

Table 9.27.7.A.
Forming Part of Article 9.27.7.6.

Exposure and Thickness of Wood Shingles and Machine Grooved Shakes			
Shake or Shingle Length, mm	Maximum Exposure		Minimum Butt Thickness, mm
	Single Coursing, mm	Double Coursing, mm	
400	190	305	10
450	216	356	11
600	292	406	13
Column 1	2	3	4

9.27.8. Asbestos-Cement Shingles and Sheets

9.27.8.1. Material Standards

(1) Asbestos-cement shingles and sheets shall conform to

(a) CAN/CGSB-34.4-M, "Siding, Asbestos Cement, Shingles and Clapboards,"
(b) CAN/CGSB-34.5-M, "Sheets, Asbestos Cement, Corrugated,"
(c) CAN/CGSB-34.14-M, "Sheets, Asbestos Cement, Decorative,"
(d) CAN/CGSB-34.16, "Sheets, Asbestos Cement, Flat, Fully Compressed,"
(e) CAN/CGSB-34.17-M, "Sheets, Asbestos Cement, Flat, Semi-compressed," or
(f) CAN/CGSB-34.21-M, "Panels, Sandwich, Asbestos Cement with Insulating Cores."

9.27.8.2. Weight and Thickness

(1) Asbestos-cement shingles shall weigh not less than 8.06 kg/m^2.

(2) Asbestos-cement sheet shall be not less than 4.75 mm thick where applied to studs spaced not more than 400 mm o.c., nor less than 6 mm thick where applied to studs spaced not more than 600 mm o.c.

(3) Where applied over sheathing, the thickness of asbestos-cement sheet shall be not less than 3.15 mm.

9.27.8.3. Fastening of Shingles. Asbestos-cement shingles shall be fastened with nails located not less than 25 mm above the exposure line.

9.27.8.4. Joints of Shingles

(1) Asbestos-cement shingles shall be installed so that vertical joints in succeeding courses are staggered.

(2) Asphalt-coated backer strips shall be installed behind each vertical joint.

(3) Shingles referred to in Sentence (1) shall have not less than a 25 mm head lap.

9.27.8.5. Joints in Panels

(1) Vertical joints of asbestos-cement panels shall be protected with batten strips, caulking or other suitable method.

(2) Horizontal joints of asbestos-cement panels shall be lapped, flashed, caulked or otherwise suitably protected.

9.27.9. Plywood

9.27.9.1. Material Standards. Plywood siding shall be exterior type conforming to CSA O115, "Hardwood and Decorative Plywood," CSA O121, "Douglas Fir Plywood," CSA O151, "Canadian Softwood Plywood" or CSA O153, "Poplar Plywood."

9.27.9.2. Thickness

(1) Plywood siding shall be not less than 6 mm thick when applied directly to sheathing.

(2) When applied directly to framing or over furring strips, plywood siding thickness shall conform to Table 9.27.9.A.

(3) The thickness of grooved or textured plywood siding shall be measured at the point of least thickness.

9.27.9.3. Edge Treatment. The edges of plywood siding shall be treated with a suitable paint or sealer.

Table 9.27.9.A.
Forming Part of Sentence 9.27.9.2.(2)

Minimum Plywood Thickness, Exterior Wall Finish		
Spacing of Supports, mm	Face Grain Parallel to Supports, mm	Face Grain Right Angles to Supports, mm
400 600	8 11	6 8
Column 1	2	3

9.27.9.4. Panel Siding

(1) Plywood applied in panels shall have all edges supported.

(2) Not less than a 2 mm gap shall be provided between panels referred to in Sentence (1).

(3) Vertical joints in siding referred to in Sentence (1) shall be protected with batten strips or caulking when the plywood joints are not matched.

(4) Horizontal joints in siding referred to in Sentence (1) shall be lapped not less than 25 mm or shall be suitably flashed.

9.27.9.5. Lapped Strip Siding

(1) Plywood applied in horizontal lapped strips shall have not less than a 2 mm gap provided at the butted ends, which shall be caulked.

(2) The horizontal joints of siding described in Sentence (1) shall be lapped not less than 25 mm.

(3) Wedges shall be inserted under all vertical butt joints and at all corners when horizontal lapped plywood is applied without sheathing.

9.27.10. Hardboard

9.27.10.1. Material Standards

(1) Factory-finished hardboard siding shall conform to CAN/CGSB-11.5M, "Hardboard, Precoated, Factory-Finished, for Exterior Cladding."

(2) Hardboard siding which is not factory finished shall conform to Types 1, 2 or 5 in CAN/CGSB 11.3-M, "Hardboard."

9.27.10.2. Thickness

(1) Type 1 or 2 hardboard siding shall be not less than 6 mm thick when applied over sheathing that provides continuous support and not less than 7.5 mm thick when applied over furring or framing members not more than 400 mm o.c.

(2) Type 5 hardboard siding shall be not less than 9 mm thick when applied over sheathing that provides continuous support or over furring or framing members spaced not more than 400 mm o.c.

(3) Where hardboard siding is grooved, the grooves shall not extend more than 1.5 mm into the minimum required thickness. (See Appendix A.)

A-9.27.10.2.(3) Grooves in Hardboard Siding. Grooves deeper than that specified may be used in thicker siding providing they do not reduce the thickness to less than the required thickness minus 1.5 mm. Thus for type 1 or 2 siding, grooves must not reduce the thickness to less than 4.5 mm or 6 mm depending on method of support, or to less than 7.5 mm for type 5 material.

9.27.10.3. Panel Siding

(1) Hardboard siding applied in panels shall have all edges supported with not less than a 5 mm gap provided between sheets.

(2) Vertical joints in siding described in Sentence (1) shall be protected with batten strips or caulking when the joints are not matched.

(3) Horizontal joints in siding described in Sentence (1) shall be lapped not less than 25 mm or shall be suitably flashed.

9.27.10.4. Lapped Strip Siding

(1) Hardboard applied in horizontal lapped strips shall have not less than a 5 mm gap provided at the butted ends, which shall be caulked or otherwise protected with suitable mouldings.

(2) The horizontal joints of siding described in Sentence (1) shall overlap not less than 1 mm per 16 mm width of siding board but not less than 9.5 mm for matched joint siding or 25 mm for lapped siding.

9.27.10.5. Clearance. Not less than 3 mm clearance shall be provided between hardboard siding and door or window frames.

9.27.11. Waferboard and Strandboard

9.27.11.1. Material Standard. Waferboard and strandboard siding shall conform to CAN3-O437.0 "Waferboard and Strandboard."

9.27.11.2. Thickness

(1) Waferboard and strandboard conforming to grade O–2 shall be not less than 6.0 mm thick where applied directly to sheathing.

(2) Grade O–2 waferboard and strandboard applied directly to framing or over furring strips shall conform to the thickness shown for plywood in Table 9.27.9.A. (See Appendix A.)

A-9.27.11.2.(2) Thickness of Grade O-2 Waferboard and Strandboard. In using Table 9.28.9.A. to determine the thickness of Grade O-2 waferboard and strandboard cladding, substitute "face orientation" for "face grain" in the column headings.

(3) Waferboard and strandboard conforming to grades R–1 and O–1 shall be not less than 7.9 mm thick where applied directly to sheathing.

(4) Where applied directly to framing or over furring strips, waferboard and strandboard conforming to grades R–1 and O–1 shall be not less than 9.5 mm thick on supports spaced not more than 400 mm o.c. and 12.7 mm thick on supports spaced not more than 600 mm o.c.

9.27.11.3. Panel Siding

(1) Waferboard and strandboard applied in panels shall have all edges supported and treated with a primer or sealer.

(2) Not less than a 3 mm gap shall be provided between sheets in siding described in Sentence (1).

(3) Vertical joints in siding described in Sentence (1) shall be protected with batten strips or caulking when the waferboard and strandboard joints are not matched.

(4) Horizontal joints in siding described in Sentence (1) shall be lapped not less than 25 mm or shall be suitably flashed.

9.27.11.4. Clearance. Not less than a 3 mm clearance shall be provided between waferboard and strandboard siding and door or window frames.

9.27.12. Metal Siding

9.27.12.1. Material Standards

(1) Horizontal and vertical strip steel siding, including flashing and trim accessories, shall conform to CGSB 93-GP-4M, "Siding, Soffits and Fascia, Steel, Galvanized, Prefinished, Residential."

(2) Steel sheet siding shall have a minimum thickness of 0.3 mm and conform to CGSB 93-GP-3M, "Sheet, Steel, Galvanized, Prefinished, Residential."

(3) Horizontal and vertical strip aluminum siding, including flashing and trim accessories, shall conform to CGSB 93-GP-2Ma, "Siding, Soffits and Fascia, Aluminum, Prefinished, Residential."

(4) Aluminum sheet siding shall conform to CAN/CGSB 93.1-M, "Sheet, Aluminum Alloy, Prefinished, Residential" and shall have a thickness of not less than 0.58 mm, except that siding supported by backing or sheathing shall have a thickness of not less than 0.46 mm.

9.27.13. Vinyl Siding

9.27.13.1. Material Standard. Vinyl siding, including flashing and trim accessories, shall conform to CGSB 41-GP-24Ma, "Siding, Soffits and Fascia, Rigid Vinyl."

9.27.13.2. Attachment. The attachment of vinyl siding shall conform to the requirements in Subsection 9.27.5. for metal siding.

Section 9.28 Stucco

9.28.1. General

9.28.1.1. Sheathing beneath Stucco

(1) Sheathing shall be provided beneath stucco applied over wood-frame walls except as permitted in Article 9.28.4.2.

(2) Where applied beneath stucco, sheathing shall conform to Subsection 9.23.16.

9.28.1.2. Lath and Reinforcing

(1) Stucco lath or reinforcing shall be used to attach stucco to wood-frame construction.

(2) Stucco lath or reinforcing shall be used to attach stucco to masonry where the masonry is soft-burned tile or brick of less strength than the stucco or if the masonry surface is not sound, clean and sufficiently rough to provide a good key.

(3) Stucco applied over *masonry chimneys* shall be reinforced.

9.28.1.3. Concrete Masonry Units. Stucco finish shall not be applied over concrete masonry units less than one month old unless the units have been cured by the autoclave process.

9.28.1.4. Clearance over Ground Level. Stucco shall be not less than 200 mm above finished ground level except when it is applied over concrete or masonry.

9.28.1.5. Flashing and Caulking. Flashing and caulking used with stucco shall conform to Subsections 9.27.3. and 9.27.4., except that if aluminum flashing is used, it shall be separated from the stucco by an impervious membrane or coating. (See Article 9.7.4.2. for caulking around window frames.)

9.28.2. Stucco Materials

9.28.2.1. Portland Cement. Portland cement shall conform to CAN3-A5, "Portland Cements."

9.28.2.2. Aggregate

(1) Aggregate shall be clean, well-graded natural sand or sand manufactured from crushed stone, gravel or air-cooled blast furnace slag and shall contain no significant amounts of deleterious material.

(2) Aggregate grading shall conform to Table 9.28.2.A.

9.28.2.3. Water. Water shall be clean and free of significant amounts of deleterious material.

9.28.3. Fasteners

9.28.3.1. Materials. Fasteners for stucco lath or reinforcing shall be corrosion-resistant and of a material other than aluminum.

Table 9.28.2.A
Forming Part of Sentence 9.28.2.2.(2)

Aggregate Grading for Stucco		
Sieve Sizes, mm	Per Cent Passing	
	Maximum	Minimum
4	—	100
2	—	90
1	90	60
0.5	60	45
0.25	30	10
0.125	5	—
Column 1	2	3

9.28.3.2. Nails and Staples

(1) Nails for stucco lath or reinforcing shall be not less than 3.2 mm diam with a head diameter of not less than 11.1 mm.

(2) Staples for stucco lath or reinforcing shall be not less than 1.98 mm diam or thickness.

(3) Staples and nails for attaching stucco lath or reinforcing to vertical surfaces shall be of sufficient length to penetrate 25 mm into framing members or to the full depth of the sheathing where the sheathing is used for attachment.

(4) On horizontal surfaces nails for stucco lath or reinforcing shall be not less than 38 mm long.

9.28.4. Stucco Lath

9.28.4.1. Materials

(1) Rib lath or expanded metal stucco mesh shall be copper-alloy steel coated with rust-inhibitive paint after fabrication or shall be galvanized.

(2) Woven or welded wire mesh shall be galvanized.

9.28.4.2. No Sheathing Required. Sheathing need not be provided beneath stucco where not less than 1.19 mm diam galvanized wire is applied horizontally to the framing at vertical intervals of not more than 150 mm, or where paper-backed welded wire metal lath is used.

9.28.4.3. Stucco Lath Specifications. Stucco lath shall conform to Table 9.28.4.A.

9.28.4.4. Self-Furring Devices. Stucco lath shall be held not less than 6 mm away from the backing by means of suitable self-furring devices.

Table 9.28.4.A.
Forming Part of Article 9.28.4.3.

Stucco Lath				
Location	Type of Lath	Minimum Diam of Wire, mm	Maximum Mesh Opening	Minimum Mass, kg/m^2
Vertical surfaces	Welded or woven wire	1.19 1.35 1.60	25 mm 38 mm 51 mm	— — —
	Stucco mesh reinforcing (expanded metal)	—	25.8 cm^2	0.98
Horizontal surfaces (1)	9.5 mm rib lath	—	—	1.84
	Cedar lath	—	—	—
Column 1	2	3	4	5

Note to Table 9.28.4.A.: (1) See Appendix A.

A-9.28.4.A. Stucco Lath. Paper-backed welded wire lath may also be used on horizontal surfaces provided its characteristics are suitable for such application.

9.28.4.5. Application of Stucco Lath

(1) Stucco lath shall be applied with the long dimension horizontal. Horizontal and vertical joints shall be lapped not less than 50 mm.

(2) End joints of stucco lath shall be staggered and shall occur over framing members.

(3) External corners of stucco lath shall be reinforced with a vertical strip of lath or reinforcing extending not less than 150 mm on both sides of the corner, or the lath or reinforcing shall extend around corners not less than 150 mm.

9.28.4.6. Fastening

(1) Stucco lath shall be fastened in conformance with Subsection 9.27.5.

(2) Fasteners on vertical surfaces shall be spaced not more than 150 mm o.c. vertically and 400 mm o.c. horizontally, or 100 mm o.c. vertically and 600 mm o.c. horizontally.

(3) Nailing patterns other than those required in Sentence (2) are permitted to be used provided there are not fewer than 20 fasteners per square metre of wall surface.

(4) Fasteners on horizontal surfaces shall be spaced not more than 150 mm o.c. along the framing members when members are spaced not more than 400 mm o.c., and 100 mm o.c. along members when members are spaced not more than 600 mm o.c.

9.28.5. Stucco Mixes

9.28.5.1. Mixes. Stucco mixes shall conform to Table 9.28.5.A.

9.28.5.2. Pigments

(1) Pigment if used shall consist of pure mineral oxides inert to the action of sun, lime and cement.

(2) Pigment shall not exceed 6 per cent of the portland cement by weight.

Table 9.28.5.A.
Forming Part of Article 9.28.5.1.

Stucco Mixes (by volume)			
Portland Cement	Masonry Cement	Lime	Aggregate
1	—	0.25 to 1	3.25 to 4 parts per part of cementitious material
1	1	—	
Column 1	2	3	4

9.28.5.3. Mixing

(1) Materials shall be thoroughly mixed before and after water is added.

(2) Stucco shall be applied not later than 3 h after the initial mixing.

9.28.6. Stucco Application

9.28.6.1. Low Temperature Conditions

(1) The base for stucco shall be maintained above freezing.

(2) Stucco shall be maintained at a temperature of not less than 10°C during application, and for not less than 48 h afterwards.

9.28.6.2. Number of Coats and Total Thickness. Stucco shall be applied with not less than 2 base coats and one finish coat, providing a total thickness of not less than 15 mm, measured from the face of the lath or face of the masonry where no lath is used.

9.28.6.3. First Coat

(1) The first coat shall be not less than 6 mm thick, measured from the face of the lath or masonry, fully embedding the lath.

(2) The surface of the first coat shall be scored to provide a key with the second coat.

9.28.6.4. Second Coat

(1) The second coat shall be not less than 6 mm thick.

(2) The surface of the second coat shall be lightly roughened to provide a key with the finish coat if the finish coat is other than stone dash.

9.28.6.5. Finish Coat

(1) When the finish coat is other than stone dash, the base shall be dampened but not saturated before the finish coat is applied.

(2) The thickness of the finish coat shall be not less than 3 mm.

(3) When a stone dash finish is used, the stone shall be partially embedded in the second coat before the second coat starts to set or stiffen.

Section 9.29 Interior Wall and Ceiling Finishes

9.29.1. General

9.29.1.1. A wall or ceiling finish shall also conform to the appropriate requirements in Sections 9.10 and 9.11, in addition to the requirements in this Section.

9.29.2. Waterproof Wall Finish

9.29.2.1. Where Required. Waterproof finish shall be provided to a height of not less than 1.8 m above the floor in shower stalls, 1.2 m above the rims of bathtubs equipped with showers and 400 mm above the rims of bathtubs not equipped with showers.

9.29.2.2. Materials. Waterproof finish shall consist of ceramic, plastic or metal tile, sheet vinyl, tempered hardboard, laminated thermosetting decorative sheets or linoleum.

9.29.3. Wood Furring

9.29.3.1. Size and Spacing of Furring. Wood furring for the attachment of wall and ceiling finishes shall conform to Table 9.29.3.A.

9.29.3.2. Fastening. Furring shall be fastened to the framing or to wood blocks with not less than 51 mm nails.

9.29.4. Plastering

9.29.4.1. Application of plaster wall and ceiling finishes including installation of metal or gypsum lath, shall conform to CSA A82.30, "Interior Furring, Lathing and Gypsum Plastering."

9.29.5. Gypsum Board Finish (Taped Joints)

9.29.5.1. Application

(1) The requirements for application of gypsum board in this Subsection apply to the single layer application of gypsum board to wood furring or framing using nails or screws.

(2) Gypsum board applications not described in this Subsection shall conform to CSA A82.31, "Gypsum Board Application."

9.29.5.2. Materials. Gypsum board shall conform to CSA A82.27, "Gypsum Board Products."

9.29.5.3. Maximum Spacing of Supports. Maximum spacing of supports for gypsum board applied as a single layer shall conform to Table 9.29.5.A.

9.29.5.4. Support of Insulation. Gypsum board supporting insulation shall be not less than 12.7 mm thick.

9.29.5.5. Length of Fasteners. The length of fasteners for gypsum board shall conform to Table 9.29.5.B., except that lesser depths of penetration are

Table 9.29.3.A.
Forming Part of Article 9.29.3.1.

Minimum Size and Maximum Spacing of Furring, mm			
Maximum Spacing of Furring, mm	Maximum Spacing of Furring Supports		
	Continuous Support	400 mm (o.c.)	600 mm (o.c.)
300	19 × 38	19 × 38	19 × 64
400	19 × 38	19 × 38	19 × 64
600	19 × 38	19 × 64	19 × 89
Column 1	2	3	4

Table 9.29.5.A.
Forming Part of Article 9.29.5.3.

Maximum Spacing of Supports for Gypsum Board				
Thickness, mm	Orientation of Board to Framing	Maximum Spacing of Supports o.c., mm		
		Walls	Ceilings Painted Finish	Ceilings Water-Based Texture Finish
9.5	parallel perpendicular	— 400	— 400	— —
12.7	parallel perpendicular	600 600	400 600	— 400
15.9	parallel perpendicular	600 600	400 600	— 600
Column 1	2	3	4	5

Table 9.29.5.B.
Forming Part of Article 9.29.5.5.

Minimum Fastener Penetration into Wood Supports, mm				
Required *Fire-Resistance Rating* of Assembly	Walls		Ceilings	
	Nails	Screws	Nails	Screws
Fire-resistance rating not required	20	15	20	15
45 min	20	20	30	30
1 h	20	20	45	45
1.5 h	20	20	60	60
Column 1	2	3	4	5

permitted for assemblies required to have a *fire-resistance rating* provided it can be shown, on the basis of fire tests, that such depths are adequate for the required rating.

9.29.5.6. Nails. Nails for fastening gypsum board to wood supports shall conform to CSA Standard B111, "Wire Nails, Spikes and Staples."

9.29.5.7. Screws. Screws for fastening gypsum board to wood supports shall conform to ASTM C1002, "Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases."

9.29.5.8. Spacing of Nails

(1) For single-layer application nails shall be spaced not more than 180 mm o.c. on ceiling supports and not more than 200 mm apart along vertical wall supports, except that nails may be spaced in pairs about 50 mm apart every 300 mm along such wall or ceiling supports.

(2) Where the ceiling sheets are supported by the wall sheets around the perimeter of the ceiling, this support may be considered as equivalent to nailing at this location.

(3) The uppermost wall nails shall be not more than 200 mm below the ceiling.

(4) Nails shall be located not less than 10 mm from the side or edge of the board.

(5) Nails shall be driven so that the heads are below the plane of the board surface but do not puncture the paper.

9.29.5.9. Spacing of Screws. Where gypsum board is applied with drywall screws, the screws shall be spaced not more than 300 mm o.c. along supports, except that on vertical surfaces the screws may be spaced 400 mm o.c. where the supports are not more than 400 mm o.c.

9.29.5.10. Low Temperature Conditions. In cold weather, heat shall be provided to maintain a temperature of not below 10°C for 48 h prior to taping and finishing and maintained for not less than 48 h thereafter.

9.29.6. Plywood Finish

9.29.6.1. Thickness

(1) The minimum thickness of plywood interior finish shall conform to Table 9.29.6.A., except that no minimum thickness is required when the plywood is applied over solid backing.

(2) Thicknesses listed in Table 9.29.6.A. shall permit a manufacturing tolerance of $\pm$ 0.4 mm.

Table 9.29.6.A.
Forming Part of Articles 9.29.6.1. and 9.29.6.2.

