BC Hydro

UPDATING FORM + CHARACTER GUIDELINES TO SUPPORT HIGH-PERFORMANCE BUILDINGS

A GUIDE FOR LOCAL GOVERNMENTS

JULY 18, 2024

ORIGIN Introba ZGF

Acknowledgments

This resource was developed for BC Hydro's Community Energy Manager network by **Origin Sustainable Design + Planning** (Devon Miller), **Introba Canada** (Stewart Somerville), **ZGF Architects** (Iain MacFadyan and Maryam Alirezaei) and **Lisa Westerhoff.**

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Contents

Purpose of this Guide

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The purpose of this Guide is to provide local government staff with a recommended process and supporting materials for improving alignment between Development Permit (DP) Form and Charcter Guidelines and design strategies that are commonly used to meet high-performance building requirements, such as the highest steps of the Energy Step Code and the Zero Carbon Step Code.

This Guide also includes supplementary educational materials to help improve local government staff understanding of high-performance design strategies and potential implications for building form.

The ultimate goal is for local government staff members to be able to use this Guide to develop, scope, and carry out a review process of DP Guidelines in their community to ensure alignment with high-performance building design strategies.

Who is this guide for?

This Guide is intended to be used by climate action and planning staff at local governments across British Columbia.

Community Planners, Energy Planners and/or **City Architects** can use this Guide to establish guidelines for urban form and character that promote and support high-performance building design strategies.

Community Planners and/or **Community Energy Managers** can consult this Guide for example policy and guideline language as part of new Official Community Plans or Local Area Plans.

Development Planners can use this Guide as a resource to support the review of rezoning and development permit applications for high-performance buildings.

Community Planners, Energy Planners and/or **City Architects** can use this Guide to better understand high-performance building design principles. These different groups are who the guide is for/who should be engaged in the project.

High-performance buildings: buildings that are highly energy efficient, low or zero carbon, and climate resilient.

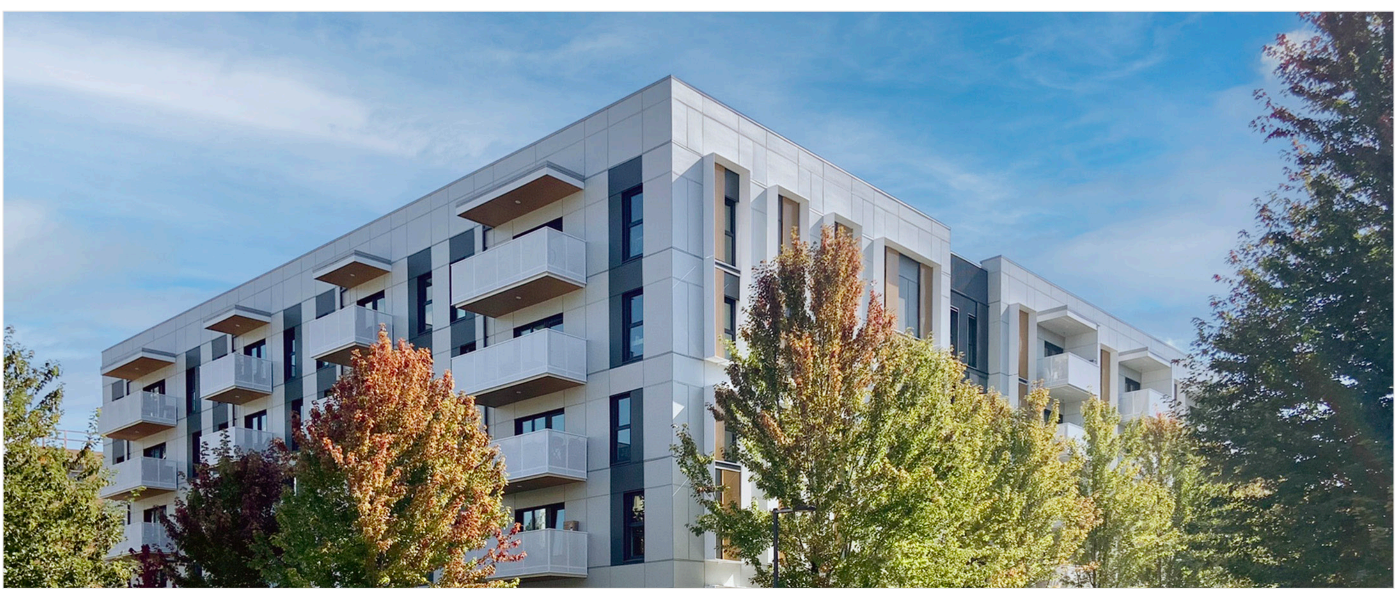
Why is this guide needed?

With the implementation of the BC Energy Step Code and Zero Carbon Step Code across the province, many local governments are undertaking processes to ensure that their internal processes and policy documents are aligned with and supportive of high-performance design outcomes required by the abovementioned codes. This Guide provides support for local governments that are looking to improve alignment between current Development Permit Guidelines and high-performance design strategies.

Development Permit (DP) Guidelines are an important tool that local governments can use to ensure that new construction is aligned with Official Community Plan goals for livability and sustainability. While high-performance buildings can generally be designed to meet common objectives set out in DP Guidelines, sometimes these guidelines can present unintended challenges to affordably achieving building performance.

In addition to DP Guidelines, zoning bylaw definitions related to floor area ratio, setback requirements, and building height limits can also inadvertently penalize high-performance design strategies, such as the use of thicker wall and roof assemblies. As the BC Energy Step Code moves toward net-zero energy-ready construction by 2032, it is increasingly important that local government bylaws and guidelines support high-performance design strategies to avoid misalignment between policies, bylaws, guidelines, and building code requirements for energy efficiency and emissions reduction.

Overall, it is important that energy efficiency and form and character objectives are harmonious to support the development of complete, livable communities made up of high-performance buildings. Several local governments in BC have recently undertaken the process of reviewing their guidelines to address these potential issues, and while local governments and their communities have unique considerations, there are also some commonalities in terms of form and character objectives and urban design best practices. This Guide provides a recommended process and sample guideline language that can be used to improve support for high-performance buildings.



Evolve, Vancouver BC. UBC Properties Trust (photo: ZGF Architects)

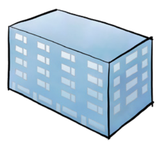
Organization of this Guide

1

Introduction to high-performance building design

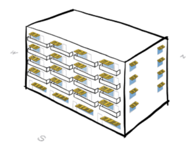
1. Introduction to high-performance building design

Simplified building form



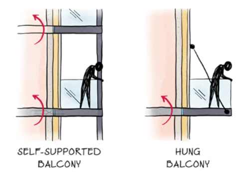
A compact building with a simple shape loses less energy through the walls, floors and roofs as there is less surface area in relation to the volume of interior space.

Glazing and Shading



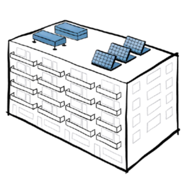
The size and location of windows is key to energy performance, and the use of exterior shading can be used as a strategy to reduce the risk of overheating.

Limited thermal bridging



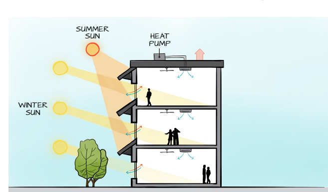
The use of high-performance balcony systems (such as exterior supported or thermally broken systems) can be used to limit thermal bridging potential.

Low Carbon Systems



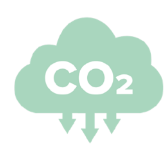
Once passive strategies are maximized, active strategies can be used to reduce building energy consumption through the use of efficient systems.

