January
2023

TECHNICAL BULLETIN NO. 3-2023

SUBJECT:

Climate Adaptation and Resiliency: Extreme Heat and Smoke Mitigation and Reduction of Greenhouse Gas Emissions

Revisions to BC Housing Design Guidelines and Construction Standards 2019, Section 2 Energy and Environmental Design and Section 4 – 23 00 00 – Heating, Ventilation and Air Conditioning

REFERENCE:

BC Housing Design Guidelines and Construction Standards 2019, Technical Bulletin No. 1-2020

PURPOSE

This Technical Bulletin sets out to meet the following purposes:

1) To ensure people's thermal safety while optimizing life cycle costs
2) To mitigate the effects of extreme heat on BC Housing new construction and major retrofit projects due to rapidly increasing temperatures, smoke pollution from forest wildfires and other climate change factors
3) To align BC Housing's energy performance targets with BC Building Code and Greenhouse Gas (GHG) reduction targets and the provincial Climate Change Accountability Act

Revision 2 of BC Building Code 2018 was amended effective December 12th, 2019 and the provincial Climate Change Accountability Act amended on November 28th, 2019. The BC Building Code 2018 Revision 2 includes changes to BC Energy Step Code to better reflect colder climate conditions outside of Climate Zone 4. The Province has also announced interim GHG reduction targets as well as upcoming requirements that all new buildings are to be zero-carbon by 2030.

It is an undisputed fact that the weather in British Columbia (B.C.) is changing due to the global warming effect, resulting in warmer, wetter winters and hotter, drier summers. This is taking place as a result of human-induced climate change, with global temperatures already 1.2°C higher than pre-industrial levels. Temperatures in B.C. are increasing faster than the global average. Between 1948 and 2016, B.C. experienced 1.9°C of warming[1]. The numbers of extremely hot days (above 30°C) and nights (above 20°C) have already increased significantly in the last decade and are going to continue to increase across B.C. According to predictions developed by the Pacific Climate Impacts Consortium (PCIC), if this trend continues, summer weather in Metro Vancouver will be similar by 2050 to present-day weather patterns in San Diego, California. This translates to four times the number of days above 30°C (18 days per year) and two times the number of days above 25°C (59 days per year). By 2050, an extreme heat event that used to happen once every 25 years will occur three times as frequently[2].

According to the U.S. Center for Disease Control and Prevention (CDC)[3], extreme heat presents health and life risks such as:

- **HEAT STROKE** resulting in high body temperature, fast pulse, headache, dizziness, nausea, confusion and loss of consciousness
- **HEAT EXHAUSTION** resulting in sweating, weak pulse, nausea/vomiting, muscle cramps, tiredness, dizziness, headaches and fainting
- **HEAT CRAMPS** resulting in heavy sweating and muscle spasms
- **SUNBURN** resulting in painful red skin and blisters
- **HEAT RASH** resulting in red clusters of small blisters

In the summer of 2021, B.C. experienced the deadliest climate-related disaster on record in Canada. An extreme heat event known as a heat dome was associated with 619 deaths[4] across the Province over a seven-day period and 98% of these deaths occurred in a residential setting[5]. Temperatures in the Province set all-time records, with the Town of Lytton posting a high of 49.6°C, breaking the previous national record by almost 5°C. The heat dome event then rolled over into one of the most damaging wildfire seasons on record that triggered a state of emergency lasting nearly two months.

Hotter and drier summers contribute directly to the increased frequency and intensity of forest wildfires. In 2021, wildfires were third on record in size of area burned, following the 2017 season and the record 2018 season. On July 1, 2021, the Town of Lytton was destroyed by wildfires, forcing the evacuation of the entire population and severely affecting nearby Indigenous communities.

Of Particulate mass produced by wildfires, 90% are fine particles with a median diameter of 2.5micron or less ($PM_{2.5}$). $PM_{2.5}$ particles can be transported by wind over long distances and are the most significant factor in public health concerns over air pollution from wildfires.

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1 https://changingclimate.ca/regional-perspectives/chapter/5-0/

2 BC Housing Extreme Heat and Wildfire Smoke Response Plan. https://www.bchousing.org/projects-partners/extreme-heat

3 Department of Health & Human Services, U.S. Center for Disease Control and Prevention. https://www.cdc.gov/niosh/topics/heatstress/heatrelillness.html

4 BC Centre for Disease Control, Evidence Review: Filtration in institutional settings during wildfire smoke events. http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/WFSG_EvidenceReview_FiltrationinInstitutions_FINAL_v3_edstrs.pdf

5 https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/death-review-panel/extreme_heat_death_review_panel_report.pdf

As published by CDC[4], exposure to $PM_{2.5}$ particles from wildfire smoke is harmful to humans because it:

- Makes getting oxygen into blood harder
- Can irritate a respiratory system and cause an immune respond leading to inflammation
- Can result in common symptoms such as eye irritation, runny nose, cough and headaches
- Can result in severe symptoms such as shortness of breath, severe cough, dizziness, chest pain or heart palpitations
- Increases risk of infections such as pneumonia, COVID-19 and ear infections
- Can be associated with premature mortality

In 2019, the Province completed a Preliminary Strategic Climate Risk Assessment to better understand climate-related risks in B.C. and help government develop appropriate measures to address them. It has been documented[6] that the people most at risk from heat- and air-pollution-related illnesses and death are people living in poverty; older adults; chronically ill, disabled, and socially isolated people; infants; and newcomers to Canada. These constitute some of the core populations that BC Housing serves. In partnering with different ministries and local governments, the Province has developed a set of recommendations for preparedness during extreme heat emergencies and for implementing prevention and long-term risk mitigation strategies responding to changing weather patterns. These strategies relate to communication, staff training, preparations to address extreme weather events, and best practices to mitigate hazards. This also requires changes to the BC Housing Design Guidelines and Construction Standards to ensure that new social housing and major retrofit projects are designed to meet requirements for both passive and active cooling measures and wildfire-related air filtration and are built to higher resiliency standards to better protect the vulnerable populations served by BC Housing.

Presently, buildings are constructed on the basis of outdated weather data upon which the Building Code is based. Design teams need clear guidelines and requirements for adequate sources of cooling, using both passive and active building strategies, and proper outdoor air filtration to maintain comfort and livability for today and the foreseeable future.

Additionally, BC Housing has the responsibility for implementing reductions of GHG emissions in alignment with the provincial Climate Change Accountability Act. The Province has legislated targets for reducing GHG emissions to be 40% below 2007 levels by 2030, 60% below by 2040, and 80% below by 2050. The interim target is to reduce emissions to 16% below 2007 levels by 2025. This requires further reductions of the Greenhouse Gas Intensity (GHGI) targets on BC Housing projects, as compared to targets defined in the preceding version of the BC Housing Design Guidelines and Construction Standards.

