City of Vancouver *Land Use and Development Policies and Guidelines*

Planning, Urban Design and Sustainability Department

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ENERGY MODELLING GUIDELINES

Version 1.0

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(These guidelines are referenced in the Green Buildings Policy for Rezonings, amended by Council on November 29, 2016)

Contents

1 Introduction and Intent

The City of Vancouver Energy Modelling Guidelines (the "Modelling Guidelines", or "the guidelines") provide clarity on energy modelling inputs for the purposes of showing compliance with the Performance Limits, as established in the updated Green Buildings Policy for Rezonings approved by Council on November 29, 2016, and Vancouver's Building Bylaw ("the Policy", "the VBBL", or "code"). This document is not intended to be an exhaustive set of technical and administrative requirements or best practices for energy modelling, and these guidelines are to be used in addition to rules for energy performance modelling of proposed buildings as written in the energy code used by the building for energy compliance, such as NECB Part 8. The objectives of the Modelling Guidelines are to:

(a) Standardize and clarify inputs to ensure that modelled building performance is comparable between projects and with fixed performance limits; and,

(b) Reduce the performance gap between energy models and actual operating performance of buildings.

This document standardizes energy modelling inputs that may have a large impact on the Policy's performance targets but are not integral to building system performance (ex. Schedules). It also clarifies inputs where current industry practice for those inputs does not support the Policy's intended outcomes or leads to performance gaps (ex. Not properly accounting for total envelope heat loss through thermal bridges). To further reduce performance gaps, these guidelines may be updated in future versions with additional modelling guidance or to further calibrate standardized inputs.

Design-related modelling inputs not specified in this document shall represent the actual design. Software limitations shall not limit the accuracy of energy modelling to show compliance with the Policy; consultants are expected to overcome software limitations with appropriate engineering calculations. All other modelling inputs not discussed in these guidelines shall be based on accepted industry best practice.

1.1 Guidelines are Additional to Energy Code Modelling Rules

As stated above, these guidelines are intended to be used in addition to rules for energy performance modelling of proposed buildings as written in the energy code used by the building for energy compliance. In the event of overlap between these guidelines and the modelling rules for proposed buildings in the chosen energy code, the following conditions shall apply:

(a) Spaces where heating or cooling capacity has been purposely undersized, or where there is no heating or cooling equipment, shall be modelled as per the design. These spaces do not need to be modelled as fully-conditioned and do not contribute to annual unmet hours.

(b) Components of the building envelope are to be modelled as per Section 3.

(c) In cases where the design ventilation rate exceeds the minimum required by code, ventilation rates shall be modelled as per the design.

1.2 Modelled vs Actual Results

The results of models created to meet these guidelines are intended for regulatory purposes only, to enable the City to determine whether a building complies with the Policy. Much like an emissions test on a car, test results are used for standardized comparison, and are not predictive of actual performance. The energy and thermal comfort performance of actual buildings will depend on many factors that can vary from these standardized assumptions, including: intensity and hours of use, weather, occupant behavior, as-built vs as-designed parameters, among many others. This applies to performance in both actively and passively cooled buildings.

In addition to varying from actual energy use, the standardized assumptions used may vary from those used in other ratings systems or modelling guidelines developed for their respective programs, which will cause differences in modelled performance. As noted above, the standardized inputs in these guidelines were developed to facilitate easy comparison with fixed limits and between projects, with better prediction of actual performance as a secondary goal. For this reason, some assumptions may be higher or lower than other references, and may be updated in future versions of the guidelines.

1.3 Definitions

Building – A wholly enclosed structure intended for supporting or sheltering any use or occupancy.

Performance Limits – Limits on TEUI, TEDI, and GHGI established in policy or code.

Other Building Types – Building types that do not have limits established for energy use, heat loss, or greenhouse gases, and instead use a percent improvement to measure beyond-code performance. For these building types, please refer to Section 5.

Site – The building(s) and all associated area where energy is used or generated. A site may include one or more buildings, either as independent structures or interconnected. For the purposes of these guidelines, sites containing multiple buildings may be divided into separate sites where desirable (ex. where one building must register for LEED), and larger sites may be required to divide sites by block or parcel.

