Model National Energy Code of Canada for Houses 1997

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Preface

The Model National Energy Code of Canada for Houses (MNECH) is prepared by the Canadian Commission on Building and Fire Codes (CCBFC) and is published by the National Research Council (NRC). Since, under the Constitution Act, regulation of building in Canada is the responsibility of provincial and territorial governments, the MNECH is prepared in the form of a model code to permit adoption by the appropriate authority.

Liaison between the Commission and provincial and territorial code authorities is maintained through the Provincial/Territorial Committee on Building Standards, established by these authorities to provide policy guidance to the CCBFC.

This is the first in what may become a series of separate stand-alone or "progeny" documents as envisaged in "Building the Future—The Strategic Plan of the Canadian Commission on Building and Fire Codes, 1995-2000." Such documents are designed to account for situations in which broad consensus has not been reached as to whether an issue at hand should be controlled by regulation, but where there is sufficient agreement that having model national technical requirements would be beneficial. Regulatory authorities thus have these codes available should they decide to regulate in the subject areas covered by the codes, but can ignore them if such regulation is not part of their government's agenda.

To identify these "progeny" documents, they will be designated in the title as "model" codes, in recognition that they have not yet achieved the same widespread use and acceptance as other CCBFC model codes such as the National Building Code of Canada (NBC) and the National Fire Code of Canada (NFC).

The MNECH differs from model codes traditionally produced by CCBFC in that it addresses environmental protection and resource conservation issues rather than the health and safety of occupants. It is essentially a set of minimum requirements for energy efficiency in small residential buildings. These requirements are, for the most part, based on extensive cost-benefit analyses that take into consideration climate, fuel types and costs, and construction costs. The MNECH establishes a standard of construction for those features of small residential buildings that affect their energy efficiency. Energy efficiency in buildings other than small residential buildings is addressed by a companion document, the Model National Energy Code of Canada for Buildings (MNECB).

The CCBFC and NRC have not taken a position as to whether energy conservation should be regulated. The CCBFC has agreed, in response to requests from provincial and territorial energy ministries and agencies, to produce this model code so that authorities wishing to deal with energy conservation through regulation have access to a consensus-based, technically supportable set of requirements.

Where a jurisdiction has not decided to control energy use through regulation, this document can be used as a guide to a minimum level of energy performance.

The cost analyses on which the MNECH is based were intended to reflect the cost of construction as closely as practical for the regions considered, with due allowance for the essentially unstable nature of such costs and the local variations in construction techniques. Moreover, since the impact of energy conservation features in a house depends to a significant extent on the performance of other surrounding features, a certain degree of conservatism had to be introduced in order to avoid unreasonably stringent requirements. The cost studies for the MNECH did not take into account secondary effects such as the reduction of the size of heating equipment due to improvements in the building envelope. Similarly, they did not account for the cost of electricity incurred in running a furnace, because such costs will vary with the size and operation of the equipment. They also did not include the energy spent in fabricating and transporting materials, except to the extent that the cost of such energy is reflected in the costs of these materials.

The requirements in this Code do not constitute a design procedure. Once the requirements of the Code have been determined, the designer should strive to design actual buildings and systems that will provide an effective and energy-efficient service in accordance with the use of the space, while meeting the requirements of the Code. Some design principles for energy-efficient residential buildings are contained in various referenced handbooks.

Because the requirements of the MNECH are based to a large extent on economic considerations, and particularly the economics of new construction, this Code is intended primarily to be applied to new buildings. It may be suitable for application to the alteration or renovation of existing buildings, where the extent of alteration or renovation is such that the economics of new construction apply. Therefore, since additions to existing buildings are essentially new construction, this Code does apply to additions.

Committees. This Code has been developed and continues to be developed through the voluntary assistance of many experts from coast to coast. The members of the CCBFC are appointed by NRC. They serve as individuals and not as designated appointees of any organization and are broadly representative of all major phases of construction in Canada. The CCBFC has direct responsibility under NRC for the preparation and publication of the Code.

The CCBFC is assisted in the technical aspects of code writing by standing committees, each of which is responsible for specific portions of a code or its associated documents. The members of each standing committee are knowledgeable in the particular field for which the committee is responsible. Building and fire officials, architects, engineers, contractors, building owners and others share their experience in the national interest. The committees responsible for the MNECH and their memberships are listed in the following pages.

The CCBFC wishes to acknowledge the assistance provided by the many individuals who have contributed to the production of this edition of the Code and to express its appreciation to the standards development organizations whose standards are referenced throughout the Code documents.

IRC Staff. The staff of the Canadian Codes Centre of the Institute for Research in Construction (IRC) of NRC provide technical and administrative support at the direction of the CCBFC. Technical issues identified in developing and maintaining this Code are often referred to the research laboratories of the IRC or to other agencies for study, to make available to the CCBFC the most up-to-date information on building technology on which to base its decisions.

Technical Support. As this is an entirely new code, a great deal of technical support was needed in its development, an amount beyond the normal capacity of IRC's research laboratories to provide. However, in this case, IRC was able to assemble sufficient resources from its Building Envelope and Structure Program to respond to the CCBFC's needs, thanks to funding provided by the Canadian Electrical Association, Natural Resources Canada and the energy ministries of provinces and territories. The CCBFC gratefully acknowledges the support of these organizations.

Changes from the 1983 "Measures for Energy Conservation." The new energy code incorporates several new and important features that make it significantly more than an updating of "Measures for Energy Conservation in New Buildings," the energy code last published in 1983 by the Associate Committee on the National Building Code (the predecessor to the CCBFC).

As with "Measures," the requirements in the MNECH have been based as much as possible on life cycle costing, taking into account climate, fuel types and costs, and construction costs. In the case of "Measures," however, this determination was based on national average values for these parameters, whereas the requirements in the MNECH are based on regional values for these parameters, as determined in consultation with provincial/territorial governments. This has resulted in requirements that are economically justified and regionally sensitive. The process of determining these regionally sensitive requirements is described in more detail in Appendix F.

The MNECH also provides alternate compliance paths, allowing designers to follow a simple prescriptive path (with internal trade-off options) or a performance path based on computer simulation, i.e., a great deal of design flexibility is permitted provided it can be shown, using a prescribed computer simulation, that the building will use no more energy than it would if it were to comply with the prescriptive requirements of this Code.

Coordination with the National Building Code of Canada. The MNECH is intended to be used in conjunction with the NBC, which is a code of minimum regulations for public health, fire safety and structural sufficiency. For this reason, the MNECH does not address these issues but is based on the assumption that the buildings to which it is applied comply with the NBC or a provincial or municipal code based on the NBC. Those wishing to use the MNECH in conjunction with a building code that differs significantly from the NBC, or in the absence of a building code, should ensure that relevant aspects of the building not addressed in this Code are considered. This would include the installation of insulation, vapour barriers and air barriers and the effectiveness and safety of heating, ventilating and air-conditioning systems.

Public Comment and Inquiries. Comments and inquiries on the use of this Code and suggestions for its improvement are welcomed and should be submitted to:

The Secretary
Canadian Commission on Building and Fire Codes
National Research Council Canada
Ottawa, Ontario
K1A 0R6.

The Commission also publishes "Guidelines for Proposing Changes to the National Code Documents," a leaflet describing how to submit a proposed change to a National Code and what material to include to support the proposal.

Related Documents. NRC publishes other code-related documents that may be of interest to users of this Code:

Model National Energy Code for Buildings 1997. A model set of technical requirements for the construction of energy-efficient buildings other than small residential buildings.

National Building Code of Canada 1995. A model set of technical requirements designed to establish a standard of safety for the construction of buildings, including extensions or alterations, the evaluation of buildings undergoing a change of occupancy and the upgrading of buildings to remove an unacceptable hazard.

National Fire Code of Canada 1995. A model set of technical requirements designed to provide an acceptable level of fire protection and fire prevention within a community.

National Plumbing Code of Canada 1995. Contains detailed requirements for the design and installation of plumbing systems in buildings.

National Farm Building Code of Canada 1995. A model set of minimum requirements affecting human health, fire safety and structural sufficiency for farm buildings.

National Housing Code of Canada and Illustrated Guide 1997.[*] A compilation of all requirements from the National Building Code of Canada 1995 that apply to small residential buildings, including detached, semi-detached and row houses without shared egress.

User's Guide — NBC 1995 Fire Protection, Occupant Safety and Accessibility (Part 3). Explains the intent of many Part 3 requirements and provides a background to and reasons for many of its more complex requirements.

User's Guide — NBC 1995 Structural Commentaries (Part 4). Provides commentaries on the structural design requirements of Part 4 of the Code, including a new commentary on Application of NBC Part 4 for the Structural Evaluation and Upgrading of Existing Buildings.

User's Guide — NBC 1995 Wind, Water and Vapour Protection (Part 5).[*] Describes the environmental loads on building envelopes, discusses means to respond to those loads, and indicates how the Code requirements relate to current knowledge of building envelope design and construction theory and practice.

User's Guide — NBC 1995 Housing and Small Buildings (Part 9).[*] Describes the principles behind many of the requirements of Part 9 and some of the historical background where this will assist users in understanding the objectives of certain provisions.

CCBFC Policies and Procedures 1992. Contains the terms of reference and operating procedures of the CCBFC and its standing committees, a statement on the supporting role of the Institute for Research in Construction of NRC and the membership matrices for the various standing committees.

[*] Scheduled for publication in Fall/Winter 1997.

A Guide to the Use of this Code

The MNECH is essentially a code of minimum regulations for energy efficiency in small residential buildings, which takes into consideration climate, fuel types and costs, and construction costs. It establishes a standard of construction for the energy-related features of such buildings, including additions to existing buildings. It is not intended to be a textbook on building design, advice on which should be sought from professional sources. Its primary purpose is the promotion of a reasonable minimum level of energy efficiency in new small residential buildings through the application of appropriate uniform building standards throughout Canada.

This Code is drafted in such a way that it may be adopted or enacted for legal use by any jurisdictional authority in Canada. It is divided into 9 Parts. A decimal numbering system has been used throughout the Code. The first number indicates the Part of the Code; the second, the Section in the Part; the third, the Subsection and the fourth, the Article in the Subsection. An Article may be further broken down into Sentences (indicated by numbers in brackets), and the Sentence further divided into Clauses and Subclauses. These divisions are illustrated as follows:

2	Part
2.8.	Section
2.8.2.	Subsection
2.8.2.1.	Article
2.8.2.1.(1)	Sentence
2.8.2.1.(1)(a)	Clause
2.8.2.1.(1)(a)(i)	Subclause

A summary of the contents of the Code follows:

Part 1: Scope and Definitions

Part 1 describes the buildings and parameters covered by this Code. It also contains the definitions of all terms that have a constrained or specific meaning for the purposes of this Code. These terms appear in italic type where they are used in the Code. This Part also contains a list of abbreviations used in the Code.

Part 2: General Requirements

Part 2 contains provisions of an administrative nature such as the use of referenced documents, climatic data, plans and specifications; calculation methods; provision for equivalent materials, systems, equipment, and procedures; and the construction review process.

Part 3: Building Envelope

This Part contains requirements related to the thermal resistance and airtightness of the various building assemblies that make up the building envelope.

Part 4: Lighting

This Part contains requirements intended to minimize energy use for lighting and to encourage the provision of means of efficiently controlling lighting.

Part 5: Heating, Ventilating and Air-conditioning Systems

This Part includes requirements for the design and installation of heating, ventilating and air-conditioning systems with the characteristics and controls necessary to operate efficiently.

Part 6: Service Water Heating Systems

This Part includes requirements for the design and installation of service water heating systems with the characteristics and controls necessary to operate efficiently.

Part 7: Electrical Power

This Part contains requirements for those electricity-consuming features of small residential buildings not covered in Parts 4, 5 and 6.

Part 8: Building Energy Performance Compliance

Part 8 provides an alternative to the prescriptive requirements of other parts by specifying a means of demonstrating that a building will not use more energy than if it were to comply with those prescriptive requirements.

Part 9: Manufactured Housing

This Part contains specific requirements and exemptions from certain requirements of the Code for manufactured housing.

Appendix A: Regional Requirements

Appendix A contains tables of regional requirements for the thermal characteristics of the envelope, for heat recovery and for energy source adjustment factors. These requirements form part of the prescriptive requirements of this Code, to the extent that the tables apply to the administrative region considered.

Appendix B: Thermal Characteristics of Common Building Assemblies

Appendix B contains tables providing thermal characteristics of common building assemblies, such as exterior walls, windows, doors, roofs, exposed floors, foundation walls and floors on ground. They are given as an aid in assessing the compliance of building assemblies to the regional requirements of this Code and as such form part of its requirements.

Appendix C: Method for Calculating the Thermal Resistance of Building Assemblies

Appendix C describes methods required in Part 2 to be used in establishing the effective thermal resistance of building assemblies for the purpose of checking compliance with the requirements of this Code. These methods form part of the requirements of this Code.

Appendix D: Energy Source Adjustment Factors

Appendix D contains a table of regional energy source adjustment factors used in determining the principal heating source of a building and used by the performance compliance software. This table forms part of the mandatory requirements of this Code.

Appendix E: Commentary

Appendix E contains additional explanatory information to assist Code users in understanding the intent of the requirements contained in Parts 1 to 9. Appendix E does not form part of the requirements of this Code.

Appendix F: Determination Of Regionally Sensitive Requirements

Appendix F explains the calculation method used to establish the levels of the regional requirements of the Code and details the parameters considered. It allows the reader to understand the logic behind the requirements. Appendix F does not form part of the requirements of this Code.

Appendix G: Conversion Factors

Appendix G gives a table of factors for converting units used in this Code from the metric system to the imperial system. Appendix G does not form part of the requirements of this Code.

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(1) IRC staff who provided assistance to the Committee.
(2) Term completed during the preparation of the 1997 Model National Energy Codes.

Part 1
Scope and Definitions

Section 1.1. General

1.1.1. Administration

1.1.1.1. Administrative Requirements

1) This Code shall be administered in conformance with the relevant provincial, territorial or municipal regulations or, in the absence of such regulations, in conformance with the Canadian Commission on Building and Fire Codes' Administrative Requirements for Use with the National Building Code of Canada.

1.1.2. Scope

1.1.2.1. Buildings Covered by this Code

1) This Code applies to the design, construction and *occupancy* of

a) new *buildings* of 3 *storeys* or less in *building height*, having a *building area* not exceeding 600 m^2 and containing only *dwelling units*, related ancillary *service rooms*, shared means of egress or garages serving the units (see Appendix E),

b) all new *buildings* of *residential occupancy* containing not more than one *dwelling unit*, and

c) *additions* to existing *buildings* of the types described in Clauses (a) and (b) (see Appendix E).

1.1.2.2. Building Parameters Covered by this Code

1) This Code defines requirements for the design and construction of the *building envelope*, and the design and construction or specification of systems and equipment for heating, ventilating or air-conditioning, *service water* heating, lighting, and provision of electrical power.

1.1.2.3. Relationship to Other Building Regulations

1) This Code is to be used in conjunction with the relevant provincial, territorial or municipal *building* regulations or, in the absence of such regulations, in conjunction with the National Building Code of Canada.

2) In cases where the requirements of this Code are in conflict with the requirements of the relevant provincial, territorial or municipal *building* regulations or, where relevant, with the National Building Code of Canada, the requirements of the relevant *building* regulations shall supersede those of this Code.

1.1.3. Definitions of Words and Phrases

1.1.3.1. Words Not Defined Herein

1) Words and phrases used in this Code that are not included in the list of definitions in this Part shall have the meanings that are commonly assigned to them in the context in which they are used in this Code, taking into account the specialized use of terms within the various trades and professions to which the terminology applies (see Appendix E).

1.1.3.2. Words Italicized in this Code

1) The words and terms in italics in this Code have the following meanings:

Addition means any heated space that is added to an existing *building* and that increases the *building*'s *floor surface area* by more than 10 m^2.

Annual adjusted energy consumption means the annual sum of the lighting energy consumption, *service water* heating energy consumption and space-conditioning energy consumption of the proposed *building* design, as calculated in accordance with the requirements of Part 8 of this Code.

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

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

* The definition for this word or term is identical to that in the National Building Code of Canada 1995.

Boiler means an *appliance*† intended to supply hot water or steam for space or *service water* heating purposes, except *storage-type service water heaters.*

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

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

Building energy target means the *annual adjusted energy consumption* of a hypothetical replica of the proposed *building*, using the same energy sources for the same functions and having the same environmental requirements, *occupancy*, climate data and operation schedules, but made to comply with all applicable prescriptive requirements of this Code.

Building envelope means the collection of components that separate heated space from unheated space, the exterior air or the ground, or that separate heated spaces that are intended to be heated to temperatures differing by more than 10°C at design conditions (see Appendix E).

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

Coefficient of performance (COP) means, for a heat pump in the heating mode, the ratio of the rate of net heat output to the total energy input expressed in consistent units and under designated rating conditions, as described in the referenced standards; for refrigerating equipment or a heat pump in the cooling mode, COP means the ratio of the rate of heat removal to the rate of energy input in consistent units and under designated rating conditions, as described in the referenced standards.

Cooled means that a *building* is equipped with a permanent mechanical cooling system providing comfort conditions to some or all of its interior spaces, or is designed to be equipped with such a system.

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

Effective thermal resistance (RSI-value) means the inverse of the *overall thermal transmittance.* For assemblies in contact with the ground, it excludes the resistance of the ground and exterior air film on the surface of the ground.

Energy-efficiency ratio (EER), for refrigerating equipment or a heat pump in the cooling mode, means the ratio of net cooling capacity in Btu/h to the total rate of electric input in watts, under designated operating conditions, as described in the referenced standards.

Energy factor (EF) means a dimensionless measure of the overall efficiency of a *service water* heater and is obtained as described in the referenced standards.

Energy rating (ER) means a method of rating the relative thermal performance of windows that gives, in a single number, a window's combined response to solar heat gain, conductive heat loss and air leakage in typical Canadian climatic conditions. It is based on the total performance of all window components, including glazing, spacers, *sash* and *frame*.

Energy source adjustment factor means the factor by which the consumption of a given energy source is multiplied to obtain the *annual adjusted energy consumption* of a *building* for the purposes of *building* energy performance compliance calculations described in Part 8, where more than one energy source is used by the *building.*

*Exhaust duct** means a duct through which air is conveyed from an interior space to the outdoors.

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

Exterior entrance means a doorway that is used for entering, or entering and exiting, a *building*, which leads from an exterior space to the area served by the entrance, and where the area served is provided with *interior lighting.*

Exterior exit means a doorway that is used for exiting only, which leads from the area it serves to an exterior space, and where the area served is provided with *interior lighting.*

Exterior lighting means lighting that is not defined as *interior lighting*.

Facade lighting means lighting installed to highlight features of the principal front of a *building* or a face of a *building* that overlooks a street or open space. *Facade lighting* includes lighting installed on the facade and lighting installed on constructed or natural surfaces in close proximity to the facade. *Facade lighting* does not include signage, or other lighting installed on the facade but intended to light exterior spaces or surfaces other than the facade.

*Firewall** means a type of *fire separation*† of *noncombustible construction*† that subdivides a *building* or separates adjoining *buildings* to resist the spread

† See the National Building Code of Canada 1995 for these definitions.

of fire and that has a *fire-resistance rating*†, as prescribed in the National Building Code of Canada, and has structural stability to remain intact under fire conditions for the required fire-rated time.

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

Floor surface area means the area of a floor surface, including heated garages, measured from the interior surface of the perimeter walls at or near floor level, including the area occupied by columns, interior walls and openings in the floor.

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

Frame in a door, window or other glazed area means the associated head, jambs, sill and, where applicable, mullions that, when assembled, house the door, *sash* or fixed glazing.

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

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

Heat trap means an energy-conserving arrangement of the water piping entering or leaving a *service water* heater constructed to counteract the convective forces of the hot water (thermosyphoning) during standby periods.

Integrated part-load value (IPLV) means a single-number figure of merit based on part-load *energy-efficiency ratio* or *coefficient of performance* expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment, as described in the referenced standards.

Interior lighting means
(a) lighting installed in spaces that are within the *building envelope*,
(b) lighting installed in spaces that are sheltered from the outdoor environment, whether or not they are heated spaces, where the lighting is intended to light only those spaces, except for spaces at *exterior entrances* and *exterior exits*, and
(c) lighting installed in unsheltered exterior spaces that serve *occupancies* that are commonly accommodated within the confines of the *building envelope*.
(See Appendix E.)

Landscape lighting means lighting installed to highlight landscape elements, such as trees, shrubs, rocks and pools. *Landscape lighting* does not include lighting of exterior spaces or walkways.

Luminous efficacy means the total luminous flux emitted by a luminaire divided by the total power input to the luminaire, including lamps and ballasts.

Multiple-unit residential building means a *building* of *residential occupancy* that contains more than one *dwelling unit*.

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

Opaque component of the *building envelope* means a *building* assembly that does not let any light pass through, and refers to assemblies other than doors, windows and other glazed areas.

Overall thermal transmittance (U-value) is a measure of the rate at which heat is transferred through a *building* assembly subject to a temperature difference. It is expressed as the amount of heat transferred through a unit area in a unit of time induced under steady-state conditions by a unit temperature difference between the environments on its two faces. As used in this Code, it reflects the resistance to such heat transfer of all elements through the thickness of the assembly, as well as that of air films on both faces. Where the resistance to heat transfer is not homogeneous across the area being considered, an average value of the *overall thermal transmittance* must be calculated in accordance with the procedures prescribed in this Code.

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

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

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

Principal heating source of a *building* or part of a *building* means the source with the highest *energy source adjustment factor* in Table D-1 of Appendix D that accounts for more than 10% of the installed space-heating capacity for the *building* or part of the *building*. In the case of purchased heat, the *principal heating source* of the plant supplying the heat shall be considered (see Appendix E).

*Residential occupancy** means the *occupancy* or use of a *building* or part thereof by persons for whom sleeping accommodation is provided but who are not harboured or detained to receive medical care or treatment or are not involuntarily detained.

RSI-value — see *effective thermal resistance.*

Sash means an assembly of secondary framing members that fits within the primary *frame* of a window and whose main purpose is to hold and support the glass in operable windows; however, a *sash* is often included in fixed windows to maintain a uniform appearance with operable windows.

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

Service water means water for plumbing services, excluding systems used exclusively for space heating or cooling, or for processes.

Skylight means a *building envelope* assembly that transmits visible light and is inclined less than 60° from horizontal.

Skylight-to-roof ratio means a parameter that is calculated as described in Sentence 2.2.2.9.(5) and used in the establishment of required thermal characteristics of *skylights* (see Sentence 3.3.1.3.(3)).

Solar heat gain coefficient means the ratio of solar heat gain through a window component to the solar radiation incident on it, for a given angle of incidence and for given environmental conditions (indoor temperature, outdoor temperature, wind speed, solar radiation) (see Appendix E).

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

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

Standby losses are the heat losses incurred by a *storage-type service water heater* under a stable condition when no water is withdrawn from the tank and the water temperature is held constant by the thermostats.

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

*Storage-type service water heater** means a *service water* heater with an integral hot water storage tank.

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

Suite means a single room or series of rooms of complementary use, operated under a single tenancy, and includes *dwelling units* (see Appendix E).

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

Thermal break means an insulating material incorporated in a metal window, *skylight* or door *frame* or *sash* to reduce thermal conduction.

Thermal efficiency (E_t) means a measure of the efficiency of fuel-burning equipment in converting fuel to heat, as obtained through the procedures described in the referenced standards.

U-value — see *overall thermal transmittance.*

*Unit heater** means a suspended *space heater* with an integral air circulating fan.

1.1.4. Abbreviations

1.1.4.1. Addresses and Abbreviations of Proper Names

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

AGA	American Gas Association (55 Scarsdale Road, Don Mills, Ontario M3B 2R3)
AHAM	Association of Home Appliance Manufacturers (20 North Wacker Drive, Suite 1500, Chicago, Illinois, 60606 U.S.A.)
ANSI	American National Standards Institute (11 West 42nd Street, 13th Floor, New York, New York 10036 U.S.A.)
ARI	Air-Conditioning and Refrigeration Institute (4301 North Fairfax Drive, Suite 425, Arlington, Virginia 22203 U.S.A.)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers (1791 Tullie Circle N.E., Atlanta, Georgia 30329 U.S.A.)
ASTM	American Society for Testing and Materials (100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428-2959 U.S.A.)
CAN	National Standard of Canada designation (The number or name following the CAN designation

represents the agency under whose auspices the standard is issued.
CAN1 designates CGA,
CAN2 designates CGSB, and
CAN3 designates CSA.)

CCBFC	Canadian Commission on Building and Fire Codes (National Research Council of Canada, Ottawa, Ontario K1A 0R6)
CGA	Canadian Gas Association (International Approval Services Canada Inc., 55 Scarsdale Road, Don Mills, Ontario M3B 2R3)
CGSB	Canadian General Standards Board (Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6)
CSA	Canadian Standards Association (178 Rexdale Blvd., Etobicoke, Ontario M9W 1R3)
CTI	Cooling Tower Institute (P.O. Box 73383, Houston, Texas 77273 U.S.A.)
Government of Canada	Canada Communications Group Publishing (Ottawa, Ontario K1A 0R9)
HI	Hydronics Institute (35 Russo Place, Berkeley Heights, New Jersey 07922 U.S.A.)
HRAI	Heating, Refrigerating and Air-Conditioning Institute of Canada (5045 Orbitor Drive, Building 11, Suite 300, Mississauga, Ontario L4W 4Y4)
NBC	National Building Code of Canada
NRC	National Research Council Canada (Ottawa, Ontario K1A 0R6)
SMACNA	Sheet Metal and Air Conditioning Contractors National Association Inc. (8224 Old Courthouse Road, Vienna, Virginia 22180 U.S.A.)
U.S. Government	U.S. Government Printing Office (P.O. Box 371954, Pittsburgh, Pennsylvania 15250 U.S.A.)

1.1.4.2. Symbols and Other Abbreviations

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

Btu	British thermal unit(s)
Btu/h	British thermal unit(s) per hour
cm	centimetre
COP	*coefficient of performance*
°	degree(s)
°C	degree(s) Celsius
db	dry bulb (temperature)
E_t	*thermal efficiency*
EER	*energy-efficiency ratio*
EF	*energy factor*
ER	*energy rating*
%	per cent
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
h	hour(s)
IPLV	*integrated part-load value*
kW	kilowatt(s)
L	litre(s)
lin	linear
lm	lumen
m	metre(s)
min	minute(s)
mm	millimetre(s)
No.	number(s)
o.c.	on centre
Pa	pascal(s)
RSI	thermal resistance value in the metric system
s	second(s)
temp.	temperature
V	volts
W	watt(s)
wb	wet bulb (temperature)

Part 2
General Requirements

Section 2.1. General

2.1.1. Compliance

2.1.1.1. Compliance with Mandatory Provisions

1) *Buildings* within the scope of this Code shall comply with the mandatory provisions of Sections 3.2., 4.2., 5.2., 6.2. and 7.2.

2.1.1.2. Prescriptive or Performance Compliance

(See Appendix E.)

1) Except as provided in Sentence (2), *buildings* shall comply with

a) the prescriptive requirements of Part 3, Building Envelope; and Part 5, Heating, Ventilating and Air-conditioning Systems; or

b) the performance requirements of Part 8, Building Energy Performance Compliance.

2) *Building envelope* components need not comply with the prescriptive requirements of Section 3.3. if compliance can be shown using the trade-off procedures in Section 3.4.

Section 2.2. Basic Data and Calculation Methods

2.2.1. Climatic Data

2.2.1.1. Climatic Values

1) The climatic values required for the design of *buildings* under this Code shall be in conformance with the values established by the *authority having jurisdiction* or, in the absence of such data, with the climatic values in Appendix C, Climatic Information for Building Design in Canada, of the National Building Code of Canada for the location nearest to the *building* site (see Appendix E).

2.2.2. Calculation Procedures

2.2.2.1. Good Practice

1) Calculations carried out to ensure compliance with this Code and not described in the balance of this Subsection or in other Parts of this Code shall be carried out using procedures recognized as good practice for the particular purposes.

2.2.2.2. Thermal Characteristics of Building Assemblies

(See Appendix E.)

1) The thermal characteristics of materials shall be determined in accordance with the relevant product standards listed in the National Building Code or, in the absence of such a standard or where such a standard does not address determination of thermal resistance, in accordance with ASTM Standard C 518, “Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus,” or ASTM Standard C 177, “Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.”

2) Calculations and tests performed according to Sentence (1) shall be carried out at an average temperature of 24°C (± 3°C) and under a temperature difference of 22°C (± 2°C).

3) The thermal characteristics of windows and of sliding glass doors that are within the scope of CSA Standard A440.2, “Energy Performance Evaluation of Windows and Sliding Glass Doors,” shall be determined for the reference sizes listed in accordance with that standard.

4) The *overall thermal transmittance* of other forms of windows and other glazed areas not covered under Sentence (3) shall be determined from

a) calculations carried out using the procedure described in the ASHRAE Handbook — Fundamentals, or

b) laboratory tests performed in accordance with ASTM C 236, “Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box."

5) Calculations and tests performed according to Sentence (4) shall be carried out on the basis of reference window sizes called for in CSA Standard A440.2, "Energy Performance Evaluation of Windows and Sliding Glass Doors."

6) Tests conducted according to Clause (4)(b) shall be carried out with an indoor air temperature of 21°C (± 1°C) and an outdoor air temperature of – 18°C (± 1°C) measured at the mid-height of the window.

7) The thermal characteristics of swinging doors that are within the scope of CSA Standard A453, "Energy Performance Evaluation of Swinging Doors," shall be determined for the reference sizes listed in accordance with that standard.

8) The *effective thermal resistance* of other *building* assemblies shall be determined from
a) the tables in Appendix B,
b) calculations carried out using the procedure described in Appendix C, or
c) laboratory tests performed in accordance with ASTM Standard C 236, "Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box."
(See Appendix E.)

9) Tests conducted according to Clause (8)(c) shall be carried out at an average temperature of 24°C (± 3°C) and under a temperature difference of 22°C (± 2°C).

2.2.2.3. Solar Characteristics of Windows and Other Glazed Areas

1) The *solar heat gain coefficient* of windows that are within the scope of CSA Standard A440.2, "Energy Performance Evaluation of Windows and Sliding Glass Doors," shall be determined in accordance with Section 6, Solar Heat Gain Coefficient, of that Standard.

2) The *solar heat gain coefficient* of other forms of windows and other glazed areas shall be determined using the procedures described in the Chapter on Fenestration in the ASHRAE Handbook — Fundamentals.

2.2.2.4. Areas of Roof Assemblies

1) For the purposes of trade-off calculations described in Section 3.4. and *building* energy performance compliance calculations described in Part 8, the insulated surface areas of roof assemblies
a) shall be calculated along the plane of the insulation using dimensions measured to the interior surfaces of intersecting exterior walls, and
b) shall exclude openings for *skylights* and chimneys as measured to the surfaces of structural framing surrounding such openings.

2.2.2.5. Areas of Above-ground Wall Assemblies

1) For the purposes of trade-off calculations described in Section 3.4. and *building* energy performance compliance calculations described in Part 8, the insulated surface areas of exterior above-ground wall assemblies
a) shall be calculated using dimensions measured to the interior surfaces of intersecting exterior walls and to the exterior ground level, but shall not include the perimeter areas of floors or roofs;
b) shall include perimeter areas of intersecting interior walls; and
c) shall exclude openings for doors, windows and other glazed areas, as measured to the surfaces of structural framing surrounding such openings.

2.2.2.6. Areas of Above-ground Floor Assemblies

1) For the purposes of trade-off calculations described in Section 3.4. and *building* energy performance compliance calculations described in Part 8, the insulated surface areas of above-ground exterior floor assemblies shall be calculated using dimensions measured to the interior surfaces of perimeter walls.

2.2.2.7. Areas of Wall Assemblies in Contact with the Ground

1) For the purposes of trade-off calculations described in Section 3.4. and *building* energy performance compliance calculations described in Part 8, the insulated surface areas of wall assemblies in contact with the ground shall be calculated using dimensions measured horizontally to the interior surfaces of perimeter wall assemblies in contact with the ground and vertically from the exterior ground level to the surface of intersecting floors in contact with the ground.

2.2.2.8. Areas of Floor Assemblies in Contact with the Ground

1) For the purposes of trade-off calculations described in Section 3.4. and *building* energy performance compliance calculations described in Part 8, the insulated surface areas of floor assemblies in contact with the ground shall be calculated using dimensions measured to the interior surfaces of perimeter walls.

2.2.2.9. Areas of Doors, Windows and Other Glazed Areas

1) For the calculation of the area of windows and other glazed areas; doors, windows and other glazed areas shall be considered to include all related *frame* and *sash* members (in addition to the glazing) and their areas shall be measured to the rough opening in the wall (see Appendix E).

2) Except as provided in Sentence (3), the area of windows and other glazed areas made of curved panes or flat panes that are not all in the same plane shall be measured along the glass surface (see Appendix E).

3) The area of *skylights* having a rough opening of not more than 5 m^2 and for which the height above the curb is not greater than half the largest dimension of the base may be approximated by multiplying the area of the rough opening by 1.5.

4) For the calculation of the total area of windows and other glazed areas, the areas of clerestories, glass blocks, *skylights*, transoms, sidelights, glass doors and glazed inserts in doors shall be included with that of windows.

5) The *skylight-to-roof ratio* shall be calculated as the total area of *skylights*, as determined in Sentences (1) and (2), divided by the sum of insulated roof areas plus *skylights*.

6) For the calculation of the ratio of windows and other glazed areas to walls and for the calculation of the *skylight-to-roof ratio*, the compliance of *additions* shall be based upon either
- a) the *addition* being considered by itself, or
- b) the *addition* being considered together with the existing *building*.

Section 2.3. Documentation

2.3.1. General

2.3.1.1. Required Information

1) Sufficient information shall be provided to show that the proposed work will conform to this Code (see Appendix E).

2.3.1.2. Required Plans

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

2.3.1.3. Design Calculations and Analysis

1) The calculations and analysis made in the process of ensuring conformity with the requirements of this Code shall be available for inspection upon request.

Section 2.4. Materials, Appliances, Systems and Equipment

2.4.1. General

2.4.1.1. Characteristics

1) 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

1) 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

1) 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

1) The provisions of this Code are not intended to limit the appropriate use of materials, appliances, systems, equipment, methods of design, methods of calculation or construction procedures not specifically described herein.

2.5.1.2. Evidence of Equivalent Performance

1) Any person wishing to provide 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

1) Materials, appliances, systems, equipment, methods of design, methods of calculation and construction procedures not specifically described herein, or that 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 (see Appendix E).

2.5.1.4. Equivalent Test Standards

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. Referenced Documents

2.6.1. Application

2.6.1.1. Application to Buildings

1) The provisions of referenced documents in this Code apply only to the extent that they relate to the purpose of this Code.

2.6.1.2. Conflicting Requirements

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.

2.6.1.3. Effective Date

1) Unless otherwise specified herein, the documents referenced in this Code shall include all amendments, revisions and supplements effective to 30 June 1996.

2) Where documents are referenced in this Code, they shall be the editions designated in Table 2.6.1.3.

Table 2.6.1.3.
Documents Referenced in the Model National Energy Code for Houses 1997
Forming Part of Sentence 2.6.1.3.(2)

Issuing Agency	Document Number	Document Title	Code Reference
AGA	ANSI Z21.56-1994	Gas-Fired Pool Heaters	Table 6.2.2.1.
AHAM	ANSI/AHAM RAC-1-1982 (R1992)	Room Air Conditioners	Table 5.2.10.1.
ANSI	C82.11-1993	High-Frequency Fluorescent Lamp Ballasts	4.2.5.1.(2)
ARI	210/240-94	Unitary Air-Conditioning and Air-Source Heat Pump Equipment (Addendum)	Table 5.2.10.1.
ASHRAE		ASHRAE 1997 Handbook — Fundamentals, SI Edition	2.2.2.2.(4)(a) 2.2.2.3.(2)
ASTM	C 177-85 (1993)	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus	2.2.2.2.(1)
ASTM	C 236-89 (1993)	Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box	2.2.2.2.(4)(b) 2.2.2.2.(8)(c)
ASTM	C 518-91	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus	2.2.2.2.(1)
ASTM	E 283-91	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen	3.2.4.3.(1)(a)

Table 2.6.1.3. (Continued)

Issuing Agency	Document Number	Document Title	Code Reference
CGA	CAN/CGA-2.3-M93	Gas-Fired Central Furnaces	Table 5.2.10.1.
CGA	CAN/CGA-2.6-M86 (R1996)	Gas Unit Heaters (including August 1986 and January 1989 Amendments)	Table 5.2.10.1.
CGA	CGA 2.8-M86 (R1996)	Gas-Fired Duct Furnaces (including August 1986 and January 1989 Amendments)	Table 5.2.10.1.
CGA	CAN1-4.1-M85	Gas-Fired Automatic Storage Type Water Heaters with Inputs Less than 75,000 Btu/h (including November 1992 and June 1994 Amendments)	Table 6.2.2.1.
CGA	CAN1-4.3-M85	Circulating Tank, Instantaneous and Large Automatic Storage Type Gas Water Heaters (including November 1992 Amendment)	Table 6.2.2.1.
CGA	CAN1-4.7-M85 (R1996)	Gas-Fired Pool Heaters	Table 6.2.2.1.
CGA	CGA 4.9-1969	Gas-Fired Steam and Hot Water Boilers (including September 1974 Amendment)	Table 5.2.10.1.
CGSB	CAN/CGSB-82.5-M88	Insulated Steel Doors	3.2.4.3.(2)
CGSB	CAN/CGSB-149.10-M86	Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method	3.2.4.1.(3)
CSA	CAN/CSA-A440-M90	Windows	3.2.4.2.(1)
CSA	A440.2-93	Energy Performance Evaluation of Windows and Sliding Glass Doors	2.2.2.2.(3) 2.2.2.2.(5) 2.2.2.3.(1) 3.3.1.3.(1) 9.2.1.1.(2)
CSA	A453-95	Energy Performance Evaluation of Swinging Doors	2.2.2.2.(7) 3.3.1.4.(1)
CSA	B125-M93	Plumbing Fittings	6.2.5.1.(1)
CSA	B140.4-1974 (R1991)	Oil-Fired Warm Air Furnaces	Table 5.2.10.1.
CSA	CAN/CSA-B211-M90 (R1996)	Seasonal Energy Utilization Efficiencies of Oil-Fired Water Heaters	Table 6.2.2.1.
CSA	B212-93	Seasonal Energy Utilization Efficiencies of Oil-Fired Furnaces and Boilers	Table 5.2.10.1.
CSA	CAN3-C17-M84 (R1995)	Alternating-Current Electricity Metering	7.2.1.1.(2)
CSA	CAN/CSA-C273.3-M91	Performance Standard for Split-System Central Air-Conditioners and Heat Pumps (including General Instruction No. 4)	Table 5.2.10.1.
CSA	C273.4-M1978 (R1992)	Performance Requirements for Electric Heating Line-Voltage Wall Thermostats	5.2.6.2.(1)
CSA	CAN/CSA-C368.1-M90 (R1996)	Performance Standard for Room Air Conditioners	Table 5.2.10.1.
CSA	CAN/CSA-C439-88	Standard Methods of Test for Rating the Performance of Heat-Recovery Ventilators	5.3.1.1.(2)
CSA	CAN/CSA-C446-94	Performance of Ground Source Heat Pumps	Table 5.2.10.1.