Resilient Design



The use of strategies and approaches that help to ensure a building will be able to withstand and recover from the impacts of climate change in a timely and effective manner.

Low Embodied Carbon



The use of strategies for reducing carbon emissions associated with the extraction, manufacturing, transportation, and installation of building materials, and the construction processes.

1.1 High-performance building regulatory framework

The primary regulatory tools for requiring high-performance buildings in British Columbia are the BC Energy Step Code and BC Zero Carbon Step Code.

ENERGY STEPCODE
BUILDING BEYOND THE STANDARD

The **BC Energy Step Code** has been in effect since 2017 and was introduced to help provide consistency in the regulation of new construction across the province. It is a performance-based code that sets out tiered thresholds for energy efficiency in new homes and buildings. While the provincial government mandates a base level of performance via the BC Building Code, local governments can choose to require higher levels of the code ahead of the provincial schedule.

ZERO CARBON STEPCODE

The **BC Zero Carbon Step Code** was introduced in May 2023 and, in a similar way the to Energy Step Code, sets out tiered thresholds for carbon performance in new homes and buildings that local governments can voluntarily adopt alongside the BC Energy Step Code. Adopting carbon thresholds encourages a move towards low-carbon mechanical equipment. This marked an important milestone for local governments interested in pursuing emissions reductions in the building sector, as without emissions limits, homes and buildings meeting even the highest steps of the Energy Step Code could still use high-emissions fossil fuel-based mechanical systems.

Both codes follow a provincial timeline that acts as a backstop when higher levels will become mandatory for all new homes and buildings in BC. For the purposes of this report, the use of the term “high-performance building” predominately refers to any project that has set goals for:

- high energy efficiency (e.g., higher steps of the BC Energy Step Code),
- low or zero carbon (e.g. higher levels of the BC Zero Carbon Step Code),
- responding to climate impacts, and
- reducing embodied carbon.

1.2 High-performance building definitions

Active design: the use of mechanical systems that are powered with purchased energy to provide heating, cooling, ventilation and lighting.

Climate resilience: assets and systems that are designed to absorb disturbances and continue to function in response to climate impacts such as extreme heat, flooding, storms, and sea level rise.

Climate resilient buildings: buildings that can maintain critical operations and functions in response to extreme events and return to normal operations in a fast and efficient manner, in order to maintain healthy, livable spaces for their occupants.

Decarbonization: reducing carbon emissions from building construction and/or operations.

Electrification: replacing technologies that use fossil fuels (coal, oil, and natural gas) with technologies that use (hydro)electricity as a source of energy.

Embodied carbon emissions: carbon emissions released during the lifecycle of building materials (e.g. structure, foundation, insulation, etc.), including extraction, manufacturing, transportation, construction, and disposal.

High-performance buildings: buildings that are highly energy efficient, low or zero carbon, and climate resilient.

Net-zero energy buildings (and zero carbon operational emissions): buildings that are highly energy efficient (up to 80% less operational energy use than typical new buildings) and generate or procure as much renewable energy as they consume. If renewable energy is carbon-free, this results in zero carbon operation emissions.

Operational carbon emissions: carbon emissions associated with the operational energy use of a building, including space heating and cooling, hot water, lighting, and equipment.

Passive design: systems and strategies that utilize conditions of the site to provide heating, cooling, ventilation, and lighting and are not powered with purchased energy.

Solar gains: the natural heat from the sun that enters a space through transparent building elements and increases the space temperature.

Thermal comfort: the state when an occupant is satisfied with the temperature of a particular space. Thermal comfort is highly subjective and can depend on individual characteristics, behavioural factors, cultural norms, and environmental conditions.

Thermal safety: the ability of a particular space to maintain temperatures that do not negatively impact the health and well-being of all building occupants, particularly during extreme heat events.

1.3 Passive and active strategies for achieving high performance

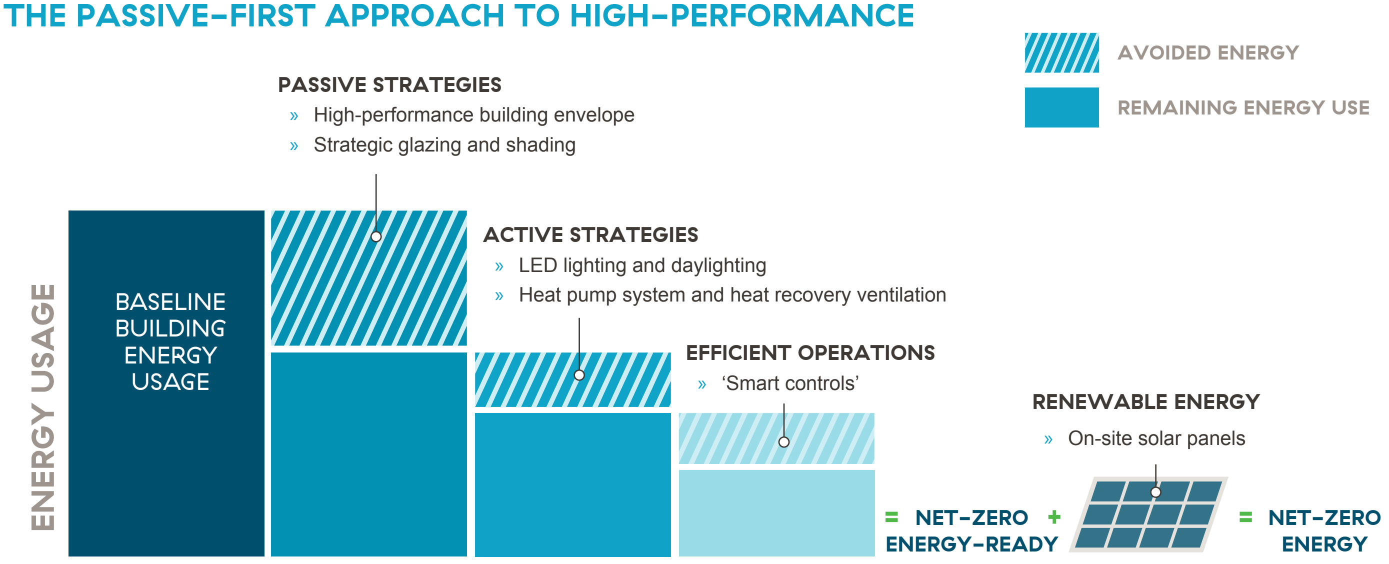
Successful high-performance buildings set clear performance targets and apply a hierarchy to the design approach and decision making, sometimes referred to as a "passive first" approach. This approach considers opportunities to reduce demand for resources by optimizing the conditions of the site before considering active strategies such as improved building mechanical system efficiency.

Passive strategies help minimize the demand for energy required to heat or cool a building and include the optimization of building orientation, enhanced envelope performance (e.g., additional insulation, high-quality windows and doors), compact building form, and consideration of daylighting and shading. As passive strategies are directly related to site planning, building massing, and the architectural treatment of walls, windows, and roofs, they can be directly impacted by DP guidelines.

Once passive strategies are explored and maximized, further reductions in energy use can be obtained using **active strategies**. These include measures to improve the energy efficiency of building mechanical systems, such as heating, cooling, ventilation, lighting, and electrical plug loads. Active strategies typically do not fall under the purview of DP guidelines, as they are generally hidden within the building itself – with the exception of mechanical and renewable energy system siting, and exterior lighting. Efficient active strategies that make use of low-carbon energy sources (e.g., hydroelectricity) reduce emissions as well as energy. In addition to passive and active strategies, the use of 'smart controls' for improving efficiency of operations and generating renewable energy on-site (e.g., via solar photovoltaic panels) can also be explored to provide a source of clean energy for the building's remaining energy demand.

