ENERGY and ENVIRONMENTAL DESIGN GUIDELINES

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Version 1.0

TABLE OF CONTENTS

1. Introduction

Manitoba Housing's *Energy and Environmental Design Guidelines* provide a sustainability and energy framework for all projects developed or seeking a project commitment from Manitoba Housing.

The intent of this document is to provide sustainability and energy related design requirements and prescribed construction targets to ensure that buildings are designed and built to be efficient, sustainable, and cost-effective. Manitoba Housing's standards related to visitable design, accessible design, modesty assurance as well as other design guidelines and standards are encompassed within the ***Manitoba Housing Design Guidelines*** document, which is separate from this one.

This document is subject to regular review and revision by Manitoba Housing. Please contact Manitoba Housing for the most up-to-date version of these guidelines.

In all cases, the Manitoba Building Code, the Manitoba Electrical Code, the Manitoba Plumbing Code, the Manitoba Fire Code, the Manitoba Energy Code for Buildings, and municipal code/requirements take precedence over the requirements outlined in this document. Where there is a difference in requirements, the most stringent shall apply.

Applicabilty

The design guidelines and project requirements outlined in this document are intended primarily for the new construction or deep energy retrofit of buildings, namely:

- multi-family;
- row housing;
- semi-detached;
- single family detached and;
- two-family

All sections of this document are applicable to projects where Manitoba Housing owns the building or provides more than 35% in funding support toward the capital cost of a project or on any other project specifically identified by Manitoba Housing.

2. Definitions

“dwelling, multi-family” means a building, containing three (3) or more dwelling units, each of which is designed for or occupied by one family only, with separate housekeeping and cooking facilities for each.

“dwelling, row” means a multi-family dwelling that contains three (3) or more dwelling units located side by side that are separated by common party walls extending from foundation to roof, where no dwelling unit is located entirely or partially above another dwelling unit.

“dwelling, semi-detached” means a two-family dwelling where no dwelling unit is located entirely or partially above another dwelling unit.

“dwelling, single-family detached” means a building designed for residential occupancy by one family, including modular and ready-to-move homes, but not including a mobile home.

“dwelling, two-family” means a building containing two dwelling units, each designed and used or intended to be used exclusively by one family.

“energy retrofit, minor” involves a single measure or focused group of measures that result in savings as high as 15%.

“energy retrofit, major” involves several measures across multiple building systems and can lead to savings between 15 and 40%.

“energy retrofit, deep” is typically not driven by energy savings but by space changes, modernization or building renewal. Savings can be greater than 40% because the majority of the building’s energy-using systems are improved.

3. Sustainability Goals

3.1 Manitoba Housing is committed to actively support the provincial government's vision of making Manitoba the cleanest, greenest and most climate resilient province.

3.2 Manitoba Housing's sustainability plan focuses on three strategic areas:

.1 Establishing a best practice approach to integrating sustainability into all levels of decision making.

.2 Development of cutting-edge expertise in demonstrated delivery of sustainable social housing.

.3 Gaining recognition within the social housing sector and construction industry as leaders in sustainable social housing.

3.3 The plan is supported by the following objectives related to buildings:

.1 Reduce energy consumption levels and GHG emissions

.1 Manitoba Housing is dedicated in working towards having all new buildings be Net Zero Energy Ready by 2030.

.2 Manitoba Housing monitors and reports to the Manitoba government on energy consumption, and related greenhouse gas emissions, for all buildings it owns.

.3 Manitoba Housing has independently adopted a GHG policy for new construction projects that it funds (irrespective of the building ownership) with the goal of reducing GHG emissions to the greatest extent possible while being cost conscious. It also requires project managers to include GHG reduction strategies in renovation projects where applicable.

.2 Achieve Manitoba Housing's Building and Energy Performance Targets

Manitoba Housing established the following minimum Performance Targets for all new projects:

- Thermal Energy Demand Intensity (TEDI) (kWh/m2/yr)
- Total Energy Use Intensity (TEUI) (kWh/m2/yr)
- Envelope Air Leakage Rate (EALRn75) (l/s/m2)
- Interior Partitions Air Leakage Rate (IPALRn50) (l/s/m2)
- Peak Thermal Load (PTL) (W/m2)
- Mechanical Energy Use Intensity (MEUI) (kWh/m2/yr)

.3 Improve indoor environmental quality for tenants

Manitoba Housing will ensure high quality, healthy living conditions for its occupants by integrating daylighting and outdoor views into rooms, selecting materials that either reduce or eliminate indoor pollutants and providing high levels of air exchange.

.4 Enhance resource efficiency

Manitoba Housing projects will improve resource efficiency by reducing water consumption, waste generation, and potential damage to the natural environment during construction, renovation, operation and demolition of buildings.

.5 Reduce operating and maintenance costs

Manitoba Housing projects will preferentially select materials and designs that emphasize durability and ease of maintenance to minimize the long term operating costs.