Table 2.6.1.3. (Continued)

Issuing Agency	Document Number	Document Title	Code Reference
CSA	CAN/CSA-C654-M91	Fluorescent Lamp Ballast Efficacy Measurements	4.2.5.1.(1) 4.2.5.1.(2)
CSA	CAN/CSA-C655-M91	Performance Standard for Internal Water-Loop Heat Pumps	Table 5.2.10.1.
CSA	CAN/CSA-C656-M92	Performance Standard for Single Package Central Air-Conditioners and Heat Pumps (including General Instruction No. 2)	Table 5.2.10.1.
CSA	CAN/CSA-C745-95	Energy Efficiency of Electric Storage Tank Water Heaters and Heat Pump Water Heaters	Table 6.2.2.1.
CSA	C748-94	Performance of Direct-Expansion (DX) Ground-Source Heat Pumps	Table 5.2.10.1.
CSA	CAN/CSA-C861-95	Performance of Compact Fluorescent Lamps and Ballasted Adapters	4.2.1.1.(3)
CSA	CAN/CSA-Z240.2.1-M-92	Structural Requirements for Mobile Homes	9.2.1.1.(1)
CSA	CAN/CSA-Z240.9.1-M-92	Requirements for Load Calculation and Duct Design for Heating and Cooling of Mobile Homes	9.2.1.2.(1)
CTI	201(86)	Certification Standard for Commercial Water Cooling Towers	Table 5.2.10.1.
Govern-ment of Canada	LMB-EG-01-1986	Canadian Regulations Relating to the Inspection of Electricity and Gas Meters and Supplies	7.2.1.1.(1)
NRC		Administrative Requirements for Use with the National Building Code of Canada	1.1.1.1.(1)
NRC		Air Barrier Systems for Houses(1)	3.2.4.1.
NRC		Model National Energy Code of Canada for Buildings 1997	5.1.1.1.(2) 5.1.1.1.(3) 5.3.1.2.(1) 6.1.1.1.(2)
NRC		National Building Code of Canada 1995	1.1.1.1.(1) 1.1.2.3.(1) 1.1.2.3.(2) 1.1.3.2.(1) 2.2.1.1.(1) 3.2.1.1.(1) 3.2.4.1.(1) 5.2.1.1.(1) 5.2.2.1.(1) 5.2.3.1.(2) 5.2.4.1.(1) 5.3.1.1.(2)
NRC		National Plumbing Code of Canada 1995	6.2.1.1.(1)
NRC		Performance Compliance for Houses: Specifications for Calculation Procedures for Demonstrating Compliance to the Model National Energy Code for Houses Using Whole House Performance, 1997	8.2.1.3.(1) 8.2.1.6.(1)

Table 2.6.1.3. (Continued)

Issuing Agency	Document Number	Document Title	Code Reference
NRC		Trade-off Compliance for Houses: Specifications for Calculation Procedures for Demonstrating Compliance to the Model National Energy Code for Houses Using Trade-offs, 1997	3.4.3.2.(1)
U.S. Government		DOE Test Procedures, US Code of Federal Regulations, 10 CFR, Part 430, Subpart B, Appendix E, Uniform Test Method for Measuring the Energy Consumption of Water Heaters (55 FR 42619, October 17, 1990)	Table 6.2.2.1.

Notes to Table 2.6.1.3.:

(1) Scheduled for publication in Spring 1998

Part 3
Building Envelope

Section 3.1. General

3.1.1. Scope

3.1.1.1. Application

1) Except as provided in Sentence (3), this Part applies to the components of the *building envelope* for *buildings* within the scope of this Code.

2) The requirements of this Part also apply to those components of a *building* that separate a *dwelling unit* from an adjoining *storage garage*, even if the *storage garage* is intended to be heated (see Appendix E).

3) This Part does not apply to *dwelling units* that are not equipped with space heating or cooling systems and have no provisions for future installation of such systems (see Appendix E).

3.1.1.2. Compliance

1) The mandatory provisions of Section 3.2. must be satisfied regardless of the compliance path chosen.

2) The prescriptive requirements of Section 3.3. must be satisfied unless the trade-offs permitted in Section 3.4. are used or the *building* energy performance compliance path described in Part 8 is followed.

Section 3.2. Mandatory Provisions

3.2.1. General

3.2.1.1. Construction

1) Components of the *building envelope* shall be constructed in accordance with the appropriate provincial, territorial or municipal *building* regulations or, in the absence of such regulations, or where components of the *building envelope* are not covered by such regulations, with the National Building Code of Canada.

3.2.1.2. Continuity of Insulation

1) Except as provided in Sentences (2) to (9), interior components that meet components of the *building envelope* and major structural members that partly penetrate the *building envelope* shall not break the continuity of the insulation and shall not reduce the *effective thermal resistance* at their projected area to less than that required in Section 3.3. (see Appendix E).

2) In calculating the thermal resistance of assemblies for purposes of comparison with the prescriptive requirements in Section 3.3., the thermal bridging effect of closely-spaced, repetitive structural members such as studs and joists, and of ancillary members such as lintels, sills and plates, shall be accounted for as described in Appendices B and C.

3) In calculating the thermal resistance of assemblies for purposes of comparison with the prescriptive requirements in Section 3.3., pipes, ducts, equipment with through-the-wall venting, packaged terminal air-conditioners or heat pumps, shelf angles, anchors and ties and associated fasteners, and other minor structural members that must completely penetrate the *building envelope* to perform their intended function need not be taken into account provided that the insulation is installed tight against the outline of the penetration.

4) In calculating the thermal resistance of assemblies for purposes of comparison with the prescriptive requirements in Section 3.3., major structural penetrations, such as floor and roof decks, balcony slabs, beams, columns and other structural members that must completely penetrate the *building envelope* to perform their intended function need not be taken into account, provided that

a) the insulation is installed tight against the outline of the penetration, and
b) the sum of the cross-sectional areas at such major structural penetrations is limited to a maximum of 2% of the above-ground *building envelope* area.

5) Where a *foundation* wall, *firewall* or *party wall* built of concrete or masonry penetrates an exterior wall or insulated roof or ceiling and breaks the continuity of the *building envelope*, it shall be insulated

a) on both of its sides inward from the *building envelope* for a distance equal to 4 times the uninsulated thickness of the penetrating wall, and
b) to an *effective thermal resistance* no less than that required for the exterior wall.

6) Except as provided in Sentence (4), where a floor other than a floor on ground intersects an exterior wall, the intersection shall be insulated to the same nominal level of insulation as the wall above the floor.

7) Except as provided in Sentence (4), where a roof other than an *attic*-type roof intersects an exterior wall, the intersection shall be insulated to the same nominal level of insulation as the wall below the roof.

8) Where part of a component of a *building envelope* meets another portion where the planes of insulation do not physically join, the 2 expanses of insulation shall be lapped for a distance of at least 4 times the distance separating the planes of insulation (see Appendix E).

9) Except as provided in Article 9.2.1.2., pipes and ducts that partly penetrate the *building envelope* shall be located on the warm side of the insulation and shall not reduce the *effective thermal resistance* at the projected area of the pipe or duct to less than that required in Section 3.3.

10) Except as provided by Sentence (8), joints between components of the *building envelope*, such as expansion or construction joints, or joints between walls and doors or windows or other glazed areas, shall be insulated in a manner that provides continuously across such joints an *effective thermal resistance* no less than the lesser of the 2 required for the components (see Appendix E).

3.2.2. Above-ground Components of the Building Envelope

3.2.2.1. Roofs

1) Roof assemblies shall be considered to include all related structural framing.

2) A ceiling assembly shall be considered to constitute part of the related roof assembly and the entire assembly shall be insulated at either the ceiling level or the roof level or both, as dictated by good practice, in order to achieve the required *effective thermal resistance.*

3) For sloped *attic*-type roofs, the *effective thermal resistance* may be reduced to the extent made necessary by the roof slope and ventilation clearances, but in no case shall it be less than that required for the exterior wall below (see Appendix E).

3.2.2.2. Walls

1) Wall assemblies shall be considered to include all related structural framing and perimeter areas of intersecting interior walls for purposes of determining the *effective thermal resistance* permitted, but shall not include the perimeter areas of floors or roofs (see Appendix E).

3.2.3. Building Assemblies in Contact With the Ground

3.2.3.1. Walls

1) Where a wall in contact with the ground is constructed of hollow core masonry and is insulated on its interior surface, the wall shall be insulated over its full height or its cells must be sealed at the level of the bottom part of the insulation (see Appendix E).

3.2.4. Airtightness

3.2.4.1. General

1) Air barrier systems shall be provided in accordance with the appropriate provincial, territorial or municipal *building* regulations or, in the absence of such regulations, or where air barrier systems are not covered by such regulations, with Section 9.25. of the National Building Code of Canada.

2) Except as provided in Sentence (3), any location where there is a possibility of air leakage into or out of a heated space through the *building envelope* shall be caulked, gasketed or otherwise sealed in accordance with good practice such as that described in “Air Barrier Systems for Houses,” published by the Canadian Commission on Building and Fire Codes (see Appendix E).

3) A *building envelope* that is constructed so that its normalized leakage area does not exceed 2.0 cm^2/m^2 when tested in accordance with CAN/CGSB-149.10, “Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method,” need not comply with Sentence (2) (see Appendix E).

3.2.4.2. Windows

1) Windows shall comply with the relevant federal, provincial or territorial appliance or equipment energy-efficiency act or, in the absence of such an act, or where windows are not covered by such an act, windows other than those meeting the *energy rating* (ER) requirement of Sentence 3.3.1.3.(1) shall comply with at least the A2 air leakage classification of CAN/CSA-A440-M, “Windows.”

3.2.4.3. Doors

1) Except as provided in Sentence (2), exterior swing-type door assemblies other than those meeting the *energy rating* (ER) requirement of Clause 3.3.1.4.(1)(a) shall

a) be designed to limit the rate of air leakage to no more than 0.82 L / s for each metre of door crack when tested in conformance with ASTM E 283, "Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen," at a static air pressure difference of 75 Pa, or

b) be weather-stripped on all edges.

2) Insulated steel doors prehung in a wood or steel *frame* other than those meeting the *energy rating* (ER) requirement of Clause 3.3.1.4.(1)(a) shall conform to the air leakage requirements of CAN / CGSB-82.5-M, "Insulated Steel Doors."

3) Garage doors that separate heated garages from unheated space or the exterior shall be weather-stripped on all edges.

3.2.4.4. Fireplace Doors

1) Fireplaces shall be equipped with doors or enclosures to restrict air movement in the chimney when the fireplace is not in use.

Section 3.3. Prescriptive Compliance

3.3.1. Above-ground Components of the Building Envelope

3.3.1.1. Thermal Characteristics of Opaque Components of the Building Envelope

1) Except as provided in Sentences (3) and (4) and in Articles 3.3.1.2. and 9.2.1.1., the *effective thermal resistance* of above ground *opaque components* of the *building envelope* shall be not less than that shown in Table A-3.3.1.1. of Appendix A for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* enclosed by the component (see Appendix E).

2) For the purpose of the requirements of Sentence (1), wall assemblies inclined less than 60° from horizontal are considered to be roof assemblies, and roof assemblies inclined 60° or more from horizontal are considered to be wall assemblies.

3) Portions of a *foundation* wall that are above ground, where the top of a *foundation* wall is less than 1.2 m above the adjoining ground level, shall be insulated to the levels required by Sentence 3.3.2.1.(1).

4) Where radiant heating cables, pipes or membranes are embedded in the surface of an above-ground component of the *building envelope*, that component shall have an *effective thermal resistance* 20% greater than that required by Sentence (1) (see Appendix E).

3.3.1.2. Thermal Characteristics of Log Walls

(See Appendix E.)

1) Where round-scribed log walls are installed with no interior or exterior finish that incorporates insulation or creates a space that could accommodate insulation, such walls need not comply with the *effective thermal resistance* requirements of Article 3.3.1.1., provided the mean diameter of each log is at least 300 mm.

2) Where rectangular-milled log walls are installed with no interior or exterior finish that incorporates insulation or creates a space that could accommodate insulation, such walls need not comply with the *effective thermal resistance* requirements of Article 3.3.1.1., provided the mean thickness of each log is at least 150 mm.

3.3.1.3. Thermal Characteristics of Windows and Other Glazed Areas

1) Except as provided in Article 9.2.1.1., windows and sliding glass doors that are within the scope of CSA Standard A440.2, "Energy Performance Evaluation of Windows and Sliding Glass Doors," shall have a label indicating an *energy rating* (ER) not less than shown in Table A-3.3.1.3. of Appendix A for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* enclosed by the component (see Appendix E).

2) For windows and other glazed areas not included in Sentence (1) and except as provided in Sentence (3) and Article 9.2.1.1., the *overall thermal transmittance* of the whole assembly including *frame,* as measured according to Article 2.2.2.9., shall not exceed that shown in Table A-3.3.1.3. of Appendix A for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* enclosed by the component (see Appendix E).

3) Where the *skylight-to-roof ratio* does not exceed 2%, *skylights* need not comply with Sentence (2), provided that

a) they are at least double-glazed and their *frames*, if metallic, are provided with *thermal breaks,* or

b) they have an *overall thermal transmittance* of not more than 3.4 W/m^2·°C (see Appendix E).

3.3.1.4. Doors and Access Hatches

1) Except as provided in Sentences (2) to (4), swinging doors that separate heated space from unheated space or the exterior and are within the scope of CSA Standard A453, "Energy Performance Evaluation of Swinging Doors," shall have a label indicating

a) an *energy rating* (ER) of not less than -20, or

b) an *overall thermal transmittance* of not more than 1.2 W/m^2·°C, or

c) where protected by a storm door, an *energy rating* (ER) of not less than -27, or an *overall thermal transmittance* of not more than 1.5 W/m^2·°C.

2) In any *dwelling unit*, one door that separates heated space from unheated space or the exterior and that does not comply with Sentence (1) is permitted, provided that its *overall thermal transmittance* is not more than 2.6 W/m^2·°C (see Appendix E).

3) Storm doors need not comply with Sentences (1) and (2).

4) Garage doors that separate heated space from unheated space or the exterior shall have a nominal thermal resistance of no less than 0.38 m^2·°C/W.

5) Access hatches from heated space to unheated space such as an *attic* or a crawl space shall be insulated to a level equivalent to that required for the component of the *building envelope* in which they are installed.

3.3.1.5. Total Area of Windows and Other Glazed Areas

1) Subject to the provisions of Sentences (2) and (3), the total exposed surface area of windows and other glazed areas that separate heated space from unheated space or the exterior, as determined in accordance with Article 2.2.2.9., shall not exceed 20% of the *floor surface area* of the *building*, where the *floor surface area* is calculated, excluding:

(a) *storage garages*,

(b) rooms or spaces with less than 2.1 m clear height,

(c) rooms or spaces with less than 20% of their exterior wall area above ground.

2) Except as provided in Sentence (3), the area of clear glass or other glazing material that has a *solar heat gain coefficient* of more than 0.61, that is unshaded at noon on December 21 and that faces a direction within 45° of due South, may be assumed to count as 50% of its unshaded area in calculating the maximum area of glass in Sentence (1), provided the *building* is designed so that it is capable of distributing the solar heat gain from such glazed areas throughout the *building* (see Appendix E).

3) Sentence (2) does not apply where the *building* is designed to be *cooled* in summer, unless that glass or other glazing material is also shaded at noon on June 21 with exterior devices (see Appendix E).

3.3.1.6. Effect of an Unheated Space

1) Where a component of the *building envelope* separates heated space from an enclosed unheated space, such as a sun porch, enclosed veranda or vestibule, the unheated enclosure may be considered to provide a thermal resistance of 0.16 m^2·°C/W or the equivalent of one layer of glass (see Appendix E).

3.3.2. Building Assemblies in Contact With the Ground

3.3.2.1. Walls

1) Except as provided in Sentence (2), the *effective thermal resistance* of walls that are below the exterior ground level and that separate heated space from the ground shall be not less than that shown in Table A-3.3.2.1. of Appendix A for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* enclosed by the component.

2) Where radiant heating cables, pipes or membranes are embedded in the surface of a wall that is below the exterior ground level and that separates heated space from the ground, that wall shall have an *effective thermal resistance* 20% greater than that required by Sentence (1) (see Appendix note E-3.3.1.1.(4)).

3) Except as provided in Sentences (4) and (6), the insulation required in Sentence (1) shall extend to a depth below the exterior ground level not less than that determined from Table A-3.3.2.1. of Appendix A for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* enclosed by the component, or to the floor of the space, whichever is less (see Appendix E).

4) Except as provided in Sentence (5), where the interior side of a wall that is below the exterior ground level and that separates heated space from the ground is finished over its full height with a wall-covering material, the wall shall be insulated to the floor of the space.

5) Insulation in walls described in Sentence (4) does not need to extend more than 2.4 m below the exterior ground level.

6) Where the depth at the top of the footing is less than 0.6 m below the exterior ground level, wall insulation shall extend down to the top of the footing and the same level of insulation shall be placed on the top or bottom surface of the floor for a distance not less than 1 m from the perimeter.

3.3.2.2. Floors

(See Appendix E.)

1) The *effective thermal resistance* of floors separating heated space from the ground that are less than 0.6 m below *grade* and of all floors with imbedded heating ducts, cables or pipes shall be not less than that shown in Table A-3.3.2.1. of Appendix A for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* enclosed by the component.

2) Except as otherwise noted in the relevant Table A-3.3.2.1. of Appendix A, floors on ground with no imbedded heating ducts, cables or pipes and required to be insulated shall have insulation placed:

a) on their top or bottom surface for a distance of not less than 1 m from their perimeter or over their full area, as shown in Table A-3.3.2.1. of Appendix A for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* enclosed by the component, or

b) for suspended wood floors or wood sleeper floors directly on ground, as shown in Table A-3.3.2.1. of Appendix A for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* enclosed by the component,

   i) vertically around their perimeters and horizontally on the ground for a distance not less than 1 m from their perimeter, or

   ii) over their full area.

3) Floors on ground with imbedded heating ducts, cables or pipes and required to be insulated shall have insulation placed under their full bottom surface.

4) Except where the wall insulation is placed on the outside of the *foundation* wall and extends down to the level of the bottom of the floor, floors on ground required to be insulated shall have their insulation extended vertically around their perimeter so as to reduce heat losses from the slab to the *foundation* wall.

Section 3.4. Trade-offs

(See Appendix note E-2.1.1.2.)

3.4.1. General

3.4.1.1. Treatment of Log Walls

1) For the purpose of trade-off calculations described in this Section, the required *effective thermal resistance* values for log walls that are installed with no interior or exterior finish that incorporates insulation or creates a space that could accommodate insulation shall be taken as

a) 2.0 $m^2 \cdot {}^\circ C/W$ for round-scribed log walls, and

b) 1.3 $m^2 \cdot {}^\circ C/W$ for rectangular-milled log walls.

2) Benefits in trade-off calculations due to increases in the thickness of log walls beyond the minimums required in Article 3.3.1.2. shall be limited to the amount by which the increase makes the *effective thermal resistance* of the log walls greater than the minimum *effective thermal resistance* required for other types of walls in Article 3.3.1.1.

3.4.1.2. Treatment of Windows and Doors

(See Appendix E.)

1) For the purpose of trade-off calculations described in this Section, *effective thermal resistances* for doors and windows and other glazed areas shall be calculated as follows:

a) for operable windows and non-operable windows in a *sash*, covered under Sentence 3.3.1.3.(1),

$$R_w = 22/(32 - ER_o)$$

b) for windows with fixed glazing, sealed in a *frame* without a *sash*, covered under Sentence 3.3.1.3.(1),

$$R_w = 22/(45 - ER_f)$$

c) for windows covered under Sentence 3.3.1.3.(2),

$$R_w = 1/U_w$$

d) for doors covered under Sentence 3.3.1.4.(1),

$$R_d = 1/U_d$$

where

R_w = *effective thermal resistance* for windows, $(m^2 \cdot °C)/W$,
R_d = *effective thermal resistance* for doors, $(m^2 \cdot °C)/W$,
ER_o = *energy rating* for operable windows, W/m^2,
ER_f = *energy rating* for fixed windows, W/m^2,
U_w = *overall thermal transmittance* of window, $W/(m^2 \cdot °C)$, and
U_d = *overall thermal transmittance* of door, $W/(m^2 \cdot °C)$.

3.4.1.3. Limitations

1) Trade-off calculations described in this Section shall be subject to the limitations described in Sentences (2) to (5).

2) The *effective thermal resistance* of above-ground *opaque components* of the *building envelope* shall not be reduced to less than

a) 75% of that required in Section 3.3., for above-ground walls other than log walls and for joist-type roofs, and
b) 60% of that required in Section 3.3., for other *opaque components* of the *building envelope*.

3) The *effective thermal resistance* of components of the *building envelope* that have radiant heating cables, pipes or membranes embedded in them shall not be reduced to less than the *effective thermal resistance* required by Sentences 3.3.1.1.(4), 3.3.2.1.(2) and 3.3.2.2.(1).

4) Doors covered in Sentences 3.3.1.4.(2) to (4) shall not be the subject of trade-off calculations.

5) Where construction techniques are used that are more thermally efficient than those permitted in the mandatory provisions of Section 3.2., the extra performance over the mandatory provisions shall not be used in trade-off calculations (see Appendix E).

3.4.1.4. Treatment of Additions

1) In calculating trade-offs for an *addition*, it is not permitted to take into account improvements being made to existing components of the *building* (see also Sentence 2.2.2.9.(6) and Appendix E).

3.4.2. Simple Trade-offs

3.4.2.1. Above-ground Components of the Building Envelope

1) Except as limited in Subsection 3.4.1., the *effective thermal resistance* of one or more above-ground components of the *building envelope* of a single *building* is permitted to be less than required in Section 3.3., provided the *effective thermal resistance* of one or more other above-ground components of the *building envelope* is increased, so that the sum of the areas of all above-ground components of the *building envelope* divided by their respective *effective thermal resistances* is not more than it would be if all components were to comply with Section 3.3.

3.4.3. Computer-assisted Trade-offs

3.4.3.1. Components of the Building Envelope

1) Subject to the limitations of Subsection 3.4.1. and Sentence (2), the thermal characteristics of one or more components of the *building envelope* of a single *building* is permitted to be less energy-efficient than otherwise required in this Part and the area of windows is permitted to be more than the maximum allowed in Article 3.3.1.5., provided it is demonstrated, using computer software conforming to Article 3.4.3.2., that the *building* will not use more energy than it would if all components were to comply with Section 3.3. (see Appendix E).

2) This type of trade-off calculation may only be carried out where

a) all walls and windows of the *building* are vertical, and
b) the total area of *skylights* is no greater than 2% of the total roof area, including *skylights*.

(See Appendix E.)

3.4.3.2. Compliance Software

1) Evaluation of compliance with Article 3.4.3.1. shall be done using computer software that conforms to specifications detailed in "Trade-off Compliance for Houses: Specifications for Calculation Procedures for Demonstrating Compliance to the Model National Energy Code for Houses Using Trade-offs," published by the Canadian Commission on Building and Fire Codes.

Section 3.5. Building Energy Performance Compliance

(See Appendix note E-2.1.1.2.)

3.5.1. Alternate Compliance Path

3.5.1.1. Non-compliance with Prescriptive Requirements

1) Where the *building envelope* does not comply with the requirements of Sections 3.3. or 3.4., it shall be demonstrated, using the procedures described in Part 8, Building Energy Performance Compliance, that the *building* will not use more energy than it would if the *building envelope* did comply with Sections 3.3. or 3.4.

Part 4
Lighting

Section 4.1. General

4.1.1. Scope

4.1.1.1. Application

1) This Part applies to lighting for *buildings* within the scope of this Code, including
a) lighting in interior spaces,
b) lighting of *building* exteriors and exterior areas of *buildings* such as *exterior entrances* and *exterior exits*, and
c) lighting for grounds, parking and other common exterior areas of *multiple-unit residential buildings* or *building* complexes.

4.1.1.2. Compliance

1) The mandatory provisions of Section 4.2. must be satisfied regardless of the compliance path chosen.

Section 4.2. Mandatory Provisions

4.2.1. Exterior Lighting Power

(See Appendix E.)

4.2.1.1. High-efficacy Exterior Lighting for Common Areas

1) Except as provided in Sentence (2), lamps for *exterior lighting* serving common areas of *multiple-unit residential buildings* or *building* complexes shall have an initial *luminous efficacy* of not less than 40 lm/W, determined according to accepted good practice.

2) Lamps for *exterior lighting* described in Sentence (1) need not comply with Sentence (1) where
a) the lighting is *landscape lighting*, or
b) power limits are specified in Article 4.2.1.2.

3) Efficacy of compact fluorescent lamps shall be determined according to CAN/CSA-C861, "Performance of Compact Fluorescent Lamps and Ballasted Adapters."

4.2.1.2. Exterior Lighting Power for Common Areas

1) Except as provided in Sentence (2), lighting shall comply with the maximum power densities specified in Table 4.2.1.2., where that lighting is
a) lighting for common *exterior exits* and *exterior entrances* of *multiple-unit residential buildings*, and
b) *facade lighting* of *multiple-unit residential buildings*.

Table 4.2.1.2.
Lighting Power Limits for Exits, Entrances and Facades
Forming Part of Sentence 4.2.1.2.(1)

Area Description	Maximum Power Density		
	W/lin m of threshold	W/m²	
		of canopied area	of facade surface area
Exterior exit with or without canopy	82.0	-	-
Exterior entrance			
without canopy	98.0	-	-
with canopy	-	43.0	-
Facade lighting	-	-	2.4

2) *Exterior entrances* or *exterior exits* identified either by local ordinances or regulations, or by security or safety officials, as requiring additional lighting for safety or security reasons need not comply with Sentence (1).

3) The facade surface area referred to in Table 4.2.1.2. is that delimited by the projection of the facade onto a vertical plane parallel to the facade.

4.2.2. Exterior Lighting Controls

4.2.2.1. Exterior Lighting Controls for Common Areas

1) Except as provided in Sentence (2), *exterior lighting* for *multiple-unit residential buildings* or *building* complexes shall be controlled by
- a) lighting schedule controllers,
- b) photocells, or
- c) a combination of lighting schedule controllers and photocells.

2) *Exterior lighting* need not be controlled as described in Sentence (1) where the lighting is intended for 24-h continuous use.

3) Lighting schedule controllers required in Sentence (1) shall be of the automatic type or otherwise capable of being programmed for 7 days and for seasonal daylight schedule variations.

4.2.2.2. Exterior Lighting Controls for Individual Dwelling Units

1) *Exterior lighting* fixtures serving individual *dwelling units* shall be controlled by
- a) photocells, and
- b) timers, with or without a manual override, or motion detectors.

(See Appendix E.)

4.2.3. Interior Lighting Power

4.2.3.1. Exit Signs

1) Power requirements for lighting units for *exit* signs shall not exceed 22 W per *exit* sign.

4.2.3.2. Lighting Power in Dwellings

1) Lighting within *dwelling units* is exempt from allowances and limits on *interior lighting* power (see Appendix E).

4.2.3.3. Interior Lighting Power for Common Areas

1) The power densities for *interior lighting* in common areas shall not exceed the limits provided in Table 4.2.3.3.

Table 4.2.3.3.
Interior Lighting Power Limits for Common Areas
Forming Part of Article 4.2.3.3.

Area Description	Power Limits, W/m^2
Corridor	8.6
Electrical/Mechanical equipment room	
General	7.5
Control rooms	16.2
Lobby	
Reception and waiting areas	10.8
Elevator lobbies	8.6
Stairs	
Active traffic	6.5
Emergency exit	4.3
Indoor parking	3.2

4.2.4. Interior Lighting Controls

4.2.4.1. Requirement for Controls

1) Except as provided in Sentence (2), *interior lighting* shall be provided with manual, automatic, or programmable controls.

2) Controls are not required where
- a) continuous lighting is required for safety or security purposes, or
- b) lighting is emergency or *exit* lighting.

3) Each space enclosed by walls or ceiling-height *partitions* shall be provided with one or more controls that are capable of turning off all the hard-wired lights within the space.

4) At least one control shall be installed on each circuit.

4.2.4.2. Location of Controls

1) Except as provided in Sentence (2), lighting controls shall be
- a) located next to the main entrance or entrances to the room or space whose lighting is controlled by those controls,
- b) located such that there is a clear line of sight from the control to the area lighted, and
- c) readily accessible to persons occupying or using the space.

2) Lighting controls may be centralized in remote locations where
- a) controls are automatic,
- b) controls are programmable,
- c) controls require trained operators, or
- d) it is desirable, for security or safety reasons, that lighting be under the control of staff or *building* management.

3) Except as provided in Sentence (4), where lighting controls are grouped, each control shall be identified to indicate the area controlled.

4) Lighting controls need not comply with Sentence (3) where they are located within a *dwelling unit*.

4.2.5. Ballasts

4.2.5.1. Fluorescent Lamp Ballasts

1) Except as provided in Sentence (3), fluorescent lamp ballast types within the scope of CAN/CSA-C654-M, "Fluorescent Lamp Ballast Efficacy Measurements," shall conform to that standard.

2) Except as provided in Sentence (3), electronic fluorescent lamp ballasts within the scope of ANSI C82.11, "High-Frequency Fluorescent Lamp Ballasts," but not within the scope of CAN/CSA-C654-M, "Fluorescent Lamp Ballast Efficacy Measurements," shall conform to the ANSI C82.11 standard.

3) Fluorescent lamp ballasts shall comply with the relevant federal, provincial or territorial appliance or equipment energy-efficiency act.

Part 5
Heating, Ventilating and Air-conditioning Systems

Section 5.1. General

5.1.1. Scope

5.1.1.1. Application

1) This Part applies to heating, ventilating and air-conditioning systems and equipment serving a single *dwelling unit*.

2) Where a system is intended to serve more than one *dwelling unit*, it shall comply with the requirements of the Model National Energy Code for Buildings.

3) Systems and equipment of types or sizes not covered by standards referenced in Table 5.2.10.1. shall conform to the requirements of Part 5 of the Model National Energy Code for Buildings.

4) This Part does not apply to the existing components of systems that are extended to serve *additions*.

5.1.1.2. Compliance

1) The mandatory provisions of Section 5.2. must be satisfied regardless of the compliance path chosen.

2) The prescriptive requirements of Section 5.3. must be satisfied unless the *building* energy performance compliance path described in Part 8 is followed.

Section 5.2. Mandatory Provisions

5.2.1. Equipment Sizing

5.2.1.1. Load Calculations

1) Heating, ventilating and air-conditioning systems shall be sized to meet the needs of the *building* in which they are installed, in accordance with the relevant provincial, territorial or municipal *building* regulations or, in the absence of such regulations, or where heating, ventilating and air-conditioning systems are not covered by such regulations, with the National Building Code of Canada (see Appendix E).

5.2.2. Air Distribution Systems

5.2.2.1. Design and Installation of Ducts

1) Ducts shall be designed and installed in accordance with the relevant provincial, territorial or municipal *building* regulations or, in the absence of such regulations, or where ducts are not covered by such regulations, with the National Building Code of Canada (see Appendix E).

5.2.2.2. Provision for Balancing

1) All branch *supply ducts* shall be equipped with diffusers with adjustable balance stops or with adjustable dampers that are fitted with devices to indicate the position of the dampers.

5.2.2.3. Duct and Plenum Insulation

1) Except as provided in Sentence (2) and Article 9.2.1.2., and except for *exhaust ducts*, all ducts and *plenums* forming part of a heating, ventilating or air-conditioning system and located outside the *building envelope* shall be sealed and insulated to the same level as required for exterior walls in Subsection 3.3.1.

2) Factory-installed *plenums*, or ducts furnished as part of equipment tested and rated in accordance with Subsection 5.2.10., need not comply with Sentence (1), provided they are insulated to a thermal resistance of at least 0.58 $m^2 \cdot {}^\circ C/W$.

3) Ducts referred to in Sentences (1) and (2) and carrying untempered outside air shall be provided with vapour barrier protection.

5.2.2.4. Protection of Duct Insulation

1) Duct insulation located in areas where it may be subject to mechanical damage or weathering shall be protected.

5.2.3. Air Intake and Outlet Dampers

5.2.3.1. Required Dampers

1) Except as provided in Sentences (3) and (4), every duct or opening intended to discharge air to the outdoors shall be equipped with a motorized damper or gravity or spring-operated backflow damper.

2) Except as provided in Sentences (3) and (4) and except in regions that have fewer than 3500 degree-days (°C) as listed in Appendix C of the National Building Code of Canada, every outside air intake duct or air intake opening shall be equipped with a motorized damper.

3) Where dampers are not permitted by other regulations, air intakes and outlets need not comply with Sentences (1) and (2).

4) Air intakes and outlets serving systems required to operate continuously need not comply with Sentences (1) and (2).

5.2.4. Piping for Heating and Cooling Systems

5.2.4.1. Design and Installation of Piping

1) Piping shall be designed and installed in accordance with the relevant provincial, territorial or municipal *building* regulations or, in the absence of such regulations, or where piping is not covered by such regulations, with the National Building Code of Canada (see Appendix E).

5.2.4.2. Provision for Balancing

1) All hydronic systems shall be designed so that they can be balanced.

5.2.4.3. Piping Insulation

1) Except for high-temperature refrigerant piping, all piping forming part of a heating, ventilating or air-conditioning system and located outside the *building envelope* shall be insulated to a thermal resistance of at least 1.5 $m^2\cdot°C/W$.

5.2.4.4. Protection of Piping Insulation

1) Piping insulation located in areas where it may be subject to mechanical damage or weathering shall be protected.

5.2.5. Equipment Installed Outdoors

5.2.5.1. Manufacturer's Designation

1) Equipment installed outdoors or in an unheated space shall be designated by the manufacturer for such installation.

5.2.6. Electric Heating Systems

5.2.6.1. Electric Resistance Heater Units

1) Electric heaters of the baseboard type shall be controlled by remotely mounted thermostats.

5.2.6.2. Line-voltage Thermostats

1) Line-voltage thermostats used to control electric resistance heater units shall conform to CSA Standard C273.4-M, "Performance Requirements for Electric Heating Line-Voltage Wall Thermostats."

5.2.7. Recessed Heaters

5.2.7.1. Insulation Behind Recessed Heaters

1) Recessed heaters that partly penetrate the *building envelope* shall be located on the warm side of the insulation and shall not reduce the *effective thermal resistance* at the projected area of the heater to less than that required in Section 3.3. (see Appendix E).

5.2.8. Temperature Controls

5.2.8.1. Thermostatic Controls

1) The supply of heating and cooling energy to each *dwelling unit* shall be controlled by at least one thermostatic control that responds to temperature within the heated space.

2) Thermostatic controls for comfort heating shall be capable of adjusting the temperature of the space they serve down to at least 13°C.

3) Thermostatic controls for comfort cooling shall be capable of adjusting the temperature of the space they serve up to at least 29°C.

4) Where heating and cooling are controlled by separate thermostatic controls, means shall be provided to prevent these controls from simultaneously calling for heating and cooling.

5) Controls required by Sentence (1) shall be designed so that lowering a heating thermostat setpoint will not cause energy for cooling to be expended to reach the lowered setting, and raising a cooling thermostat setpoint will not cause energy for heating to be expended to reach the raised setting.

6) Sensors of wall-mounted thermostats shall be installed in accordance with manufacturer's instructions and located

a) between 1400 and 1500 mm above the floor,

b) on interior *partitions* or walls, or on exterior walls where a minimum *effective* *thermal resistance* of 3.5 m^2·°C / W is provided between the sensor and outdoors,

c) away from direct exposure to sunlight and heat-producing sources, and

d) away from draughts or dead pockets of air.

(See Appendix E.)

5.2.8.2. Reduction of Heating to Individual Rooms

1) Means shall be provided to reduce the heating of each room by automatic devices, or by means of manually operated dampers, valves or switches, as appropriate for the heating system used.