[6] Extreme Heat and Human Mortality: A Review of Heat-Related Deaths in B.C. in Summer 2021. https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/death-review-panel/extreme_heat_death_review_panel_report.pdf

DESCRIPTION

Technical Bulletin No. 3-2023 includes important revisions to the BC Housing Design Guidelines and Construction Standards under Section 2 Energy and Environmental Design, Section 4 – 23 00 00 – Heating, Ventilation and Air Conditioning and Technical Bulletin No. 1 – 2020. **The changes are to take effect immediately on new developments and retrofit projects that have not received Design Development approvals from BC Housing.**

Highlights of the revisions include:

- **REVISIONS TO SECTION 2, Article 2 Building and Energy Performance**
  - Part 3 Projects – Less than 7 Storeys – reduction of GHGI from 5.5 to 3.0 $kgCO_2e/m^2$/year for Climate Zone 4 and reduction of GHGI from 5.5 to 5.0 $kgCO_2e/m^2$/year for Climate Zone 5
  - Part 3 Projects – 7 Storeys and Higher – reduction of GHGI from 6.0 to 3.0 $kgCO_2e/m^2$/year for Climate Zone 4 and reduction of GHGI from 6.0 to 5.0 $kgCO_2e/m^2$/year for Climate Zone 5
  - Part 9 Projects - inclusion of GHGI 3.0 $kgCO_2e/m^2$/year for all Climate Zones
  - Revised requirements for Thermal Comfort Evaluation
  - Inclusion of sensitivity analysis requirement to assess future overheating risk

- **REVISIONS TO SECTION 2, Article 3 Passive Design Strategies**

  The guidelines for passive strategies have been revised to incorporate the following passive design measures:
  - Optimize Solar Orientation
  - Optimize Retention and Planting of Trees
  - Optimize Form Factor
  - Optimize Thermal Layout
  - Incorporate Shading
  - Maximize Passive Cooling Potential through Window Design
  - Optimize Insulation
  - Minimize Thermal Bridges
  - Utilize Additional Passive Design Measures

- **REVISIONS TO SECTION 2, Article 4 Energy Efficient Products, Incentives and Energy Assessment, new Sub-Section 4.6 Retrofit Projects**
  - Major retrofit projects to include a whole-building energy modelling and summer overheating analysis
  - Requirement to provide an electrical load analysis to evaluate impacts of electrification on the project
  - Targeting 50% GHG emissions reduction relative to current emissions levels[7]
  - Inclusion of MERV-13 filtration to minimize adverse effects of wildfire smoke pollutants
  - Energy modelling is to be completed as per the City of Vancouver Energy Modelling Guidelines

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[7] https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

- **REVISIONS TO SECTION 4 – 23 00 00 – Heating, Ventilation and Air Conditioning**
    - Article 1.1.3 - Clarifications to mechanical peer review process
    - Article 1.2 - Reduction of warranty and service requirements to one year
    - Article 1.3 - Clarifications to Mandatory Mechanical Systems Commissioning
    - Article 1.4 - Revisions to Design Requirements including the requirement for summer design temperatures as per Design Value Explorer developed by PCIC and adjusted by the global warming Change Factor (CF) of 0.5°C
    - New Articles 2.5 Through-the Wall Heat Pump Units and 2.6 All-in-One HVAC Systems
    - Article 2.7 - Revisions to Ventilation to address requirements for combination fire/smoke dampers (FSDs)
    - New Article 2.8 Filtration and Mitigation of Air Pollution providing requirements for mitigating air pollution due to forest wildfires
    - New Article 2.9 Major Retrofit Projects involving building envelope and mechanical upgrades providing requirements for mitigating overheating and air pollution due to forest wildfires
    - New Article 3.4 Condensate Drains

LEGEND:

ADD followed by Green font text or Green background (for table headers): Added provision to BC Housing Design Guidelines and Construction Standards 2019 through Technical Bulletin No. 3-2023

DELETE followed by ~~Stroked text~~: Deleted provision from BC Housing Design Guidelines and Construction Standards 2019 through Technical Bulletin No. 3-2023

RENUMBER "X" to "Y": indicates the numerical notation and relative location within the BC Housing Design Guidelines and Construction Standards 2019 for this item has been changed from X to Y; there is no change to the item content itself

SECTION 2 ENERGY AND ENVIRONMENTAL DESIGN

2 BUILDING AND ENERGY PERFORMANCE

2.1 REQUIREMENTS

2.1.1.1 DELETE ~~Change the Article title to~~ "Part 3 Projects – Less than 7 Storeys":

DELETE ~~Remove wording "Combustible (i.e. wood frame)"~~

Change the table in this article as follows:
[Technical Bulletin No. 1-2020 revised as follows]

Climate Zone[1]	Step Code Level	GHGI (kgCO_2e/m^2/year)	$EALR_{N75}$ (L/s*m^2@75 Pa)	$IPALR_{N50}$ (l/s/m^2@50 Pa)
4[2]	Step 4	**DELETE** ~~5.5~~ **ADD** 3.0	2.0	1.2
5[3]	Step 3	**DELETE** ~~5.5~~ **ADD** 5.0		
6[4], 7[5], 8[5]	Step 3	6.0		

1 Climate Zone is based on Heating Degree Days (HDD) below 18°C for 25-year period ending in 2006 as per BC Building Code Appendix C - Division B Climatic And Seismic Information for Building Design in Canada
2 Less than 3000 HDD
3 3000 to 3999 Heating Degree Days (HDD)
4 4000 to 4999 Heating Degree Days (HDD)
5 Greater than 4999 Heating Degree Days (HDD)

2.1.1.2 DELETE ~~Change the Article title to~~ "Part 3 Projects – 7 Storeys and Higher":

DELETE ~~**Remove** wording "Non-combustible (i.e. concrete)"~~

Change the table in this article as follows:
[Technical Bulletin No. 1-2020 revised as follows]

Climate Zone[1]	Step Code Level	GHGI (kgCO_2e/m^2/year)	$EALR_{N75}$ (L/s*m^2@75 Pa)	$IPALR_{N50}$ (l/s/m^2@50 Pa)
4[2] **DELETE** ~~,5[3],6[4],7[5],8[5]~~	Step 3	**DELETE** ~~6.0~~ **ADD** 3.0	2.0	1.2
ADD 5[3]	Step 3	**DELETE** ~~6.0~~ **ADD** 5.0		
ADD 6[4], 7[5], 8[5]	Step 3	6.0		

1 Climate Zone is based on Heating Degree Days (HDD) below 18°C for 25-year period ending in 2006 as per BC Building Code Appendix C - Division B Climatic And Seismic Information for Building Design in Canada
2 Less than 3000 HDD
3 3000 to 3999 Heating Degree Days (HDD)
4 4000 to 4999 Heating Degree Days (HDD)
5 Greater than 4999 Heating Degree Days (HDD)

2.1.1.3 Part 9 Projects:
[BC Housing Design Guidelines and Construction Standards 2019 revised as follows]

Climate Zone[1]	Step Code Level	GHGI ($kgCO_2e/m^2$/year)	Airtightness Testing (ACH@50 Pa)
4[2]	Step 4	ADD 3.0	Refer to BC Energy Step Code
5[3]			
6[4], 7[5], 8[5]			

1 Climate Zone is based on Heating Degree Days (HDD) below 18°C for 25-year period ending in 2006 as per BC Building Code Appendix C - Division B Climatic And Seismic Information for Building Design in Canada
2 Less than 3000 HDD
3 3000 to 3999 Heating Degree Days (HDD)
4 4000 to 4999 Heating Degree Days (HDD)
5 Greater than 4999 Heating Degree Days (HDD)

2.1.3 Thermal Comfort Evaluation

DELETE

Revise ~~as follows:~~

~~**2.1.3** Thermal Comfort Evaluation: A thermal comfort evaluation is required for all passively cooled buildings (i.e. buildings without full mechanical cooling in all occupied spaces). For all BC Housing buildings, it shall not exceed more than 20 overheating hours per year for any zone and must adhere to the City of Vancouver Energy Modelling Guidelines.~~

ADD

2.1.3 Thermal Comfort Evaluation: A thermal comfort evaluation is required for all passively cooled buildings (i.e. buildings without full mechanical cooling in all occupied spaces). For all BC Housing buildings, it shall not exceed more than 20 overheating hours per year for any climate zone and must adhere to the City of Vancouver Energy Modelling Guidelines. The Canadian Weather Year for Energy Calculation (CWEC) 2020 file shall be used as the baseline for all thermal comfort evaluations.