4. Building and Energy Performance

4.1 Requirements

Manitoba Housing has developed performance requirements modeled after the *BC Energy Step Code* (www.energystepcode.ca) in order to meet its goals in relation to energy and GHG reductions.

.1 Energy Targets

The minimum Performance Targets for all new Manitoba Housing projects shall be as follows:

.1 Part 3 Building Projects

Table 1: Manitoba Housing Energy Targets (Part 3 Buildings)

Climate Zone[1]	Compliance Years	Step Code Level	Building Envelope – Maximum TEDI ($kWh/m^2/yr$)	Equipment & Systems – Maximum TEUI ($kWh/m^2/yr$)	$EALR_{75}$ ($L/s/m^2$ @ 75 Pa)	$IPNLR_{50}$ ($L/s/m^2$ @ 50 Pa)
7A[2]	2019 – 2024	3	30	120	1.0	1.2
7A[2]	2025+	4	15	100	0.75	1.2
7B[3], 8[4]	2019 – 2024	2	45	130	1.25	1.2
7B[3], 8[4]	2025 – 2029	3	30	120	1.0	1.2
7B[3], 8[4]	2030+	4	15	100	0.75	1.2

1 Climate Zone is based on Heating Degree Days (HDD) below 18°C for 25 years.
2 Less than 6000 Heating Degree Days (HDD)
3 6000 to 6999 Heating Degree Days (HDD)
4 Greater than 6999 Heating Degree Days (HDD)

.2 Part 9 Building Projects

Table 2: Requirements for Part 9 Buildings Located in Climate Zone 7A

	Building Envelope TEDI (kWh/m2/yr)	Equipment & Systems % < REF* or MEUI	Airtightness Testing (ACH@50 Pa)
STEP 3 (2019)	70	20% or see below	≤ 2.5
STEP 4 (2020-2029)	55	40% or see below	≤ 1.5
STEP 5 (2030+)	35	see below	≤ 1.0

MEUI Targets per Building Size						
	≤ 50 m^2 (538 ft^2)	≤ 75 m^2 (807 ft^2)	≤ 120 m^2 (1292 ft^2)	≤ 165 m^2 (1776 ft^2)	≤ 210 m^2 (2357 ft^2)	> 210 m^2 (2357 ft^2)
Buildings Designed and Constructed with No Cooling System						
STEP 3	165	145	120	108	98	95
STEP 4	120	110	90	78	70	70
STEP 5	95	85	70	60	55	55
Buildings Designed and Constructed with Cooling System						
STEP 3	200	173	138	118	105	100
STEP 4	155	138	108	88	78	75
STEP 5	130	113	88	70	63	60

* REF refers to the EnerGuide Reference House

Table 3: Requirements for Part 9 Buildings Located in Climate Zone 7B

	Building Envelope TEDI (kWh/m2/yr)		Equipment & Systems % < REF* or MEUI		Airtightness Testing (ACH@50 Pa)	
STEP 3 (2019)	90		20% or see below		≤ 2.5	
STEP 4 (2020-2029)	65		40% or see below		≤ 1.5	
STEP 5 (2030+)	50		see below		≤ 1.0	
MEUI Targets per Building Size						
	≤ 50 m^2 (538 ft^2)	≤ 75 m^2 (807 ft^2)	≤ 120 m^2 (1292 ft^2)	≤ 165 m^2 (1776 ft^2)	≤ 210 m^2 (2357 ft^2)	> 210 m^2 (2357 ft^2)
Buildings Designed and Constructed with No Cooling System						
STEP 3	185	165	140	128	118	115
STEP 4	135	125	105	93	85	85
STEP 5	105	95	80	70	65	65
Buildings Designed and Constructed with Cooling System						
STEP 3	220	193	158	138	125	120
STEP 4	170	153	123	103	93	90
STEP 5	140	123	98	80	73	70

* REF refers to the EnerGuide Reference House

Table 4: Requirements for Part 9 Buildings Located in Climate Zone 8

	Building Envelope TEDI (kWh/m2/yr)		Equipment & Systems % < REF* or MEUI		Airtightness Testing (ACH@50 Pa)	
STEP 3 (2019)	105		20% or see below		≤ 2.5	
STEP 4 (2020-2029)	80		40% or see below		≤ 1.5	
STEP 5 (2030+)	60		see below		≤ 1.0	
MEUI Targets per Building Size						
	≤ 50 m^2 (538 ft^2)	≤ 75 m^2 (807 ft^2)	≤ 120 m^2 (1292 ft^2)	≤ 165 m^2 (1776 ft^2)	≤ 210 m^2 (2357 ft^2)	> 210 m^2 (2357 ft^2)
Buildings Designed and Constructed with No Cooling System						
STEP 3	200	180	155	143	133	130
STEP 4	150	140	120	108	100	100
STEP 5	115	105	90	80	75	75
Buildings Designed and Constructed with Cooling System						
STEP 3	235	208	173	153	140	135
STEP 4	185	168	138	118	108	150
STEP 5	150	133	108	90	83	80

* REF refers to the EnerGuide Reference House

4.2 Energy Modelling

Energy modelling shall be performed for all new build and deep energy retrofit projects and results shall be submitted (both report and software modelling files) to the Owner and development team at each stage of design (schematic, design development, and construction) and as-built stages. Any changes as the drawings and specifications progress that may impact energy performance shall be included in each stage. As-built energy modelling should include actual airtightness testing result.

