Canadian Housing Code 1990

First Revisions and Errata

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

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The attached pages identify revisions and errata to the Canadian Housing Code 1990. The revisions have been approved by the Associate Committee on the National Building Code for immediate implementation.

In accordance with the ACNBC Policies and Procedures, the list of referenced documents in Table 2.7.3.A. of the 1990 CHC is updated annually. The revisions contained herein include updates to 30 June 1990. Where changes to the title have been made, the relevant requirements have also been updated.

The errata are corrections which have been identified and are included to facilitate the use of the Code. Revisions are identified by an ***r*** in the margin nearest the change; errata are identified by an ***e***.

1991 first revisions and errata

2.7.3.1.
Table 2.7.3.A.

9.3.1.8.
Table 9.3.2.A.
Table 9.4.4.A.
9.6.4.1.(1)
A-9.6.6.5.
9.7.1.2.
Table A-9.7.3.2.A.
Table A-9.7.3.2.B.
9.7.7.2.
9.8.9.1.(1), (2)
9.10.4.1.
9.10.5.
9.10.11.3.
9.10.12.4.(1)
9.10.14.3.
9.10.16.1.(2)
9.12.2.1.
9.13.1.3.(1)
9.13.2.1.(1)
9.13.6.5.
9.14.2.1.(2)
9.14.3.1.(1)
A-9.15.1.3.(4)
9.18.6.1.(3)
9.20.1.1.(1)
9.20.1.2.(2)
9.20.2.4.
9.20.6.2.(3)
9.20.12.2.(1), (2)
9.21.2.4.
A-9.21.3.6.
9.22.5.2.(2)
A-9.23.4.1.(1)
9.23.4.5.
9.23.4.6.
Table 9.23.12.B.
Table 9.23.13.A
9.24.3.5.(1)
9.25.3.1.(1)
9.25.3.5.
A-9.25.4.3.(2)
9.25.4.4.
9.26.2.1.(1)
9.27.4.2.(2)
Table 9.27.5.A
9.29.10.5.
9.31.2.1.
Table 9.32.2.A.
9.32.3.1.(2)
A-9.33.1.1.
9.33.2.1.(1)
9.33.2.2.
9.34.1.5.
9.35.3.1.
9.35.3.2.(1), (3)
9.35.4.3.

Table A-8
Table A-9

A-9.3.2.1.
Lumber Grade Marks
A-9.11.1.1.
A-9.32.3. (Running head)

Index
Balconies
floor loads
Chimney
clearances
Clearances
chimney
Grab bars

(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
r 30 June 1990.

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**
r ASTM	A123-89A	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)
r ASTM	C412M-90	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.
r ASTM	E90-90	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions	9.11.1.1.
r ASTM	E336-90	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.
r CGSB	CAN/CGSB-7.2-M88	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)
r CGSB	CAN/CGSB-19.22-M89	Mildew Resistant Sealing Compound, for Tubs and Tile	9.29.10.5.
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

	Issuing Agency	Document Number	Title of Document	Code Reference
r	CGSB	CAN/CGSB-19.24-M90	Multi-Component, Chemical Curing Sealing Compound	9.27.4.2.(2)
	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)
e	CGSB	CAN/CGSB-34.14-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)
e	CGSB	CAN/CGSB-37.2-M88	Emulsified Asphalt, Mineral Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings	9.13.2.1.(1)
r	CGSB	CAN/CGSB-37.3-M89	Application of Emulsified Asphalts for Dampproofing or Waterproofing	9.13.1.3.(1)
e	CGSB	CAN/CGSB-37.4-M89	Fibrated, Cutback, Lap Cement for Asphalt Roofing	9.26.2.1.(1)
e	CGSB	CAN/CGSB-37.5-M89	Cutback Asphalt Plastic Cement	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)
r	CGSB	CAN/CGSB-37.16-M89	Filled Cutback Asphalt, 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)
r	CGSB	CAN/CGSB-37.22-M89	Application of Unfilled Cutback Tar Foundation Coating for Dampproofing	9.13.1.3.(1)
	Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

	Issuing Agency	Document Number	Title of Document	Code Reference
r	CGSB	CAN/CGSB-37.50-M89	Hot Applied Rubberized Asphalt 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.
	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)
r	CGSB	CAN/CGSB-51.33-M89	Vapor Barrier, Sheet Excluding Polyethylene, 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)
r	CGSB	CAN/CGSB-51.60-M90	Cellulose Fibre Loose Fill Thermal Insulation	9.25.3.1.(1)
	Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
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.
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 Cement	9.3.1.2. 9.20.3.1.(1) 9.28.2.1.
CSA	CAN3-A8-M88	Masonry Cement	9.20.3.1.(1)
r CSA	CAN/CSA-A23.1-M90	Concrete Materials and Methods of Concrete Construction	9.3.1.3.(1) 9.3.1.4.
r CSA	CAN/CSA-A23.2-M90	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)
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