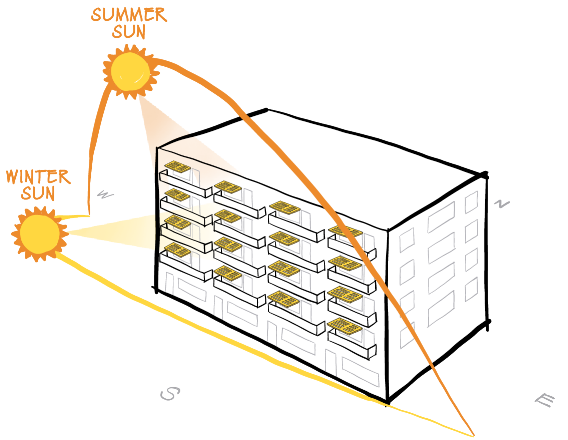
More details are provided on each of these two main strategies in **Section 1.3.1 Passive Strategies** and **1.3.2. Active Strategies**. For additional details on these strategies, refer to BC Energy Step Code Design Guide.

THE PASSIVE-FIRST APPROACH TO HIGH-PERFORMANCE

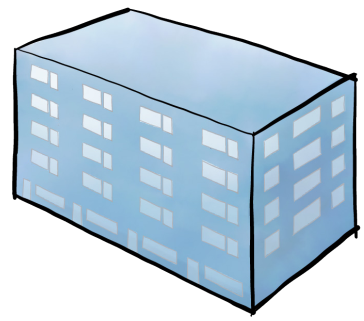


1.3.1 Passive Strategies

Passive design strategies typically fall under the purview of form and character guidelines, and include the following considerations:



Optimized Site Planning and Orientation
Maximize southern exposure to harness solar gains in winter and reduce the amount of energy needed to heat a building.



Massing and Articulation - Compact Building Form
A compact building with a simple shape loses less energy through the walls, floors and roofs as there is less surface area in relation to the volume of interior space.

Optimized Site Planning and Orientation

Optimizing a building's orientation means exploring the conditions of the site to identify any broad considerations that can help a building achieve higher levels of energy performance.

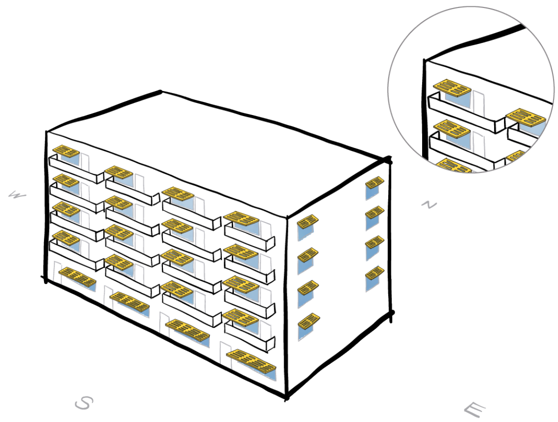
Of primary importance is the building's orientation – in the northern hemisphere, orienting buildings along an east-west axis increases their southern exposure, which increases their ability to harness passive solar gains, reducing the amount of energy needed to heat interior spaces in colder months.

As the building site and the density of development proposed for the site can dictate orientation, it can be challenging for buildings to optimize for solar orientation. As such, optimizing for solar orientation can therefore be more easily achieved in large master planning type projects (e.g., townhouse complexes, mixed-use community developments) as opposed to infill projects in established neighbourhoods. The surrounding context for the building should also be considered, including any shading from adjacent buildings or trees that could impact the site.

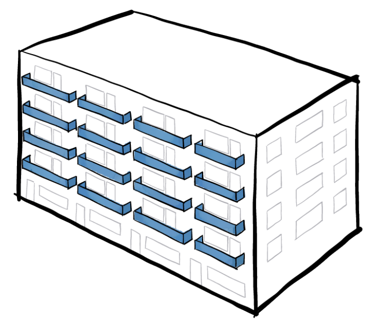
Massing and Articulation — Compact Building Form

A compact building with a simple shape loses less energy through walls, floors, and roofs than a complex building as there is less surface area in relation to the volume of interior space.

Building form is often measured in terms of the 'form factor' ratio, which compares the amount of surface area to the volume of interior space that is contained within the building. A building's form factor indicates how energy-efficient it will be. Buildings with lower form factors typically have an easier time achieving a high level of performance, but it is not an absolute determinant of energy performance. As such, building articulation (such as the use of step-backs) in support of a building form that responds to sustainability and liveability objectives is possible with high-performance buildings. Form factor becomes more important as buildings become smaller, in part because this unavoidably increases the ratio of surface area to volume.



Glazing, Shading and Daylighting
The size and location of windows is key to energy performance, and the use of exterior shading can be used as a strategy to reduce the risk of overheating.



Improved Envelope Performance and Limiting Thermal Bridging
Ensuring building envelope systems have high levels of thermal efficiency can help to significantly reduce heat loss.

Glazing, Shading and Daylighting

Higher energy efficiency can be achieved by optimizing glazing, shading, and daylighting. Optimizing glazing levels on the south elevation to maximize solar gain potential during winter heating months means increasing glazing as much as possible while accounting for the risk of overheating in the summer months, reducing the amount of heating required from mechanical systems.

At the same time, limiting glazing to east, west, and north elevations where heat loss is higher can also help to reduce heating demand. Optimizing daylighting to reduce lighting loads and adding methods of natural ventilation (e.g., operable windows) are also ways to reduce reliance on mechanical systems.

Optimized shading means adding shading above, beside, or in front of glazing to allow solar exposure during the winter when the sun is low in the sky, and restrict it during summer months when the sun is higher to avoid overheating. Because there is greater heat loss through windows than well-insulated solid walls, the correct placement of windows is also essential and will impact the appearance of the building.

Improved Envelope Performance

Ensuring building envelope systems have high levels of thermal efficiency can help to significantly reduce heat loss.

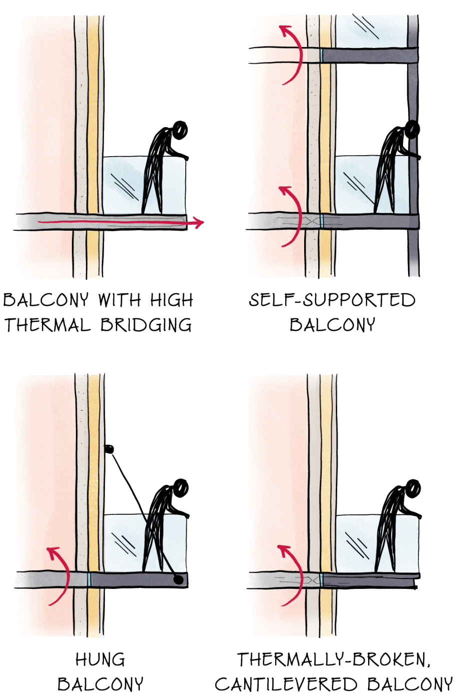
This means improving the performance (and often the thickness) of insulation on exterior walls, floors and roofs, as well as the heat-trapping properties of windows (e.g., triple-glazed) set within highly insulated frames. As heat loss is greater through the interior and perimeter mullions of a window than through the glass pane itself, having fewer larger windows is preferable to many smaller windows. This approach maximizes the amount of glass (with a higher potential for increased passive heating from the sun) and reduces framing (which has a higher potential for heat loss).