.1 Part 3 Buildings

The energy targets shall be verified through mandatory building and energy modelling as described in the latest edition of the ***Energy Modelling Guidelines*** as produced by the City of Vancouver (https://vancouver.ca/home-property-development/large-building-energy-requirements-forms-checklists.aspx).

Energy modelling shall be performed by an experienced Energy Modeler hired by the Owner/Consultant in compliance with ***Whole Building Energy Modelling Services*** as produced by Architectural Institute of British Columbia and Engineers & Geoscientists of British Columbia (https://www.egbc.ca/Practice-Resources/Professional-Practice-Guidelines).

.2 Part 9 Buildings

The energy modelling performed for Part 9 buildings may use the requirements set out for Part 3 buildings, or alternatively the modelling may be undertaken by a Natural Resources Canada (NRCan) Certified EnerGuide Modeler.

Refer to Appendix A - Energy Model Emission Factors.

4.3 Whole building air tightness testing

The as-built Envelope Air Leakage Rate shall be confirmed through a mandatory testing performed in accordance with the following methods:

Part 3 Residential Buildings in accordance to ASTM E3158 – Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building in both building envelope and operational envelope conditions.

Part 9 Residential Buildings in accordance to CGSB 149.10 – Determination of the Air Tightness of Building Envelopes by the Fan Pressurization Method.

.1 Testing for new building construction

Perform an air leakage test as soon as possible; at earliest when the building's air barrier is complete. Testing early will help identify deficiencies before they are fully covered up by finish materials allowing for quicker and less expensive repairs.

The test method outlines the testing procedures and the pass/fail requirements for the air leakage test are identified in either the testing guidelines or the energy target tables above, the most stringent will apply. In addition to the reported values from the test, the air leakage must also be reported in air changes per hour at 50 Pa (ACH50). Results must be reported to the project team within 48 hours after testing.

.2 Testing for Deep Energy Retrofits

Owner or consultant shall arrange to conduct a whole building air tightness pre-test prior to the design stage. This test is used to quantify the amount of air leakage and identify the sources of leakage, to ensure a solution to all major deficiencies will be incorporated into the renovation design specifications. The pass/fail requirement for air tightness testing is outlined in the performance requirement tables above; however the target might not be achievable with the approved scope of work. The alternate pass/fail criteria are for the building test to achieve a decrease in air leakage of at least 20% over the baseline test conducted pre-construction, with a maximum of 3 $L/s/m^2$. This target is based on an average decrease determined by the experience of Manitoba Housing. In addition to the reported values from the test, the air leakage must also be reported in air changes per hour at 50 Pa (ACH50). Test results must be provided to the project team within 48 hours after testing.

4.4 Unit air tightness testing

Interior Partitions Leakage Rate should be tested to ASTME 779 or equivalent standard, and reported demonstrating its compliance. The sample set shall require testing of 10% of total units with a minimum of 2 units and maximum of 10 units and be representative of the variety of unit types and locations in the building. Refer to Appendix B Reducing Air Leakage between Suites for further details.

4.5 Building Envelope Commissioning

Manitoba Housing shall directly hire a commissioning agent for Building Envelope, Mechanical, and Electrical work on all new build and deep energy retrofit projects.

4.6 Beyond Targets

Manitoba Housing encourages any projects that may choose to go beyond the specified targets to further reduce energy consumption or provide further GHG reduction. Manitoba Housing will review any new proposed targets and provide approval on case by case basis.

5. Passive Design Strategies

5.1 Intent of Passive Design

"Passive design" is an approach to building design that uses the building architecture to minimize energy consumption and improve thermal comfort. The building form and thermal performance of building elements are carefully considered and optimized for interaction with the local micro-climate. It is intended to establish a common vision and support decision making for new developments that will maximize occupant health and comfort and minimize energy use by relying less on mechanical and electrical systems. Furthermore, it is intended to move toward a new, higher standard of energy efficiency without sacrificing thermal comfort.

This section is not prescriptive, but rather discusses and analyzes recommended design approaches and the energy saving opportunities each presents. The design teams should understand the basic concepts and implement the strategies recommended in the following section to optimize passive performance and achieve the many spinoff benefits of energy efficient, thermally comfortable buildings. The application of passive design must be carefully considered within the specific constraints and opportunities of each project.

Consultants are expected to provide a brief description of how each passive design strategy has been considered on a given project.