A sensitivity analysis is required to assess future overheating potential risk. Provide a comparison between the projected 2050 weather file[8] and the existing thermal comfort evaluation and prepare a pathway to address resiliency against the future overheating potential risk. The methodology for calculating overheating temperature limits for a future weather file as defined in ASHRAE 55 and outlined in the City of Vancouver Energy Modelling Guidelines should be followed. The reported results are to be considered by the design team in the decision-making process.

8 https://www.pacificclimate.org/data/weather-files

3 PASSIVE DESIGN STRATEGIES

DELETE

~~3.1 INTENT OF PASSIVE DESIGN~~

DELETE

~~3.2 RECOMMENDED PASSIVE DESIGN STRATEGIES~~

ADD

3.1 ACHIEVING PASSIVE DESIGN OUTCOMES

The main benefit of passive design is to limit costs payable by the building owner to upfront capital costs during the design and construction phase, rather than repeatedly throughout building operations. Highly efficient, high quality, durable, and long-lasting systems and materials provide additional benefits. Good passive design saves energy, reduces GHG emissions, reduces the risk of overheating, provides resilience in the event of service disruption and future climate changes, prolongs the life of mechanical equipment and other systems and provides an improved occupant experience.

To determine a budget for good passive design, the long-term costs and benefits should be judiciously modelled and compared to those of conventional design, taking into consideration any impacts on operating and maintenance costs, utility price escalation, carbon tax escalation, and the cost and risk of building system failure in extreme or catastrophic conditions. Even though projects will incur some capital costs for incorporating passive design measures, it will reduce Total Costs of Ownership (TCO).

Current modelling guidelines prescribe the use of CWEC 2016 weather files, which are based on historical data. Recent study[9] has also shown, the use of future climate models dramatically changes the modelled results for the key overheating metrics. With the understanding that the climate will continue to change throughout a building's lifetime, the modelling and design of new buildings and major retrofits incorporate CWEC 2020 files for more resilient buildings in the future. Refer to Section 2 Energy and Environmental Design, Article 2.1.3 Thermal Comfort Evaluation.

As building designs progress toward the highest steps of the BC Energy Step Code, the solar heat gain reduction measures become critical in order to meet thermal comfort in the current and future climate without sacrificing energy demand reduction targets. A well-insulated building with an airtight enclosure and design elements to mitigate solar heat gain, paired with passive cooling strategies, is shown to be beneficial for managing cooling loads, reducing annual energy costs and electricity demands and providing greater resiliency in the face of power outages and poor-air-quality events such as forest wildfires.

3.2 PASSIVE DESIGN MEASURES

Each of the items below can be applied to BC Housing projects to help achieve beneficial passive design performance outcomes. A brief description is provided along with the applicable building Typology, Consideration (implement, recommend, consider) and potential Co-benefits beyond

[9] https://planning.ubc.ca/sites/default/files/2020-05/REPORT_UBC_Climate%20Resilient%20Multifamily%20Buildings.pdf

energy savings; for instance, climate change and overheating resilience. The measures are to be applied to new construction projects and, where practicable, to retrofit projects. To optimize passive performance, the architect (and design team) shall review and implement the strategies recommended in the following section at early design stages. Where such strategies cannot be applied due to site constraints, or municipal requirements, the architect shall provide a written summary of such deviations to the Owner and BC Housing.

.1 Optimize Solar Orientation

To the extent possible, the building and windows should be oriented to optimize solar heat gains and daylighting. Direct daylight into the building as deeply as practicable while managing overheating and overlighting. A north-south orientation is ideal, with daylight-optimized glazing on the north façade and between 15% and 25% glazing on the south façade. Where there is an east-west aspect due to site constraints, additional care should be taken when designing glazing areas and shading to deal with low sun angles that are typical at the beginning and end of the day in summer.

Typologies: All
Consideration: Implement
Co-benefits: Improved thermal comfort and reduced overheating
Reduced use of artificial lights
Improved daylighting

.2 Optimize Retention And Planting of Trees

Mature trees provide shade and wind protection at no or insignificant costs. They also help to manage the microclimate and soil hydrology. Planting and/or retaining deciduous trees in front of the building's south and west orientations will provide shading, lower the cooling load in summer and allow the sun to warm a building in winter. There may be good reasons to remove trees that are too close to building foundations or site services but such removals should be duly justified. The architect shall review the energy modelling report at an early design stage and coordinate with the landscape designer how a tree retention plan and planting new trees should contribute to the passive cooling strategy. Buildings located within the Wildland Urban Interface (WUI) should consider FireSmart BC's landscaping guide to increase wildfire resiliency[10].

Typologies: All
Consideration: Implement
Co-benefits: Habitat and ecosystem health
Biophilia

[10] https://firesmartbc.ca/wp-content/uploads/2021/04/FireSmartBC_LandscapingGuide_Web_v2.pdf

.3 Optimize Form Factor

Building surface area and articulation should be minimized to reduce thermal bridging. In this regard, simple and solid forms, like cubes or rectangles, are recommended, notwithstanding the need for daylight, access, natural ventilation, views, etc. Articulations for reasons of aesthetics, variations and scale should be minimized, and should be considered only for functional reasons, site conditions and to meet Authority Having Jurisdiction (AHJ) requirements.

Typologies: All
Consideration: Implement
Co-benefits: Reduced construction cost
Simplified maintenance

.4 Optimize Thermal Layout

During planning and layout of buildings, minimize thermal loads and losses with strategic space adjacencies, and consider buffer spaces. Plan mechanical systems early with short pipe and duct runs. Consider internal heat gains, the impact of site orientation and shading, variation in seasonality and space usage and the effects of other passive and active systems.

Typologies: All
Consideration: Implement
Co-benefits: Reduced construction cost
Reduced maintenance cost

.5 Incorporate Shading

.1 External Shading

External shading systems are highly effective in reducing solar heat gain. From maintenance and operation standpoints, most preferred are systems that are fixed (i.e., brise soleil and overhangs) and require no movement or occupant action in order to be effective. At a minimum, one- or two-building elevations should benefit from fixed shading systems unless functional shading is provided by other means. If exterior shading is considered, the architect should review the energy modelling report at an early stage. Where exterior shading has not been provided, the feasibility of future exterior operable shading should be considered, with rough-ins for support brackets, especially in west-, east- and south-elevation bedrooms.

Typologies: All
Consideration: Implement
Co-benefits: Improved thermal comfort and reduced overheating
Better daylighting and reduced glare

.2 Internal shading

Where effective external shading is not feasible, internal shading can be considered. However, this method is far less effective than external shading. External shading can reduce solar heat gain by between 80% and 100%. In contrast, even the most effective internal shading will only reduce solar gain by a maximum of 40% and in most cases it will be considerably less. As well, internal shading is less effective because it is also almost entirely reliant on occupant behaviour. Internal shades work by reflecting solar radiation back out through the glass and so should be reflective or bright, white coloured blinds installed close to the window.