Issuing Agency	Document Number	Title of Document	Code Reference
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)
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 Chimneys and 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	CAN/CSA-A440-M90	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.
Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

	Issuing Agency	Document Number	Title of Document	Code Reference
r	CSA	CAN/CSA-B139-M91	Installation Code for Oil Burning Equipment	6.2.1.4.(1)
e	CSA	CAN/CSA-B182.1-87	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.
r	CSA	C22.1-1990	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.
r	CSA	CAN/CSA-F280-M90	Determining the Required Capacity of Residential Space Heating and 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)
e	CSA	CAN3-O86-M84	Engineering Design in Wood (Working Stress Design)	4.3.1.1.
e	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)
	Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

	Issuing Agency	Document Number	Title of Document	Code Reference
				Table 9.23.16.A. 9.27.9.1. 9.30.2.2.(1)
r	CSA	CAN/CSA-O122-M89	Structural Glued-Laminated Timber	9.23.4.3.(2)
r	CSA	CAN/CSA-O132.2-M90	Wood Flush Doors	9.6.4.1.(1)
	CSA	O141-1970	Softwood Lumber	9.3.2.6.
	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)
	Column 1	2	3	4

Table 2.7.3.A. (Cont'd)

	Issuing Agency	Document Number	Title of Document	Code Reference
	NLGA	1987	Standard Grading Rules for Canadian Lumber	9.3.2.1. Table 9.3.2.A.
r	ULC	CAN/ULC-S101-M89	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)
	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.
e	ULC	CAN/ULC S110-M86	Standard Methods of Fire 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

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).

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 CAN/CSA-A23.2-M, "Methods of Test for Concrete." r

(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.

* Requirement modified to apply to houses only.

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 Common	— e
Wall sheathing not required as a nailing base	No. 5 Common	Economy	No. 5 Common	— e
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.

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 Flush Doors." e

(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.

9.6.6.2. 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.)

e **A-9.6.6.5.(1) 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

e * **(1)** Except as required in Article 9.7.1.3., the minimum window glass area for rooms shall 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 CAN/CSA–A440-M, "Windows." (See Appendix A.) r

A-9.7.2.1. Windows. The CSA Standard CAN/CSA-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. r

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, m²
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							
	2.5	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, m²
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							
	2.5	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	2.05	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 e CAN/CGSB 63.14-M "Plastic Skylights."

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; e

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

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

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 Storeys

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(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.

e * 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

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.

e **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 9.9.4.5., where exterior walls of a *building* meet at an external * e

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.*

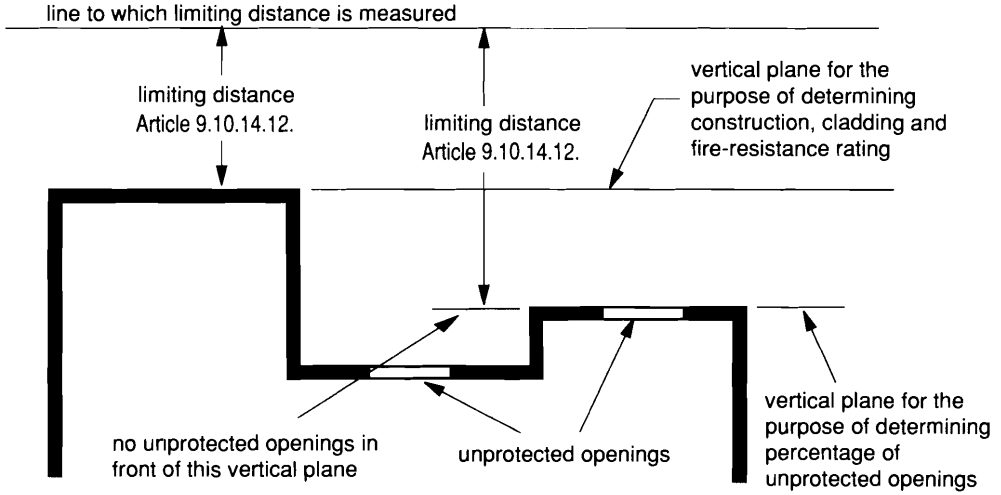
* **9.10.14.5. Openings in Walls Having a Limiting Distance Less Than 1.2 m.** Openings in a wall having a *limiting distance* of less than 1.2 m shall be protected by *closures,* of other than wired glass or glass block, having a *fire protection rating* of at least 20 minutes.