5.2.8.3. Heat Pump Controls

1) Heat pumps equipped with supplementary heaters shall incorporate controls to prevent supplementary heater operation when the heating load can be met by the heat pump alone, except during defrost cycles.

2) Heat pumps equipped with a programmable thermostat shall be equipped with setback controls that provide temporary suppression of electrical backup or adaptive anticipation of the recovery point, in order to prevent the unit from resorting to supplementary heat at the time of recovery (see Appendix E).

5.2.9. Humidification

5.2.9.1. Humidification Controls

1) If a system is equipped with a means for adding moisture to maintain specific humidity levels, an automatic humidity control device shall be provided.

2) Humidistats required by Sentence (1) shall be capable of being set down to 30% relative humidity.

5.2.10. Equipment Efficiency

5.2.10.1. Unit and Packaged Equipment

1) Heating, ventilating or air-conditioning equipment and components that are included in the scope of a standard referenced in Table 5.2.10.1. shall comply with the relevant federal, provincial or territorial appliance or equipment energy-efficiency act or, in the absence of such an act or where equipment is not covered by such an act, with the relevant standard in Table 5.2.10.1. (see Appendix E).

Table 5.2.10.1.
Heating, Ventilation and Air Conditioning Equipment Performance Standards
Forming Part of Sentence 5.2.10.1.(1)

<table>
<tr><th>Component</th><th>Cooling Capacity</th><th>Standard</th><th>Rating Conditions</th><th>Minimum Performance</th></tr>
<tr><td colspan="5">Air-cooled Unitary Air-conditioners and Heat Pumps — Electrically operated (Except Room Air-conditioners)</td></tr>
<tr><td>Split-system</td><td>≤ 19 kW</td><td>CAN/CSA-C273.3-M (including General Instruction No. 4)</td><td rowspan="2"></td><td rowspan="2">in Standard</td></tr>
<tr><td>Single package</td><td>≤ 19 kW</td><td>CAN/CSA-C656-M (including General Instruction No. 2)</td></tr>
</table>

Table 5.2.10.1. (Continued)

Component	Cooling Capacity	Standard	Rating Conditions	Minimum Performance
Water-cooled Unitary Air-conditioners and Heat Pumps — Electrically operated				
Ground/water-source heat pumps	< 35 kW	CAN/CSA-C446		in Standard
Internal water-loop heat pumps	< 40 kW	CAN/CSA-C655-M		
Water-cooled air-conditioners	< 19 kW	ARI 210/240, CTI 201	Indoor air 80°F db/67°F wb (26.7°C db/ 19.4°C wb) Entering water 85°F (29.4°C)	EER = 9.3(1)
			Entering water 75°F (23.9°C)	IPLV = 8.3(2)
Direct-expansion Ground-source Heat Pumps — Electrically operated				
Direct-expansion ground-source heat pumps	≤ 21 kW	CSA C748		in Standard
Room Air-conditioners and Room Air-conditioners/Heat Pumps				
Without reverse cycle	< 10.55 kW	CAN/CSA-C368.1-M		in Standard
With reverse cycle with louvered sides without louvered sides		ANSI/AHAM RAC-1		 EER = 8.5(1) EER = 8.0(1)
Boilers				
Gas-fired *boilers*,(3) ≤ 117.23 kW		CGA 4.9		in Standard
Oil-fired *boilers*, ≤ 88 kW		CSA B212		
Warm-air Furnaces, Combination Warm-air Furnaces/Air-conditioning Units, Duct Furnaces and Unit Heaters				
Gas-fired warm-air *furnaces*,(3) ≤ 117.23 kW		CAN/CGA-2.3-M		in Standard
Gas-fired duct *furnaces*,(3) ≤ 117.23 kW		CGA 2.8-M		
Gas-fired *unit heaters*,(3) ≤ 117.23 kW		CAN/CGA-2.6-M		
Oil-fired warm-air *furnaces*, ≤ 66 kW		CSA B212		
Oil-fired duct *furnaces* and *unit heaters*		CSA B140.4		

Notes to Table 5.2.10.1.:

(1) EER is the *energy efficiency ratio* in Btu/(h·W) (no metric equivalent)
(2) IPLV is the *integrated part-load value* (no units)
(3) Includes propane

5.2.10.2. Field-assembled Equipment and Components

1) When components from more than one manufacturer are used as parts of heating, ventilating or air-conditioning equipment, the system shall be designed in accordance with good engineering practice, based on component efficiency data provided by the component manufacturers, to provide the overall efficiency called for in Article 5.2.10.1.

5.2.10.3. Service Water Heating Equipment Used for Space Heating

1) *Service water* heating equipment used to provide space heating solely or in combination with *service water* heating shall comply with the relevant federal, provincial or territorial appliance or equipment energy-efficiency act or, in the absence of such an act or where equipment is not covered by such an act, with the standard in Table 6.2.2.1. that is relevant to that piece of equipment.

Section 5.3. Prescriptive Compliance

5.3.1. Heat Recovery

5.3.1.1. Heat Recovery in Dwelling Units

1) Except as provided in Article 9.2.1.2., where a self-contained mechanical ventilation system is used to serve a single *dwelling unit* and where required in Table A-5.3.1.1. of Appendix A for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* ventilated by the equipment, the principal exhaust component of such a ventilation system shall be equipped with heat-recovery capability (see Appendix E).

2) Heat-recovery ventilators used to meet the requirements of Sentence (1) shall have a sensible heat-recovery efficiency, determined in conformity with the low temperature thermal and ventilation test method described in CAN/CSA-C439, "Standard Methods of Test for Rating the Performance of Heat-Recovery Ventilators,"
a) of at least 65% at an outside air (Station 1) test temperature of 0°C, and
b) of not less than that required in Table 5.3.1.1. for the 2.5% January design temperature for the *building* location, as listed in Appendix C, Climatic Information for Building Design in Canada, of the National Building Code of Canada.
(See Appendix E.)

Table 5.3.1.1.
Performance of Heat-recovery Ventilators
Forming Part of Sentence 5.3.1.1.(2)

2.5% January Design Temperature at *Building* Location	Outside Air Test Temperature at Station 1, °C	Sensible Heat-recovery Efficiency, %
≥ -10	0	65
< -10 and > -30	-25	55
≤-30	-40	45

3) The tests described in Sentence (2) shall be performed at the rated air flow for continuous operation of the equipment, which meets the principal exhaust component of the ventilating system referred to in Sentence (1).

4) Where a form of heat recovery other than a heat-recovery ventilator is used to meet the requirements of Sentence (1), the alternate system shall have a heat-recovery performance equivalent to that required in Sentence (2) for heat-recovery ventilators.

5.3.1.2. Heat Recovery in Swimming Pools

1) Systems that exhaust air from swimming pools within heated spaces shall conform to the requirements of Article 5.3.4.1. of the Model National Energy Code for Buildings.

Section 5.4. Building Energy Performance Compliance

5.4.1. Alternate Compliance Path

5.4.1.1. Non-compliance with Prescriptive Requirements

1) Where the heating system does not comply with the requirements of Section 5.3., it shall be demonstrated, using the procedures described in Part 8, Building Energy Performance Compliance, that the *building* will not use more energy than it would if the heating system did comply with Section 5.3.

Part 6
Service Water Heating Systems

Section 6.1. General

6.1.1. Scope

6.1.1.1. Application

1) This Part applies to *service water* heating systems intended specifically for application to a single *dwelling unit* within a *building.*

2) Where a *service water* heating system is intended to serve more than one *dwelling unit*, it shall comply with the requirements of the Model National Energy Code for Buildings.

6.1.1.2. Compliance

1) The mandatory provisions of Section 6.2. must be satisfied regardless of the compliance path chosen.

Section 6.2. Mandatory Provisions

6.2.1. System Design

6.2.1.1. Regulations

1) *Service water* heating systems shall be designed in accordance with the appropriate provincial, territorial or municipal *building* regulations or, in the absence of such regulations, or where *service water* heating systems are not covered by such regulations, with the National Plumbing Code of Canada 1995 (see Appendix E).

6.2.2. Storage Vessels and Heating Equipment

6.2.2.1. Equipment Efficiency

1) *Service water* heaters, *boilers*, storage tanks and pool heaters that are included in the scope of a standard referenced in Table 6.2.2.1. shall comply with the relevant federal, provincial or territorial appliance or equipment energy-efficiency act or, in the absence of such an act or where equipment or vessels are not covered by such an act, with the relevant standard in Table 6.2.2.1. (see Appendix E).

2) Except for tanks covered by Sentence (1), hot *service water* storage tanks shall be covered with insulation having a minimum thermal resistance of 0.8 $m^2 \cdot °C/W$.

3) Tank insulation located in areas where it may be subject to mechanical damage shall be protected by a durable covering.

Table 6.2.2.1.
Service Water Heating Equipment Performance Standards
Forming Part of Sentence 6.2.2.1.(1)

Component	Input	Capacity, L	Standard	Performance Requirement
Storage-type Service Water Heaters				
Electric	≤ 12 kW	50-454	CAN/CSA-C745	in Standard
Heat pump water heaters	≤ 24 A and ≤ 250 V			
Gas-fired(1)	< 22 kW		CGA CAN1-4.1-M	
Oil-fired	≤ 30.5 kW	≤ 190	CAN/CSA-B211-M	
Non-storage Service Water Heaters				
Gas-fired(1)	22-117.2 kW		CGA CAN1-4.3	in Standard
Oil-fired	≤ 61.5 kW		DOE test procedures, US Code of Federal Regulations, 10 CFR, Part 430, Subpart B, Appendix E	$EF \geq 0.59 - 0.0019 \cdot V$ (2)(3)
Pool Heaters				
Gas-fired(1)	< 117.2 kW		CGA CAN1-4.7-M	in Standard
Oil-fired			AGA ANSI Z21.56	$E_t \geq 78\%$(4)

Notes to Table 6.2.2.1.:
(1) Includes propane
(2) EF is the *energy factor* (%/h).
(3) V is the storage volume in US gallons as specified by the manufacturer.
(4) E_t is the thermal efficiency with 70°F (38.9°C) water temperature difference.

6.2.2.2. Location of Service Water Heating Equipment

1) *Service water* heating equipment shall be installed inside the *building envelope*.

6.2.2.3. Space Heating Equipment Used for Service Water Heating

1) Space heating equipment used to provide *service water* heating solely or in combination with space heating shall comply with the relevant federal, provincial or territorial appliance or equipment energy-efficiency act or, in the absence of such an act or where equipment is not covered by such an act, with the standard in Table 5.2.10.1. that is relevant to that piece of equipment.

6.2.3. Piping

6.2.3.1. Heat Traps

1) Where *storage-type service water heaters* are not equipped with integral *heat traps*, *heat traps* shall be installed on vertical inlet and outlet piping directly above or as close as possible to the top of the tank (see Appendix E).

6.2.3.2. Insulation

1) Inlet and outlet piping between the storage or heating vessel and the *heat traps* referred to in Article 6.2.3.1., and the first 2 m of outlet piping downstream of the *heat traps*, shall be covered with insulation having a minimum thickness of 12 mm.

2) All piping forming part of a *service water* heating system and located outside the *building envelope* or in an uninsulated crawl space shall be insulated to a thermal resistance of at least 1.5 $m^2 \cdot °C/W$.

6.2.4. Controls

6.2.4.1. Temperature Controls

1) *Service water* heating systems with storage tanks shall be equipped with automatic temperature controls capable of adjustment between the lowest and the highest acceptable temperature settings for the intended use.

6.2.4.2. Shutdown

1) Except for systems in which the storage capacity is less than 100 L, each *service water* heating system shall be equipped with a readily accessible and clearly labeled device to allow shutting off the system (see Appendix E).

6.2.5. Conservation of Hot Water

6.2.5.1. Showers

1) Shower heads shall have integral means of limiting the maximum water discharge to 9.5 L/min, when tested according to CSA Standard B125-M, "Plumbing Fittings" (see Appendix E).

6.2.6. Swimming Pools

6.2.6.1. Controls

1) Pool heaters shall be equipped with a readily accessible and clearly labeled device to allow shutting off the heater without adjusting the thermostat setting and, where applicable, to allow restarting the heater without manually relighting the pilot light.

2) Except for pumps required by public health standards to operate on a 24-h basis and pumps required to operate solar or waste-heat-recovery pool-heating systems, swimming pool pumps and swimming pool heaters shall be equipped with time switches or other controls that can be set to automatically turn off the pumps and heaters when their operation is not required.

6.2.6.2. Pool Covers

1) Except for pools deriving more than 60% of their pool-heating energy from site-recovered energy or site solar energy, heated outdoor and indoor swimming pools and heated tubs shall be equipped with pool covers.

2) Pool covers required in Sentence (1) shall be capable of covering at least 90% of the water surface.

3) For pools and tubs heated to a temperature above 32°C, pool covers required in Sentence (1) shall have a nominal thermal resistance of no less than 2.1 $m^2 \cdot °C/W$.

Part 7
Electrical Power

Section 7.1. General

7.1.1. Scope

7.1.1.1. Application

1) Except as provided in Sentence (2), this Part applies to electrical systems in *buildings* within the scope of this Code, including:
a) electrical systems serving interior spaces,
b) electrical systems serving *building* exteriors and exterior *building* areas such as *exterior entrances* and *exterior exits*, and
c) electrical systems serving grounds, parking and other common exterior areas of *multiple-unit residential buildings* or *building* complexes.

2) Required emergency systems need not comply with this Part.

7.1.1.2. Compliance

1) The mandatory provisions of Section 7.2. must be satisfied regardless of the compliance path chosen.

Section 7.2. Mandatory Provisions

7.2.1. Power Distribution

7.2.1.1. Metering

1) Each *dwelling unit* shall be individually metered to billing accuracy, in conformance with the Canadian Regulations Relating to the Inspection of Electricity and Gas Meters and Supplies (see Appendix E).

2) Meters required in Sentence (1) shall conform to CSA Standard CAN3-C17-M, "Alternating-Current Electricity Metering."

7.2.2. Power Controls

7.2.2.1. Controls for Power Receptacles
(See Appendix E.)

1) Where exterior receptacles are provided serving an individual *dwelling unit*, at least one exterior receptacle shall be controlled.

2) In addition to the requirements of Sentence (1), where receptacles are provided for indoor or outdoor parking, and where these receptacles are supplied from a panelboard located within the *dwelling unit*, these receptacles shall be controlled.

3) The controls referred to in Sentences (1) and (2) shall be
a) switches, or
b) timers, with or without manual over-ride.

4) The controls referred to in Sentences (1) and (2) shall be located inside the *dwelling unit*.

Part 8
Building Energy Performance Compliance

Section 8.1. General

8.1.1. Scope

8.1.1.1. Application

1) This Part may be used as an alternative to the prescriptive requirements of Sections 3.3. and 5.3. of this Code and the trade-off provisions of Section 3.4. (see Appendix note E-2.1.1.2.).

2) The procedures of this Part shall be applied to a single *building* at a time.

Section 8.2. Performance Compliance

8.2.1. Compliance

8.2.1.1. Mandatory Provisions

1) In the establishment of the *building energy target*, all *building* features and systems must be accounted for in conformity with the mandatory provisions of Sections 3.2., 4.2., 5.2., 6.2. and 7.2. of this Code.

2) Except as provided in Sentence (3), where construction techniques are used that are more thermally efficient than those permitted in the mandatory provisions, the extra performance over the mandatory provisions shall not be used for performance compliance calculations (see Appendix note E-3.4.1.3.(5)).

3) Where space-heating equipment listed in Table 5.2.10.1. is used that is more thermally efficient than required in the mandatory provisions of that Table, performance compliance calculations may take into account the extra performance over the mandatory provisions.

8.2.1.2. Prescriptive Requirements

1) In the establishment of the *building energy target*, all *building* features and systems must be accounted for in conformity with the prescriptive requirements of Sections 3.3. and 5.3. for the administrative region considered and for the *principal heating source* for the *building* or part of the *building* enclosed by the components.

8.2.1.3. General Requirements

1) Subject to the provisions of this Section and to the limitations of Article 8.2.1.4., the *annual adjusted energy consumption* of the *building* or part of the *building*, as determined in accordance with the rules and specifications detailed in "Performance Compliance for Houses: Specifications for Calculation Procedures for Demonstrating Compliance to the Model National Energy Code for Houses Using Whole House Performance," published by the Canadian Commission on Building and Fire Codes, shall not exceed the *building energy target* (see Appendix E).

8.2.1.4. Limitations

1) *Building* performance calculations described in this Part shall be subject to the limitations described in Sentences (2) to (7).

2) The *effective thermal resistance* of above-ground *opaque components* of the *building envelope* shall not be reduced to less than
a) 75% of that required in Section 3.3., for above-ground walls other than log walls and for joist-type roofs, and
b) 60% of that required in Section 3.3., for other *opaque components* of the *building envelope*.

3) The *effective thermal resistance* of components of the *building envelope* that have radiant heating cables, pipes or membranes embedded in them shall not be reduced to less than the *effective thermal resistance* required by Sentences 3.3.1.1.(4), 3.3.2.1.(2) and 3.3.2.2.(1).

4) Doors covered in Sentences 3.3.1.4.(3) and (4) shall not be the subject of performance compliance calculations.

5) Benefits in performance calculations due to reductions in the *overall thermal transmittance* of doors below the maximum permitted in Sentence 3.3.1.4.(2) shall be limited to the amount by which the reduction makes the *overall thermal transmittance* of the door less than the maximum *overall thermal transmittance* permitted for doors in Clauses 3.3.1.4.(1)(b) or (c).

6) For the purpose of performance compliance calculations described in this Part, the required *effective thermal resistance* values for log walls that are installed with no interior or exterior finish that incorporates insulation or creates a space that could accommodate insulation shall be taken as

a) 2.0 m²·°C/W for round-scribed log walls, and
b) 1.3 m²·°C/W for rectangular-milled log walls.

7) Benefits in performance compliance calculations due to increases in the thickness of log walls beyond the minimum required in Article 3.3.1.2. shall be limited to the amount by which the increase makes the *effective thermal resistance* of the log walls greater than the minimum *effective thermal resistance* required for other types of walls in Article 3.3.1.1.

8.2.1.5. Treatment of Additions

(See Appendix E.)

1) For the purpose of performance compliance calculations, the compliance of *additions* shall be based upon either

a) the *addition* being considered by itself, or
b) the *addition* being considered together with the existing *building*, in which case both the *building energy target* and the *annual adjusted energy consumption* of the *building* shall be determined using the existing thermal characteristics of existing components of the *building envelope*.

2) When evaluating an *addition* together with the existing *building* for compliance with this Part, the existing characteristics of a component that is already built shall be its actual characteristics as determined, to the extent possible, in the same way as required in Part 2 of this Code for new components.

8.2.1.6. Compliance Software

1) Evaluation of compliance with Article 8.2.1.3. shall be done through computer software that conforms to specifications detailed in "Performance Compliance for Houses: Specifications for Calculation Procedures for Demonstrating Compliance to the Model National Energy Code for Houses Using Whole House Performance," published by the Canadian Commission on Building and Fire Codes.

8.2.1.7. Energy Source Adjustment Factor

1) When calculating the *building energy target* and the *annual adjusted energy consumption* of a *building* under this Part, the consumption of energy from each source shall be adjusted by multiplying it by the *energy source adjustment factor* shown in Table D-1 of Appendix D for the administrative region considered.

Part 9
Manufactured Housing

Section 9.1. General

9.1.1. Scope

9.1.1.1. Application

1) This Part applies to housing manufactured in a factory and shipped from the factory to its final site in 3-dimensional form.

Section 9.2. Exemptions

9.2.1. Exempted Code Provisions

9.2.1.1. Building Envelope

1) Subject to the provisions of Sentences (2) and (3), manufactured housing that complies with Clause 5.4 of CAN / CSA-Z240.2.1, "Structural Requirements for Mobile Homes," is exempted from compliance with the following requirements of this Code:

a) Article 3.3.1.1., Thermal Characteristics of Opaque Components of the Building Envelope, and
b) Sentences (1) and (2) of Article 3.3.1.3., Thermal Characteristics of Windows and Other Glazed Areas.

2) In manufactured houses covered by Sentence (1), all windows and sliding glass doors within the scope of CSA Standard A440.2, "Energy Performance Evaluation of Windows and Sliding Glass Doors," shall have a label indicating an *energy rating* (ER) not less than

a) –13 for operable glazing or fixed glazing with *sash*, and
b) –3 for fixed glazing without *sash*.

3) In manufactured houses covered by Sentence (1), the *overall thermal transmittance* of windows and other glazed areas not included in Sentence (2) shall not exceed 2.6 $W/m^2 \cdot {}^{\circ}C$.

9.2.1.2. Heating, Ventilating and Air-conditioning Systems

1) Manufactured housing that complies with Clause 7 of CAN / CSA-Z240.9.1, "Requirements for Load Calculation and Duct Design for Heating and Cooling of Mobile Homes," is exempted from compliance with the following requirements of this Code:

a) Sentence (9) of Article 3.2.1.2., Continuity of Insulation,
b) Article 5.2.2.3., Duct and Plenum Insulation, and
c) Article 5.3.1.1., Heat Recovery in Dwelling Units.

Appendix A
Regional Requirements

General. The legal definition and / or geographical boundaries of the regions listed in this Appendix shall be as described in the adopting legislation of the authority having jurisdiction.

A-3.3.1.1. Roof Types in Appendix A Tables. The tables in Appendix A differentiate between various types of construction for roofs:

- **Type I Roofs:** roofs where the space available for the inclusion of insulation is ample, such as for attic-type roofs, hopper roofs and pitched or scissor trusses; "attic" here implies that the roof and ceiling are framed separately;
- **Type II Roofs:** generally all other types of roofs where the space available for the inclusion of insulation is limited because of the large incremental cost of a greater depth of the structural members, such as for sawn-lumber joists and wood I-joists or parallel-chord trusses, or where the insulation is not contained within the depth of the structural members but is installed above or below the deck; for example, concrete decks with rigid insulation.

A-3.3.1.3. Windows in Appendix A Tables:

Fixed and Operable Windows Having Different Requirements

It may appear illogical that the U-value requirement for operable windows would be a less stringent requirement than that for fixed windows, for the same zone and fuel. A partial explanation is that the two types of windows are evaluated under the CSA standard using different arbitrary sizes: therefore, the two types do not have the same frame-to-glass ratio. Another reason is that for the same technology (type of glass, number of layers of glass, edge-filler type, etc.), an operable window will have poorer performance than its fixed counterpart because the extra sashes and hardware needed to make the window operable generally have a negative impact on overall energy performance. Therefore, different requirements for fixed and operable windows don't necessarily involve different technologies. In fact, the window requirements for houses were chosen to ensure that the same technology could be used for both fixed and operable windows in a given house.

Newfoundland

Region A – Island, except Northern Peninsula

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	8.80	8.80	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	5.20	4.30	-
Walls	4.10	4.10	-
Floors	5.20	4.60	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-10.0	-13.0	-
Fixed glazing without sash	0.0	-3.0	-
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.40	2.60	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Propane, Other	Oil, Heat Pump	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.50 @ full floor area	1.08 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region B – Northern Peninsula and Labrador Coast

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	8.80	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	5.20	-
Walls	4.70	4.10	-
Floors	8.10	5.20	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-6.0	-13.0	-
Fixed glazing without sash	4.0	-3.0	-
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.20	2.60	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Propane, Other	Oil, Heat Pump	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	1.50 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	2.80 @ perimeter	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region C – Goose Bay/Happy Valley

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot ^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	7.00	10.60	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	5.20	-
Walls	3.00	4.10	-
Floors	4.60	5.20	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-13.0	-10.0	-
Fixed glazing without sash	-3.0	0.0	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot ^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.60	2.40	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Oil, Propane, Heat Pump	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	1.50 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region D – Western Labrador

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot °C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	4.90	10.60	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	5.20	-
Walls	2.10	4.10	-
Floors	4.60	5.20	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-13.0	-10.0	-
Fixed glazing without sash	-3.0	0.0	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot °C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.60	2.40	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls	1.70 @ 600 mm below ground	3.10 @ full wall area	-
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	1.50 @ full floor area	-
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	no insulation required	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	-	required	-

Prince Edward Island

Region A – Prince Edward Island

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane	Oil, Heat Pump
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	8.80	7.00
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	7.10	5.20	4.30
Walls	4.70	4.10	3.00
Floors	7.10	5.20	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane	Oil, Heat Pump
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-6.0	-13.0	-13.0
Fixed glazing without sash	4.0	-3.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.20	2.60	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Propane	Oil, Heat Pump
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	3.10 @ full wall area	3.10 @ full wall area
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	1.08 @ full floor area	1.08 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.50 @ perimeter	1.08 @ perimeter	1.08 @ perimeter

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Propane	Oil, Heat Pump
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	required

Nova Scotia

Region A – Nova Scotia

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	8.80	7.00	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	5.20	4.30	-
Walls	3.90	3.00	-
Floors	5.20	4.60	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-10.0	-13.0	-
Fixed glazing without sash	0.0	-3.0	-
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.40	2.60	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls	3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.50 @ full floor area	1.08 @ full floor area	-
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Propane, Other	Oil, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

New Brunswick

Region A – New Brunswick

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane	Oil, Heat Pump
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	7.00	8.80	7.00
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	5.20	4.30
Walls	3.00	4.10	3.00
Floors	4.60	5.20	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane	Oil, Heat Pump
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-13.0	-13.0	-13.0
Fixed glazing without sash	-3.0	-3.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.60	2.60	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Propane	Oil, Heat Pump
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls		3.10 @ full wall area	3.10 @ full wall area	3.10 @ full wall area
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	1.50 @ full floor area	1.08 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	1.08 @ perimeter	1.08 @ perimeter

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Propane	Oil, Heat Pump
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	required

Quebec

Region A – (existing Zone A)

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	All Sources	-	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	7.00	-	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	-	-
Walls	4.10	-	-
Floors	4.60	-	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	All Sources	-	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-13.0	-	-
Fixed glazing without sash	-3.0	-	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.60	-	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		All Sources	-	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	-	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	-	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	-	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	All Sources	-	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	-	-

Region B – (existing Zones B, C and D)

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	All Sources	-	-
	Minimum Effective Thermal Resistance (RSI-value), m^2·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	7.00	-	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	5.20	-	-
Walls	4.10	-	-
Floors	5.20	-	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	All Sources	-	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-13.0	-	-
Fixed glazing without sash	-3.0	-	-
	Maximum Overall Thermal Transmittance (U-value), W/m^2·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.60	-	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		All Sources	-	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	-	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	-	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	-	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	All Sources	-	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	-	-

Region C – (existing Zones E and F)

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	All Sources	-	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	8.80	-	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	7.10	-	-
Walls	4.70	-	-
Floors	7.10	-	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	All Sources	-	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-10.0	-	-
Fixed glazing without sash	0.0	-	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.40	-	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		All Sources	-	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	-	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.90 @ full floor area	-	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.50 @ perimeter	-	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	All Sources	-	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	-	-

Ontario

Region A – < 5000 Degree-days

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Effective Thermal Resistance (RSI-value), $m^2\cdot{}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	8.80	7.00	5.60
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	5.20	4.30	4.30
Walls	4.40	3.00	2.90
Floors	5.20	4.60	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-10.0	-13.0	-13.0
Fixed glazing without sash	0.0	-3.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), $W/m^2\cdot{}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.40	2.60	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls		3.10 @ full wall area	3.10 @ full wall area	2.10 @ full wall area
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.90 @ full floor area	1.90 @ full floor area	1.90 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.60 @ full floor area	1.60 @ full floor area	1.60 @ full floor area

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region B – ≥ 5000 Degree-days

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot ^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	8.80	7.00
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	7.10	4.30	4.30
Walls	4.70	4.10	3.30
Floors	7.10	4.60	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-10.0	-13.0	-13.0
Fixed glazing without sash	0.0	-3.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot ^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.40	2.60	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls	3.10 @ full wall area	3.10 @ full wall area	3.10 @ full wall area
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.90 @ full floor area	1.90 @ full floor area	1.90 @ full floor area
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.60 @ full floor area	1.60 @ full floor area	1.60 @ full floor area

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	required

Manitoba

Region A – South of the 53rd Parallel (< 6500 Degree-days approximately)

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Ground Source Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	8.80	7.00	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	4.30	-
Walls	4.10	3.00	-
Floors	4.60	4.60	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Ground Source Heat Pump	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-6.0	-6.0	-
Fixed glazing without sash	4.0	4.0	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.20	2.20	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Oil, Propane, Other	Natural Gas, Ground Source Heat Pump	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	1.08 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Ground Source Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region B – At or North of the 53rd Parallel

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Ground Source Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	8.80	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	5.20	4.30	-
Walls	4.40	4.10	-
Floors	5.20	4.60	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Ground Source Heat Pump	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-3.0	-3.0	-
Fixed glazing without sash	7.0	7.0	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.00	2.00	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Oil, Propane, Other	Natural Gas, Ground Source Heat Pump	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.50 @ full floor area	1.08 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Ground Source Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Saskatchewan

Region A – Saskatchewan

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	5.60	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	5.20	4.30	-
Walls	4.10	3.00	-
Floors	5.20	4.60	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Heat Pump	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-10.0	-13.0	-
Fixed glazing without sash	0.0	-3.0	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.40	2.60	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls	3.10 @ full wall area	2.10 @ 600 mm below ground	-
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.50 @ full floor area	1.08 @ full floor area	-
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	no insulation required	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Oil, Propane, Other	Natural Gas, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	-	-

Alberta

Region A – Calgary/Lethbridge

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	8.80	8.80	5.80
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	5.30	5.30	5.30
Walls	4.10	4.10	3.00
Floors	5.20	4.60	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-13.0	-13.0	-13.0
Fixed glazing without sash	-3.0	-3.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.60	2.60	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls		3.10 @ full wall area	3.10 @ full wall area	2.10 @ full wall area
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	1.08 @ full floor area	1.08 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	1.08 @ perimeter	no insulation required

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region B – Red Deer/Edmonton/Grande Prairie

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	8.80	8.80	5.80
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	5.30	5.30	5.30
Walls	4.10	4.10	3.00
Floors	5.20	5.20	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-10.0	-13.0	-13.0
Fixed glazing without sash	0.0	-3.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.40	2.60	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls		3.10 @ full wall area	3.10 @ full wall area	2.10 @ full wall area
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.50 @ full floor area	1.08 @ full floor area	1.08 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	1.08 @ perimeter	1.08 @ perimeter

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region C – Fort McMurray

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	8.80	5.80
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	5.30	5.30	5.30
Walls	4.10	4.10	3.00
Floors	5.20	5.20	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-10.0	-13.0	-13.0
Fixed glazing without sash	0.0	-3.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.40	2.60	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls		3.10 @ full wall area	3.10 @ full wall area	2.10 @ full wall area
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.50 @ full floor area	1.08 @ full floor area	1.08 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter	1.08 @ perimeter	1.08 @ perimeter

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Propane, Oil, Heat Pump	Natural Gas
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

British Columbia

Region A – ≤ 3500 Degree-days, excluding: Vancouver Island, The District of Squamish, the communities of Woodfibre, Port Mellon, Gibsons, Sechelt and Powell River, and Texada Island

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description		Principal Heating Source		
		Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):				
Type I	- attic-type roofs	5.40	7.00	-
Type II	- all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	4.30	-
Walls		2.00	3.10	-
Floors:				
Type I	- all floors except concrete slab type	4.80	4.80	-
Type II	- concrete slab type	2.10	2.10	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-24.0	-24.0	-
Fixed glazing without sash	-15.0	-15.0	-
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	3.20	3.20	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^{\circ}C/W$		
Walls	1.70 @ 600 mm below ground	2.10 @ 600 mm below ground	-
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.50 @ full floor area	1.90 @ full floor area	-
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter for 600 mm	1.08 @ perimeter for 600 mm	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	-	required	-

Region B – ≥ 4500 Degree-days

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description		Principal Heating Source		
		Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):				
Type I	- attic-type roofs	5.90	7.00	-
Type II	- all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	4.30	-
Walls		2.90	3.10	-
Floors:				
Type I	- all floors except concrete slab type	4.80	4.80	-
Type II	- concrete slab type	2.10	2.10	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-24.0	-24.0	-
Fixed glazing without sash	-15.0	-15.0	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	3.20	3.20	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		2.10 @ 600 mm below ground	2.10 @ full wall area, or 2.64 @ 600 mm below ground	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	1.50 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter for 600 mm	1.08 @ perimeter for 600 mm	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	-	required	-

Region C – Vancouver Island Gas Pipeline Service Area, including: Vancouver Island; the District of Squamish; the communities of Woodfibre, Port Mellon, Gibsons, Sechelt and Powell River; and Texada Island

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description		Principal Heating Source		
		Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):				
Type I	- attic-type roofs	5.90	7.00	-
Type II	- all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	4.30	-
Walls		2.90	3.10	-
Floors:				
Type I	- all floors except concrete slab type	4.80	4.80	-
Type II	- concrete slab type	2.10	2.10	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-24.0	-24.0	-
Fixed glazing without sash	-15.0	-15.0	-
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	3.20	3.20	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls	1.70 @ 600 mm below ground	2.10 @ 600 mm below ground	-
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.50 @ full floor area	1.90 @ full floor area	-
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter for 600 mm	1.08 @ perimeter for 600 mm	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	-	required	-

Region D – 3501 to 4500 Degree-days, B.C. Hydro Service Area

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	5.90	7.00	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	4.30	-
Walls	2.90	3.10	-
Floors:			
Type I - all floors except concrete slab type	4.80	4.80	-
Type II - concrete slab type	2.10	2.10	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-24.0	-24.0	-
Fixed glazing without sash	-15.0	-15.0	-
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	3.20	3.20	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot °C/W$		
Walls		1.70 @ 600 mm below ground	2.10 @ 600 mm below ground	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	1.50 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter for 600 mm	1.08 @ perimeter for 600 mm	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	-	required	-

Region E – 3501 to 4500 Degree-days, West Kootenay Power Service Area

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description		Principal Heating Source		
		Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):				
Type I	- attic-type roofs	5.90	7.00	-
Type II	- all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	4.30	4.30	-
Walls		2.90	3.10	-
Floors:				
Type I	- all floors except concrete slab type	4.80	4.80	-
Type II	- concrete slab type	2.10	2.10	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-24.0	-24.0	-
Fixed glazing without sash	-15.0	-15.0	-
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	3.20	3.20	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls	1.70 @ 600 mm below ground	2.10 @ 600 mm below ground	-
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.08 @ full floor area	1.50 @ full floor area	-
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.08 @ perimeter for 600 mm	1.08 @ perimeter for 600 mm	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Natural Gas	Electricity, Oil, Propane, Heat Pump, Other	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	-	required	-

Yukon

Region A – Southern Yukon

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source			
	Electricity, Other	Propane	Oil, Heat Pump	Wood
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$			
Roofs (See Appendix Note A-3.3.1.1.):				
Type I - attic-type roofs	10.60	10.60	8.80	7.00
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	7.10	5.20	4.30	4.30
Walls	4.70	4.10	4.10	3.00
Floors	7.10	5.20	4.60	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source			
	Electricity, Other	Propane	Oil, Heat Pump	Wood
	Minimum Energy Rating (ER), W/m^2			
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):				
Operable or fixed glazing with sash	-10.0	-10.0	-13.0	-13.0
Fixed glazing without sash	0.0	0.0	-3.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$			
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.40	2.40	2.60	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source			
		Electricity, Other	Propane	Oil, Heat Pump	Wood
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$			
Walls		3.10 @ full wall area	3.10 @ full wall area	3.10 @ full wall area	3.10 @ full wall area
Floors-on-ground:					
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.90 @ full floor area	1.50 @ full floor area	1.08 @ full floor area	1.08 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.50 @ perimeter	1.08 @ perimeter	1.08 @ perimeter	1.08 @ perimeter

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source			
	Electricity, Other	Propane	Oil, Heat Pump	Wood
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	required	required

Region B – Central Yukon

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source			
	Electricity, Other	Propane	Oil, Heat Pump	Wood
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$			
Roofs (See Appendix Note A-3.3.1.1.):				
Type I - attic-type roofs	10.60	10.60	8.80	8.80
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	7.10	4.30	4.30
Walls	4.70	4.70	4.10	4.10
Floors	8.10	7.10	4.60	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source			
	Electricity, Other	Propane	Oil, Heat Pump	Wood
	Minimum Energy Rating (ER), W/m^2			
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):				
Operable or fixed glazing with sash	2.0	-10.0	-13.0	-13.0
Fixed glazing without sash	12.0	0.0	-3.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$			
Windows and other glazed areas outside the scope of CSA Standard A440.2	1.70	2.40	2.60	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source			
		Electricity, Other	Propane	Oil, Heat Pump	Wood
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W			
Walls		3.10 @ full wall area	3.10 @ full wall area	3.10 @ full wall area	3.10 @ full wall area
Floors-on-ground:					
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	1.50 @ full floor area	1.08 @ full floor area	1.08 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.90 @ perimeter	1.08 @ perimeter	1.08 @ perimeter	1.08 @ perimeter

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source			
	Electricity, Other	Propane	Oil, Heat Pump	Wood
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	required	required

Region C – Northern Yukon

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source			
	Electricity, Other	-	Oil, Heat Pump	Wood
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W			
Roofs (See Appendix Note A-3.3.1.1.):				
Type I - attic-type roofs	10.60	-	10.60	10.60
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	-	7.10	5.20
Walls	6.70	-	4.70	4.10
Floors	8.10	-	7.10	5.20