Typologies: All
Consideration: Implement
Co-benefits: Improved thermal comfort and reduced overheating

.6 Maximize Passive Cooling Potential Through Window Design

Moving cooler outside air through the building is achieved primarily by opening windows. Thus, the building's windows are critical factors in achieving sufficient passive cooling. The following design parameters will need to be considered and optimized:

.1 Optimize window-wall ratio

Window design is highly nuanced; performance drivers include passive gains and losses, daylighting, ventilation, views, equity among suites, design variety to accommodate different needs, and more. When evaluating energy performance, consider not only total window area but also total frame length and thermal bridging (see Optimize window frames, below). The architect shall review the energy modelling report at an early design stage.

Typologies: All
Consideration: Implement
Co-benefits: Reduced construction costs

.2 Optimize window frames

Minimize total frame length; window frames are typically the longest thermal bridges in the building. Identify and select the best thermally broken frames the project can afford. Refer to BC Housing Design Guidelines and Construction Standards 2019, Section 4 – 08 50 00 – Windows, Side Hinged and Sliding Glass Doors.

Typologies: All
Consideration: Implement
Co-benefits: Improved thermal comfort and reduced overheating
Reduced maintenance cost

.3 Optimize Glazing SHGC

Explore options for solar heat gain coefficient (SHGC) on all glazing; consider year-round gains and losses and strive to achieve a balance between passive gains (winter) and overheating (summer). All windows are to have a SHGC with visual transmittance as outlined in BC Housing Design Guidelines and Construction Standards 2019, Section 4 – 08 50 00 – Windows, Side Hinged and Sliding Glass Doors. Windows with high exposure to summer sun can be considered for a lower coefficient, but it should not be not very low to compromise against winter heat.

Typologies: All
Consideration: Implement
Co-benefits: Improved thermal comfort and reduced overheating
More daylighting

.4 Include operable windows

The way in which the window can be opened (i.e., tilted, side-hung, top-hung, etc.), combined with its area, determines the actual amount of free-flow operable area that can be achieved. In addition, security- or safety-related constraints, such as opening restrictors on higher windows, need to be taken into account. Insect meshes can permit overnight ventilation and should be clearly identified as part of the design). Ensure adequate ventilation and thermal comfort when all windows must be closed during extreme temperatures and smoke events.

Typologies: All
Consideration: Implement
Co-benefits: Improved thermal comfort and reduced overheating
Autonomy and happiness

.5 Optimize cross-ventilation

Cross-ventilation should be included in the design wherever possible or where operable windows are located on adjacent or opposite walls, or through innovative window design (such as operable upper/lower portion). For cross-ventilation to be effective, the design should ensure that there is a clear path within the building for the air to flow.

Typologies: All
Consideration: Recommend
Co-benefits: Improved thermal comfort and reduced overheating

.7 Optimize Insulation

Optimize envelope assemblies for maximum effective R-value; provide space for maximum insulation on pipes and fittings, to the extent that the budget will allow.

Typologies: All
Consideration: Implement
Co-benefits: Improved thermal comfort
Improved acoustic comfort water conservation

8. Minimize Thermal Bridges

Optimize building form, layout, materials, and design details to minimize overall thermal bridging to the extent that the budget will allow. Refer to BC Housing Design Guidelines and Construction Standards 2019, Section 4 – 07 05 00 – Thermal Bridging & Airtightness.

Typologies: All
Consideration: Implement
Co-benefits: Improved thermal comfort and reduced overheating
Reduced condensation and mould

.9 Utilize Additional Passive Design Measures

.1 Include heat recovery/pump systems

The combination of heat recovery and different energy-efficient heat pump systems will reduce heat loss and energy consumption significantly. All major ventilation systems in BC Housing projects shall include heat recovery with a minimum sensible heat recovery effectiveness (or apparent sensible effectiveness for in-suite Energy Recovery Ventilators (ERVs)) of 75%. Refer to BC Housing Design Guidelines and Construction Standards 2019, Section 4 – 23 00 00 – Heating, Ventilation and Air Conditioning. Where justified by climatic conditions, consider utilizing heat pump equipment. A drain water heat recovery system can also save on energy used to heat water. This system takes advantage of the warm water flowing down the drains to preheat the water going into the hot water tank.

Typologies: All
Consideration: Implement
Co-benefits: Prolong life of equipment

.2 Pre-condition intake air

Using earth tubes, buffer spaces, or other approaches, consider means of passively pre-conditioning intake air to reduce energy requirements. Systems must be properly designed to manage humidity.

Typologies: All
Consideration: Consider
Co-benefits: Prolong life of mechanical equipment

.3 Use solar photovoltaic (PV) panels as shading

Compare against conventional shading design and test business case. Consider a stand-alone PV system with batteries (i.e., not grid-tied) for partial energy independence and resilience in the event of utility service disruption.

Typologies: All
Consideration: Consider
Co-benefits: Increased passive survivability

TABLE 1: PASSIVE DESIGN STRATEGIES

The table below shows the strategies that should be implemented in all projects including new development and retrofits. When deciding which design strategies to adopt, it is advisable to focus on those that are feasible (in all typologies and conditions), effective (performance) and cost-effective to implement. A summary of these various design strategies, with a subjective assessment of the relative effectiveness, feasibility and capital cost impact of each, is set out below:

Passive Design Measure	Feasibility Assessment	Feasibility	Effectiveness	Cost Impact
		High: (green) Moderate: (blue) Low: (pink)		High: (pink) Moderate: (blue) Low: (light green)
Solar orientation	Moderately feasible - subject to site condition	Moderate	High	Low
Form factor, insulation and thermal bridging	Feasible in all situations	High	High	Moderate
Thermal layout	Moderately feasible - subject to design	Moderate	Moderate	Low
Retention and planting of trees	Moderately feasible - subject to site condition	Moderate	High	Low
External/overhang shading (on south-facing windows)	Feasible in all situations	High	High	High
Internal shading	Subject to action by occupants	High	Moderate	Moderate
Window/wall ratio	Feasible in all situations	High	High	Low
Window frames & reduced SHGC	Feasible in all situations	High	Moderate	Moderate
Operable windows	Subject to action by occupants and to external factors such as noise or pollution	High	Moderate	Low
Heat recovery/ pump systems	Feasible in all situations	High	High	High

4 ENERGY EFFICIENT PRODUCTS, INCENTIVES AND ENERGY ASSESSMENTS

4.1 ENERGY EFFICIENT SYSTEMS

4.1.1 Heating, Ventilation and Air Conditioning (HVAC) Systems

[Technical Bulletin No. 1-2020 revised as follows]

DELETE ~~**Add the following sentence at the end of first paragraph:**~~

~~All make up air units (MUA) shall be high efficiency condensing model if using natural gas as a source.~~

ADD All major systems should be fully electric wherever possible. Any gas systems must be reviewed and approved by BC Housing.

DELETE

~~4.6 ENERGY ASSESSMENT AND ENERGY CONSERVATION MEASURES (ECM)~~

[Technical Bulletin No. 1-2020 and BC Housing Design Guidelines and Construction Standards 2019 revised as follows]

ADD

4.6 RETROFIT PROJECTS

.1 All retrofit projects shall target a 50% GHG emissions reduction relative to current emissions levels.

.2 Project design team is required to explore and implement all opportunities to electrify space heating, domestic hot water and ventilation systems. Electrification here refers to the replacement of fossil-fuel-based building HVAC systems with low-carbon, electric-powered systems. An electrical load analysis and feasibility study are required to establish the existing building demand profile, whole building/suite panel and service capacities and estimates of the costs and schedule impacts of implementing electrification on the project. The electrical load analysis shall identify any electrical panel or service upgrades that may be required to actualize proposed and future low-carbon electrification measures. If domestic hot water (DHW) fuel switching is considered, a DHW demand assessment will be required to properly size the DHW heating plant.