Minimum Thickness of Plywood Interior Finish		
Maximum Spacing of Supports, mm (o.c.)	On Supports with no Horizontal Blocking, mm	On Supports with Blocking at Vertical Intervals not Exceeding 1.2 m, mm
400 600	4.7 8.0	4.0 4.7
Column 1	2	3

9.29.6.2. Grooved Plywood

(1) Except as permitted in Sentence (2), where plywood for interior finish is grooved, the grooves shall not extend through the face ply and into the plies below the face ply unless the groove is supported by framing or furring.

(2) If the grain of the face ply is at right angles to the supporting members, the groove is permitted to extend into plies below the face ply provided the thickness of the plywood exceeds the value shown in Table 9.29.6.A. by an amount equal to not less than the depth of penetration of the grooves into the plies below the face ply.

9.29.6.3. Nails and Staples. Nails for attaching plywood finishes shall not be less than 38 mm casing or finishing nails spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports, except that staples providing equivalent lateral resistance may also be used.

9.29.6.4. Edge Support. All plywood edges shall be supported by furring, blocking or framing.

9.29.7. Hardboard Finish

9.29.7.1. Material Standard. Hardboard shall conform to CGSB 11-GP-3M, "Hardboard."

9.29.7.2. Thickness. Hardboard shall be not less than 3 mm thick where applied over continuous back-up, 6 mm thick when applied over supports spaced not more than 400 mm o.c. and 9 mm thick when applied over supports spaced not more than 600 mm o.c.

9.29.7.3. Nails. Nails for fastening hardboard shall be casing or finishing nails not less than 38 mm long, spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports.

9.29.7.4. Edge Support. All hardboard edges shall be supported by furring, blocking or framing where the back-up is not continuous.

9.29.8. Insulating Fibreboard Finish

9.29.8.1. Material Standard. Insulating fibreboard shall conform to CAN3-A247-M, "Insulating Fibreboard."

9.29.8.2. Thickness

(1) Insulating fibreboard sheets shall be not less than 11.1 mm thick on supports not more than 400 mm o.c.

(2) Insulating fibreboard tile shall be not less than 12.7 mm thick on supports spaced not more than 400 mm o.c.

9.29.8.3. Nails

(1) Nails for fastening fibreboard sheets shall be not less than 2.6 mm shank diameter casing or finishing nails of sufficient length to penetrate not less than 20 mm into the supports.

(2) Nails shall be spaced not more than 100 mm o.c. along edge supports and 200 mm o.c. along intermediate supports.

9.29.8.4. Edge Support. All fibreboard edges shall be supported by blocking, furring or framing.

9.29.9. Particleboard, Waferboard or Strandboard Finish

9.29.9.1. Material Standard

(1) Particleboard finish shall conform to CAN3-O188.1, "Interior Mat-Formed Wood Particleboard."

(2) Waferboard and strandboard finish shall conform to CAN3-O437.0 "Waferboard and Strandboard."

9.29.9.2. Minimum Thickness

(1) The minimum thickness of O-2 grade waferboard and strandboard used as an interior finish shall conform to that shown for plywood in Table 9.29.6.A., except that no minimum thickness is required when applied over solid backing.

(2) Thicknesses listed in Table 9.29.6.A. shall permit a manufacturing tolerance of $\pm$ 0.4 mm.

(3) Waferboard and strandboard conforming to grades R–1 and O–1, and particleboard shall be

(a) not less than 6.35 mm thick on supports not more than 400 mm o.c.,

(b) not less than 9.5 mm thick on supports not more than 600 mm o.c., and

(c) not less than 6.35 mm thick on supports not more than 600 mm o.c. in walls where blocking is provided at midwall height.

9.29.9.3. Nails. Nails for fastening particleboard, waferboard or strandboard shall be not less than 38 mm casing or finishing nails spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports.

9.29.9.4. Edge Support. All particleboard, waferboard or strandboard edges shall be supported by furring, blocking or framing.

9.29.10. Wall Tile Finish

9.29.10.1. Tile Application

(1) Ceramic tile shall be set in a mortar base or applied with an adhesive.

(2) Plastic tile shall be applied with an adhesive.

9.29.10.2. Mortar Base

(1) When ceramic tile is applied to a mortar base the cementitious material shall consist of 1 part portland cement to not more than one-quarter part lime by volume.

(2) The cementitious material described in Sentence (1) shall be mixed with not less than 3 nor more than 5 parts of aggregate per part of cementitious material by volume.

(3) Mortar shall be applied over metal lath or masonry.

(4) Ceramic tile applied to a mortar base shall be thoroughly soaked and pressed into place forcing the mortar into the joints while the tile is wet.

9.29.10.3. Adhesives. Adhesives to attach ceramic and plastic tile shall be applied to the finish coat or brown coat of plaster that has been steel-trowelled to an even surface or to gypsum board or to masonry provided the masonry has an even surface.

9.29.10.4. Moisture Resistant Backing. Ceramic and plastic tile installed on walls around bathtubs or showers shall be applied over moisture resistant backing.

9.29.10.5. Joints between Tiles and Bathtub. The joints between wall tiles and a bathtub shall be suitably caulked with material conforming to CGSB 19-GP-22M, "Sealing Compound, Mildew Resistant, for Tubs and Tile."

Section 9.30 Flooring

9.30.1. General

9.30.1.1. Required Finished Flooring. Finished flooring shall be provided in all *residential occupancies*.

9.30.1.2. Water Resistance. Finished flooring in bathrooms, kitchens, public entrance halls, laundry and general storage areas shall consist of resilient flooring, felted-synthetic-fibre floor coverings, concrete, terrazzo, ceramic tile, mastic or other types of flooring providing similar degrees of water resistance.

9.30.1.3. Sleepers. Wood sleepers supporting finished flooring over a concrete base supported on the ground shall be not less than 19 mm by 38 mm and shall be treated with a wood preservative.

9.30.1.4. Finish Quality. Finished flooring shall have a surface that is smooth, even and free from roughness or open defects.

9.30.2. Panel-Type Underlay

9.30.2.1. Required Underlay

(1) A panel-type underlay shall be provided under resilient flooring, parquet flooring, ceramic tile, felted-synthetic-fibre floor coverings or carpeting laid over lumber subflooring. (See Sentence 9.30.3.2.(1).)

(2) Panel-type underlay shall be provided under resilient flooring, parquet flooring, felted-synthetic-fibre floor coverings or carpeting on panel-type subflooring whose edges are unsupported. (See Article 9.23.14.3.)

(3) Panel-type underlay shall be provided under resilient flooring on waferboard or strandboard subflooring.

(4) Panel-type underlay shall be provided under ceramic tile applied with adhesive.

9.30.2.2. Materials and Thickness

(1) Panel-type underlay shall be not less than 6 mm thick and shall conform to

(a) CSA O115, "Hardwood and Decorative Plywood,"
(b) CSA O121, "Douglas Fir Plywood,"
(c) CSA O151, "Canadian Softwood Plywood,"
(d) CSA O153, "Poplar Plywood,"
(e) CAN3-O188.1, "Interior Mat-Formed Wood Particleboard,"
(f) CAN3-O437.0 "Waferboard and Strandboard," or
(g) CAN/CGSB 11.3-M, "Hardboard."

(2) Panel-type underlay under ceramic tile applied with adhesive shall be not less than

(a) 6 mm thick where the supports are spaced up to 300 mm o.c., and
(b) 11 mm thick where the supports are spaced wider than 300 mm o.c.

9.30.2.3. Fastening

(1) Panel-type underlay shall be fastened to the subfloor with staples, annular grooved flooring nails or spiral nails, spaced not more than 150 mm o.c. along the edges and 200 mm o.c. both ways at other locations.

(2) Nails for panel-type underlay shall be not less than 19 mm long for 6 mm thick underlay and 22 mm long for 7.9 mm thick underlay.

(3) Staples for panel-type underlay shall have not less than a 1.2 mm shank diameter or thickness with a 4.7 mm crown and shall be not less than 22 mm long for 6 mm underlay and 28 mm long for 7.9 mm and 9.5 mm underlay.

9.30.2.4. Joints Offset. Where panel-type underlay is required to be installed over plywood or waferboard or strandboard, the joints in the underlay shall be offset not less than 200 mm from the joints in the underlying subfloor.

9.30.2.5. Surface Defects. Underlay beneath resilient or ceramic floors applied with an adhesive shall have all holes or open defects on the surface patched so that the defects will not be transmitted to the finished surface.

9.30.3. Wood Strip Flooring

9.30.3.1. Thickness. The thickness of wood strip flooring shall conform to Table 9.30.3.A.

Table 9.30.3.A.
Forming Part of Article 9.30.3.1.

Wood Strip Flooring			
Type of Flooring	Maximum Joist Spacing, mm	Minimum Thickness of Flooring, mm	
		With Subfloor	No Subfloor
Matched hardwood (interior use only)	400 600	7.9 7.9	19.0 33.3
Matched softwood (interior or exterior use)	400 600	19.0 19.0	19.0 31.7
Square edge softwood (exterior use only)	400 600	— —	25.4 38.1
Column 1	2	3	4

9.30.3.2. Strip Direction and End Joints

(1) Wood strip flooring shall not be laid parallel to lumber subflooring unless a separate underlay is provided.

(2) If wood strip flooring is applied without a subfloor, it shall be laid at right angles to the joists so that the end joints are staggered and occur over supports or are end matched.

(3) If the flooring is end matched, it shall be laid so that no 2 adjoining strips break joints in the same space between supports and each strip bears on no fewer than 2 supports.

9.30.3.3. Nailing

(1) When nails are used wood strip flooring shall be toe nailed or face nailed with not less than one nail per strip at the spacings shown in Table 9.30.3.B., except that face nailed strips of more than 25 mm in width shall have no fewer than 2 nails per strip.

(2) Face nails shall be countersunk and the holes filled with suitable filler.

9.30.3.4. Staples. Staples may be used to fasten wood strip flooring not more than 7.9 mm in thickness provided the staples are not less than 29 mm long with a shank diameter of 1.19 mm and with 4.7 mm crowns.

Table 9.30.3.B.
Forming Part of Sentence 9.30.3.3.(1)

Nailing of Wood Strip Flooring		
Finish Floor Thickness, mm	Minimum Length of Flooring Nails, mm	Maximum Spacing of Flooring Nails, mm
7.9 11.1 19.0 25.4 31.7 38.1	38 (1) 51 57 63 70 83	200 300 400 400 600 600
Column 1	2	3

Note to Table 9.30.3.B.:
(1) See Article 9.30.3.4.

9.30.4. Parquet Flooring

9.30.4.1. Adhesive used to attach parquet block flooring shall be suitable for bonding wood to the applicable subfloor material.

9.30.5. Resilient Flooring

9.30.5.1. Materials

(1) Resilient flooring used on concrete slabs supported on ground shall consist of asphalt, rubber,

vinyl-asbestos, unbacked vinyl or vinyl with an inorganic type backing.

(2) Flooring described in Sentence (1) shall be attached to the base with a suitable waterproof and alkali-resistant adhesive.

9.30.6. Ceramic Tile

9.30.6.1. Ceramic tile shall be set in a mortar bed or applied to a sound smooth base with a suitable adhesive.

9.30.6.2. Panel-type subfloor to which ceramic tile is to be applied with adhesive shall have its edges supported according to Article 9.23.14.3.

Section 9.31 Plumbing Facilities

9.31.1. Scope

9.31.1.1. Application

(1) This Section applies to the plumbing facilities and *plumbing systems* within *dwelling units*.

9.31.2. General

9.31.2.1. General. The construction, extension, alteration, renewal or repair of *plumbing systems* and sewage disposal systems shall conform to Part 7.

> **7.1.2.1.** Every *plumbing system* shall be designed and installed in conformance with appropriate municipal or provincial regulations or, in the absence of such regulations, in conformance with the ACNBC Canadian Plumbing Code 1990.

9.31.2.2. Corrosion Protection. Metal pipes in contact with cinders or other corrosive material shall be protected by a heavy coating of bitumen or other corrosion protection.

9.31.2.3. Grab Bars. When provided, grab bars shall be capable of resisting a load of not less than 1.3 kN applied vertically or horizontally.

9.31.3. Water Supply and Distribution

9.31.3.1. Required Water Supply. Every *dwelling unit* shall be supplied with potable water.

9.31.3.2. Required Connections

(1) Where a piped water supply is available, piping for hot and cold water shall be connected to every kitchen sink, lavatory, bathtub, shower, slop sink and laundry area.

(2) Piping for cold water shall be run to every water closet and hose bib.

9.31.4. Required Facilities

9.31.4.1. Required Fixtures. A kitchen sink, lavatory, bathtub and water closet shall be provided for every *dwelling unit* where a piped water supply is available.

9.31.4.2. Laundry Facilities. Laundry facilities or a space for laundry facilities shall be provided in every *dwelling unit*. *

9.31.4.3. Hot Water Supply. Where a piped water supply is available a hot water supply shall be provided in every *dwelling unit*.

9.31.4.4. Floor Drains

(1) Where gravity drainage to a sewer, drainage ditch or dry well is possible, a floor drain shall be installed in a *basement* forming part of a *dwelling unit*.

9.31.5. Sewage Disposal

9.31.5.1. Building Sewer. Wastes from every plumbing fixture shall be piped to the *building* sewer.

9.31.5.2. Discharge of Sewage

(1) *Building* sewers shall discharge into a public sewage system where such system is available.

(2) Where a public sewage system is not available, the *building* sewer shall discharge into a *private sewage disposal system*.

9.31.6. Service Water Heating Facilities

9.31.6.1. Hot Water Temperature. Where a hot water supply is required by Article 9.31.4.3., equipment shall be installed which is capable of heating to at least 45°C but not above 60°C an adequate supply of service hot water for every *dwelling unit*.

9.31.6.3. Equipment and Installation Requirements. Every *service water heater* and its installation shall conform to Part 6.

9.31.6.4. Corrosion-Resistant Coating. Where storage tanks for *service water heaters* are of steel, they shall be coated with zinc, vitreous enamel (glass lined), hydraulic cement or other corrosion-resistant material.

9.31.6.5. Fuel-Burning Heaters. Fuel-burning *service water heaters* shall be connected to a *chimney flue* conforming to Section 9.21.

9.31.6.6. Heating Coils. Heating coils of *service water heaters* shall not be installed in a *flue* or in the combustion chamber of a *boiler* or *furnace* heating a *building*.

Section 9.32 Ventilation

9.32.1. General

9.32.1.1. Application

(1) This Section applies to the ventilation of rooms and spaces in *residential occupancies* by natural ventilation and to self-contained mechanical ventilation systems serving only one *dwelling unit*.

9.32.1.2. General. Rooms or spaces in *dwelling units* shall be ventilated during the non-heating season by natural means in accordance with Subsection 9.32.2. or by a mechanical ventilation system conforming to Subsection 9.32.3.

9.32.2. Natural Ventilation

9.32.2.1. Natural Ventilation Area

(1) The unobstructed openable ventilation area to the outdoors for rooms and spaces in residential *buildings* ventilated by natural means shall conform to Table 9.32.2.A.

(2) Where a vestibule opens directly off a living or dining room within a *dwelling unit*, ventilation to the outdoors for such rooms may be through the vestibule.

Table 9.32.2.A.
Forming Part of Sentence 9.32.2.1.(1)

Natural Ventilation Area		
Location		Minimum Unobstructed Area
	Bathrooms or water-closet rooms	0.09 m^2
	Unfinished *basement* space	0.2 per cent of the floor area
	Dining rooms, living rooms, bedrooms, kitchens, combined rooms, dens, recreation rooms and all other finished rooms	0.28 m^2 per room or combination of rooms
Column 1	2	3

9.32.2.2. Protection from Weather and Insects

(1) Openings for natural ventilation other than windows shall be constructed to provide protection from the weather and insects.

(2) Screening shall be of rust-proof material.

9.32.3. Mechanical Ventilation
(See Appendix A.)

9.32.3.1. Required Mechanical Ventilation for Dwelling Units

(1) Every *dwelling unit* shall be provided with a mechanical ventilation system having a capacity to exhaust inside air or to introduce outside air at the rate of not less than 0.3 air changes per hour averaged over any 24-hour period.

(2) The rate of air change required in Sentence (1) shall be based on the total interior volume of all storeys including the basement, but excluding any attached or built-in garage or unheated crawl space.

9.32.3.2. Mechanical Ventilation of Rooms and Spaces. Where a habitable room or space in a *dwelling unit* is not provided with natural ventilation described in Article 9.32.1.2., mechanical ventilation shall be provided to exhaust inside air or to introduce outside air to that room or space at the rate of one-half air change per hour if the room or space is mechanically cooled in summer, and one air change per hour if it is not.

9.32.3.3. Design and Installation Requirements

(1) Except as provided in Sentence (2), mechanical ventilation shall conform to the requirements in Part 6. (These requirements are reproduced in Section 9.33.)

(2) Mechanical ventilation required in Articles 9.32.3.1. and 9.32.3.2., and consisting of one or more exhaust fans without an air circulating ductwork system, need not conform with Part 6, provided

(a) each exhaust fan conforms to CSA C22.2 No. 113, "Fans and Ventilators,"

(b) except as permitted in Sentences (4) and (5), air intake openings for make-up air are installed and are of a size to prevent excessive depressurization in the *dwelling unit* when all exhaust fans of the system are operating, and

(c) the exhaust fans are controlled either manually by a switch or automatically by a humidistat.

(3) The mechanical ventilation capacity of the system described in Sentence (2) shall be assumed to be the sum of the capacities of the individual fans, as rated at a differential static pressure of at least 25 Pa.

(4) The air intake openings described in Clause (2)(b) are not required if spillage-susceptible fuel-fired heating *appliances* which are required to be vented are not installed in the *dwelling unit*.

(5) The air intake openings described in Clause (2)(b) are not required if it can be shown by test that air leakage is sufficient to prevent excessive depressurization in the *dwelling unit* when all exhaust fans of the system are operating.

(6) Special purpose air exhausting equipment such as central vacuum cleaning systems, downdraft cook tops and clothes dryers shall not be included in the calculation of the capacity of the system described in Sentence (2).

9.32.3.4. Combustion and Dilution Air.

Systems designed to provide combustion and/or dilution air for fuel-burning *appliances* shall not be used to supply make-up air for ventilation systems unless their capacity is sufficient to serve both functions simultaneously without creating excessive depressurization in the *dwelling unit*.

9.32.3.5. Exhaust Ducts

(1) *Exhaust ducts* shall discharge directly to the outdoors.

(2) Where the *exhaust duct* passes through or is adjacent to unheated space, the duct shall be insulated to prevent moisture condensation in the duct.

9.32.3.6. Accessibility

(1) Ventilation equipment shall be accessible for inspection, maintenance, repair and cleaning.

(2) Kitchen *exhaust ducts* shall be designed and installed so that the entire duct can be cleaned where the duct is not equipped with a filter at the intake end.

9.32.3.7. Protection from Weather and Insects

(1) Outdoor air intake and exhaust outlets shall be shielded from weather and insects.

(2) Screening shall be of rust-proof material.

9.32.3.8. Requirements for Ducts. Ventilating ducts shall conform to the requirements of Part 6 for *supply ducts*, except *exhaust ducts* that serve only a bathroom or water-closet room may be of *combustible* material provided the duct is reasonably air tight and constructed of a material impervious to water. (Requirements for supply ducts in Part 6 are reproduced in 9.33.)

Section 9.33 Heating and Air-Conditioning

9.33.1. General

9.33.1.1. Design and Installation Requirements

(1) The design and installation of central heating systems, including requirements for combustion air, shall conform to the requirements in Part 6 and to this Section. (See Appendix A.)

A-9.33.1.1. Combustion Air and Tight Houses. The operation of an air exhaust system or of a fuel-burning appliance removes the air from a house, creating a slight negative pressure inside. In certain cases the natural flow of air up a chimney can be reversed, leading to a possible danger of carbon monoxide poisoning for the inhabitants.

Newer houses are generally more tightly constructed than older ones because of improved construction practices, including tighter windows, weather stripping and caulking. This fact increases the probability that infiltration may not be able to supply enough air to compensate for simultaneous operation of exhaust fans, fireplaces, clothes dryers, furnaces and space heaters. It is necessary, therefore, to introduce outside air to the space containing the fuelburning appliance. Information regarding combustion air requirements for various types of appliances can be found in the installation standards referenced in Sentence 6.2.1.4.(1). In the case of solid fuelburning stoves, ranges and space heaters, CSA B365M84 suggests that the minimum size of openings be determined by trial and error to accommodate the flue characteristics, the firing rate, the building characteristics, etc. and that, as a guide, the combustion air opening should be 0.5 times the flue collar area.

Further information is available in Canadian Building Digest 222, "Airtight Houses and Carbon Monoxide Poisoning," from the Institute for Research in Construction, National Research Council of Canada, Ottawa K1A 0R6.

(2) The design and installation of air-conditioning systems shall conform to the requirements in Part 6.

Section 6.2 Design and Installation

6.2.1. General

6.2.1.1. Good Engineering Practice. Heating, ventilating and air-conditioning systems, including mechanical refrigeration equipment, shall be designed, constructed and installed to conform to good engineering practice such as described in the ASHRAE Handbooks and Standards, the HRA Digest, the Hydronics Institute Manuals, and the SMACNA Manuals. *

6.2.1.2. Capacity of Heating Appliances in Dwelling Units. The required capacity of heating *appliances* located in a *dwelling unit* and serving only that *dwelling unit*, shall be determined in accordance with CAN/CSA-F280, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances," except that the outside winter design temperatures shall conform to Subsection 2.2.1.

6.2.1.3. Structural Movement. Mechanical systems and equipment shall be designed and installed to accommodate the maximum amount of relative structural movement provided for in the construction of the *building*.