Modelled Floor Area (MFA) – The total enclosed floor area of the building, as reported by the energy simulation software, excluding exterior areas and indoor or underground parking areas. All other spaces, including partially-conditioned and unconditioned spaces, are included in the MFA. The MFA must be within 5% of the gross floor area from the architectural drawings, unless justification is provided demonstrating where the discrepancy arises and why the MFA should differ from the gross floor area by greater than 5%.

Total Energy Use Intensity (TEUI) **–** The sum of all energy used on site (i.e. Electricity, natural gas, district heat), minus all renewable energy generated on site, divided by the *Modelled Floor Area*.

$$TEUI\ \left[\frac{kWh}{m^2a}\right] = \frac{\sum Site\ Energy\ Use\ \left[\frac{kWh}{a}\right] - \sum Site\ Renewable\ Energy\ Generation\ \left[\frac{kWh}{a}\right]}{Modelled\ Floor\ Area\ [m^2]}$$

TEUI shall be reported in kWh/m^{2}a, where *a* represents *year*.

Site Energy Use – All energy used on site including all end-uses, such as heating, cooling, domestic hot water, fans, pumps, elevators, parkade lighting and fans, plug and process energy, interior and exterior lighting, among others. It incorporates all site efficiencies, including the use of heat pumps or re-use of waste heat, but does not include energy generated on site.

Site Renewable Energy Generation – Energy generated on site from renewable sources, such as solar or wind. Where a site is not able to send energy off-site (ex. connected to the electricity grid), only energy that can be consumed (or stored and then consumed) on site shall be counted as Site Renewable Energy Generation.

Greenhouse Gas Intensity (GHGI) – The total greenhouse gas emissions associated with the use of all energy utilities on site, using the following emissions factors:

Table 1.2 Emissions Factors by Fuel Type	
Fuel Type	Emissions Factor ($kgCO_{2e}/kWh$)
Natural Gas	0.185
Electricity	0.011
Low-Carbon Energy System	0.070

Refer to Section 1.3 for details on how these emissions factors may be reduced through renewable energy.

$$GHGI\ \left[\frac{kgCO_{2e}}{m^2a}\right] = \frac{\sum\left(Site\ Energy\ Use\ \left[\frac{kWh}{a}\right] \times Emissions\ Factor\ \left[\frac{kgCO_{2e}}{kWh}\right]\right)}{Modelled\ Floor\ Area\ [m^2]}$$

GHGI shall be reported in kg eCO_2/m^2a.

Thermal Energy Demand Intensity (TEDI) – The annual heating energy demand for space conditioning and conditioning of ventilation air. This is the amount of heating energy that is output from any and all types of heating equipment, per unit of *Modelled Floor Area*. Heating equipment includes electric, gas, hot water, or DX heating coils of central air systems (ex. make-up air units, air handling units, etc.), terminal equipment (ex. baseboards, fan coils, heat pumps, reheat coils, etc.) or any other equipment used for the purposes of space conditioning and ventilation. Heating output of any heating equipment whose source of heat is not directly provided by a utility (electricity, gas or district) must still be counted towards the TEDI. For example, hot water or heat pump heating sources that are derived from a waste heat source or a renewable energy source do not contribute to a reduction in TEDI, as per the above definition.
Specific examples of heating energy that are not for space conditioning and ventilation, that would not be included in the TEDI, include domestic hot water, maintaining swimming pool water temperatures, outdoor comfort heating (ex. Patio heaters, exterior fireplaces), gas fired appliances (stoves, dryers), heat tracing, and others.

$$TEDI\ \left[\frac{kWh}{m^2a}\right] = \frac{\sum Space\ and\ Ventilation\ Heating\ Output\ \left[\frac{kWh}{a}\right]}{Modelled\ Floor\ Area\ [m^2]}$$

TEDI shall be reported in kWh/m^2a.

Clear Field – An opaque wall or roof assembly with uniformly distributed thermal bridges, which are not practical to account for on an individual basis for U-value calculations. Examples of thermal bridging included in the Clear Field are brick ties, girts supporting cladding, and structural studs. The heat loss associated with a Clear Field assembly is represented by a U-value (heat loss per unit area).

Interface Details – Thermal bridging related to the details at the intersection of building envelope assemblies and/or structural components. Interface details interrupt the uniformity of a clear field assembly and the additional heat loss associated with interface details can be accounted for by linear and point thermal transmittances (heat loss per unit length or heat loss per occurrence).

