

NAVIGATING BCBC 2024 OVERHEATING PROTECTION REQUIREMENTS

INDUSTRY GUIDANCE REPORT

RDH REF: 31307.000

MAY 14TH, 2025

Prepared for



Township of
Langley

By

RDH BUILDING
SCIENCE

Executive Summary

With the growing frequency and intensity of heatwaves in British Columbia (BC), the impacts on our health and safety are becoming increasingly evident. Mitigating the risks of overheating has become a top priority for health authorities and policymakers across the province.

Recognizing the significant role that residential buildings can play in both exacerbating and preventing overheating, the 2024 British Columbia Building Code (BCBC) has introduced new overheating protection requirements for residential units. These regulations apply to all new construction residential buildings seeking permitting after March 2024, including both Part 9 (small and single-family homes) and Part 3 (multifamily buildings). The code states that:

At the outside summer design temperature, required cooling facilities shall be capable of maintaining an indoor air temperature of not more than 26°C in at least one living space in each dwelling unit.

(BCBC 9.33.3.1.(2))

This requirement can be met primarily through two complimentary approaches:



Passive/Demand Reduction Overheating Protection – Measures inherent to the building design and operation that reduce cooling needs.



Active Mechanical Cooling for Overheating Protection – Building integrated mechanical systems that reduce interior temperatures through space conditioning.

The BCBC does not offer comprehensive direction on how to meet the new requirement through these approaches, nor does it provide local permitting authorities with clear criteria for assessing project applications and ensuring compliance. While this new requirement may seem brief and generic, it has the potential to significantly shift residential building design in BC. This is especially true for builders and developers who have not traditionally incorporated cooling systems into their residential projects.

This report expands on the Building and Safety Standards Branch Bulletin B24-08. The purpose of the report is to provide an overview of the new overheating protection requirements and provide recommendations based on industry standards and best practices to assist municipal officials and industry professionals with evaluation and achieving compliance. The report outlines key considerations for different building types and explains how to undertake design evaluations that align with the intent of the new requirements. While this report primarily focuses on Part 9 buildings, considerations specific to Part 3 buildings are highlighted throughout. Finally, this report also highlights how overheating protection strategies can also support meeting the energy and emissions requirements set by the BC Energy Step Code and Zero Carbon Step Code.

Glossary

Part 9 Small and Single-Family Buildings	Single family homes and other low-rise residential construction types subject to specific requirements within Part 9 of the BC Building Code.
Part 3 Multi-Unit Residential Building (MURB)	All other residential building types, including larger (i.e., outside Part 9) residential and mixed-use residential buildings.
Overheating	Occurs when the surrounding indoor temperatures exceed recommended levels for human health and safety.
Cooling Load	The amount of energy required to cool a building to a specific temperature.
Good Engineering Practice	Engineering work that follows established codes and standards, considers context specific factors, and follows best practices. A person qualified as a Registered Professional under the <i>Architects Act</i> or the <i>Engineers and Geoscientists Act</i> directly oversees the work. The BCBC requires good engineering practice for Part 3 buildings and allows it as an option for complying with Part 9 requirements for overheating protection.
Heat Gain Reduction	General best practice design strategies that mitigate how much heat gain the building receives due to its exposure, shape, materials, and shading. Distinct from <i>passive overheating protection</i> strategies.
Passive Overheating Protection	Specific building design and operation strategies used to lower cooling demand and limit rising indoor temperatures. As distinct from “passive cooling” which is considered a misnomer for the purposes of this report.
Mechanical Cooling	Active mechanical systems that reduce/maintain sufficiently low interior temperatures.
Dedicated Mechanical Cooling	Active mechanical cooling systems that are integrated into the building (e.g., mini-split heat pumps).
Temporary Mechanical Cooling	Active mechanical cooling that is not integrated with the building (e.g., portable air conditioners).
Full Cooling	Active cooling provided to always maintain sufficient comfortable temperatures throughout an entire dwelling unit.
Partial Cooling	Active cooling provided to always maintain sufficient comfortable temperatures under non-extreme conditions or for a select area within a dwelling unit.
Cooling Zone	A single living space with mechanical cooling equipment that can maintain conditions below a maximum temperature of 26°C.

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1 Addressing Overheating in New Residential Buildings

1.1 BCBC 2024 Overheating Protection Requirements

Hot summer weather, heat waves, and heat domes (collectively referred to as heat events) are becoming increasingly intense and frequent in BC and across Canada. As a result, regulatory bodies and the broader building industry are shifting their approach to address building overheating as a life safety concern.

In response, the 2024 updates to the British Columbia Building Code (BCBC) introduced new requirements for cooling in residential buildings¹. Residential projects applying for permits under the BCBC after March 2024 must comply with the following:

Part 9 (small and single-family homes):

At the outside summer design temperature, required cooling facilities shall be capable of maintaining an indoor air temperature of not more than 26°C in at least one living space in each dwelling unit.

(BCBC 9.33.3.1.(2))

Part 3 (multi-family and mixed-use residential buildings):

Indoor design temperatures for residential buildings shall be those established in Article 9.33.3.1.

(BCBC 6.2.1.1.(2))



Figure 1.1: Example mini split heat pump condenser placement for a Part 9 single family home (left) and a low-rise Part 3 multi-unit residential building (right).

¹ Similar overheating protection requirements are also anticipated in upcoming 2025 revisions to the National Building Code and the Vancouver Building Bylaw, aiming to maintain overall consistency in the regulatory language.

1.2 Why This BCBC Update Matters

Cooling and overheating protection has not traditionally been a design or code compliance priority in BC’s construction industry. However, a changing climate has demonstrated that inadequate provisions for cooling in buildings can have deadly consequences.

Following the BC heat dome event in Summer 2021, the report to the Chief Coroner on overheating deaths² confirmed that 619 people died due to extreme heat. The vast majority (98%) of these deaths occurred inside, within residences, and of those 93% of the dwelling units did not have active mechanical cooling (i.e., air conditioning). The Chief Coroner’s report emphasized prevention and risk mitigation strategies as critical to reducing heat-related deaths. Prior to the 2024 BCBC updates, there were no overheating protection provisions for Part 9 residential buildings and requirements for Part 3 buildings primarily focused on limiting occupant discomfort to no more than 200 hours per year. Now, with a prescriptive maximum indoor temperature requirement in place, Authorities Having Jurisdiction (AHJs) will play a crucial role in ensuring that new residential buildings provide adequate overheating protection as a fundamental life safety measure.

1.3 Guidance for Industry

The new BCBC language for overheating protection provides the high-level design requirement to maintain no more than 26°C in at least one living space in a dwelling unit. However, as a Code document, the BCBC does not explicitly provide designers and local permitting authorities with clear criteria on how projects can demonstrate compliance.



Further clarifications and additional intent have been provided by the Province in **Bulletin B24-08**³. This report builds on the information in the Bulletin to provide a more extensive understanding of the new overheating protection requirements and provide recommendations based on industry standards and best practices that assist the Authority Having Jurisdiction (AHJ) and industry professionals with achieving compliance. This report outlines key considerations for different building types and explains how to carry out design evaluations that align with the intent of the BCBC requirements.



While the primary focus is on Part 9 residential buildings, this report also includes general considerations for Part 3 buildings, highlighted in text boxes like this throughout.



This report also includes key compliance considerations and guidance on potential challenges for designers, builders, and Building Officials, highlighted in text boxes like this throughout.

² Report to the Chief Coroner of British Columbia, 2022, “Extreme Heat and Human Mortality: A Review of Heat-Related Deaths in BC 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)

³ Building and Safety Standards Branch, 2024, “Information Bulletin: Protection from Overheating in Dwelling Units”, https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/construction-industry/building-codes-and-standards/bulletins/2024-code/b24-08_overheating.pdf

2 Where to Start – Designing for Overheating Protection

2.1 Overheating Sources

Overheating occurs when occupants within a space are exposed to prolonged high temperatures that lead to serious health and safety risks. While the risk threshold may differ for everyone, the BCBC uses 26°C as the maximum interior temperature. There are many sources of heat that can contribute to overheating in a building, as noted in **Figure 2.1**.

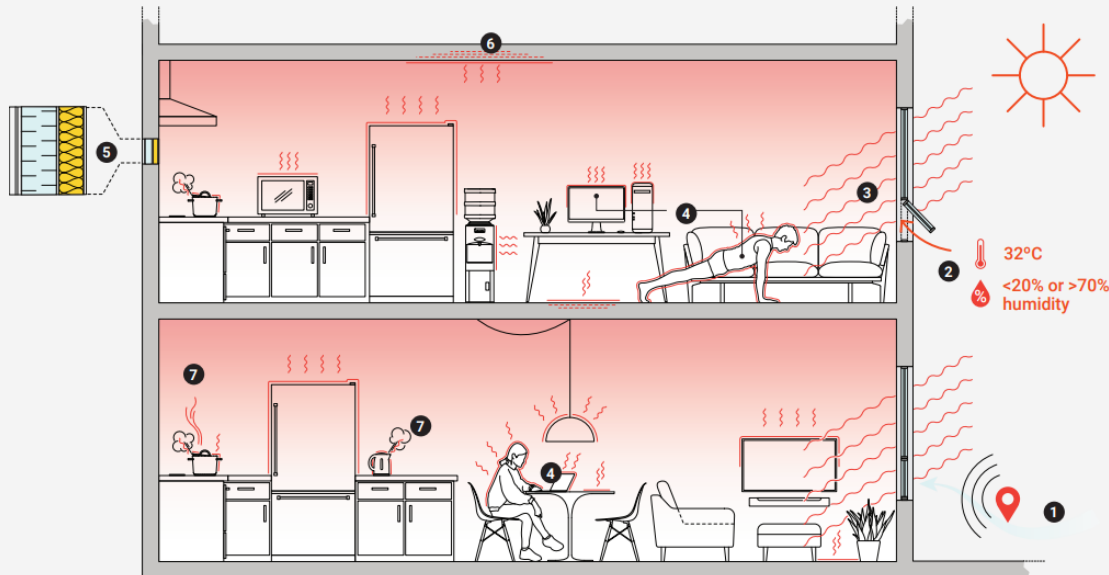


Figure 2.1: Sources of Interior Heat Gains, source: BC Housing, 2019, “BC Energy Step Code Design Guide Supplement S3 on Overheating and Air Quality”

- 1** Contextual or situational factors that prevent occupants from opening their windows (e.g. noise, pollution, poor outdoor air quality)
- 2** High external temperatures and/or extreme humidity levels
- 3** Internal heat gains via incoming solar radiation through the building glazing
- 4** Internal heat gains from lighting, equipment, occupants and occupant activities
- 5** High wall and roof insulation and/or building airtightness that retain internal heat gains
- 6** Absorption of heat by the buildings structure that create high surface temperatures
- 7** Lack of adequate ventilation that could assist in cooling

2.2 Designing for Demand Reduction First

While the BCBC does not explicitly require cooling demand reduction by design, it is best practice to **prioritize reducing the cooling demand instead of relying solely on mechanical cooling.**



Cooling Demand Reduction means using measures inherent to the building design and operation that reduce cooling needs of the building (e.g., building orientation, shading). It is an effective way to help meet the overheating protection requirements, whether used alone or in combination with mechanical cooling.