.3 Retrofit projects involving major retrofit scope for building envelope and mechanical systems shall accommodate passive design strategies and mechanical cooling for common areas and in-suites to the extent possible within the limits of budgets and existing conditions of the building.

.4 At a minimum, retrofit projects involving major building envelope and mechanical systems upgrades shall provide active cooling to common areas and amenity spaces.

.5 Retrofit projects involving building envelope upgrades shall install additional exterior insulation for better thermal performance of the building. All such projects are in addition required to conduct a whole building ventilation and overheating assessment and implement measures to mitigate and make acceptable ventilation and indoor air conditions, following such upgrades. Refer to Section 4 – 23 00 00 – Heating, Ventilation and Air Conditioning for system and equipment performance.

.6 Whole building energy modelling is required for all major retrofit projects. Refer to Article 2.1.3 Thermal Comfort Evaluation of this section for the use of climate data in energy modelling.

.7 Retrofit projects with mechanical systems upgrade have inclusion of effective filtration to lessen effects of outside wildfire smoke pollutants into the building. Refer to Section 4 – 23 00 00 – Heating, Ventilation and Air Conditioning.

.8 Retrofit projects involving window replacement shall include better performing windows with lower SHGC and effective visual transmittance to reduce overheating as per Section 4 – 08 50 00 Windows, Side Hinged and Sliding Glass Doors.

.9 Depending on the size, scope, type, and complexity of the building renewal and retrofit project, the project team will choose appropriate commissioning option as described in the BC Housing Building Commissioning Guidelines.

End of Section

SECTION 4 CONSTRUCTION STANDARDS

23 00 00 - HEATING, VENTILATION AND AIR CONDITIONING

[BC Housing Design Guidelines and Construction Standards 2019 revised as follows]

1 GENERAL

The HVAC systems in multi-unit residential buildings three-storeys **ADD** and higher or exceeding 600 m^2 in building area shall be designed to meet all applicable requirements of the valid edition of ASHRAE 90.1 Standard "Energy Standard for Buildings except Low-Rise Residential Buildings" and the BC Building Code or Vancouver Building By-law for Part 3 buildings, including all additional re-zoning and energy by-law requirements of the Authorities Having Jurisdiction for Part 3 buildings.

Multi-family buildings less than three-storeys and **ADD** less than 600 m^2 shall be designed to meet all applicable requirements of the BC Building Code or Vancouver Building By-law for Part 9 buildings, including all additional re-zoning and energy by-law requirements of the Authorities Having Jurisdiction for Part 9 buildings.

Unless governed by more stringent local by-laws, all new projects shall meet the minimum building and energy performance targets as stated in **ADD** Section 2 Energy and Environmental Design.

Passive design strategies and a better performing building envelope shall be chosen ahead of utilizing complex and difficult to operate/maintain HVAC systems. The strategies of harnessing solar radiation and capturing internal gains for heating and utilizing mechanical ventilation overnight to cool the warm building structures should be considered. Refer to **ADD** Section 2 Energy and Environmental Design.

BC 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, BC Housing is committed to selecting energy efficient materials and securing all rebates and incentives associated with these energy efficient choices. The Consultant is to ensure that any of these applicable programs are included and captured in all projects.

Designing and specifying material and/or equipment must account for local servicing availability and accessibility of parts for future maintenance and replacement.

BC Energy Step Code requirements, including maximum Thermal Energy Demand Intensity (TEDI) and Total Energy Use Intensity (TEUI) as defined in Section 2 Energy and Environmental Design, shall be used as targets for meeting Building and Energy Performance. Strategies for meeting these targets shall be identified and verified through a mandatory building energy modelling. Energy modelling shall comply with requirements of the current BC Energy Step Code and the City of Vancouver Modelling Guidelines **ADD** using CWEC 2020 weather files. In addition, BC Housing is committed to reducing carbon emissions and requires meeting maximum Greenhouse Gas Emission Intensity (GHGI) targets. Refer to Section 2 Energy and Environmental Design for detailed requirements.

Refer to Appendix C for meeting higher BC Energy Step Code targets through efficient mechanical design.

.1 Quality Assurance

DELETE

~~.3 In order to provide a better quality assurance of the mechanical design, BC Housing will retain an independent consultant to provide a mechanical peer review at the end of the design development stage. On the larger projects this might be followed up by a second review at the 50% construction documents stage. The mechanical Engineer of Record will be asked to provide all relevant information for the independent review and will be requested to address any potential design issues and comments brought up by the reviewer before moving to next design stage or tender.~~

ADD

.3 Mechanical Peer Review Process:

To provide a better-quality assurance of the mechanical design, BC Housing will retain an independent consultant to provide a mandatory mechanical peer review (MPR), typically at the 50% design stage (no later than before BP submission). The Mechanical Engineer of Record is asked to provide sufficient information for the independent review and will be requested to address any potential design issues and comments brought up by the reviewer before moving to the next design stage or tender. A meeting is to be conducted with the project team to discuss the recommendations included in the MPR report. The Mechanical Engineer of Record must submit a signoff letter to the Owner and BC Housing at the end of the design stage clearly stating that all recommended revisions have been implemented or, if not, providing a rationale for why they have not been included in the design.

.2 Warranty

.1 Provide full **DELETE** ~~2~~ **ADD** one year warranty for all labour and materials along with full **DELETE** ~~2~~ **ADD** one year of service contracts for projects under Part 3 buildings for new construction and as appropriate for renovation projects for overall mechanical systems including control systems. For Part 9 projects, provide **ADD** standard one year warranty **DELETE** ~~with full one year of service contract.~~

.2 The service contracts are to follow the manufacturer's recommended annual maintenance recommendations and running inspections throughout the service terms. They shall include one major annual maintenance visit and a minimum of three running inspections **DELETE** ~~each~~ **ADD** throughout the year. All findings and work completed shall be recorded in a report issued to the Owner. **ADD** All warranty items shall be resolved by the Contractor.

.3 Mandatory Mechanical Systems Commissioning

DELETE [~~all Paragraphs .1 to .6~~]

ADD

.1 All BC Housing projects require mandatory mechanical systems commissioning by an independent Commissioning Provider (CxP) or contractor's hired Commissioning Agent

(CxAg). Refer to Section 4 – 01 91 00 Building Commissioning and BC Housing Building Commissioning Guidelines to establish the commissioning option, requirements and activities for the mechanical contractor in the project.

.2 Under all commissioning options, The mechanical contractor will be responsible for the pre-functional tests and equipment startups and for retaining the Testing, Adjusting & Balancing (TAB) Agency. Preparation of operating and maintenance manuals and testing of fire and smoke dampers must be included in the scope of work by the TAB Agency hired by the mechanical contractor. In Option 4, the mechanical contractor (or their CxAg) is responsible to complete full commissioning including functional testing.

.3 The general contractor shall be responsible, with the cooperation of sub-trades, for coordinating integrated systems testing of the Fire Protection and Life Safety Systems as per CAN/ULC-S1001. Additional commissioning requirements for the electrical systems and building envelope shall be covered by the electrical consultant and architect.

.4 The mechanical consultant shall incorporate all commissioning requirements into the specifications, including listing all required pre-functional and functional testing specific to the project, and clearly identifying the responsibilities of the contractor and CxP. The reference to the commissioning option as per the BC Housing Building Commissioning Guidelines must be included in the mechanical specifications.