1.4 Renewable Energy

1.4.1 Site-Generated Renewable Energy

As stated in the definition of TEUI, renewable energy generated on site may reduce the TEUI. Additionally, the Zero Emissions Building Plan states that if grid electricity is not 100% renewable, a building may achieve zero emissions by installing on site renewable energy generation to offset the portion of grid electricity that is non-renewable. As electricity in BC is legislated to be a minimum of 93% renewable, an all-electric building can achieve zero emissions by installing renewable electricity generation equal to 7% of site electricity use, and in this case the electricity emissions factor is considered to be zero. For sites installing renewable electricity generation totaling less than 7% of site electricity use, the electricity emissions factor is reduced proportionally, to a minimum of zero. For the purposes of these guidelines, this may be read from Table 2 below or calculated as follows.

$$Emissions\ Factor_{elec}\left[\frac{kgCO_{2e}}{kWh}\right] = -0.157 \times \left(\frac{Site\ Generated\ Renewable\ Energy_{elec}}{Site\ Energy\ Use_{elec}}\right) + 0.011$$

Table 1.3.1 Reduced Electrical Emissions Factors	
Percent of Electrical Site Energy Use Generated On Site	Reduced Electrical Emissions Factor ($kgCO_{2e}/kWh$)
0%	0.0110
1%	0.0094
2%	0.0079
3%	0.0063
4%	0.0047
5%	0.0032
6%	0.0016
7%	0.0000

1.4.2 Purchased Renewable Energy

Where renewable energy is purchased directly from utilities or renewable energy providers, and guarantees of long-term supply are provided to the satisfaction of the authority having jurisdiction, an emissions factor of zero may be applied to the portion of the utility that is renewable.

Note: Guarantees of long-term supply must be provided for at least portion of renewable energy used to demonstrate compliance with the limits.

1.5 Weather File

Projects shall use the Canadian Weather year for Energy Calculation (CWEC) weather file for Vancouver, available online here:
https://energyplus.net/weather-location/north_and_central_america_wmo_region_4/CAN/BC/CAN_BC_Vancouver.718920_CWEC

2 Standardized Assumptions

2.1 Schedules

Occupancy, temperature setpoints, lighting, plug load, DHW, and ventilation fan schedules shall generally be as per NECB 2011 for the corresponding building type or building function with the clarifications, additions and exceptions listed below.

Table 2.1 Schedules	
Building or Space Type	NECB 2011 Schedule
Residential	Table A-8.4.3.2(1)G
Office	Table A-8.4.3.2(1)A
Retail	Table A-8.4.3.2(1)C
Hotel	Table A-8.4.3.2(1)G
Other Building Types	At modellers discretion
Residential Corridors	Lighting at 24 hours per day
Parking Garages	Lighting at 24 hours per day, Fans at 4 hours per day
Lighting Schedules only for spaces whose functions are not directly tied to the main building function (ex. stairways, mechanical and electrical rooms, etc.)	Use recommended lighting annual hours as guidance, provided in Appendix B of BC Hydro's New Construction Program's Energy Modelling Guideline
Exterior Lighting	Schedule on at night, using Astronomical clock

2.2 Internal Gains and Domestic Hot Water

Occupancy, plug loads, lighting power and DHW shall be modelled according to the following:

2.2.1 Residential Suites

For Suites in MURBs, use the following:

Occupancy – 2 people for the 1st bedroom, 1 additional person for each bedroom thereafter. Studios and Single Room Occupancies (SROs) may assume one person per unit.

Plug Loads – 5 W/m^2. If there are gas-fired cooking appliances, then 1 W/m^2 shall be assigned to gas and 4 W/m^2 shall be assigned to electricity. Credit for use of energy efficient appliances (ex. refrigerator, stove/range/oven, dishwasher, washer, dryer) may be applied, provided that the appliances use less energy than current EnergyStar requirements for that appliance. Savings are to be determined based on the relative savings using the appliance kWh ratings, applied to the plug value of 5 W/m^2. If the appliance type in question does not have an EnergyStar rating available, then no credit is to be applied for that appliance.

Example – EnergyStar minimum kWh ratings for suite appliances – 1,000 kWh
Project's kWh use for selected suite appliances – 900 kWh
Reduction in plug load = 5 W/m^2 x 900/1000 = 4.5 W/m^2

Lighting – 5 W/m^2, unless a complete suite lighting design is provided as part of the contract documents for the project.