For more information on designing for reduced cooling demand, see Section 4.1 Cooling Demand Reduction Measures on page 19.

Prioritizing cooling demand reduction offers several key advantages:

- **Lower Mechanical Sizing and Costs:** By minimizing unnecessary heat gains in a building's interior spaces, the cooling load (i.e., energy used for cooling) required to keep indoor temperatures below 26°C can be significantly reduced. This allows for the installation of smaller cooling systems, reducing mechanical system footprint, and lowering overall costs.
- **Improved Resilience:** Mechanical cooling should not compensate for poor building design that would otherwise lead to excessive overheating. A mechanical cooling system may meet the BCBC requirements, but over-reliance on cooling increases health and safety risks if the system fails. In buildings with high heat gains and minimal passive cooling measures, mechanical cooling failure or power outages could cause indoor temperatures to quickly exceed 26°C.
- **Enhanced Energy Efficiency:** Reducing heat gains also supports compliance with the BC Energy Step Code and Zero Carbon Step Code by lowering the energy needed to condition the building. Many heat gain reduction strategies can also improve heating efficiency.
- **Consistency in Demand:** Lower cooling demand ensures more stable interior conditions, even when outdoor temperatures fluctuate, such as from a cool night to a hot morning. Buildings designed for lower cooling demand reduce the strain on mechanical systems by preventing spikes in cooling loads (see **Figure 2.2**). This results in more consistent indoor comfort.

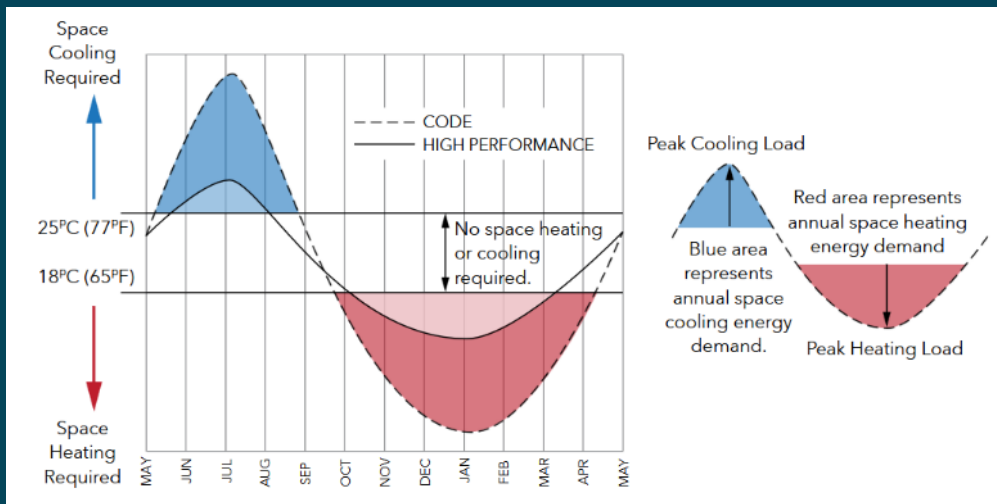


Figure 2.2: Example cooling and heating demands between a typical design and demand reduction (high performance) focused design, source: University of Toronto, 2019, "Thermal Resilience Design Guide"

2.4 Full Cooling Versus Partial Cooling

Another key design consideration is the quantity of overheating protection space included in the dwelling unit. If all areas of a dwelling unit are equipped with sufficient cooling, the unit is considered to have **Full Cooling**. This approach will meet the BCBC requirements while also providing comfort benefits to the occupants. However, the BCBC overheating protection provisions specify that only at least *one living space* per dwelling unit (including secondary suites and multi-plexes) must be capable of maintaining a maximum indoor temperature of 26°C.

In dwelling units where there is only one space or room designed to maintain the maximum temperature of 26°C, the unit is considered to have **Partial Cooling** and the designated space may be referred to as a **Cooling Zone**. A Cooling Zone must be an intentionally designated living space within the dwelling unit, not a utility or storage area. Common areas can not be Cooling Zones because they are not part of an individual dwelling unit. Further considerations for the Cooling Zone are outlined in Section 3 and Section 6 of this report.

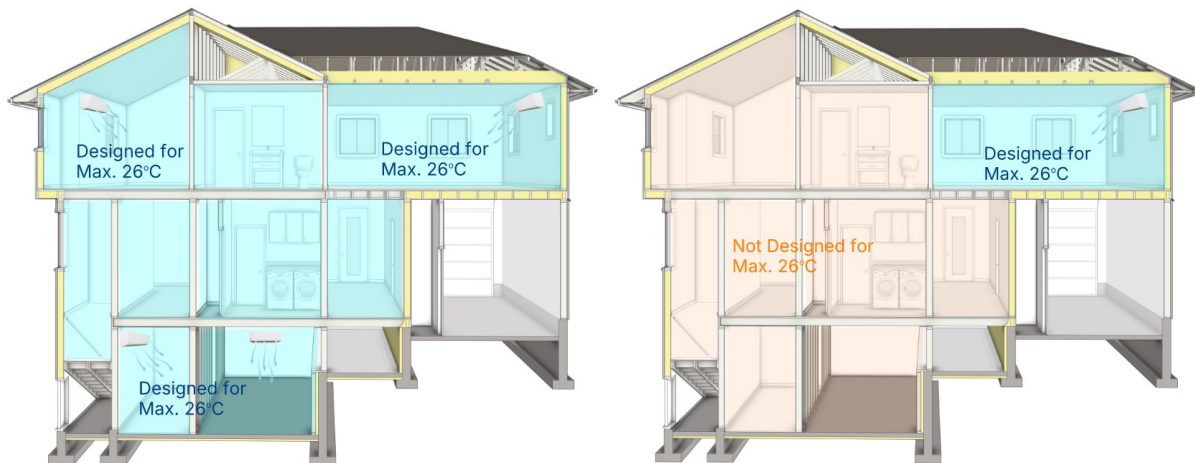


Figure 2.3: Full Cooling (left) vs Partial Cooling using a Cooling Zone (right), both acceptable for BCBC 2024 overheating protection compliance using mechanical cooling .

3 Compliance Pathways for Overheating Protection

This section discusses design parameters and limitations for overheating protection design. This information is based on **Bulletin B24-08**, as well as best practices for overheating protection design from various sources (see also Additional Resources on page 34).

3.1 General Approach for Compliance

Compliance with the BCBC overheating protection requirements must be demonstrated through specific evaluation procedures. As noted in the previous section, it is best practice to prioritize reducing the cooling demand with building design strategies, which are outlined in Section 4. From there, there are two primary compliance pathways (**Figure 3.1**). The appropriate compliance pathway is determined by whether mechanical cooling is included in the dwelling unit.



Exactly how code compliance is demonstrated to the authority having jurisdiction (AHJ) is established by each local government. Implementation of code compliance processes through policies and bylaws should be done in consultation with their insurer and legal counsel.

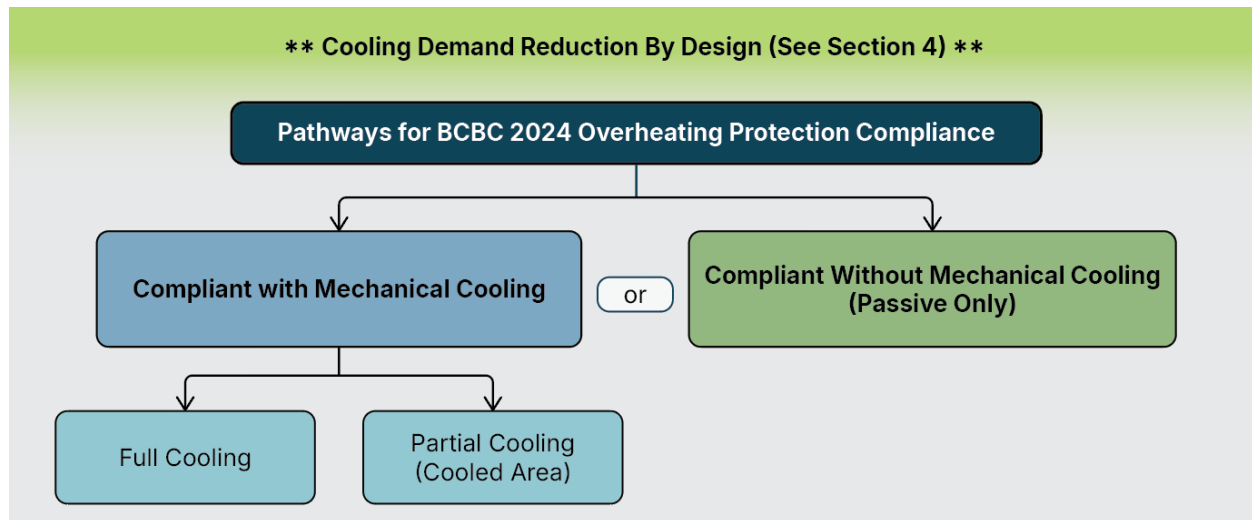


Figure 3.1: Compliance pathways for meeting the overheating protection requirements in the BCBC 2024

Note that a building designed with full cooling from an electric heat pump system already has all or most of the components needed to provide full heating using the same heat pump system. See Section 5.2 Other Benefits of Installing Heat Pumps on page 24 for more information on how the compliance pathways for overheating protection requirements and the Zero Carbon Step Code coincide.