Limiting Thermal Bridging

Improved efficiency can also be achieved by ensuring the connections between the main assemblies of a building do not provide a thermally conductive route (or "thermal bridge") for heat loss through the envelope.

Thermal bridging often occurs at windows and doors, balconies, parapets, and other architectural projections. The negative impact of thermal bridges depends on their combined area (i.e., total size, length, and quantity). Heat transfer through building elements that represent common thermal bridges can be significantly reduced through careful detailing and the use of specialty construction methods and products.

For example, conventional balconies created from concrete floor slabs penetrating through the thermal envelope of the building create significant thermal bridges between the conditioned space of the building and the exterior. This approach allows large amounts of heat to be conducted between the exterior and interior, even in well-insulated building envelopes. The use of thermally broken balconies, hung balconies, or self-supported structures minimizes unwanted heat losses/gains through the building envelope.



Balconies and Thermal Bridging
Balconies can present significant thermal bridging issues unless high-performance balcony systems (such as exterior supported or thermally broken systems) are utilized.

1.3.2 Active Strategies

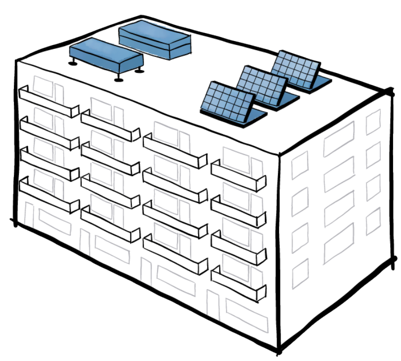
Active strategies help reduce building energy consumption through the use of efficient systems.

Active strategies for high-performance buildings can include:

- Heat recovery ventilation.
- Selecting and properly sizing/zoning efficient mechanical systems.
- Using energy-efficient lighting and appliances.
- On-site renewable energy generation.

Because the carbon emissions intensity of BC's electrical grid is already very low, most decarbonization strategies for both new and existing buildings rely on electrification, eliminating the carbon impact of natural gas. Such 'low carbon electrification' strategies typically make use of heat pumps for space and domestic hot water heating.

While active strategies are important for meeting high-performance building requirements, they typically do not fall under the purview of DP guidelines (with the exception of siting and screening considerations for mechanical and/or renewable energy systems). This may, among other things, conflict with outdoor residential amenity space requirements. Guidelines are typically neutral when it comes to the type of mechanical system to be screened; however, it is important to note that the municipalities may increasingly see projects come forward with mechanical systems that require additional siting considerations and roof space, especially if the Zero Carbon Step Code is adopted in their jurisdiction. As the size of rooftop mechanical equipment increases, the importance of effective screening becomes increasingly important.



Active Strategies
Active strategies help optimize energy consumption through the use of efficient systems.

1.4 Embodied carbon and mass timber construction

Embodied carbon refers to carbon emissions associated with the extraction, manufacturing, transportation, and installation of building materials, and the construction processes. Essentially, it encompasses all the carbon emissions produced throughout the lifecycle of a building or infrastructure project, from the initial stages of material extraction to the completion of construction. Operational carbon, on the other hand, refers to the carbon emissions generated during the operation of a building or infrastructure over its lifetime. This includes energy consumption for heating, cooling, lighting, and powering equipment within the building.

As operational carbon is reduced (e.g., through the strategies outlined in this guide, including designing to the Higher Steps of the Energy Step Code and Levels of the Zero Carbon Step Code), reducing embodied carbon becomes more important.

While there are several strategies that can be used to reduce embodied carbon in buildings, this Guide will focus on Mass Timber Construction considerations due the focus on building form and alignment with DP guidelines.

Mass Timber Construction

Mass timber buildings are built using engineered wood products (typically made of large, solid wood panels, columns or beams) for load-bearing walls, floors, and roof construction through a prefabricated process. Mass timber construction can provide benefits to the construction schedule and has less embodied carbon compared to typical concrete or steel structural materials.

Not only does mass timber require far less fossil fuel during production, but it also sequesters carbon in the structure itself, creating a carbon bank.

It should be noted that the benefits of mass timber are still being evaluated to fully consider forest management practices. It is best practice to use timber certified by the Forest Stewardship Council (FSC) or equivalent and investigate the potential for culturally responsible sourcing.

Mass timber construction does have some unique characteristics that present challenges in meeting some common form and character objectives. Implications for building form associated with mass timber are noted on the following page.

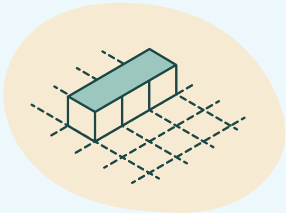
For more information on mass timber construction, refer to **Simon Fraser University's** Design Solutions to Prefab Mass Timber Construction v2.0**.**

981 Davie, Vancouver BC. New Commons Development and Community Land Trust on behalf of VAHA.

This mass timber high-rise mixed use project is also targeting Passive House certification. This building is a good example of simplified massing on a high-rise building form, with the use of materiality, thermally-broken balconies, and glazing detailing as an articulation strategy. The building also includes a welcoming and active frontage and high quality amenity space for residents.

Images: ZGF Architects

Mass Timber Building Form Considerations and Potential Conflicts with Guidelines



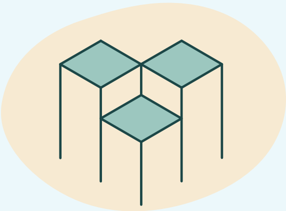
Structural Logic

Building form consideration:

The most efficient mass timber form requires repeating floor plates.

This potentially conflicts with:

Guidelines or zoning bylaws that require building step-backs.



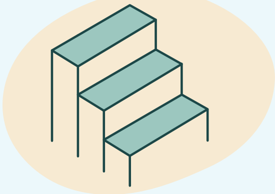
Building Height

Building form consideration:

Mass timber construction requires thicker floors than concrete, meaning a mass timber building of equivalent storeys is taller. This issue is compound if step-backs are introduced as floor assemblies need to be stacked on top of one another.

This potentially conflicts with:

Building height limits established in zoning bylaws.



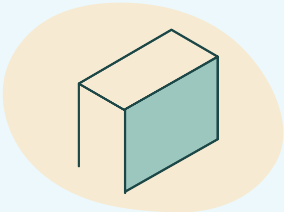
Articulation of Massing

Building form consideration:

The most efficient mass timber form has less articulation and modulation.

This potentially conflicts with:

Guidelines that call for more variable building forms with facade articulation and modulation.



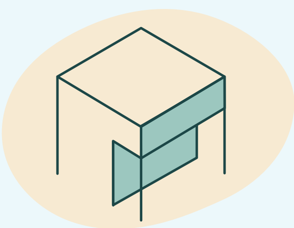
Large Building Face

Building form consideration:

The most efficient form for mass timber construction has less articulation and modulation, which can present overbearing building faces.

This potentially conflicts with:

Guidelines that call for more variable building forms with facade articulation and modulation.



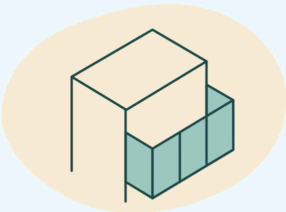
Public / Ground Interface

Building form consideration:

The most efficient mass timber form makes it challenging to provide an appealing public interface at the ground level.

This potentially conflicts with:

Guidelines that call for transparent, active frontages at grade.



Balconies / Private Outdoor Space

Building form consideration:

Thermal bridging issues associated with balconies require extra detailing/effort/cost in mass timber buildings.