Domestic Hot Water (DHW) – 0.0016 L/s/person (0.025 gpm/person), modelled as the peak hourly flow and modified by the schedule noted in Section 2.1. Reduction to this peak hourly flow is allowed and shall be determined using industry standard methods for hot water use estimates (e.g. LEED Canada NC 2009, Water Efficiency Prerequisite 1) with savings calculated relative to BC Building Code requirements for maximum fixture flow rates. Reductions are also allowed for installations of drain water heat recovery systems to a maximum of 15%. Savings shall be determined using good engineering practice and relative to the areas in which the system is installed (i.e. the 15% reduction is only allowed if drain water heat recovery was installed on all DHW fixtures).

2.2.2 All Other Spaces

Except in residential suites, all occupancy, plug, lighting, and DHW loads shall be based on Table A-8.4.3.3.(1)B of NECB 2011. Credit for lighting occupancy sensors can be applied as a reduction to the schedule or modelled lighting power density as per the methodology in NECB 2011, Section 4.3.2.10. Daylight sensors shall be modelled directly in the software, where credit will be as per actual modelled results.

2.3 Other Loads

2.3.1 Elevators

Elevators shall be modelled using an electrical load of 3kW per elevator and the equipment schedule of the building type.

2.3.2 Other Process Loads

All process loads expected on the project site are to be included in the energy model. This includes but is not limited to: IT/data loads, exterior lighting, swimming pool heating, patio heaters, exterior fireplaces, heat tracing, etc. All loads are to be estimated to reflect the actual design and using good engineering practice.

Note that electric car charging is not included in building process loads, as this is a growing load that is associated with transportation rather than buildings, and may include sub-metering and/or re-sale of electricity.

For Other Building Types that have a target based on a percentage improvement over a Reference building, process loads savings may be applied for the use of EnergyStar equipment provided it is documented to the satisfaction of the Authority Having Jurisdiction.

2.3.3 Exterior Fireplaces

For projects with exterior fireplaces, assume that each fireplace has a capacity of 10 kW each and runs 2h/week. The energy and GHGs shall be captured in the overall EUI and GHGI results.

2.4 Infiltration

Infiltration shall be modelled as a function of wind speed from the weather file according to the equation below. Infiltration shall be scheduled on at all times.

Infil (m3/s) = 0.00024 m3/s/m2 x (0.224 x Wind Speed), Wind Speed is measured in m/s SI

Infil (cfm) = 0.047 cfm/ft2 x (0.224 x Wind Speed), Wind Speed is measured in mph IP

The area in the equations above is reflective of total, above grade, envelope surface area (i.e. roofs, walls, windows).

2.5 Ventilation

2.5.1 Ventilation Rates

Ventilation rates are to be modelled as per design, including but not limited to ventilation for occupants according to building code requirements, make-up air for exhaust requirements, corridor pressurization make-up air in MURBs, among others. Note that for MURB projects designing to ASHRAE 62-2001, make-up air quantities for the suites should typically not be lower than that required by Table 2: Outdoor Air Requirements for Ventilation - 2.3 Residential Facilities, of ASHRAE 62-2001 (i.e. 0.35 ACH but not less than 7.1 L/s/person (15 cfm/person), based on 2 occupants for the first bedroom and 1 additional occupant for each additional bedroom.

2.5.2 Corridor Pressurization in MURBs

As the industry moves towards more airtight suites and buildings, and lower energy use, the quantity and purpose of air delivered into corridors is evolving. During this transition period, projects that provide additional airflow to corridors above the minimum required by code may subtract an adjustment value from the modelled TEUI, TEDI, and GHGI when demonstrating compliance with the performance limits. These adjustment values are to be implemented as a post-processing exercise, using the modelled outputs that are reflective of the actual ventilation design. Adjustments shall not be made to the simulation files themselves, and modellers will be required to report the TEUI, TEDI and GHGI both pre- and post-adjustment.

Adjustment values shall be calculated according to the equations below, to a maximum TEDI adjustment of 10, and a minimum of 0.

TEDI Adjustment = ((90 x # Suites x (L/s)/door) – (22.4 x Corridor Area)) / MFA

TEUI Adjustment = TEDI Adjustment

GHGI Adjustment = TEUI Adjustment x Emissions Factor

The GHGI Adjustment shall use the emissions factor of the fuel used to heat air supplied to the corridors. Systems using heat pumps to heat corridor supply air, including heat pump make-up air units with natural gas backup, shall be considered electric.