.4 Design Requirements

DELETE

~~.1 **Design Temperatures (Heating):** Design heating systems to maintain indoor temperature of 21°C (70°F). Design outdoor temperatures shall be based on BC Building Code climatic data for the 1% January design temperature for the location.~~

ADD

.1 **Design Temperatures (Heating):** Design outdoor temperatures shall be based on the present BC Building Code climatic data for the 1% January design temperature for the location.

Design heating systems to maintain indoor temperature of 21°C (70°F).

DELETE

~~.2 **Design Temperatures (Cooling):** For common areas (excluding corridors), design cooling and ventilation systems to maintain maximum indoor temperature of 24°C (75.2°F). For residential suites, design systems to maintain indoor operative temperatures within 80% acceptable limits as per the current edition of ASHRAE Standard 55 "Thermal Environmental Conditions for Human Occupancy". It shall be demonstrated that 80% acceptability limits are not exceeded for more than 20 hours per year for any zone. Design outdoor temperatures shall be based on BC Building Code climatic data for the 2.5% July design temperature for the location.~~

~~Unless addressed by implementing passive design strategies, provide full mechanical cooling for the amenity / office areas in the Lower Mainland, Vancouver Island, Northern Interior and North Regions, and provide full mechanical cooling for the amenity / office areas and residential suites in the Southern Interior Region. Where mechanical cooling is required, window mounted air conditioning units are not permitted~~

ADD

.2 Design Temperatures (Cooling): Summer overheating in buildings is a real concern due to the ever-increasing effects of global warming and aggressive measures to reduce winter heating energy use, resulting in tighter and better insulated structures. Designers must provide an adequate source of cooling using both passive and active building strategies to maintain the comfort and livability of buildings.

Design outdoor temperatures shall be based on the present BC Building Code climatic data for 2.5% July Dry and Wet Bulb design temperatures adjusted by the global warming Change Factor (CF) of 0.5°C using Table C-2 of [Design Value Explorer](https://services.pacificclimate.org/pcex/app/#/data/climo/ce_files) developed by the Pacific Climate Impact Consortium (PCIC)[11].

NOTE: This will result in temperature adjustments of between 0.8°C – 1.5°C for Dry Bulb and between 0.8°C – 1.2°C for Wet Bulb design temperatures, depending on the location. For the City of Vancouver use July 2.5% Dry Bulb temperature of 30°C (86°F) and Wet Bulb Temperature of 22°C (71.6°F) as per Table C-2 of Design Value Explorer developed by the Pacific Climate Impact Consortium (PCIC).

For common areas (excluding corridors), design cooling and ventilation systems to maintain maximum indoor temperature of 24°C (75.2°F).

For residential suites, design systems to maintain indoor operative temperatures within 80% acceptable limits as per the current edition of ASHRAE Standard 55 "Thermal Environmental Conditions for Human Occupancy". It shall be demonstrated that 80% acceptability limits are not exceeded for more than 20 hours per year for any climate zone.

For any projects without or with only partial (living room only) mechanical cooling provided for the residential suites, the comfort acceptability limits must be confirmed by the summer overheating analysis modelling using the CWEC 2020 weather file. A sensitivity analysis is also required to a assess future overheating potential.

All projects must use the energy modelling methodology as per Section 2 Energy and Environmental Design.

Provide full mechanical cooling for the amenity/office areas in all regions and provide full mechanical cooling for residential suites including living room and bedrooms, in the Southern Interior Region. Full mechanical cooling for residential suites is defined as providing air conditioning for living room and all bedrooms with sized based on 2.5% July Dry and Wet Bulb design temperatures adjusted by the global warming Change Factor as described above in this section.

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[11] https://services.pacificclimate.org/pcex/app/#/data/climo/ce_files

DELETE

~~.4 Take into consideration redundancy in the design of the mechanical systems. When centralized mechanical systems serve multiple dwelling units a failure of equipment shall not cause a total failure of that system. i.e. provide multiple circulation pumps, provide multiple boilers, multiple hot water tanks etc.~~

ADD

.4 For revisions to the GHGI targets and passive design measures, refer to Section 2 Energy and Environmental Design.

2 PRODUCTS

2.2 Heating Systems

ADD [after last paragraph]

The following are different types of heating systems in BC Housing projects:

.1 Electric Heating

DELETE

~~.1 Utilizing passive design strategies and a better building envelope allows considering use of electric baseboard heaters for heating of residential suites in a majority of new projects in the Lower Mainland and Vancouver Island regions, and for selected projects in other regions. Utilizing electric baseboard heaters can be combined with partial mechanical cooling provided by central or semi-central Energy Recovery Ventilators (ERVs).~~

ADD

.1 Utilizing electric baseboard heaters (EBH) is the most cost-effective option available. Where EBHs are used as a source of heating supplementary to heat pump equipment serving the same room, they must be controlled as a second-stage heating from a thermostat controlling a heat pump unit.

.4 The mechanical consultant is responsible for sizing electric heaters based on heating load calculations. **ADD** Locations and sizes of all required electric heaters must be shown on the mechanical drawings for coordination with the electrical design. EBHs shall be of heavy-duty commercial construction with a 20-gauge cold rolled steel front cover and brackets to limit vandalism. The mechanical consultant shall coordinate this requirement with the electrical consultant.

ADD

.5 Supply and installation of EBHs and electric force-flow heaters shall be by the electrical division. Supply and installation of electric duct heaters shall be by the mechanical division.

.2 Forced Air Heating

DELETE

~~.1 All furnaces shall be ENERGY STAR® rated high-efficiency condensing appliances with minimum 95% Annual Fuel Utilization Efficiency (AFUE).~~

ADD

.1 Forced-air furnaces with electric or heat pump heating shall be considered over traditional gas-fired furnaces to reduce GHG emissions. Any natural gas systems must be reviewed and approved by BC Housing and shall be ENERGY STAR®-rated, high-efficiency condensing appliances with minimum 95% Annual Fuel Utilization Efficiency (AFUE).

DELETE

~~.2 Flue vent and combustion air intake shall be connected directly to the furnace to provided operation with a sealed combustion.~~

.2 At least one heating outlet per each occupied room shall be provided and located, preferably, at the floor level. For each floor of a dwelling unit there shall be at least one return duct. Do not locate heating ducts under refrigerators or food storage cabinets.

.3 Each furnace shall be controlled by a wall-mounted, low-voltage programmable thermostat with a setback controls option.

.3 Hot Water Boilers

DELETE

~~.2 For buildings with multiple residential suites and where boilers are the main source of heating, the boiler plant shall consist of at least two boilers, each sized for a minimum of 60% of the peak heating demand.~~

ADD

.2 Gas-fired boilers shall be used only as a supplementary or backup source of heating in Climate Zone 4 to meet the GHGI targets.

.5 In-floor Heating

DELETE

~~.9 Solid PVC sleeves shall be provided where tubes pass through concrete floors.~~

ADD

.9 In-slab PEX piping shall be protected by high-density polyethylene (HDPE) corrugated sleeves. Solid PVC sleeves shall be provided where tubes enter or exit concrete floors.

.3 HEAT PUMP SYSTEMS

.2 Air-to-Water Heat Pumps

.4 Air-to-water heat pumps shall be protected from freezing. For buildings that do not have emergency power, provide a minimum 25% polypropylene glycol solution in the heat pump source loop. Separate the heat pump source loop from the building load loop with a heat exchanger **ADD** to limit glycol solution for outdoor heat pumps only. For buildings that have emergency power, it is up to the Engineer of Record to choose between an option of providing glycol solution or using heat tracing connected to emergency power for freeze protection.