6.2.1.4. Installation Standards

(1) Except as provided in 9.33.1.2., Section 9.22 and 6.2.1.7., the installation of heating and air-conditioning equipment, including mechanical refrigeration equipment, and including provisions for mounting, clearances and air supply, shall conform to appropriate provincial requirements or, in the absence of such requirements, to the requirements of

(a) CSA B139, "Installation Code for Oil Burning Equipment,"
(b) CAN/CGA-B149.1, "Natural Gas Installation Code,"
(c) CAN/CGA-B149.2, "Propane Installation Code,"
(d) CSA C22.1, "Canadian Electrical Code, Part I,"
(e) CSA B51, "Boiler, Pressure Vessel and Pressure Piping Code,"
(f) CSA B52, "Mechanical Refrigeration Code," and
(g) CAN/CSA B365, "Installation Code for Solid-Fuel Burning Appliances and Equipment."

6.2.1.7. Heat Recovery Ventilators.

Heat recovery ventilators with rated capacities of not less than 25 L/s and not more than 200 L/s shall be installed in accordance with CAN/CSA-C444, "Installation Requirements for Heat Recovery Ventilators."

6.2.1.9. Installation – General

(1) Equipment forming part of a heating, ventilating or air-conditioning system, with the exception of embedded pipes or ducts, shall be installed with provision for access for inspection, maintenance, repair and cleaning.

(3) Equipment forming part of a heating or air-conditioning system that may be adversely affected by freezing temperatures and that is located in an unheated area shall be protected from freezing.

6.2.1.10. Expansion, Contraction and System Pressure.

Heating and cooling systems shall be designed to allow for expansion and contraction of the heat transfer fluid and to maintain the system pressure within the rated working pressure limits of all components of the system.

6.2.1.11. Asbestos.

Asbestos shall not be used in air distribution systems or equipment in a form or in a location where asbestos fibres could enter the air supply or return systems.

6.2.3. Air Duct Systems

6.2.3.2. Materials in Air Duct Systems

(1) Except as provided in Sentences (2) to (4), all ducts, duct connectors, associated fittings and *plenums* used in air duct systems shall be constructed of steel, aluminum alloy, copper, clay, asbestos-cement or similar *noncombustible* material.

(2) Ducts, associated fittings and *plenums* may contain limited amounts of *combustible* material provided they

(a) conform to the appropriate requirements for Class 1 duct materials in CAN/ULC-S110-M, "Standard Methods of Test for Air Ducts,"
(c) are not used in vertical runs serving more than 2 *storeys*, and
(d) are not used in air duct systems in which the air temperature may exceed 120°C.

(3) Duct sealants shall have a *flame-spread rating* of not more than 25 and a smoke developed classification of not more than 50.

(4) Duct connectors that contain *combustible* materials and that are used between ducts and air outlet units shall

(a) conform to the appropriate requirements for Class 1 air duct materials in CAN/ULC-S110-M, "Standard Methods of Test for Air Ducts,"
(b) be limited to 4 m in length, and
(c) be used only in horizontal runs.

(5) Materials in Sentences (1) to (4) when used in a location where they may be subjected to excessive moisture shall have no appreciable loss of strength when wet and shall be corrosion-resistant.

6.2.3.3. Connections and Openings in Air Duct Systems

(1) Air duct systems shall have tight-fitting connections throughout, and shall have no openings other than those required for proper operation and maintenance of the system.

6.2.3.4. Connectors

(1) Vibration isolation connectors in air duct systems shall be *noncombustible*, except that *combustible* fabric connectors are permitted provided they

(a) do not exceed 250 mm in length,
(b) comply with the flame-resistance requirements of CAN/ULC-S109, "Standard for Flame Tests of Flame-Resistant Fabrics and Films," and
(c) are not used in a location where they are exposed to heated air or radiation from heat sources that may cause the exposed surface to exceed a temperature of 120°C.

6.2.3.5. Tape. Tape used for sealing joints in air ducts, *plenums* and other parts of air duct systems shall meet the flame-resistance requirements for fabric in CAN/ULC-S109, "Standard for Flame Tests of Flame-Resistant Fabrics and Films."

6.2.3.6. Coverings, Linings, Adhesives and Insulation

(1) Coverings, linings and associated adhesives and insulation of air ducts, *plenums* and other parts of air duct systems shall be of *noncombustible* material when exposed to heated air or radiation from heat sources that would result in the exposed surface exceeding a temperature of 120°C.

(2) When *combustible* coverings and linings, including associated adhesives and insulation, are used, they shall have a *flame-spread rating* of not more than 25 on any exposed surface or any surface that would be exposed by cutting through the material in any direction, and a smoke developed classification of not more than 50, except that the outer covering of ducts, *plenums* and other parts of air duct systems used within an assembly of *combustible construction* may have an exposed surface *flame-spread rating* of not more than 75 and may have a smoke developed classification greater than 50.

(3) *Combustible* coverings and linings in Sentence (2) shall not flame, glow, smoulder or smoke when tested in accordance with the method of test in ASTM C411, "Hot-Surface Performance of High-Temperature Thermal Insulation" at the maximum temperature to which the coverings and linings are to be exposed in service.

(4) Foamed plastic insulation shall not be used as part of an air duct or for insulating an air duct. *

(6) *Combustible* coverings and linings of ducts, including associated adhesives and insulation, shall be interrupted at the immediate area of operation of heat sources in a duct system, such as electric resistance heaters or fuel-burning heaters or *furnaces*. *

(7) Linings of ducts shall be installed so that they will not interfere with the operation of volume or balancing dampers. *

6.2.3.8. Clearances. The clearances from *combustible* material and supply *plenums*, *supply ducts*, boots and register boxes of heating systems shall conform to the requirements of Subsection 6.2.4.

6.2.3.10. Exhaust Ducts and Outlets

(3) *Exhaust ducts* of ventilating systems shall have provision for the removal of condensation where this may be a problem.

(4) Exhaust outlets shall be designed to prevent back draft under wind conditions.

(5) *Exhaust ducts* directly connected to laundry drying equipment shall be independent of other *exhaust ducts*.

(9) Where *exhaust ducts* containing air from heated spaces pass through or are adjacent to unheated spaces, the ducts shall be insulated to prevent moisture condensation in the ducts.

6.2.3.11. Interconnection of Systems

(1) Air duct systems serving garages shall not be directly interconnected with other parts of the *building*.

(2) In a *residential occupancy*, air from one *suite* shall not be circulated to any other *suite* . *

6.2.3.12. Make-up Air. In ventilating systems that exhaust air to the outdoors, provision shall be made for the admission of a supply of make-up air in sufficient quantity so that the operation of the exhaust system and other exhaust equipment or combustion equipment is not adversely affected. (See Appendix A.)

A-6.2.3.12. Make-Up Air for Exhaust Systems. When make-up air is introduced into a building in cold weather, it should be preheated when the comfort of people in the air path is a consideration.

6.2.3.13. Supply, Return, Intake and Exhaust Air Openings

(1) Supply, return and exhaust air openings in rooms or spaces in *buildings* when located less than 2 m above the floor shall be protected by grilles having openings of a size that will not allow the passage of a 15 mm diam sphere.

(2) *Combustible* grilles, diffusers and other devices for supply-, return-, and exhaust-air openings in rooms shall conform to the *flame-spread rating* and smoke developed classification requirements for the interior finish of the surface on which they are installed.

(3) Outdoor air intakes and exhaust outlets at the *building* exterior shall be designed or located so that the air entering the *building* system will not contain more contaminants that the normal exterior air of the locality in which the *building* is situated.

(4) Exterior openings for outdoor air intakes and exhaust outlets shall be shielded from the entry of snow and rain and shall be fitted with corrosion-resistant screens of mesh not larger than 15 mm, except where climatic conditions may require larger openings.

(5) Screens required in Sentence (4) shall be accessible for maintenance.

6.2.3.14. Filters and Odour Removal Equipment

(1) Air filters for air duct systems shall conform to the requirements for Class 2 air filter units as described in CAN4-S111, "Standard Method of Fire Tests For Air Filter Units."

(2) When electrostatic-type filters are used, they shall be installed so as to ensure that the electric circuit is automatically de-energized when filter access doors are opened or when the furnace circulating fan is not operating.

(3) When odour removal equipment of the adsorption type is used it shall be

(a) installed to provide access so that adsorption material can be reactivated or renewed, and

(b) protected from dust accumulation by air filters installed on the inlet side.

6.2.4. Air Ducts for Low Capacity Heating Systems

6.2.4.2. Galvanized Steel or Aluminum Supply Ducts

(1) Galvanized steel or aluminum *supply ducts* shall conform to Table 6.2.4.A.

(2) The design of fittings for ducts shall conform to CSA B228.1, "Pipes, Ducts, and Fittings for Residential Type Air Conditioning Systems," except that metal thickness requirements shall conform to those in Table 6.2.4.A.

6.2.4.3. Construction and Installation of Ducts and Plenums

(1) Rectangular panels in *plenums* and ducts more than 300 mm wide shall be shaped to provide sufficient stiffness.

(2) Where the installation of heating *supply ducts* in walls and floors creates a space between the duct and construction material, the space shall be fire stopped with *noncombustible* material at each end.

(3) Ducts shall be securely supported by metal hangers, straps, lugs or brackets, except that, where zero clearance is permitted, wooden brackets may be used.

(4) All round duct joints shall be tight-fitting and lapped not less than 25 mm.

(5) Rectangular duct connections shall be made with S and drive cleats or equivalent mechanical connections.

(6) Trunk *supply ducts* shall not be nailed directly to wood members.

(7) Branch ducts shall be supported at suitable spacings to maintain alignment and prevent sagging.

(8) *Combustible* ducts in concrete slabs-on-ground that are connected to a *furnace* supply

Table 6.2.4.A.
Forming part of Sentence 6.2.4.2.(1)

Minimum Metal Thickness of Ducts, mm				
Type of Duct	Maximum Diameter, mm	Maximum Width or Depth, mm	Duct Material	
			Galvanized Steel	Aluminum
Round	350 Over 350	— —	0.33 0.41	0.30 0.41
Rectangular, enclosed	— —	350 Over 350	0.33 0.41	0.30 0.41
Rectangular, not enclosed, for single *dwelling units* with required clearance up to 12 mm	— —	350 Over 350	0.33 0.41	0.41 0.48
Rectangular, not enclosed, with required clearance of more than 12 mm	— —	350 Over 350	0.41 0.48	0.41 0.48
Column 1	2	3	4	5

plenum shall be located not closer than 600 mm to that *plenum* and not less than 600 mm from its connection to a riser or register.

(9) Ducts in or beneath concrete slabs-on-ground shall be watertight and corrosion-, decay-, and mildew-resistant.

6.2.4.4. Clearances of Ducts and Plenums

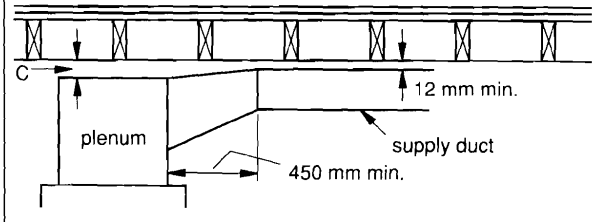
(1) The clearance of *furnace plenums* from *combustible* material shall conform to the requirements of the appropriate standards of Sentence 6.2.1.4.(1).

(2) Where the *plenum* clearance required in Sentence (1) is 75 mm or less, the clearance between a *supply duct* and *combustible* material shall

(a) be equal to the required *plenum* clearance within 450 mm of the *plenum*, and

(b) be not less than 12 mm at a distance of 450 mm or more from the *plenum*, except that this clearance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the *furnace* heat exchanger. (See Appendix A.)

A-6.2.4.4. Clearances for Warm-Air Supply Ducts.



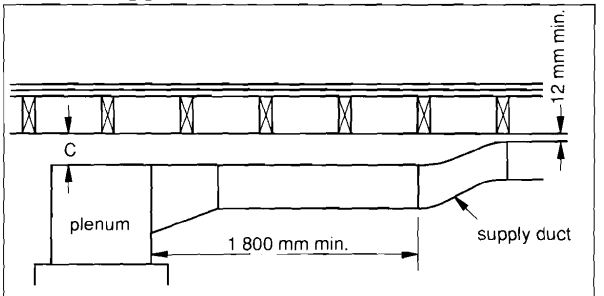
(a) Applicable to forced-air furnaces where permissible clearance C above plenum is 75 mm or less. Refer to Sentence 6.2.4.4. (2)

(3) Where the *plenum* clearance required in Sentence (1) is more than 75 mm but not more than 150 mm, the clearance between a *supply duct* and *combustible* material shall

(a) be equal to the required *plenum* clearance within a horizontal distance of 1.8 m of the *plenum*, and

(b) be not less than 12 mm at a horizontal distance of 1.8 m or more from the *plenum*, except that this distance may be

reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the *furnace* heat exchanger. (See Appendix A.)



(b) Applicable to forced-air furnaces where permissible clearance C above plenum is more than 75 mm but not more than 150 mm. Refer to Sentence 6.2.4.4.(3)

(4) Where the *plenum* clearance required in Sentence (1) is more than 150 mm, the clearance between a *supply duct* and *combustible* material shall

(a) be equal to the required *plenum* clearance within a horizontal distance of 1 m of the *plenum*,

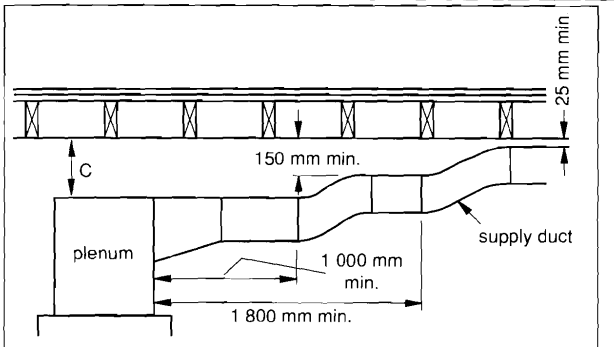
(b) be not less than 150 mm within a horizontal distance between 1 and 1.8 m from the *plenum*, and

(c) be not less than 25 mm at a horizontal distance of 1.8 m or more from the *plenum*, except that this distance may be reduced to 8 mm beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger. (See Appendix A.)

(5) Where a register is installed in a floor directly over a pipeless *furnace*, a double-walled register box with not less than 100 mm between walls, or a register box with the warm-air passage completely surrounded by the cold-air passage, shall be permitted in lieu of the clearances listed in Sentences (2), (3) and (4).

6.2.4.5. Warm-Air Supply Outlets

(1) In a *dwelling unit*, a warm-air supply outlet shall be provided in each finished room which is located adjacent to unheated space.



(c) Applicable to forced-air furnaces where permissible clearance C above plenum is more than 150 mm. Refer to Sentence 6.2.4.4.(4)

(2) When a room described in Sentence (1) is located adjacent to exterior walls, such outlet shall be located so as to bathe not less than one exterior wall or window with warm air, except in bathrooms, utility rooms or kitchens, where this may not be practical. (See Appendix A.)

A-6.2.4.5.(2) Warm Air Supply Outlets. If the heating system is designed to also distribute ventilation air, high inside wall or ceiling outlets with diffusers, and designed for such applications, may be used.

(3) Not less than one warm-air supply outlet shall be provided for each 40 m^2 of floor surface area in unfinished *basements* serving *dwelling units*, and it shall be located so as to provide adequate distribution of warm air throughout the *basement*.

(4) Except for pipeless *furnaces* and floor *furnaces*, the capacity of warm-air supply outlets serving *dwelling units* shall be not less than the design heat loss from the area served and shall not exceed 3 kW per outlet.

(5) In *basements* and heated crawl spaces, the calculated heat gain from the *supply ducts* and *plenum* surfaces may be considered in calculating the design heat loss.

(6) Warm-air supply outlets located in finished areas shall be provided with diffusers and adjustable openings and shall not be located on a *furnace plenum*.

(7) The temperature of supply air at warm-air supply outlets shall not exceed 70°C.

6.2.4.6. Concrete Slabs-on-Grade. Warm-air supply systems for residential *buildings* built on concrete slabs-on-grade shall be installed in the slab and shall be of the perimeter loop type or radial perimeter type.

6.2.4.7. Adjustable Dampers and Balance Stops. All branch *supply ducts* which are not fitted with diffusers with adjustable balance stops shall be supplied with adjustable dampers and fitted with devices to indicate the positions of the dampers.

6.2.4.8. Return-Air System

(1) The return-air system shall be designed to handle the entire air supply.

(2) Except as provided in Sentences (3) and (4), *return ducts* shall be constructed of material having a surface *flame-spread rating* of not more than 150.

(3) Where any part of a *return duct* will be exposed to radiation from the *furnace* heat exchanger or other radiating part within the *furnace*, such part of a *return duct* directly above or within 600 mm of the outside *furnace* casing shall be *noncombustible*.

(4) *Return ducts* serving solid-fuel fired *furnaces* shall be constructed of *noncombustible* material.

(5) *Combustible return ducts* shall be lined with *noncombustible* material below floor registers, at the bottom of vertical ducts and under *furnaces* having a bottom return.

(6) Spaces between studs used as *return ducts* shall be separated from the unused portions of such spaces by tight-fitting metal stops or wood blocking.

(7) A vertical *return duct* shall have openings to return air on not more than one floor.

(8) A *public corridor* or public stairway shall not be used as a return-air *plenum*.

(9) The return-air system shall be designed so that the negative pressure from the circulating fan cannot affect the *furnace* combustion air supply nor draw combustion products from joints or openings in the *furnace* or *flue pipe*.

(10) Return-air inlets shall not be installed in an enclosed room or crawl space that provides combustion air to a *furnace*.

(11) Return air from a *dwelling unit* shall not be recirculated to any other *dwelling unit*.

(12) Except for unfinished areas and floor levels which are less than 900 mm above or below an adjacent floor level which is provided with a return-air inlet, not less than one return-air inlet shall be provided in each floor level in a *dwelling unit*.

(13) Provision shall be made for the return of air from all rooms by leaving gaps beneath doors, using louvred doors or installing *return duct* inlets.

6.2.8. Radiators and Convectors

6.2.8.1. Every steam or hot water radiator and convector located in a recess or concealed space or attached to the face of a wall of *combustible construction* shall be provided with a *noncombustible* lining or backing.

6.2.9. Piping for Heating and Cooling Systems

6.2.9.1. Piping Materials and Installation *

(1) Piping shall be made from materials designed to withstand the effects of temperatures and pressures that may occur in the system. (See Article 9.10.9.10. for fire safety requirements.)

(2) Every pipe used in a heating or air-conditioning system shall be installed to allow for expansion and contraction due to temperature changes.

(3) Supports and anchors for piping in a heating or air-conditioning system shall be designed and installed to ensure that undue stress is not placed on the supporting structure.

6.2.9.2. Insulation and Coverings

(1) Insulation and coverings on pipes shall be composed of material suitable for the operating temperature of the system to withstand deterioration from softening, melting, mildew and mold.

(2) Insulation and coverings on pipes in which the temperature of the fluid exceeds 120°C

(a) shall be made of *noncombustible* material, or

(b) shall not flame, glow, smoulder or smoke when tested in accordance with the method of test ASTM C411, "Hot-Surface Performance of High-Temperature Thermal Insulation," at the maximum temperature to which such insulation or covering is to be exposed in service.

* **(3)** Except as provided in Sentence (7), where *combustible* insulation is used on piping in a *horizontal* or *vertical service space*, the insulation and coverings on such pipes shall have a *flame-spread rating* throughout the material of not more than 75.

(4) Except as provided in Sentence (7), insulation and coverings on piping located in rooms and spaces other than the *service spaces* described in Sentence (3) shall have a *flame-spread rating* not more than that required for the interior finish for the ceiling of the room or space.

(6) Pipes that are exposed to human contact shall be insulated so that the exposed surface does not exceed 70°C. (See Appendix A.)

A-6.2.9.2.(6) Temperature of Exposed Piping. Normally piping carrying steam or high-temperature hot water at pressures above atmospheric (corresponding temperature 100°C or above) will be insulated to reduce heat losses as an economy measure. Above a temperature of approximately 70°C, however, a bare pipe can cause a burn to human flesh coming in contact with the pipe. If pipes above this temperature are normally out of reach of all persons other than maintenance personnel or are properly guarded, it would be expected that no insulation would be needed for public safety.

(7) No *flame-spread rating* or smoke developed classification limitations are required where *combustible* insulation and coverings are used on piping when such piping is

(a) located within a concealed space in a wall,

(b) located in a floor slab, or

(c) enclosed in a *noncombustible* raceway or conduit.

Table 6.2.9.A.
Forming Part of Article 6.2.9.3.

Clearance between Steam or Hot Water Pipes and Combustible Material	
Steam or Water Temperature, °C	Minimum Clearance, mm
up to 120	15
above 120	25
Column 1	2

6.2.9.3. Clearances. Clearances between *combustible* material and bare pipes carrying steam or hot water shall conform to Table 6.2.9.A.

6.2.9.4. Surface Temperature. The exposed surface temperature of a steam or hot water radiator shall not exceed 70°C unless precautions are taken to prevent human contact.

6.2.9.5. Protection

(1) Where a pipe carrying steam or hot water at a temperature above 120°C passes through a *combustible* floor, ceiling or wall, the construction shall be protected by a sleeve of metal or other *noncombustible* material not less than 50 mm larger in diameter than the pipe.

(2) Unprotected steam or hot water pipes that pass through a storage space shall be covered with not less than 25 mm of *noncombustible* insulation to prevent direct contact with the material stored.

6.2.10. Refrigerating Systems and Equipment for Air-Conditioning

6.2.10.1. Cooling Units

(1) Where a cooling unit is combined with a fuel-fired *furnace* in the same duct system, the cooling unit shall be installed

(a) in parallel with the heating *furnace*,

(b) upstream of the *furnace* provided the *furnace* is designed for such application, or

(c) downstream of the *furnace* provided the cooling unit is designed to prevent excessive temperature or pressure in the refrigeration system.