Example – A 10,000m² MURB with 125 suites is designed to provide 7 L/s/door (15cfm/door) of supply air to 1,500m² of corridor space, using a gas-fired make-up air unit.

TEDI Adjustment = ((90 x 125 x 7) – (22.4 x 1,500)) / 10,000 = 4.5 kWh/m²

TEUI Adjustment = 4.5 kWh/m²

GHGI Adjustment = 4.5 x 0.185 = 0.8 $kgCO_{2e}/m^2$

After the design is modelled and the as-designed TEUI, TEDI, and GHGI have been documented, the calculated adjustment factors may be subtracted, and both the pre- and post-adjustment values reported when demonstrating compliance.

2.5.3 Demand Control Ventilation

Credit may be taken for demand control ventilation systems that monitor CO_2 levels by zone and that have the ability to modulate ventilation at either the zone or system level in response to CO_2 levels. Reductions in outdoor air shall be modelled as closely as possible to reflect the actual operation of the designed ventilation system and controls. The occupancy schedule from Section 2.1 can be used as a surrogate for CO_2 control in the model. For example, if a zone has the ability to decrease ventilation in response to CO_2 levels in that zone, the ventilation for that zone at each time step shall be determined by multiplying the zone's design ventilation rate with the scheduled occupancy fraction.

2.6 Other Considerations

Depending on the stage of the project that the energy model is developed, there may be the need to make a number of assumptions, of which many can have a significant impact on the performance of the building. While it is up to the design team and energy modeller to make reasonable assumptions based on past experience or engineering judgement, the items noted below are explicitly listed as they are often misrepresented in energy models.

2.6.1 Heat or Energy Recovery Ventilators

Heat or energy recovery ventilators shall be modelled according to design, even in instances where there exists software limitations. Appropriate workarounds or external engineering calculations are expected to be performed to accurately assess the performance of the as-designed systems. This includes the use of preheat coils and/or other frost control strategies.

Heat or energy recovery ventilators that use frost control strategies which limit the amount of ventilation supplied to the space (i.e. exhaust only defrost) shall be modelled as follows: An electric preheat coil shall be modelled before the heat or energy recovery ventilator that heats the air to the minimum temperature before frost control is employed, as indicated by the manufacturer. For example, if the minimum temperature prior to frost control being deployed is -5°C, then an electric preheat coil shall heat the incoming air to -5°C prior to it entering into the heat or energy recovery ventilator. The purpose of this approach is to not reward designs that reduce ventilation to the space due to their lack of efficiency.

2.6.2 Terminal Equipment Fans

Terminal equipment fans shall be modelled according to design. Specifically, ensure that fan power and fan control (i.e. cycling, always on, multi or variable speed) of terminal equipment represent the design and design intent as accurately as possible.

2.6.3 VAV and Fan-Powered Boxes

Modellers must ensure that minimum flow rates and control sequences of VAV terminals and Fan Powered Boxes are modelled according to the design, and if not available at the time of modelling, according to expected operation based on maintaining ventilation and other air change requirements as appropriate. Note that default values for minimum flows of VAV terminals are often unreasonably low in most energy modelling software.

2.6.4 Exhaust Fans

Suite exhaust fans that are not part of the ventilation system (ex. kitchen exhaust or bathroom exhaust not connected to an HRV or similar), shall have a runtime of 2 hours/day. All other exhaust fans, including heat recovery units, shall be modelled to reflect the design intent as accurately as possible.

2.7 Projects Not Sub-Metering Hot Water for Space Heating

Research indicates that MURB projects that do not sub-meter hot water for space heating at the suite level typically use 15% additional heating energy or more when compared to sub-metered suites. To account for this increase in heating energy use, projects where suite hot water for space heating is not sub-metered must add 15% to their modelled heating energy end-use. This increase would be reflected in the TEUI only (i.e. TEDI results would remain as a direct output from the model, with no additional 15% added).

3 Calculating Envelope Heat Loss

One of the Policy's key performance targets is based on TEDI, which is primarily a representation of the annual heating load required to offset envelope heat loss and ventilation loads. Choosing TEDI as a target supports the Policy's direction to encourage energy efficient building envelopes. However, building envelope heat loss has historically been simplified due to past difficulties in cost-effectively providing more accuracy. This has generally led to overly optimistic assessments of building envelope performance by way of ignoring or underestimating the impact of thermal bridging.