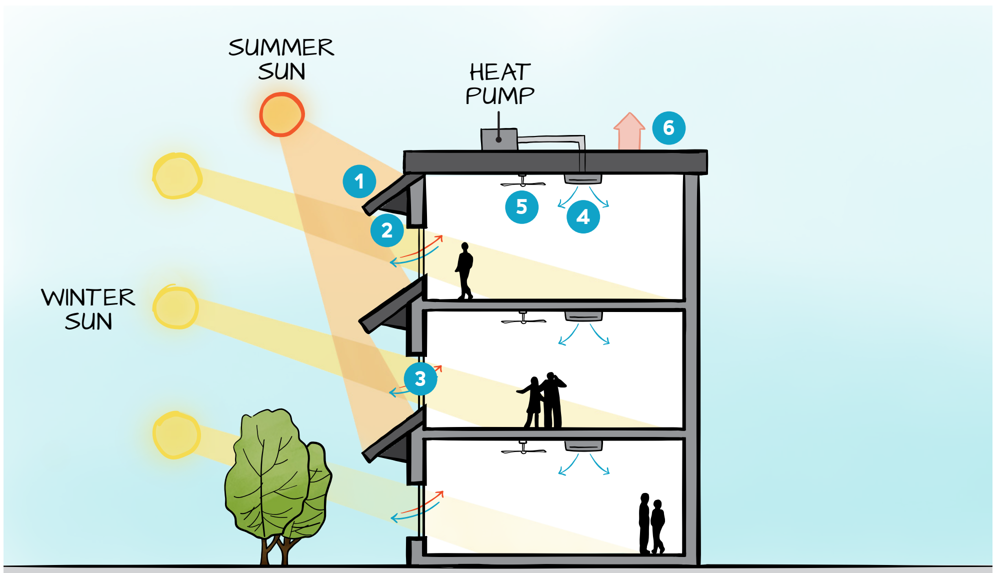
This potentially conflicts with:

Cost-effective compliance with guidelines or zoning bylaws that require a balcony for each unit.

1.5 Strategies for climate-resilient design

Climate-resilient building design refers to strategies and approaches that help to ensure a building will be able to withstand and recover from the impacts of climate change in a timely and effective manner.

Good climate-resilient design goes beyond considering how to protect the building and its occupants from changing climate hazards to identifying ways to enhance occupant health, comfort and enjoyment. Climate-resilient design strategies most relevant to building form and character are outlined below, focusing on heat, indoor air quality, flooding and extreme events.



1. Exterior Shading
2. Natural Ventilation
3. Optimized window design
4. Mechanical cooling
5. Fan-assisted cooling
6. Cool roof

1.5.1 Heat and Air Quality

The strategies below describe the key approaches to improving thermal comfort and/or thermal safety, as well as indoor air quality in new buildings. For more details on these strategies, refer to [BC Energy Step Code Design Guide Supplement S3 on Overheating and Air Quality].

Best practices for resilience to extreme heat take a "passive first" approach, but many communities in BC will require a combination of passive and mechanical cooling strategies to guarantee the thermal comfort and safety of occupants during hotter summers due to climate change. Key passive design strategies for resilience to extreme heat include:

- **Strategic orientation of buildings** to maximize the south and north façade and minimize the east and west façade to optimize energy performance for interior temperature control and leverage solar gains for passive heating in winter while blocking solar gains during the hottest part of the day in summer.
- **Optimized window design** with high-efficiency glazing, window coatings or electrochromic glazing, and higher window-to-wall ratios, particularly along south and west façades, to reduce solar gains while balancing the need for natural light into the building.
- **Natural ventilation** approaches that use strategic placement of operable vents and/or windows to promote air cross flow throughout a building to improve occupant thermal comfort, particularly during shoulder seasons when temperatures are lower outside the building than inside.
- **Exterior shading** to reduce incoming solar gains using fixed vertical or horizontal blinds, screens, overhangs, or deciduous trees planted at ground level.

- **Cool roof design** that uses high albedo colours (such as white) to reduce the absorption of solar heating into the building, or green roofs that can also reduce the urban heat island effect for the surrounding neighbourhood.

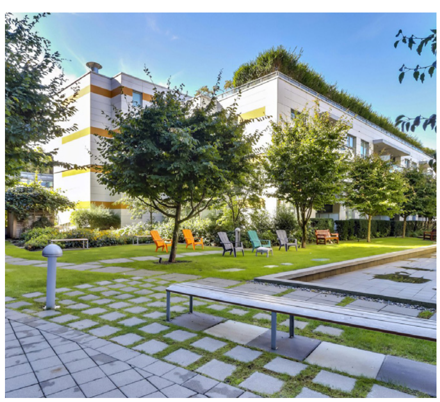
While the passive measures described above are an excellent starting point to maintain desirable indoor temperatures, they may not be sufficient to provide adequate comfort or safety in the warmer summer months. Active strategies that can be layered in to meet cooling needs under future temperatures include:

- **Fan-assisted cooling** that can help improve airflow and thermal comfort at a lower additional cost than other active measures. These strategies include cooling supply air by installing a cooling coil into central ventilation systems, incorporating a bypass into heat recovery ventilation systems, or using supply, exhaust or ceiling fans.
- **Mechanical cooling systems** that provide air conditioning throughout the building, ideally using heat pump technology, which can be deployed as a centralized system (i.e. rooftop or ground-level unit) or decentralized system (i.e. multiple smaller scale systems located in each zone of the building) and are lower-carbon and higher-efficiency than conventional HVAC systems. Where active cooling isn't possible throughout the building, designers should consider adding cooling to a central refuge area (e.g. common room) that can be accessed by all occupants when temperatures inside their units become too hot.
- **Backup power** that ensure buildings that rely on mechanical cooling can provide continued cooling in the case of a regional brownout or building electrical system failure during or due to extreme temperatures (i.e. due to system overload to keep up with cooling demand). Backup power can include natural gas generators, backup batteries, or solar panels.

Building HVAC systems should also be designed to consider how they will operate during poor air quality events such as wildfire smoke or high ground-level ozone concentrations that are becoming more significant due to climate change. Key design strategies to manage building air quality during extreme events include:

- **High-performance air filtration systems** should be incorporated into HVAC system design, targeting MERV-13 systems at a minimum and HEPA and/or carbon filters in high-criticality buildings (e.g. health facilities). Where this is not possible for the entire building, consider providing advanced filtration for a central refuge area that occupants can use during poor air quality events.
- **Air handling units (AHUs) with the capacity to recirculate air** during poor air quality events can reduce the amount of particulate matter that enters the building and filters.

Many of these strategies for managing extreme heat and air quality require features on building envelopes, rooftops and sites. While HVAC and backup power system design isn't typically under the purview of DP guidelines, including and upsizing these systems to accommodate future climate conditions will have space implications that could affect building size and footprint, site layouts and set-backs, and on-site enclosures (e.g. heat pump and backup power). Designers should carefully select a combination of passive and mechanical approaches that will adequately protect occupant comfort and safety and consider how external-facing features (e.g. air conditioning units) can be made to fit in with existing neighbourhood character and minimize impacts on neighbouring viewscapes and soundscapes.



1661 Ontario Street in Vancouver's Olympic Village serves as a good example of many of the resilient design strategies noted in this section. It features a range of shading strategies including automatically controlled external shades that are mechanically raised and lowered to manage solar gains. Moreover, the courtyard on the podium level provides shading, green space and rainwater management.