Section 6.3 Chimneys and Venting Equipment

6.3.1. General

* **6.3.1.1. Requirement for Venting.** Except as provided in Section 21, the products of combustion from oil-, gas- and solid-fuel burning *appliances* shall be vented in conformance with the requirements in the applicable *appliance* installation standard listed in Sentence 6.2.1.4.(1).

9.33.1.2. Solid-Fuel Burning Appliances. The installation of solid-fuel burning *stoves, ranges* and *space heaters,* including the requirements for combustion air, shall conform to CAN/CSA-B365, "Installation Code for Solid–Fuel Burning Appliances and Equipment."

9.33.1.3. Design Temperatures

(1) Residential *buildings* intended for use in the winter months on a continuing basis shall be equipped with heating facilities capable of maintaining an indoor air temperature of 22°C at the outside winter design temperature except as provided in Sentences (4) and (5).

(2) All *buildings* other than those described in Sentence (1) shall be equipped with heating facilities of sufficient capacity to maintain the desired indoor air temperature, commensurate with the use of the *building*, at the outside winter design temperature.

(3) Winter design temperatures shall be determined in conformance with Subsection 2.2.1.

(4) Heating facilities shall be provided which shall be capable of maintaining a temperature not below 18°C in an unfinished *basement* in *buildings* of *residential occupancy*.

(5) Where crawl spaces are required to be heated, the heating facilities shall be capable of maintaining a temperature not below 15°C.

9.33.2. Fire Protection for Gas and Electric Ranges

9.33.2.1. Vertical Clearance

(1) Except as provided in Sentence (2), a vertical clearance of not less than 750 mm shall be provided above the elements or burners of electric- and gas-fired domestic ranges.

(2) Where cabinets located above the elements or burners referred to in Sentence (1) are *noncombustible* or are protected with asbestos millboard not less than 6 mm thick, covered with sheet metal not less than 0.33 mm thick, or by a metal hood with a 125 mm projection beyond the upper cabinets, the vertical clearance may be reduced to 600 mm.

9.33.2.2. Clearance to Wall Framing. *Combustible* wall framing members within 450 mm of the area where the range is to be located shall be protected above the level of the heating elements by material providing fire resistance not less than that of a 9.5 mm thickness of gypsum board.

Section 9.34 Electrical Facilities

9.34.1. General

9.34.1.1. Standard for Electrical Installations. Electrical installations, including the service capacity of the installation and the number and distribution of circuits and receptacles, shall meet the requirements of the appropriate provincial or municipal legislation or, in the absence of such legislation, shall conform to CSA C22.1, "Canadian Electrical Code, Part I."

9.34.1.2. Required Facilities. Where electrical services are available, electrical facilities shall be provided for every *building* in conformance with this Section.

9.34.1.4. Recessed Lighting Fixtures. Recessed lighting fixtures shall not be located in insulated ceilings unless the fixtures are designed for such installations.

9.34.1.5. Wiring and Cables. Electrical wiring and cables installed in *buildings* permitted to

be of *combustible construction* shall conform to Sentence 3.1.4.3.(1).

3.1.4.3. Electrical Wires and Cables

(1) Electrical wires and cables installed in *buildings* permitted to be of *combustible construction* shall

(a) not convey flame or continue to burn for more than 1 min when tested in conformance with the Vertical Flame Test in Clause 4.11.1. of CSA C22.2 No. 0.3, "Test Methods for Electrical Wires and Cables," or

(b) be located in

(i) totally enclosed *noncombustible* raceways (see Appendix A),

(ii) masonry walls, or

(iii) concrete slabs.

9.34.2. Lighting Outlets

9.34.2.1. Lighting of Entrances. An exterior lighting outlet with fixture controlled by a wall switch located within the *building* shall be provided at every entrance to *buildings* of *residential occupancy*.

9.34.2.2. Outlets in Dwelling Units

(1) Except as provided in Sentence (2), a lighting outlet with fixture controlled by a wall switch shall be provided in kitchens, bedrooms, living rooms, utility rooms, laundry rooms, dining rooms, bathrooms, water-closet rooms, vestibules and hallways in *dwelling units*.

(2) Where a receptacle controlled by a wall switch is provided in bedrooms or living rooms, such rooms need not conform to the requirements in Sentence (1).

9.34.2.3. Stairways

(1) Every stairway shall be lighted.

(2) Except as provided in Sentence (3), 3-way wall switches located at the head and foot of every stairway shall be provided to control not less than one lighting outlet with fixture for stairways with 4 or more risers in *dwelling units*.

(3) The stairway lighting for *basements* that do not contain finished space or lead to an outside entrance or built-in garage and which serve not more than one *dwelling unit* may be controlled by a single switch located at the head of the stairs.

9.34.2.4. Basements

(1) A lighting outlet with fixture shall be provided for each 30 m^2 or fraction thereof of floor area in unfinished *basements*.

(2) The outlet required in Sentence (1) nearest the stairs shall be controlled by a wall switch located at the head of the stairs.

9.34.2.5. Storage Rooms. A lighting outlet with fixture shall be provided in storage rooms.

9.34.2.6. Garages and Carports

(1) A lighting outlet with fixture shall be provided for an attached, built-in or detached garage or carport.

(2) Outlets required in Sentence (1) shall be controlled by a wall switch near the doorway where the fixture is ceiling mounted above an area normally occupied by a parked car; otherwise a switched lampholder may be used.

(3) Where a carport is lighted by a light at the entrance to a *dwelling unit*, additional carport lighting is not required.

Section 9.35 Garages and Carports

9.35.1. Scope

9.35.1.1. Application. This Section applies to garages and carports serving not more than one *dwelling unit*.

9.35.1.2. Construction Requirements. The construction of a garage or carport shall conform to the requirements for other *buildings* in this Part except as provided in this Section.

9.35.2. General

9.35.2.1. Where a roofed enclosure used for the storage or parking of a car or cars has more than 60 per cent of the total perimeter enclosed by walls, doors or windows, the enclosure shall be considered a garage.

9.35.2.2. Garage Floor. Where an attached or built-in garage is provided, the garage floor shall be sloped to the outdoors.

9.35.3. Foundations

9.35.3.1. Foundation Required. Except as permitted in this Subsection, foundations conforming to Sections 9.12 and 9.15 shall be provided for the support of carport and garage super-structures, including that portion beneath garage doors.

9.35.3.2. Protection from Damage due to Soil Movement

(1) In clay-type soils subject to significant movement with a change in soil moisture content, the foundation depth of carports or garages connected to a *dwelling unit* by a breezeway shall be approximately the same depth as the main *building* foundation.

(2) Where slab-on-grade construction is used, a construction joint shall be provided between the main *building* slab and the garage or breezeway or carport slab.

(3) Except as provided in Section 9.12, foundations for attached unheated garages or carports shall be below frost level.

9.35.3.3. Small Garages. Detached garages of less than 50 m^2 floor area and not more than 1 *storey* in height may be supported on wood mud sills provided the garage is not of masonry or masonry veneer construction.

9.35.3.4. Column Piers

(1) Piers for the support of carport columns shall extend not less than 150 mm above ground level.

(2) Piers referred to in Sentence (1) shall project not less than 25 mm beyond the base of the column but in no case be less than 190 mm by 190 mm in size.

9.35.4. Walls and Columns

9.35.4.1. Interior Finish. Interior finish need not be applied to garage and carport walls.

9.35.4.2. Columns. Columns for garages and carports shall conform to Section 9.17, except that 89 mm by 89 mm wood columns may be used.

9.35.4.3. Anchorage. Garage or carport walls and columns shall be anchored to the foundation to resist wind uplift in conformance with Subsection 9.23.6., except that where a garage is supported on the surface of the ground, ground anchors shall be provided to resist wind uplift.

Table A–1
Forming Part of Sentence 9.23.4.1.(1)

Floor Joists – Living Quarters

Commercial Designation	Grade	Member Size, mm	Strapping Only			Bridging Only			Strapping and Bridging		
			Joist Spacing			Joist Spacing			Joist Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m	m	m	m
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	2.13	1.97	1.73	2.19	1.99	1.73	2.19	1.99	1.73
		38 × 140	3.23	3.07	2.73	3.44	3.12	2.73	3.44	3.12	2.73
		38 × 184	3.88	3.69	3.51	4.18	3.92	3.59	4.37	4.07	3.59
		38 × 235	4.57	4.34	4.13	4.86	4.57	4.29	5.05	4.70	4.39
		38 × 286	5.21	4.95	4.71	5.49	5.16	4.85	5.66	5.28	4.92
	No. 1 and No. 2	38 × 89	2.00	1.85	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 × 140	3.09	2.91	2.62	3.29	2.99	2.62	3.29	2.99	2.62
		38 × 184	3.71	3.53	3.36	4.00	3.76	3.44	4.19	3.90	3.44
		38 × 235	4.38	4.16	3.96	4.66	4.38	4.11	4.84	4.51	4.20
		38 × 286	4.99	4.75	4.52	5.26	4.94	4.65	5.43	5.06	4.72
	No. 3	38 × 89	1.90	1.69	1.38	1.95	1.69	1.38	1.95	1.69	1.38
		38 × 140	2.78	2.41	1.97	2.78	2.41	1.97	2.78	2.41	1.97
		38 × 184	3.38	2.93	2.39	3.38	2.93	2.39	3.38	2.93	2.39
		38 × 235	4.14	3.58	2.93	4.14	3.58	2.93	4.14	3.58	2.93
		38 × 286	4.80	4.16	3.39	4.80	4.16	3.39	4.80	4.16	3.39
	Construction	38 × 89	1.90	1.77	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 × 89	1.81	1.68	1.55	1.96	1.78	1.55	1.96	1.78	1.55
Hemlock – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	2.08	1.93	1.71	2.16	1.96	1.71	2.16	1.96	1.71
		38 × 140	3.18	3.03	2.69	3.39	3.08	2.69	3.39	3.08	2.69
		38 × 184	3.82	3.64	3.46	4.12	3.87	3.54	4.31	4.02	3.54
		38 × 235	4.50	4.28	4.08	4.80	4.51	4.23	4.98	4.64	4.33
		38 × 286	5.14	4.89	4.65	5.42	5.09	4.78	5.59	5.21	4.86
	No. 1 and No. 2	38 × 89	2.00	1.85	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 × 140	3.09	2.91	2.62	3.29	2.99	2.62	3.29	2.99	2.62
		38 × 184	3.71	3.53	3.36	4.00	3.76	3.44	4.19	3.90	3.44
		38 × 235	4.38	4.16	3.96	4.66	4.38	4.11	4.84	4.51	4.20
		38 × 286	4.99	4.75	4.52	5.26	4.94	4.65	5.43	5.06	4.72
	No. 3	38 × 89	1.90	1.77	1.61	2.03	1.84	1.61	2.03	1.84	1.61
		38 × 140	2.99	2.78	2.43	3.19	2.90	2.43	3.19	2.90	2.43
		38 × 184	3.60	3.42	2.95	3.88	3.61	2.95	4.06	3.61	2.95
		38 × 235	4.24	4.03	3.61	4.51	4.24	3.61	4.68	4.37	3.61
		38 × 286	4.84	4.60	4.19	5.10	4.79	4.19	5.26	4.90	4.19
	Construction	38 × 89	1.90	1.77	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 × 89	1.81	1.68	1.55	1.96	1.78	1.55	1.96	1.78	1.55

Table A–1 (Continued)

Floor Joists – Living Quarters

Commercial Designation	Grade	Member Size, mm	Strapping Only			Bridging Only			Strapping and Bridging		
			Joist Spacing			Joist Spacing			Joist Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m	m	m	m
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	1.95	1.81	1.64	2.06	1.87	1.64	2.06	1.87	1.64
		38 × 140	3.05	2.85	2.57	3.24	2.95	2.57	3.24	2.95	2.57
		38 × 184	3.66	3.48	3.31	3.94	3.70	3.38	4.12	3.84	3.38
		38 × 235	4.31	4.10	3.90	4.59	4.31	4.05	4.76	4.44	4.14
		38 × 286	4.91	4.67	4.45	5.18	4.87	4.57	5.34	4.98	4.64
	No. 1 and No. 2	38 × 89	1.86	1.72	1.58	1.99	1.81	1.58	1.99	1.81	1.58
		38 × 140	2.92	2.71	2.49	3.14	2.85	2.49	3.14	2.85	2.49
		38 × 184	3.54	3.36	3.20	3.81	3.58	3.27	3.99	3.72	3.27
		38 × 235	4.17	3.96	3.77	4.44	4.17	3.92	4.60	4.29	4.00
		38 × 286	4.75	4.52	4.30	5.01	4.71	4.42	5.17	4.82	4.49
	No. 3	38 × 89	1.81	1.68	1.55	1.96	1.78	1.55	1.96	1.78	1.55
		38 × 140	2.84	2.64	2.43	3.08	2.80	2.43	3.08	2.80	2.43
		38 × 184	3.47	3.30	2.95	3.74	3.52	2.95	3.92	3.61	2.95
		38 × 235	4.09	3.89	3.61	4.36	4.09	3.61	4.52	4.22	3.61
		38 × 286	4.67	4.44	4.19	4.92	4.62	4.19	5.08	4.73	4.19
	Construction	38 × 89	1.81	1.68	1.55	1.96	1.78	1.55	1.96	1.78	1.55
	Standard	38 × 89	1.70	1.58	1.47	1.88	1.71	1.50	1.88	1.71	1.50
Northern Species (includes any Canadian softwood covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	1.65	1.53	1.42	1.84	1.68	1.46	1.84	1.68	1.46
		38 × 140	2.59	2.41	2.24	2.90	2.63	2.30	2.90	2.63	2.30
		38 × 184	3.27	3.11	2.94	3.52	3.31	3.03	3.69	3.44	3.03
		38 × 235	3.85	3.66	3.48	4.10	3.85	3.62	4.26	3.97	3.70
		38 × 286	4.39	4.18	3.97	4.63	4.35	4.09	4.78	4.45	4.15
	No. 1 and No. 2	38 × 89	1.59	1.48	1.37	1.80	1.64	1.43	1.80	1.64	1.43
		38 × 140	2.51	2.33	2.16	2.83	2.57	2.25	2.83	2.57	2.25
		38 × 184	3.19	3.04	2.84	3.44	3.23	2.96	3.60	3.36	2.96
		38 × 235	3.76	3.58	3.41	4.01	3.77	3.54	4.16	3.88	3.62
		38 × 286	4.29	4.08	3.88	4.53	4.25	4.00	4.67	4.35	4.06
	No. 3	38 × 89	1.54	1.43	1.32	1.74	1.57	1.36	1.76	1.60	1.36
		38 × 140	2.42	2.24	1.94	2.74	2.38	1.94	2.75	2.38	1.94
		38 × 184	3.12	2.90	2.37	3.35	2.90	2.37	3.35	2.90	2.37
		38 × 235	3.67	3.49	2.89	3.91	3.54	2.89	4.06	3.54	2.89
		38 × 286	4.19	3.98	3.36	4.42	4.11	3.36	4.55	4.11	3.36
	Construction	38 × 89	1.54	1.43	1.32	1.74	1.57	1.40	1.76	1.60	1.40
	Standard	38 × 89	1.48	1.37	1.27	1.67	1.51	1.36	1.71	1.55	1.36

Table A–2
Forming Part of Sentence 9.23.4.1.(1)

Floor Joists – Bedrooms and Accessible Attics

Commercial Designation	Grade	Member Size, mm	Strapping Only			Bridging Only			Strapping and Bridging		
			Joist Spacing			Joist Spacing			Joist Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m	m	m	m
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	2.13	1.97	1.83	2.42	2.20	1.92	2.42	2.20	1.92
		38 × 140	3.23	3.07	2.88	3.53	3.31	3.02	3.72	3.46	3.02
		38 × 184	3.88	3.69	3.51	4.18	3.92	3.69	4.37	4.07	3.80
		38 × 235	4.57	4.34	4.13	4.86	4.57	4.29	5.05	4.70	4.39
		38 × 286	5.21	4.95	4.71	5.49	5.16	4.85	5.66	5.28	4.92
	No. 1 and No. 2	38 × 89	2.00	1.85	1.72	2.31	2.09	1.84	2.32	2.11	1.84
		38 × 140	3.09	2.91	2.70	3.38	3.17	2.90	3.57	3.31	2.90
		38 × 184	3.71	3.53	3.36	4.00	3.76	3.53	4.19	3.90	3.64
		38 × 235	4.38	4.16	3.96	4.66	4.38	4.11	4.84	4.51	4.20
		38 × 286	4.99	4.75	4.52	5.26	4.94	4.65	5.43	5.06	4.72
	No. 3	38 × 89	1.90	1.77	1.57	2.19	1.93	1.57	2.23	1.93	1.57
		38 × 140	2.99	2.75	2.25	3.18	2.75	2.25	3.18	2.75	2.25
		38 × 184	3.60	3.35	2.73	3.86	3.35	2.73	3.86	3.35	2.73
		38 × 235	4.24	4.03	3.34	4.51	4.09	3.34	4.68	4.09	3.34
		38 × 286	4.84	4.60	3.88	5.10	4.75	3.88	5.26	4.75	3.88
	Construction	38 × 89	1.90	1.77	1.64	2.19	1.98	1.78	2.25	2.04	1.78
	Standard	38 × 89	1.81	1.68	1.56	2.07	1.88	1.70	2.17	1.97	1.72
Hemlock – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	2.08	1.93	1.80	2.39	2.17	1.89	2.39	2.17	1.89
		38 × 140	3.18	3.03	2.82	3.48	3.27	2.98	3.67	3.41	2.98
		38 × 184	3.82	3.64	3.46	4.12	3.87	3.64	4.31	4.02	3.75
		38 × 235	4.50	4.28	4.08	4.80	4.51	4.23	4.98	4.64	4.33
		38 × 286	5.14	4.89	4.65	5.42	5.09	4.78	5.59	5.21	4.86
	No. 1 and No. 2	38 × 89	2.00	1.85	1.72	2.31	2.09	1.84	2.32	2.11	1.84
		38 × 140	3.09	2.91	2.70	3.38	3.17	2.90	3.57	3.31	2.90
		38 × 184	3.71	3.53	3.36	4.00	3.76	3.53	4.19	3.90	3.64
		38 × 235	4.38	4.16	3.96	4.66	4.38	4.11	4.84	4.51	4.20
		38 × 286	4.99	4.75	4.52	5.26	4.94	4.65	5.43	5.06	4.72
	No. 3	38 × 89	1.90	1.77	1.64	2.19	1.98	1.78	2.25	2.04	1.78
		38 × 140	2.99	2.78	2.58	3.27	3.08	2.77	3.46	3.21	2.77
		38 × 184	3.60	3.42	3.26	3.88	3.64	3.37	4.06	3.78	3.37
		38 × 235	4.24	4.03	3.84	4.51	4.24	3.98	4.68	4.37	4.07
		38 × 286	4.84	4.60	4.37	5.10	4.79	4.50	5.26	4.90	4.57
	Construction	38 × 89	1.90	1.77	1.64	2.19	1.98	1.78	2.25	2.04	1.78
	Standard	38 × 89	1.81	1.68	1.56	2.07	1.88	1.70	2.17	1.97	1.72

Table A–2 (Continued)

Floor Joists – Bedrooms and Accessible Attics

Commercial Designation	Grade	Member Size, mm	Strapping Only			Bridging Only			Strapping and Bridging		
			Joist Spacing			Joist Spacing			Joist Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m	m	m	m
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	1.95	1.81	1.68	2.25	2.04	1.81	2.28	2.07	1.81
		38 × 140	3.05	2.85	2.64	3.33	3.13	2.85	3.51	3.26	2.85
		38 × 184	3.66	3.48	3.31	3.94	3.70	3.48	4.12	3.84	3.58
		38 × 235	4.31	4.10	3.90	4.59	4.31	4.05	4.76	4.44	4.14
		38 × 286	4.91	4.67	4.45	5.18	4.87	4.57	5.34	4.98	4.64
	No. 1 and No. 2	38 × 89	1.86	1.72	1.60	2.14	1.93	1.75	2.21	2.01	1.75
		38 × 140	2.92	2.71	2.51	3.22	3.02	2.75	3.40	3.16	2.76
		38 × 184	3.54	3.36	3.20	3.81	3.58	3.36	3.99	3.72	3.47
		38 × 235	4.17	3.96	3.77	4.44	4.17	3.92	4.60	4.29	4.00
		38 × 286	4.75	4.52	4.30	5.01	4.71	4.42	5.17	4.82	4.49
	No. 3	38 × 89	1.81	1.68	1.56	2.07	1.88	1.70	2.17	1.97	1.72
		38 × 140	2.84	2.64	2.45	3.16	2.95	2.67	3.34	3.10	2.71
		38 × 184	3.47	3.30	3.14	3.74	3.52	3.30	3.92	3.65	3.37
		38 × 235	4.09	3.89	3.70	4.36	4.09	3.85	4.52	4.22	3.93
		38 × 286	4.67	4.44	4.22	4.92	4.62	4.34	5.08	4.73	4.41
	Construction	38 × 89	1.81	1.68	1.56	2.07	1.88	1.70	2.17	1.97	1.72
	Standard	38 × 89	1.70	1.58	1.47	1.95	1.76	1.59	2.09	1.89	1.66
Northern Species (includes any Canadian softwood covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	1.65	1.53	1.42	1.88	1.70	1.54	2.04	1.83	1.62
		38 × 140	2.59	2.41	2.24	2.96	2.67	2.42	3.14	2.88	2.55
		38 × 184	3.27	3.11	2.94	3.52	3.31	3.11	3.69	3.44	3.20
		38 × 235	3.85	3.66	3.48	4.10	3.85	3.62	4.26	3.97	3.70
		38 × 286	4.39	4.18	3.97	4.63	4.35	4.09	4.78	4.45	4.15
	No. 1 and No. 2	38 × 89	1.59	1.48	1.37	1.81	1.64	1.48	1.98	1.76	1.56
		38 × 140	2.51	2.33	2.16	2.85	2.58	2.33	3.07	2.77	2.46
		38 × 184	3.19	3.04	2.84	3.44	3.23	3.04	3.60	3.36	3.13
		38 × 235	3.76	3.58	3.41	4.01	3.77	3.54	4.16	3.88	3.62
		38 × 286	4.29	4.08	3.88	4.53	4.25	4.00	4.67	4.35	4.06
	No. 3	38 × 89	1.54	1.43	1.32	1.74	1.57	1.42	1.90	1.69	1.50
		38 × 140	2.42	2.24	2.08	2.74	2.48	2.22	2.99	2.65	2.22
		38 × 184	3.12	2.95	2.70	3.36	3.16	2.70	3.51	3.28	2.72
		38 × 235	3.67	3.49	3.31	3.91	3.67	3.31	4.06	3.78	3.31
		38 × 286	4.19	3.98	3.79	4.42	4.15	3.84	4.55	4.25	3.84
	Construction	38 × 89	1.54	1.43	1.32	1.74	1.57	1.42	1.90	1.69	1.50
	Standard	38 × 89	1.48	1.37	1.27	1.67	1.51	1.36	1.82	1.61	1.43