3.2 Compliant With Mechanical Cooling

A mechanical cooling approach achieves compliance with the BCBC overheating protection requirements when each dwelling unit has mechanical cooling equipment that is integrated and permanently installed and sized for the space(s) it serves.



Active Mechanical Cooling for Overheating Protection – Building integrated mechanical systems that reduce interior temperatures through space conditioning.

Considerations for Part 3 Buildings

The sizing and design of mechanical cooling systems in Part 3 buildings use industry standards and proprietary software in accordance with “good engineering practice” as listed in BCBC 6.2.1.1.



Part 3 mechanical design is always provided by a Registered Professional, and the indoor design temperature must be at most 26°C (see Section 1.1 BCBC 2024 Overheating Protection Requirements on page 5 and Section 3.4 Compliance for Part 3 Buildings on page 16). Otherwise, the same compliance requirements apply for full versus partial cooling for Part 3 buildings as for Part 9 buildings, as outlined in this section. Section 3.4 Compliance for Part 3 Buildings on page 16 outlines further compliance considerations.

Full Mechanical Cooling for Part 9 Residential Buildings

Peak cooling capacity calculations for overheating protection of individual Part 9 residential dwelling units must follow a modified CSA standard F280-12 *Determining the Required Capacity of Residential Space Heating and Cooling Appliances* (referred to in this report as CSA F280) per BCBC 9.33.5.1. This standard allows for calculations using spreadsheet data entry and analysis and/or hand calculations; however, there are numerous CSA F280 software programs that can assist designers⁴. It is used for sizing cooling equipment located in a dwelling unit and serving only that dwelling unit. CSA F280 calculations for full mechanical cooling do not require a Registered Professional. If another sizing procedure is used, it would need to be provided by a Registered Professional.

The CSA F280 heat loss and heat gain calculations account for heat transfer caused by conduction through the building enclosure, radiation through windows, skylights, and glazed doors, convection due to air leakage, and interior heat gains from occupants, lights, and appliances. The calculations are based on indoor and outdoor design temperatures. The results of the CSA F280 calculations determine the peak heating and cooling loads of the building. That is, a CSA F280 load calculation simply shows the minimum heating and cooling capacities that the mechanical system(s) need to have to maintain the given indoor temperature at peak loads (i.e., during winter or summer outdoor design temperatures). Results are typically in terms of minimum kilowatts (kW) or British thermal units (BTUs).

The CSA F280 output values are then used for minimum sizing of the mechanical equipment. Note that CSA F280 does not dictate mechanical system specifics such as efficiencies, the distribution approach, how the equipment is installed, or commissioning and controls. Furthermore, CSA F280 is not an energy modelling or thermal comfort tool and does not explicitly calculate overheating metrics. BCBC 9.33.4.1. outlines other applicable industry standards that would apply, and CSA SPE-17:23 HVAC Guide for Part 9 Homes is also a useful reference.

⁴ Approved and verified F280-12 Software, HVAC Designers of Canada, <https://hvacdc.ca/f280-12software/>

To demonstrate overheating protection using CSA F280 calculations with full mechanical cooling, two modifications are required: the indoor design temperature must be increased from default 24°C to 26°C, and the mechanical system capacity must be at least 100% of the cooling load, instead of the default 80%. Sizing to at least 100% capacity is needed to ensure the equipment can maintain the indoor design temperature. Using a lower indoor design temperature and sizing to 100% is also acceptable.



Section 743 of the Local Government Act provides statutory immunity for local governments that accept submissions from Registered Professionals. However, no immunity is provided for reliance on non-professional confirmations of compliance. Note that sizing of full mechanical cooling systems that serve more than one dwelling unit likely require a Registered Professional.

For more information on the compliance process for BCBC 9.33.3.1. overheating protection with full mechanical cooling, see Section 6 Considerations for Permitting Authorities on page 30.

Procedure for Showing Compliance with Full Mechanical Cooling

1. Use a CSA F280 software or calculation tool verified by the HVAC Designers of Canada.
2. Conduct CSA F280 sizing output calculation with the following modifications and specifications:
 - a. Indoor design temperature (cooling setpoint) 26°C or lower
 - b. Exterior temperature per requirements of the Authority Having Jurisdiction, otherwise as per the July 2.5% dry temperatures from the Climatic Values in Appendix C of Div. B of BCBC.
 - c. No accounting for interior operable blinds, but can include the influence of exterior shades
3. Provide a summary report, noting the Total Building Value (100% capacity) for heat gain used for output sizing rather than Minimum Installed Output Capacity (80% capacity).

OR

Conduct an evaluation and reporting of the cooling design as per good engineering practice by a Registered Professional, following Part 6, Division B of BCBC, with the same indoor design temperature and sizing requirements met. This also applies to Part 3 buildings and Part 9 buildings with mechanical cooling that serves more than one dwelling unit.

Partial Mechanical Cooling for Part 9 Residential Buildings

A mechanically cooled Cooling Zone approach achieves compliance with the BCBC overheating protection requirements when:

1. All mechanical cooling units are integrated, permanently installed, and sized for the spaces they serve, including the appropriate occupant load (see below).
2. The Cooling Zone can accommodate all the dwelling unit's occupants for an extended period.
3. Cooling Zone is a living space designed for occupancy (i.e., not an unfinished basement, service rooms, crawlspaces, or ancillary spaces), and are not overly restrictive (e.g., closets, bathrooms, laundry rooms).
4. The Cooling Zone also meets adaptability/accessibility requirements when the dwelling unit is designed as an adaptable unit.

In buildings with a secondary suite or other dwelling units (e.g., duplex, townhouse grouping, or multi-unit residential building), each dwelling unit must be assessed separately and comply with overheating requirements per BCBC 9.33.3.1.(2).

The cooling load sizing inputs and calculations for overheating protection of a Cooling Zone will vary significantly from those of a whole building, including individual rooms in a whole-building assessment. As the Cooling Zone is expected to accommodate all occupants of a dwelling during heat events, the assessment will include a higher occupant load than standard sizing considerations and therefore will have higher internal heat gain when compared to a whole-building calculation where occupants are assumed to be distributed throughout. Specific guidance on calculating the occupant load for the Cooling Zone is provided in the forthcoming *Guideline on Single Zone Cooling in Dwelling Units*, jointly published by HVAC Designers of Canada and the Thermal and Environmental Comfort Association (TECA).

Similar to the full mechanical cooling compliance, a dwelling unit with a Cooling Zone may achieve overheating protection compliance through either a CSA F280 analysis or by Registered Professional design.

For more information on the compliance process for BCBC 9.33.3.1. overheating protection with partial mechanical cooling, see Section 6 Considerations for Permitting Authorities on page 30.

Procedure for Showing Compliance with Partial Mechanical Cooling

1. Identify at least one space in the home to be the Cooling Zone.
2. Use an approved CSA F280 sizing software output calculation for overheating protection on a standalone model of the Cooling Zone. Follow the modelling and calculation guidelines in the forthcoming *Guideline on Single Zone Cooling in Dwelling Units*, jointly published by HVAC Designers of Canada and the Thermal and Environmental Comfort Association (TECA). Additional guidance is provided in the *Indoor Design Temperatures - Overheating Protection* bulletin published by the Township of Langley.

OR

Conduct an evaluation and reporting of the cooling design as per good engineering practice by a Registered Professional, following Part 6, Division B of BCBC, with the same indoor design temperature and sizing requirements met. This also applies to Part 3 buildings and Part 9 buildings with mechanical cooling that serves more than one dwelling unit.

3.3 Compliant Without Mechanical Cooling - Passive Only Approach

Note that Part 9 residential buildings are assumed by default to have a mechanical cooling system, as per existing BCBC stipulations:

Except where [CSA F280 sizing or good engineering practice] can show it to be unnecessary, dwelling units...shall be equipped with cooling facilities conforming to this Section.

(BCBC 9.33.2.1.(2))

In limited locations with low cooling demand, it may be possible to maintain interior dwelling temperatures below 26°C without using mechanical cooling. The Passive Only approach relies on building design elements and limited non-cooling mechanical systems to prevent overheating. This report assumes that Part 9 residential buildings with no mechanical cooling may only achieve overheating protection compliance with Registered Professional oversight. **If a dwelling will be known to house vulnerable occupants (such as seniors, supportive housing, etc.), active mechanical cooling is strongly recommended, regardless of location.**

To appropriately determine the overheating risks and compliance for projects with no mechanical cooling, the design must be validated through modelling (or equivalent engineering evaluation) based on **hourly weather data and calculations**. This is the typical approach used for Part 3 residential buildings, with general procedures for overheating analysis set out in Section 4 of the City of Vancouver Energy Modelling Guidelines. These procedures are not explicitly intended for Part 9 residential projects but can still be utilized for this level of analysis. The procedures contain specific assumptions for what should and should not be included in the modelling related to passive measures (see Section 3.4 for further information).