Left Image Link

Right Image Link

1.5.2 Flooding and Extreme Events

There is an extensive array of strategies and best practices for managing flooding and extreme events, including approaches to prevent rainwater ingress into the building, convey flood waters away from the building, and capture and treat storm- and floodwaters on-site to manage runoff to neighbouring properties. Key design considerations for building design and site drainage are summarized below.

Building Design considerations

- Envelope rain screening, foundation waterproofing, roof and roof drainage design to convey water around the building and into perimeter drains.
- Designing vestibules at entryways to prevent overland flows into main floor areas and stairwells.
- Designing buildings that are within a floodplain to locate critical equipment above the flood construction level (FCL), with the potential for taller structures and mechanical and electrical equipment on rooftops or visible ground-level enclosures.
- Installing fixtures for flood barriers to be deployed during a river or coastal flood event.
- Including alternative power sources for backup power, including rooftop solar or backup generators and batteries in enclosures that may be visible from neighbouring properties.
- Designing envelope and outdoor furnishings to be strongly affixed for wind load resilience.

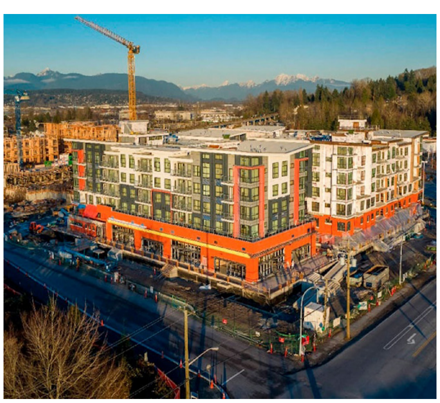
Site-scale considerations

- Siting buildings at higher elevations to be above the flood construction level may have implications for neighbour views and access to light.
- Designing site grading and drainage systems to convey floodwaters around and away from the building.
- Installing retaining walls and erosion control strategies that can affect the look and character of the public realm.
- Increasing use of nature-based approaches for stormwater management such as permeable pavement, stormwater ponds and rain gardens.
- Removal of large trees that may pose a limb-falling hazard during extreme wind storms.

1.5.3 Fire and Drought

While not all communities in BC are at risk of interface fires, key considerations for minimizing the risk of both interface fire and drought include the following:

- Prioritizing low-maintenance, drought, and heat-tolerant species to reduce deadwood and fire risk during drought.
- Trending toward drought-tolerant species, xeriscaping, or less green space to reduce maintenance during drought.
- Drawing on FireSmart recommendations to create an open buffer between trees and homes (noting that these can conflict with goals for shading and greenspace on private and public property).



The new Metro Apartments in the City of Surrey's South Westminster Neighbourhood provides clear design responses to its location in a high flood risk area. The main floor is raised above the flood construction level but remains easily accessible with considerate landscaping, which itself includes a variety of permeable surfaces. The sloped roof design is part a site wide rainwater management strategy.

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Right Image Link

Understanding Potential Trade-offs between High-Performance Design Strategies

Achieving high-performance buildings with high levels of energy efficiency while also thoughtfully responding to embodied carbon and resilience design considerations can be a balancing act. Design strategies that are beneficial for achieving one target may have implications for achieving another target. It is therefore important to take a holistic approach to design and understand the potential trade-offs. Some key examples are noted below.

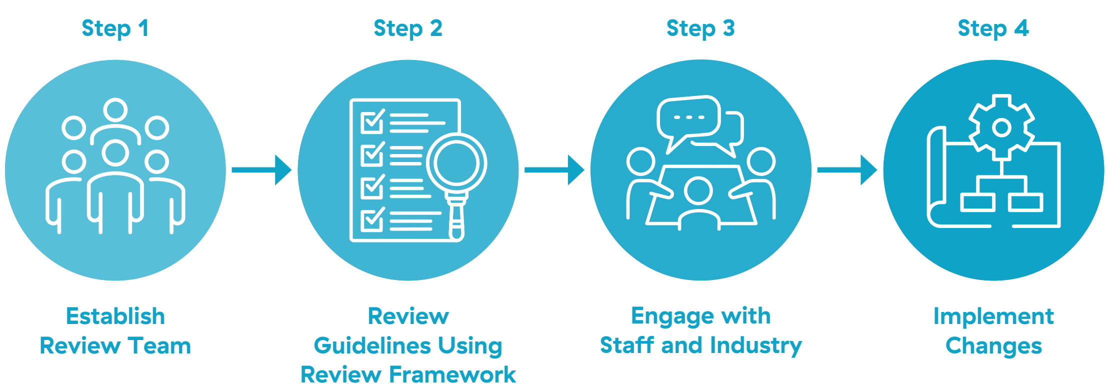
Description	Trade-off	
Increasing wall and roof thickness with greater insulation to achieve a high-performing building can lead to greater embodied carbon.	▼ **Lower** Total Energy Use	▲ **Higher** Embodied Carbon
Using exterior shading is an effective strategy to reduce the risk of overheating. However, it can also block beneficial solar gains in winter if not carefully designed, resulting in increased heating demand. The same is true for certain window coatings.	▼ **Lower** Risk of Overheating	▲ **Higher** Thermal Energy Demand
Operable windows and natural ventilation allow occupants to passively cool their space. However this may not be viable in instances when there is poor outdoor air quality or high-levels of noise pollution.	▼ **Lower** Risk of Overheating	▲ **Higher** Risk of Poor Indoor Air Quality
Including mechanical cooling and ventilation can eliminate any overheating issues and provide opportunities to control indoor air quality, but will also result in increased energy use.	▼ **Lower** Risk of Overheating	▲ **Higher** Total Energy Use
Adding high-performance filters into HVAC systems can be used to improve indoor air quality but can result in increased energy use.	▼ **Lower** Risk of Poor Indoor Air Quality	▲ **Higher** Total Energy Use
Dual aspect units allows more opportunity for natural ventilation but are often achieved with increased articulation or smaller floor plates, which can impact energy efficiency.	▼ **Lower** Risk of Poor Indoor Air Quality	▲ **Higher** Total Energy Use and Thermal Energy Demand

2

Recommended process for reviewing guidelines

2. Recommended process for reviewing guidelines

This section provides an overview of the recommended process for integrating high-performance design considerations to form and character guidelines.



Step 1 – Establish review team

It is recommended to establish an inter-department staff project team to guide the project and process, and to provide input from various points of view on the guidelines. The make up of this staff team will vary depending on the size and context of your municipality, but recommended staff include:

- ☑ **Community / Long Range Planning staff.** Commonly, this department writes the Development Permit Guidelines as part of long range planning efforts such as Official Community Plan or Local Area Plan processes.
- ☑ **Current / Development Planning staff.** Commonly, this department uses and implements the Development Permit Guidelines on a daily basis while reviewing development applications.
- ☑ **Sustainability / Climate Action staff** (if applicable). Commonly, sustainability staff will bring knowledge regarding high-performance design strategies and/or linkage between this work and broader Climate Action initiatives at the municipality, such as linking to objectives found in a Climate Action Plan.
- ☑ **Building Inspections staff.** Commonly, this department deals with the implementation of high-performance building requirements such as Step Code, and so will have unique perspectives on integrating high-performance design considerations through the development approvals process.