Typical building envelope thermal bridging elements that can have a significant impact on heat loss that have historically been underestimated or unaccounted for include: balcony slabs, cladding attachments, window wall slab by-pass and slab connection details, interior insulated assemblies with significant lateral heat flow paths such as interior insulated poured-in-place concrete or interior insulation inside of window wall or curtain wall systems, and others. With the recent addition of industry resources that support more efficient and accurate calculations of building envelope heat loss, assemblies and associated thermal bridging elements must be accurately quantified for the purposes of complying with the Policy, according the requirements below.

3.1 Opaque Assemblies

The overall thermal transmittance of opaque building assemblies shall account for the heat loss of both the Clear Field performance, as well as the heat loss from Interface Details. Additional heat loss from Interface Details are to be incorporated in the modelled assembly U-values, according to the provisions below.

3.1.1 Acceptable Approaches

Overall opaque assembly U-values can be determined using any of or a combination of the following approaches:

(a) Using the performance data for Clear Fields and Interface Details from the Building Envelope Thermal Bridging Guide (BETBG), and the calculation methodology as outlined in 3.4 of the BETBG. A detailed example is provided in Section 5 of the BETBG and a supporting calculation spreadsheet is available from bchydro.com/construction, titled "Enhanced thermal performance spreadsheet".

(b) Using the performance data for Clear Field and Interface Details from other reliable resources such as ASHRAE 90.1-2010, Appendix A, ISO 14683 Thermal bridges in building construction – Linear thermal transmittance – Simplified Methods and default values, with the methodology described above in (1).

(c) Calculations, carried out using the data and procedures described in the ASHRAE Handbook – Fundamentals

(d) Two or three dimensional thermal modelling, or

(e) Laboratory tests performed in accordance with ASTM C 1363, "Thermal Performance of Building materials and Envelope Assemblies by Means of a Hot Box Apparatus," using an average temperature of 24±1°C and a temperature difference of 22±1°C.

3.1.2 Thermal Bridges to be Included

Except where it can be proven to be insignificant (see below), the calculation of the overall thermal transmittance of opaque building envelope assemblies shall include the following thermal bridging effect elements:

(a) Closely spaced repetitive structural members, such as studs and joists, and of ancillary members, such as lintels, sills and plates,

(b) Major structural penetrations, such as floor slabs, beams, girders, columns, curbs or structural penetrations on roofs and ornamentation or appendages that substantially or completely penetrate the insulation layer,

(c) The interface junctions between building envelope assembles such as: roof to wall junctions and glazing to wall or roof junctions,

(d) Cladding structural attachments including shelf angles, girts, clips, fasteners and brick ties,

(e) The edge of walls or floors that intersect the building enclosure that substantially or completely penetrate the insulation layer.

3.1.3 Thermal Bridges that may be Excluded

The following items need not be taken into account in the calculation of the overall thermal transmittance of opaque building envelope assemblies:

(a) Mechanical penetrations such as pipes, ducts, equipment with through-the-wall venting, packaged terminal air conditioners or heat pumps.

(b) The impact of remaining small unaccounted for thermal bridges can be considered insignificant and ignored if the expected cumulative heat transfer through these thermal bridges is so low that the effect does not change the overall thermal transmittance of the above grade opaque building envelope by more than 10%.

3.2 Fenestration and Doors

The overall thermal transmittance of fenestration and doors shall be determined in accordance with NFRC 100, "Determining Fenestration Product U-factors", with the following limitations:

(a) The thermal transmittance for fenestration shall be based on the actual area of the windows and not the standard NRFC 100 size for the applicable product type. It is acceptable to area-weight the modelled fenestration U-value based on the relative proportions of fixed and operable windows and window sizes. It is also acceptable to simplify the calculations by assuming the worst case by using the highest window U-value for all fenestration specified on the project.

(b) If the fenestration or door product is not covered by NFRC 100, the overall thermal transmittance shall be based on calculations carried out using the procedures described in the ASHRAE Handbook – Fundamentals, or Laboratory tests performed in accordance with ASTM C 1363, "Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus," using an indoor air temperature of 21±1°C and an outdoor air temperature of -18±1°C measured at the mid-height of the fenestration or door.