5.2 Recommended Passive Design Strategies

.1 Site and Orientation

The Building's orientation determines the amount of solar radiation it receives and affects energy and comfort implications of solar shading and window-to-wall area ratio. The south facing windows will capture desirable solar gains during winter when the sun angle is low providing desirable passive solar heating during winter. The same solar gains should be reduced through properly designed external shading to reduce requirements for mechanical cooling and to increase comfort of occupants in summer. Windows on the east and west orientations should be carefully planned as they receive the second highest radiation intensities.

.2 Building Shape and Geometry

Building shape and geometry have potential to reduce building energy intensity. Buildings with a smaller exterior area, minimal articulation and projections, and a more compact shape will achieve better energy performance. Building geometry must also be considered in relation to daylighting and natural ventilation.

5.3 Landscape

Properly designed landscape can reduce ambient temperature and limit the heat island effect around the building, protect the building from sun, wind and rain and reduce solar intensity. Planting deciduous trees in front of the building's south and west orientations will provide shading, lower the cooling load in summer, and allow sun to warm a building in winter.

5.4 Space Planning

Planning and locating spaces with specific requirements in their ideal thermal locations in the building can reduce mechanical heating and cooling energy by taking advantage of the building natural thermal responses. Locating spaces with large internal heat gains (such as commercial kitchens and administrative offices) on north or east facing orientations or introducing south facing buffer zones can reduce energy use for mechanical cooling. Any space planning considerations must also take into account the base floor planning guidelines set out in the Manitoba Housing Design Guideline.

5.5 Buffer Spaces

Enclosed balconies are a good example of buffer spaces. Integrating occupied buffer spaces such as corridors and entryways as transition spaces can also be beneficial as they can accept a wider thermal comfort range compared to the fully occupied spaces.

5.6 Solar Shading

Effective shading design requires a balance between admitting desirable solar gains during winter and blocking undesirable solar gains during summer. Fixed external shading devices can be effectively used for the south and east facing orientations. Excessive solar gains on the west orientations coincide with the hottest part of the day and are difficult to reduce with fixed external shading devices. Use of low solar gain window coatings should be considered to help blocking undesired solar radiation on the west orientations.

5.7 Windows

Windows are the weakest thermal elements in a building's insulated envelope and have significant impact on indoor thermal comfort and building energy consumption. Transmitting solar radiation through windows is beneficial during winter and undesirable during summer. Carefully selecting window-to-wall ratios for different orientations, choosing adequate shading devices and utilizing good thermal and visual transmittance characteristics are important passive design strategies. Window performance shall be properly modelled in accordance with the guidelines set out above.

5.8 Continuous Insulation

Effective thermal insulation of the building's opaque elements is one of the most critical design parameters of a building envelope. Thermal insulation impacts the surface temperature on the envelope interior, which directly impacts thermal comfort. Better thermal insulation not only reduces energy use for heating and cooling, but also can significantly reduce the peak heating / cooling demand and the need for a larger HVAC system. Design of a building envelope should reduce to minimum or completely eliminate thermal bridging through exposed slab edges, roof, balcony overhangs or exposed concrete elements. Effective thermal performance of the building's opaque elements shall be properly modelled in accordance with the Energy Modelling Guidelines above in section 3 to capture effect of all thermal bridging.

5.9 Air Tightness

The air and moisture tightness of a building envelope is a critical factor in its thermal performance and durability. Incorrectly detailed building envelope with undesirable air and moisture diffusion can result in reducing effective thermal insulation, uncontrolled air and moisture exchange between the exterior and interior, potential condensation within the envelope, physical damage of the envelope components from condensation, and occupant health impact associated with mildew and fungus growth. Additional airtightness criteria, specific for Manitoba Housing projects, also requires all partition walls of a residential suite to prevent transfer of tobacco smoking and cooking odours between the suites and to a corridor. Envelope Air Leakage Rate and Interior Partitions Leakage Rate shall meet the minimum Performance Targets and shall be confirmed by a mandatory testing performed in accordance with guideline.

5.10 Passive Cooling

To enhance passive cooling, low and high level operable windows should be considered. cross-ventilation is more effective, where operable windows are located on adjacent or opposite walls and allow drawing outdoor air across the occupied space. Utilizing passive natural cooling strategies can contribute to reducing energy use for mechanical cooling and improving indoor thermal comfort. Using overnight mechanical ventilation to remove heat accumulated in the building mass during the day and supplying cooler night air can also be an effective passive cooling strategy. Window shading, window coatings and landscape design can also reduce the need for mechanical cooling.

6. Energy Efficient Products, Incentives and Energy Assessment

Manitoba Housing is committed to achieving optimal energy performance on equipment and materials that are specified for our existing buildings and in new developments. As such, Manitoba Housing is committed to selecting energy efficient materials and securing all rebates and incentives associated with these energy efficient choices.

.1 Energy-using equipment shall be selected in consideration of its effect on the Energy Performance Target.