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 e need not conform to Sentence (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*. e

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) CAN/CGSB-37.3M, "Application of Emulsified Asphalts for Dampproofing or Waterproofing," *r*

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

(c) CAN/CGSB-37.22M, "Application of Unfilled Cutback Tar Foundation Coating for Dampproofing." *r*

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, "Emulsified Asphalt, Mineral Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings," *e*

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

(c) CAN/CGSB-37.16M, "Filled Cutback Asphalt, for Dampproofing and Waterproofing," *r*

(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) CAN/CGSB-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) CAN/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, "Engineering Design in Wood (Working Stress Design)" with the following assumptions: e

(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 Pa,
wall (with masonry veneer)	1.94 kPa, e
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*.

9.17.6. 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
e sheet conforming to CAN/CGSB-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 e 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."

e #### 9.20.1.2. 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 reinforce- e ment required in Subsection 9.20.15. (See Appendix 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. e

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 9.2 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
e 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

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. e e

(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. e e

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/m²
Hardware and bolts	A153	See A153
Strip, plate, bars and rolled sections (not less than 3.18 mm thick)	A123	610 g/m²
Sheet (less than 3.18 mm thick)	A123	305 g/m² 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 * e

(1) Except for *chimneys* serving fireplaces, the size of a *chimney flue* shall conform to the require-

e 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, m²	*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, m²	*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.)

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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.)

(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 e opening raised not less than 200 mm from a *combustible* floor is permitted 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.

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, "Engineering Design in Wood (Working Stress Design)."

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(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-1 and A-2 or the spacing of the members shall be reduced to allow for the loads due to the topping. (See Appendix A.)

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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-4 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

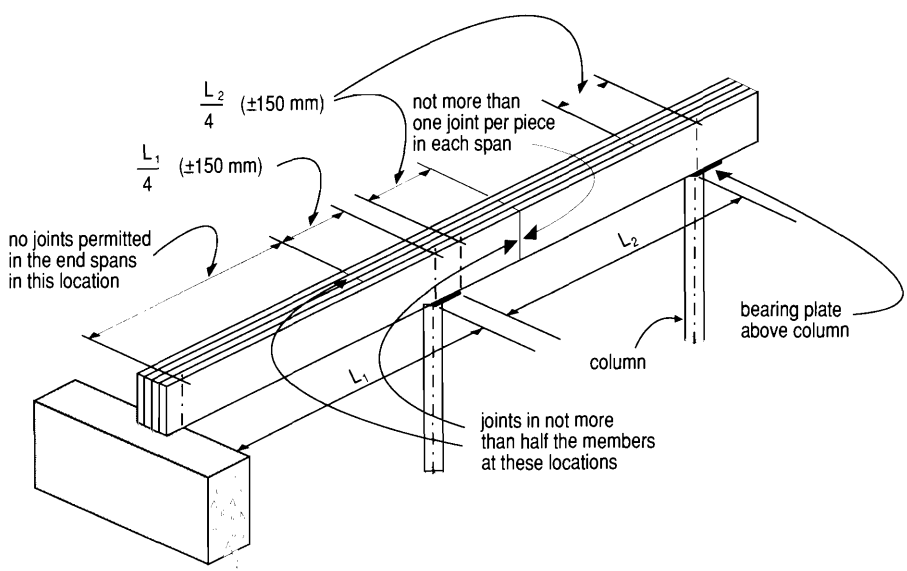


Table 9.23.12.B.
Forming Part of Sentence 9.23.12.3.(5)

Built-Up Wood Lintels Supporting Roof and Ceiling Loads over Large Openings [4, 5]														
Supported Length, m [1]	No. 1 and No.2 Lintel Span, m [2, 3]							Select Structural Lintel 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 Lintel Span, m [2, 3]							Select Structural Lintel 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 Lintel Span, m [2, 3]							Select Structural Lintel 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 Lintel Span, m [2, 3]							Select Structural Lintel 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*
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Addendum to Table 9.23.12.B.:

(1) Supported length means half the span of trusses, roof joists or rafters supported by the lintel 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 – Lintel 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.