.4 Split Heat Pump Systems

.1 Split heat pump systems include: single-zone mini-split heat pump units, multi-zone mini-split heat pump units and multi-zone mini-VRF heat pump units. These systems can be considered for small to medium-sized projects **ADD** or for the amenity areas in any buildings.

ADD

Where supplementary EBHs are provided, they shall be controlled as a second-stage heating from a thermostat controlling a fan coil unit.

The split heat pump system will require a separate ventilation system. This would have to include a central or semi-central energy recovery ventilator or individual in-suite energy recovery ventilators. Refer to Part 3 of this division for proper installation of condensate drains.

DELETE

~~.5 PACKAGE TERMINAL AIR CONDITIONERS (PTACS)~~ [the entire Section]

ADD

.5 THROUGH-THE-WALL HEAT PUMP UNITS

.1 Through-the-wall heat pump units are a type of package terminal air conditioner (PTAC) but with one important difference – they require only two round sleeves through the outside wall rather than large wall openings, as are typical for the North-American-made "motel"-style PTACs with CSA standard/certification.

Heat pump units with two-sleeved openings, each not more than 200mm (8") in diameter, are the only PTAC-type units allowed on BC Housing projects. All penetrations shall be properly sealed to reduce air leakage.

.2 Through-the-wall heat pump units must include DC inverter compressors and built-in supplementary electric heaters for operations in low ambient temperatures.

.3 Through-the-wall heat pump units shall be controlled by a built-in controller with an LED display. An optional hard-wired remote controller can be provided but only if specifically requested by the Operator/Owner.

.4 Through-the-wall heat pump units offer a cost-effective method of providing heating and cooling of residential living rooms where partial cooling of residential suites is acceptable. Refer to Part 3 of this division for proper installation of condensate drains.

.5 Where supplementary EBHs are provided, they shall be controlled as a second-stage heating from a thermostat controlling a fan coil unit.

ADD

.6 ALL-IN-ONE HVAC SYSTEMS

.1 Each type of centralized or decentralized HVAC system typically requires a ventilation system, separate from the heating and cooling system.

All-in-one HVAC systems include heating, cooling, ventilation, controls, and filtration components in one packaged, self-contained and self-controlled unit designed to service a single residential household.

.2 This relatively new type of decentralized HVAC system is expected to gain popularity and new products are expected to be available as market demand increases. The design teams are encouraged to research the availability of this type of HVAC system and consider utilizing them on selected BC Housing projects. Only well-researched products by manufacturers with proven track records shall be considered and prior consultation with BCH is required.

.3 HVAC units that incorporate passive and active heat recovery by adding a heat pump component to the energy recovery ventilator (ERV) should be of special interest for applications on BC Housing projects. This type of product can be considered as an all-in-one HVAC system for smaller residential suites or suites requiring partial cooling.

RENUMBER 2.6 to 2.7

.7 VENTILATION

.3 Ventilation rates for central and semi-central ERVs shall be at minimum **DELETE** ~~23L/S (49cfm)~~ **ADD** 24 l/s (50cfm) for studio and one-bedroom apartments, **DELETE** ~~30l/s (64cfm)~~ **ADD** 31 l/s (65cfm) for two- and three-bedroom apartments with a single bathroom, and 47 l/s (100cfm) for three-bedroom apartments with two bathrooms.

.4 [last paragraph] If the central ventilation system serves common and amenity areas in addition to residential suites, consider providing a separate **DELETE** ~~heat~~ **ADD** ERV unit for the amenity areas to allow shutting it down during unoccupied hours. **ADD** Consider providing a two-speed operation controlled from space CO_2 sensors for larger ERVs serving non-residential areas.

DELETE

~~**.5** For smaller buildings, utilizing a standard gas-fired or heat pump rooftop unit integrated with a separate heat recovery ERV can be considered as a cost-effective solution for providing a central ventilation system with heat recovery and supplementary cooling / heating options.~~

ADD

.5 Revisions to the BC Building Code 2018 and Vancouver Building By-law 2019 include the requirement for providing combination fire/smoke dampers (FSDs) at all required fire separations of public corridors. The cost, maintenance and testing requirements of FSDs in multiple, small-diameter duct penetrations of public corridors make centralized ventilation systems impractical.

Before deciding to utilize a centralized ventilation system, the mechanical consultant, with help from the code consultant, must confirm that the local authorities are agreeable to waiving the requirement for smoke dampers through a project-specific Alternative Solution, without compromising the safety of the building. If it is pre-determined that the Authority Having Jurisdiction will not waive this requirement, centralized ventilation systems must not be utilized on the project.

Any design of ductwork distribution in the building must be done to avoid, where possible, the need for installing numerous FSDs.

.6 Individual in-suite ERVs shall be installed with proper access for maintenance and servicing. ERVs shall be provided with electronically commutated motors (ECMs) on supply and exhaust fans. **ADD** Heat recovery ventilators (HRVs), which do not transfer latent heat (moisture) and require condensate drain connections, shall be avoided. **DELETE** ~~In-suite ERVs for apartments with single bathrooms shall be sized for minimum 17L/s (35cfm) air flow at the continuous low speed and 33 L/s (70 cfm) at the high speed when activated by a switch in a bathroom.~~

DELETE

~~Ventilation units for apartments with two bathrooms shall be sized for minimum 24L/S (50cfm) at the low speed and 47L/S (100cfm) at the high speed. Round 150 mm (5") diameter concentric adjustable grilles, either ceiling or wall mounted, are recommended for exhaust and supply air distribution.~~

ADD

One single model of the in-suite ERV shall be selected for serving different types of residential suites with different air flow requirements, as follows:

- Studio and one-bedroom suites – 17/33 l/s (35/70cfm) Low/High speed
- Two-bedroom suites with a single bathroom – 21/40 l/s (45/80cfm) Low/High Speed
- Three-bedroom suites with two bathrooms (or additional washroom) – 28/47 l/s (60/100cfm) Low/High speed

The low and high speed air balancing requirements for ERVs serving different types of suites must be clearly shown on the mechanical equipment schedules.

Round, concentric, adjustable grilles, either ceiling- or wall-mounted and matching sizes of distribution ducts, are recommended for exhaust and supply air distribution. Utilizing commercial-type steel grilles for termination of ventilation inlets and outlets from ERVs shall be avoided.

An ERV in a residential suite shall be ducted to all bathrooms on the exhaust side and to all bedrooms and a living area on the supply side.

In buildings with concrete construction located in the Lower Mainland or on Vancouver Island, utilize in-slab ducts for outdoor air intake and exhaust discharge. Intake ducts shall be wrapped with a reflective-type insulation **DELETE** ~~for a minimum of 6 m (20 ft) from outside wall. Where possible, maintain a minimum 1.8 m (6 ft) separation between exhaust outlets and outdoor air intakes~~ **ADD** to prevent condensation. Maintain a minimum 1 m (3.3ft) separation between exhaust outlets and outdoor air intakes. ERVs shall operate continuously at a low speed and shall automatically turn into a high speed by use of a timer switch in any bathroom.

DELETE ~~Consider providing a single ERV serving more than one residential suite and located in the common area.~~

.8 Provide residential kitchens with range hoods as per Division 11 30 00 – Equipment. A charcoal-filtered (ductless) range hood can be considered only for Passive House projects with approval from the Owner and AHJ. **ADD** Range hoods for accessible suites must be provided with low-level controls.