.2 Energy efficiency measures are meant to reduce the amount of energy consumed while maintaining or improving the level of comfort in the building. System design and equipment selection should consider the suitability, capital, cost of operation and ease of maintenance, experience and reputation of the equipment manufacturer, local availability, durability, lifespan, energy benefit, environmental health attributes and safety.

6.1 Heating, Ventilation, Air Conditioning (HVAC) Systems

All furnaces shall be ENERGY STAR® rated high efficiency condensing appliances with minimum 95% Annual Fuel Utilization Efficiency (AFUE). “Right sizing” an HVAC system improves efficiency, reduces noise, offers greater cooling/heating comfort and saves money. All appliances shall have an installed capacity no greater than 10% of the modeled design capacity.

All major ventilation systems shall include heat recovery with a minimum sensible recovery efficiency (SRE) at -25°C and 30 l/s airflow of 70%.

All boilers shall be high-efficiency appliances with minimum of:

- 94% Annual Fuel Utilization Efficiency (AFUE) and ENERGY STAR® rated for 299 MBH and less;
- 94% Thermal and Combustion Efficiency for condensing boiler with 300 MBH and greater.

6.2 Lighting

.1 All lighting fixtures used shall be of integrated LED type and conform with all other requirements as set out in the ***Manitoba Housing Lighting Design Guideline***.

6.3 Appliances

.1 All appliances shall be ENERGY STAR® rated where applicable and conform to Manitoba Housings standard appliance specifications.

6.4 Utility Incentive and Rebate Documentation

.1 The Consultant shall ensure that any Federal, Provincial or Utility rebates and incentives programs available for implementing energy efficient designs are included and captured in all projects.

.2 The consultant shall include wording in the contract documents for the contractor to provide all documentation necessary to apply for and receive all applicable incentives and rebates.

6.5 Metering and Reporting

.1 Independent Utility metering shall be provided for each of the following areas:

- Electricity: separate Manitoba Hydro meters for residential areas, common areas, lease spaces and common lease space. Each residential unit shall be provided with a meter base for future individual metering.
- Gas: where heating and domestic hot water loads are both gas fired, provide a sub meter with pulse output to allow monitoring of each load.

6.6 Energy Assessment and Energy Conservation Measures (ECM)

.1 Energy assessment (energy audit) shall be performed for all renovation and conversion projects by minimum ASHRAE level 2 assessment or equivalent for appropriate project scope. The detailed energy assessment report should be completed by a qualified professional and submitted during the pre design stage.

.2 The energy audit report should provide the list of all potential ECMs applicable to the project with associated implementation cost, savings, lifetime of measures, payback periods and net present value (NPV). ECMs should be identified to improve the energy efficiency of building infrastructure, such as lighting, heating/cooling/ventilation systems, utility systems, building envelope systems, windows, etc.

.3 Project team should implement ECMs to achieve GHG emission reduction target. Consult with the Manitoba Housing Professional Services Team.

.4 If installing new equipment or appliances, products shall meet the most up-to-date requirement of Manitoba Housing’s energy efficient products as mentioned in above articles.

7. Construction Waste Management

Manitoba Housing is committed to reducing resource consumption and waste. Waste reduction and diversion from landfills will be targeted for all

Construction, renovation and Demolition (C&D) projects funded by Manitoba Housing across the Province.

7.1 Requirements

.1 Projects must achieve a C&D waste diversion target of 60% by weight. The total waste generated excludes any hazardous or excavated materials. All materials banned and prohibited from landfill according to the regional regulations shall be recycled.

.2 C&D waste reduction and diversion from landfills is required across the Province for all projects that are owned or receive over 35% of funding from Manitoba Housing including:

.1 all new construction projects;

.2 all demolition projects regardless of budget; and

.3 all renovation and capital improvement projects over $100,000.

.3 The consultant team shall incorporate the Waste Management requirements into the contract documents and project specifications

.4 The Contractor shall submit the Waste Management Plan prior to demolition and construction stage.

.5 The Contractor is responsible for tracking waste diversion rates throughout the construction project, and shall submit the Waste Management Reporting Form. The completed form is required to submit at the following stages:

.1 completion of demolition (if applicable);

.2 50% construction progress claim; and

.3 substantial completion.

.6 For further details on construction waste management, including sample forms and templates, please refer to the Manitoba Green Building Program (https://www.gov.mb.ca/finance/greenbuilding/pubs/2017-07-11_constructionrenovationdemolition.pdf)

A deficiency holdback will be retained for incomplete or non-submitted waste tracking forms.

8. Water Efficient Design

Water conservation strategies should be employed to reduce water consumption at a facility through efficient water system design, water efficient plumbing fixtures and appliances, water metering, etc.