Table A-3
Forming Part of Sentence 9.23.4.1.(1)

Ceiling Joists – Attic Not Accessible by a Stairway					
Commercial Designation	Grade	Member Size, mm	All Ceilings		
			Joist Spacing		
			300 mm	400 mm	600 mm
			m	m	m
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	3.41	3.10	2.71
		38 × 140	5.37	4.88	4.26
		38 × 184	7.05	6.41	5.60
		38 × 235	9.01	8.18	7.15
		38 × 286	10.96	9.96	8.70
	No. 1 and No. 2	38 × 89	3.27	2.97	2.59
		38 × 140	5.14	4.67	4.08
		38 × 184	6.76	6.14	5.36
		38 × 235	8.63	7.84	6.85
		38 × 286	10.50	9.54	8.34
	No. 3	38 × 89	3.17	2.88	2.42
		38 × 140	4.89	4.23	3.46
		38 × 184	5.95	5.15	4.20
		38 × 235	7.27	6.30	5.14
		38 × 286	8.44	7.31	5.97
	Construction	38 × 89	3.17	2.88	2.51
	Standard	38 × 89	3.06	2.78	2.43
Hemlock – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	3.36	3.06	2.67
		38 × 140	5.29	4.81	4.20
		38 × 184	6.96	6.32	5.52
		38 × 235	8.88	8.07	7.05
		38 × 286	10.81	9.82	8.58
	No. 1 and No. 2	38 × 89	3.27	2.97	2.59
		38 × 140	5.14	4.67	4.08
		38 × 184	6.76	6.14	5.36
		38 × 235	8.63	7.84	6.85
		38 × 286	10.50	9.54	8.34
	No. 3	38 × 89	3.17	2.88	2.51
		38 × 140	4.98	4.53	3.95
		38 × 184	6.55	5.95	5.19
		38 × 235	8.36	7.60	6.34
		38 × 286	10.18	9.01	7.36
	Construction	38 × 89	3.17	2.88	2.5
	Standard	38 × 89	3.06	2.78	2.43

Table A–3 (Continued)

Ceiling Joists – Attic Not Accessible by a Stairway					
Commercial Designation	Grade	Member Size, mm	All Ceilings		
			Joist Spacing		
			300 mm	400 mm	600 mm
			m	m	m
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	3.22	2.92	2.55
		38 × 140	5.06	4.60	4.02
		38 × 184	6.65	6.05	5.28
		38 × 235	8.50	7.72	6.74
		38 × 286	10.34	9.40	8.21
	No. 1 and No. 2	38 × 89	3.11	2.83	2.47
		38 × 140	4.90	4.45	3.89
		38 × 184	6.44	5.85	5.11
		38 × 235	8.22	7.47	6.52
		38 × 286	10.00	9.09	7.94
	No. 3	38 × 89	3.06	2.78	2.43
		38 × 140	4.81	4.37	3.82
		38 × 184	6.32	5.74	5.02
		38 × 235	8.07	7.33	6.34
		38 × 286	9.82	8.93	7.36
	Construction	38 × 89	3.06	2.78	2.43
	Standard	38 × 89	2.94	2.67	2.33
Northern Species (includes any Canadian softwood covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	2.88	2.61	2.28
		38 × 140	4.53	4.11	3.59
		38 × 184	5.95	5.40	4.72
		38 × 235	7.60	6.90	6.03
		38 × 286	9.25	8.40	7.34
	No. 1 and No. 2	38 × 89	2.81	2.55	2.23
		38 × 140	4.42	4.02	3.51
		38 × 184	5.81	5.28	4.61
		38 × 235	7.42	6.74	5.89
		38 × 286	9.03	8.21	7.17
	No. 3	38 × 89	2.74	2.49	2.18
		38 × 140	4.31	3.92	3.42
		38 × 184	5.67	5.09	4.16
		38 × 235	7.19	6.23	5.08
		38 × 286	8.34	7.23	5.90
	Construction	38 × 89	2.74	2.49	2.18
	Standard	38 × 89	2.67	2.43	2.12

Table A–4

Forming Part of Sentence 9.23.4.1.(1)

Roof Joists – (Design Roof Snow Loads 1.0 and 1.5 kPa)								
Commercial Designation	Grade	Member Size, mm	1.0 kPa			1.5 kPa		
			Joist Spacing			Joist Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	2.71	2.46	2.15	2.37	2.15	1.88
		38 × 140	4.26	3.87	3.38	3.72	3.38	2.95
		38 × 184	5.60	5.09	4.44	4.89	4.44	3.88
		38 × 235	7.15	6.49	5.67	6.24	5.67	4.96
		38 × 286	8.70	7.90	6.91	7.60	6.91	6.03
	No. 1 and No. 2	38 × 89	2.59	2.36	2.06	2.27	2.06	1.80
		38 × 140	4.08	3.71	3.24	3.57	3.24	2.83
		38 × 184	5.36	4.87	4.26	4.69	4.26	3.72
		38 × 235	6.85	6.22	5.44	5.98	5.44	4.74
		38 × 286	8.34	7.57	6.40	7.28	6.62	5.50
	No. 3	38 × 89	2.49	2.16	1.76	2.14	1.85	1.51
		38 × 140	3.56	3.08	2.51	3.06	2.65	2.16
		38 × 184	4.33	3.75	3.06	3.72	3.22	2.63
		38 × 235	5.29	4.58	3.74	4.55	3.94	3.22
		38 × 286	6.14	5.32	4.34	5.28	4.57	3.73
	Construction	38 × 89	2.51	2.28	1.99	2.20	1.99	1.74
	Standard	38 × 89	2.43	2.20	1.93	2.12	1.93	1.68
Hemlock – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	2.67	2.43	2.12	2.33	2.12	1.85
		38 × 140	4.20	3.82	3.33	3.67	3.33	2.91
		38 × 184	5.52	5.02	4.38	4.82	4.38	3.83
		38 × 235	7.05	6.41	5.60	6.16	5.60	4.89
		38 × 286	8.58	7.80	6.81	7.50	6.81	5.95
	No. 1 and No. 2	38 × 89	2.59	2.36	2.06	2.27	2.06	1.80
		38 × 140	4.08	3.71	3.24	3.57	3.24	2.83
		38 × 184	5.36	4.87	4.26	4.69	4.26	3.72
		38 × 235	6.85	6.22	5.44	5.98	5.44	4.75
		38 × 286	8.34	7.57	6.62	7.28	6.62	5.77
	No. 3	38 × 89	2.51	2.28	1.99	2.20	1.99	1.74
		38 × 140	3.95	3.59	3.10	3.45	3.14	2.67
		38 × 184	5.20	4.62	3.77	4.54	3.97	3.24
		38 × 235	6.53	5.65	4.61	5.61	4.86	3.97
		38 × 286	7.57	6.56	5.35	6.51	5.64	4.60
	Construction	38 × 89	2.51	2.28	1.99	2.20	1.99	1.74
	Standard	38 × 89	2.43	2.20	1.93	2.12	1.93	1.68

Table A–4 (Continued)

Roof Joists – (Design Roof Snow Loads 1.0 and 1.5 kPa)								
Commercial Designation	Grade	Member Size, mm	1.0 kPa Joist Spacing			1.5 kPa Joist Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	2.55	2.32	2.03	2.23	2.03	1.77
		38 × 140	4.02	3.65	3.19	3.51	3.19	2.79
		38 × 184	5.28	4.80	4.19	4.61	4.19	3.66
		38 × 235	6.74	6.13	5.35	5.89	5.35	4.68
		38 × 286	8.21	7.46	6.52	7.17	6.52	5.69
	No. 1 and No. 2	38 × 89	2.47	2.24	1.96	2.16	1.96	1.71
		38 × 140	3.89	3.53	3.08	3.40	3.08	2.69
		38 × 184	5.11	4.64	4.05	4.46	4.05	3.54
		38 × 235	6.52	5.93	5.18	5.70	5.18	4.52
		38 × 286	7.94	7.21	6.30	6.94	6.30	5.50
	No. 3	38 × 89	2.43	2.20	1.93	2.12	1.93	1.68
		38 × 140	3.82	3.47	3.03	3.33	3.03	2.65
		38 × 184	5.02	4.56	3.77	4.38	3.97	3.24
		38 × 235	6.41	5.65	4.61	5.60	4.86	3.97
		38 × 286	7.57	6.56	5.35	6.51	5.64	4.60
	Construction	38 × 89	2.43	2.20	1.93	2.12	1.93	1.68
	Standard	38 × 89	2.33	2.12	1.85	2.04	1.85	1.62
Northern Species (includes any Canadian softwood covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	2.28	2.07	1.81	1.99	1.81	1.58
		38 × 140	3.59	3.26	2.85	3.14	2.85	2.49
		38 × 184	4.72	4.29	3.75	4.12	3.75	3.27
		38 × 235	6.03	5.48	4.79	5.27	4.79	4.18
		38 × 286	7.34	6.67	5.82	6.41	5.82	5.09
	No. 1 and No. 2	38 × 89	2.23	2.03	1.77	1.95	1.77	1.55
		38 × 140	3.51	3.19	2.79	3.07	2.79	2.43
		38 × 184	4.61	4.19	3.66	4.03	3.66	3.20
		38 × 235	5.89	5.35	4.68	5.15	4.68	4.09
		38 × 286	7.17	6.52	5.58	6.26	5.69	4.80
	No. 3	38 × 89	2.18	1.98	1.73	1.90	1.73	1.50
		38 × 140	3.42	3.05	2.49	2.99	2.62	2.14
		38 × 184	4.28	3.71	3.03	3.68	3.19	2.60
		38 × 235	5.23	4.53	3.70	4.50	3.90	3.18
		38 × 286	6.07	5.26	4.29	5.22	4.52	3.69
	Construction	38 × 89	2.18	1.98	1.73	1.90	1.73	1.51
	Standard	38 × 89	2.12	1.93	1.68	1.85	1.68	1.47

Table A–5

Forming Part of Sentence 9.23.4.1.(1)

Roof Joists – (Design Roof Snow Loads 2.0 and 2.5 kPa)

Commercial Designation	Grade	Member Size, mm	2.0 kPa Joist Spacing			2.5 kPa Joist Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	2.15	1.95	1.71	1.99	1.81	1.58
		38 × 140	3.38	3.07	2.68	3.14	2.85	2.49
		38 × 184	4.44	4.04	3.53	4.12	3.75	3.27
		38 × 235	5.67	5.15	4.50	5.27	4.79	4.18
		38 × 286	6.91	6.27	5.48	6.41	5.82	5.09
	No. 1 and No. 2	38 × 89	2.06	1.87	1.63	1.91	1.74	1.52
		38 × 140	3.24	2.94	2.57	3.01	2.73	2.39
		38 × 184	4.26	3.87	3.38	3.95	3.59	3.14
		38 × 235	5.44	4.94	4.22	5.05	4.59	3.84
		38 × 286	6.62	6.00	4.90	6.14	5.46	4.46
	No. 3	38 × 89	1.91	1.65	1.35	1.74	1.50	1.23
		38 × 140	2.72	2.36	1.92	2.48	2.15	1.75
		38 × 184	3.31	2.87	2.34	3.01	2.61	2.13
		38 × 235	4.05	3.51	2.86	3.69	3.19	2.61
		38 × 286	4.70	4.07	3.32	4.28	3.70	3.03
	Construction	38 × 89	1.99	1.81	1.58	1.85	1.68	1.47
	Standard	38 × 89	1.93	1.75	1.53	1.79	1.62	1.42
Hemlock – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	2.12	1.93	1.68	1.97	1.79	1.56
		38 × 140	3.33	3.03	2.65	3.10	2.81	2.46
		38 × 184	4.38	3.98	3.48	4.07	3.70	3.23
		38 × 235	5.60	5.09	4.44	5.20	4.72	4.12
		38 × 286	6.81	6.19	5.41	6.32	5.75	5.02
	No. 1 and No. 2	38 × 89	2.06	1.87	1.63	1.91	1.74	1.52
		38 × 140	3.24	2.94	2.57	3.01	2.73	2.39
		38 × 184	4.26	3.87	3.38	3.95	3.59	3.14
		38 × 235	5.44	4.94	4.32	5.05	4.59	4.01
		38 × 286	6.62	6.01	5.25	5.14	5.58	4.68
	No. 3	38 × 89	1.99	1.81	1.58	1.85	1.68	1.47
		38 × 140	3.14	2.85	2.37	2.91	2.65	2.16
		38 × 184	4.09	3.54	2.89	3.72	3.22	2.63
		38 × 235	5.00	4.33	3.53	4.55	3.94	3.22
		38 × 286	5.80	5.02	4.10	5.28	4.57	3.73
	Construction	38 × 89	1.99	1.81	1.58	1.85	1.68	1.47
	Standard	38 × 89	1.93	1.75	1.53	1.79	1.62	1.42

Table A–5 (Continued)

Roof Joists – (Design Roof Snow Loads 2.0. and 2.5 kPa)								
Commercial Designation	Grade	Member Size, mm	2.0 kPa Joist Spacing			2.5 kPa Joist Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	2.03	1.84	1.61	1.88	1.71	1.49
		38 × 140	3.19	2.90	2.53	2.96	2.69	2.35
		38 × 184	4.19	3.81	3.33	3.89	3.54	3.09
		38 × 235	5.35	4.86	4.25	4.97	4.52	3.94
		38 × 286	6.52	5.92	5.17	6.05	5.50	4.80
	No. 1 and No. 2	38 × 89	1.96	1.78	1.56	1.82	1.65	1.44
		38 × 140	3.08	2.80	2.45	2.86	2.60	2.27
		38 × 184	4.05	3.68	3.22	3.76	3.42	2.99
		38 × 235	5.18	4.70	4.11	4.81	4.37	3.82
		38 × 286	6.30	5.73	5.00	5.85	5.31	4.64
	No. 3	38 × 89	1.93	1.75	1.53	1.79	1.62	1.42
		38 × 140	3.03	2.75	2.37	2.81	2.56	2.16
		38 × 184	3.98	3.54	2.89	3.70	3.22	2.63
		38 × 235	5.00	4.33	3.53	4.55	3.94	3.22
		38 × 286	5.80	5.02	4.10	5.28	4.57	3.73
	Construction	38 × 89	1.93	1.75	1.53	1.79	1.62	1.42
	Standard	38 × 89	1.85	1.68	1.47	1.72	1.56	1.36
Northern Species (includes any Canadian softwood covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	1.81	1.65	1.44	1.68	1.53	1.34
		38 × 140	2.85	2.59	2.26	2.65	2.40	2.10
		38 × 184	3.75	3.40	2.97	3.48	3.16	2.76
		38 × 235	4.79	4.35	3.80	4.44	4.04	3.53
		38 × 286	5.82	5.29	4.62	5.41	4.91	4.29
	No. 1 and No. 2	38 × 89	1.77	1.61	1.41	1.64	1.49	1.31
		38 × 140	2.79	2.53	2.21	2.59	2.35	2.05
		38 × 184	3.66	3.33	2.91	3.40	3.09	2.70
		38 × 235	4.68	4.25	3.68	4.34	3.94	3.35
		38 × 286	5.69	5.17	4.27	5.28	4.76	3.89
	No. 3	38 × 89	1.73	1.57	1.33	1.60	1.46	1.21
		38 × 140	2.69	2.33	1.90	2.45	2.12	1.73
		38 × 184	3.28	2.84	2.32	2.98	2.58	2.11
		38 × 235	4.01	3.47	2.83	3.65	3.16	2.58
		38 × 286	4.65	4.03	3.29	4.23	3.66	2.99
	Construction	38 × 89	1.73	1.57	1.37	1.60	1.46	1.27
	Standard	38 × 89	1.68	1.53	1.34	1.56	1.42	1.24

Table A–6

Forming Part of Sentence 9.23.4.1.(1)

Roof Rafters – (Design Roof Snow Loads 1.0 and 1.5 kPa)								
Commercial Designation	Grade	Member Size, mm	1.0 kPa Rafter Spacing			1.5 kPa Rafter Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	3.41	3.10	2.71	2.98	2.71	2.37
		38 × 140	5.37	4.88	4.26	4.69	4.26	3.72
		38 × 184	7.05	6.41	5.60	6.16	5.60	4.89
		38 × 235	9.01	8.18	7.15	7.87	7.15	6.24
		38 × 286	10.96	9.96	8.70	9.58	8.70	7.40
	No. 1 and No. 2	38 × 89	3.27	2.97	2.59	2.86	2.59	2.27
		38 × 140	5.14	4.67	3.95	4.49	4.08	3.34
		38 × 184	6.76	5.88	4.80	5.74	4.97	4.06
		38 × 235	8.30	7.19	5.87	7.02	6.08	4.96
		38 × 286	9.63	8.34	6.81	8.14	7.05	5.76
	No. 3	38 × 89	2.65	2.30	1.87	2.24	1.94	1.58
		38 × 140	3.78	3.28	2.68	3.20	2.77	2.26
		38 × 184	4.61	3.99	3.26	3.89	3.37	2.75
		38 × 235	5.63	4.88	3.98	4.76	4.12	3.37
		38 × 286	6.53	5.66	4.62	5.52	4.78	3.91
	Construction	38 × 89	3.17	2.88	2.51	2.77	2.51	2.20
	Standard	38 × 89	3.06	2.78	2.36	2.67	2.43	2.00
Hemlock – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	3.36	3.06	2.67	2.94	2.67	2.33
		38 × 140	5.29	4.81	4.20	4.62	4.20	3.67
		38 × 184	6.96	6.32	5.52	6.08	5.52	4.82
		38 × 235	8.88	8.07	7.05	7.76	7.05	6.16
		38 × 286	10.81	9.82	8.58	9.45	8.58	7.28
	No. 1 and No. 2	38 × 89	3.27	2.97	2.59	2.86	2.59	2.27
		38 × 140	5.14	4.67	4.08	4.49	4.08	3.50
		38 × 184	6.76	6.14	5.04	5.90	5.21	4.26
		38 × 235	8.63	7.54	6.16	7.36	6.37	5.20
		38 × 286	10.11	8.75	7.15	8.54	7.40	6.04
	No. 3	38 × 89	3.17	2.83	2.31	2.76	2.39	1.95
		38 × 140	4.67	4.04	3.30	3.95	3.42	2.79
		38 × 184	5.68	4.92	4.02	4.80	4.16	3.40
		38 × 235	6.95	6.02	4.91	5.87	5.08	4.15
		38 × 286	8.06	6.98	5.70	6.81	5.90	4.82
	Construction	38 × 89	3.17	2.88	2.51	2.77	2.51	2.20
	Standard	38 × 89	3.06	2.78	2.43	2.67	2.43	2.09

Table A–6 (Continued)

Roof Rafters – (Design Roof Snow Loads 1.0 and 1.5 kPa)								
Commercial Designation	Grade	Member Size, mm	1.0 kPa Rafter Spacing			1.5 kPa Rafter Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	3.22	2.92	2.55	2.81	2.55	2.23
		38 × 140	5.06	4.60	4.02	4.42	4.02	3.51
		38 × 184	6.65	6.05	5.28	5.81	5.28	4.61
		38 × 235	8.50	7.72	6.74	7.42	6.74	5.89
		38 × 286	10.34	9.40	8.21	9.03	8.21	7.17
	No. 1 and No. 2	38 × 89	3.11	2.83	2.47	2.72	2.47	2.16
		38 × 140	4.90	4.45	3.89	4.28	3.89	3.40
		38 × 184	6.44	5.85	5.11	5.62	5.11	4.41
		38 × 235	8.22	7.47	6.38	7.18	6.52	5.39
		38 × 286	10.00	9.06	7.40	8.74	7.66	6.25
	No. 3	38 × 89	3.06	2.78	2.31	2.67	2.39	1.95
		38 × 140	4.67	4.04	3.30	3.95	3.42	2.79
		38 × 184	5.68	4.92	4.02	4.80	4.16	3.40
		38 × 235	6.95	6.02	4.91	5.87	5.08	4.15
		38 × 286	8.06	6.98	5.70	6.81	5.90	4.82
	Construction	38 × 89	3.06	2.78	2.43	2.67	2.43	2.12
	Standard	38 × 89	2.94	2.67	2.33	2.57	2.33	2.04
Northern Species (includes any Canadian softwood covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	2.88	2.61	2.28	2.51	2.28	1.99
		38 × 140	4.53	4.11	3.59	3.95	3.59	3.14
		38 × 184	5.95	5.40	4.72	5.20	4.72	4.12
		38 × 235	7.60	6.90	6.03	6.64	6.03	5.11
		38 × 286	9.25	8.40	7.01	8.08	7.26	5.93
	No. 1 and No. 2	38 × 89	2.81	2.55	2.23	2.46	2.23	1.95
		38 × 140	4.42	4.02	3.44	3.86	3.51	2.91
		38 × 184	5.81	5.13	4.19	5.00	4.33	3.54
		38 × 235	7.24	6.27	5.12	6.12	5.30	4.33
		38 × 286	8.40	7.27	5.94	7.10	6.15	5.02
	No. 3	38 × 89	2.62	2.27	1.85	2.22	1.92	1.57
		38 × 140	3.74	3.24	2.65	3.16	2.74	2.24
		38 × 184	4.56	3.94	3.22	3.85	3.33	2.72
		38 × 235	5.57	4.82	3.94	4.71	4.08	3.33
		38 × 286	6.46	5.60	4.57	5.46	4.73	3.86
	Construction	38 × 89	2.74	2.49	2.18	2.40	2.18	1.90
	Standard	38 × 89	2.67	2.43	2.05	2.33	2.12	1.73