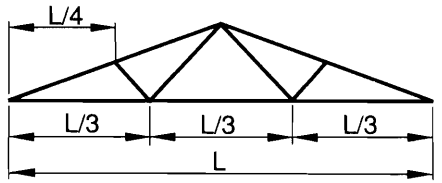
Where wood roof trusses are intended for use in a locality having a design roof snow load higher than shown in the tables, the maximum truss spacing may be adjusted to allow for the higher loading in the same manner as described for roof rafters and roof joists.

Table 9.23.13.A.
Forming Part of Sentences 9.23.13.8.(4) and (5)

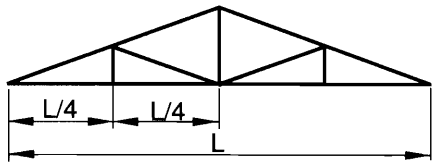
Rafter-to-Joist Nailing
(Minimum Number of Nails not less than 76 mm Long)
(Unsupported Ridge)

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-

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 m 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) CAN/CGSB-51.60M, "Cellulose Fibre, Loose Fill Thermal Insulation." r

(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. e

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) CAN/CGSB-51.33M, "Vapor Barrier Sheet Excluding Polyethylene, for Use in Building Construction." r

(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 repellent type. A test for water–repellency of loose-fill insulation suitable for installation in masonry cavity walls can be found in ASTM C516, "Specification for Vermiculite Loose Fill Insulation." e

(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

(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, "Fibrated, Cutback, Lap Cement for Asphalt Roofing," *e*
(b) CAN/CGSB 37.5-M, "Cutback Asphalt Plastic Cement," *e*
(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) CAN/CGSB-37.50M, "Hot Applied Rubberized Asphalt for Roofing and Waterproofing," *r*
(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

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

r (d) CAN/CGSB-19.24, "Multi-Component, Chemical Curing Sealing Compound."

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	38	—	600 mm (o.c.) (nailed to framing) e 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.

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 CAN/CGSB-19.22M, "Mildew Resistant Sealing Compound, for Tubs and Tile." r

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	38 (1)	200
11.1	51	300
19.0	57	400
25.4	63	400
31.7	70	600
38.1	83	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 m²
	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 m² 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, CAN/CSA B365-M87 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. e

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.

(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*. e

(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. e

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

e 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–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, m	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. 1 and 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. 1 and 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. 1 and 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. 1 and 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, m	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. 1 and 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. 1 and 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. 1 and 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. 1 and 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

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, including mill supervisory service, in accordance with CSA Standard 0141, "Softwood Lumber." e

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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 301, 197 Second Avenue N. Williams Lake, British Columbia V2G 1Z5
® 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
(FPA® 00 S-P-F S-DRY CONST	Central Forest Products Association P.O. Box 1169 Hudson Bay, Saskatchewan S0E 0Y0
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Facsimiles of Grade Mark	Association or Agency
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RIB® 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

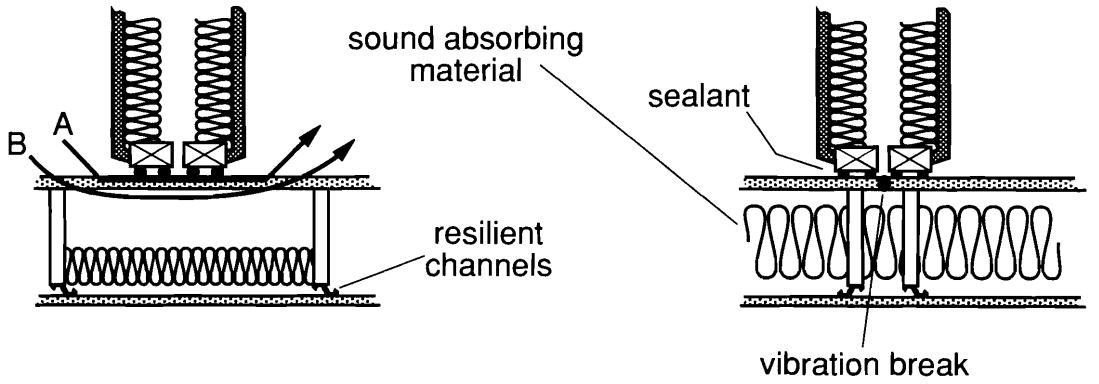
A-9.11.1.1. Sound Transmission Class Ratings. The specified STC rating of 50 is considered the minimum acceptable value, but many builders prefer to design for STC 55 or more in high quality accommodation.

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 arises 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. *e*

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

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

Index[1]

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[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.

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