4 Passively Cooled Buildings

Overheating is already a concern for non-mechanically cooled buildings, due to large amounts of glass, minimal shading, and few natural ventilation strategies. Improving the building envelope to meet the requirements of the Policy may lead to increasing overheating if they are not addressed through design strategies that limit heat gain and promote passive cooling. The following requirements are intended to mitigate this effect, as well as ensure any benefit a project might seek from passive solar gains is balanced with considerations of summertime overheating. As noted in Section 1.1, the actual thermal performance of the building will depend on many factors, and these requirements are not intended as a guarantee of thermal comfort.

For buildings that do not incorporate mechanical cooling, it must be demonstrated that interior temperatures of occupied spaces do not exceed the 80% acceptability limits for naturally conditioned spaces, as outlined in ASHRAE 55-2010 Section 5.3, for more than 200 hours per year for any zone. For buildings or spaces with vulnerable groups, it is recommended that projects target a higher threshold of not exceeding the 80% acceptability limits for more than 20 hours per year.

Measures such as solar shading, minimizing internal gains, dynamic glass, effective methods of natural ventilation, etc. shall be validated through engineering calculations (i.e. computer modelling or similar). Calculations must be based on annual weather data using the weather file described above. For the purposes of demonstrating compliance, the following temperature criteria should be used.

Table 4 Acceptability Limits for Naturally Conditioned Spaces

Month	80% Acceptability Limit
April	N/A (Mean temperature too low)
May	25.0 ˚C
June	26.0 ˚C
July	26.6 ˚C
August	26.6 ˚C
September	25.6 ˚C
October	N/A (Mean temperature too low)

5 Mixed Use and Other Building Types

5.1 Mixed-Use Buildings

Buildings consisting of different occupancies with different EUI, TEDI, and GHGI targets shall area-weight the EUI, TEDI, and GHGI requirements accordingly. For buildings consisting of different occupancies that have different fundamental requirements (i.e. part of the building has a EUI, TEDI, and GHGI target and part of the building has a Reference building target), the following methodology shall be used to determine the overall building requirements:

(a) Develop a Reference building only for the portion of the building that has a Reference building requirement. Note that the Reference building may use a de-rated R-value according to the methodology outlined in the white paper "Accounting for thermal bridging at interface details – a methodology for de-rating prescriptive opaque envelope requirements in energy codes", found at bchydro.com/construction.

(b) Extract the EUI and GHGI for that reference building.

(c) Reduce the EUI and GHGI according to the percentage savings required by the Policy.

(d) The total building EUI and GHGI requirement shall be based on an area weighted average between the resulting % better than Reference based EUI and GHGI, and the EUI and GHGI target for the rest of the building.

(e) The total building shall meet the same TEDI requirement as the portions of the building that have a TEDI requirement.

5.2 Other Building Types

For other building types that do not have performance limits and instead have a Reference building target, follow the modelling requirements and methodologies laid out in ASHRAE 90.1-2010, Appendix G. Note that the Reference building may use a de-rated R-value according to the methodology outlined in the white paper "Accounting for thermal bridging at interface details – a methodology for de-rating prescriptive opaque envelope requirements in energy codes", found at bchydro.com/construction.

6 References and Resources

(a) 2014 Building America House Simulation Protocols, NREL, 2014

(b) Accounting for thermal bridging at interface details – a methodology for de-rating prescriptive opaque envelope requirements in energy codes, BC Hydro, 2015

(c) ASHRAE Handbook of Fundamentals, ASHRAE, 2013

(d) ASHARE Standard 90.1-2010 – Energy Standard for Buildings Except Low-Rise Residential Buildings, ASHRAE 2010

(e) Commercial Buildings Building Envelope Thermal Bridging Guide, Version 1.1, BC Hydro, 2016

(f) Energy Modelling Guidelines and Procedures, CONMET, 2014

(g) EnergyStar Multifamily High Rise Program, Simulation Guidelines, Version 1.0, Revision 03, January 2015

(h) Infiltration Modelling Guidelines for Commercial Building Energy Analysis, PNNL, 2009

(i) National Energy Code of Canada for Buildings, NRCan, 2011

(j) New Construction Program's Energy Modelling Guideline, BC Hydro, March 2016

(k) TM54 – Evaluating Operational Energy Performance of Buildings at the Design Stage, CIBSE, 2014