Table A–7

Forming Part of Sentence 9.23.4.1.(1)

Roof Rafters – (Design Roof Snow Loads 2.0 and 2.5 kPa)								
Commercial Designation	Grade	Member Size, mm	2.0 kPa Rafter Spacing			2.5 kPa Rafter Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	2.71	2.46	2.15	2.51	2.28	1.99
		38 × 140	4.26	3.87	3.38	3.95	3.59	3.14
		38 × 184	5.60	5.09	4.44	5.20	4.72	4.12
		38 × 235	7.15	6.49	5.62	6.64	6.03	5.08
		38 × 286	8.70	7.90	6.52	8.08	7.23	5.90
	No. 1 and No. 2	38 × 89	2.59	2.36	2.06	2.41	2.19	1.86
		38 × 140	4.08	3.60	2.94	3.76	3.26	2.66
		38 × 184	5.06	4.38	3.58	4.58	3.96	3.24
		38 × 235	6.19	5.36	4.38	5.60	4.85	3.96
		38 × 286	7.18	6.22	5.08	6.50	5.63	4.59
	No. 3	38 × 89	1.98	1.71	1.40	1.79	1.55	1.26
		38 × 140	2.82	2.44	1.99	2.55	2.21	1.80
		38 × 184	3.43	2.97	2.43	3.10	2.69	2.20
		38 × 235	4.20	3.64	2.97	3.80	3.29	2.68
		38 × 286	4.87	4.22	3.44	4.41	3.82	3.12
	Construction	38 × 89	2.51	2.28	1.99	2.33	2.12	1.85
	Standard	38 × 89	2.43	2.16	1.76	2.25	1.95	1.59
Hemlock – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	2.67	2.43	2.12	2.48	2.25	1.97
		38 × 140	4.20	3.82	3.33	3.90	3.54	3.10
		38 × 184	5.52	5.02	4.38	5.13	4.66	4.07
		38 × 235	7.05	6.41	5.54	6.55	5.95	5.01
		38 × 286	8.58	7.80	6.42	7.97	7.12	5.81
	No. 1 and No. 2	38 × 89	2.59	2.36	2.06	2.41	2.19	1.91
		38 × 140	4.08	3.71	3.08	3.79	3.42	2.79
		38 × 184	5.31	4.60	3.75	4.80	4.16	3.40
		38 × 235	6.49	5.62	4.59	5.87	5.08	4.15
		38 × 286	7.53	6.52	5.33	6.81	5.90	4.82
	No. 3	38 × 89	2.44	2.11	1.72	2.21	1.91	1.56
		38 × 140	3.48	3.01	2.46	3.15	2.73	2.23
		38 × 184	4.23	3.67	2.99	3.83	3.32	2.71
		38 × 235	5.18	4.48	3.66	4.68	4.06	3.31
		38 × 286	6.01	5.20	4.25	5.43	4.71	3.84
	Construction	38 × 89	2.51	2.28	1.99	2.33	2.12	1.85
	Standard	38 × 89	2.43	2.20	1.84	2.25	2.04	1.67

Table A–7 (Continued)

Roof Rafters – (Design Roof Snow Loads 2.0 and 2.5 kPa)								
Commercial Designation	Grade	Member Size, mm	2.0 kPa Rafter Spacing			2.5 kPa Rafter Spacing		
			300 mm	400 mm	600 mm	300 mm	400 mm	600 mm
			m	m	m	m	m	m
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	2.55	2.32	2.03	2.37	2.15	1.88
		38 × 140	4.02	3.65	3.19	3.73	3.39	2.96
		38 × 184	5.28	4.80	4.19	4.90	4.45	3.89
		38 × 235	6.74	6.13	5.35	6.26	5.69	4.97
		38 × 286	8.21	7.46	6.52	7.62	6.92	5.90
	No. 1 and No. 2	38 × 89	2.47	2.24	1.96	2.29	2.08	1.82
		38 × 140	3.89	3.53	3.08	3.61	3.28	2.86
		38 × 184	5.11	4.64	3.89	4.74	4.31	3.52
		38 × 235	6.52	5.82	4.75	6.06	5.27	4.30
		38 × 286	7.80	6.76	5.52	7.06	6.11	4.99
	No. 3	38 × 89	2.43	2.11	1.72	2.21	1.91	1.56
		38 × 140	3.48	3.01	2.46	3.15	2.73	2.23
		38 × 184	4.23	3.67	2.99	3.83	3.32	2.71
		38 × 235	5.18	4.48	3.66	4.68	4.06	3.31
		38 × 286	6.01	5.20	4.25	5.43	4.71	3.84
	Construction	38 × 89	2.43	2.20	1.93	2.25	2.05	1.79
	Standard	38 × 89	2.33	2.12	1.85	2.17	1.97	1.72
Northern Species (includes any Canadian softwood covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	2.28	2.07	1.81	2.12	1.93	1.68
		38 × 140	3.59	3.26	2.85	3.33	3.03	2.65
		38 × 184	4.72	4.29	3.68	4.38	3.98	3.33
		38 × 235	6.03	5.48	4.51	5.60	4.99	4.08
		38 × 286	7.34	6.40	5.23	6.69	5.79	4.73
	No. 1 and No. 2	38 × 89	2.23	2.03	1.77	2.07	1.88	1.62
		38 × 140	3.51	3.14	2.56	3.26	2.84	2.32
		38 × 184	4.41	3.82	3.12	3.99	3.46	2.82
		38 × 235	5.40	4.67	3.82	4.88	4.23	3.45
		38 × 286	6.26	5.42	4.43	5.66	4.90	4.00
	No. 3	38 × 89	1.95	1.69	1.38	1.77	1.53	1.25
		38 × 140	2.79	2.42	1.97	2.52	2.19	1.78
		38 × 184	3.40	2.94	2.40	3.07	2.66	2.17
		38 × 235	4.15	3.60	2.94	3.76	3.25	2.66
		38 × 286	4.82	4.17	3.41	4.36	3.77	3.08
	Construction	38 × 89	2.18	1.98	1.73	2.02	1.84	1.60
	Standard	38 × 89	2.12	1.87	1.53	1.95	1.69	1.38

Table A–8

Forming Part of Sentence 9.23.4.1.(1)

Maximum Spans (m) for Built-up Floor Beams Supporting not more than One Floor in Houses[1]

Commercial Designation	Grade	Supported Length, mm	Size of Built-Up Beam, mm					
			3 – 38 x 184	4 – 38 x 184	3 – 38 x 235	4 – 38 x 235	3 – 38 x 286	4 – 38 x 286
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	2.4	3.84	4.43	4.70	5.42	5.45	6.29
		3.0	3.43	3.97	4.20	4.85	4.87	5.63
		3.6	3.14	3.62	3.83	4.43	4.45	5.14
		4.2	2.90	3.35	3.55	4.10	3.95	4.76
		4.8	2.67	3.14	3.13	3.83	3.46	4.45
	No. 2	2.4	2.99	3.45	3.66	4.22	4.24	4.90
		3.0	2.67	3.09	3.27	3.78	3.79	4.38
		3.6	2.44	2.82	2.98	3.45	3.46	4.00
		4.2	2.26	2.61	2.76	3.19	3.21	3.70
		4.8	2.11	2.44	2.59	2.98	3.00	3.46
Hemlock – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	2.4	3.78	4.37	4.62	5.34	5.37	6.20
		3.0	3.38	3.91	4.09	4.78	4.53	5.54
		3.6	2.91	3.57	3.41	4.36	3.78	5.03
		4.2	2.50	3.30	2.92	3.90	3.24	4.31
		4.8	2.19	2.91	2.56	3.41	2.83	3.78
	No. 2	2.4	3.14	3.62	3.83	4.43	4.45	5.14
		3.0	2.80	3.24	3.43	3.96	3.98	4.60
		3.6	2.56	2.96	3.13	3.61	3.63	4.19
		4.2	2.37	2.74	2.90	3.35	3.24	3.88
		4.8	2.19	2.56	2.56	3.13	2.83	3.63
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4	3.84	4.43	4.70	5.42	5.45	6.29
		3.0	3.43	3.97	4.20	4.85	4.87	5.63
		3.6	3.14	3.62	3.79	4.43	4.19	5.14
		4.2	2.78	3.35	3.25	4.10	3.60	4.76
		4.8	2.43	3.14	2.84	3.79	3.15	4.19
	No. 2	2.4	3.25	3.75	3.97	4.59	4.61	5.32
		3.0	2.90	3.35	3.55	4.10	4.12	4.76
		3.6	2.65	3.06	3.24	3.74	3.76	4.34
		4.2	2.45	2.83	3.00	3.47	3.48	4.02
		4.8	2.30	2.65	2.81	3.24	3.15	3.76
Northern Species (includes any Canadian softwood covered by the NLGA Standard Grading Rules)	Select Structural	2.4	3.08	3.55	3.76	4.35	4.37	5.04
		3.0	2.75	3.18	3.37	3.89	3.91	4.51
		3.6	2.51	2.90	3.07	3.55	3.57	4.12
		4.2	2.33	2.69	2.85	3.29	3.24	3.81
		4.8	2.18	2.51	2.56	3.07	2.83	3.57
	No. 2	2.4	2.61	3.01	3.19	3.68	3.70	4.27
		3.0	2.33	2.69	2.85	3.29	3.31	3.82
		3.6	2.13	2.46	2.60	3.00	3.02	3.49
		4.2	1.97	2.27	2.41	2.78	2.80	3.23
		4.8	1.84	2.13	2.25	2.60	2.61	3.02

Note to Table A-8

(1) See A-9.23.4.1.(1) in Appendix A

Table A–9

Forming Part of Sentence 9.23.4.1.(1)

Maximum Spans (m) for Built-up Floor Beams Supporting not more than Two Floors in Houses[1]

Commercial Designation	Grade	Supported Length, mm	Size of Built-Up Beam, mm					
			3 – 38 x 184	4 – 38 x 184	3 – 38 x 235	4 – 38 x 235	3 – 38 x 286	4 – 38 x 286
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	2.4	2.91	3.36	3.56	4.11	3.98	4.77
		3.0	2.46	3.01	2.88	3.68	3.19	4.25
		3.6	2.05	2.73	2.40	3.20	2.66	3.54
		4.2	1.76	2.84	2.06	2.74	2.28	3.04
		4.8	1.54	2.05	1.80	2.40	1.99	2.66
	No. 2	2.4	2.27	2.62	2.77	3.20	3.22	3.72
		3.0	2.03	2.34	2.48	2.86	2.88	3.32
		3.6	1.85	2.14	2.26	2.62	2.63	3.03
		4.2	1.71	1.98	2.06	2.42	2.28	2.81
		4.8	1.54	1.85	1.80	2.26	1.99	2.63
Hemlock – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	2.4	2.52	3.31	2.95	3.93	3.26	4.35
		3.0	2.01	2.68	2.36	3.14	2.61	3.48
		3.6	1.68	2.24	1.96	2.62	2.17	2.90
		4.2	1.44	1.92	1.68	2.25	1.86	2.48
		4.8	1.26	1.68	1.47	1.96	1.63	2.17
	No. 2	2.4	2.38	2.75	2.91	3.36	3.26	3.90
		3.0	2.01	2.46	2.36	3.00	2.61	3.48
		3.6	1.68	2.24	1.96	2.62	2.17	2.90
		4.2	1.44	1.92	1.68	2.25	1.86	2.48
		4.8	1.26	1.68	1.47	1.96	1.63	2.17
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4	2.80	3.36	3.27	4.11	3.62	4.77
		3.0	2.24	2.98	2.62	3.49	2.90	3.86
		3.6	1.86	2.49	2.18	2.91	2.42	3.22
		4.2	1.60	2.13	1.87	2.49	2.07	2.76
		4.8	1.40	1.86	1.64	2.18	1.81	2.42
	No. 2	2.4	2.46	2.85	3.01	3.48	3.50	4.04
		3.0	2.20	2.55	2.62	3.11	2.90	3.61
		3.6	1.86	2.32	2.18	2.84	2.42	3.22
		4.2	1.60	2.13	1.87	2.49	2.07	2.76
		4.8	1.40	1.86	1.64	2.18	1.81	2.42
Northern Species (includes any Canadian softwood covered by the NLGA Standard Grading Rules)	Select Structural	2.4	2.34	2.70	2.86	3.30	3.26	3.83
		3.0	2.01	2.41	2.36	2.95	2.61	3.42
		3.6	1.68	2.20	1.96	2.62	2.17	2.90
		4.2	1.44	1.92	1.68	2.25	1.86	2.48
		4.8	1.26	1.68	1.47	1.96	1.63	2.17
	No. 2	2.4	1.98	2.28	2.42	2.79	2.81	3.24
		3.0	1.77	2.04	2.16	2.50	2.51	2.90
		3.6	1.61	1.86	1.96	2.28	2.17	2.65
		4.2	1.44	1.73	1.68	2.11	1.86	2.45
		4.8	1.26	1.61	1.47	1.96	1.63	2.17

Note to Table A-9

[1] See A-9.23.4.1.(1) in Appendix A

Table A–10

Forming Part of Article 9.23.13.11.

Maximum Clear Spans (m) between End Supports for Fink Trusses

Top Member Size, mm	Bottom Member Size, mm	Roof Slope	No. 1 Grade Lumber				No. 2 Grade Lumber			
			Design Roof Snow Load, kPa				Design Roof Snow Load, kPa			
			1.0	1.5	2.0	2.5	1.0	1.5	2.0	2.5
38 × 89	38 × 89	1 in 4.8	6.75	4.87	–	–	5.84	4.01	–	–
		1 in 4	9.57	8.12	6.01	4.54	8.02	7.13	5.18	3.78
		1 in 3	9.60	8.83	7.62	6.75	8.91	7.69	6.60	5.84
		1 in 2.4	9.80	9.04	7.79	6.93	9.11	7.87	6.78	6.01
	38 × 114	1 in 4.8	7.74	5.74	3.78	–	6.75	4.85	–	–
		1 in 4	9.27	8.53	7.06	5.48	8.58	7.36	6.14	4.67
		1 in 3	9.60	8.83	7.62	6.75	8.91	7.69	6.60	5.84
		1 in 2.4	9.80	9.04	7.79	6.93	9.11	7.87	6.78	6.01
	38 × 140	1 in 4.8	8.50	6.35	4.39	–	7.44	5.46	3.47	–
		1 in 4	9.27	8.53	7.28	5.89	8.58	7.36	6.29	5.08
		1 in 3	9.60	8.83	7.62	6.75	8.91	7.69	6.60	5.84
		1 in 2.4	9.80	9.04	7.79	6.93	9.11	7.87	6.78	6.01
38 × 114	38 × 89	1 in 4.8	7.97	5.91	3.96	–	6.95	5.02	–	–
		1 in 4	9.57	8.66	7.18	5.56	8.02	7.16	6.24	4.77
		1 in 3	10.54	9.75	8.81	7.97	8.96	8.20	7.31	6.57
		1 in 2.4	11.20	9.90	9.65	8.89	9.57	8.91	8.10	7.41
	38 × 114	1 in 4.8	9.27	6.98	4.95	3.30	8.12	6.04	4.08	–
		1 in 4	11.91	10.23	8.48	6.68	10.31	9.24	7.44	5.79
		1 in 3	12.19	10.64	9.14	8.66	10.74	9.24	8.48	7.49
		1 in 2.4	12.19	10.89	9.39	8.91	10.99	9.49	8.71	7.74
	38 × 140	1 in 4.8	10.23	7.79	5.63	4.08	9.01	6.78	4.77	–
		1 in 4	11.91	10.23	9.11	7.23	10.31	9.47	8.05	6.29
		1 in 3	12.19	10.64	9.14	8.66	10.74	9.47	8.48	7.49
		1 in 2.4	12.19	10.89	9.39	8.91	10.99	9.49	8.71	7.74
38 × 140	38 × 89	1 in 4.8	8.89	6.73	4.72	–	7.39	5.81	3.86	–
		1 in 4	9.57	8.66	7.62	6.35	8.02	7.16	6.24	5.48
		1 in 3	10.54	9.75	8.81	7.97	8.96	8.20	7.31	6.57
		1 in 2.4	11.20	10.49	9.65	8.89	9.57	8.91	8.10	7.41
	38 × 114	1 in 4.8	10.46	7.97	5.79	4.24	9.22	6.95	4.92	3.27
		1 in 4	12.19	11.12	9.62	7.64	10.33	9.24	8.02	6.68
		1 in 3	12.19	12.19	11.17	9.90	11.50	10.54	9.42	8.45
		1 in 2.4	12.19	12.19	11.48	10.18	12.19	11.45	9.98	9.44
	38 × 140	1 in 4.8	11.68	8.96	6.60	5.00	10.33	7.84	5.68	4.14
		1 in 4	12.19	12.19	10.43	8.33	12.19	10.82	9.22	7.31
		1 in 3	12.19	12.19	11.17	9.90	12.19	11.30	9.67	9.16
		1 in 2.4	12.19	12.19	11.48	10.18	12.19	11.60	9.98	9.44

Table A–11

Forming Part of Article 9.23.13.11.

Maximum Clear Spans (m) between End Supports for Howe Trusses

Top Member Size, mm	Bottom Member Size, mm	Roof Slope	No. 1 Grade Lumber				No. 2 Grade Lumber			
			Design Roof Snow Load, kPa				Design Roof Snow Load, kPa			
			1.0	1.5	2.0	2.5	1.0	1.5	2.0	2.5
38 × 89	38 × 89	1 in 4.8	9.44	7.31	5.48	4.24	8.30	6.45	4.77	3.63
		1 in 4	9.44	8.50	7.28	6.42	8.55	7.36	6.27	5.53
		1 in 3	9.57	8.83	7.59	6.73	8.89	7.67	6.57	5.84
		1 in 2.4	9.77	9.04	7.79	6.93	9.09	7.87	6.78	6.01
	38 × 114	1 in 4.8	9.62	8.15	6.17	4.82	8.30	7.11	5.41	4.19
		1 in 4	9.62	8.50	7.28	6.42	8.55	7.36	6.27	5.53
		1 in 3	9.62	8.83	7.59	6.73	8.89	7.67	6.57	5.84
		1 in 2.4	9.77	9.04	7.79	6.93	9.09	8.87	6.78	6.01
	38 × 140	1 in 4.8	9.62	8.25	7.03	5.63	8.30	7.11	6.04	4.92
		1 in 4	9.62	8.50	7.28	6.42	8.55	7.36	6.27	5.53
		1 in 3	9.62	8.83	7.59	6.73	8.89	7.67	6.57	5.84
		1 in 2.4	9.77	9.04	7.79	6.93	9.09	7.87	6.78	6.01
38 × 114	38 × 89	1 in 4.8	10.18	8.28	6.27	4.92	8.35	7.16	5.48	4.26
		1 in 4	11.20	9.85	8.45	7.34	9.27	8.07	6.83	5.89
		1 in 3	12.19	10.64	9.14	8.66	10.64	9.22	8.28	7.28
		1 in 2.4	12.19	10.89	9.37	8.89	10.97	9.47	8.71	7.72
	38 × 114	1 in 4.8	11.53	9.37	7.13	5.66	9.95	8.30	6.27	4.92
		1 in 4	11.88	10.21	9.37	8.28	10.28	9.44	8.07	7.11
		1 in 3	12.19	10.64	9.37	8.66	10.71	9.44	8.45	7.49
		1 in 2.4	12.19	10.89	9.37	8.89	10.97	9.47	8.71	7.72
	38 × 140	1 in 4.8	11.53	9.90	8.35	6.68	9.95	9.14	7.39	5.86
		1 in 4	11.88	10.21	9.37	8.28	10.28	9.44	8.07	7.11
		1 in 3	12.19	10.64	9.37	8.66	10.71	9.44	8.45	7.49
		1 in 2.4	12.19	10.89	9.37	8.89	10.97	9.47	8.71	7.72
38 × 140	38 × 89	1 in 4.8	10.18	8.73	6.90	5.46	8.35	7.16	5.96	4.74
		1 in 4	11.20	9.85	8.45	7.34	9.27	8.07	6.83	5.89
		1 in 3	12.19	11.48	10.10	8.96	10.64	9.52	8.28	7.28
		1 in 2.4	12.19	12.19	11.35	10.18	11.60	10.59	9.39	8.40
	38 × 114	1 in 4.8	12.19	10.31	7.89	6.29	10.74	9.16	6.95	5.51
		1 in 4	12.19	12.19	10.69	9.42	11.91	10.38	8.78	7.59
		1 in 3	12.19	12.19	11.17	9.90	12.19	11.27	9.67	9.16
		1 in 2.4	12.19	12.19	11.45	10.18	12.19	11.58	9.95	9.44
	38 × 140	1 in 4.8	12.19	12.09	9.34	7.51	12.16	10.41	8.30	6.62
		1 in 4	12.19	12.19	10.69	9.42	12.19	10.79	9.19	8.68
		1 in 3	12.19	12.19	11.17	9.90	12.19	11.27	9.67	9.16
		1 in 2.4	12.19	12.19	11.45	10.18	12.19	11.58	9.95	9.44

Appendix A
Explanatory Material for the Canadian Housing Code 1990

A-1.1.2.1. Application to Existing Buildings. This Code is most often applied to existing buildings when an owner voluntarily wishes to rehabilitate a building, change its use or build an addition; or when an enforcement authority decrees that the building be altered for reasons of public safety. Whatever the reason, its application to existing buildings requires careful consideration of the level of safety needed for that building.