Considerations for Part 3 Buildings

Overheating protection without mechanical cooling in Part 3 residential buildings also requires validation through modelling. See Section 3.4 Compliance for Part 3 Buildings on page 16 for further compliance considerations.

As the modelling is only intended to evaluate overheating, it may not be necessary to model the entire dwelling. Instead, either the “worst case” location (e.g., a south-facing bedroom) or the designated Cooling Zone may be modelled as an independent single zone. A satisfactory “worst case” room evaluation can serve as an assessment for the whole dwelling. The model may also be a useful tool for refining the impact of cooling demand reduction strategies, such as adjusting window performance or shading.

Energy modelling programs that are typically used for Part 9 buildings (e.g., HOT2000 and PHPP) have limited cooling design information. These programs use monthly weather averages for energy calculations and assume a whole building average for interior conditions. The programs cannot provide a direct zonal analysis within the building, except for peak loads in a room-by-room analysis. As a result, these programs cannot provide a thorough assessment of overheating risks.

Supplementary programs (e.g., DesignPH), can assist in optimizing a design for cooling demand reduction measures, such as orientation, shading, and glazing layouts; however, these supplemental programs cannot directly determine if the dwelling or a specific space can maintain 26°C.



PHPP provides an estimate of the number of overheated hours and version 10 of the software has an integrated summer stress test. However, the outputs are an estimate based on average monthly temperatures and should not solely be relied upon to determine if cooling is necessary.

For more information on the compliance process for BCBC 9.33.3.1. overheating protection with passive cooling only, see Section 6 Considerations for Permitting Authorities on page 30.

Procedure for Showing Compliance Without Mechanical Cooling

Conduct an overheating analysis, following the EGBC/AIBC Joint Practice Guidelines for Whole Building Energy Modelling Services. A Registered Professional must conduct or oversee the analysis.

1. Use an appropriate hourly modelling software, validated to ASHRAE 140. Ideally, this can capture exterior shading effectively or if not, another other supplementary analytical program is needed.
2. Conduct an overheating analysis following the modelling procedures as per the City of Vancouver Energy Modelling Guidelines (EMGs). Include assumptions for schedules and loads (supplemented by Section 4 of EMGs for overheating analysis) and the following:
 - a. Exterior temperature per the requirements of the Authority Having Jurisdiction, otherwise per the July 2.5% dry bulb temperatures from the Climatic Values in Appendix C of Div. B of the BCBC.
 - b. Exterior enclosure assemblies modelled as proposed and connected to the appropriate temperature boundaries. The zoning/cooling area modelled as per professional judgement.
 - c. Do not include user driven passive cooling strategies, such as natural ventilation from operable windows and operable shades.
3. Provide a sealed report that includes inputs, assumptions, results and clear summary statement to indicate that the Passive Only cooling approaches as designed and modelled can maintain at most 26°C in each dwelling unit.

3.4 Compliance for Part 3 Buildings

Part 3 compliance follows good engineering practice for cooling design and equipment sizing. Current BCBC Part 10 requirements for building energy modelling include reference to the City of Vancouver Energy Modelling Guidelines (EMGs) which further define objectives for overheating analysis and overheating protection. At the time of this report, Version 2.0 of the EMGs is referenced in the BCBC 2024.

The EMGs outline the design requirements for thermal comfort in buildings without or with partial mechanical cooling, following ASHRAE 55-2010 *Thermal Environmental Conditions for Human Occupancy* (ASHRAE 55). ASHRAE 55 uses “acceptability limits” to determine thermal comfort based on a variety of conditions. This includes a threshold of allowable hours over the comfort limits, defined by each AHJ, typically a maximum of 200 hours for average populations and 20 for vulnerable populations.

ASHRAE 55 guidelines do not require 26°C to be set as the maximum indoor temperature, which is allowed to fluctuate by location and by month based on the following equation:

Upper 80% Acceptability Limit (°C) = $0.31 \times \text{Average Monthly Air Temperature} + 21.3 \text{ °C}$

Per Bulletin B24-08, following the acceptability limits for overheating hours alone is not acceptable for determining compliance with the Passive Only and Cooling Zone approaches. The explicit 26°C maximum must be maintained. However, the EMGs are still relevant, particularly for modelling surrounding living spaces in the Cooling Zone approach.

In general, building energy models used for energy compliance modelling alone are not appropriate for determining overheating protection requirements. Energy models will typically use averaged temperature values to evaluate how much energy a building will use over the course of a year. Modelling to determine overheating is different because it must consider the building conditions under extreme outdoor temperatures and, in the case of a Cooling Zone, higher occupant load concentration.

Note, the draft Version 3.0b of the EMGs (not yet formally adopted by the Province or applicable to the BCBC 2024 at the time of this report) includes provisions for fully cooled buildings to also report an estimate of overheating hours with all mechanical cooling systems disabled to quantify the building’s resiliency and encourage further demand reduction measures. It also requires that overheating analyses use 2050 future weather files among other specific modelling assumptions to be incorporated, including:

1. Operable windows are opened when indoor air temperature is >24°C.
2. Operable windows are closed when outdoor air temperature > indoor air temperature.
3. Patio doors are not to be used for passive cooling demand reduction.
4. Interior blinds/shades are not to be modelled.
5. Operable exterior shades are deployed when indoor air temperature is >24°C.
6. Operation of bathroom exhausts, and boost modes for ventilation systems, for the purpose of reducing space temperature is only permitted when there is a documented plan to educate occupants on how to use these features for this purpose.
7. The use of range hoods for passive cooling demand reduction is not permitted

As the overheating provisions are intended to be for each dwelling unit, the procedures for modelling a “worst-case” suite (see Section 3.3) should be considered as generally applicable to evaluate for every suite in a multi-unit building.

3.5 Additional Best Practices and Optional Analysis

Outdoor Summer Design Temperature – Future Climate Files

The outdoor summer design temperature is a crucial input in cooling sizing calculations. BCBC 9.33.3.1.(2) and 6.2.1.1.(2) both indicate that, unless a different value is set by the authority having jurisdiction (see BCBC 1.1.3.1.), the 2.5% July dry temperature per Appendix C of the BCBC is to be used.

While the July 2.5% dry temperature may be an appropriate reference point for typical hot summer weather, it may not accurately represent outdoor temperatures that can occur during extreme heat events. Consider that the deadly 2021 Heat Dome resulted in extended periods with the outdoor temperatures well above the current BCBC Appendix C 2.5% July dry bulb temperatures across the province.

This, combined with projected changes in the climate, can mean the current code minimum outdoor summer design temperature used for determining overheating protection requirements may not be appropriate. This is especially true for locations where the 2.5% July dry temperature is below 26°C. Therefore, individual authorities having jurisdiction may choose to require a higher design temperature as part of their compliance pathway, such as those of nearby locations with higher 2.5% dry bulb temperatures or future weather files (see Section 3.4). Further research may be required to determine if and to what extent higher design temperatures should be used for each jurisdiction across BC. **Note that AIBC and EGBC practice guidelines indicate Registered Professionals must consider future climate impacts in design, which may include higher design temperatures.**

Internal Heat Gains and Mechanical Oversizing

Internal heat gains are a significant driver of cooling demands and are largely the result of occupants and their behaviour within a dwelling unit. Sizing standards typically provide default assumptions for interior heat gains; however, these may not be appropriate for all occupants or occupant types in evaluating overheating risks, especially in a Passive Only approach. For instance, it is not uncommon for a dwelling to support a larger number of occupants than the number of bedrooms, or certain occupants may have higher than typical equipment use, such as chest freezers or computers. This can result in over- or underestimating actual cooling demands in a dwelling.

If a mechanical system is significantly over- or undersized compared to the actual cooling demands in situ, this will result in sub-optimal system operations. This may result in lower efficiency, higher utility usage, and premature wear and tear on the system.

A specific mechanical design cannot be perfect for every occupant situation, as behaviours, number of occupants and other equipment in a dwelling unit can vary significantly over the lifespan of a cooling system. As the overall intent of the overheating protection stipulations in BCBC is to reduce overheating risks, it may be prudent to test higher than expected interior heat gains during the summer for comparison to best understand what the optimal design may be.

Other Overheating Mitigation Analysis Strategies

Previous studies, including *Future Climate Design for Multi-Family Buildings*, commissioned by the University of British Columbia, provide additional analysis measures that could be incorporated into overheating protection evaluations. These may provide further methods to improve building climate resilience through design. Please see Additional Resources for further information.

4 Considerations for Passive and Cooling Demand Reduction Strategies

The following section highlights common strategies for reducing a dwelling unit's cooling needs, which should be prioritized before incorporating mechanical cooling. Many demand reduction measures are fundamental to the architectural approach and should be considered early in the design process. **Figure 4.1** shows examples of common strategies. In some regions of the province, these measures alone may be sufficient to meet the BCBC overheating protection requirements without additional active cooling. However, no one measure is likely to meet the requirements on its own, and compliance would need to be verified using the procedures outlined in Sections 3 and 6 of this report. This section provides general information on passive and cooling demand reduction strategies; please see Additional Resources for more detailed information on any of the concepts presented here.