Step 2 – Review guideline documents using a review framework

Once the review team is established, it is recommended to systematically review existing guidelines using the following approach:

- ☑ Identify the most commonly used DP Guidelines that will be the basis for review (for example, DPA Guidelines for Form and Character that form part of the Official Community Plan, or Local Area Plan Guidelines that are regularly used by development planners). It is recommended to avoid reviewing design guidelines that are tied to Master Planned communities or guidelines that are not regularly used by development planning staff.
- ☑ Utilize the **Document Review Framework** found on the next page for areas to consider as part of your review, including:
  - Key high-performance design strategies (see **Table 1**)
  - Local Government Form and Character Priorities (see **Table 2**)
- ☑ Identify unique areas of consideration, emphasis, and/or priority in your local government in terms of form and character considerations. While there are some common areas of priority for form and character outcomes, every local government will have some unique considerations or priorities that should be addressed and/or explored in greater detail. Examples of this could include:
  - Importance of balconies as a key design strategy for livability and alternative balcony design strategies that can be used in high-performance buildings (e.g., exterior supported or thermally-broken slab balconies)
  - Heritage building considerations and interaction between high-performance buildings adjacent to heritage designated/registered buildings
- ☑ Review Guideline documents and highlight language that is identified as having implications with respect to the Key High-Performance Design Strategies outlined in **Table 1**. Flag these guidelines for further analysis.
- ☑ For any language that was flagged for further analysis, review and compare that language with the Common Local Government Form and Character Priorities (outlined in **Table 2** to identify possible tension points with respect to high-performance design.
- ☑ Bring forward these possible tension points with the internal staff team, to further refine findings and to identify possible recommendations for addressing.
  - For each possible tensions point, consider the recommended improvements identified in **Section 3** to address the language

Review Framework

This Review Framework identifies areas that are recommended to consider as part of a review process of local government Form and Character Guidelines for alignment with high-performance. These include

- Key high-performance design strategies (see **Table 1**)
- Local Government Form and Character Priorities (see **Table 2**)

High–Performance Building Form & Character Considerations

Key High-Performance Strategies for achieving the higher steps of the Energy Step Code that are most relevant to form and character guidelines are outlined in the table below.

Table 1: High–Performance Building Form & Character Considerations

Design Category	Key High–Performance Design Strategies
Optimized Site Planning and Orientation	• Consider solar orientation for passive heating benefits while mitigating overheating potential. • Consider existing and possible future shading from off-site as the context may change over time. • Consider orientation and building forms to support passive cooling/natural ventilation.
Massing and Articulation – Compact Building Form	• Consider energy performance when developing building massing and articulation, using strategies such as: » Simple massing to limit thermal bridging – reducing the number of complex junctions helps to minimize building envelope heat loss. » A compact building with a small form factor (e.g., less surface area in relation to the volume of interior space that is contained within). » More complex massing can be useful/assist building energy performance where this reduces overheating potential and improves daylighting. » Consider strategies for articulation that do not affect the thermal envelope (e.g., changes in colour and material, externally supported balconies, and limited shifts in the building face).

Design Category	Key High-Performance Design Strategies
Glazing, Shading and Daylighting	• Lower window-to-wall ratio (WWR) - a best practice target of 40% overall WWR can be used to reduce heat gain and loss through the building envelope. » WWR can be lower on north-facing facades (i.e., smaller or less windows facing north) than south-facing facades to account for lower solar gain potential. » Use glazing strategies on east/west facades to help reduce overheating risk. • Use exterior shading devices to balance solar gains throughout the year: » Prioritize horizontal shading on the southern elevation. This is not necessary on north-facing elevations. » Vertical fins are a good option for west and east-facing elevations. » Shading options range from fixed to operable, and from opaque to semi-transparent. • Natural ventilation - include operable windows to provide ventilation and help reduce mechanical heating and cooling requirements. • Use daylighting strategies to reduce the need for artificial light and associated energy use, and to improve occupant health, comfort, and well-being.
Balconies and Thermal Bridging	• Minimize thermal bridging in elements such as projecting concrete slabs (e.g., from balconies or decorative features) and beams that run from the building's interior to exterior. » Select balcony strategies that can reduce thermal bridging potential (e.g., exterior supported balconies, using structural thermal breaks for balcony connections)
Low Carbon Mechanical Systems	• Use low-carbon mechanical equipment such as heat recovery ventilators and heat pumps to meet BC Energy Step Code and Zero Carbon Step Code requirements. » In some cases, these systems have unique siting and sizing requirements which may lead to competition for space from other uses such as outdoor amenity space and rooftop solar photovoltaic panels. These competing demands should be balanced and considered.
Other considerations (e.g., embodied carbon, resilience)	• Consider the use of low embodied carbon materials in the design and construction of buildings. In some cases, the use of these materials may present implications for form and character (e.g., mass timber can in some cases present technical challenges with regard to building step backs or other articulation strategies

Common Local Government Form & Character Considerations & Priorities

The table below describes some common best practice form and character design considerations and priorities to capture as part of a guideline document review process.

Table 2: Common Form & Character Considerations & Priorities

Design Category	Common form and character guideline/urban design objective
Open Space	• Providing flexible and accessible public and private open spaces on site. • Providing private amenity spaces for apartment residents by using balconies and rooftop patios, as well as public amenity space. • The use of balconies as a key strategy to satisfying livability objectives and private outdoor amenity space requirements for multi-family residential development.
Relationship to the Street	• Siting and designing buildings to frame and activate streets and public open spaces. • Limiting adverse impacts on the public realm and pedestrian right-of-way from parking, site servicing, and access. • Provide high levels of transparent glazing at-grade to provide 'eyes on the street' and improve the pedestrian experience.
Building Articulation and Materials	• Designing buildings to enhance livability, visual interest, and sense of place through building form, architectural composition, and materials. • Articulation and form modulation - providing a variety of architectural features and details to achieve a unified and cohesive architectural concept and achieve the desired end state of creating a human-scale built environment (e.g., one that is optimized to be used by people and oriented towards pedestrian activity).
Other Considerations	• The need to develop cost-effective affordable housing (e.g., housing people can afford to rent/buy) with low ongoing energy costs for residents over the long-term.

Step 3 – Engage with staff and local development industry

It is best practice to conduct both staff engagement and industry engagement to supplement the document review. This engagement provides an opportunity for those working with the DPA guidelines to provide their thoughts on the key issues, opportunities and challenges with achieving high-performance buildings in relation city planning priorities. This could take several forms:

- ☑ Staff and industry workshop(s) or focus group(s) (e.g., Urban Development Institute, Architectural Institute of British Columbia, Canadian Home Builders Association)
- ☑ Presentation(s) and workshop(s) with Advisory Design Panel members (strongly recommended if applicable)
- ☑ Presentation(s) and workshop(s) with Development Advisory Committees (strongly recommended if applicable)

Examples of questions to consider asking to both staff and industry include:

- ☑ What are some examples of high-performance (i.e. Step 3 or higher of Energy Step Code) building projects that have sought approvals in the municipality?
- ☑ What challenges have you experienced in achieving high-performance buildings in relation to development permit form and character guidelines?
- ☑ What design strategies have you had successes or challenges with (either in design or construction)?
- ☑ What solutions do you think would help achieve the multiple goals you're being asked to meet?

Step 4 – Implement changes

Depending on the result of the review process and your municipal context, there are several different approaches for integrating high-performance design considerations to existing form and character guidelines:

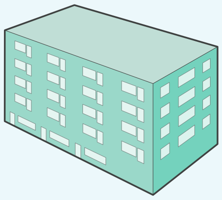
1. **Review and Update Guideline Documents** and/or write new Guidelines to better align and harmonize high-performance design strategies with urban design best practices.
2. **Provide design exemptions and allowances** for demonstrated high-performance buildings for certain strategies (e.g., balconies, articulation, floor plate size). In this approach, an applicant describes what form & character guidelines their project needs to be exempted from with a rationale as to why, and then the Director of Planning (or equivalent) decides whether to allow it or not.
3. **Create Standalone / Supplemental Documents** for high-performance buildings, including illustrative case studies demonstrating key concepts.