This consideration involves an analytical process similar to that required to assess alternate design proposals for new construction. First the objective of the Code requirements must be established. To assist the Code user in this regard, Appendix notes are included to clarify the intent of certain requirements. In addition, commentaries on the more complicated Code issues are available. Once the objective is defined, one must then determine to what extent the existing building must be altered to meet the objective.

In developing Code requirements for new buildings, consideration has been given to the cost they impose on a design in relation to the perceived benefits in terms of safety. The former is definable; the latter difficult to establish on a quantitative basis. In applying the Code requirements to an existing building, the benefits derived are the same as in new buildings. On the other hand, the increased cost of implementing in an existing building a design solution that would normally be intended for a new building may be prohibitive.

The successful application of Code requirements to existing construction becomes a matter of balancing the cost of implementing a requirement with the relative importance of that requirement to the overall Code objectives. The degree to which any particular requirement can be relaxed without affecting the intended level of safety of the Code requires considerable judgment on the part of both the designer and the authority having jurisdiction.

Further information on the application of Code requirements to existing buildings may be found in Canadian Building Digest No. 230, "Applying Building Codes to Existing Buildings," available from the Institute for Research in Construction, National Research Council of Canada, Ottawa, K1A 0R6.

A-9.3.2.1. Grade Marking of Lumber. Lumber is generally grouped for marketing into the species combinations contained in the following table. The maximum allowable spans for those combinations are listed in the span tables for joists, rafters and beams. Some species of lumber are also marketed individually. Since the allowable span for the northern species combination is based on the weakest species in the combination, the use of the span for this combination is permitted for any individual species not included in the Spruce-Pine-Fir, Douglas Fir-Larch, Hem-Fir combinations.

Facsimiles of typical grade marks of lumber associations and grading agencies accredited by the Canadian Lumber Standards (CLS) Accreditation Board to grade mark lumber in Canada are shown in the following table. Accreditation by the CLS Accreditation Board applies to the inspection, grading and grade marking of lumber, inclusing mill supervisory service, in accordance with CSA Standard 0141, "Softwood Lumber."

The Appendix to this document is included for explanatory purposes only and does not form part of the requirements. The bold-face reference numbers that introduce each item apply to the requirements in the Code.

The grade mark of a CLS accredited agency on a piece of lumber indicates its assigned grade, species or species combination, moisture condition at the time of surfacing, the responsible grader or mill of origin and the CLS accredited agency under whose supervision the grading and marking was done.

Canadian lumber is graded to the NLGA Standard Grading Rules for Canadian Lumber, published by the National Lumber Grades Authority. The NLGA rules specify standard grade names and grade name abbreviations for use in grade marks to provide positive identification of lumber grades. In a similar fashion standard species names or standard species abbreviations, symbols or marks are provided in the rules for use in grade marks.

Grade marks denote the moisture content of lumber at the time of surfacing. "S-Dry" in the mark indicates the lumber was surfaced at a moisture content not exceeding 19 per cent. "MC 15" indicates a moisture content not exceeding 15 per cent. "S-GRN" in the grade mark signifies that the lumber was surfaced at a moisture content higher than 19 per cent at a size to allow for natural shrinkage during seasoning.

Each mill or grader is assigned a permanent number. The point of origin of lumber is identified in the grade mark by use of a mill or grader number or by the mill name or abbreviation. The CLS certified agency under whose supervision the lumber was grade marked is identified in the mark by the registered symbol of the agency.

Species Designations and Abbreviations

Commercial Designation of Species or Species Combination	Abbreviation Permitted on Grade Stamps	Species Included
Douglas Fir – Larch	D Fir – L (N)	Douglas Fir, Western Larch
Hemlock – Fir	Hem – Fir (N)	Western Hemlock, Amabilis Fir
Spruce – Pine – Fir	S – P – F or Spruce – Pine – Fir	White Spruce, Engelmann Spruce, Black Spruce, Red Spruce, Lodgepole Pine, Jack Pine, Alpine Fir, Balsam Fir
Northern Species	North Species	Any Canadian softwood covered by the NLGA Standard Grading Rules

Facsimiles of Grade Marks Used by Canadian Lumber Manufacturing Associations and Agencies Authorized To Grade Mark Lumber in Canada

FACSIMILES OF GRADE MARK	ASSOCIATION OR AGENCY
A.F.P.A.® 00 S – P – F S-DRY STAND	Alberta Forest Products Assoc. 204 – 11710 Kingsway Avenue Edmonton, Alberta T5G 0X5
C L® A S-P-F 100 No. 2 S - GRN.	Canadian Lumbermen's Association 27 Goulburn Avenue Ottawa, Ontario K1N 8C7
LMA® 1 S-GRN 1 1 D FIR-N	Cariboo Lumber Mfrs. Association 1200 – 555 Burrard Street Vancouver, British Columbia V2L 4Y2
® W. CEDAR S-GRN.-(N) 100 No 3	Council of Forest Industries of British Columbia 1200 – 555 Burrard Street Vancouver, British Columbia V7X 1S7 Council of Forest Industries of British Columbia Northern Interior Lumber Sector 400 – 1488 Fourth Avenue Prince George, British Columbia V2L 4Y2
CFPA® 00 S-P-F S-DRY CONST	Central Forest Products Association P.O. Box 1169 Hudson Bay, Saskatchewan S0E 0Y0
M L B S-P-F No. 1 S-GRN MILL 205	Maritime Lumber Bureau P.O. Box 459 Amherst, Nova Scotia B4H 4A1

Facsimiles of Grade Mark	Association or Agency
NFLD. LUMBER NLBA NORTH SPECIES STUD S-GRN MILL 9	Newfoundland Lumber Producers Association P.O. Box 8 Glovertown, Newfoundland A0G 2L0
O.L.M.A.® 01-1 CONST. S-DRY SPRUCE - PINE - FIR	Ontario Lumber Manufacturers Association 55 University Avenue, Ste. 325 Toronto, Ontario M5J 2H7
S-P-F GRN 2 ® 031	L'association des manufacturiers des bois de sciage du Québec Quebec Lumber Manufacturers Association 5055, boul. Hamel ouest, bureau 200 Québec, Québec G2E 2G6
PLIB® NLGA RULE No 1 S-GRN 00 HEM-FIR-N	Pacific Lumber Inspection Bureau 1110 – 355 Burrard Street Vancouver, British Columbia V6C 2G8
ILMA® S-DRY 1 00 S-P-F	Interior Lumber Inspection Bureau 203 – 2350 Hunter Road Kelowna, British Columbia V1X 6C1
0 0 No 1 S-DRY D FIR (N) NLGA RULE	MacDonald Inspection c/o Warnock Hersey Professional Services Ltd. 211 School House Street Coquitlam, British Columbia V3K 4X9
NWT 10 CONST S-P-F S-GRN	Northwest Territories Forest Industries Association 6301 Silverthorne Road P.O. Box 346 Sardis, British Columbia V2R 2N1

A-9.10.3.1. Fire and Sound Resistance of Building Assemblies. The following tables may be used to select building assemblies for compliance with Article 9.10.3.1. and Subsection 9.11.2. However, these tables are provided only for the convenience of Code users. Assembles not listed in these tables are equally acceptable provided their fire and sound resistance can be demonstrated to meet the above-noted requirements on the basis of tests described in 9.10.3.1. and 9.11.1. or by using the data in Chapter 2 of the Supplement to the NBC 1990.

Table A-9.10.3.A.

Fire and Sound Resistance of Walls

Type of Wall	No.	Description	Finish on Each Side[1]	Fire-Resistance Rating	Typical Sound Transmission Class[2]
Hollow concrete block (normal weight aggregate)	1	140-mm block	None[3]	1 h	48
	2	Same as 1	B	2 h	51
	3	Same as 1, with both surfaces fastened directly, or both on metal resilient channels, or both on metal resilient channels with absorptive material[4]	A	2 h	47
	4	Same as 1, with metal resilient channels and absorptive material on one side[4]	A	1.75 h	51
	5	Same as 1, with 38-mm x 38-mm wood strapping and absorptive material on both sides[4]	A	2 h	57
	6	190-mm block	None[3]	1.5 h	50
	7	190-mm block	B	2 h	50
	8	Same as 6, with both surfaces fastened directly, or both on metal resilient channels, or both on metal resilient channels with absorptive material[4]	A	2.5 h	49

Table A-9.10.3.A. (Cont'd)

Fire and Sound Resistance of Walls					
Type of Wall	No.	Description	Finish on Each Side[1]	Fire-Resistance Rating	Typical Sound Transmission Class[2]
	9	Same as 6, with metal resilient channels and absorptive material on one side[4]	A	2.5 h	53
	10	Same as 6, with 38-mm x 38-mm wood strapping on at least one side	A[6]	2.5 h	53
	11	Same as 6, with 38-mm x 38-mm wood strapping and absorptive material on both sides[4]	A[6]	2.5 h	59
	12	Same as 6, with 50-mm metal Z-bars (or 38-mm x 38-mm wood strapping plus metal resilient channels) and absorptive material on both sides[4]	A	2.5 h	64
	13	Same as 6, with studs (65-mm steel or 38-mmx 64-mm wood) and absorptive material on both sides[4]	A[6]	2.5 h	70
	14	Same as 6, with metal resilient channels and absorptive material on one side	D (finish one side only)	2.5 h	55
Concrete	15	150 mm	None[3]	3 h	55
	16	200 mm	None[3]	4 h	58
Interior wood stud single row	17	38-mm x 89-mm studs 400 mm o.c.	C	1 h	34
	18	38-mm x 89-mm studs 400 mm o.c., with absorptive material[5]	A[6]	45 min	36

Table A-9.10.3.A. (Cont'd)

Fire and Sound Resistance of Walls

Type of Wall	No.	Description	Finish on Each Side[1]	Fire-Resistance Rating	Typical Sound Transmission Class[2]
	19	Same as 18 [4]	C	1 h	36
	20	Same as 18, with resilient metal channels on at least one side [5]	A[6]	45 min	48
	21	Same as 18, with resilient metal channels on at least one side [4]	C	1 h	48
	22	Same as 18, with resilient metal channels on at least one side [4]	D	1 h	54
Interior wood stud two rows staggered on 38-mm x 140-mm plate	23	Two rows 38-mm x 89-mm studs, each set 400 or 600 mm o.c., staggered on common 38-mm x 140-mm plate, with absorptive material on both sides [5]	A[6]	45 min	50
	24	Same as 23, but with absorbtive material on one side [4]	C	1 h	51
	25	Same as 23, but with absorbtive material on one side [4]	D	1 h	54
Interior wood stud two rows on separate plates	26	Two rows 38-mm x 89-mm studs, each set 400 or 600 mm o.c. on separate 38-mm x 89-mm plates set 25 mm apart, with absorptive material one side [4]	C	1 h	53
	27	Same as 26, but absorptive material on both sides [5]	A[6]	45 min	57
	28	Same as 26, but absorptive material on both sides [4]	C	1 h	57
	29	Same as 26, but absorptive material on both sides [4]	D	1 h	63

Table A-9.10.3.A. (Cont'd)

Fire and Sound Resistance of Walls

Type of Wall	No.	Description	Finish on Each Side[1]	Fire-Resistance Rating	Typical Sound Transmission Class[2]
Exterior wood stud	30	38-mmx 89-mm or 38 mm x 140-mm studs spaced up to 600 mm o.c., mineral fiber with mass of at least 1.22 kg/m^2, wall sheathing and siding	A[6] (interior side)	45 min	N/A
	31	Same as 30	C or D (interior side)	1 h	N/A
Non-loadbearing steel studs	32	90-mm steel studs spaced up to 600 mm o.c.	C	45 min	39
	33	Same as 32, with absorptive material in cavity [4]	C	1 h	45
	34	Same as 32, with absorptive material in cavity [4]	D	1 h	53

Addendum to Table A-9.10.3.A.:

[1] Finishes designated by letter as follows:
A = 12.7-mm gypsum board with joints taped and filled,
B = 12.7-mm gypsum-sand plaster,
C = 15.9-mm special fire-resistant Type X gypsum board conforming to CSA A82.27, "Gypsum Board Products" with joints taped and filled, and
D = two layers of 12.7-mm gypsum board with joints taped and filled.

[2] Sound ratings listed are based on the most reliable laboratory test data available. Results of specific tests may differ slightly because of measurement precision and minor variations in construction details. Constructions with sound transmission class ratings of 50 or more require acoustical sealant applied around electrical boxes and other openings, and at the junction of intersecting walls and floors, except intersection of walls constructed of concrete or solid brick.

[3] Sound ratings require no discernible cracks or voids. For concrete blocks, surfaces must be sealed by at least 2 coats of paint or other surface finish described in Section 9.29 to prevent sound leakage.

[4] Sound absorptive material includes fibre processed from rock, slag, or glass, and must fill at least three-quarters of the cavity space to provide the listed STC.

[5] Absorptive material required to achieve fire-resistance rating and STC rating and includes mineral fibre processed from rock or slag with mass of at least 1.22 kg/m^2 and completely filling the wall cavity.

[6] Regular gypsum board shall be installed so that all edges are supported.

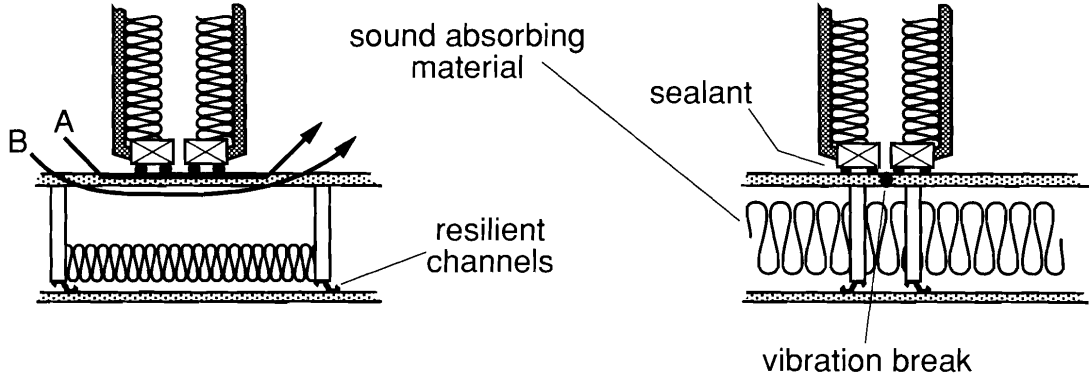
A-9.11.1.1. Sound Transmission Class Ratings. The specified STC rating of 50 is considered the minimum acceptable value, but many builders prefer to design for STC 55 or more in high quality accommodation.

Another reason to choose assemblies rated higher than STC 50 is that the STC ratings of assemblies are based on laboratory tests, but the sound transmission of any assembly as constructed in the field may be significantly less than its rating. This can be due to sound leaks, departures from design, poor workmanship or indirect (flanking) transmission paths overlooked in design. To provide a margin of safety to compensate for these builders often select wall and floor systems that have been rated at least 5 points higher than the design STC rating in laboratory tests

Sound leaks can occur where one wall meets another, the floor, or the ceiling. Leaks may also occur where the wall finish is cut for the installation of equipment or services. Avoid back-to-back electrical outlets or medicine cabinets. Carefully seal cracks or openings so structures are effectively airtight. Apply sealant below the plates in stud walls, between the bottom of drywall sheets and the structure behind, around all penetrations for services and, in general, wherever there is a crack, a hole or the possibility of one developing. Sound-absorbing material inside a well-designed wall decreases sound transmission. It has another advantage; it also helps to reduce the effects of leaks due, perhaps, to poor workmanship.

Indirect or flanking transmission arised where the parts of a building are rigidly connected together and where cavities in hollow walls or floors, or continuous lightweight layers connect apartments. Sound travels in cavities, as vibration along surfaces and through walls, ceilings and floors to adjacent rooms. Many paths other than the direct one through the party wall or floor may be involved. To achieve good sound insulation, transmission along flanking paths must be minimized by introducing breaks and resilient connections in the construction. Some examples of bad and good details are shown in the illustration.

Changes to constructions should not be made without consultation with someone competent in the field of acoustical design. Adding extra layers of drywall to walls in an attempt to reduce sound transmission, can actually increase it if done incorrectly. For example, attaching drywall on resilient channels directly to an existing wall or ceiling usually in-



Cross section through wall floor junctions

A-9.11.1.1.

Wall and floor get good STC ratings in laboratory tests and the sealing procedures are good. The system performance is low, however, because of flanking paths A and B.

This detail is better. There is no hollow cavity and the break in the floor prevents transmission along the floor. The same techniques should be applied to walls.

creases low frequency sound transmission. Adding an additional layer of drywall inside a double layer wall will also seriously increase sound transmission. Adding blocking inside walls to reduce the risk of firespread should be done so it does not increase vibration transmission from one part of a wall or floor to the other.

To verify that acoustical privacy is being achieved, a field test can be done at an early stage in the construction; ASTM E336 will give a complete measurement. A simpler and less expensive method is ASTM E597, "Standard Practice for Determining a Single Number Rating of Airborne Sound Insulation in Multi Unit Building Specifications." The rating provided by this test is usually within 2 points of the STC obtained from ASTM E336. It is useful for verifying performance and finding problems during construction. Alterations can then be made prior to project completion.

Impact Noise. Section 9.11 has no requirements for control of impact noise transmission. Footstep and other impacts can cause severe annoyance in multi-family residences. Builders concerned about quality and reducing occupant complaints will ensure that floors are designed to minimize impact transmission. A recommended criterion is that bare floors (tested without a carpet) should achieve an impact insulation class (IIC) of 55. Some lightweight floors that satisfy this requirement may still cause complaints about low frequency impact noise transmission. Adding carpet to a floor will always increase the IIC rating but will not necessarily reduce low frequency-noise transmission. Good footstep noise rejection requires fairly heavy floor slabs or floating floors. Impact noise requirements are being considered for inclusion in future versions of the NBC.

Most frequently used methods of test for impact noise are ASTM E492, "Method of Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using The Tapping Machine", or ASTM E1007, "Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures".

Machinery Noise. Elevators, garbage chutes, plumbing, fans, and heat pumps are common sources of noise in buildings. To reduce annoyance from these, they should be placed as far as possible from sensitive areas. Vibrating parts should be isolated from the building structure using resilient materials such as neoprene or rubber.

A-9.13 Exclusion of Soil Gas (see also A-9.16.2.1.) Outdoor air entering a dwelling through above-grade leaks in the building envelope normally improves the indoor air quality in the dwelling by reducing the concentrations of pollutants and water vapour. It is only undesirable because it cannot be controlled. On the other hand, air entering a dwelling through below-grade leaks in the envelope may increase the water vapour content of the indoor air and may also bring in a number of pollutants which it picks up from the soil. This mixture of air, water vapour and pollutants is sometimes referred to as "soil gas." One pollutant often found in soil gas is radon.

Radon is a colourless, odourless, radioactive gas that occurs naturally as a result of the decay of radium. It is found to varying degrees as a component of soil gas in all regions of Canada and is known to enter dwelling units by infiltration into basements and crawl spaces. The presence of the decay products of radon in sufficient quantity can lead to increased risk of lung cancer.

The potential for high levels of radon infiltration is very difficult to evaluate prior to construction and thus a radon problem may only become apparent once the building is completed and occupied. Therefore various sections of Part 9 require the application of certain radon exclusion measures in all dwellings. These measures are

(1) low in cost,
(2) difficult to retrofit, and
(3) desirable for other benefits they provide.

There are two principal methods of excluding soil gas:

(1) Sealing the interface between the soil and the occupied space, so far as is reasonably practicable.

    Sections 9.13 and 9.18 include requirements for dampprooofing of slabs and ground covers in

crawl spaces, which are intended to help in isolating the occupied space from the soil.

Providing control joints to reduce cracking of foundation walls and airtight covers for sump pits are other measures which can help achieve this objective.

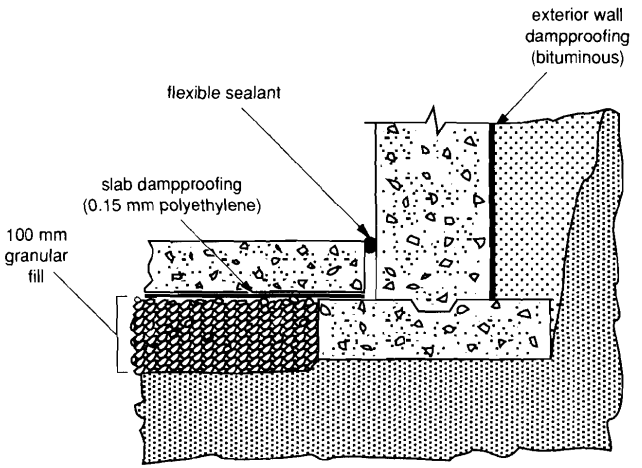
(2) Ensuring that the pressure difference across the soil/space interface is positive (i.e., towards the outside) so that inward soil gas flow through any remaining leaks will be prevented.

Section 9.16 includes requirements related to this objective.

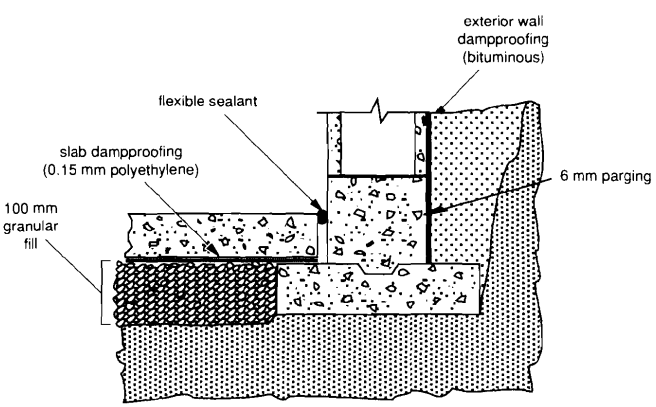
The measures covered in Section 9.13 are illustrated on the following drawings. The measures covered in Section 9.18 are similar. The measures covered in Section 9.16 are discussed in a separate Appendix note.