8.1 Water Efficient Fixtures and Appliances

.1 Low water consumption fixtures shall be provided for all units:

.1 Aerated bathroom faucet with flow rate of 2 LPM (0.5 GPM);

.2 Low flow showerhead with flow rate of 5.7 LPM (1.5 GPM);

.3 Low Flush Water Closets: single flush 4.8 LPF (1.3 GPF), and complies with the most recent Maximum Performance (MaP) testing rated at 1000 grams of waste per flush;

.4 Kitchen sink faucet: 5.7 LPM (1.5 GPM) flow pressure compensating aerator outlet,

.2 Water efficient appliances with ENERGY STAR® certification shall be provided, including clothes washer and dishwasher, where required .

8.2 Water Metering

.1 A total building water meter shall be provided. Where applicable, provide separate water sub-meters to areas with separate lease agreements. Confirm requirements for water sub-metering with Manitoba Housing.

9. Building Material Selection

9.1 Low Emitting Materials Requirement

.1 Select low emitting materials and products for interior paints, coatings, adhesives, sealants, flooring, composite wood, ceilings, walls, and thermal and acoustic insulation.

.1 Paints and coatings must meet Canadian Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations (SOR/2009-264).

.2 Adhesives, and sealants must meet SCAQMD Rule 1168, effective July 1, 2005.

.3 Paints, coatings, adhesives and sealants must not contain methylene chloride and perchloroethylene.

.4 Stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick and unfinished or untreated solid wood flooring must not include integral organic-based surface coatings, binders or sealants.

.5 Composite Wood to comply with California Air Resources Board (CARB) ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

Composite wood cannot exceed 0.05 ppm of formaldehyde as tested under EN-717-1:2004, ISO 16000-3:2010, ISO 16000-6: 2011, ISO 16000-9:2006, ISO 16000-11:2006 or CEN/TS 16516: 2013.

9.2 Recycled Product and Local Availability

.1 Consider using materials that are sourced locally and have high recycled content. Utilize existing materials on site when possible. The selection of interior and exterior materials is a vital part of a project's sustainability.

10. Sustainable Site Management

10.1 Construction Activity Pollution Prevention

.1 Pollution, erosion and sedimentation control plan for all construction activities associated with the project should be created and implemented. The plan must conform with the erosion and sedimentation requirements of the 2012 US Environmental Protection Agency (EPA) Construction General Permit (CGP) or local equivalent, whichever is more stringent.

.2 In sensitive environmental areas (adjacent to waterways, wetlands, flood plains, etc.) an environmental consultant should be engaged.

10.2 Sustainable Site Water Management and Landscape

.1 Incorporating passive landscape design strategies into the project strategy should be considered, to contribute to the environmental quality of the project and to minimize heat island effect around the building.

- **.1** To address erosion control and storm water management, a comprehensive site water management strategy should be developed by the project team, such as implementing pervious paving, rain gardens, and bio swales.

- **.2** To promote water conservation, provide native or drought resistant landscaping in order to avoid the need for a permanent landscape irrigation system. Providing temporary irrigation from hose bibs on the exterior of the building to help establish initial planting may be considered.

- **.3** To minimize the heat island effect around the building, and reduce solar intensity, locate deciduous trees in front of the building's south and west orientations to provide shading, lower the cooling load in summer, and to allow the sun to warm the building in winter.

10.3 Recycling and Composting Area

.1 All sites shall be equipped with a collection and storage area for garbage, recyclable materials and organics, in accordance with municipality requirement.

Appendix A – Energy Model Emission Factors

Emission Factors by Fuel Type to be used for calculating GHG emissions in energy modelling.

Fuel Type	**GHG Emission Intensity** (kg CO_2e/kWh)
Electricity	0.00125
Natural Gas	0.185
Propane	0.219

Appendix B – Reducing Air Leakage Between Suites

Background

Air movement from floor to floor and suite to suite is relatively common in multi-unit residential buildings. While smoke and fire control measures are implemented, little other attention is given during construction to ensuring the air tightness of internal partitions. Limiting the amount of uncontrolled air movement within the building will improve building performance by:

1. Reducing tobacco smoke and odour transfer between suites
2. Enhancing smoke and fire integrity between zones
3. Preventing bed bug infestations
4. Minimizing paths for sound transfer between suites
5. Permitting better sizing of in-suite ventilation and space conditioning systems, thus energy and cost savings
6. Enhancing occupant comfort, health and safety

While the intrinsic benefits of air leakage control within buildings are relatively well-understood, there is little practical knowledge available regarding how easily internal partitions between suites, and between suites and common areas could be sealed. This appendix has been developed to assist the Design Team and Contractor with a focus on reducing air leakage/smoke and ensuring bed bug control between suites in Manitoba Housing projects. Manitoba Housing requirements for Interior Partitions Air Leakage Rate ($IPALR_{n50}$) is 1.2 $l/s/m^2$ at 50 Pa. Refer to Energy and Environmental Design.

The appendix provides general guidance only and is not intended to replace professional judgement for site specific requirements. The Consultants (including mechanical and electrical consultants) will provide the details on interior suite air-tightness in the project specifications and drawings. The contractor shall have relevant experience in air-leakage control training and experience, and the different types of construction (for example, wood frame vs. masonry vs. steel studs).