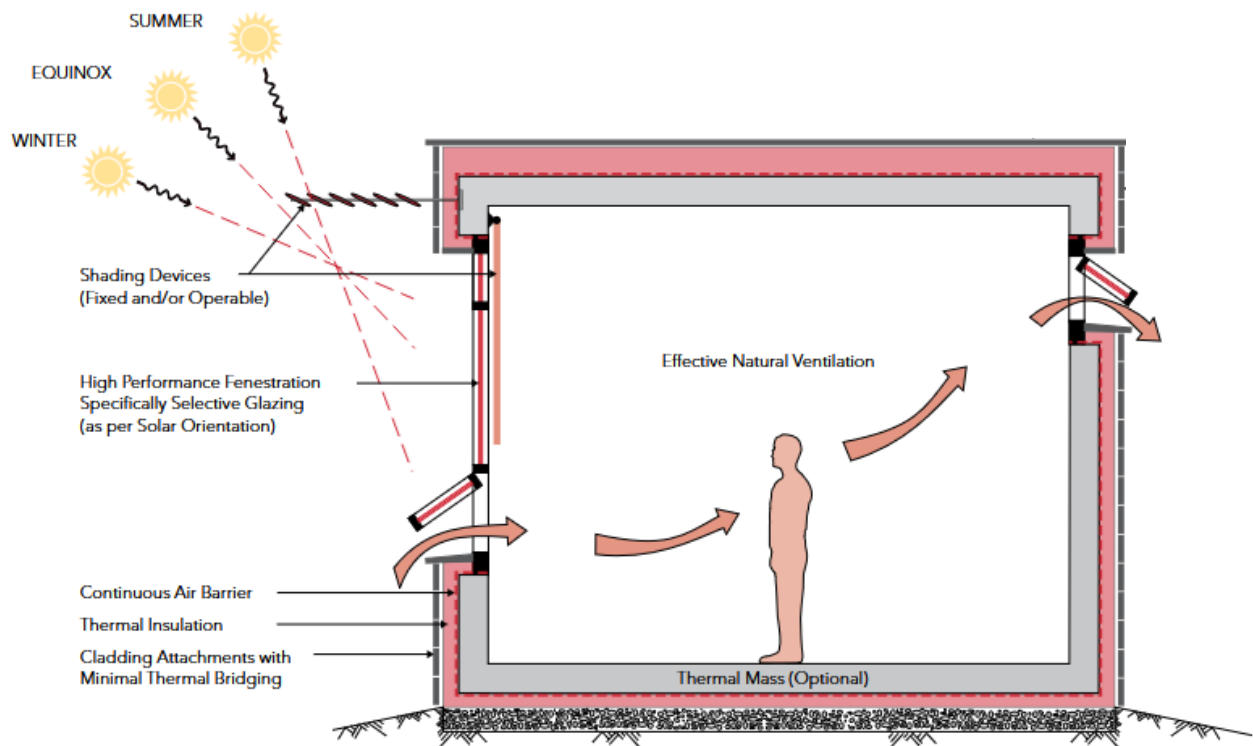


Figure 4.1: Example strategies for passive and cooling demand reduction, source: University of Toronto, 2019, "Thermal Resilience Design Guide"



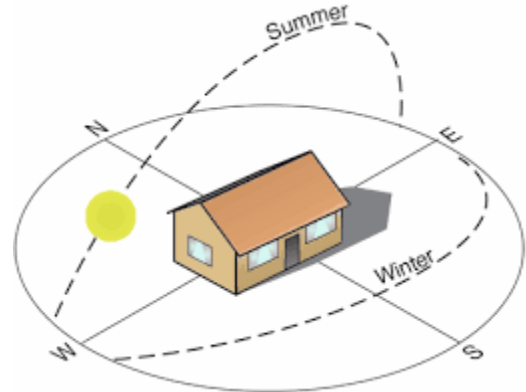
Considerations for Part 3 Buildings

The impact of cooling demand reduction strategies in larger buildings must be carefully considered because occupant behaviours that affect interior heat gains can differ significantly compared to small and single-family buildings. The implementation of these strategies will always be overseen and evaluated by a Registered Professional.

4.1 Cooling Demand Reduction Measures

Building Orientation and Form

Selecting a building's position on a site is key to help promote other passive measures. When possible, effective passive solar design orients a building to maximize solar gain in the winter while minimizing it in the summer, optimizing indoor comfort and energy efficiency. The building form can also be utilized to promote cross flow for natural ventilation. The ideal building orientation varies by site and is influenced by factors such as building form, surrounding structures, and AHJ zoning and planning requirements.



Exterior Shading

Exterior shading helps block or reduce solar radiation before it enters the building. Shading the south elevation is particularly effective due to its high sun exposure and shading the east and west façades protects from the low-angle summer sun. In dense urban areas, buildings may be significantly shaded by other buildings. Whereas in open terrain, buildings may be very exposed, and tall buildings have little opportunity for shading from landscaping beyond their first or second floors.

Common exterior shading strategies include building overhangs, balconies, fins, screens, and landscaping elements such as trees and tall shrubs. Beyond providing shade, trees and plants also contribute to local cooling through evaporative processes, further enhancing a building's passive overheating protection.



Interior window shading (e.g., blinds and curtains) is not an effective strategy for reducing solar heat gain in the context of overheating protection. Once solar energy passes through glazing and reaches interior blinds, it is already inside the living space and effectively trapped, contributing to indoor heat buildup. Additionally, the effectiveness of interior shading depends on occupant behavior, making it an unreliable overheating protection measure.

Optimized Glazing

Windows have a significant impact on interior heat gains due to solar radiation. Sunlight entering through glazing can extend deep into a dwelling space and significantly increase indoor temperatures, especially when exterior shading is absent. The following should be considered with any glazing design:

- Optimize window to wall ratio and layouts, with considerations for minimizing unshaded windows on the south, east, and west façades to reduce direct sun exposure in the summer.
- Glass coatings with a low solar heat gain coefficient (SHGC) can regulate solar energy transmission. A balanced approach will reduce heat gain in summer while still allowing passive solar heating in winter. BC Housing design guidelines a SHGC of between 0.27 and 0.33⁵.
- Triple-glazed insulating glass units (IGUs) and low-U-value glazing help mitigate heat gain and can enhance energy efficiency.

⁵BC Housing, 2019 "Design Guidelines and Construction Standards" <https://www.bchousing.org/publications/BCH-Design-Guidelines-Construction-Standards.pdf>

Airtightness and Thermal Insulation

An airtight enclosure helps prevent heat from entering through uncontrolled air leakage, while thermal insulation slows conductive heat transfer through the roof, exterior walls, and foundation. A high-performance building—one that is airtight, highly insulated, and designed to minimize thermal bridging—will experience significantly reduced heat transfer from the exterior to the interior, resulting in lower overall heat gains.

Additionally, hot water piping can be an overlooked source of internal heat buildup, particularly in dwellings where occupants frequently use hot water. To minimize this effect, hot water pipes should be insulated, including at elbows and junctions, to reduce unwanted heat release into living spaces.

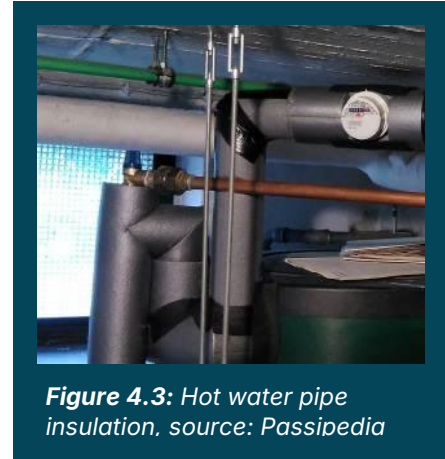


Figure 4.3: Hot water pipe insulation, source: Passipedia



Airtightness and thermal insulation can trap heat that has already reached the interior or was generated inside the building. High performance buildings are most effective at reducing overheating risk when they incorporate multiple design strategies to reduce sources of heat gain.

Cladding Materials and Thermal Mass

Cladding materials can impact how much solar gain is absorbed or reflected by a building. Darker colours will retain more heat than lighter-coloured materials and cladding materials with high reflectivity (albedo) will reflect more solar radiation. Specific cladding or finish systems, such as green roofs, can even perform like an additional insulation layer. Cladding materials that reflect more solar radiation also help reduce the urban heat island effect. Some cladding materials have additional considerations. For example, green roofs increase the risk of leaks and light-coloured roofs lower cooling load in the summer but increase heating load in the winter.

Materials with high thermal mass, such as concrete and brick, can absorb and retain heat large amounts of heat. Thermally massive materials can help regulate interior temperatures and reduce heating loads in the winter. However, these materials have the potential to negatively impact interior summer temperatures if not placed strategically. It is recommended that large areas of above-grade concrete are shaded from solar exposure during the summer.

Natural Ventilation and Night Cooling

Breezes and air movement through open, operable windows and doors can flush out built-up interior heat and improve comfort, especially when there are cooling summer evenings.

Operable windows are a requirement for most living spaces and are referred to in Part 9 to achieve “natural ventilation” in the non-heating season. However, to achieve effective natural ventilation, operable systems need to be strategically placed to allow for air cross flow through a dwelling unit.

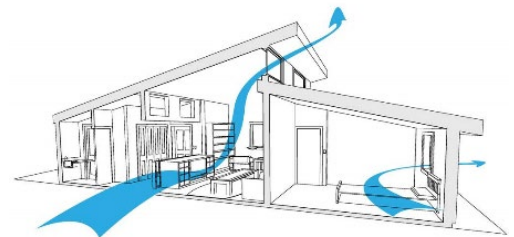


Figure 4.4: Cross Ventilation, Source: Vertical Studio



During heat events, open windows can increase the indoor temperature, especially if outdoor temperatures are above 26°C. While it is good practice to incorporate operable windows, **natural ventilation cannot be used in demonstrating compliance with the BCBC overheating protection requirements**, as it is assumed windows will be closed during heat waves and peak exterior temperatures.

Considerations for Part 3 Buildings



Natural ventilation can be very difficult to achieve in buildings with double loaded corridors. Aside from corner or multi-story units, the typical layout provides little opportunity for cross flow. Unit articulation can assist in creating more opportunities for cross flow within a single suite but should not be relied upon without thorough evaluation.

Mechanical Ventilation

There are several types of mechanical systems that can reduce cooling demand reduction without actively conditioning a space. These include ceiling fans, exhaust fans and heat recovery ventilators (HRVs) with summer bypass mode. Rather than providing active cooling, these systems are often installed as part of the building's ventilation approach and assist in cooling demand reduction by removing warm indoor air and replacing it with cooler outdoor air.