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source			
	Electricity, Other	-	Oil, Heat Pump	Wood
	Minimum Energy Rating (ER), W/m²			
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):				
Operable or fixed glazing with sash	2.0	-	-10.0	-10.0
Fixed glazing without sash	12.0	-	0.0	0.0
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C			
Windows and other glazed areas outside the scope of CSA Standard A440.2	1.70	-	2.40	2.40

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source			
		Electricity, Other	-	Oil, Heat Pump	Wood
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W			
Walls		3.10 @ full wall area	-	3.10 @ full wall area	3.10 @ full wall area
Floors-on-ground:					
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	-	1.90 @ full floor area	1.50 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	2.80 @ perimeter	-	1.50 @ perimeter	1.08 @ perimeter

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source			
	Electricity, Other	-	Oil, Heat Pump	Wood
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	-	required	required

Northwest Territories

Region A – Southwest Northwest Territories

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	7.00	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	4.30	-
Walls	4.70	3.00	-
Floors	8.10	4.60	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	-6.0	-13.0	-
Fixed glazing without sash	4.0	-3.0	-
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	2.20	2.60	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Oil, Propane, Heat Pump	-
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls		3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	1.90 @ full floor area	1.08 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.50 @ full floor area	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region B – Great Slave Lake

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Heat Pump	Oil
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot °C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	8.80	8.80
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	5.20	4.30
Walls	4.70	4.10	4.10
Floors	8.10	5.20	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Heat Pump	Oil
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	2.0	-10.0	-13.0
Fixed glazing without sash	12.0	0.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot °C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	1.70	2.40	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Propane, Heat Pump	Oil
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls		3.10 @ full wall area	3.10 @ full wall area	3.10 @ full wall area
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	1.08 @ full floor area	1.08 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	1.90 @ perimeter	1.08 @ perimeter	1.08 @ perimeter

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Propane, Heat Pump	Oil
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	required

Region C – Mackenzie Valley

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	Natural Gas
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	10.60	5.60
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	5.20	4.30
Walls	6.70	4.10	2.10
Floors	8.10	5.20	4.60

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	Natural Gas
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	2.0	-10.0	-13.0
Fixed glazing without sash	12.0	0.0	-3.0
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	1.70	2.40	2.60

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	Natural Gas
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Walls	3.10 @ full wall area	3.10 @ full wall area	2.00 600 mm below ground
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	1.08 @ full floor area	1.08 @ full floor area
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	2.80 @ full floor area	1.08 @ perimeter	no insulation required

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	Natural Gas
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region D – Western Arctic

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Heat Pump	Oil
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	10.60	10.60
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	8.10	5.20
Walls	6.70	4.70	4.10
Floors	8.10	8.10	5.20

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Propane, Heat Pump	Oil
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	2.0	2.0	-10.0
Fixed glazing without sash	12.0	12.0	0.0
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	1.70	1.70	2.40

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Propane, Heat Pump	Oil
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls		3.10 @ full wall area	3.10 @ full wall area	3.10 @ full wall area
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	2.80 @ full floor area	1.50 @ full floor area
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	2.80 @ full floor area	1.90 @ perimeter	1.50 @ perimeter

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Propane, Heat Pump	Oil
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	required

Region E – Keewatin

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	10.60	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	5.20	-
Walls	6.70	4.10	-
Floors	8.10	5.20	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Energy Rating (ER), W/m²		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	2.0	-10.0	-
Fixed glazing without sash	12.0	0.0	-
	Maximum Overall Thermal Transmittance (U-value), W/m²·°C		
Windows and other glazed areas outside the scope of CSA Standard A440.2	1.70	2.40	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls	3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	1.50 @ full floor area	-
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	2.80 @ full floor area	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region F – Baffin

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot °C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	8.80	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	4.30	-
Walls	6.70	4.10	-
Floors	8.10	4.60	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	2.0	-13.0	-
Fixed glazing without sash	12.0	-3.0	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot °C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	1.70	2.60	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Oil, Propane, Heat Pump	-
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls		3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	1.08 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	2.80 @ full floor area	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region G – Eastern Arctic

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), $m^2·°C/W$		
Roofs (See Appendix Note A-3.3.1.1.):			
Type I - attic-type roofs	10.60	7.00	-
Type II - all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	4.30	-
Walls	6.70	3.00	-
Floors	8.10	4.60	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	2.0	-13.0	-
Fixed glazing without sash	12.0	-3.0	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2·°C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	1.70	2.60	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description		Principal Heating Source		
		Electricity, Other	Oil, Propane, Heat Pump	-
		Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls		3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:				
Type I	- with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	1.08 @ full floor area	-
Type II	- other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	2.80 @ full floor area	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Region H – Arctic Islands

Table A-3.3.1.1.
Prescriptive Requirements – Above-ground Building Assemblies
Forming Part of Sentence 3.3.1.1.(1)

Assembly Description		Principal Heating Source		
		Electricity, Other	Oil, Propane, Heat Pump	-
		Minimum Effective Thermal Resistance (RSI-value), $m^2 \cdot {}^\circ C/W$		
Roofs (See Appendix Note A-3.3.1.1.):				
Type I	- attic-type roofs	10.60	8.80	-
Type II	- all other roofs (e.g., sawn lumber joists, parallel-chord trusses and wood I-joists)	8.10	4.30	-
Walls		6.70	4.10	-
Floors		8.10	4.60	-

Table A-3.3.1.3.
Prescriptive Requirements – Windows and Other Glazed Areas
Forming Part of Sentences 3.3.1.3.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Energy Rating (ER), W/m^2		
Windows and sliding glass doors within the scope of CSA Standard A440.2 (See Appendix Note A-3.3.1.3.):			
Operable or fixed glazing with sash	2.0	-13.0	-
Fixed glazing without sash	12.0	-3.0	-
	Maximum Overall Thermal Transmittance (U-value), $W/m^2 \cdot {}^\circ C$		
Windows and other glazed areas outside the scope of CSA Standard A440.2	1.70	2.60	-

Table A-3.3.2.1.
Prescriptive Requirements – Building Assemblies in Contact with the Ground
Forming Part of Sentences 3.3.2.1.(1) and (3) and 3.3.2.2.(1) and (2)

Assembly Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
	Minimum Effective Thermal Resistance (RSI-value), m²·°C/W		
Walls	3.10 @ full wall area	3.10 @ full wall area	-
Floors-on-ground:			
Type I - with imbedded heating cables, ducts or pipes (e.g., radiant heating slabs)	2.80 @ full floor area	1.08 @ full floor area	-
Type II - other floors-on-ground less than 0.6 m below grade (e.g., concrete slab with rigid insulation)	2.80 @ full floor area	1.08 @ perimeter	-

Table A-5.3.1.1.
Prescriptive Requirements – Heat Recovery
Forming Part of Sentence 5.3.1.1.(1)

Description	Principal Heating Source		
	Electricity, Other	Oil, Propane, Heat Pump	-
Heat recovery on principal exhaust component of the mechanical ventilation system in dwelling units	required	required	-

Appendix B
Thermal Characteristics of Common Building Assemblies

Abbreviations and Symbols

Effective RSI	• effective thermal resistance of the overall assembly, including insulation, sheathing and finishing materials, air films and thermal bridging of framing members
Overall U-value	• overall thermal transmittance (for opaque components, this includes air films and thermal bridging of framing members)
EPS board Type I	• expanded polystyrene (bead board) type 1
EPS board Type II	• expanded polystyrene (bead board) type 2
EPS board Type III	• expanded polystyrene (bead board) type 3
XPS board Type II	• extruded polystyrene type 2
XPS board Type III	• extruded polystyrene type 3
XPS board Type IV	• extruded polystyrene type 4
PIR	• polyisocyanurate insulation board
PUR	• polyurethane insulation board
RSI Adjustment	• additional thermal resistance to be added to the effective thermal resistance of the overall assembly if the materials differ from what is specified in the main table section or if additional materials are specified

Examples

The following examples demonstrate how to use Appendix B. In Example 1, the building assembly is specified and its effective RSI is found. In Example 2, an effective RSI (or overall U-value) is given and possible sheathing and cavity insulation materials that meet the RSI requirement are determined.

Example 1. Determine the effective RSI and overall U-value for the specified steel stud wall assembly.

Given: The wall assembly consists of 41 x 152 mm steel studs at 610 mm on centre (o.c.) with mineral fibre batt cavity insulation, 38 mm EPS board Type II sheathing, 16 mm gypsum board interior finish and 100 mm brick exterior finish.

Step 1 Determine the RSI values for the sheathing and insulation.

Table B-1, Thickness of Insulation Materials, lists the RSI values for insulating sheathing and insulation. Using the “Insulating Sheathing” section, follow across the table to EPS board Type II and down the table to 38 mm. In the leftmost column is the RSI value for the sheathing type and thickness:

$$RSI_{\text{EPS board Type II}} = 1.05$$

Similarly, find the cavity insulation RSI using the “Stud Cavity/Floor Joist Cavity/Truss-Type-Roof Cavity Insulation” section. Follow across the table to glass/mineral fibre batts and down the table to “140 and 152”:

$$RSI_{\text{mineral fibre batts}} = 3.52$$

Step 2 Determine the effective RSI (or overall U-value) of the building assembly, using the appropriate table in Tables B-2 to B-23.

Table B-9, Metal Frame Wall: 41 x 152 mm @ 610 mm o.c., provides effective RSI and overall U-values for common insulating sheathing and cavity insulation RSI values applied to the specified framing. Using the RSI values from Step 1, move across the table under "Cavity Insulation" to RSI 3.52 and down the table to RSI 1.05 sheathing under "Sheathing":

$$\text{effective RSI } (RSI_{T1}) = 3.42$$
$$\text{overall U-value } (U_{T1}) = 0.293$$

However, as noted below the table title, these numbers have been generated using aluminum or vinyl siding as the exterior finish and 13 mm gypsum board as the interior finish. The "RSI Adjustment" sections of Table B-9 must be used to adjust the values for the 100 mm brick and 16 mm gypsum board specified for this example.

Step 3 Adjusting the effective RSI and overall U-value for exterior and interior finishes.

To determine the adjustment for the 100 mm brick exterior finish, locate "100 mm brick and 25 mm air" under the "Exterior Finish" RSI adjustment section of the table:

$$\text{RSI adjustment}_{\text{exterior, 100 mm brick}} = 0.14$$

Similarly, find the adjustment for the 16 mm gypsum board interior finish:

$$\text{RSI adjustment}_{\text{interior, 16 mm gypsum board}} = 0.02$$

For the total effective RSI value, add these adjustments to RSI_{T1}:

$$RSI_T = 3.42 + 0.14 + 0.02$$
$$= 3.58$$

Use RSI_T to determine the new overall U-value:

$$U_T = 1 \div RSI_T$$
$$= 1 \div 3.58$$
$$= 0.279$$

Example 2. For a truss-type floor, determine possible floor assembly materials, given the required effective RSI (overall U-value).

Given: A truss-type floor assembly at 610 mm o.c. must have a minimum effective RSI of 8.33 (maximum overall U-value of 0.120).

Step 1 Locate the appropriate table for truss-type floors in Tables B-2 to B-23.

Table B-17, Floor: Truss- or Wood I-Joist-Type @ 610 mm o.c., lists the effective RSI (overall U-value) for truss- or wood I-joist-type floors with no exterior finish and carpet and fibrous pad interior finish.

Step 2 Find the sheathing and cavity insulation RSI values that provide the required minimum effective RSI (maximum overall U-value).

From Table B-17, the closest effective RSI (overall U-value) equal to or greater than 8.33 (0.120) is 8.35 (0.120). This value corresponds to a cavity insulation RSI of 7.04 and a sheathing RSI of 0.88 when used with carpet and fibrous pad interior finish and no exterior finish.

Step 3 Determine possible material types for the indicated sheathing and cavity insulation RSI values.

Table B-1, Thickness of Insulation Materials, lists the RSI values for insulating sheathing and insulation. In the "Insulating Sheathing" section, move down the RSI column to 0.88. This row shows the thickness of the various sheathing materials that will meet this RSI value. Two possibilities are 30 mm EPS board Type III or 54 mm insulating fibreboard sheathing.

From the "Attic-type Roof/Truss-type Floor" section of Table B-1, the cavity insulating material can be determined by moving down the RSI column to 7.04. Two possible cavity insulators are 265 mm glass or mineral fibre batts and 352 mm loose fill mineral fibre.

Table B-1
Thickness of Insulation Materials
for RSI Values Shown in Tables B-2 to B-23

RSI	Material Thickness, mm						
	Insulating Sheathing						
	EPS board Type I	EPS board Type II	EPS board Type III	XPS board Type II, III, IV	semi-rigid glass fibre	insulated fibreboard sheathing	faced PIR/ PUR
0.68	26	24	23	19	23	41	14
0.79	30	28	27	23	26	48	16
0.88	34	31	30	25	29	54	18
0.97	37	35	33	28	32	59	19
1.05	40	38	35	30	35	64	21
1.14	44	41	39	33	38	70	23
1.32	51	47	45	38	44	80	26
1.42	55	51	48	41	47	87	28
1.76	68	63	59	50	59	107	35
2.13	82	76	72	61	71	130	43
2.84	109	101	96	81	95	173	57
	Attic-Type Roof/Truss-Type Floor Insulation						
	glass/mineral fibre batts[1]	loose fill cellulose	loose fill mineral fibre				
5.46	222	218	273				
5.64	-	226	282				
6.00	-	240	300				
6.16	251	246	308				
7.04	265	282	352				
8.81	152 + 222	352	441				
10.6	265 + 152	424	530				
	Joist-Type Roof Insulation						
	glass/mineral fibre batts[1]	EPS board Type I	unfaced PIR/ PUR board	sprayed cellulose fibre	sprayed glass fibre	sprayed polyurethane foam	
3.52	152	135	84	147	135	84	
4.93	202	190	117	205	190	117	
5.46	222	210	130	228	210	130	
6.00	-	231	143	250	231	143	
6.16	251	237	147	257	237	147	
7.04	265	271	168	293	271	168	

Table B-1 (Continued)

RSI	Material Thickness, mm					
	Built-Up Roof Insulation					
	rigid glass fibre roof insulation	EPS board Type I	EPS board Type II	EPS board Type III	XPS board Type II, III, IV	faced PIR/ PUR board
0.68	25	26	24	23	20	16
0.97	38	37	35	33	28	19
1.41	57	54	50	48	41	28
1.85	75	71	66	63	53	37
2.20	89	85	79	74	63	44
2.64	109	102	94	89	76	53

RSI	Stud Cavity/Floor Joist Cavity/Truss-Type-Roof Cavity Insulation				
	glass/mineral fibre batts(1)	EPS board Type I	sprayed cellulose fibre	sprayed glass fibre	sprayed polyurethane foam
1.41	65	54	59	54	34
2.11	89	81	88	81	50
2.29	89	88	95	88	55
2.46	89	95	103	95	59
3.25	140	125	135	125	77
3.34	140(2)	128	139	128	80
3.52	140 and 152	135	147	135	84
3.70	-	142	154	142	88
3.87	140	149	161	149	92
4.93	202	190	205	190	117
5.46	222	210	228	210	130
5.90	-	227	246	227	140
6.16	251	237	257	237	147
6.40	-	246	267	246	152
7.04	265	271	293	271	168

RSI	Double Wall Insulation				
	glass/mineral fibre batts(1)	loose fill cellulose fibre	sprayed cellulose fibre	sprayed glass fibre	sprayed polyurethane foam
4.58	89 + 89	183	191	176	109
5.63	89 + 140 or 89 + 152	225	235	217	134
7.04	89 + 202	282	293	271	168
7.39	89 + 202	296	308	284	176

Table B-1 (Continued)

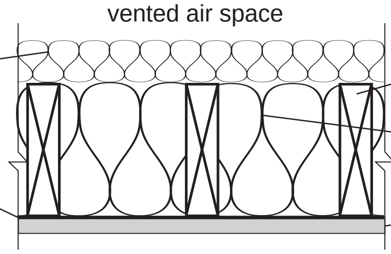
RSI	Material Thickness, mm		
	Concrete Floor Insulation		
	EPS board Type II	EPS board Type III	XPS board Type IV
0.88	31	30	25
1.32	47	45	38
1.76	63	59	51
2.64	94	89	76
3.52	126	119	101
4.42	158	149	127

Notes to Table B-1:

(1) Batt thickness may vary for a given thermal resistance, depending on the manufacturer.

(2) 152 mm medium-density batt, compressed to 140 mm.

Table B-2
Roof: Attic-Type
with 13 mm gypsum board interior finish



Framing/Spacing	Cavity Insulation(1)(2)				
	RSI 5.64	RSI 6.00	RSI 7.04	RSI 8.81	RSI 10.6
	Effective RSI (Overall U-Value)(3)(4)				
38 x 89 mm @ 406 mm o.c.	5.66 (0.177)	6.03 (0.166)	7.07 (0.141)	8.85 (0.113)	10.65 (0.094)
38 x 89 mm @ 610 mm o.c.	5.72 (0.175)	6.08 (0.164)	7.13 (0.140)	8.90 (0.112)	10.70 (0.093)
38 x 114 mm @ 406 mm o.c.	5.59 (0.179)	5.95 (0.168)	7.01 (0.143)	8.79 (0.114)	10.59 (0.094)
38 x 114 mm @ 610 mm o.c.	5.67 (0.176)	6.03 (0.166)	7.08 (0.141)	8.86 (0.113)	10.66 (0.094)
38 x 140 mm @ 406 mm o.c.	5.49 (0.182)	5.86 (0.171)	6.93 (0.144)	8.72 (0.115)	10.52 (0.095)
38 x 140 mm @ 610 mm o.c.	5.60 (0.179)	5.96 (0.168)	7.02 (0.142)	8.81 (0.114)	10.61 (0.094)

	Interior Finish		
	13 mm plywood	hung ceiling	strapping
RSI Adjustment	0.03	0.18	0.15

Example: 38 x 89 mm @ 406 mm o.c. with RSI 5.64 cavity insulation

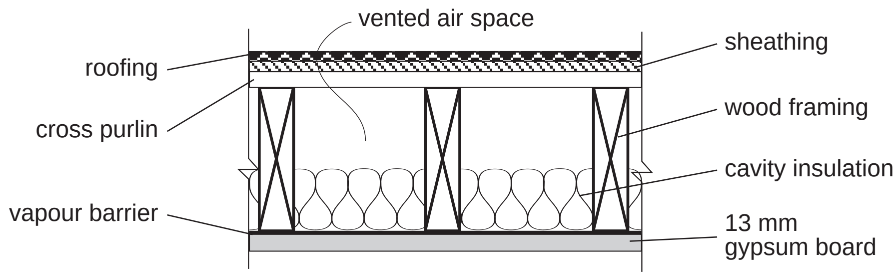
RSI_F = Exterior Air + 89 mm Wood Framing + Insulation Above Framing + 13 mm Gypsum + Interior Air
$= 0.03 + 0.7209 + (5.64 - (89 \times (5.64 \div 226))) + 0.0793 + 0.11$
$= 4.359$

RSI_I = Exterior Air + Insulation + 13 mm Gypsum + Interior Air
$= 0.03 + 5.64 + 0.0793 + 0.11$
$= 5.8593$

$RSI_T = 1 \div ((0.1 \div RSI_F) + (0.9 \div RSI_I))$
$= 5.66$

Notes to Table B-2:
(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) Loose fill cellulose used to determine insulation thickness.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(4) No credit for materials to the exterior of vented air space.

Table B-3
Roof: Roof-Joist-Type
with 13 mm gypsum board interior finish



Joist Spacing	Cavity Insulation(1)(2)				
	RSI 3.52	RSI 4.93	RSI 5.46	RSI 6.16	RSI 7.04
	Effective RSI (Overall U-Value)(3)(4)				
wood @ 406 mm o.c.	3.23 (0.310)	4.37 (0.229)	4.81 (0.208)	5.39 (0.185)	6.02 (0.166)
wood @ 610 mm o.c.	3.37 (0.297)	4.58 (0.218)	5.04 (0.198)	5.65 (0.177)	6.34 (0.158)

	Interior Finish		
	13 mm plywood	hung ceiling	strapping
RSI Adjustment	0.03	0.18	0.15

Example: wood @ 406 mm o.c. with RSI 3.52 cavity insulation

RSI_F = Exterior Air + Wood Framing (to top of insulation) + 13 mm Gypsum + Interior Air
$= 0.03 + (0.0081 \times 152) + 0.0793 + 0.11$
$= 1.4505$

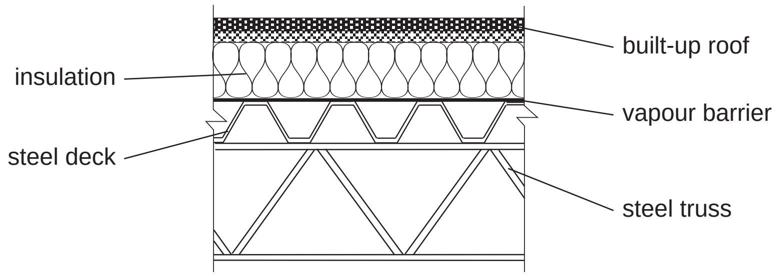
RSI_I = Exterior Air + Insulation + 13 mm Gypsum + Interior Air
$= 0.03 + 3.52 + 0.0793 + 0.11$
$= 3.7393$

$RSI_T = 1 \div ((0.1 \div RSI_F) + (0.9 \div RSI_I))$
$= 3.23$

Notes to Table B-3:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) Glass/mineral fibre batts used to determine insulation thickness.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(4) No credit for materials to the exterior of vented air space.

Table B-4
Roof: Built-Up
with asphalt built-up roofing and no interior finish



Deck	Insulation(1)					
	RSI 0.68	RSI 0.97	RSI 1.41	RSI 1.85	RSI 2.20	RSI 2.64
	Effective RSI (Overall U-Value)(2)					
metal deck	0.88 (1.135)	1.17 (0.854)	1.61 (0.621)	2.05 (0.488)	2.40 (0.416)	2.84 (0.352)
100 mm concrete with deck	0.92 (1.086)	1.21 (0.826)	1.65 (0.606)	2.09 (0.478)	2.44 (0.410)	2.88 (0.347)
150 mm concrete with deck	0.94 (1.063)	1.23 (0.812)	1.67 (0.598)	2.11 (0.474)	2.46 (0.406)	2.90 (0.345)
precast concrete	0.92 (1.087)	1.21 (0.826)	1.65 (0.606)	2.09 (0.478)	2.44 (0.410)	2.88 (0.347)

	Interior Finish			
	13 mm gypsum board	13 mm plywood	hung ceiling	strapping and 13 mm gypsum board
RSI Adjustment	0.08	0.11	0.26	0.23

Example: 100 mm concrete deck with RSI 0.68 insulation

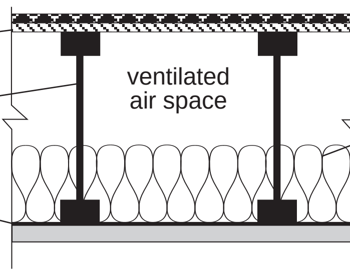
RSI_T = Exterior Air + Built-Up Roofing + Insulation + 100 mm concrete + Metal Deck + Interior Air
= 0.03 + 0.06 + 0.68 + 0.04 + negligible + 0.11
= 0.92

Notes to Table B-4:

(1) To convert insulation RSI to insulation thickness, see Table B-1.

(2) No credit for materials to the exterior of vented air space.

Table B-5
Roof: Flat, Truss or Wood I-Joist-Type
Trusses or I-Joists with 13 mm gypsum board interior finish



Truss Spacing	Cavity Insulation(1)(2)					
	RSI 2.46	RSI 3.52	RSI 4.93	RSI 5.46	RSI 6.16	RSI 7.04
	Effective RSI (Overall U-Value)(3)(4)					
trusses or I-Joists @ 406 mm o.c.	2.49 (0.401)	3.55 (0.282)	4.88 (0.205)	5.38 (0.186)	6.05 (0.165)	6.85 (0.146)
trusses or I-Joists @ 610 mm o.c.	2.55 (0.393)	3.60 (0.278)	4.96 (0.202)	5.47 (0.183)	6.15 (0.163)	6.97 (0.144)

	Interior Finish		
	13 mm plywood	hung ceiling	strapping
RSI Adjustment	0.03	0.18	0.15

Example: wood I-Joists @ 406 mm o.c. with RSI 3.52 cavity insulation

RSI_{Fweb} = Exterior Air + Wood Web (to top of insulation) + 13 mm Gypsum + Interior Air
$= 0.03 + (152 \times 0.0081) + 0.0793 + 0.11$
$= 1.4505$

$RSI_{Fflange}$ = Exterior Air + 38 mm Wood Flange + Insulation + 13 mm Gypsum + Interior Air
$= 0.03 + 0.308 + (3.52 \div (152 \times (152 - 38)) + 0.0793 + 0.11$
$= 3.1673$

RSI_I = Exterior Air + Insulation +13 mm Gypsum + Interior Air
$= 0.03 + 3.52 + 0.0793 + 0.11$
$= 3.7393$

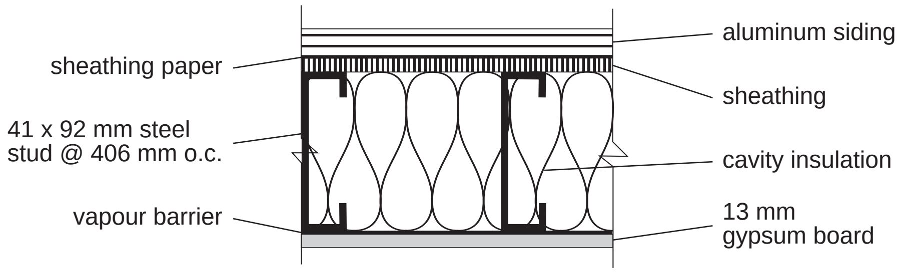
Assuming that the thickness of the I-Joist web is 25% of the width of the flanges:

$RSI_T = 1 \div (((0.25 \times 0.1) \div RSI_{Fweb}) + ((0.75 \times 0.1) \div RSI_{Fflange}) + (0.9 \div RSI_I))$
$= 3.55$

Notes to Table B-5:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) Glass/mineral fibre batts used to determine insulation thickness.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(4) No credit for materials to the exterior of vented air space.

Table B-6
Metal Frame Wall: 41 x 92 mm @ 406 mm o.c.
with aluminum or vinyl siding exterior finish and 13 mm gypsum board interior finish



	Cavity Insulation[1]				
	no insulation	RSI 2.11	RSI 2.29	RSI 2.46	RSI 3.70
Sheathing[2]	Effective RSI (Overall U-Value)[3]				
no sheathing	0.48 (2.093)	1.16 (0.859)	1.22 (0.820)	1.27 (0.786)	1.65 (0.608)
13 mm gypsum	0.56 (1.795)	1.25 (0.802)	1.30 (0.767)	1.36 (0.736)	1.74 (0.575)
11 mm plywood or particle board	0.57 (1.744)	1.26 (0.791)	1.32 (0.757)	1.38 (0.727)	1.76 (0.569)
11 mm waferboard or OSB	0.60 (1.670)	1.29 (0.775)	1.35 (0.742)	1.40 (0.713)	1.79 (0.560)
11 mm fibreboard	0.66 (1.519)	1.35 (0.739)	1.41 (0.709)	1.46 (0.683)	1.85 (0.540)
RSI 0.88 sheathing	1.36 (0.734)	2.19 (0.457)	2.26 (0.443)	2.32 (0.430)	2.81 (0.356)
RSI 1.05 sheathing	1.53 (0.652)	2.36 (0.424)	2.43 (0.412)	2.50 (0.401)	2.98 (0.336)
RSI 1.14 sheathing	1.62 (0.616)	2.45 (0.409)	2.52 (0.397)	2.59 (0.387)	3.07 (0.326)
RSI 1.32 sheathing	1.80 (0.555)	2.63 (0.380)	2.70 (0.370)	2.77 (0.361)	3.25 (0.307)

	Exterior Finish			
	13 mm stucco	wood siding	100 mm brick and 25 mm air	19 mm furring behind finish
RSI Adjustment	-0.10	0.04	0.14	0.18

	Interior Finish		
	6 mm wood paneling	16 mm gypsum board	strapped air space
RSI Adjustment	-0.02	0.02	0.19

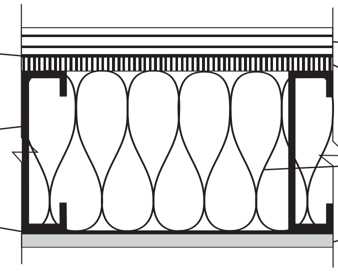
Table B-6 (Continued)

Example:	RSI 0.88 sheathing with RSI 2.29 cavity insulation
RSI_F	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 92 mm Steel Framing + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 0.0014812 + 0.0793 + 0.12
	= 1.2318
RSI_I	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + Insulation + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 2.29 + 0.0793 + 0.12
	= 3.5203
RSI_{T1}	$= 1 \div ((0.0063 \div RSI_F) + (0.9937 \div RSI_I))$
	= 3.4796
RSI_{T2}	= 1 ÷ ((0.0063 ÷ RSI of Steel Framing) + (0.9937 ÷ RSI of Insulation))
	$= 1 \div ((0.0063 \div 0.0014812) + (0.9937 \div 2.29))$
	= 0.2133
RSI_{T3}	= RSI_{T2} + Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 13 mm Gypsum + Interior Air
	= 0.2133 + 0.03 + 0.11 + 0.011 + 0.88 + 0.0793 + 0.12
	= 1.4436
RSI_T	$= ((2 \times RSI_{T1}) + (3 \times RSI_{T3})) \div 5$
	= 2.26

Notes to Table B-6:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) For other insulating sheathings, add the sheathing RSI value to the ‘no sheathing’ category.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.

Table B-7
Metal Frame Wall: 41 x 92 mm @ 610 mm o.c.
with aluminum or vinyl siding exterior finish and 13 mm gypsum board interior finish



Sheathing(2)	Cavity Insulation(1)				
	no insulation	RSI 2.11	RSI 2.29	RSI 2.46	RSI 3.70
	Effective RSI (Overall U-Value)(3)				
no sheathing	0.50 (1.991)	1.55 (0.646)	1.64 (0.611)	1.72 (0.582)	2.31 (0.434)
13 mm gypsum	0.58 (1.720)	1.63 (0.613)	1.72 (0.581)	1.80 (0.555)	2.40 (0.417)
11 mm plywood or particle board	0.60 (1.672)	1.65 (0.607)	1.74 (0.576)	1.82 (0.549)	2.42 (0.414)
11 mm waferboard or OSB	0.62 (1.605)	1.67 (0.597)	1.76 (0.567)	1.85 (0.541)	2.44 (0.409)
11 mm fibreboard	0.68 (1.465)	1.74 (0.576)	1.83 (0.548)	1.91 (0.524)	2.51 (0.398)
RSI 0.88 sheathing	1.38 (0.723)	2.44 (0.409)	2.53 (0.395)	2.62 (0.382)	3.24 (0.309)
RSI 1.05 sheathing	1.55 (0.644)	2.61 (0.382)	2.71 (0.370)	2.79 (0.358)	3.41 (0.293)
RSI 1.14 sheathing	1.64 (0.609)	2.71 (0.370)	2.80 (0.358)	2.88 (0.347)	3.50 (0.286)
RSI 1.32 sheathing	1.82 (0.549)	2.89 (0.347)	2.98 (0.336)	3.06 (0.327)	3.68 (0.272)

	Exterior Finish			
	13 mm stucco	wood siding	100 mm brick and 25 mm air	19 mm furring behind finish
RSI Adjustment	-0.10	0.04	0.14	0.18

	Interior Finish		
	6 mm wood paneling	16 mm gypsum board	strapped air space
RSI Adjustment	-0.02	0.02	0.19

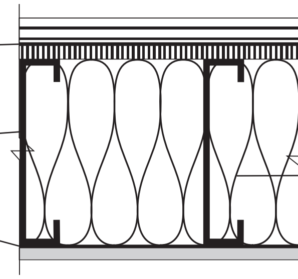
Table B-7 (Continued)

Example:	RSI 0.88 sheathing with RSI 2.29 cavity insulation
RSI_F	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 92 mm Steel Framing + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 0.0014812 + 0.0793 + 0.12
	= 1.2318
RSI_I	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + Insulation +13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 2.29 + 0.0793 + 0.12
	= 3.5203
RSI_{T1}	$= 1 \div ((0.0037 \div RSI_F) + (0.9963 \div RSI_I))$
	= 3.4963
RSI_{T2}	= 1 ÷ ((0.0037 ÷ RSI of Steel Framing) + (0.9963 ÷ RSI of Insulation))
	$= 1 \div ((0.0037 \div 0.0014812) + (0.9963 \div 2.29))$
	= 0.3409
RSI_{T3}	= RSI_{T2} + Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 13 mm Gypsum + Interior Air
	= 0.3409 + 0.03 + 0.11 + 0.011 + 0.88 + 0.0793 + 0.12
	= 1.5712
RSI_T	$= (RSI_{T1} + RSI_{T3}) \div 2$
	= 2.53

Notes to Table B-7:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) For other insulating sheathings, add the sheathing RSI value to the ‘no sheathing’ category.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.

Table B-8
Metal Frame Wall: 41 x 152 mm @ 406 mm o.c.
with aluminum or vinyl siding exterior finish and 13 mm gypsum board interior finish



	Cavity Insulation(1)			
	no insulation	RSI 3.52	RSI 3.87	RSI 6.4
Sheathing(2)	Effective RSI (Overall U-Value)(3)			
no sheathing	0.49 (2.033)	1.68 (0.596)	1.78 (0.561)	2.49 (0.401)
13 mm gypsum	0.57 (1.751)	1.77 (0.565)	1.88 (0.533)	2.61 (0.383)
11 mm plywood or particle board	0.59 (1.702)	1.79 (0.559)	1.90 (0.528)	2.63 (0.380)
11 mm waferboard or OSB	0.61 (1.631)	1.82 (0.551)	1.92 (0.520)	2.67 (0.375)
11 mm fibreboard	0.67 (1.487)	1.88 (0.532)	1.99 (0.503)	2.74 (0.365)
RSI 0.88 sheathing	1.38 (0.727)	2.81 (0.355)	2.95 (0.339)	3.91 (0.256)
RSI 1.05 sheathing	1.55 (0.647)	2.99 (0.335)	3.12 (0.320)	4.09 (0.244)
RSI 1.14 sheathing	1.64 (0.611)	3.08 (0.325)	3.21 (0.311)	4.18 (0.239)
RSI 1.32 sheathing	1.82 (0.551)	3.26 (0.307)	3.40 (0.294)	4.37 (0.229)

	Exterior Finish			
	13 mm stucco	wood siding	100 mm brick and 25 mm air	19 mm furring behind finish
RSI Adjustment	-0.10	0.04	0.14	0.18

	Interior Finish			
	6 mm wood paneling	16 mm gypsum board	strapped air space	
RSI Adjustment	-0.02	0.02	0.19	

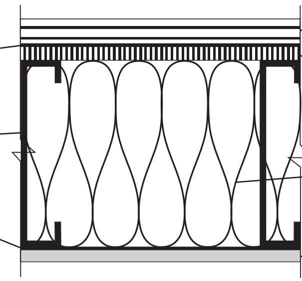
Table B-8 (Continued)

Example:	RSI 0.88 sheathing with RSI 3.52 cavity insulation
RSI_F	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 152 mm Steel Framing + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 0.0024472 + 0.0793 + 0.12
	= 1.2328
RSI_I	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + Insulation + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 3.52 + 0.0793 + 0.12
	= 4.7503
RSI_{T1}	$= 1 \div ((0.0063 \div RSI_F) + (0.9937 \div RSI_I))$
	= 4.6664
RSI_{T2}	= 1 ÷ ((0.0063 ÷ RSI of Steel Framing) + (0.9937 ÷ RSI of Insulation))
	$= 1 \div ((0.0063 \div 0.0024472) + (0.9937 \div 3.52))$
	= 0.3501
RSI_{T3}	= RSI_{T2}+ Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 13 mm Gypsum + Interior Air
	= 0.3501 + 0.03 + 0.11 + 0.011 + 0.88 + 0.0793 + 0.12
	= 1.5804
RSI_T	$= ((2 \times RSI_{T1}) + (3 \times RSI_{T3})) \div 5$
	= 2.81

Notes to Table B-8:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) For other insulating sheathings, add the sheathing RSI value to the 'no sheathing' category.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.