Typical Air Leakage Areas

While each building will be somewhat different, the location of significant air leakage is usually the same. Here are some common locations of air leakage within the interior partitions:

- Stairway, corridor doors
- Bottom/top plate to the floor/ceiling slab

- Plumbing risers, and stack penetrations through floor levels
- HVAC duct risers through partition walls and floors
- Garbage chute door and access hatches
- Wiring raceways through walls and floors
- Wall-floor and wall-ceiling joint in service areas such as, mechanical room, electrical room, common areas and suites
- Elevator doors
- Electrical outlets

Approach and Air Sealing Details

Air leakage between suites can be minimized through:

1. Sealing of penetrations in floors, ceilings and walls
2. Air sealing vertical chases located adjacent to units
3. Weather stripping the suite access door

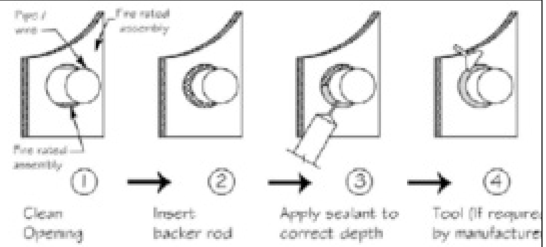
A range of approaches may be applied to minimize air leakage between units, including:

1. Sealed polyethylene air/vapour barrier installation
2. Air tight drywall
3. Installation of closed cell expanding foam in conjunction with typical drywall installation

The table below provides potential leakage points and sealing options to address interior compartmentalization of MURBs. In addition to sealing the interior walls, continuity of the exterior air barrier is critical too. Envelope air barrier details are not included in this table or appendix.

Location	Description	Detail
Seal Bottom/top plate to the floor/ceiling slab	Foam Sealant installed after drywall installation. Sealant is recommended for joints from 3 mm to 20 mm. Foam sealant is recommended for joints between 20 mm and 75 mm. Alternatively, the slab to wall joint may be treated by sealing the bottom plate/top plate to the slab, then using neoprene gasket to seal the drywall to the plates.	

<table>
<tr>
<td>Plumbing/electrical fixtures</td>
<td>Plumbing and electrical penetrations may be treated similarly using sealant for small joints and foam for larger joints. Fire rated foam may be used to achieve both air leakage control and fire stopping.

Large electrical or plumbing penetrations (greater than 50 mm diameter) are most effectively treated by boxing out the penetration within the stud cavity, filling with foam, then installing neoprene gaskets around the perimeter of the box. This is used when a double plate party wall provides the sound and fire separation and is required by Code.</td>
<td>
</td>
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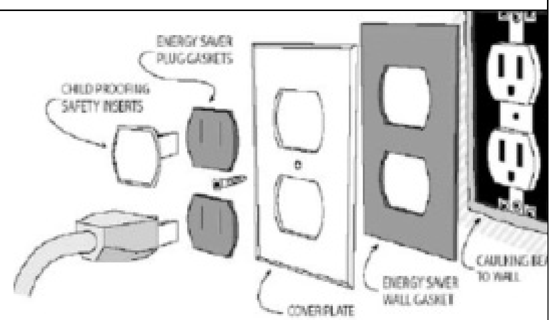
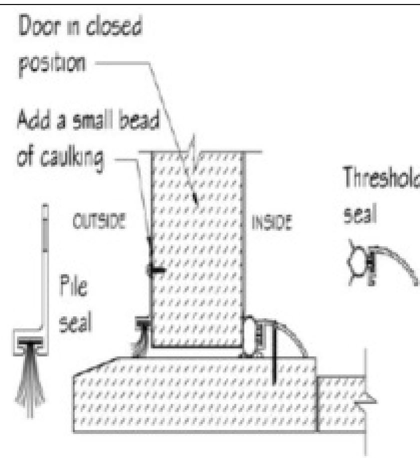
<tr>
<td>Electrical Receptacles</td>
<td>Electrical receptacles may be treated using air tight drywall type gasketed boxes prior to the installation of drywall.
In situations where the drywall has been installed, pre-punched neoprene gaskets may be installed.
In cases where the fit between the electrical box and the drywall is poor, foam may be installed to seal the joint</td>
<td>
</td>
</tr>
<tr>
<td>Door weather stripping</td>
<td>A range of products are available for jamb, head and sill details.
In applications where accessibility precludes the use of a sill threshold, a pile seal may be considered to provide the necessary air sealing. As entrance doors are self latching, ensuring the door can operate properly with the door weather stripping should be confirmed.</td>
<td>
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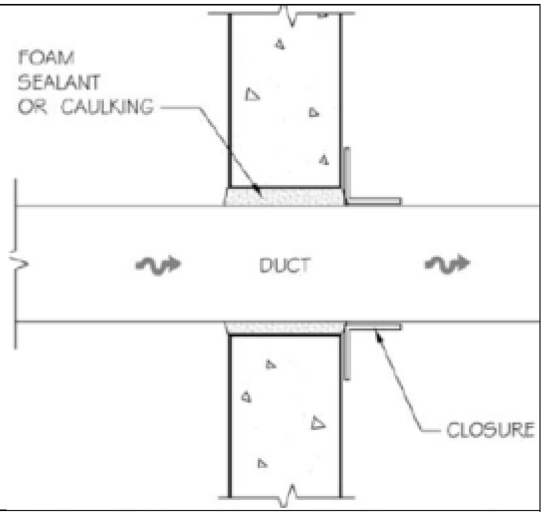
</table>