The requirement in 9.13.6.5. regarding sealing of penetrations of the slab also applies to hollow metal and masonry columns. Not only the perimeters but also the centres of such columns must be sealed or blocked.

The requirement in Article 9.13.6.6. regarding drainage openings in slabs can be satisfied with any of a number of proprietary devices which prevent soil gas entry through floor drains. Some types of floor drains incorporate a trap which is connected to a nearby tap so that the trap is filled every time the tap is used. This is intended to prevent the entry of sewer gas but would be equally effective against the entry of soil gas.



Dampproofing details for solid walls dampproofed on the exterior



Dampproofing details for hollow walls dampproofed on the exterior

A-9.16.2.1. Control of Infiltration of Soil Gas. (See also A-9.13.)

As noted in A-9.13, one method of excluding soil gas from below-grade living space is to ensure that the pressure difference across the soil/space interface is positive (i.e., towards the outside) so that inward soil gas flow through any leaks will be prevented. This requires consideration of the air pressure on the inside of the envelope and the pressure within the soil. Each is affected by quite different factors.

A-9.13.

There is a safe range for the interior pressure in a house. The upper limit is primarily due to the need to minimize outward leakage of the warm, moist interior air through leaks in the building envelope. The lower limit depends on the type of combustion heating equipment present in the house. It also follows from the need to avoid drawing in soil gas, as discussed in Appendix Notes A-9.13 and A-9.33.

Controlling the entry of soil gas by house or basement pressurization is therefore problematic, since it could lead to exfiltration-caused condensation problems in the building envelope. This leaves the option of reducing the pressure outside the envelope as the most practical method of achieving the desired outward pressure difference. The remainder of this note describes how this may be accomplished.

At least in areas which are prone to higher than normal radon levels, or other ground pollutants, the practice described below should be followed:

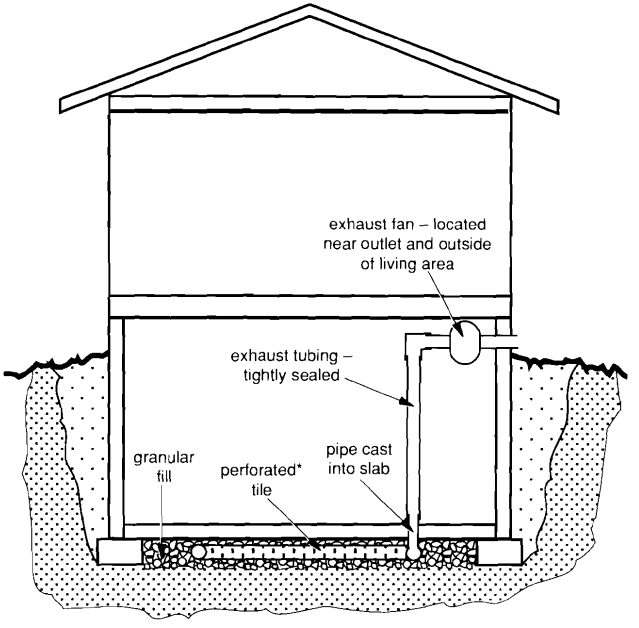
(1) Any slab-on-ground should have not less than 100 mm of coarse granular fill beneath the slab (as required in Article 9.16.2.1.) if no perforated tile is laid within the fill. If tile is used, not less than 50 mm of fill is required and no point in the filled area should be more than 3 m from the tile. The tile should not be connected to any drainage tile.

(2) A short length of pipe, of not less than 100 mm diameter, should be cast vertically into the slab. If no tile is used, this pipe should be located near the centre of the slab and the fill around the pipe location should not be less than 150 mm deep for a radius of 300 mm. If tile is used, the bottom end of the pipe should connect to the tile at its lowest point. The top end of the pipe should have a removeable cap.

(3) When the house is completed, a test should be carried out to determine the radon concentration. (Local health authorities can provide guidance as to whether the test results indicate the need for remedial measures.)

(4) If radon concentrations are above guideline levels, the sub-slab space should be ventilated. This requires that the pipe connection to the sub-slab space be uncapped and connected to a ventilation system exhausting to the outside. Exhaust pipes passing through unheated spaces should be insulated. The fan should be located where noise will not be a nuisance and outside the occupied space. It is also best to locate the fan as close to the final outlet end of the ventilation system as possible so that the pressurized portion of the system downstream of the fan will not be located in or adjacent to the living space. If the pressurized portion of the system were to pass through the living space, then any leak in the system would have the potential to spill high radon concentration soil gas into the living space, thus exacerbating the situation the system was intended to correct. The fan should be of a type suitable for the application and capable of continuous operation. This sub-slab ventilation system is illustrated below.

(5) The house should be re-tested for radon after completion of the ventilation system.



One type of sub-slab ventilation system

*suggested for radon-prone areas

A-9.16.2.1.

A-9.23.4.1.(2) Numerical Method to Establish Vibration-Controlled Spans for Wood Frame Floors. In addition to the normal strength and deflection analyses, the calculations on which the floor joist span tables are based include a method of ensuring that the spans are not so long that floor vibrations could lead to occupants' perceiving the floors as too "bouncy" or "springy." Limiting deflection under the normal uniformly distributed loads to 1/360 of the span does not provide this assurance.

Normally, vibration analysis requires detailed dynamic modelling. However, the calculations for the span tables use the following simplified static analysis method of estimating vibration-acceptable spans:

- The span which will result in a 2-mm deflection of a single joist supporting a 1 kN concentrated midpoint load is calculated.

- This span is multiplied by a factor, K, to determine the "vibration-controlled" span for the entire floor system. If this span is less than the strength- or deflection-controlled span under uniformly distributed load, the vibration-controlled span becomes the maximum allowable span.

The K factor is determined from the following relationship:

$$\ln(K) = A - B \cdot \ln(S_i/S_{184}) + G$$

where A = a constant, the value of which is determined from Table A,

B = a constant, the value of which is determined from Table B,

S_i = span which results in 2-mm deflection of the joist in question under 1 kN con centrated midpoint load,

S_{184} = span which results in 2-mm deflection of 38 x 184-mm joist of same species and grade as the joist in question under 1 kN concentrated midpoint load,

G = a constant, the value of which is determined from Table G.

For any joist size, species and grade, the value of K which results in a vibration controlled span of 3 m is the largest allowed value.

Note that, for a sawn lumber joist, the ratio S_i/S_{184} is equivalent to its depth (mm) divided by 184.

Due to rounding differences, the method, as presented here, might produce results slightly different from those produced by the computer program used to generate the span tables.

Additional background information on this method can be found in the following publications:

- Onysko, D.M. Serviceability Criteria for Residential Floors Based on a Field Study of Consumer Response. Project 03-50-10-008. Forintek Canada Corp., Ottawa, Canada 1985.

Table A

Constant A									
Sheathing Thickness, mm	Strapping Only			Bridging Only			Strapping + Bridging		
	Joist Spacing, mm			Joist spacing, mm			Joist spacing, mm		
	300	400	600	300	400	600	300	400	600
12.5	0.28	0.24	0.19	0.36	0.30	0.24	0.40	0.33	0.27
15.5	0.30	0.25	0.20	0.37	0.31	0.25	0.42	0.35	0.28
19.5	0.36	0.30	0.24	0.45	0.37	0.30	0.50	0.42	0.33

- Onysko, D.M. Performance Criteria for Residential Floors Based on Consumer Responses. 1988 International Conference on Timber Engineering, Seattle, September 19-22, Forest Products Research Society, Vol.1, 1988 pp. 736-745.
- Onysko, D.M. Performance and Acceptability of Wood Floors - Forintek Studies. Proceedings of Symposium/Workshop on Serviceability of Buildings, Ottawa, May 16-18, National Research Council of Canada, Ottawa, 1988.

Table B

Floor Description	Constant B
Basic floor – 15.5-mm plywood sheathing (or equivalent in Table 9.23.14.A.) – 400-mm joist spacing – no bridging	0.33
Basic floor with bridging	0.38
Basic floor with bridging and strapping	0.41

Table G

Floor Description	Constant G
Floors with nailed subfloor	0
Floor with field-glued subfloor, * vibration-controlled span greater than 3 m	0.10
Floor with field-glued subfloor, * vibration-controlled span 3 m or less	0.15

* Subfloor glued to floor joists with elastomeric adhesive complying with CGSB Standard 71-GP-26M, "Standard for Adhesives for Field-gluing Plywood to Lumber Framing for Floor Systems."

A-9.32.3. Mechanical Ventilation. For many years, houses were constructed without mechanical ventilation systems and relied on natural air leakage through the building envelope for winter ventilation. For the past 50 years or so, however, houses have become progressively more airtight through the introduction of new products such as plywood and waferboard, polyethylene film, improved caulking materials, tighter windows and doors, more efficient heating systems and generally improved construction methods. Following the energy crisis in the early 1970's, considerable emphasis was placed on reducing air leakage in order to conserve energy. Electric heating systems were encouraged and higher efficiency furnaces were developed, which further reduced air change rates in buildings.

A significant portion of the air change rate in houses is due to air flow up the flue. Electric heating, however, eliminates the need for flues and high efficiency combustion furnaces greatly reduce the air flow up the flue through more efficient combustion and by restricting flue air leakage between firing periods. The increased use of such heating systems combined with increased emphasis on sealing the building envelope led to concern that the natural air change in dwelling units might be inadequate in some instances to provide a healthful environment. Condensation problems resulting from higher humidity levels were also a concern.

Exhaust fans were specified for electrically heated houses in the 1980 edition of the NBC to reduce the incidence of excessive humidity levels in these houses. However, with the continuing emphasis on reduced air leakage and the development of more efficient fuel burning systems, health concerns became paramount. These concerns led to the current requirements for mechanical ventilation in all dwelling units regardless of the type of heating system used.

(1) Capacity

The system must be capable of providing at least 0.3 air changes per hour (ach). This value is approximately equal to the rate called for in the preliminary CSA Standard F326.1 (Residential Mechanical Ventilation Requirements) and is about equal to the rate that would be achieved using ASHRAE Standard 62, "Ventilation for Acceptable Indoor Air Quality," which relates ventilation rate to occupant load.

Because many ventilation systems designed to run essentially continuously must nevertheless be shut down for brief periods (e.g., the defrost cycle of a heat recovery ventilator), the rate is specified as the rate averaged over 24 h. In other words, if the system must be periodically shut down, the air change rate when it is running must be proportionately higher in order to achieve the specified average rate.

It should be emphasized that this air change rate refers to the installed capacity of the system, not the rate of ventilation that is actually used in the house. In many households, ventilating at 0.3 ach would provide more ventilation than required, resulting in higher than necessary heating bills and perhaps excessively low indoor relative humidity. Thus, although a system with the minimum capacity must be installed, it can incorporate controls that allow the system to be used at less than its full capacity most of the time.

(a) The simplest form of control is a manual on/off switch. While acceptable, this is not the best solution, since the occupants might turn the system off and forget to turn it back on or might turn it off to save on heating bills or to reduce noise, not realizing the importance of proper ventilation.

(b) A better form of control is a humidistat-activated on/off switch, which turns the ventilation system on in response to rising humidity. Humidity is often the main reason that ventilation is required, but not always. Depending on the activities of the occupants and the relative strengths of other sources of pollutants and humidity, the amount of ventilation required to control humidity may not be enough to control other pollutants.

(c) Ventilation systems in large buildings are sometimes controlled by carbon dioxide (CO_2) sensors and this technology is just beginning to be available at a residential scale. Increasing CO_2 concentration is usually a good indication of decreasing air quality. But even this form of control may not be satisfactory in cases where there are

unusual pollutants, such as those generated by certain hobbies.

Mechanical ventilation systems can be as simple as a ductless kitchen or bathroom fan exhausting air directly to the outdoors, or they may be as elaborate as a completely ducted system distributing a balanced supply of fresh air to each room. All are permitted provided the air change capacity requirements are met.

(2) Simple Exhaust Systems

Where an exhaust system depends on natural air leakage through the building envelope to replace the exhaust air, the exhaust fan may have to operate against a substantial pressure difference if the building is relatively airtight. This can reduce the air flow through the fan significantly below its rated capacity. Also, the resulting negative pressure may cause spillage of combustion products from certain types of combustion appliances.

The types of appliances that are susceptible to pressure-induced spillage are those which draw combustion and/or draft dilution air from the dwelling. Thus a gas furnace with a draft hood is susceptible to spillage, as is an oil furnace with a barometric damper. On the other hand, appliances such as gas furnaces with induced draft venting systems and the "sealed combustion" oil furnaces commonly used in mobile homes, are more resistant to spillage and do not require make-up air openings. Almost all fireplaces are spillage-susceptible, even those with so-called "airtight" glass doors and outside combustion air intakes, since most "airtight" doors are not really airtight. Certain types of gas combustion appliances, such as cooking appliances and "decorative appliances," are not required to be vented. Their operation will not be significantly affected by depressurization of the house so make-up air openings are not required.

To reduce the risk of pressure-induced spillage from spillage-susceptible combustion appliances, tight buildings which incorporate such appliances must be provided with air intake openings to facilitate the inward flow of replacement air. The intake openings should be located a reasonable distance from the exhaust outlets to allow adequate mixing of the replacement air with the inside air and should be sized to prevent excessive negative pressure from being created by the exhaust fans. The following table provides suggested intake opening areas based on an allowable level of depressurization of 5 Pa.

Sum of Fan Capacities, L/s	Size of Intake Openings Necessary to Avoid Excessive Depressurization in Dwellings with Spillage-Susceptible Heating Equipment, m^2
25	0.014
30	0.016
35	0.019
40	0.022
50	0.027
60	0.033
70	0.038
80	0.044
90	0.049
100	0.055
110	0.060
120	0.066
130	0.071
140	0.076
150	0.082

Air intake openings are not required where tests show that spillage of combustion products is not likely to be a problem. Canada Mortgage and Housing Corporation has developed the "Venting System Test," which is suitable for this purpose.

Generally such intake openings are not required in dwellings that do not incorporate spillage-susceptible combustion appliances. However, even in these dwellings, some control on the potential for high levels of depressurization created by the ventilation system is recommended since, as mentioned above, high levels can impair the ability of the system to function. Also, high levels of depressurization can result in contaminants being drawn into the dwelling from the envelope itself (e.g., formaldehyde from some building materials) or from the soil (e.g., radon and other constituents of soil gas). Thus, in dwellings which have very low leakage areas (e.g., special low energy houses) and which incorporate exhaust-only ventilation systems, some intake opening should be provided even if the heating system is not

prone to spillage. The following table provides suggested intake opening areas based on an allowable level of depressurization of 20 Pa.

Sum of Fan Capacities, L/s	Size of Intake Openings Necessary to Avoid Excessive Depressurization in Airtight Dwellings without Spillage-Susceptible Heating Equipment, m^2
20	0.004
30	0.008
50	0.012
80	0.018
125	0.024
170	0.031

Indoor barbecue-type ranges incorporate an exhaust fan with a capacity so high that the operation of other exhaust equipment and appliances requiring combustion air may be affected. Where such ranges are installed, a separate make-up air supply installed near the appliance may be necessary. The capacity of these fans is so high (>150 L/s) that it is often impractical to provide a large enough intake air opening to avoid excessive depressurization. In such cases, one solution is to incorporate a make-up air fan with a capacity similar to that of the exhaust fan.

(3) Location of Intake Openings and Tempering of Make-up Air

In cold weather, the make-up air should be tempered before it reaches living areas in the house or it may create so much discomfort that the occupants will simply block the intake openings. In some ventilation systems, fresh air is ducted to the return air side of the furnace, so that it is drawn into the furnace plenum. This has the advantages of heating the fresh air before it reaches the living areas, thereby eliminating cold drafts, and distributing the fresh air to all parts of the house served by the heating ducts. Although this method has been successfully used for many years to control surface condensation problems, it can cool the furnace heat exchanger to the point where condensation may occur within the furnace. This can lead to corrosion unless the furnace is designed with adequate corrosion resistance. This problem can be avoided if the incoming air is mixed with return air and/or is tempered (e.g., with an electrical in-duct heating coil) before it comes in contact with the heat exchanger. A minimum temperature of 12°C is recommended by the heating industry.

Another method of tempering the make-up air is to have it enter the house in some room not normally occupied, such as a storage room, so that it mixes with indoor air before migrating to the living areas. Where this method is used, the amount of separation (i.e., restriction to air flow) between the room chosen and the rest of the house is critical. With too little separation, not enough pre-mixing will take place and draft problems are likely. With too much separation, the fresh air may not get to where it is needed and the room with the intake could become extremely cold. It is difficult to provide much guidance in this area except to suggest normal interior partition construction practice and normally fitted interior doors with no attempt at air sealing.

Another method of tempering the make-up air is to have it enter the house through ducts which incorporate electrical or hydronic in-duct heating coils.

Intake ducts should be insulated and wrapped with an air/vapour barrier (on the side of the insulation away from the duct) to prevent the formation of condensation on the cold surface of the duct.

(4) Choice of Fans

The flow capacity of some types of fans decreases quite dramatically when the fan is required to work against a significant pressure difference. Therefore in selecting fans for a ventilation system, the fan capacity when rated at a 25 Pa pressure difference must be compared with the required system capacity.

Another important characteristic that should be borne in mind when selecting fans is the noise rating. If the ventilation system is too noisy, the occupants may just turn it off. Although much can be accomplished in reducing noise by locating the fans away from occupied areas and by mounting them in a manner that isolates them from the structure, the first step is to choose quiet fans. The noise disturbance created by a fan is usually expressed as its "sone"

rating. Fans used in ventilation systems should have sone ratings of less than 2.0.

(5) Fully Ducted Balanced Systems

Fully ducted "balanced" ventilation systems with both intake and exhaust fans have the advantage of providing better control of the ventilation rate and more effective distribution of the fresh air within the dwelling. Such systems can be relatively expensive; however this need not be the case in houses with forced warm air heating systems since the heating ducts can also be used for ventilation.

In fact, it is very difficult to achieve a perfect balance between the intake and exhaust flows in "balanced" systems. It is therefore best to err on the side of slightly higher exhaust flow in order to avoid pressurizing the house, which can lead to interstitial moisture problems in the roof and wall structures.

These systems may also incorporate heat recovery equipment to reduce the energy loss due to ventilation.

Section 6.2 deals with design and installation of ventilation systems and includes references to relevant standards and manuals that are considered representative of good practice.

(6) Summer Ventilation

When windows are not openable, the mechanical ventilation system must provide fresh air on a year-round basis. While 0.3 ach is adequate for health purposes, it may not be adequate in summer to keep the indoor temperatures from climbing to uncomfortable levels as a result of solar heating. Unless the dwelling unit is air-conditioned, therefore, the mechanical ventilation rate to individual rooms must be increased to 1 ach if the windows are not designed to provide summer ventilation. Even this rate is marginal in warm weather. Fortunately most houses incorporate openable windows.

(7) Fan Sizes

The specified ventilation rates are additional to the natural infiltration that also occurs. The rates are based on the total volume enclosed within the building envelope.

A 2-storey house with openable windows has 100 m^2 of floor area on each of the first and second storeys and in the basement. Exhaust fans are to be provided in each of 2 bathrooms and if necessary in the kitchen. The ceiling height is 2.4 m.

Find the fan capacity required for winter ventilation.

Volume of house

$$(100 + 100 + 100) \times 2.4 = 720 \ m^3.$$

Required rate of ventilation

$$720 \times 0.3 = 216 \ m^3/h.$$

Required total fan capacity

$$(216 \ m^3/h \times 1\,000 \ L/m^3)/3\,600 \ s/h = 60 \ L/s.$$

In this case, a 30 L/s (60 cfm) exhaust fan in each bathroom will provide adequate capacity, or a 60 L/s (120 cfm) kitchen exhaust fan can be used.

If the dwelling incorporates naturally-aspirating fuel-fired heating equipment, intake openings with a total area of at least 0.033 m^2 should be installed.

(8) Reference Sources

Information on acceptable levels of air quality in dwelling units and methods of design to control air quality can be found in the documents listed below. Designs which comply with these methods can be expected to meet or exceed the requirements in 9.32.3.

Health and Welfare Canada, "Exposure Guidelines for Residential Indoor Air Quality,"

ASHRAE 62-81, "Ventilation for Acceptable Indoor Air Quality,"

Canadian Home Builders Association,"R-2000, Design and Installation Guidelines for Ventilation Systems,"

CSA preliminary standard F326.1- "Requirements for Residential Ventilation,"

Institute for Research in Construction, Canadian Building Digest 245, "Mechanical Ventilation and Air Pressure in Houses."

Index[1]

A

[1] Items contained in the Index are referenced to the numbering system used in this Code instead of to page numbers. For more information on the numbering system, refer to "A Guide to the Use of the Code" at the front of the document.

[2] Part 6 requirement reproduced in Section 9.33.

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

W

Y

Conversion Factors		
To Convert	**To**	**Multiply by**
°C	°F	1.8 and add 32
kg	lb	2.205
kPa	lbf/in^2 (psi)	0.1450
kPa	lbf/ft^2	20.88
L	gal (imp.)	0.2200
L/s	gal/min (gpm)	13.20
lx	ft-candle	0.09290
m	ft	3.281
m^2	ft^2	10.76
m^3	ft^3	35.31
mm	in.	0.03937
m^3/h	ft^3/min (cfm)	0.5886
m/s	ft/min	196.8
MJ	Btu	947.8
N	lbf	0.2248
ng/Pa · sm^2	perms	0.0174
Pa	Inches of water	0.004014
W	Btu/h	3.412