Table B-9
Metal Frame Wall: 41 x 152 mm @ 610 mm o.c.
with aluminum or vinyl siding exterior finish and 13 mm gypsum board interior finish



Sheathing[2]	Cavity Insulation[1]			
	no insulation	RSI 3.52	RSI 3.87	RSI 6.40
	Effective RSI (Overall U-Value)[3]			
no sheathing	0.51 (1.957)	2.32 (0.431)	2.49 (0.402)	3.64 (0.275)
13 mm gypsum	0.59 (1.694)	2.41 (0.415)	2.58 (0.388)	3.75 (0.266)
11 mm plywood or particle board	0.61 (1.649)	2.43 (0.411)	2.60 (0.385)	3.78 (0.265)
11 mm waferboard or OSB	0.63 (1.583)	2.46 (0.407)	2.63 (0.381)	3.81 (0.262)
11 mm fibreboard	0.69 (1.447)	2.52 (0.396)	2.69 (0.371)	3.89 (0.257)
RSI 0.88 sheathing	1.39 (0.719)	3.25 (0.308)	3.42 (0.292)	4.66 (0.215)
RSI 1.05 sheathing	1.56 (0.641)	3.42 (0.293)	3.59 (0.278)	4.84 (0.207)
RSI 1.14 sheathing	1.65 (0.606)	3.51 (0.285)	3.68 (0.271)	4.93 (0.203)
RSI 1.32 sheathing	1.83 (0.546)	3.69 (0.271)	3.87 (0.259)	5.12 (0.195)

	Exterior Finish			
	13 mm stucco	wood siding	100 mm brick and 25 mm air	19 mm furring behind finish
RSI Adjustment	-0.10	0.04	0.14	0.18

	Interior Finish			
	6 mm wood paneling	16 mm gypsum board	strapped air space	
RSI Adjustment	-0.02	0.02	0.19	

Table B-9 (Continued)

Example:	RSI 0.88 sheathing with RSI 3.52 cavity insulation
RSI_F	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 92 mm Steel Framing + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 0.0014812 + 0.0793 + 0.12
	= 1.2327
RSI_I	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + Insulation + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 3.52 + 0.0793 + 0.12
	= 4.7503
RSI_{T1}	$= 1 \div ((0.0037 \div RSI_F) + (0.9963 \div RSI_I))$
	= 4.7007
RSI_{T2}	= 1 ÷ ((0.0037 ÷ RSI of Steel Framing) + (0.9963 ÷ RSI of Insulation))
	$= 1 \div ((0.0037 \div 0.0024472) + (0.9963 \div 3.52))$
	= 0.5571
RSI_{T3}	= RSI_{T2} + Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 13 mm Gypsum + Interior Air
	= 0.5571 + 0.03 + 0.11 + 0.011 + 0.88 + 0.0793 + 0.12
	= 1.7874
RSI_T	$= (RSI_{T1} + RSI_{T3}) \div 2$
	= 3.25

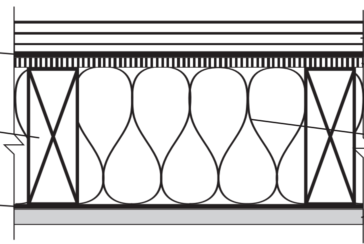
Notes to Table B-9:

(1) To convert insulation RSI to insulation thickness, see Table B-1.

(2) For other insulating sheathings, add the sheathing RSI value to the 'no sheathing' category.

(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.

Table B-10
Wood Frame Wall: 38 x 89 mm @ 406 mm o.c.
with aluminum or vinyl siding exterior finish and 13 mm gypsum board interior finish



Sheathing(2)	Cavity Insulation(1)				
	no insulation	RSI 2.11	RSI 2.29	RSI 2.46	RSI 3.70
	Effective RSI (Overall U-Value)(3)				
no sheathing	0.59 (1.705)	1.97 (0.507)	2.07 (0.484)	2.15 (0.466)	2.65 (0.377)
13 mm gypsum	0.67 (1.494)	2.07 (0.484)	2.16 (0.463)	2.24 (0.445)	2.77 (0.361)
11 mm plywood or particle board	0.69 (1.457)	2.08 (0.480)	2.18 (0.459)	2.26 (0.442)	2.79 (0.358)
11 mm waferboard or OSB	0.71 (1.403)	2.11 (0.473)	2.21 (0.453)	2.30 (0.436)	2.83 (0.354)
11 mm fibreboard	0.77 (1.292)	2.18 (0.459)	2.28 (0.439)	2.37 (0.423)	2.91 (0.343)
RSI 0.88 sheathing	1.49 (0.672)	2.94 (0.340)	3.05 (0.327)	3.16 (0.317)	3.82 (0.262)
RSI 1.05 sheathing	1.66 (0.602)	3.12 (0.320)	3.24 (0.309)	3.34 (0.299)	4.03 (0.248)
RSI 1.14 sheathing	1.75 (0.571)	3.22 (0.311)	3.33 (0.300)	3.44 (0.291)	4.13 (0.242)
RSI 1.32 sheathing	1.93 (0.517)	3.40 (0.294)	3.52 (0.284)	3.63 (0.276)	4.34 (0.230)

	Exterior Finish			
	13 mm stucco	wood siding	100 mm brick and 25 mm air	19 mm furring behind finish
RSI Adjustment	-0.10	0.04	0.14	0.18

	Interior Finish		
	6 mm wood paneling	16 mm gypsum board	strapped air space
RSI Adjustment	-0.02	0.02	0.19

Table B-10 (Continued)

Example:	RSI 0.88 sheathing with RSI 2.29 cavity insulation
RSI_F	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 89 mm Wood + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 0.7209 + 0.0793 + 0.12
	= 1.9512
RSI_I	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + Insulation + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 2.29 + 0.0793 + 0.12
	= 3.5203
RSI_T	$= 1 \div ((0.19 \div RSI_F) + (0.81 \div RSI_I))$
	= 3.05

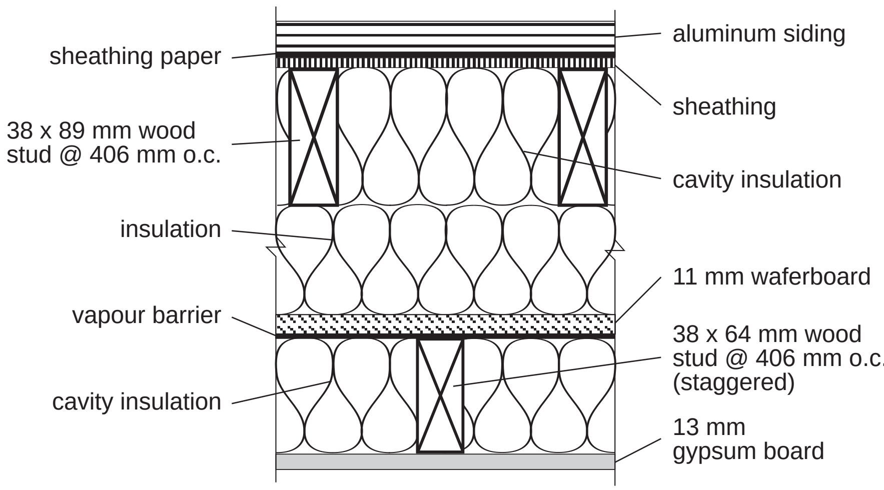
Notes to Table B-10:

(1) To convert insulation RSI to insulation thickness, see Table B-1.

(2) For other insulating sheathings, add the sheathing RSI value to the 'no sheathing' category.

(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.

Table B-11
Wood Frame Wall: Double Studs @ 406 mm o.c.
with aluminum or vinyl siding exterior finish and 13 mm gypsum board interior finish



	Cavity Insulation(1)			
	RSI 4.58	RSI 5.63	RSI 7.04	RSI 7.39
Structure	Effective RSI (Overall U-Value), No Sheathing(2)			
38 x 89 mm and 38 x 64 mm staggered	4.52 (0.221)	5.59 (0.179)	7.01 (0.143)	7.36 (0.136)
38 x 89 mm and 38 x 64 mm unstaggered	4.32 (0.231)	5.44 (0.184)	6.91 (0.145)	7.27 (0.138)
38 x 89 mm and 38 x 89 mm staggered	4.42 (0.226)	5.49 (0.182)	6.92 (0.145)	7.27 (0.137)
38 x 89 mm and 38 x 89 mm unstaggered	4.11 (0.243)	5.27 (0.190)	6.77 (0.148)	7.13 (0.140)
	Exterior Finish			
	13 mm stucco	wood siding	100 mm brick and 25 mm air	19 mm furring behind finish
RSI Adjustment	-0.10	0.04	0.14	0.18
	Sheathing(3)			
	13 mm gypsum	11 mm plywood or particle board	11 mm waferboard or OSB	11 mm fibreboard
RSI Adjustment	0.08	0.10	0.12	0.18
	Interior Finish			
	6 mm wood paneling	16 mm gypsum board	strapped air space	
RSI Adjustment	-0.02	0.02	0.19	

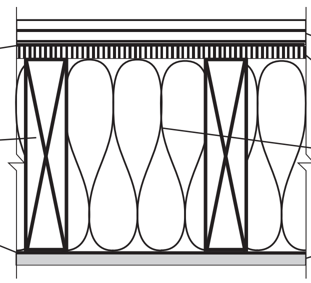
Table B-11 (Continued)

Example:	38 x 89 mm and 38 x 64 mm staggered, no sheathing, with RSI 5.63 cavity insulation
RSI_{F1}	= Exterior Air + Aluminum Siding + Sheathing Paper + 89 mm Wood + Insulation (between stud rows) + 11 mm Waferboard + Insulation (interior) + 13 mm Gypsum + Interior Air
	$= 0.03 + 0.11 + 0.011 + 0.7209 + (5.63 - 0.0236 \times (89 + 64)) + 0.121 + (0.0236 \times 64) + 0.0793 + 0.12$
	= 4.7218
RSI_{F2}	= Exterior Air + Aluminum Siding + Sheathing Paper + Insulation (exterior) + Insulation (between stud rows) + 11 mm Waferboard + 64 mm Wood + 13 mm Gypsum + Interior Air
	$= 0.03 + 0.11 + 0.011 + (0.0236 \times 89) + (5.63 - 0.0236 \times (89 + 64)) + 0.121 + 0.5184 + 0.0793 + 0.12$
	= 5.1093
RSI_I	= Exterior Air + Aluminum Siding + Sheathing Paper + Insulation + 11 mm Waferboard + 13 mm Gypsum + Interior Air
	$= 0.03 + 0.11 + 0.011 + 5.63 + 0.121 + 0.0793 + 0.12$
	= 6.1013
RSI_T	$= 1 \div ((0.19 \div RSI_{F1}) + (0.19 \div RSI_{F2}) + ((1 - (2 \times 0.19)) \div RSI_I))$
	= 5.59

Notes to Table B-11:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(3) For other insulated sheathings, add the sheathing RSI to total RSI.

Table B-12
Wood Frame Wall: 38 x 140 mm @ 406 mm o.c.
with aluminum or vinyl siding exterior finish and 13 mm gypsum board interior finish



Sheathing[2]	Cavity Insulation[1]					
	no insulation	RSI 3.25	RSI 3.34	RSI 3.52	RSI 3.87	RSI 5.90
	Effective RSI (Overall U-Value)[3]					
no sheathing	0.60 (1.655)	2.83 (0.353)	2.88 (0.348)	2.96 (0.337)	3.13 (0.320)	3.88 (0.258)
13 mm gypsum	0.69 (1.450)	2.93 (0.342)	2.97 (0.336)	3.06 (0.327)	3.23 (0.310)	4.01 (0.249)
11 mm plywood or particle board	0.71 (1.414)	2.95 (0.339)	2.99 (0.334)	3.08 (0.324)	3.25 (0.308)	4.03 (0.248)
11 mm waferboard or OSB	0.73 (1.362)	2.98 (0.336)	3.02 (0.331)	3.11 (0.321)	3.28 (0.305)	4.07 (0.245)
11 mm fibreboard	0.80 (1.254)	3.05 (0.328)	3.09 (0.323)	3.18 (0.314)	3.35 (0.298)	4.17 (0.240)
RSI 0.88 sheathing	1.53 (0.655)	3.83 (0.261)	3.88 (0.258)	3.99 (0.251)	4.18 (0.239)	5.16 (0.194)
RSI 1.05 sheathing	1.70 (0.588)	4.01 (0.249)	4.07 (0.246)	4.17 (0.240)	4.37 (0.229)	5.38 (0.186)
RSI 1.14 sheathing	1.79 (0.557)	4.11 (0.243)	4.17 (0.240)	4.27 (0.234)	4.47 (0.224)	5.49 (0.182)
RSI 1.32 sheathing	1.98 (0.506)	4.30 (0.232)	4.36 (0.229)	4.47 (0.224)	4.67 (0.214)	5.72 (0.175)

	Exterior Finish			
	13 mm stucco	wood siding	100 mm brick and 25 mm air	19 mm furring behind finish
RSI Adjustment	-0.10	0.04	0.14	0.18

	Interior Finish		
	6 mm wood paneling	16 mm gypsum board	strapped air space
RSI Adjustment	-0.02	0.02	0.19

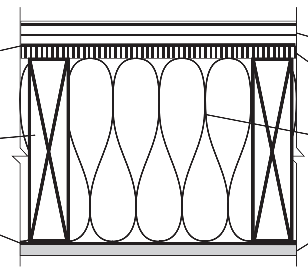
Table B-12 (Continued)

Example:	RSI 0.88 sheathing with RSI 3.52 cavity insulation
RSI_F	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 140 mm Wood + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 1.134 + 0.0793 + 0.12
	= 2.3643
RSI_I	= Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + Insulation + 13 mm Gypsum + Interior Air
	= 0.03 + 0.11 + 0.011 + 0.88 + 3.52 + 0.0793 + 0.12
	= 4.7503
RSI_T	$= 1 \div ((0.19 \div RSI_F) + (0.81 \div RSI_I))$
	= 3.99

Notes to Table B-12:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) For other insulating sheathings, add the sheathing RSI value to the 'no sheathing' category.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.

Table B-13
Wood Frame Wall: 38 x 140 mm @ 610 mm o.c.
with aluminum or vinyl siding exterior finish and 13 mm gypsum board interior finish



Sheathing[2]	Cavity Insulation[1]					
	no insulation	RSI 3.25	RSI 3.34	RSI 3.52	RSI 3.87	RSI 5.90
	Effective RSI (Overall U-Value)[3]					
no sheathing	0.57 (1.752)	3.11 (0.321)	3.17 (0.315)	3.29 (0.304)	3.51 (0.285)	4.62 (0.217)
13 mm gypsum	0.65 (1.530)	3.20 (0.312)	3.26 (0.306)	3.38 (0.296)	3.61 (0.277)	4.74 (0.211)
11 mm plywood or particle board	0.67 (1.491)	3.22 (0.310)	3.28 (0.305)	3.40 (0.294)	3.63 (0.276)	4.76 (0.210)
11 mm waferboard or OSB	0.70 (1.435)	3.25 (0.308)	3.31 (0.302)	3.43 (0.292)	3.66 (0.274)	4.80 (0.208)
11 mm fibreboard	0.76 (1.318)	3.32 (0.301)	3.38 (0.296)	3.50 (0.286)	3.73 (0.268)	4.89 (0.204)
RSI 0.88 sheathing	1.48 (0.678)	4.08 (0.245)	4.14 (0.241)	4.28 (0.234)	4.52 (0.221)	5.84 (0.171)
RSI 1.05 sheathing	1.65 (0.607)	4.26 (0.235)	4.33 (0.231)	4.46 (0.224)	4.71 (0.212)	6.05 (0.165)
RSI 1.14 sheathing	1.74 (0.575)	4.35 (0.230)	4.42 (0.226)	4.55 (0.220)	4.81 (0.208)	6.16 (0.162)
RSI 1.32 sheathing	1.92 (0.520)	4.54 (0.220)	4.61 (0.217)	4.75 (0.211)	5.00 (0.200)	6.38 (0.157)

	Exterior Finish			
	13 mm stucco	wood siding	100 mm brick and 25 mm air	19 mm furring behind finish
RSI Adjustment	-0.10	0.04	0.14	0.18

	Interior Finish		
	6 mm wood paneling	16 mm gypsum board	strapped air space
RSI Adjustment	-0.02	0.02	0.19

Table B-13 (Continued)

Example: RSI 0.88 sheathing with RSI 3.52 cavity insulation

RSI_F = Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + 140 mm Wood + 13 mm Gypsum + Interior Air

= 0.03 + 0.11 + 0.011 + 0.88 + 1.134 + 0.0793 + 0.12

= 2.3643

RSI_I = Exterior Air + Aluminum Siding + Sheathing Paper + Sheathing + Insulation + 13 mm Gypsum + Interior Air

= 0.03 + 0.11 + 0.011 + 0.88 + 3.52 + 0.0793 + 0.12

= 4.7503

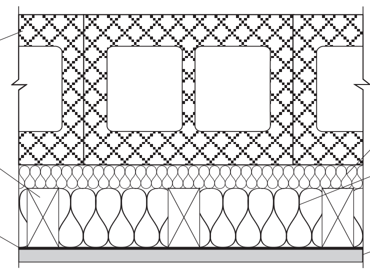
RSI_T = $1 \div ((0.11 \div RSI_F) + (0.89 \div RSI_I))$

= 4.28

Notes to Table B-13:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) For other insulating sheathings, add the sheathing RSI value to the ‘no sheathing’ category.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.

Table B-14
Masonry Wall: 190 mm Concrete Block (Normal Weight) with/without Wood Framing
with no exterior finish and 13 mm gypsum board interior finish



Framing/Spacing	Total Insulation(1)(2)				
	no insulation	RSI 1.41	RSI 2.11	RSI 2.29	RSI 2.46
	Effective RSI (Overall U-Value)(3)				
no framing	0.44 (2.276)	-	-	-	-
38 x 64 mm @ 406 mm o.c.	0.66 (1.506)	1.57 (0.636)	2.27 (0.440)	2.41 (0.415)	2.53 (0.395)
38 x 64 mm @ 610 mm o.c.	0.64 (1.552)	1.68 (0.596)	2.38 (0.420)	2.53 (0.395)	2.68 (0.374)
38 x 89 mm @ 406 mm o.c.	0.68 (1.472)	1.78 (0.563)	2.08 (0.481)	2.17 (0.461)	2.26 (0.443)
38 x 89 mm @ 610 mm o.c.	0.65 (1.532)	1.87 (0.533)	2.25 (0.444)	2.38 (0.421)	2.49 (0.402)

	Exterior Finish				
	13 mm stucco	aluminum or vinyl siding	wood siding	100 mm brick and 25 mm air	
RSI Adjustment	0.01	0.11	0.15	0.25	

	Sheathing(4)				
	RSI 0.88	RSI 1.05	RSI 1.14	RSI 1.33	RSI 1.42
RSI Adjustment	0.88	1.05	1.14	1.33	1.42

	Interior Finish		
	6 mm wood paneling	16 mm gypsum board	strapped air space
RSI Adjustment	-0.02	0.02	0.19

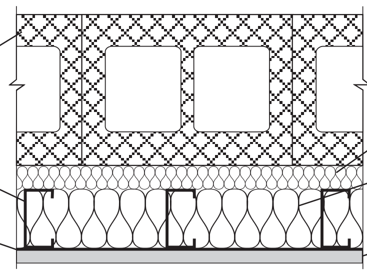
Table B-14 (Continued)

Example:	normal weight blocks, 38 x 64 mm @ 406 mm o.c. with RSI 2.29 total insulation
RSI_F	= Exterior Air + Concrete Block + 64 mm Wood + Insulation (between concrete and frame) + 13 mm Gypsum + Interior Air
	$= 0.03 + 0.21 + 0.5184 + (2.29 - (2.29 \div 89 \times 64)) + 0.0793 + 0.12$
	= 1.6010
RSI_I	= Exterior Air + Concrete Block + Insulation + 13 mm Gypsum + Interior Air
	= 0.03 + 0.21 + 2.29 + 0.0793 + 0.12
	= 2.7293
RSI_T	$= 1 \div ((0.19 \div RSI_F) + (0.81 \div RSI_I))$
	= 2.41

Notes to Table B-14:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) The batts are not compressed; the studs are pulled away from the concrete to accommodate batt thickness.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(4) For other insulated sheathings, add the sheathing RSI to total RSI.

Table B-15
Masonry Wall: 190 mm Concrete Block (Normal Weight) with/without Metal Framing
with no exterior finish and 13 mm gypsum board interior finish



Framing/Spacing	Total Insulation[1][2]				
	no insulation	RSI 1.41	RSI 2.11	RSI 2.29	RSI 2.46
	Effective RSI (Overall U-Value)[3]				
no framing	0.44 (2.276)	-	-	-	-
41 x 92 mm @ 406 mm o.c.	0.57 (1.764)	1.09 (0.918)	1.26 (0.795)	1.31 (0.761)	1.37 (0.731)
41 x 92 mm @ 610 mm o.c.	0.59 (1.691)	1.38 (0.724)	1.64 (0.609)	1.73 (0.578)	1.81 (0.551)

	Exterior Finish			
	13 mm stucco	aluminum or vinyl siding	wood siding	100 mm brick and 25 mm air
RSI Adjustment	0.01	0.11	0.15	0.25

	Sheathing[4]				
	RSI 0.88	RSI 1.05	RSI 1.14	RSI 1.33	RSI 1.42
RSI Adjustment	0.88	1.05	1.14	1.33	1.42

	Interior Finish		
	6 mm wood paneling	16 mm gypsum board	strapped air space
RSI Adjustment	-0.02	0.02	0.19

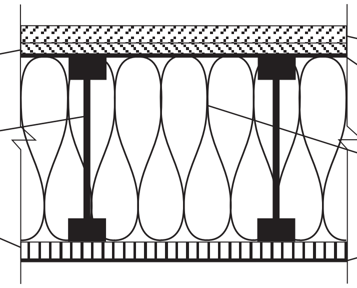
Table B-15 (Continued)

Example:	normal weight blocks, 41 x 92 mm @ 406 mm o.c. with RSI 2.29 total insulation
RSI_F	= Exterior Air + Concrete Block + 92 mm Steel Framing +13 mm Gypsum + Interior Air
	= 0.03 + 0.21 + 0.0014812 + 0.0793 + 0.12
	= 0.4408
RSI_I	= Exterior Air + Concrete Block + Insulation +13 mm Gypsum + Interior Air
	= 0.03 + 0.21 + 2.29 + 0.0793 + 0.12
	= 2.7293
RSI_{T1}	$= 1 \div ((0.0063 \div RSI_F) + (0.9937 \div RSI_I))$
	= 2.6422
RSI_{T2}	= 1 ÷ ((0.0063 ÷ RSI of Steel Framing) + (0.9937 ÷ RSI of Insulation))
	$= 1 \div ((0.0063 \div 0.0014812) + (0.9937 \div 2.29))$
	= 0.2133
RSI_{T3}	= RSI_{T2} + Exterior Air + Concrete Block + 13 mm Gypsum + Interior Air
	= 0.2133 + 0.03 + 0.21 + 0.0793 + 0.12
	= 0.6526
RSI_T	$= (RSI_{T1} + (2 \times RSI_{T3})) \div 3$
	= 1.31

Notes to Table B-15:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) The batts are not compressed; the studs are pulled away from the concrete to accommodate batt thickness.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(4) For other insulated sheathings, add the sheathing RSI to total RSI.

Table B-16
Floor: Truss- or Wood I-Joist-Type @ 406 mm o.c.
Trusses or I-Joists with no exterior finish and carpet and fibrous pad interior finish



Sheathing(2)	Cavity Insulation(1)			
	RSI 5.46	RSI 7.04	RSI 8.81	RSI 10.6
	Effective RSI (Overall U-Value)(3)			
no sheathing	5.85 (0.171)	7.32 (0.137)	9.07 (0.110)	10.73 (0.093)
13 mm gypsum	5.93 (0.169)	7.40 (0.135)	9.16 (0.109)	10.81 (0.092)
11 mm plywood or particle board	5.95 (0.168)	7.42 (0.135)	9.17 (0.109)	10.83 (0.092)
11 mm waferboard or OSB	5.97 (0.167)	7.44 (0.134)	9.20 (0.109)	10.86 (0.092)
11 mm fibreboard	6.03 (0.166)	7.51 (0.133)	9.26 (0.108)	10.92 (0.092)
RSI 0.88 sheathing	6.76 (0.148)	8.24 (0.121)	9.99 (0.100)	11.66 (0.086)
RSI 0.97 sheathing	6.85 (0.146)	8.33 (0.120)	10.09 (0.099)	11.75 (0.085)
RSI 1.05 sheathing	6.93 (0.144)	8.42 (0.119)	10.17 (0.098)	11.84 (0.084)
RSI 1.14 sheathing	7.02 (0.142)	8.51 (0.118)	10.26 (0.097)	11.93 (0.084)

	Exterior Finish	
	3 mm plywood	6 mm plywood
RSI Adjustment	0.03	0.05

	Interior Finish(4)			
	ceramic tile	linoleum, vinyl, rubber or terrazzo tile	hardwood finish	carpet and rubber pad
RSI Adjustment	-0.37	-0.36	-0.25	-0.15

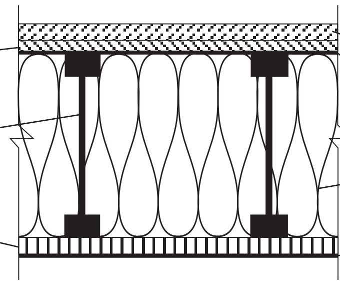
Table B-16 (Continued)

Example:	with wood I-Joists, RSI 0.88 sheathing with RSI 7.04 cavity insulation
RSI_{Fweb}	= Exterior Air + Sheathing Paper + Sheathing + Wood Web + 16 mm Plywood + Carpet and Pad + Interior Air
	= 0.03 + 0.011 + 0.88 + (265 × 0.0081) + 0.1392 + 0.37 + 0.16
	= 3.7367
$RSI_{Fflange}$	= Exterior Air + Sheathing Paper + Sheathing + 2 x 38 mm Wood Flanges + Insulation + 16 mm Plywood + Carpet and Pad + Interior Air
	= 0.03 + 0.011 + 0.88 + (2 × 0.3078) + (7.04 - 2 × 38 × (7.04 ÷ 265)) + 0.1392 + 0.37 + 0.16
	= 7.2268
RSI_I	= Exterior Air + Sheathing Paper + Sheathing + Insulation + 16 mm Plywood + Carpet and Pad + Interior Air
	= 0.03 + 0.011 + 0.88 + 7.04 + 0.1392 + 0.37 + 0.16
	= 8.6302
	Assuming that the thickness of the I-Joist web is 25% of the width of the flanges:
RSI_T	$= 1 \div (((0.25 \times 0.1) \div RSI_{Fweb}) + ((0.75 \times 0.1) \div RSI_{Fflange}) + (0.9 \div RSI_I))$
	= 8.24

Notes to Table B-16:

(1) To convert insulation RSI to insulation thickness,see Table B-1.
(2) For other insulating sheathings, add the sheathing RSI value to the 'no sheathing' category.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(4) Interior finish includes subfloor.

Table B-17
Floor: Truss- or Wood I-Joist-Type @ 610 mm o.c.
Trusses or I-Joists with no exterior finish and carpet and fibrous pad interior finish



	Cavity Insulation(1)			
	RSI 5.46	RSI 7.04	RSI 8.81	RSI 10.6
Sheathing(2)	Effective RSI (Overall U-Value)(3)			
no sheathing	5.94 (0.168)	7.44 (0.134)	9.20 (0.109)	10.90 (0.092)
13 mm gypsum	6.02 (0.166)	7.52 (0.133)	9.29 (0.108)	10.98 (0.091)
11 mm plywood or particle board	6.04 (0.166)	7.54 (0.133)	9.30 (0.107)	11.00 (0.091)
11 mm waferboard or OSB	6.06 (0.165)	7.57 (0.132)	9.33 (0.107)	11.02 (0.091)
11 mm fibreboard	6.13 (0.163)	7.63 (0.131)	9.39 (0.106)	11.09 (0.090)
RSI 0.88 sheathing	6.84 (0.146)	8.35 (0.120)	10.11 (0.099)	11.81 (0.085)
RSI 0.97 sheathing	6.93 (0.144)	8.45 (0.118)	10.20 (0.098)	11.91 (0.084)
RSI 1.05 sheathing	7.02 (0.143)	8.53 (0.117)	10.29 (0.097)	11.99 (0.083)
RSI 1.14 sheathing	7.11 (0.141)	8.62 (0.116)	10.38 (0.096)	12.08 (0.083)

	Exterior Finish	
	3 mm plywood	6 mm plywood
RSI Adjustment	0.03	0.05

	Interior Finish(4)			
	ceramic tile	linoleum, vinyl, rubber or terrazzo tile	hardwood finish	carpet and rubber pad
RSI Adjustment	-0.37	-0.36	-0.25	-0.15

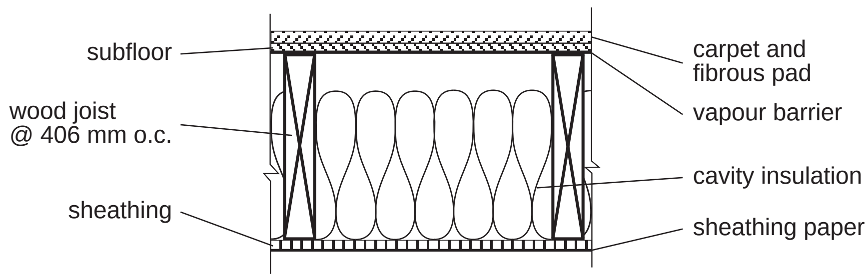
Table B-17 (Continued)

Example:	with wood I-Joists, RSI 0.88 sheathing with RSI 7.04 cavity insulation
RSI_{Fweb}	= Exterior Air + Sheathing Paper + Sheathing + Wood Web + 16 mm Plywood + Carpet and Pad + Interior Air
	$= 0.03 + 0.011 + 0.88 + (265 \times 0.0081) + 0.1392 + 0.37 + 0.16$
	$= 3.7367$
$RSI_{Fflange}$	= Exterior Air + Sheathing Paper + Sheathing + 2 x 38 mm Wood Flanges + Insulation + 16 mm Plywood + Carpet and Pad + Interior Air
	$= 0.03 + 0.011 + 0.88 + (2 \times 0.3078) + (7.04 - 2 \times 38 \times (7.04 \div 265)) + 0.1392 + 0.37 + 0.16$
	$= 7.2268$
RSI_I	= Exterior Air + Sheathing Paper + Sheathing + Insulation + 16 mm Plywood + Carpet and Pad + Interior Air
	$= 0.03 + 0.011 + 0.88 + 7.04 + 0.1392 + 0.37 + 0.16$
	$= 8.6302$
	Assuming that the thickness of the I-Joist web is 25% of the width of the flanges:
RSI_T	$= 1 \div (((0.25 \times 0.07) \div RSI_{Fweb}) + ((0.75 \times 0.07) \div RSI_{Fflange}) + (0.93 \div RSI_I))$
	$= 8.35$

Notes to Table B-17:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) For other insulating sheathings, add the sheathing RSI value to the 'no sheathing' category.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(4) Interior finish includes subfloor.

Table B-18
Floor: Floor-Joist-Type
Joist @ 406 mm o.c. with no exterior finish and carpet and fibrous pad interior finish



	Cavity Insulation(1)(2)				
	RSI 2.46	RSI 3.52	RSI 4.93	RSI 5.46	RSI 7.04
Sheathing(3)	Effective RSI (Overall U-Value)(4)				
no sheathing	3.23 (0.310)	4.04 (0.247)	5.22 (0.192)	5.58 (0.179)	6.85 (0.146)
13 mm gypsum	3.31 (0.302)	4.13 (0.242)	5.30 (0.189)	5.67 (0.176)	6.94 (0.144)
11 mm plywood or particle board	3.33 (0.301)	4.14 (0.241)	5.32 (0.188)	5.69 (0.176)	6.96 (0.144)
11 mm waferboard or OSB	3.35 (0.298)	4.17 (0.240)	5.35 (0.187)	5.71 (0.175)	6.99 (0.143)
11 mm fibreboard	3.41 (0.293)	4.23 (0.236)	5.42 (0.185)	5.78 (0.173)	7.06 (0.142)
RSI 0.88 sheathing	4.12 (0.243)	4.97 (0.201)	6.17 (0.162)	6.55 (0.153)	7.85 (0.127)
RSI 1.05 sheathing	4.29 (0.233)	5.14 (0.194)	6.35 (0.158)	6.73 (0.149)	8.03 (0.124)
RSI 1.14 sheathing	4.38 (0.228)	5.24 (0.191)	6.44 (0.155)	6.83 (0.146)	8.13 (0.123)
RSI 1.32 sheathing	4.57 (0.219)	5.42 (0.184)	6.63 (0.151)	7.02 (0.142)	8.33 (0.120)

	Joists @ 610 mm o.c.(5)				
	RSI 2.46	RSI 3.52	RSI 4.93	RSI 5.46	RSI 7.04
RSI Adjustment	0.05	0.10	0.16	0.20	0.28

	Exterior Finish	
	3 mm plywood	6 mm plywood
RSI Adjustment	0.03	0.05

	Interior Finish(6)			
	ceramic tile	linoleum, vinyl, rubber or terrazzo tile	hardwood finish	carpet and rubber pad
RSI Adjustment	-0.37	-0.36	-0.25	-0.15

Table B-18 (Continued)

Example: RSI 0.88 sheathing with RSI 3.52 cavity insulation

RSI_F = Exterior Air + Sheathing Paper + Sheathing + 191 mm Wood + 16 mm Plywood + Carpet and Pad + Interior Air

$= 0.03 + 0.011 + 0.88 + (191 \times 0.0081) + 0.1392 + 0.37 + 0.16$

$= 3.1373$

RSI_I = Exterior Air + Sheathing Paper + Sheathing + Insulation + 40 mm Air Space + 16 mm Plywood + Carpet and Pad + Interior Air

$= 0.03 + 0.011 + 0.88 + 3.52 + 0.20 + 0.1392 + 0.37 + 0.16$

$= 5.3102$

$RSI_T = 1 \div ((0.1 \div RSI_F) + (0.9 \div RSI_I))$

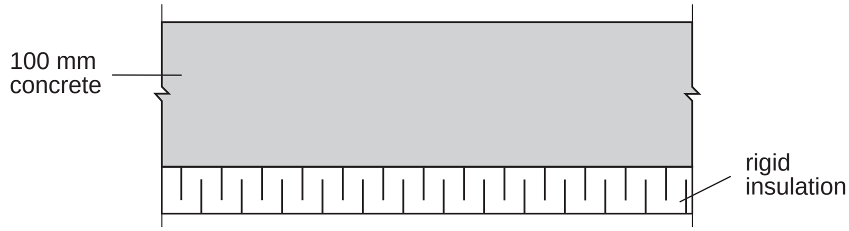
$= 4.97$

Notes to Table B-18:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) Glass/mineral fibre batts used to determine insulation thickness.
(3) For other insulating sheathings, add the sheathing RSI value to the 'no sheathing' category.
(4) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(5) Joist sizes used:
- 38 x 191 mm for RSI 2.46 and RSI 3.52
- 38 x 241 mm for RSI 4.93 and RSI 5.46
- 38 x 292 mm for RSI 7.04

(6) Interior finish includes subfloor.

Table B-19
Floor: Concrete
with no exterior or interior finish



	Rigid Insulation(1)						
	no insulation	RSI 0.88	RSI 1.32	RSI 1.76	RSI 2.64	RSI 3.52	RSI 4.42
Slab Thickness	Effective RSI (Overall U-Value)						
100 mm	0.23 (4.348)	1.11 (0.901)	1.55 (0.645)	1.99 (0.503)	2.87 (0.348)	3.75 (0.267)	4.65 (0.215)

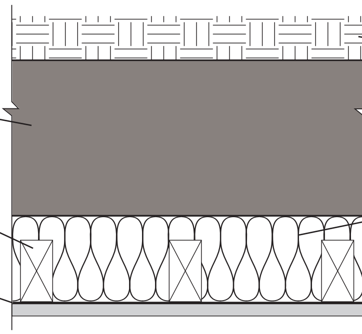
	Interior Finish(2)				
	ceramic tile	linoleum, vinyl, rubber or terrazzo tile	hardwood finish	carpet and rubber pad	carpet and fibrous pad
RSI Adjustment	0.14	0.15	0.26	0.36	0.51

Example: RSI 0.88 rigid insulation

RSI_T = Interior Air + 100 mm Concrete + Insulation + Exterior Air
= 0.16 + 0.04 + 0.88 + 0.03
= 1.11

Notes to Table B-19:
(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) Interior finish includes subfloor.

Table B-20
Walls in Contact with the Ground: 200 mm Concrete with/without Wood Framing
with 13 mm gypsum board interior finish



Framing/Spacing	Cavity Insulation(1)(2)					
	no insulation	RSI 1.41	RSI 2.11	RSI 2.29	RSI 2.46	RSI 3.52
	Effective RSI (Overall U-Value)(3)					
no framing (no gypsum board)	0.21 (4.739)	-	-	-	-	-
38 x 64 mm @ 406 mm o.c.	0.51 (1.975)	1.43 (0.698)	1.93 (0.518)	2.03 (0.494)	2.11 (0.474)	2.57 (0.390)
38 x 64 mm @ 610 mm o.c.	0.49 (2.037)	1.53 (0.653)	2.10 (0.476)	2.22 (0.450)	2.33 (0.428)	2.96 (0.337)
38 x 89 mm @ 406 mm o.c.	0.52 (1.933)	1.64 (0.610)	1.95 (0.514)	2.04 (0.490)	2.13 (0.470)	2.77 (0.361)
38 x 89 mm @ 610 mm o.c.	0.50 (2.013)	1.73 (0.578)	2.11 (0.474)	2.23 (0.448)	2.35 (0.426)	3.12 (0.320)

	Interior or Exterior Rigid Insulation(4)					
	RSI 0.88	RSI 1.05	RSI 1.42	RSI 1.76	RSI 2.13	RSI 2.84
RSI Adjustment	0.88	1.05	1.42	1.76	2.13	2.84

	Interior Finish		
	6 mm wood paneling	16 mm gypsum board	strapped air space
RSI Adjustment	-0.02	0.02	0.19

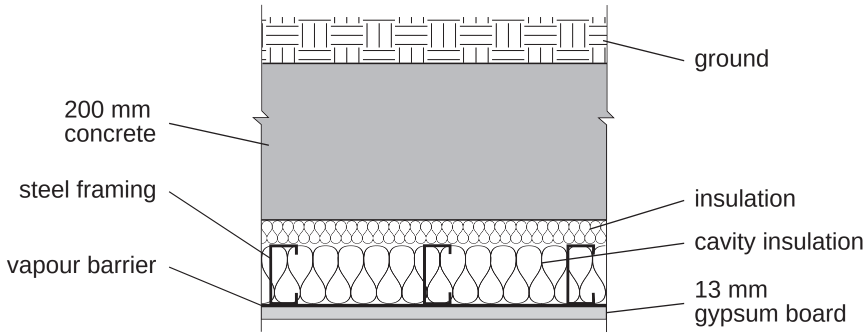
Table B-20 (Continued)

Example:	38 x 64 mm @ 406 mm o.c. with RSI 2.29 cavity insulation
RSI_F	= 200 mm Concrete + Sheathing Paper + Air Gap Behind Framing + 64 mm Wood + 13 mm Gypsum + Interior Air
	= 0.08 + 0.011 + 0.18 + 0.5184 + 0.0793 + 0.12
	= 0.9887
RSI_I	= 200 mm Concrete + Sheathing Paper + Insulation +13 mm Gypsum + Interior Air
	= 0.08 + 0.011 + 2.29 + 0.0793 + 0.12
	= 2.5803
RSI_T	$= 1 \div ((0.17 \div RSI_F) + (0.83 \div RSI_I))$
	= 2.03

Notes to Table B-20:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) The batts are not compressed; the studs are pulled away from the concrete to accommodate batt thickness.
(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(4) For other insulating sheathings, add the sheathing RSI value to total RSI.