Transfer grille fire dampers	Transfer grilles installed in walls for supply air may be sealed between the duct and the wall. If the transfer grille is installed in the door, it should be sealed between the duct and the door. In general transfer grilles require a fire damper when installed between the suite and corridor. Testing of the fire damper in the closed position should be included in assessing the overall air tightness of units.	
Supply and Exhaust Ducts	Seal duct to flange and flange to wall connections of supply and exhaust ducts. Ensure that duct grilles are equipped with flaps or dampers to prevent back flow. Joints in ducting can be a significant source of air leakage that may be addressed through specifying maximum duct leakage, and installing joint seals in all duct joints.	
Stacks and vents	Vertical stacks for water and sewer lines may run within party walls and provide floor to floor air leakage paths. In general these penetrations are fire sealed. A range of fire rated foam products are available that meet fire rating and air seal requirements and may be considered for these applications.	

Plumbing fixtures	Plumbing fixtures may be treated as other large penetrations. They are most effectively treated by boxing out the penetration within the stud cavity, filling with foam, then installing neoprene gaskets around the perimeter of the box. This detail is required by code when configured back to back but frequently gets omitted in single sided applications.	
Drop Ceiling	Drop ceiling frequently provide runs for electrical, plumbing and ventilation runs. As such they can be difficult to air seal prior to closing in. However, they are almost impossible to treat once drywall is up. It is recommended to install wiring within sleeves that can be sealed once rough in is complete. Similarly, it is recommended to install collars or flanges in ducts as they penetrate walls and seal the flanges to the walls.	
Party Wall to Exterior Wall	The interface between the building envelope air barrier and compartmentalization of interior units can be a complex detail to achieve continuity of air barriers. To ensure continuity, it is recommended that the envelope air barrier be tied to the party wall air barriers. In general a structural air barrier is recommended to ensure a durable system, precluding the use of polyethylene sheet.	

Unit Airtightness Testing

Along with whole building Envelope Air Leakage Rate testing as required by Manitoba Housing, airtightness of suites is to be tested and reported for residential buildings and must demonstrate compliance with a suite-level air-leakage target as tested to ASTME 779 or equivalent standard. The sample set shall require testing of at least 10% of total units and be representative of the variety of unit types in the building; at least one from each floor; at least one middle and corner units. The air tightness testing result shall be submitted to the Consultant by the Contractor at substantial completion.

To identify the exact locations of air leaks, hand inspections, smoke puffers or thermography (infrared cameras) can be used. Once the air leakage locations have been identified, the contractor should document, and prioritize in an order that reflects the ease of doing the work and also work on the air leakage control strategy with a focus on the most significant leaks.

Provide the airtightness testing process and result as follows, but not limited to:

- Building and site details,
- Test arrangement,
- Sample unit locations,
- Blower door testing results before and after corrective or remedial work, noticing the sources of exact air leakage and remediation method.

References

The test procedures to demonstrate compliance:

ASTM-779-03, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization

CGSB 149.10.M86, Determination Of The Air-tightness Of Building Envelopes By The Fan Depressurization Method

A range of documents have been prepared to assist with air sealing and compartmentalizing buildings:

Canada Mortgage and Housing Corporation, Air Leakage Control in Multi-unit Residential Buildings

City of Calgary, Fire Stopping Service Penetrations in Buildings, Version 1.0

BC Housing, Illustrated Guide – Achieving Airtight Buildings

Appendix C – Project Deliverables Examples

The following lists provide examples of what needs to be submitted to Manitoba Housing as project deliverables based on the project type.

New Construction Project

- ☐ Design development energy model report
- ☐ HVAC product documentation showing they meet required specifications
- ☐ Plumbing fixture documentation showing they meet required specifications
- ☐ Passive design consideration details
- ☐ Post construction energy model report
- ☐ Post construction whole building air tightness test results
- ☐ Unit air tightness testing results

Deep Energy Retrofit Project

- ☐ Energy audit report
- ☐ Pre Design/Construction whole building air tightness test results
- ☐ HVAC product documentation showing they meet required specifications
- ☐ Plumbing fixture documentation showing they meet required specifications
- ☐ Post construction whole building air tightness test results
- ☐ Unit air tightness testing results
- ☐ Post construction energy model report

END OF DOCUMENT