HRVs are typically used to exchange heat from warm outgoing exhaust air to incoming ventilation air in colder months to reduce energy use and improve comfort. When the building is mechanically cooled, HRVs also work to move heat from warm incoming air to the outgoing air. However, this heat exchange is not desired in the summer in passively cooled buildings, where the outdoor temperature may be below the indoor temperature, especially during the nights. In this case building designs should consider HRV systems with a summer bypass mode that allows the heat recovery to be turned off when needed so that outdoor ventilation air can be brought directly into the building.



Figure 4.5: Examples of mechanical systems that provide limited cooling demand reduction: ceiling fans (left), exhaust fans (middle), and continuous exhaust/heat recovery ventilators (right).

4.3 Financial Impact of Cooling Demand Reduction Strategies

Cost evaluations of cooling demand reduction strategies should consider both the costs of implementing a strategy, as well as the savings that can come from smaller mechanical systems and lower energy demands. The table below provides high level comparison of the cost to implement common cooling demand reduction methods. The costs for implementing these strategies will vary by building design and site and may be higher if relying solely on cooling demand reduction strategies to meet overheating protection compliance (Passive Only).

Relative Cost	Strategy
\$	Building Orientation and Form (within given zoning/setback allowances)
\$ - \$\$\$	Exterior Shading
\$ - \$\$\$	Optimized Glazing
\$\$ - \$\$\$	Airtightness and Thermal Insulation
\$ - \$\$	Cladding Materials and Thermal Mass
\$ - \$\$	Natural Ventilation and Night Cooling
\$	Mechanical Ventilation

4.4 Demand Reduction for Meeting Step Code

While the discussion of passive and demand reduction measures noted in the previous section focuses on reducing the cooling needs of a dwelling, these measures can also reduce heating demand and overall energy use. Thermal energy demand can be reduced when passive and demand reduction measures (e.g., efficient building form, high performance windows, air tightness, and heat recovery ventilation) consider both the heating and cooling seasons.

Minimizing energy demands is a key principle of the BC Energy Step Code and Zero Carbon Step Code⁶. Having low energy demand means lower energy use, as well as fewer overall emissions from building operations. The Step Codes use targets such as TEDI (thermal energy demand intensity), Mechanical Energy Use (MEUI) and Greenhouse Gas Emission Intensity (GHGIs) to evaluate energy demand. Implementing passive measures can simultaneously support meeting both overheating protection requirements and required energy and emissions targets.



⁶ Province of British Columbia, "BC Energy and Zero Carbon Step Codes", <https://energystepcode.ca/>

5 Active Mechanical Cooling Systems

The following provides an overview of common active cooling technologies that could assist in meeting the BCBC 2024 overheating protection requirements.

As design temperatures increase, mechanical cooling systems will likely be necessary to overcome peak temperatures, even with significant cooling load reduction from passive and demand reduction measures. For additional information on mechanical cooling systems, please see the Additional Resources. Allowances for not using a mechanical cooling system are discussed in Section 0.

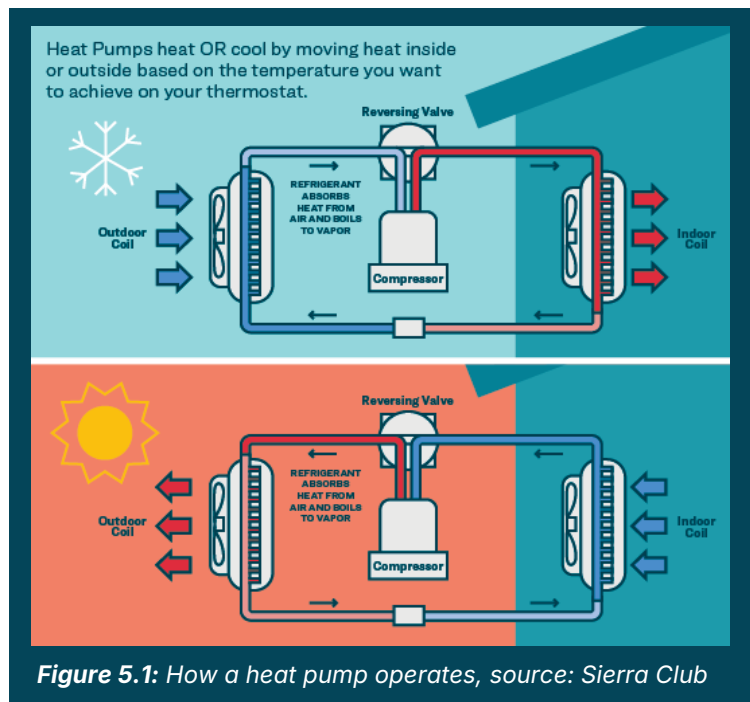


Considerations for Part 3 Buildings

The design and implementation of cooling in Part 3 buildings can be significantly more complicated than for Part 9 residential buildings, with many more mechanical systems available in larger multi-unit buildings. However, most common systems will still follow the same basic conceptual approaches as outlined in this section.

5.1 Heat Pumps for Cooling

Active mechanical cooling in residential construction is almost always provided by a heat pump system, though it may take on many different names. A heat pump functions by absorbing heat from the interior and rejecting it to the exterior through the evaporation and condensation of refrigerant as it cycles between indoor and outdoor components (see **Figure 5.1**). This process typically involves an indoor heat exchanger unit, which extracts heat from indoor air, and an outdoor condenser/evaporator unit, which expels heat outdoors (see **Figure 5.4**). Effectively, heat pumps do not generate “cooling energy” but rather use energy to move heat from indoors to outdoors, even when the outdoors is hotter than the indoors. The commonly used name for a heat pump cooling system is “air conditioner”.



Note that a conventional air conditioner expels heat directly to the outdoor air, but other less common systems work by expelling heat to the ground or even to a nearby body or water. See Additional Resources for more information on heat pump configurations and mechanical components. This section focusses on the ways mechanical cooling is provided to the dwelling unit(s), rather than the specific heat pump outdoor source/technology.



Figure 5.2: Examples of heat pump system components: indoor heat exchangers in central forced-air systems (left and middle) and outdoor air-source heat pump unit (right)

5.2 Other Benefits of Installing Heat Pumps

Just as heat pumps can move heat from inside to outside to cool a space, the same process can also be reversed to bring in heat to a space. For a heat pump to provide both heating and cooling, only a few additional components and controls are needed. There are many heat pump models readily available on the market that can provide both cooling and heating.

Zero Carbon Step Code Compliance

As heat pumps move heat rather than generate it, they are extremely energy efficient. Electrically operated heat pumps can be over three times more efficient than electric baseboards and gas fired systems. In BC, electric systems produce very few emissions due to BC's low electricity emissions factor⁷. As such, electric heat pump systems support achieving compliance with the highest Steps of the BC Energy Step Code and the most stringent Emissions Levels of the Zero Carbon Step Code. A building designed with full cooling from a heat pump system already has all or most of the components needed to provide full heating using the same heat pump system provided it is sized correctly for the heating load of the building. **Figure 5.3** outlines how the compliance pathways for the Zero Carbon Step Code and the overheating protection requirements coincide.

⁷ BCBC Section 9.37. Greenhouse Gas Emissions

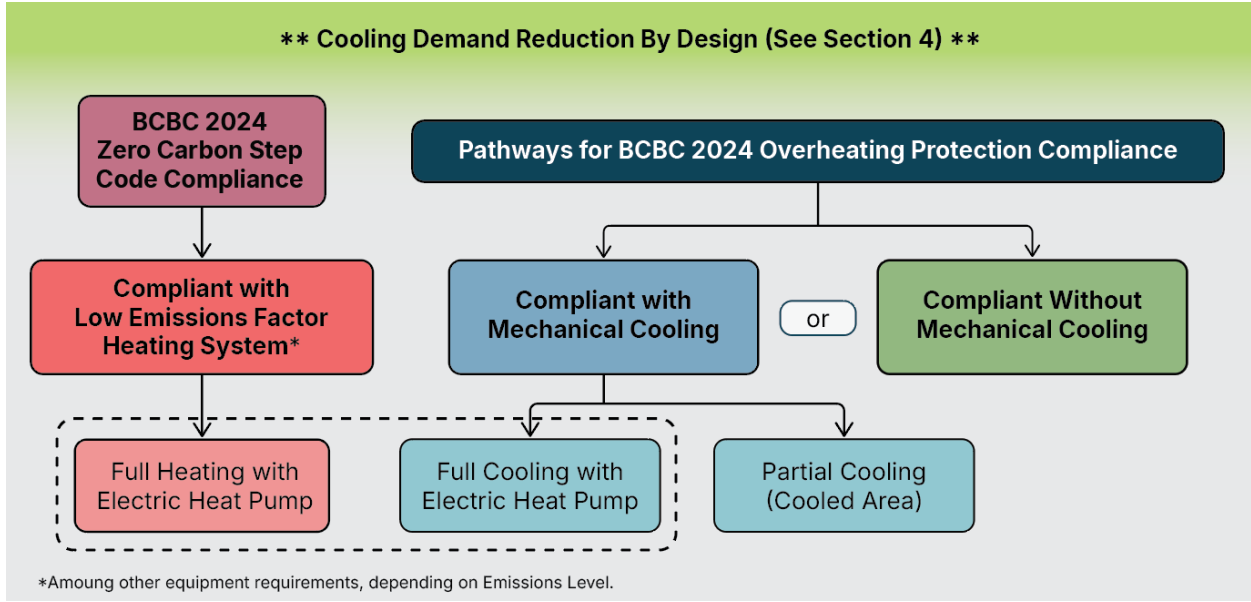


Figure 5.3: Compliance pathways for meeting the overheating protection requirements and the Zero Carbon Step Code, indicating how using a heat pump for heating and full cooling can help with meeting both.