Table B-21
Walls in Contact with the Ground: 200 mm Concrete with/without Steel Framing
with 13 mm gypsum board interior finish



Framing/Spacing	Cavity Insulation[1][2]					
	no insulation	RSI 1.41	RSI 2.11	RSI 2.29	RSI 2.46	RSI 3.50
	Effective RSI (Overall U-Value)[3]					
no framing (no gypsum board)	0.21 (4.739)	-	-	-	-	-
41 x 92 mm @ 406 mm o.c.	0.42 (2.375)	0.95 (1.052)	1.12 (0.895)	1.17 (0.852)	1.23 (0.816)	1.54 (0.650)
41 x 92 mm @ 610 mm o.c.	0.44 (2.252)	1.24 (0.805)	1.50 (0.667)	1.59 (0.630)	1.67 (0.599)	2.16 (0.462)

	Interior or Exterior Rigid Insulation[4]					
	RSI 0.88	RSI 1.05	RSI 1.42	RSI 1.76	RSI 2.13	RSI 2.84
RSI Adjustment	0.88	1.05	1.42	1.76	2.13	2.84

	Interior Finish		
	6 mm wood paneling	16 mm gypsum board	strapped air space
RSI Adjustment	-0.02	0.02	0.19

Table B-21 (Continued)

Example:	41 x 92 mm @ 406 mm o.c. with RSI 2.29 cavity insulation
RSI_F	= 200 mm Concrete + Sheathing Paper + 92 mm Steel Framing + 13 mm Gypsum + Interior Air
	= 0.08 + 0.011 + 0.0014812 + 0.0793 + 0.12
	= 0.2918
RSI_I	= 200 mm Concrete + Sheathing Paper + Insulation + 13 mm Gypsum + Interior Air
	= 0.08 + 0.011 + 2.29 + 0.0793 + 0.12
	= 2.5803
RSI_{T1}	$= 1 \div ((0.0057 \div RSI_F) + (0.9943 \div RSI_I))$
	= 2.4702
RSI_{T2}	= 1 ÷ ((0.0057 ÷ RSI of Steel Framing) + (0.9943 ÷ RSI of Insulation))
	$= 1 \div ((0.0057 \div 0.0014812) + (0.9943 \div 2.29))$
	= 0.2342
RSI_{T3}	= RSI_{T2} + 200 mm Concrete + Sheathing Paper + 13 mm Gypsum + Interior Air
	= 0.2342 + 0.08 + 0.011 + 0.0793 + 0.12
	= 0.5245
RSI_T	$= (RSI_{T1} + (2 \times RSI_{T3})) \div 3$
	= 1.17

Notes to Table B-21:

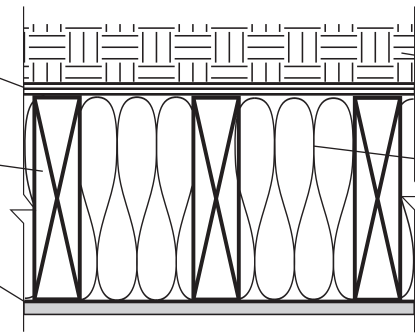
(1) To convert insulation RSI to insulation thickness, see Table B-1.

(2) The batts are not compressed; the studs are pulled away from the concrete to accommodate batt thickness.

(3) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.

(4) For other insulating sheathings, add the sheathing RSI value to total RSI.

Table B-22
Walls in Contact with the Ground: Preserved Wood Foundation Wall
with 16 mm plywood exterior finish and 13 mm gypsum board interior finish



Framing/Spacing	Cavity Insulation(1)				
	no insulation	RSI 3.25	RSI 3.52	RSI 3.87	RSI 5.9
	Effective RSI (Overall U-Value)(2)				
38 x 140 mm @ 406 mm o.c.	0.58 (1.716)	2.88 (0.347)	3.03 (0.331)	3.20 (0.313)	4.02 (0.248)
38 x 140 mm @ 610 mm o.c.	0.55 (1.804)	3.14 (0.319)	3.32 (0.301)	3.55 (0.282)	4.71 (0.212)
	Exterior Insulation(3)				
	RSI 0.88	RSI 0.97	RSI 1.05	RSI 1.14	RSI 1.42
RSI Adjustment	0.88	0.97	1.05	1.14	1.42
	Interior Finish				
	6 mm wood paneling	16 mm gypsum board	strapped air space		
RSI Adjustment	-0.02	0.02	0.19		

Example: 38 x 140 mm @ 406 mm o.c. with RSI 3.52 cavity insulation

RSI_F = 16 mm Plywood + 140 mm Wood + 13 mm Gypsum + Interior Air
= 0.1392 + 1.134 + 0.0793 + 0.12
= 1.4725

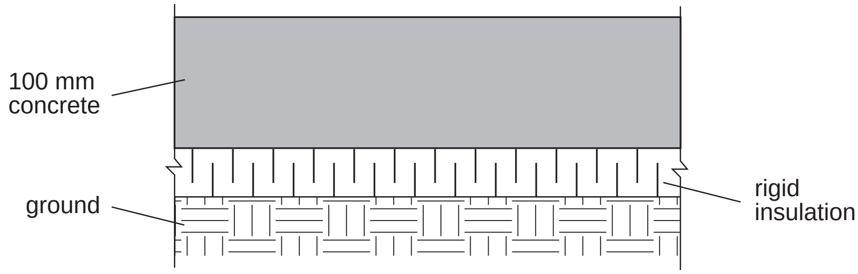
RSI_I = 16 mm Plywood + Insulation +13 mm Gypsum + Interior Air
= 0.1392 + 3.52 + 0.0793 + 0.12
= 3.8585

$RSI_T = 1 \div ((0.17 \div RSI_F) + (0.83 \div RSI_I))$
= 3.03

Notes to Table B-22:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) The effective thermal resistance and overall thermal transmittance values given have been calculated using framing percentages listed in Table C-1 of Appendix C.
(3) For other insulating sheathings, add the sheathing RSI value to total RSI.

Table B-23
Floors in Contact with the Ground: Concrete
with no interior finish



Slab Thickness	Rigid Insulation[1]						
	no insulation	RSI 0.88	RSI 1.32	RSI 1.76	RSI 2.64	RSI 3.52	RSI 4.42
	Effective RSI (Overall U-Value)						
100 mm	0.20 (5.000)	1.08 (0.926)	1.52 (0.658)	1.96 (0.510)	2.84 (0.352)	3.72 (0.269)	4.62 (0.216)

	Interior Finish[2]				
	ceramic tile	linoleum, vinyl, rubber or terrazzo tile	hardwood finish	carpet and rubber pad	carpet and fibrous pad
RSI Adjustment	0.14	0.15	0.26	0.36	0.51

Example: RSI 0.88 rigid insulation

RSI_T = 100 mm Concrete + Insulation + Interior Air
= 0.04 + 0.88 + 0.16
= 1.08

Notes to Table B-23:

(1) To convert insulation RSI to insulation thickness, see Table B-1.
(2) Interior finish includes subfloor.

Appendix C
Method for Calculating the Thermal Resistance of Building Assemblies

Assemblies With Wood Framing

Where the effective thermal resistance of a building envelope assembly containing wood framing cannot be determined from the tables in Appendix B, the procedure described herein shall be used.

This procedure is described in the ASHRAE 1997 Handbook — Fundamentals[1] for parallel path heat flow. It involves first calculating two sums of the thermal resistances of the various materials incorporated in the assembly —

- along a line that goes through the framing, RSI_F, and
- along a line that goes through the insulated portion, RSI_I.

The two sums are then combined, in proportion to the relative areas of framing and insulation, to calculate an effective thermal resistance, RSI_T, using the following formula:

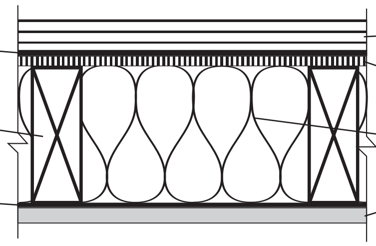
$$RSI_T = \frac{100}{\frac{\%\text{ area with framing}}{RSI_F} + \frac{\%\text{ area w/o framing}}{RSI_I}}$$

Finally, the reciprocal of the effective thermal resistance is calculated to yield the overall thermal transmittance.

Typical percentages of areas with and without framing are obtained from Table C-1 at the end of this appendix. RSI values for various materials are obtained from Table C-2.

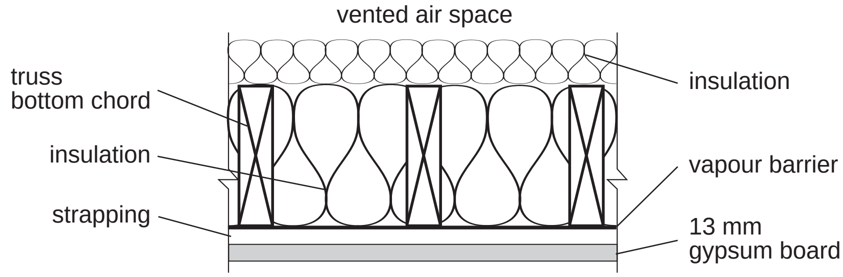
[1] Calculating Overall Thermal Resistances, page 24.2 of the ASHRAE 1997 Handbook — Fundamentals

Example 1: Wood Frame Wall



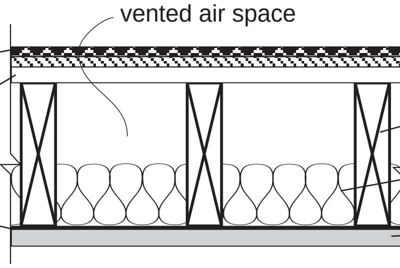
38 x 89 mm wood studs @ 406 mm o.c., RSI 2.11 batts, RSI 1.14 semi-rigid insulation		
Components	RSI_F through stud, $m^2 \cdot {}^\circ C/W$	RSI_I through insulation, $m^2 \cdot {}^\circ C/W$
Outside air film	0.03	0.03
Metal siding	0.11	0.11
Sheathing paper	0.01	0.01
Semi-rigid glass fibre (38 mm × 0.03 RSI/mm)	1.14	1.14
Stud (89 mm × 0.0081 RSI/mm)	0.72	-
Insulation (89 mm)	-	2.11
Polyethylene (vapour barrier)	-	-
Gypsum (13 mm × 0.0061 RSI/mm)	0.08	0.08
Interior film	0.12	0.12
Total	2.21	3.60
Percent of total area	19%	81%
$RSI_T = 100 \div ((19 \div 2.21) + (81 \div 3.60))$ $= 3.22$		
Overall thermal transmittance = 0.311		

Example 2: Attic with Wood Trusses



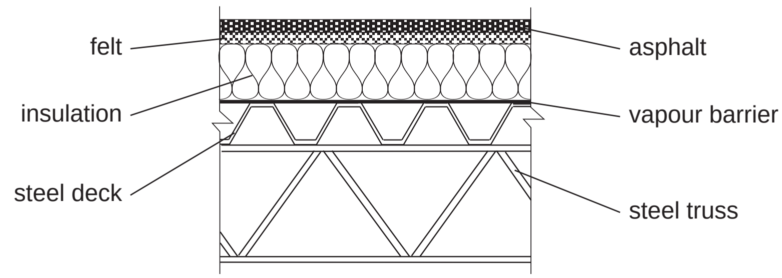
Wood trusses @ 610 mm o.c., RSI 7.04 loose fill insulation		
Components	RSI_F through insulation and wood member, $m^2 \cdot °C/W$	RSI_I through insulation, $m^2 \cdot °C/W$
Outside air film (does not count - vented roof)	-	-
Asphalt shingles (does not count - vented roof)	-	-
Oriented strand board, waferboard or plywood (does not count - vented roof)	-	-
Roof air space (like outside film)	0.03	0.03
Bottom chord (89 mm × 0.0081 RSI/mm + insulation)	5.54	-
Batt insulation (279 mm)	-	7.04
Polyethylene (vapour barrier)	-	-
Air space (created by strapping)	0.15	0.15
Gypsum (13 mm × 0.0061 RSI/mm)	0.08	0.08
Interior film	0.11	0.11
Total	5.91	7.41
Percent of total area	7%	93%
RSI_T = 100 ÷ ((7 ÷ 5.91) + (93 ÷ 7.41)) = 7.28		
Overall thermal transmittance = 0.137		

Example 3: Roof-joist-type Roof



235 mm roof joists @ 610 mm o.c., RSI 4.93 batt insulation		
Components	RSI_F through wood member, $m^2 \cdot °C/W$	RSI_I through insulation, $m^2 \cdot °C/W$
Outside air film (does not count - vented roof)	-	-
Asphalt shingles (does not count - vented roof)	-	-
Oriented strand board, waferboard or plywood (does not count - vented roof)	-	-
Roof air space (like outside film)	0.03	0.03
Roof joist 235 mm (203 mm × 0.0081 RSI/mm)	1.64	-
Batt insulation (203 mm)	-	4.93
Polyethylene (vapour barrier)	-	-
Gypsum (13 mm × 0.0061 RSI/mm)	0.08	0.08
Interior film	0.11	0.11
Total	1.86	5.15
Percent of total area	7%	93%
RSI_T = 100 ÷ ((7 ÷ 1.86) + (93 ÷ 5.15)) = 4.58		
Overall thermal transmittance = 0.218		

Example 4: Roof Deck(1)



RSI 2.88 expanded polystyrene	
Components	RSI through insulation, $m^2 \cdot {}^\circ C/W$
Outside air film	0.03
4-ply roofing and ballast	0.06
Expanded polystyrene II (102 mm × 0.028 RSI/mm)	2.88
Metal deck	0.001
Interior film	0.11
Total	3.08
RSI_T = 3.08	
Overall thermal transmittance = 0.325	

(1) In this case there is no framing, so the calculation is just a matter of adding the thermal resistances and taking the reciprocal.

Assemblies with Metal Framing

Where the effective thermal resistance of a building envelope assembly containing metal framing cannot be determined from the tables in Appendix B, the procedure described herein shall be used.

The procedure described above for wood-framed assemblies involves simple one-dimensional heat flow calculations, based on the assumption that the heat flow through the thermal bridge is parallel to the heat flow through the insulation. Another possible assumption is that the temperature at each plane is constant (typical of panels sandwiched between highly conductive panels).

Tests performed at the Institute for Research in Construction and elsewhere on metal-frame walls have shown that neither of the above assumptions properly represents the highly two-dimensional heat flow that actually occurs and that the differences between what is assumed and what actually occurs are significant with metal-framed assemblies. Europeans have been using the method described here with some degree of confidence. Comparisons with test results suggest that this method provides a good approximation if a value for the conductivity of steel of about 62 $W \cdot m / m^2 \cdot °C$ (resistivity = 0.0000161 $m^2 \cdot °C / W$ per mm) is used. This value, which is associated with galvanized steel with a carbon content of 0.14%, is the value used in this Code.

This method involves five steps:

(1) The effective thermal resistance is calculated, as described above for wood-framed assemblies. In this case, the result is designated RSI_{T1}.
(2) A similar calculation is carried out for those components of the assembly between the planes bounding the inner and outer faces of the metal framing members. This result is designated RSI_{T2}.
(3) RSI_{T2} is added to the resistances of the remaining components in the assembly (other than the insulation) to derive RSI_{T3}.
(4) RSI_{T1} and RSI_{T3} are combined using the following formula to give the effective thermal resistance:

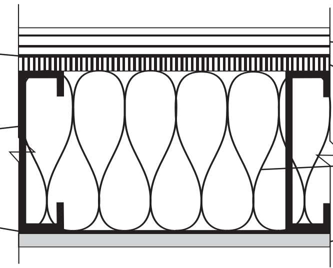
$$RSI_T = K_1 \cdot RSI_{T1} + K_2 \cdot RSI_{T3}$$

where K_1 and K_2 are as follows:

Framing Spacing, mm	K_1	K_2
< 500, without insulating sheathing	1/3	2/3
< 500, with insulating sheathing	2/5	3/5
≥ 500	1/2	1/2

(5) The reciprocal of RSI_T yields the overall thermal transmittance.

Example 5: Steel Frame Wall



41 x 92 mm steel studs @ 610 mm o.c., RSI 2.11 batts, RSI 1.33 extruded polystyrene insulation		
Step 1		
Components	RSI_F through steel stud, $m^2 \cdot °C/W$	RSI_I through insulation, $m^2 \cdot °C/W$
Outside air film	0.03	0.03
Brick veneer	0.07	0.07
Air space	0.18	0.18
Sheathing paper	0.01	0.01
Extruded polystyrene (38 mm × 0.035 RSI/mm)	1.33	1.33
Steel stud (92 mm × 0.0000161 RSI/mm)	0.00148	-
Insulation (89 mm)	-	2.11
Polyethylene (vapour barrier)	-	-
Gypsum (13 mm × 0.0061 RSI/mm)	0.08	0.08
Interior film	0.12	0.12
Total	1.82	3.93
Percent of total area	0.37%	99.63%
RSI_{T1} = 100 ÷ ((0.37 ÷ 1.82) + (99.63 ÷ 3.93)) = 3.91		
Step 2		
Components	RSI through steel stud, $m^2 \cdot °C/W$	RSI through insulation, $m^2 \cdot °C/W$
Steel stud (92 mm × 0.0000161 RSI/mm)	0.00148	-
Insulation (89 mm)	-	2.11
Total	0.00148	2.11
Percent of total area	0.37%	99.63%
RSI_{T2} = 100 ÷ ((0.37 ÷ 0.00148) + (99.63 ÷ 2.11)) = 0.34		

Step 3	
Components	RSI through steel stud and insulation, $m^2 \cdot {}^\circ C/W$
Outside air film	0.03
Brick veneer	0.07
Air space	0.18
Sheathing paper	0.01
Extruded polystyrene (38 mm × 0.035 RSI/mm)	1.33
RSI_{T2}	0.34
Polyethylene (vapour barrier)	-
Gypsum (13 mm × 0.0061 RSI/mm)	0.08
Interior film	0.12
Total	2.16

RSI_{T3} = 2.16

Step 4

$RSI_T = (RSI_{T1} + RSI_{T3}) \div 2$

$= (3.91 + 2.16) \div 2$

$= 3.04$

Step 5

Overall thermal transmittance $= 1 \div 3.04$

$= 0.329$

Calculation of Thermal Resistance of Log Walls

The effective thermal resistance of log walls shall be calculated as described herein:

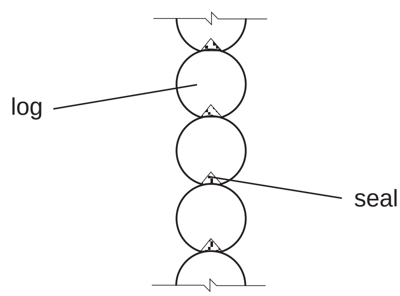
General Procedure:

- The mean log diameter/thickness of the wall is multiplied by the resistivity of the wood species from Table C-2 at the end of this appendix.
- The RSI values for the interior and exterior air films are added.
- The sum is multiplied by a profile factor to account for the irregular surfaces.

The profile factor varies with the details of the wall. Two-dimensional heat flow analyses made within the framework of IRC's Building Envelope and Structure Program indicate that the following factors will provide acceptably accurate results for most configurations:

Log Wall Type	Profile Factor
Rectangular-milled	0.97
Round-scribed	0.77

Example 6: Round Log Wall



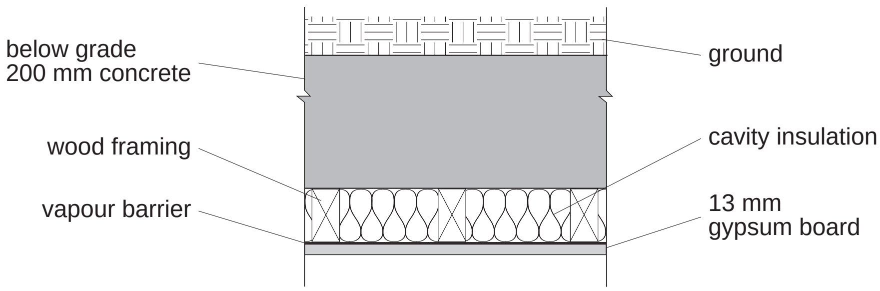
305 mm mean diameter round-scribed pine log wall, Resistivity of pine from Table C-2 is 0.0081 $m^2 \cdot {}^\circ C/W \cdot mm$, RSI of wood at mean diameter = 305 × 0.0081 = 2.47 $m^2 \cdot {}^\circ C/W$	
Components	RSI_F, $m^2 \cdot {}^\circ C/W$
Outside air film	0.03
Wood at mean diameter 305 mm	2.47
Interior film	0.12
Total	2.62
Profile factor	0.77
Wall RSI	= 2.62 × 0.77 = 2.02 $m^2 \cdot {}^\circ C/W$
RSI_T	= 2.02
Overall thermal transmittance	= 0.50

Below-Grade Assemblies

The only difference in calculating thermal resistance values for below-grade assemblies is that no external air film is included.

Although the resistance of the soil has a bearing on the heat loss through below-grade assemblies, for purposes of compliance with this Code, it is not included in the thermal resistance calculation.

Example 7: Framed Batts Added to a Foundation Wall



38 x 89 mm wood studs @ 610 mm o.c., RSI 2.11 batts added to a concrete wall		
Components	RSI_F through stud, $m^2 \cdot {}^\circ C/W$	RSI_I through insulation, $m^2 \cdot {}^\circ C/W$
200 mm concrete	0.08	0.08
Building paper	0.01	0.01
Stud (89 mm × 0.0081 RSI/mm)	0.72	-
Insulation (89 mm)	-	2.11
Polyethylene (vapour barrier)	-	-
Gypsum (13 mm × 0.0061 RSI/mm)	0.08	0.08
Interior film	0.12	0.12
Total	1.01	2.40
Percent of total area	10%	90%
RSI_T = 100 ÷ ((10 ÷ 1.01) + (90 ÷ 2.40)) = 2.11		
Overall thermal transmittance = 0.474		

Area Percentages

Where the actual percentages of the building assembly area that are underlaid by framing and by insulation are known, these values should be used. Otherwise, the values in Table C-1 shall be used. These values include allowance for typical mixes of studs, lintels and plates.

Table C-1
Framing Percentages for Typical Wood- and Steel-framed Assemblies

Assembly	Framing Spacing, mm	Wood Framing		Steel Framing(1)	
		Area With Framing, %	Area Without Framing, %	Area With Framing, %	Area Without Framing, %
Roofs, ceilings, floors	< 500	10	90	0.33	99.67
	≥ 500	7	93	0.23	99.77
Above-grade walls and strapping	< 500	19	81	0.63	99.37
	≥ 500	11	89	0.37	99.63
Below-grade walls and strapping	< 500	17	83	0.57	99.43
	≥ 500	10	90	0.33	99.67
Sheet steel wall	< 2100	-	-	0.08	99.92
	≥ 2100	-	-	0.06	99.94

Notes to Table C-1:

(1) Percentages for steel framing are based on 18-gauge (1.2 mm) steel; however, test results indicate that, for the range of thicknesses normally used in light steel framing, the actual thickness has very little effect on the effective thermal resistance.

Table C-2
Thermal Properties for Building Materials

Description		Thermal resistance					Conductivity, W/m·°C
		Per mm,(1) $m^2·°C/W/mm$	For thickness listed, $m^2·°C/W$	Range, $m^2·°C/W/mm$		Min. Req'd,(2) $m^2·°C/W/mm$	
Air Films							
Exterior: ceiling, floors and walls	wind 6.7 m/s (winter)		0.03				
Interior: ceiling (heat flow up)			0.11				
floor (heat flow down)			0.16				
walls (heat flow horizontal)			0.12				
Air Cavities(3)							
Ceiling (heat flow up):							
Faced with non-reflective material(4)	13 mm air space		0.15				0.09
	20 mm air space		0.15				0.13
	40 mm air space		0.16				0.25
	90 mm air space		0.16				0.56
Faced with 1 reflective material(4)	13 mm air space		0.28				0.05
	20 mm air space		0.30				0.07
	40 mm air space		0.32				0.13
	90 mm air space		0.34				0.26
Faced with 2 reflective materials(4)	13 mm air space		0.36				0.04
	20 mm air space		0.39				0.05
	40 mm air space		0.42				0.10
	90 mm air space		0.47				0.19
Floors (heat flow down):							
Faced with non-reflective material(4)	13 mm air space		0.16				0.08
	20 mm air space		0.18				0.11
	40 mm air space		0.20				0.20
	90 mm air space		0.22				0.41
Faced with 1 reflective material(4)	13 mm air space		0.33				0.04
	20 mm air space		0.42				0.05
	40 mm air space		0.58				0.07
	90 mm air space		0.72				0.13
Faced with 2 reflective materials(4)	13 mm air space		0.45				0.03
	20 mm air space		0.63				0.03
	40 mm air space		1.04				0.04
	90 mm air space		1.63				0.06
Walls (heat flow horizontal):							
Faced with non-reflective material(4)	13 mm air space		0.16				0.08
	20 mm air space		0.18				0.11
	40 mm air space		0.18				0.22
	90 mm air space		0.18				0.50
Faced with 1 reflective material(4)	13 mm air space		0.33				0.04
	20 mm air space		0.41				0.05
	40 mm air space		0.42				0.10
	90 mm air space		0.41				0.22
Faced with 2 reflective materials(4)	13 mm air space		0.45				0.03
	20 mm air space		0.61				0.03
	40 mm air space		0.62				0.06
	90 mm air space		0.60				0.15

Table C-2 (Continued)

Description	Thermal resistance: Per mm,(1) m2·°C/W/mm	Thermal resistance: For thickness listed, m2·°C/W	Thermal resistance: Range, m2·°C/W/mm		Thermal resistance: Min. Req'd,(2) m2·°C/W/mm	Conductivity, W/m·°C
Cladding materials						
Brick:						
fired clay (2400 kg/m2) 100 mm		0.07	0.068	0.083		1.4
concrete: sand and gravel, or stone (2400 kg/m2) 100 mm		0.04	0.035	0.069		2.3
Cement/lime, mortar, and stucco	0.0009		0.001	0.002		1.1
Wood Shingles:						
400 mm, 190 mm exposure		0.15				
double exposure, 400 mm, 300 mm		0.21				
insulating backer board, 8 mm		0.25				
Siding: Metal or Vinyl, siding over sheathing:						
hollow-backed		0.11				
insulating-board-backed: 9.5 mm nominal		0.32				
9.5 mm nominal, foiled-backed		0.52				
Siding: Wood:						
bevel - 13 x 200 mm - lapped		0.14				
bevel - 20 x 250 mm - lapped		0.18				
drop - 20 x 200 mm		0.14				
plywood - 9.5 mm - lapped		0.10				
Stone :						
Quartzitic and sandstone (2240 kg/m3)	0.0003					3.4
Calcitic, dolomitic, limestone, marble and granite (2240 kg/m3)	0.0004					2.3
Roofing materials(5)						
Asphalt roll roofing		0.03				
Asphalt/tar	0.0014					0.74
Built-up roofing (10 mm)		0.06				0.17
Crushed stone	0.0006					1.7
Metal deck		negligible				
Shingle:						
Asphalt		0.08				
Wood		0.17				
Slate (13 mm)		0.01				1.4
Sheathing materials						
Gypsum sheathing	0.0061					0.16
Insulating fibreboard	0.016				0.0164	0.061
Particleboard	0.0087					0.11
Sheathing paper		0.011				
Softwood plywood	0.0087					0.11
Vapour barrier:						
permeable felt		0.011				
seal, 2 layers of mopped 0.73 kg/m3		0.210				
seal, plastic film		negligible				
Waferboard/Oriented strand board (OSB)	0.0110					0.091

Table C-2 (Continued)

Description	Thermal resistance Per mm,[1] m^2·°C/W/mm	For thickness listed, m^2·°C/W	Range, m^2·°C/W/mm		Min. Req'd,[2] m^2·°C/W/mm	Conductivity, W/m·°C
Insulation						
Blanket and Batt:						
Mineral fibre (rock, slag, or glass):						
low-density	0.024				0.0185	0.042
medium-density	0.026				0.0185	0.039
high-density	0.028				0.0185	0.036
Board and Slabs:						
Cellular glass	0.021					0.048
Insulating fibreboard:						
Roof board	0.018				0.0182	0.055
Building board or ceiling tile, lay-in panel	0.016				0.0164	0.061
Polyisocyanurate/polyurethane faced sheathing (CGSB 51.25, Type 1)	0.042				0.0420	0.024
Polyisocyanurate/polyurethane unfaced and faced board (CGSB 51.25 Types 2, 3 and 4)	0.042				0.0420	0.024
Polystyrene:						
Expanded: Type 1	0.026		0.026	0.027	0.0260	0.038
Type 2	0.028		0.028	0.029	0.0280	0.035
Type 3	0.030		0.030	0.030	0.0296	0.034
Extruded: Types 2, 3 and 4	0.035		0.034	0.035	0.0344	0.029
Faced phenolic foam board:						
Closed cells	0.042					0.024
Open cells	0.030					0.033
Rigid glass fibre roof insulation	0.021		0.020	0.025	0.0200	0.047
Semi-rigid glass fibre sheathing	0.030		0.019	0.031	0.0185	0.034
Loose Fill:						
Cellulose	0.025		0.025	0.027	0.0247	0.040
Mineral fibre (rock, slag or glass)	0.020		0.019	0.025	0.0185	0.050
Perlite	0.019		0.017	0.026		0.053
Vermiculite	0.015		0.015	0.016		0.067
Spray Applied:						
Cellulosic fibre	0.024		0.022	0.027		0.041
Glass fibre	0.026		0.026	0.027		0.039
Polyurethane foam	0.042		0.039	0.043		0.024
Structural Materials						
Concrete:						
Low density aggregate:						
expanded shale, clay, slate or slags, cinders (1600 kg/m^3)	0.0013		0.0012	0.0015		0.75
perlite, vermiculite and polystyrene bead (480 kg/m^3)	0.0063					0.16
Sand and gravel or stone aggregate (2400 kg/m^3)	0.0004		0.0004	0.0007		2.3
Hardwood	0.0061					0.16
Softwood:						
California redwood or cedar	0.0090		0.0077	0.0103		0.11
Douglas fir, southern pine or larch	0.0071		0.0062	0.0073		0.14
White pine, fir, or spruce logs and lumber	0.0081		0.0077	0.0093		0.12
Steel, galvanized sheet, 0.14% carbon content	0.0000161					62

Table C-2 (Continued)

Description		Thermal resistance					Conductivity, W/m·°C
		Per mm,(1) m²·°C/W/ mm	For thickness listed, m²·°C/W	Range, m²·°C/W/mm		Min. Req'd,(2) m²·°C/W/ mm	
Concrete blocks							
Limestone aggregate — 2 cores:							
cores filled with perlite:	190 mm		0.37				0.51
	290 mm		0.65				0.45
Light Weight Units (expanded shale, clay, slate or slag aggregate) — 2 or 3 cores:							
no core insulation:	90 mm		0.24				0.38
	140 mm		0.30	0.26	0.34		0.47
	190 mm		0.32	0.30	0.56		0.44
	240 mm		0.33				0.73
	290 mm		0.41	0.36	0.46		0.71
cores filled with perlite:	140 mm		0.74				0.19
	190 mm		0.99	0.77	1.20		0.19
	290 mm		1.35	1.10	1.60		0.21
cores filled with vermiculite:	140 mm		0.58	0.53	0.62		0.24
	190 mm		0.81	0.69	0.93		0.23
	240 mm		0.98				0.24
	290 mm		1.06	1.00	1.13		0.27
cores filled with molded EPS beads	190 mm		0.85				0.22
molded EPS inserts in cores:	190 mm		0.62				0.31
Medium Weight Units (combination of normal and low mass aggregate) —2 or 3 cores:							
no core insulation:	190 mm		0.26	0.22	0.30		0.73
cores filled with EPS molded beads:	190 mm		0.56				0.34
EPS molded inserts in cores:	190 mm		0.47				0.40
cores filled with perlite:	190 mm		0.53	0.41	0.65		0.36
cores filled with vermiculite:	190 mm		0.58				0.33
Normal Weight Units (sand and gravel aggregate) — 2 or 3 cores:							
no core insulation:	90 mm		0.17				0.53
	140 mm		0.19				0.74
	190 mm		0.21	0.17	0.21		0.9
	240 mm		0.24				1.0
	290 mm		0.26	0.22	0.26		1.1
cores filled with perlite:	190 mm		0.35				0.54
cores filled with vermiculite:	140 mm		0.40				0.35
	190 mm		0.51	0.24	0.51		0.37
	240 mm		0.61				0.39
	290 mm		0.69				0.42

Table C-2 (Continued)

Description		Thermal resistance: Per mm,[1] $m^2 \cdot {}^\circ C/W/mm$	Thermal resistance: For thickness listed, $m^2 \cdot {}^\circ C/W$	Thermal resistance: Range, $m^2 \cdot {}^\circ C/W/mm$		Thermal resistance: Min. Req'd,[2] $m^2 \cdot {}^\circ C/W/mm$	Conductivity, $W/m \cdot {}^\circ C$
Hollow Clay Bricks							
Hollow Clay Brick — multi-cored:							
no insulation in cores:	90 mm		0.27				0.33
Hollow Clay Brick — rectangular 2-core:							
no insulation in cores:	140 mm		0.39				0.36
	190 mm		0.41				0.46
	290 mm		0.47				0.62
cores filled with vermiculite:	140 mm		0.65				0.22
	190 mm		0.86				0.22
	290 mm		1.29				0.22
Hollow Clay Brick — rectangular 3-core:							
no insulation in cores:	90 mm		0.35				0.26
	140 mm		0.38				0.37
	190 mm		0.41				0.46
	240 mm		0.43				0.56
	290 mm		0.45				0.64
cores filled with vermiculite:	140 mm		0.68				0.21
	190 mm		0.86				0.22
	240 mm		1.06				0.23
	290 mm		1.19				0.24
Interior finish materials[6]							
Building Board:							
Gypsum board		0.0061					0.16
Hardboard:	medium-density (800 kg/m^3)	0.0095					0.11
Interior finish (plank, tile) board		0.0198					0.05
Particleboard:	low-density (590 kg/m^3)	0.0098					0.10
	medium-density (800 kg/m^3)	0.0074					0.14
	high-density (1000 kg/m^3)	0.0059					0.17
	underlay (15.9 mm)		0.14				0.11
Plywood		0.0087					0.12
Flooring Material:							
Carpet and fibrous pad			0.37				
Carpet and rubber pad			0.22				
Cork tile:	3.2 mm		0.049				0.07
Hardwood flooring:	19 mm		0.12				0.16
Terrazzo:	25 mm		0.014				1.8
Tile (linoleum, vinyl, rubber)			0.009				0.17
Tile (ceramic):	9.5 mm		0.005				1.9
Wood subfloor:	19 mm		0.17				0.11
Plastering:							
Cement plaster:	sand aggregate	0.0014					0.70
Gypsum plaster:	low-density aggregate	0.0044					0.23
	sand aggregate	0.0012					0.82

Table C-2 (Continued)

Description	Thermal resistance				Conductivity, W/m·°C
	Per mm,[1] m^2·°C/W/mm	For thickness listed, m^2·°C/W	Range, m^2·°C/W/mm	Min. Req'd,[2] m^2·°C/W/mm	

Sources:

- ASHRAE 1997 Handbook — Fundamentals, Chapter 24, Tables 1, 3 and 4. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., Atlanta, GA 30329, 1993.
- Builders Manual, Canadian Home Builders' Association, Ottawa, ON K1P 5J4, 1994.
- Registry of Product Evaluations, Summer 1994. NRC, Ottawa, ON K1A 0R6, 1994.

Notes to Table C-2:

(1) The thermal resistance values given in Table C-2 are generic values for the types of materials listed. Actual materials produced by manufacturers may have values that differ slightly. A manufacturer's published value for a material may be used, provided it has been obtained in accordance with the procedures described in Article 2.2.2.2. of the Code. The Canadian Construction Materials Centre (CCMC) provides evaluation reports for certain insulation materials; these reports are a reliable source of information on thermal resistance values.

(2) Minimum requirement as per applicable product standard (not the MNECH).

(3) Interpolation for air spaces between values listed and moderate extrapolation for air spaces greater than 90 mm is permissible; no credit for air spaces less than 13 mm.

(4) These values may not be used in calculations for areas where the mean annual total degree-days exceed 4400 Celsius degree-days. For those areas over 4400 Celsius degree-days, use Air Cavities Faced with Non-Reflective Materials.