.9 Fresh-air intakes must be galvanized steel or aluminum **DELETE** ~~watertight hood type~~ **ADD** wall caps or weatherproof louvres with insect protection. All exhaust hoods must have a backdraft damper. Intakes must be designed to prevent rain penetration at design wind pressure for the location. Connections must be sealed to the weather barrier of the wall assembly. Each **DELETE** ~~hood~~ **ADD** wall cap or louvre must be connected to the duct it serves by durable, airtight connections. Screens must be removable for cleaning. **ADD** To prevent lint buildup, dryer exhaust ducts shall exclude any fire dampers and dryer terminations at outside walls shall exclude any screens.

ADD

.8 FILTRATION AND MITIGATION OF AIR POLLUTION

.1 Over the last few summers, air pollution from wildfires resulted in significant health impacts for many tenants in BC Housing buildings. All new and retrofit projects shall consider ways to mitigate effects of smoke pollution in the summer season.

.2 The easiest and most practical way to lessen effects of outside air pollution is to provide effective filtration of outdoor air supplied to the building.

90% of particulate mass produced by wildfires are fine particles with a median diameter of 2.5micron or less, referred to as $PM_{2.5}$. $PM_{2.5}$ particles can be transported by wind over long distances and are the most significant factor in public health concerns over pollution from wildfires.

MERV-13 filters can remove over 90% of $PM_{2.5}$ and smaller particles from outside air entering a building. Only MERV-13 filters and higher can be considered sufficient protection from wildfire smoke pollutants.

.3 All ERVs must have the option of accepting MERV-13 filters on the supply side. All new in-suite ERVs must be provided with MERV-13 filters plus two spare MERV-13 filters to be stored on-site prior to wildfire seasons.

Alternatively, all new specified in-suite ERVs can be provided with regular MERV-8 or washable filters; as well, two spare MERV-13 filters for each ERV must be stored on-site for replacing regular filters during the peak wildfire season.

.4 All larger ERVs serving non-residential areas must be provided with MERV-13 filters on the supply side plus two spares.

.5 All centralized ventilation air-handling units must be provided with MERV-8 pre-filters and MERV-13 filters plus two spares. It is recommended that the filter rack in air-handling units be specified to accept 12"-deep HEPA-type filters.

Larger air-handling units with 100% outdoor air supply should be two-speed units to allow lowering outdoor air flows in the peak wildfire season.

.6 Electrostatic filters can be considered, in some cases, for central ventilation air-handling units on new and retrofit projects.

.7 Permanent Air Purification Devices should be considered for common areas, which can act as areas of refuge during the wildfire season for additional protection.

.9 MAJOR RETROFIT PROJECTS

.1 The scope of mechanical retrofit work must be established at the very beginning of the design process. Projects involving major retrofit scope for building envelope and mechanical systems are required to conduct a whole-building ventilation and overheating assessment and implement measures to mitigate and make acceptable ventilation and indoor comfort conditions.

.2 The major mechanical retrofit options to be considered and cost-analyzed include:

- **Ventilation Upgrade for Residential Suites:**

  Ventilation of residential suites in older buildings is, typically, provided by on/off bathroom exhaust fans. This does not meet the present Code and BC Housing guideline requirements. Providing in-suite energy recovery ventilators (ERVs) should be considered. Replacing existing bathroom exhaust fans with new two-speed exhaust fans running continuously at the low speed and providing passive air intakes in bedrooms can be considered in Climate Zones 4 and 5 (but is not recommended).

- **Replacement of Corridor Pressurization Units:**

  Existing, often oversized, gas-fired corridor makeup air units, common in many older buildings, should be considered for replacement with new, smaller units of an electric or heat pump type.

- **Evaluation of Existing Domestic Hot Water (DHW) System:**

  The existing DHW system shall be evaluated and considered for replacement if coming close to the end of service life. New DHW systems shall be designed to reduce the use of gas by using low-carbon, electric-powered equipment.

- **Summer Overheating Analysis:**

  Each major retrofit project requires providing the summer overheating analysis to establish the number of overheating hours per year predicted for various zones in the building. This analysis is to provide the basis for establishing measures to improve indoor thermal comfort in residential suites. The possibility of adding passive and/or active cooling to common areas and residential suites shall be fully explored. When adding cooling to existing buildings, the existing electrical spare capacity must be considered and augmented as necessary. When whole-building cooling is not possible in an existing building, amenity and support rooms must be provided with full cooling and used as cooling rooms during heat waves. All types of possible air conditioning systems are described earlier in this section.

  Adding a cooling coil to the corridor ventilation AHU can also be considered when residential cooling cannot be implemented due to existing building conditions.

.3 Whole-building energy modelling and the summer overheating analysis, as per Section 2 Article 2.1.3 Thermal Comfort Evaluation, are required for all major retrofit projects.

.4 All major retrofit projects shall target 50% GHG emissions reduction relative to current emissions levels.

.5 Mechanical retrofit options that cannot be justified on the basis of potential energy cost savings alone shall be prioritized on the basis of end-of-service-life measures.

RENUMBER 2.7 to 2.10

.10 TENANT LAUNDRY ROOMS

DELETE

~~.1 Except where using condensing or heat pump dryers, include provisions for adequate make up air. Make up air shall match air exhausted by dryers. Consider means of heating make up air when using outdoor air. Transfer of air from surrounding areas may be used. Consider utilizing a concentric venting system (inner exhaust and outer make up air intake) as means of pre-heating make up air.~~

ADD

.1 Any common laundry room with three or more dryers must include a provision for an adequate makeup air system. Consider means of heating makeup air when using outdoor air. A passive makeup air system, terminated at the floor level behind dryers and provided with a motorized damper interlocked with dryers' operations, can be considered in Climate Zones 4 and 5.

.2 Connect exhaust dryers directly to the building exterior (outside). Do not use plastic or thin foil ducting; use rigid metal ducting. **DELETE** ~~Condensing or heat pump dryers require only a connection to a drain pipe.~~ **ADD** Provide a dryer booster fan and an external lint trap for exhaust ducts exceeding 10m (33ft) in developed length. Avoid, where possible, utilizing booster fans for in-suite dryers.

ADD

.3 Ventless heat pump dryers on specific projects such as Passive House projects (due to restrictions on envelope penetrations) and projects in extremely cold climates (to prevent increased infiltration from the outside) can be considered. The types of heat pump dryers selected must be proven for their operational reliability and must be approved by BC Housing. Condensing dryers are not accepted in BC Housing projects.

RENUMBER 2.8, 2.9 and 2.10 to 2.11, 2.12 and 2.13 accordingly [contents under these Sections remain unchanged]

3 EXECUTION

ADD

.4 CONDENSATE DRAINS

.1 Provide condensate drains for all interior fan coil or heat pump units.

.2 Avoid utilizing condensate pumps. Condensate drainage shall be provided by gravity flow.

.3 Horizontal condensate drain connections must be run with a minimum slope of 1/4" per foot (2%), unless stated otherwise by the manufacturer's recommendations, to provide positive condensate water drainage. Condensate drain connections from wall-mounted, ductless fan coil units to a common condensate riser shall avoid additional elbows restricting condensate water drainage.

.4 Any post-occupancy problems with condensate drainage must be corrected under the project's mechanical warranty.

RENUMBER 3.4 and 3.5 to 3.5 and 3.6 accordingly [contents under these Sections remain unchanged]

End of Section