The CleanBC Roadmap⁸ indicates that the Province intends to require that all heating and hot water systems that are sold in BC after 2030 be at least 100% efficient. Developing an industry standard and related compliance process of incorporating high efficiency heat pump systems in current construction will help prepare for this future requirement.

A final co-benefit is that a single central heat pump can greatly simplify the mechanical design where both heating and cooling are required, since both functions can be provided by a single system. This can potentially be more economical when compared to separate heating and cooling systems.

5.3 Centralized Mechanical Cooling Systems

Centralized cooling systems are ones that use a single heat pump/air conditioner that serves more than one location/area in the buildings. This section (see next page) provides examples of typical central mechanical cooling systems in Part 9 residential buildings designed for full mechanical cooling.

⁸ Province of British Columbia, "CleanBC Roadmap to 2030", https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

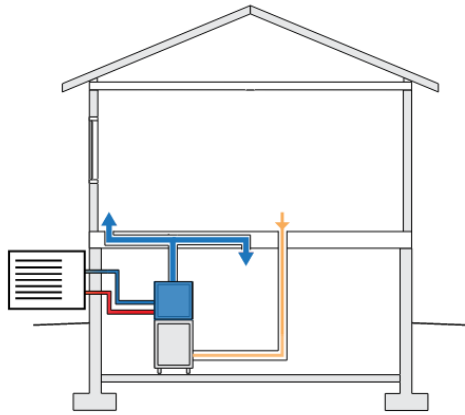


Figure 5.4: Schematic central forced air cooling system.

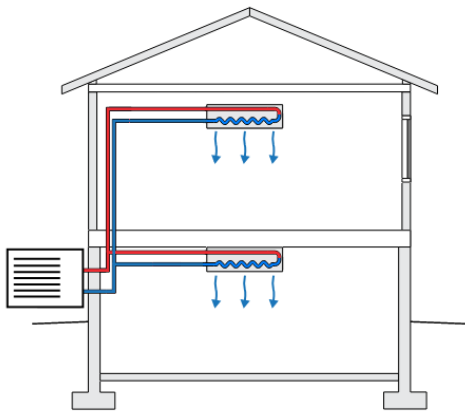


Figure 5.5: Schematic ductless multi-head heat pump cooling system.

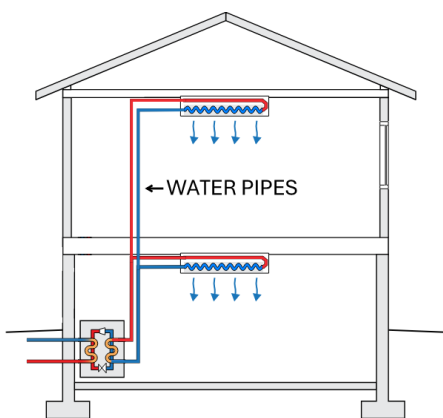


Figure 5.6: Schematic central hydronic cooling system.

Central Forced-Air Cooling

A common cooling approach is to use a central air handler (i.e., large fan and heat exchanger) to blow cooled air through ducts into the living spaces (see **Figure 5.4**). Forced air cooling is typically used to provide full mechanical cooling in larger homes. It can be integrated with the forced air heating system (with the same heat pump in heating mode and/or with supplemental heat from a different source) as well as the ventilation system. Correct cooling capacity sizing applies to the outdoor unit and exchanger, as well as all the ducts throughout the building.

Ductless Multi-Head Heat Pump Cooling

With a central ductless system, heat exchangers are located directly in the space served, typically as wall-mounted or ceiling-mounted units or “heads” (see **Figure 5.5**). A fan inside each head circulates air from within the room, and the heat exchanger is connected to the central heat pump unit with a refrigerant line set. This approach is like a single mini-split system described in the next section, but it uses multiple heads to serve more than one zone throughout the building so it is considered centralized. Correct cooling capacity sizing applies to the outdoor unit and all indoor heads for the areas they serve.

Central Hydronic Cooling

Water can also be used to distribute cooling and minimize the amount of refrigerant through a dwelling. This approach uses pipes with chilled water run throughout the building connected to terminal units, either radiant panels or more integrated with fan-coil units that blow air, which are all connected to a central heat pump, such as a ground source heat pump (see **Figure 5.6**). Hydronic cooling is often combined with hydronic heating. Correct cooling capacity sizing applies to the outdoor unit and all radiant loops/fan coils for the areas they serve.



Hydronic systems that provide radiant cooling through in-unit piping carry a risk of condensation issues, especially in warmer months. Additional design considerations may include insulation wrap, humidity controls and/or dewpoint sensors.

5.4 Distributed and Localized Mechanical Cooling

Distributed mechanical cooling systems consist of a standalone air conditioner/heat pump system that provides cooling directly to an individual room/space within a dwelling unit. This section provides examples of typical distributed mechanical cooling systems in Part 9 residential buildings designed for partial or in some cases full mechanical cooling.

Distributed cooling systems achieve compliance with the BCBC overheating protection requirements when they are permanently installed and integrated with the building and are sized for the specific space they serve. For some small and/or high-performance buildings, or single suites, it may be possible to provide full mechanical cooling with a single standalone air conditioner/heat pump system.

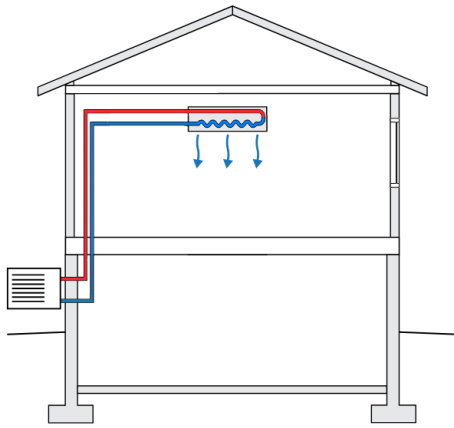


Figure 5.7: Schematic single ductless mini-split cooling system.

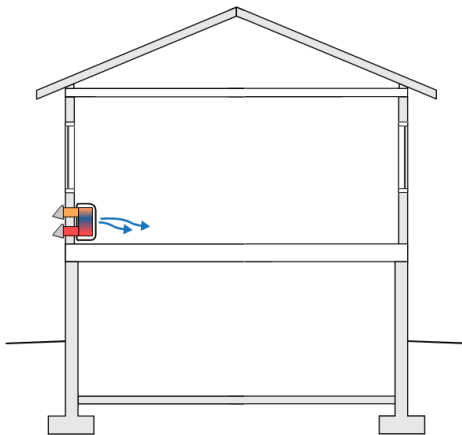


Figure 5.8: Schematic single ductless mini-split cooling system.

Single Ductless Mini-Split Heat Pump Cooling

A conventional mini-split system consists of an exterior condenser that connects with one indoor head (see **Figure 5.7**). A single condenser can connect to multiple heads as part of a central multi-head system (see previous section) using the same technology, but only systems that serve a single room/zone are considered distributed. A split system requires refrigerant lines to run between the condenser and each distribution head, which may be installed across the exterior and/or through the interior of the dwelling unit. Correct cooling capacity sizing applies to the outdoor unit capacity in combination with the single indoor head.

Through-Wall Heat Pump Cooling

A packaged through-wall heat pump (TWHP) contains all the all air-source mechanical cooling components in a single indoor unit (see **Figure 5.8**). It draws in outdoor air through a dedicated air intake, uses heat pump technology to expel indoor heat from the adjacent room/space into the airstream inside the unit, and blows the same outdoor air back out an exhaust port. This requires the system to be placed on an exterior wall. Correct cooling capacity sizing applies to the capacity of the TWHP itself. Note that these combined systems are usually limited in capacity and single units may not be sufficient for large spaces.

5.5 Relative Costs of Mechanical Cooling Systems

The table below provides a high-level comparison of the costs to implement common mechanical cooling methods in a new Part 9 residential building.

Relative Cost	System
\$-\$\$\$	Central Forced Air Heat Pump
\$\$-\$\$\$	Ductless Multi-Head Heat Pump
\$\$\$-\$\$\$\$	Central Hydronic System
\$-\$\$	Single Ductless Mini-Split Heat Pump
\$	Through Wall Heat Pump

5.6 Ventilation Air Tempering

The building ventilation system can also be used for active mechanical demand reduction. If it provides direct ventilation to the ducted forced air system without any heat recovery, a ventilation boost mode in the central air handler could help circulate fresh, potentially cooler outdoor air into the building. Heat recovery ventilators (HRVs) are also common for providing ventilation, but they work by transferring heat energy from the indoor air to the incoming outdoor air, before the new air enters the living space. In a mechanically cooled building, this heat recovery mechanism helps temper the new hot outdoor air, but it cannot fully condition it back to the desired room temperature. In a building without mechanical cooling this heat transfer should be bypassed so avoid transferring indoor heat into incoming outdoor air.

It is also possible to add a heating/cooling coil to certain types of HRVs, to provide active air conditioning. However, the air flow rate for fresh air ventilation is typically much lower than would be needed to fully condition a space with forced air cooling.

Ventilation heating/cooling should not be considered as a sole source for space conditioning unless a dwelling has extremely low cooling demands, such as an optimized Passive House or a building located in a climate with a low outdoor design temperature and therefore low cooling demand. The effectiveness of this approach would need to be verified through adequate evaluation (see Section 0).



Considerations for Part 3 Buildings

Tempered central make-up air and corridor cooling typically cannot provide high enough flow rates into suites to sufficiently cool an entire multi-unit residential building. This approach may be able to maintain temperatures at or below 26°C in common spaces, however, common hallways are not considered a Cooling Zone per the BCBC overheating protections.

5.7 Temporary Mechanical Cooling

Active cooling in BC residential buildings without built-in cooling is often provided by occupant-supplied portable plug-in air conditioning systems, such as a window mounted packaged air conditioner, or flexible ducted portable air conditioner. These require the occupant or others to first recognize the need for cooling in a space, then install and operate these systems in a timely manner.