(5) No credit for materials to the exterior of vented air space.

(6) No credit for materials to the interior of conditioned air space.

Appendix D
Energy Source Adjustment Factors

One use of the energy source adjustment factor (ESAF) is in the identification of the principal heating source of a building or part of a building, in order to establish the level of regional prescriptive requirements read from the Tables in Appendix A (see the definition of energy source adjustment factor in Part 1 of this Code). In determining the principal heating source, alternative energy sources, such as wind energy, wood derivatives or waste energy recuperated from outside the building, are generally included in the "Other" category. Solar heat gains and heat recovered within the mechanical systems are not assigned an ESAF since they are never the principal heating source and they are otherwise taken into consideration in the calculations related to the performance compliance path.

The impact of the ESAF of alternative energy sources is made less important in the performance compliance path by the provision that comparison always be made with the same fuel in both the projected building and the reference building, in order for the Model National Energy Codes to remain neutral with respect to energy sources and avoid systematic comparison with the worst fuel. This results in credit being given only to improvements in efficiency of each system over the minimum equipment standards. The Model National Energy Codes, whose objectives are to set minimum standards in the construction of buildings, are not intended to be used in the promotion of some energy sources against others.

Table D-1 contains regional ESAF used by the performance compliance software.

Table D-1
Energy Source Adjustment Factors

Province or Territory	Region	Energy Source				
		Electricity	Propane	Oil	Natural Gas	Other
Newfoundland	A	1	0.78	0.56	-	1
	B	1	0.78	0.36	-	1
	C	1	1.41	1.41	-	1
	D	1	3.72	3.72	-	1
P.E.I.	A	1	0.42	0.26	-	1
Nova Scotia	A	1	0.72	0.39	-	1
New Brunswick	A	1	1.17	0.69	-	1
Québec	A	1	0.54	0.54	0.53	1
	B	1	0.54	0.54	0.53	1
	C	1	0.54	0.54	-	1
Ontario	A	1	0.40	0.40	0.24	1
	B	1	0.40	0.40	0.24	1

Table D-1 (Continued)

Province or Territory	Region	Energy Source				
		Electricity	Propane	Oil	Natural Gas	Other
Manitoba	A	1	0.77	0.77	0.46	1
	B	1	0.77	0.77	0.46	1
Saskatchewan	A	1	1	1	0.20	1
Alberta	A	1	0.55	0.55	0.17	1
	B	1	0.55	0.55	0.17	1
	C	1	0.55	0.55	0.17	1
British Columbia	A	1	0.7	0.63	0.37	1
	B	1	0.59	0.59	0.37	1
	C	1	0.56	0.56	0.53	1
	D	1	0.59	0.59	0.37	1
	E	1	0.69	0.69	0.43	1
Yukon	A	1	0.56	0.39	-	1(1)
	B	1	0.45	0.26	-	1(1)
	C	1	-	0.18	-	1(1)
Northwest Territories	A	1	0.28	0.28	-	1
	B	1	0.30	0.22	-	1
	C	1	0.17	0.17	0.05	1
	D	1	0.25	0.15	-	1
	E	1	0.11	0.11	-	1
	F	1	0.11	0.11		1
	G	1	0.10	0.10	-	1
	H	1	0.11	0.11	-	1

Notes to Table D-1:

(1) Yukon, for Wood: Region A: 0.23; Region B: 0.20; Region C: 0.10

Appendix E
Commentary

E-1.1.2.1.(1)(a) Buildings Covered by this Code. This wording meets the scope of Part 9 of the National Building Code of Canada (NBC) as defined in Article 2.1.3.1. of the NBC, except that it excludes occupancies other than dwelling units.

E-1.1.2.1.(1)(c) Additions Covered by this Code. This Code applies to new buildings and to additions. For the purpose of understanding the scope of this Code, an addition can be thought of as a new building or building part that happens to be built contiguous to an existing building. Most of the requirements in this Code are based on cost/benefit analyses using costs relevant to new construction. Since additions are essentially new construction, the economic parameters used to establish the levels of requirement for this Code can apply to additions as well as to new buildings. However, because the costs of renovating existing buildings are significantly different from the costs of new construction, this Code should generally not be applied to the renovation of existing buildings.

It should be noted that, in extending existing systems to serve a new building addition, the existing systems and equipment do not have to be upgraded to meet this Code; only the new components of such systems and any new equipment installed to serve the addition need comply with this Code.

See also Sentence 2.2.2.9.(6) regarding windows in additions.

E-1.1.3.1.(1) Words Not Defined in this Code. For guidance on heating, ventilation and air-conditioning terminology, the publication "Terminology of Heating, Ventilation, Air-Conditioning and Refrigeration, 2nd ed., 1991," by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, is a useful source of information.

E-1.1.3.2.(1) Building Envelope Application. There are several different types of spaces that may be "unheated" (e.g., cold storage rooms, crawl spaces, garages) that might be treated differently.

E-1.1.3.2.(1) Interior lighting

Spaces within the confines of the building envelope

Given the definition of building envelope, this applies to lighting of all heated spaces.

Other Sheltered Spaces

Lighting of storage garages (parking garages) is an example of interior lighting of spaces where the lighting is intended only to light that space and where the spaces are sheltered from the exterior environment but may not be heated.

The lighting of a covered exterior walkway may be exterior lighting or interior lighting, depending on whether the lighting is intended to light the area around the walkway or only the walkway itself. If only the covered walkway is lit, limits for lighting interior corridors would apply.

Unsheltered Spaces

Examples of occupancies often accommodated within the confines of a building envelope but that can occupy unsheltered, unheated space include spaces used on a seasonal basis such as sidewalk cafés — generally found in buildings with occupancies other than dwelling units.

E-1.1.3.2.(1) Principal Heating Source. For most parts of the country, the building envelope thermal characteristics prescribed in Part 3 vary with the principal heating source. This definition of principal heating source allows a building with more than one source of heat to be arbitrarily subdivided into parts such that different parts have different principal heating sources and, thus, the required building envelope characteristics are different in the different parts. For example, in a gas-heated house with an electrically heated garage attached, the space-heating capacity of the garage could equal more than 10% of the overall space-heating capacity of the building. By considering these parts of the building separately, as permitted by this definition, it is not necessary that the envelope of the house comply with the generally higher requirements for electrically heated buildings.

E-1.1.3.2.(1) Service Room. Typical examples of service rooms include boiler rooms, furnace rooms, incinerator rooms, garbage-handling rooms, elevator machine rooms and rooms to accommodate air-conditioning or heating appliances, pumps, compressors and electrical equipment. Rooms such as common laundry rooms are not considered to be service rooms.

E-1.1.3.2.(1) Solar Heat Gain Coefficient. This definition mirrors that in CSA Standard A440.2. Included is directly transmitted solar radiation, as well as solar energy absorbed and then reradiated or conducted inwards.

E-1.1.3.2.(1) Suite. Tenancy in the context of the term "suite" applies to both rental and ownership tenure. In a condominium arrangement, for example, dwelling units are considered separate suites whether or not they are individually owned. In order to be of complementary use, a series of rooms that constitute a suite are in reasonably close proximity to each other and have access to each other either directly by means of a common doorway or indirectly by a corridor, vestibule or other similar arrangement.

The term "suite" does not apply to rooms such as service rooms, common laundry rooms and common recreational rooms that are not leased or under a separate tenure in the context of this Code.

E-2.1.1.2. Structure of the Model National Energy Code for Houses. Beyond basic mandatory requirements that cannot be by-passed, the MNECH features 3 alternate routes for compliance. Figure E-2.1.1.2. shows the alternate compliance processes.

Prescriptive requirements

The first route is a prescriptive one, which generally dictates minimum thermal characteristics for envelope elements and energy conservation measures that can be stated as specific instructions.

Trade-offs

The second route gives some degree of flexibility to the prescriptive requirements related to the building envelope. It allows the user to reduce thermal resistance in one portion of the envelope, provided that the thermal resistance in other areas is increased so that energy consumption for the building is not increased. This route is meant to be an easy way to make small adjustments to the characteristics of the building envelope without having to go the full performance route.

Performance Path

The third route is a performance path: if one finds some aspects of the prescriptive route too limiting, one may design a building with any thermal characteristics desired (subject to certain limitations), provided that the building as designed will not have a calculated energy consumption under standardized conditions that is greater than it would have been if the building had been designed in strict conformity with the prescriptive requirements, all other aspects of the building (which are not the object of a requirement in this Code) remaining the same in both cases. The proof of conformity in the performance route is made through 2 energy analyses, one on the building as it would meet the prescriptive requirements, giving the "target" performance, the other on the actual design for which a building permit is requested.

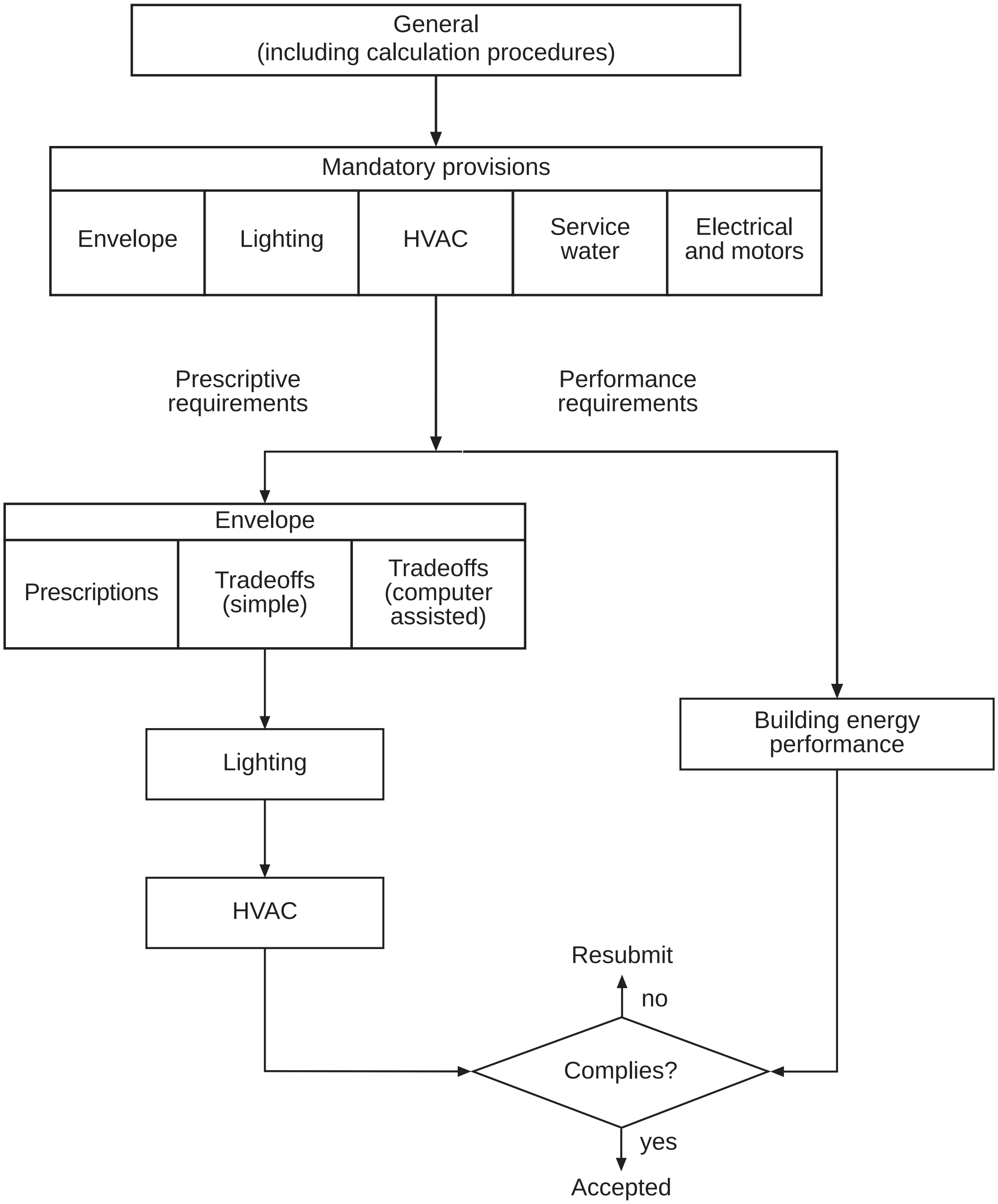


Figure E-2.1.1.2.
Structure of the Model National Energy Code for Houses

E-2.2.1.1.(1) Climatic Values. Data for municipalities not listed in Appendix C of the NBC may be obtained by writing to: the Atmospheric Environment Service, Environment Canada, 4905 Dufferin Street, Downsview, Ontario M3H 5T4.

E-2.2.2.2. Thermal Characteristics of Building Assemblies. Thermal characteristics of building assemblies, including windows, can also be determined through the use of computer simulation models; see Article 2.5.1.3. for provisions for equivalency.

E-2.2.2.2.(8) Effective Thermal Resistance of Other Building Assemblies. Appendix C gives several examples of effective thermal resistance calculations for some typical building assemblies.

Some literature in this field contains thermal properties of some products that use chlorofluorocarbons (CFCs) as blowing agents. These products are expected to be converted to non-CFC blowing agents, but will likely be referred to by the same generic name. Referenced literature may not be revised by the time this Code is adopted. The reader therefore should be careful not to use outdated information when using these references.

E-2.2.2.9.(1) Areas of Doors, Windows and Other Glazed Areas. This method of calculation of the areas of doors, windows and other glazed areas is slightly different from that used in CSA Standard A440.2 for windows and A453 for doors. For the calculation of the area of windows and other glazed areas of a house, this Code uses the dimensions of rough openings to facilitate compliance checking. In calculating the energy rating (ER) of a given window type, the manufacturer uses data available at the factory; that is, dimensions to the outside of frame, or the rough opening minus installation clearances, so as not to take into account projecting surface trim.
Figure E-2.2.2.9.(1) illustrates the requirements of Sentence 2.2.2.9.(1) as compared with those of the CSA Standard.

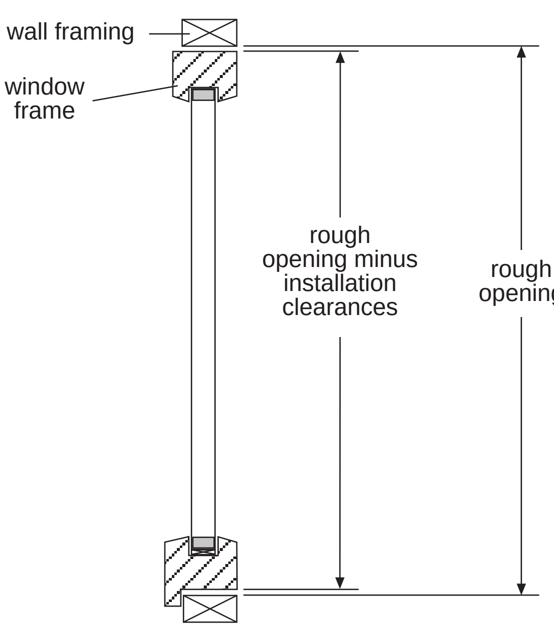


Figure E-2.2.2.9.(1)
Measuring Area of Glazing

E-2.2.2.9.(2) Area of Curved Glazing. Figure E-2.2.2.9.(2) illustrates the requirement of Sentence 2.2.2.9.(2).

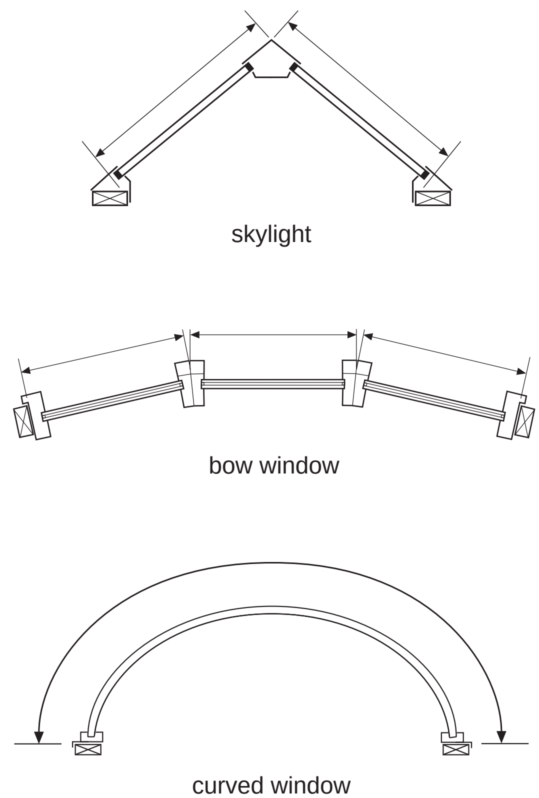


Figure E-2.2.2.9.(2)
Skylight, Bow Window and Curved Glazing

E-2.3.1.1.(1) Required Information. The information documenting the conformity of the building to this Code must describe the essential characteristics of the building and its systems. To this end, the authority having jurisdiction would normally require access to the following information:

- floor plan of the building giving the heated floor area for each storey,
- elevations of all the building faces, giving finished floor and ground levels,
- typical cross-sections of foundations, exterior walls, roofs, ceilings and floors that separate heated space from unheated space or the exterior, describing their construction and giving the thermal resistance of each material and the effective thermal resistance for each element of the building,
- description of the different types of air barrier systems and their location,
- window dimensions,
- characteristics of windows, skylights, sliding glass doors and other doors separating heated space from unheated space or the exterior

(ER rating or overall thermal transmittance and solar heat gain coefficient, airtightness),
- required report on trade-offs, where applicable,
- details of required exterior lighting controls and exterior lighting power for exits, entrances and facades of multiple-unit residential buildings,
- details of required interior lighting controls and interior lighting power for common areas in multiple unit residential buildings,
- location of required dampers and of thermostatic controls and cutoffs,
- efficiency of unit and packaged equipment,
- efficiency of required heat recovery equipment,
- efficiency of service water heating equipment,
- main electrical distribution and metering layout, for multiple-unit residential buildings,
- required report on performance compliance, where applicable.

E-2.5.1.3.(1) Equivalence Demonstrated by Computer Analysis. Thermal characteristics of building assemblies may be determined by two- and three-dimensional finite element and finite difference models. “Vision,” “Frame,” “KOBRU,” “TRISCO,” “ISO 2,” “HEAT 2” and “HEATING 7” are such programs, which may also be used to determine equivalency of other computer simulation programs used to perform these calculations. In making such simulations, care must be taken to use the data prescribed in Appendix C of this Code.

E-3.1.1.1.(2) Application to a Wall or Floor between a Garage and a Dwelling Unit. A wall or a floor between a dwelling unit and a garage must always be airtight and insulated, whether such a garage is heated or not. This requirement takes into account the fact that a residential garage may be kept unheated, even if it is equipped with space-heating equipment.

E-3.1.1.1.(3) Application to Seasonal Buildings. It is often difficult to identify a “seasonal” dwelling (i.e., a dwelling intended to be used only in the summertime). Generally, if a dwelling has a space-heating system installed or provides for the future installation of a space-heating system, it should be considered to fall within the scope of this Part. A stove, pot heater or window air conditioner should not be considered a system in this context, but electric baseboard heaters in the principal rooms should.

E-3.2.1.2.(1) Continuity of Insulation. This Sentence is intended to apply to building components such as partitions, chimneys, fireplaces, and columns and beams that are bedded along exterior walls, but not to stud framing and ends of joists. Studs and joists in frame construction are not considered to break the continuity of the insulation, because the method for calculating the effective thermal resistance of such assemblies described in Appendix C takes their presence into consideration.

E-3.2.1.2.(8) Overlapping of Insulation Where Continuity Is Not Maintained. This is the case with foundation walls insulated on the outside below grade and on the inside above grade.

In the case of hollow-core masonry walls, no amount of overlap can overcome the effect of convection in the cores, which renders overlapped interior/exterior insulation totally ineffective, unless the continuity of the air barrier is effectively carried across the wall by blocking the cells at the level of the insulation overlap. Such blocking of the core cells is required by the NBC in Sentence 9.25.2.3.(3), which requires that insulation be installed so its function will not be bypassed by convective air flow.

E-3.2.1.2.(10) Continuity of Insulation Where Components Meet. This requirement calls for continuity of the insulation at the intersection of two components of the building envelope, such as a wall with another wall or a roof, or a wall with a window. This means that there should be no gap in the insulation between the two components. An obvious application is insulating the space between a window or door frame and the rough framing members. However, closely spaced structural members, such as studs or top plates, do not have to be taken into account, as provided in Sentence 3.2.1.2.(2).

E-3.2.2.1.(3) Reduction of Effective Thermal Resistance Near the Eaves of Sloped Roofs. Thermal resistance requirements for attic-type roofs are significantly higher than the requirements for walls. The intent of the requirement is that the effective thermal resistance required directly above the exterior wall must be at least equal to the thermal resistance required for the wall and that, allowing for ventilation requirements, the insulation must be increased with the slope until there is enough space to allow for the installation of the full thickness of insulation required. It is therefore possible that the full required thickness of insulation will not be reached along the ceiling for a significant distance from the perimeter, particularly with a low-slope roof. In the case of a narrow, dormer-type projection from a main roof, there may not even be enough distance to come to the full required insulation level in the attic space. Sentence 3.2.2.1.(3) is intended to allow for such incidences and permit the use of roof trusses without unduly high raised heels.

E-3.2.2.2.(1) Wall Area. Figure E-3.2.2.2.(1) illustrates the extent of the surface that is considered as a wall at the intersection with a floor. This Code may have different requirements for the perimeter area of floors.

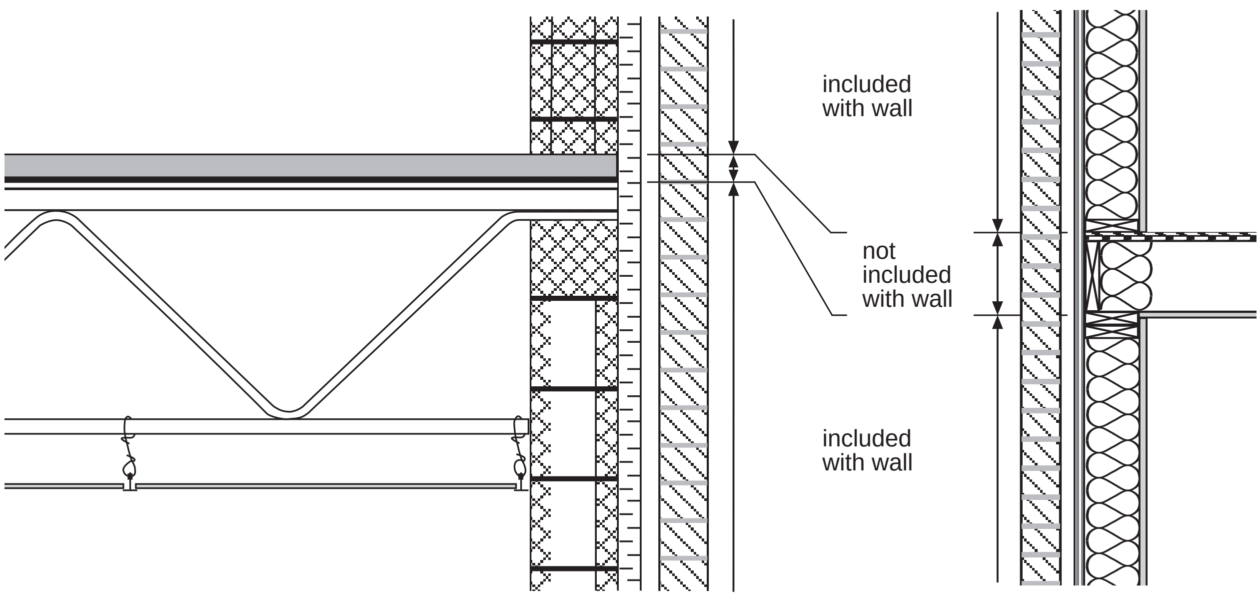
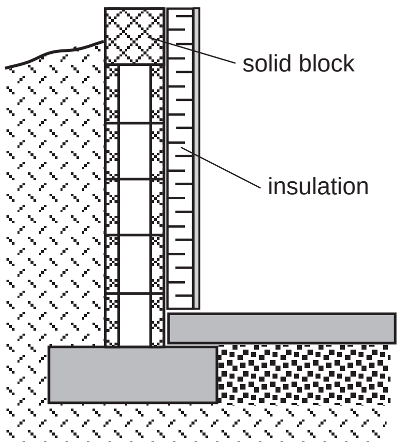
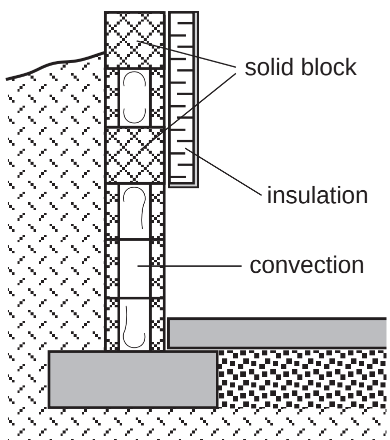


Figure E-3.2.2.2.(1)
Wall Area Discontinuous at Floor

E-3.2.3.1.(1) Hollow Core Masonry Walls in Contact with the Ground. Figure E–3.2.3.1.(1) illustrates the 2 alternate approaches for meeting the requirements of Sentence 3.2.3.1.(1), when using hollow core masonry foundation walls. However, the extent of insulation below the ground remains subject to the requirements of Sentence 3.3.2.1.(3).



Alternative 1



Alternative 2

Figure E-3.2.3.1.(1)
Hollow Core Masonry Foundation Walls

E-3.2.4.1.(2) Airtightness Requirements. Reference to the document "Air Barrier Systems for Houses" is included in this Code to provide builders and inspectors with a comprehensive set of techniques that may be used for attaining adequate airtightness. Builders are not limited to using only the techniques described in the manual, because the terms of Section 2.5., Equivalents, provide criteria for assessing and allowing equivalent techniques that may be described in other manuals, and innovative systems may obtain an evaluation from the Canadian Construction Materials Centre, Institute for Research in Construction, NRC, to help establish their equivalency.

E-3.2.4.1.(3) Alternate Airtightness Requirements. The requirement of 2.0 cm^2/m^2 is not particularly stringent; in fact, a 1989 survey of almost 200 houses across Canada indicated that 80% of houses already satisfied this criterion. The intent, therefore, is not to require that all houses be "super airtight" but to eliminate the worst air barrier practices.

Therefore, this test is not intended to be used on a regular basis or even frequently. A building official would only call for this test to be performed when glaring omissions were found in the air barrier, or when the effectiveness of some innovative approach to air barrier design or installation was in question and, even then, only on a spot-check basis.

E-3.3.1.1.(1) Thermal Characteristics of Components of the Building Envelope. The effective thermal resistance of a building envelope assembly is the area weighted average thermal resistance of the overall assembly, including insulation, sheathing, interior and exterior finish materials and air films, and taking into account thermal bridging due to framing members. Appendix B provides the user with a list of representative assemblies and their respective effective thermal resistances. Appendix C explains how the effect of studs, plates, sills and lintels is taken into account in the calculation of the effective thermal resistance.

The effective thermal resistance value for above-grade walls also applies to the perimeter areas of intersecting interior walls and to the above-ground portion of foundation walls, except as provided in Article 3.3.2.2.

E-3.3.1.1.(4) Thermal Characteristics of Components with Embedded Radiant Heating. This provision applies to insulated walls and top-storey ceilings under a roof or unheated attic space that have radiant heating equipment embedded in them. The thermal resistance of a wall or ceiling behind radiant heating cables, pipes or membranes is increased in order to counteract the increased heat loss that would occur due to the increased temperature of the interior surface. Below-ground walls incorporating radiant heating are covered under Sentence 3.3.2.1.(2). Slabs on ground incorporating radiant heating equipment are covered under Article 3.3.2.2.

E-3.3.1.2. Thermal Characteristics of Log Walls. The thermal resistance of log walls with the minimum dimensions permitted in this Article (RSI 2 for round-scribed, RSI 1.3 for rectangular-milled) will be significantly lower than that required for other types of walls. Although proponents of log construction contend that its energy performance is better than would be indicated by its RSI values, this exemption is not based on concurrence with that contention. Rather, log walls are exempted to avoid eliminating a traditional form of construction in Canada, which many home buyers continue to find attractive and desirable.

Smaller logs than required by this Article may be used if other building envelope components are improved beyond the minimum required by this Part in accordance with the trade-off (Section 3.4.) or performance (Part 8) compliance paths.

E-3.3.1.3.(1) Thermal Characteristics of Windows and Other Glazed Areas. The following are excluded from the Standard and would fall under 3.3.1.3.(2) or (3): greenhouse windows, skylights, sloped glazing, curved glazing, hinged doors and glass blocks.

E-3.3.1.3.(2) Thermal Characteristics of Windows and Other Glazed Areas not Within the Scope of CSA Standard A440.2. Overall thermal transmittance (U-values) in Table A-3.3.1.3. of Appendix A for windows and other glazed areas not covered by CSA Standard A440.2 are increased by 25% with respect to those for windows included in the Standard; this reduction in thermal resistance requirements is somewhat arbitrary, but was deemed appropriate because the reduced requirement would mostly apply to glass blocks and large skylights, which in current practice would have difficulty meeting the basic requirements. The U-values were derived by applying a factor of 1.25 to the U-values found using the equations described in Sentence 3.4.1.2.(1) for trade-off calculations.

E-3.3.1.3.(3)(b) Application to Small Skylight Areas. This requirement corresponds to a double-glazed window in a thermally broken aluminum frame.

E-3.3.1.4.(2) Decorative Entrance Doors. The provision of Sentence 3.3.1.4.(2) is intended to permit the use of one, but not more, decorative panelled-wood entrance door in a house.

E-3.3.1.5.(2) and (3) South Facing Glass. The allowances in Sentences 3.3.1.5.(2) and (3) are intended to prevent this Code's limitation of window area from being an impediment to the intelligent incorporation of passive solar heating in house design.

Where the allowance permitted in Sentence 3.3.1.5.(2) is used to increase the area of South-facing glass, it is intended that the heat gain from such glass should be used to heat the building, and that such glass should not be shaded during the heating season by overhangs and similar exterior obstructions. These requirements, which are suitable for most applications, represent a simplification of a more detailed and rigorous treatment of this subject. The solar heat gained from such glazing may be distributed by a forced air system installed for building heating and ventilating, or a house with passive solar features may have other acceptable design features for the distribution of such heat gain. It should be noted that failure to properly design the house to take advantage of the added solar heat gain in winter and to avoid excess solar heat gain in summer can lead to serious overheating problems and cooling costs that might outweigh the heating cost savings.

The solar heat gain coefficient for the glass has been assumed to be equivalent to the shading coefficient multiplied by 0.87:

$$SHGC = 0.70 \cdot 0.87 = 0.61$$

Summer Shading

The allowance for summer shading in Sentence 3.3.1.5.(3) is related to the preceding Sentence. If the building is designed to be cooled, the increased area of South-facing glass permitted in Sentence 3.3.1.5.(2) would contribute to the summer cooling load and thus may consume part or all of the heating energy saved, unless the glazing is shaded in summer. Sun screens, awnings, overhangs and louvres are some examples of exterior shading devices that would be acceptable.

The solar altitude angles for every 2° of latitude for major Canadian cities are provided in "Tables of Solar Altitude, Azimuth, Intensity and Heat Gain Factors for Latitudes from 43 to 55 Degrees North," available from the National Research Council of Canada, Institute for Research in Construction, Technical Paper No. 243, Ottawa, 1967 (NRC 9528).

Referring to the diagrams in Figure E-3.3.1.5.(2), assume that, at the latitude for which a building is designed, the solar noon sun altitude angle is 15° in December and 61° in June and that a window faces 30° East of South. Knowing these angles, the shaded area of the glass can be determined by calculation or by scale drawings for both December and June.

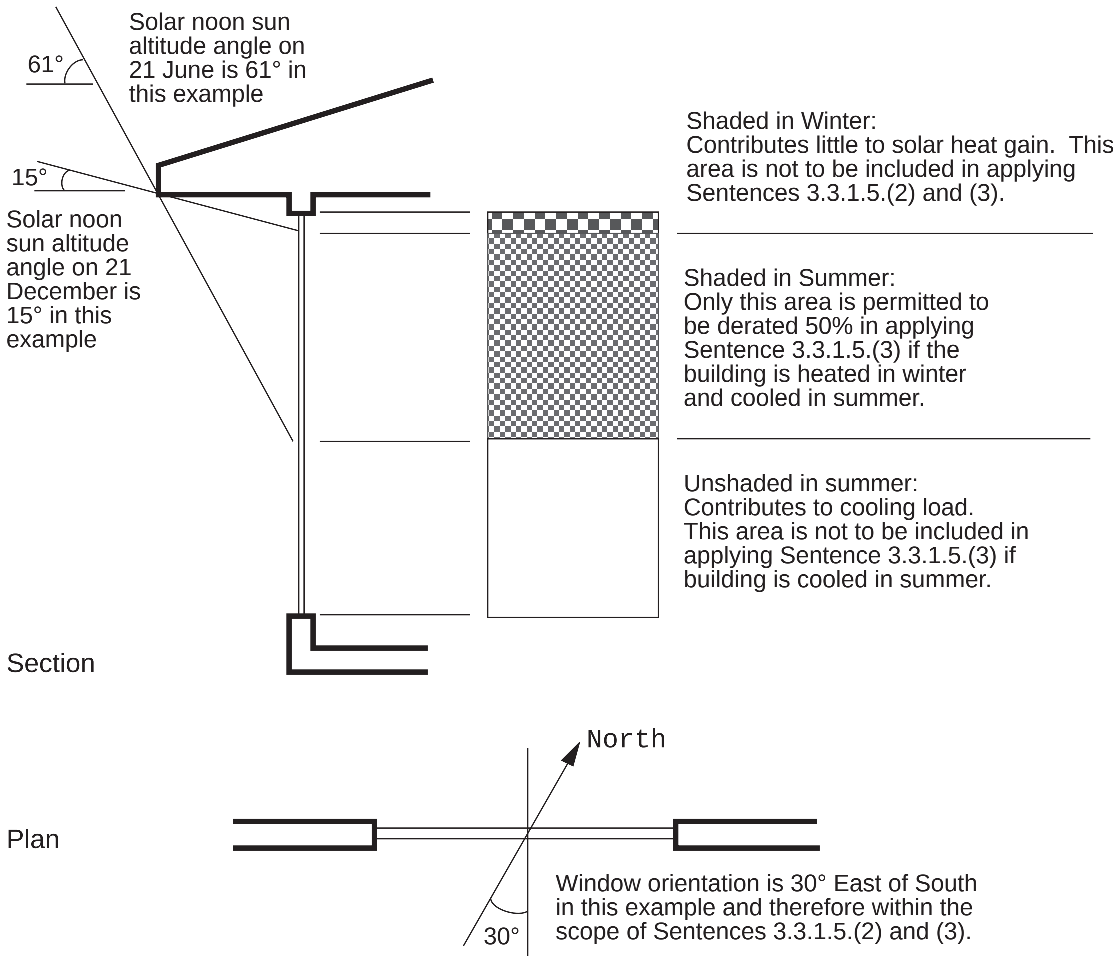


Figure E-3.3.1.5.(2)
Summer and Winter Shading of Glazed Areas

E-3.3.1.6.(1) Effect of an Unheated Space. This allowance is intended to provide an easy credit under the prescriptive path for any unheated space that may protect a component of the building envelope, that is, technically, for a space that is heated indirectly only. As such, it is conservative. It does not take into account the construction of the enclosure of the unheated space; without any control on the construction of the unheated space, too many variables, such as its size or airtightness, may negate any higher credit that could be allowed. There may be simulation tools that can be used under the performance path to provide a better assessment of the effect of an indirectly heated space; this may be used to advantage when an unheated space is designed to provide protection significantly better than the worst-case situation assumed here.

Vented spaces, such as attic and roof spaces or crawl spaces, are considered to be part of the exterior space; therefore, the provision of Article 3.3.1.6. must not be applied to them in calculating the thermal resistance of the assemblies they enclose.

E-3.3.2.1.(3) Walls in Contact with the Ground. Concerning the expression "to a depth below the exterior ground level," the reader should note that ground level is different than "grade," a defined term in the NBC and the MNECH and essentially a horizontal plane at the average exterior ground level. The wording of Sentence 3.3.2.1.(3) requires the bottom of the insulation to follow the contours of the exterior ground level at the required depth.

E-3.3.2.2. Floors in Contact with the Ground. This is intended to include "floors" of crawl spaces even when there is no actual constructed "floor." The minimum depth at which insulation is required is measured once for the entire floor from the level of grade (see comment on 3.3.2.1.(3) above); i.e., even if the exterior soil level (ground) varies, the whole floor (or perimeter) either has to be insulated or doesn't; this doesn't require some parts of the floor (or perimeter) to be insulated and some parts not. Consideration should be given to insulation of the entire floor at sites where the soil is highly conductive or where there is a permanently high water table. The requirements of this Code do not take ground water level and flow into account; in some cases, higher insulation levels may be justified.

The diagrams in Figures E-3.3.2.2.A. to G. illustrate the insulation requirements for various types of floors on ground.

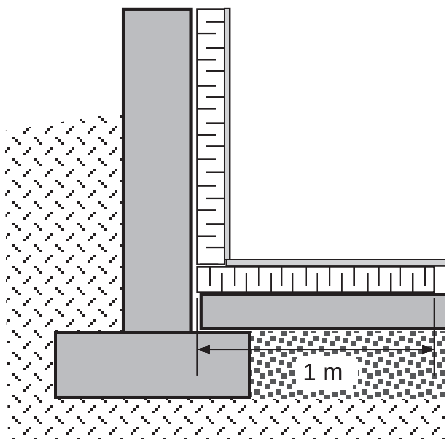


Figure E-3.3.2.2.A.