The Report to the Chief Coroner found that most people who died during the Summer 2021 heat dome event had compromised health conditions. Approximately two-thirds (69%) of the deceased had chronic illnesses that could impact mobility, while approximately two-thirds (64%) of the deceased had chronic illnesses that could impact cognitive abilities.

These findings support the recommendation that overheating protection measures must be effective even with limited or no occupant input. Dedicated mechanical cooling eliminates or reduces many obstacles relating to the installation and ongoing operation which are typical of temporary cooling solutions.



Figure 5.9: Example window mounted air conditioner.



Portable air conditioners and other temporary cooling measures require a higher degree of occupant awareness and initiative to ensure that they are installed and operated to sufficiently mitigate overheating. As per Bulletin B24-08, **temporary plug-in air conditioners do not satisfy the new provisions for overheating protection**. Acceptable cooling systems must be integral to the building.

6 Considerations for Permitting Authorities

As a general note for complying with BCBC, the code states in its administrative provisions:

Sufficient information shall be provided to show that the proposed work will conform to this code and whether or not it may affect adjacent property.

(BCBC 2.2.2.1(1) Division C)

While Bulletin B24-08 provides some guidance on evaluation procedures, there is no specific required compliance methodology to show acceptable overheating protection. As with all code compliance items, it is up to the AHJ's discretion, in consultation with their insurer and legal counsel, to set out the compliance process and required submissions for Part 9 residential buildings.

This section provides recommendations to assist AHJs in implementing their overheating protection compliance process appropriately. The information in this report and the recommendations in this section can be further developed into technical bulletins to further support AHJ permitting processes.

6.1 General Recommendations

Using the standards and best practices outlined in Section 3 and Section 4 of this report, the following are compliance recommendations for AHJs pertaining to all overheating protection approaches regardless of building type or calculation strategy.

Reference Section	Recommendation
<input checked="" type="checkbox"/> Section 4	Promote and/or incentivize the use of heat gain and cooling demand reduction strategies as a key to efficiently achieving overheating protection and for meeting Step Code targets.
<input checked="" type="checkbox"/> Section 3	Establish clear submission requirements between designs with or without active mechanical cooling and for designs with full cooling vs partial cooling.
<input checked="" type="checkbox"/> Section 3	Include peak cooling load calculations for overheating protection following a modified CSA F280 analysis, including the requirement for it to be completed as a standalone analysis from the standard load sizing submission(s).
<input checked="" type="checkbox"/> Section 3	Clarify with staff and applicants that all submissions for peak cooling load calculations/overheating protection design that do not follow CSA F280 must be provided by a Registered Professional (i.e., as a stamped engineering report).
<input checked="" type="checkbox"/> Section 3	Determine if the 2.5% July dry temperature is appropriate as the design temperature for determining overheating protection, or if a higher temperature to reflect expected extreme heat events should be used.

**Section 3**

Clarify with staff and applicants that confirming overheating protection is required for all residential buildings, regardless of energy compliance or modelling pathways, and advise that non-hourly energy modelling is not appropriate unless extreme temperatures and other specific overheating protection considerations have been accounted for in the model.

**Section 3**

Confirm that occupancy loads used in calculations reflect the requirements of the given standard.

6.2 Cooling Demand Reduction – Risk Factor Checklist

Cooling demand reduction can significantly reduce a dwelling unit's risk factors for overheating. Even in a unit with full or partial mechanical cooling, demand reduction measures reduce a building's risk factor for overheating in the event of a mechanical system failure or extreme heat events with sustained high outdoor temperatures. It is recommended that the Building Official implement a follow-up review of the building's overheating protection system, including the mechanical sizing and product specification, if the following checklist is not met. Further information about each of the demand reduction strategies is included in Section 4.

Common Overheating Risk Factors



No exterior shading elements provided for west-facing glazing areas.



Glazing solar heat gain coefficient above 0.4.



Large, unshaded areas of glazing on the south and west elevations.



No or limited provisions for natural ventilation, such as lack of operable windows that allow for cross-breezes through the unit.



An absence of exterior elements that can shade the building, such as trees, landscaping, overhangs, or other structures.



Dark-coloured siding and/or roofing.

As discussed in Bulletin B24-08, compliance is based on demonstrating that one or more spaces can maintain 26°C indoor temperature under cooling design conditions. **Typical energy modelling software used for Part 9 buildings (e.g., HOT2000) is not appropriate for demonstrating compliance or for calculating mechanical sizing.** Appropriate methods are discussed further in this section.

6.4 Full Mechanical Cooling for Part 9 per CSA F280

The following compliance process recommendations are key to implementing effective plan checking and verification for buildings using mechanical cooling to provide overheating protection for the whole building. This may be appropriate as a separate overheating protection load sizing calculation.

- The mechanical cooling unit is integrated, permanently installed, and sized for the building it serves, including the appropriate occupant load.
- The mechanical cooling system is sized according to a modified version of CSA F280 with verified software, including using 26°C as the indoor design temperature, system capacity of at least 100% of the cooling load, and the appropriate outdoor design temperature as required by the AHJ.
- Alternatively, conduct an evaluation and reporting of the cooling design as per good engineering practice by a Registered Professional, following Part 6, Division B of BCBC, with the same indoor design temperature and sizing requirements met. This applies to Part 3 buildings and Part 9 buildings with mechanical cooling that serves more than one dwelling unit.

6.5 Cooling Zone Mechanical Cooling for Part 9 per CSA F280

The following compliance process recommendations are key to implementing effective plan checking and verification for buildings using mechanical cooling to provide overheating protection for a single living space in each dwelling unit.

- The mechanical cooling unit is integrated, permanently installed, and sized for the space it serves, including the appropriate occupant load.
- The Cooling Zone can accommodate all the dwelling unit's occupants for an extended period.
- The Cooling Zone is a living space designed for occupancy, meets accessibility requirements, and is not overly restrictive.
- The mechanical cooling system is sized according to a modified version of CSA F280 with verified software, as outlined in the forthcoming *Guideline on Single Zone Cooling in Dwelling Units*, jointly published by HVAC Designers of Canada and TECA, and/or the *Indoor Design Temperatures - Overheating Protection* bulletin published by the Township of Langley. Modifications include, among several: 26°C indoor design temperature, 100% system capacity, and modelling with occupant and appliance heat gains in the room/space.
- Alternatively, conduct an evaluation and reporting of the cooling design as per good engineering practice by a Registered Professional, following Part 6, Division B of BCBC, with the same indoor design temperature and sizing requirements met. This applies to Part 3 buildings and Part 9 buildings with mechanical cooling that serves more than one dwelling unit.

6.6 Passive Only Overheating Protection for Part 9

Evaluating overheating protection compliance for a project with a Passive Only approach will require an assessment conducted through good engineering practice, overseen and submitted by a Registered Professional. Compliance can be confirmed with a stamped summary report, including assessment methodology, results and analysis. While these reports can be generally relied upon, AHJs can conduct checklist-based reviews to confirm the appropriate procedures were followed. AHJs can also establish clear reporting criteria or templated submission forms to standardize submission information to make reviews easier for permitting staff.

6.7 Following Good Engineering Practices and Part 3 Compliance

All design inputs, analysis, and calculations for overheating protection design following good engineering practices must be submitted as a stamped engineering report by a Registered Professional. Accepted methodology should align with that outlined in Section 3.4 Compliance for Part 3 Buildings on page 16. As noted with the Passive Only approach, AHJs can conduct checklist-based reviews to confirm the appropriate procedures were followed.

7 Closure

Providing overheating protection in residential buildings is critical to ensure the health and safety of occupants, especially when faced with changing environmental conditions and more frequent heat events. This report provided an overview of overheating protections for British Columbia in relation to the stipulations of 2024 BC Building Code, as well as general good design practice. For more information, please see the Additional Resources, or contact the undersigned.

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Additional Resources

For further expanded information on the passive design approaches and cooling solutions outlined in this guide, please see the following referenced resources

BC Housing, 2019	BC Energy Step Code Design Guide Supplement S3 on Overheating and Air Quality	https://www.bchousing.org/publications/BC-Energy-Step-Code-Guide-Supplemental.pdf
University of Toronto, 2019	Thermal Resilience Design Guide	https://pbs.daniels.utoronto.ca/faculty/kesik_t/PBS/Kesik-Resources/Thermal-Resilience-Guide-v1.0-May2019.pdf
Public Architecture, 2021	Study of Adjustable Exterior Shading Options for Multi-Unit Residential Projects	https://viennahouse.ca/wp-content/uploads/2022/07/PAC_StudyOfAdjustableExteriorSolarShadingForMulti-unitResidentialProjects.pdf
Canmet Energy	Air-Source Heat Pump Sizing and Selection Guide	https://natural-resources.canada.ca/sites/nrcan/files/canmetenergy/pdf/ASHp%20Sizing%20and%20Selection%20Guide%20(EN).pdf
BC Non-Profit Housing Association	Building Overheating and Air Quality: Considerations in New Construction Webinar	https://www.youtube.com/watch?v=Hy2njE0UBDk
BC Housing Maintenance Matters	Modelling Future Climate in Passively Cooled Buildings	https://www.bchousing.org/publications/Builder-insight-19-Modelling-the-future-climate-in-passively-cooled-buildings.pdf
ZEBx + University of British Columbia	Low Carbon Mechanical Systems for Houses in the Lower Mainland, BC	https://zebx.org/wp-content/uploads/2020/07/ZEBx_Primer_Low_Carbon_Mechanical_Systems_2020-1.pdf
RDH Building Science Inc	Designing Climate Resilient Multi Family Buildings	https://planning.ubc.ca/sites/default/files/2020-05/REPORT_UBC_Climate%20Resilient%20Multifamily%20Buildings.pdf