Insulation on Perimeter of Slabs-on-ground (conforming to Clause 3.3.2.2.(2)(a))

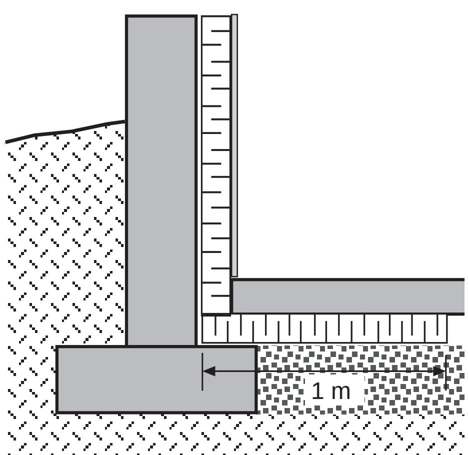


Figure E-3.3.2.2.B.

Insulation on Perimeter of Slabs-on-ground (conforming to Clause 3.3.2.2.(2)(a) and Sentence 3.3.2.2.(4))

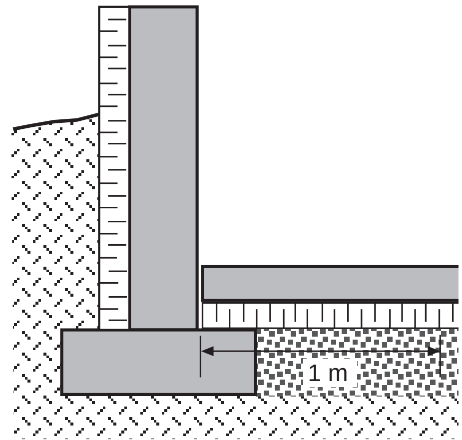


Figure E-3.3.2.2.C.

Insulation on Perimeter of Slabs-on-ground (conforming to Clause 3.3.2.2.(2)(a) and Sentence 3.3.2.2.(4))

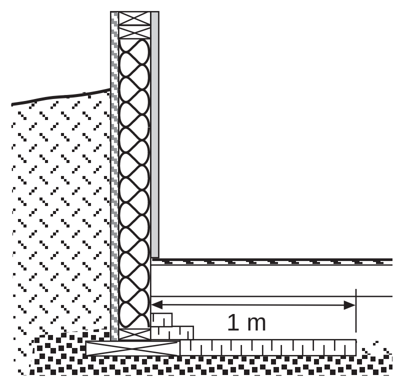


Figure E-3.3.2.2.D.

Insulation on Perimeter of Slabs-on-ground (conforming to Clause 3.3.2.2.(2)(b))

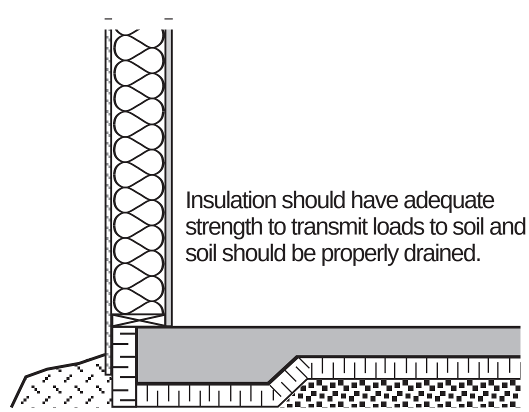


Figure E-3.3.2.2.E.

Insulation on Perimeter of Slabs-on-ground (conforming to Clause 3.3.2.2.(2)(a) and Sentence 3.3.2.2.(4))

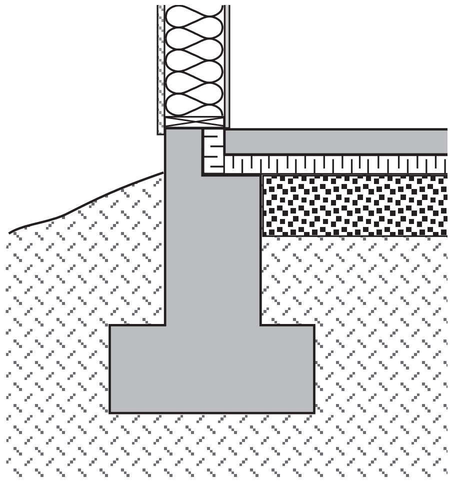


Figure E-3.3.2.2.F.
Insulation on Perimeter of Slabs-on-ground (conforming to Clause 3.3.2.2.(2)(a) and Sentence 3.3.2.2.(4))

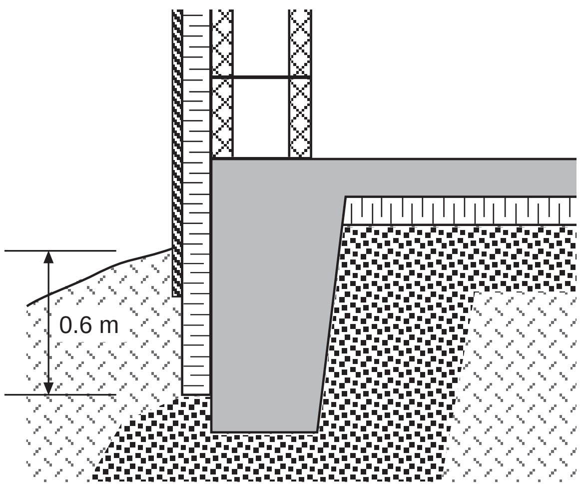


Figure E-3.3.2.2.G.
Insulation on Perimeter of Slabs-on-ground (conforming to Clause 3.3.2.2.(2)(a))

E-3.4.1.2. Treatment of Windows and Doors for Trade-offs. In a trade-off calculation involving windows, 2 U-values are needed: the reference U-value that corresponds to the prescription, and the U-value of the window under consideration. However, since the prescription is expressed as an ER value, there would be no means of providing a reference U-value for simple trade-off calculations without these equations. The equations are not intended to replace the actual U-value obtained from the window label, which is the second U-value needed for the trade-off calculation. Users do not need these equations to do computer-assisted trade-off calculations, because the computer programs will readily do the work from the ER values.

E-3.4.1.3.(5) Limits to Trade-offs and to the Performance Path Regarding Mandatory Provisions. There are several reasons why mandatory provisions are not subject to trade-off calculations or the performance path. In some cases, the energy-conserving impact of mandatory provisions cannot be easily quantified and allowing trade-offs would be unenforceable: this is the case, for instance, for airtightness requirements (Subsection 3.2.4.). In other cases, it is a question of common sense: there should be no credit given for avoiding a local condition where a reduced performance is allowed for purely practical reasons, such as the permission to reduce the insulation at the eaves to avoid trusses with high heels (Sentence 3.2.2.1.(3)), where permission is given to avoid unwarranted hardship in detailing and construction. Other mandatory provisions simply do not lend themselves to trade-offs.

E-3.4.1.4.(1) Treatment of Additions. The trade-off path cannot be used to allow the upgrading of existing components of the building envelope to compensate for components of the addition that do not satisfy the prescriptive requirements of this Code; for example, taking advantage of new windows that are replacing existing ones. Thus, even if windows in the existing building are to be upgraded at the same time as the addition is built, their characteristics cannot be used in the trade-off calculations described in Sentences 3.4.2.1.(1)and 3.4.3.1.(1).

However, the provision of Sentence 2.2.2.9.(6) that permits the calculation of the total area of windows and other glazed areas to be determined over the entire building — including existing and added parts — may be used to determine the allowable amount of windows for the addition.

E-3.4.3.1.(1) Solar Heat Gains and Thermal Mass in Computer-assisted Trade-offs. The computer-assisted trade-off path provides some means of taking into account the effects on energy consumption of such factors as solar heat gains and thermal mass of the building in order to gain some relaxation of the prescriptive requirements. The details and limitations as to how these are to be taken into account are described in the publication “Trade-off Compliance for Houses, Specifications for Calculation Procedures for Demonstrating Compliance to the Model National Energy Code for Houses Using Trade-offs,” referenced in Sentence 3.4.3.2.(1).

E-3.4.3.1.(2) Limitations to Computer-assisted Trade-offs. This limitation is necessary because accounting for solar gains through sloped or horizontal surfaces would require much more complex software. Cases subject to this limitation can be pursued using the performance compliance path described in Part 8.

E-4.2.1. Exterior Lighting Power

Lighting Levels and Safety

Applying current technology, the exterior lighting efficacy limits and entrance and exit power allowances will not reduce lighting to a level that would generally affect safety. Uniformity of lighting, rather than light level, is more critical to safety. Exceptions allowed under Sentence 4.2.1.2.(2) will accommodate exceptional cases.

High Reflectance Paving and Illumination Levels

ANSI/IESNA RP8-1983 (R1993), Recommended Practice for Roadway Lighting, recognizes that the reflectance of paved surfaces has a significant effect on the lighting power necessary to achieve required levels of illumination. The use of reflective paving should be considered as a possible alternative to the installation of more lighting fixtures or higher-powered lamps.

E-4.2.2.2.(1) Exterior Lighting Controls for Individual Dwelling Units. Photocells limit lighting to night time, but do not allow for turning lights off after the end of the evening. Timers do provide full control, but must be adjusted with the season. Motion detectors provide full control but may light up in daytime. Hence the double requirement. In a neighborhood where there is no street lighting and homeowners are responsible for night lighting, the authority having jurisdiction may waive the requirement of Clause 4.2.2.2.(1)(b) on the grounds that the lighting serves the community, not just the dwelling unit.

E-4.2.3.2.(1) Lighting within Dwellings. Research indicates that the installation of high-efficacy (non-incandescent) lighting in dwellings is cost-effective and should be encouraged. High-efficacy fixtures and lamps that provide high-quality lighting are available.

The capital cost of these high-quality units, however, is higher than that of commonly installed incandescent units, and discourages their installation. Evidence indicates that where high-efficacy units have been required by codes, the installed units would often be of lower initial cost and provide comparably lower lighting quality. These would then be replaced at a later date with low-efficacy and low-cost fixtures that provided better lighting quality.

Until this implementation and enforcement issue can be resolved, a requirement for high-efficacy lighting cannot be expected to be effective.

E-5.2.1.1.(1) Load Calculations. The NBC requires that heating systems serving single dwellings be sized in accordance with CSA Standard CAN/CSA-F280-M, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances." The HRAI Digest — published by the Heating, Refrigerating and Air-Conditioning Institute of Canada (HRAI) — is also a useful source of information in this field.

E-5.2.2.1.(1) Design and Installation of Ducts. The following publications are a useful source of information in this field:

- Publications by ASHRAE:
  - the ASHRAE Handbooks.
- Publications by HRAI:
  - HRAI Digest.
- Publications by SMACNA:
  - HVAC Duct Construction Standards — Metal and Flexible,
  - Fibrous Glass Duct Construction Standards,
  - HVAC Systems — Duct Design,
  - HVAC Air Duct Leakage Test Manual.

E-5.2.4.1.(1) Design and Installation of Piping. The ASHRAE Handbooks and publications of the Hydronics Institute are a useful source of information in this field.

E-5.2.7.1.(1) Insulation Behind Recessed Heaters. This Sentence does not apply to components of a heater that penetrate through the building envelope, such as a ducted air intake or exhaust, or to a through-the-wall unit. However, it does apply to the components of the heater that do not need to penetrate to the outside, and to any piece of equipment that is merely recessed into the wall, ceiling or floor for the sake of reducing its projection into the room.

E-5.2.8.1.(6) Mounting Height and Location of Thermostats

Mounting Height of Thermostats

Article 3.8.1.5. of the NBC has a specific requirement for the mounting height of thermostats located in a barrier-free path of travel.

Location of Thermostats

Locations to be avoided are exterior walls and locations near exterior entrances, corners or heat sources; within throw of diffusers; or in direct sunlight. Installation should include all necessary settings and adjustments, including, in the case of electrical heaters, setting of the heat anticipator to match the capacity of the heaters being controlled, as required on some thermostats for performance certification.

E-5.2.8.3.(2) Heat Pump Controls for Recovery from Setback. Several techniques of achieving this exist:

- separate exterior temperature sensor,
- gradual raising of the control point,
- controls that 'learn' when to start recovery from previous experience.

E-5.2.10.1.(1) Unit and Packaged Equipment. Table 5.2.10.1. refers to accepted values in energy-efficiency acts and in Canadian standards where available; otherwise, values from tables in ASHRAE/IESNA Standard 90.1-1989, "User's Manual," are used where appropriate. In order to reduce duplication and conflicts between requirements, minimum performance values are omitted from the Table and noted as being "in the standard" wherever the referenced standard itself contains such minimum performance requirements, since these standards are used in the federal, provincial and territorial energy-efficiency acts and could be changed on a different schedule.

For units of equipment subject to federal, provincial or territorial appliance or equipment energy-efficiency acts, a label on the appliance certifying the unit's performance according to the standard is proof that it meets the requirements of the standard and of the acts; there is therefore no need for figures to be checked.

It should be noted that, where a building is served by multiple heating or cooling units that are activated in sequence in response to increasing heating or cooling needs, it is likely economically justified to specify higher efficiency than mandated in this Code for the lead units, which operate for the longest periods of time.

E-5.3.1.1.(1) Heat Recovery in Dwelling Units. The NBC 1995 includes detailed requirements for the mechanical ventilation of dwelling units. However, as the NBC is concerned only with health and safety issues, those requirements address only the effectiveness of ventilation systems, not their efficiency, which is left to this Code. Therefore, the requirements of this Code should be read in conjunction with those of the NBC. For example, the requirements in NBC Subsection 9.32.3., Mechanical Ventilation, can be satisfied using a heat-recovery ventilator but can also be satisfied with other types of ventilation equipment. In cases where this Code requires heat recovery from the exhaust component of the ventilation system, a heat-recovery ventilator would probably become the system of choice.

The principal exhaust component of a mechanical ventilation system is described in Article 9.32.3.4. of the NBC 1995 and represents 50% of the total ventilation capacity required by Article 9.32.3.3. of that Code.

E-5.3.1.1.(2) Heat Recovery Ventilators. The referenced CSA Standard, CAN/CSA-C439 describes a laboratory test that determines the energy performance of a heat-recovery ventilator. The results of a test made for a manufacturer on a given model is listed in the Certified Home Ventilating Products Directory of the Home Ventilating Institute, Division of Air Movement and Control Association, 30 West University Drive, Arlington Heights, Illinois 60004-1893 U.S.A. and usually appears on a label on the equipment itself or in the manufacturer's published literature.

E-6.2.1.1.(1) System Design. The following documents are useful sources of information in this field:

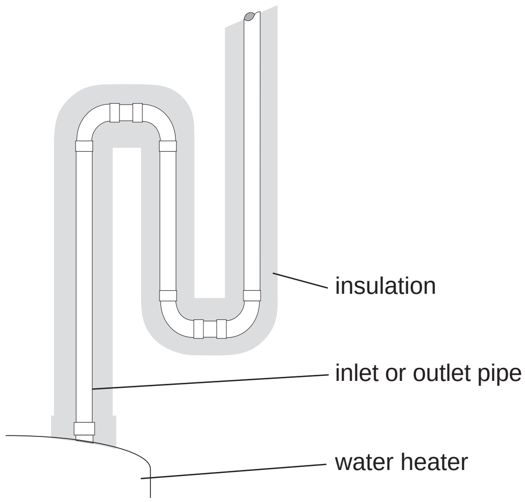
- National Plumbing Code of Canada, published by NRC,
- 1995 ASHRAE Handbook, HVAC Applications,
- American Society of Plumbing Engineers (ASPE) Data Book Volume 1, Fundamentals of Plumbing Design, chapters on Service Water Heating Systems and on Energy Conservation in Plumbing Systems, available from ASPE at 3617 Thousand Oaks Boulevard, Suite 210, Westlake, California 91362, U.S.A., and
- the appropriate provincial and local plumbing codes.

E-6.2.2.1.(1) Equipment Efficiency. Table 6.2.2.1. refers to accepted values in energy-efficiency acts and in Canadian standards where available; otherwise values from tables in ASHRAE/IESNA Standard 90.1-1989, "User's Manual," are used where appropriate. In order to reduce duplication and conflicts between requirements, minimum performance values are omitted from the Table and noted as being "in the standard" wherever the referenced standard itself contains such minimum performance requirements, since these standards are used in the federal, provincial and territorial energy-efficiency acts and could be changed on a different schedule.

For units of equipment subject to federal, provincial or territorial appliance or equipment energy-efficiency acts, a label on the appliance certifying the unit's performance according to the standard is proof that it meets the requirements of the standard and of the acts; there is therefore no need for figures to be checked.

E-6.2.3.1.(1) Heat Traps. ASHRAE/IESNA Standard 90.1-1989, "User's Manual," describes a heat trap as follows: "A heat trap may take the form of a bent piece of tubing which forms a loop of 360°; an arrangement of pipe fittings, such as elbows, connected so that the outlet and inlet piping make vertically upward runs just before turning downward to connect to the water heater's inlet and outlet fittings; a commercially available heat trap; or any other type which effectively restricts the natural tendency of hot water to rise in the vertical pipe during standby periods (see diagrams below).

When the water heater outlet is directly horizontal out of the tank or is piped with an elbow on the vertical outlet and then downward, this piping arrangement itself is effectively a heat trap and a separate heat trap is not then needed."
Figure E-6.2.3.1. illustrates two examples of site-built heat traps.



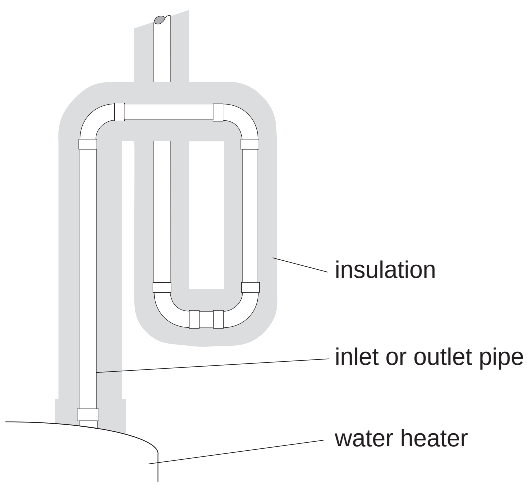


Figure E-6.2.3.1.
Heat Traps

E-6.2.4.2.(1) Shutdown. This is intended for seasonal or long-term shutdown. For electrical water heaters, a breaker approved for use as a disconnect and installed in the distribution panel can act as the shut-off device required by this Sentence. For gas water heaters, a down position on the temperature control, which sets the heater to standby with only the pilot light running, meets this requirement.

E-6.2.5.1.(1) Flow-restricting Shower Heads. Flow-restricting inserts should not be used to meet this requirement. A flow of 9.5 L / min is equivalent to 2.5 US gal / min.

E-7.2.1.1.(1) Metering. Monitoring energy consumption is considered essential to energy management. Individual metering to billing accuracy is intended to provide the building owner and tenant with a means to monitor consumption. This requirement does not necessarily imply individual billing by the distributor, but is intended as a monitoring tool which could also be used for the distribution of costs where billings are not individual.

E-7.2.2.1. Power Controls

Power Receptacles

Controls are required for exterior power receptacles and for some receptacles serving parking spaces to allow switching of seasonal decorative lighting, block heaters, car warmers or other electrical devices. Controls for parking receptacles may include ambient temperature switches.

Exterior Receptacles

One exterior receptacle should be controlled so as to accommodate decorative lights.

Receptacles for Parking

As far as possible, where indoor or outdoor parking spaces are provided with receptacles, these should also be controlled to accommodate block heaters, car warmers and other electrical devices.

E-8.2.1.3.(1) Solar Heat Gains and Thermal Mass in the Performance Compliance Path. The performance path provides some means of taking into account the effects on energy consumption of such factors as solar heat gains, thermal mass of the building and recovered energy, in order to gain some relaxation of the prescriptive requirements. The details and limitations as to how these are to be taken into account are described in the referenced publication "Performance Compliance for Houses, Specifications for Calculation Procedures for Demonstrating Compliance to the Model National Energy Code for Houses Using Whole House Performance."

E-8.2.1.5. Treatment of Additions. When the addition is considered by itself, its dimensions and thermal characteristics are used without regard to the existing building. The wall or floor or virtual plane separating the addition from the existing building is considered for what it is — a building component separating 2 conditioned spaces: no heat exchange is considered across it. Only the new mechanical and electrical systems that are part of the addition or serve only the addition are considered in the calculations. Existing central plants are not considered.

Where the addition is considered together with the existing building, energy analyses of the whole building are required, including existing parts and additions. Some existing parts of the building may not be needed for the comparison and may not have to be simulated; for example, existing central plants. It may be advantageous to consider the whole building in cases where considering the addition by itself would not permit the amount of windows desired. Existing parts of the building need not be upgraded to code requirements; however, under the performance path and in this particular situation, a simulation tool used for this task should be capable of simulating the existing components of the building with the same characteristics in both the analysis of the reference case and that of the building as proposed.

However, as implied by Clause 8.2.1.5.(1)(b), the performance path cannot be used to allow the upgrading of existing components of the building to compensate for components of the addition that do not satisfy the prescriptive requirements of this Code; for example, taking advantage of new windows that replace existing ones. Thus, even if the windows in the existing building are to be upgraded at the same time as the addition is built, the same characteristics would have to be used in both analyses for the existing windows. This results in no energy savings in the existing parts of the building that can offset any shortcomings of the addition's components.

The degree of precision required for determining the thermal characteristics of existing components, as required in Sentence 8.2.1.5.(2), is not high, since the characteristics of the existing parts of the building remain identical in both computer simulations. In fact, the existing parts of the building get compared to themselves.

Appendix F
Determination of Regionally-Sensitive Requirements

The predecessor to this Code, "Measures for Energy Conservation in New Buildings," included tables of minimum thermal resistance values that varied according to climate as expressed in degree-days. However, although the derivation of those minimum values was based on life-cycle costing analyses, those analyses did not take into account other regional variations in the parameters that enter into such life-cycle costing. For instance, they used one value for the cost of energy, even though there is a significant variation in energy costs across the country and between different types of energy within a given region.

This Code includes many requirements that vary according to region — thermal resistance values, minimum depth of foundation insulation, requirement for heat recovery from exhaust air, etc. The derivation of these requirements is also based on a life-cycle costing process. However, in this case, the life-cycle costing analyses took into account many more regionally sensitive variations in the life-cycle costing parameters.

The process used can be summarized as follows:

(1) A number of commonly used building assemblies (walls, roofs, floors, etc.) were identified, their thermal resistance values calculated, and their construction costs estimated.

(2) The effect of varying the characteristics of one of these assemblies (such as the thermal resistance of the walls) on the annual heating cost of a representative house was estimated using a computer simulation program.

(3) For each assembly in a category (such as walls), its incremental cost relative to the lowest cost assembly of those studied was added to the present worth of the increment in annual heating costs that assembly causes relative to the assembly with the highest thermal resistance.

(4) The assembly with the lowest sum of increment in cost plus increment in present worth of heating costs was identified as the apparent optimum assembly.

This process was carried out interactively with provincial and territorial officials, using their inputs on such parameters as present and future energy costs and the useful life of buildings. The thermal resistance values of the apparent optimum assemblies generated by this process were then proposed to these provincial/territorial officials as the likely choices for the minimum acceptable thermal resistance values under this Code. Although these choices were sometimes tempered by practical considerations such as local building practices and available materials, the tables of regionally sensitive requirements in Appendix A are, for the most part, direct outcomes of this life-cycle costing process.

The four-point summary above is, of course, a gross simplification of a rather complex process, described in greater detail in the papers referenced at the end of this appendix. However, it may be helpful to Code users to know the provincial inputs on which the regionally sensitive requirements are based. These are included in Table F-2 at the end of this appendix. The following discussion on life-cycle costing is provided to aid in understanding the significance of these provincial inputs.

The concept of a present-worth factor, P_f, is best explained by an example. Suppose the annual cost of the heat loss through the building envelope were to increase according to the following schedule:

Years	Annual cost
1st year	$500
+ 1 year	$514
+ 2 years	$528
+ 3 years	$543
⋮	
+ 9 years	$641
⋮	
+ 19 years	$844
⋮	
+ 25 years	$997
⋮	
+ 29 years	$1114

It is possible to calculate a sum of money that, if deposited in a bank or invested in an annuity and withdrawn according to the above schedule to pay the annual heating costs, would just be consumed (both principal and interest) at the end of the period under consideration. This amount is called the present worth of those annual heating costs. It is calculated using the following equations:

$$PW = C \times \frac{1-(1+a)^{-n}}{a}$$

or

$$PW = C \times P_f$$

where

- PW = the present worth of the heating costs over n years,
- C = the annual heating cost in the first year,
- a = the effective interest rate, = (i – e)/(1 + e),
- e = the rate at which energy costs are expected to increase (including inflation),
- P_f = the present worth factor,
- i = the discount rate or cost of money (including inflation), and
- n = the number of years under consideration.

These last two factors require further elaboration.

The discount rate can be a number of things. If the money were in fact deposited in a bank, the discount rate would be the interest rate offered by the bank. Another way to look at it would be to say that the cost of money is the interest that would be paid on the best investment an owner could make with the same amount of money if he or she did not invest in an energy-conserving option.

The number of years to be considered is equally difficult to decide upon. It might be the amortization period of a mortgage or other form of financing. However, it can be argued that it should be the life of the building, which might exceed 100 years. It can also be argued that many owners are unwilling to look beyond 10 years, so this time frame should be used. Perhaps it is reasonable to use the economic life of the building — that period over which the building is likely to remain useful without major renovations. This is about 20 to 30 years, in most cases.

Example

The schedule of annual heating costs in the example above is based on an energy cost increase rate of 2.8%, which might represent a rate of increase 0.1% below a general inflation rate of 2.9%. Assume the cost of money is 3.85% above the general inflation rate. Let us calculate present worth for the 30 years of costs in the schedule.

Therefore,

- e = 2.8% (0.1% less than the general inflation rate 2.9%),
- i = 6.75% (3.85% above the general inflation rate of 2.9%), and
- n = 30 years.

From these we can calculate:

$$a = \frac{0.0675-0.0280}{1+0.0280} = 0.0384 = 3.84\%$$

$$P_f = \frac{1-(1+0.0384)^{-30}}{0.0384} = 17.6$$

$$PW = \$500 \times 17.6 = \$8800$$

Therefore, if $8,800 were put in a bank now at 6.75% interest and used to pay for the above schedule of heating costs, it would be used up in 30 years.

We can now apply this present-worth concept to the process of deciding on minimum requirements for an energy code. Suppose we are considering a range of thermal resistance values for walls; suppose too that we know the construction cost increment of each wall type relative to the cost of constructing the wall with the lowest thermal resistance. We can calculate the heating cost increment that each type of wall produces in a representative house relative to the heating cost of the same representative house with the wall type with the highest thermal resistance. If we then apply the present-worth approach to the heating cost increments and calculate the total life-cycle cost for each thermal resistance level, the results might look like Table F-1 and its accompanying graph (Figure F-1):

Table F-1
Life-Cycle Cost of Wall Options

RSI, $m^2 \cdot {}^\circ C/W$	Construction Cost Increment, $/m² of wall	Heating Cost Increment, $/m² of wall	Present-Worth Factor	Present Worth of Heating Costs, $/m² of wall	Total Life-Cycle Cost, $/m² of wall
2.1	0	2.5	17.6	43.2	43.2
2.7	5	1.7	17.6	29.2	34.2
3.1	8	1.3	17.6	22.9	30.9
3.5	10	1.0	17.6	18.0	28.0
3.9	13	0.8	17.6	14.1	27.1
4.3	17	0.6	17.6	11.0	28.0
4.7	20	0.5	17.6	8.4	28.4
5.1	24	0.4	17.6	6.2	30.2
5.5	27	0.2	17.6	4.3	31.3
6.7	33	0.0	17.6	0.0	33.0

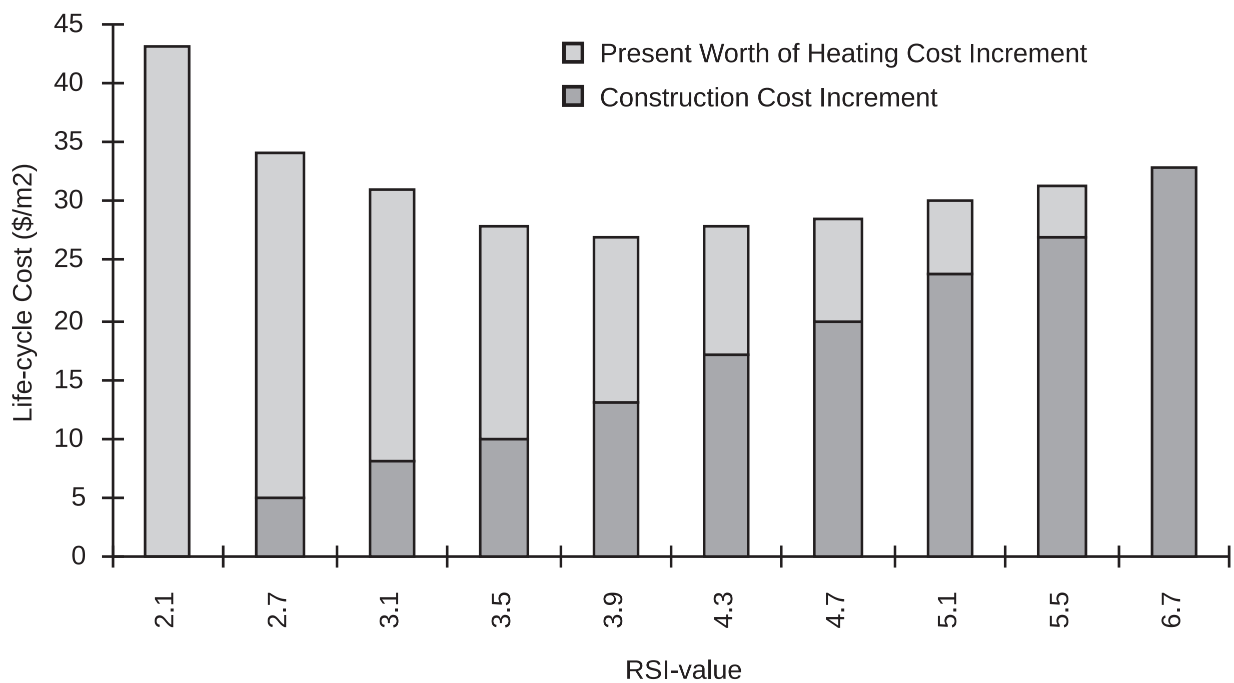


Figure F-1
Life-cycle cost of wall options

Thus, RSI 3.9 has the lowest life-cycle cost. However, other RSI values have almost the same life-cycle cost. A provincial or territorial authority that was particularly concerned about the cost of construction might choose to make RSI 3.5 the required minimum, since this would save $3/m² (about $300 for an average house) without significantly affecting the life-cycle cost. On the other hand, a provincial or territorial authority that was particularly concerned about saving energy might choose to make RSI 4.7 the required minimum, since this would reduce heating costs by about $0.30/m² per year (about $30 for an average house) or $5.70/m^2$ on a life-cycle basis (about $600 for an average house), again without significantly affecting the life-cycle cost. Another consideration might be that an RSI value lower than the theoretical optimum might be more consistent with the typical construction practices and available materials in a particular province or territory.

One more factor in Table F-2 of provincial/territorial assumptions requires further explanation. The procedure was established with provision for an "environmental multiplier." This is a factor that can be applied to energy costs to reflect the fact that current market energy costs do not necessarily reflect the full impact of the use of energy on the environment (e.g., carbon dioxide emissions from the burning of oil or natural gas). One of the principal impetuses for using codes to regulate the energy-related characteristics of buildings is the desire to reduce the effect of energy use in the heating, cooling and lighting of buildings on the environment; but simply basing the life-cycle costing process described herein on the market costs of energy may not adequately address this concern. The environmental multiplier factor can also be used to allay concerns that this process may not adequately reflect the benefits to future generations provided by saving energy today. In any case, assigning a value to this factor is difficult and, as is evident in Table F-2, all provinces and territories but one have chosen to leave this factor at a value of 1.0, at least for this edition of the Code.

Hopefully, this provides a rough understanding of the kind of cost/benefit analysis process on which this Code's regionally sensitive requirements are based and the kind of judgmental adjustments of that process's results that are sometimes necessary.

Table F-2
Provincial/Territorial Assumptions for Life-Cycle Costing

Province/Territory	General Inflation Rate	Discount Rate (not including inflation)	Economic Life (years)	Enviromental Multiplier	Energy Cost ($/GJ)			Energy Escalation Rate (not including inflation)		
					Electricity	Oil	Natural Gas, Propane	Electricity	Oil	Natural Gas, Propane
Yukon(1)	3%	6%	30	1.0	27.56	10.87	15.30	0%	0%	0%
Northwest Territories(2)	3%	6%	30	1.0	41.67	9.36	12.57	0%	0%	0%
British Columbia(1)	(3)	6%	30	1.0	16.32	10.24	6.02	0.5%	1.0%	1.1%
Alberta	3%	6%	30	1.0	18.19	10.05 (Propane)	3.08	-0.06%	1.74% (Propane)	4.03%
Saskatchewan	3%	6%	30	1.0	20.31	-	3.98	0%	-	1.5%
Manitoba	3%	6%	30	1.1	13.81	10.65	6.31	-0.81%	0.63%	1.76%
Ontario	3%	6%	30	1.0	25.09	10.10	5.94	0.4%	1.2%	1.4%
Quebec	3%	6%	30	1.0	17.53	9.46	9.23	0%	0%	0%
New Brunswick	3%	6%	30	1.0	14.06	9.64	16.45	0%	0.5%	0.5%
Nova Scotia	3%	6%	30	1.0	23.55	9.18	16.85	-0.1%	0.4%	0.4%
Prince Edward Island	3%	6%	30	1.0	35.76	9.26	15.08	-0.1%	0.4%	0.4%
Newfoundland(1)	3%	6%	30	1.0	19.44	10.79	-	1.0%	1.0%	-

Notes to Table F-2:

(1) Prices vary by zone; prices shown are for Zones A, which include Whitehorse (Yukon), Vancouver (BC), and St. John's (Nfld).
(2) Prices vary by zone; prices shown are for Zone B, which includes Yellowknife.
(3) Constant dollar analysis.

Adjustments Made to the Life-Cycle Cost Analyses Results by the Standing Committee on Energy Conservation in Buildings

- **Walls in contact with the ground.** In studies done to generate construction cost data for use in the life-cycle cost analyses, the most economical method identified for insulating foundation walls to higher RSI values was the installation, on the interior, of gypsum board finish on 38 x 64 mm stud framing spaced out from the foundation wall enough to accommodate various thicknesses of batt insulation. Increasing the amount of insulation involves simply spacing the framing further from the foundation wall. This results in relatively low incremental costs for added insulation, since it only involves the added cost of the thicker insulation. This, in turn, tends to result in higher optimum RSI levels. This obviously ignores the value of the lost basement space due to thicker insulation, but no reliable method of accounting for that value could be identified. The Standing Committee therefore decided to place an arbitrary upper limit on the required RSI values for foundation walls. That limit was set at the RSI value that is provided by 100 mm of expanded polystyrene foam insulation with gypsum board covering — RSI 3.1, including the foundation wall and the interior air film.

- **Floors on ground incorporating heating elements.** Although the life-cycle cost results, in some cases, indicated that perimeter insulation of heated floors on ground was more cost-effective than full-surface insulation, the Standing Committee decided to require full-surface insulation in all cases because —
  (a) the available methods for calculating below-grade heat loss cannot be applied to heated floors with confidence, and
  (b) full-surface insulation is standard industry practice.

References

(1) Swinton, M.C.; Sander, D.M., A Method for Life Cycle Cost Analysis for the New Energy Code for Houses, Innovative Housing ’93 Conference, Vancouver, 1993. Vol. 2, pp. 278–284, (NRCC-35223) (IRC-P-3091).

(2) Specification for Calculation Procedures for Life-Cycle Cost Analysis for the Canadian Code for Energy Efficiency in New Houses, Canadian Commission on Building and Fire Codes, National Research Council Canada, Ottawa, 1993.

(3) Development of a Database of Construction Costs of Opaque Envelope Components for Use in the Development of the Energy Code — Residential Construction, Energy Building Group Ltd., for Building Performance Laboratory, Institute for Research in Construction, National Research Council Canada, Ottawa, 1993.

Appendix G
Conversion Factors

Table G-1
Conversion Factors

To convert	To	Multiply by	Notes
°C	°F	1.8 and add 32	
L	gal (imperial)	0.2200	
L	US gal	0.2642	
L/s	ft^3/min (cfm)	2.1189	ft = foot, min = minute
lx	ft-candle	0.09290	
m	ft	3.281	
m^2	ft^2	10.76	
m^2·°C/W (RSI)	h·ft^2·°F/Btu (R)	5.678	Thermal Resistance
m^3	ft^3	35.31	
mm	in.	0.03937	in. = inch
Pa	in. of water	0.004014	
W	Btu/h	3.413	
W/m^2	Btu/h·ft^2	0.3170	
W/m^2·°C	Btu/h·ft^2·°F	0.17612	U-value
W/m·°C (per m thickness)	Btu·ft/h·ft^2·°F	0.5777	Conductivity (per ft)
	Btu·in/h·ft^2·°F	6.9444	Conductivity (per in.)
W/L	BTU/h·US gal	12.916	