These implementation options should be discussed with the internal staff working group to determine the most suitable option for your municipality.

3

Recommended guideline language for supporting high-performance

3.1 Massing and articulation



Overview

- A common form and character consideration is to articulate building facades in order to break up their apparent bulk, add visual interest, and design buildings to the human scale.
- High-performance buildings typically have more simplified massing to limit thermal bridging, as fewer complex junctions help to minimize building envelope heat loss.
- However, there are a number of articulation strategies that can be used in high-performance buildings to meet form and character objectives and add visual interest, including:
  - » Simple shifts in massing (careful and modest facade modulation).
  - » The use of colours and materials to provide visual breaks and help proportion the building's visual mass.
  - » Other strategies that can be accommodated outside of the building's thermal envelope (e.g., the use of facade projections or balconies that are fastened to the building from outside of the building's thermal envelope).
- While modest articulation can be accommodated, challenges for high-performance buildings can arise when guidelines are interpreted in a way that leads to overly complex building facades, with articulation and facade modulation to a level that impedes energy performance.

Recommendations to consider when updating guidelines

Common Guideline	Tension with High-performance Design Strategies	Recommended Guideline Improvements
Guidelines often call for using a variety of strategies to articulate buildings to break up massing and achieve more of a 'human scale' design. Such strategies include stepping back or extending forward a portion of the building facade, providing a stepped roof, repeating window patterns, and providing cornice details.	High-performance buildings typically have simple massing to limit thermal bridging, as fewer complex junctions help to minimize building envelope heat loss.	Articulation can be achieved in high-performance building, include thoughtful and careful facade modulation. Revising or adding a new guideline to consider the impact of massing and articulation on building performance and identifying strategies is recommended. **Example improved guideline:** *Consider the impact of massing and articulation on energy performance, including consideration for strategies such as: [a] Designing buildings with a simplified form, using simple shifts in massing and fewer complex junctions to minimize building envelope heat loss; and [b] Using articulation strategies for the building facade that are able to be done outside of the building thermal envelope, such as changes in exterior colours, textures, and materials.*

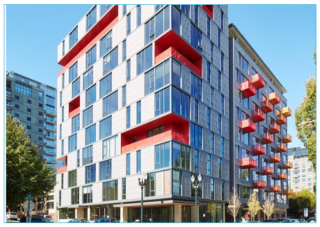
A variety of articulation strategies can be accommodated in high-performance buildings

EASIER TO ACCOMMODATE

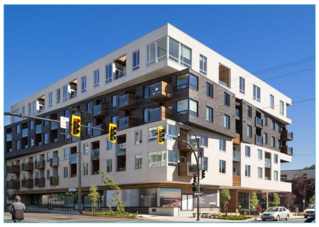
MORE CHALLENGING TO ACCOMMODATE

Simple building form with use of materials, and window bays for articulation..

Use of materials, colour, and modest facade modulation.

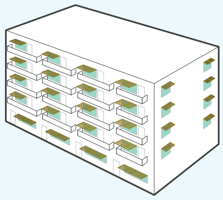


Use of colour, modest facade modulation, use of recessed and extended balconies.



More significant facade modulation and use of recessed and extended balconies.

3.2 Glazing, shading and daylighting



Overview

- High-performance buildings can achieve an active/transparent frontage at grade (e.g., higher WWR) while achieving a lower overall WWR as a high-performance design strategy.
- Window size and location, as well as the use of exterior shading, is unique on every project depending on its site and location.
- Having guidelines that accommodate lower WWR and the use of exterior shading devices provide flexibility to designers who are using such approaches to meet energy performance requirements.
- A co-benefit of exterior shading mechanisms is that they address both improved resilience to future climate scenarios (limiting overheating potential) and improve livability and occupant comfort.
- Daylighting is an important consideration to reduce artificial lighting (and associated energy usage) and improve occupant comfort and livability, and such should also be taken into consideration when developing glazing strategies.

Recommendations to consider when updating guidelines

Common Guideline	Tension with High–performance Design Strategies	Recommended Guideline Improvements
Guidelines often encourage the extensive use of glazing at grade to promote eyes on the street and create an active frontage. In some cases Guidelines also encourage the use of extensive glazing above the ground floor as a strategy to reduce the perceived bulk of the building massing.	» The quality and number of windows are critical to high-performance. » A lower overall WWR is a common high-performance design strategy (with 40% overall considered an industry best practice target). » Active frontages with transparent glazing at grade can be accommodated in larger projects while accommodating a lower overall WWR.	» Note higher WWR is acceptable at grade for active frontage, but remove guidelines encouraging extensive glazing on upper floors as this would present barriers to achieving high-performance. **Example improved guideline:** *For larger buildings, consider targeting an overall window-to wall ratio (WWR) of 40% to reduce heat gain and loss through the building envelope by increasing the area of insulated wall. Additional considerations include:* » *Higher WWR ratios can be accommodated at grade to promote at-grade transparency while accommodating the 40% WWR in the building overall.* » *Lower WWR ratios can be accommodated on north facing facades to account for lower solar gain potential.* » *Daylighting potential should also be considered when establishing window size and location.*

Recommendations to consider when updating guidelines

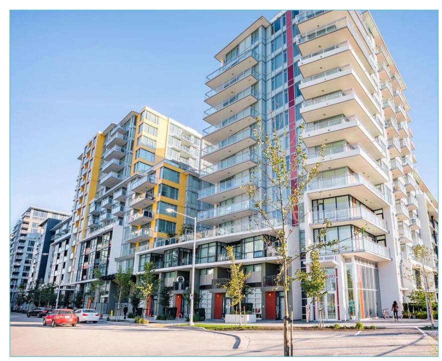
Common Guideline	Tension with High-performance Design Strategies	Recommended Guideline Improvements
Shading: Guidelines commonly reference the use of exterior building ornaments such as awnings and cornices, but rarely note the use of exterior shading device.	**Shading:** The use of exterior shading devices can be helpful to balance solar gains throughout the year to minimize energy use for heating and cooling and maximize occupant comfort in the warmer months.	**Shading:** » Consider adding guidelines to accommodate and support the use of exterior shading devices. **Example guideline:** *Use appropriately designed exterior shading devices to block unwanted solar gains in warmer months while welcoming solar gains from lower winter sunlight. Additional considerations include:* » *Their use should be prioritized on southern elevations.* » *Shading is not necessary on north-facing facades.* » *Vertical fins are a good strategy to use for blocking incoming summer sun on western elevations.*

A variety of glazing strategies can be accommodated in high-performance buildings

EASIER TO ACCOMMODATE — MORE CHALLENGING TO ACCOMMODATE

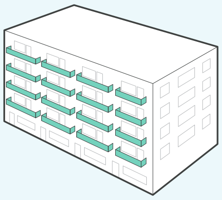
Low overall WWR with an active frontage and integrated shading.

Lower overall WWR with an active, transparent frontage.



Higher overall WWR with active (residential) frontage.

3.3 Building envelope and limiting thermal bridging



Overview

- Because of the potential for extensive thermal bridging (and associated implications for meeting Energy Step Code targets related to building envelope performance, careful consideration of alternative balcony design approaches, together with how to balance the associated potentially competing demands of urban design and energy performance, should be communicated and accommodated in guidelines.
- Externally supported balconies look differently than cantilevered balconies due to the external supports, and guidelines should acknowledge and accommodate this. There are building products designed to create structural thermal breaks for balcony connections. These add cost to building design, but limit thermal bridging and should be accommodated in guidelines as a strategy to consider.

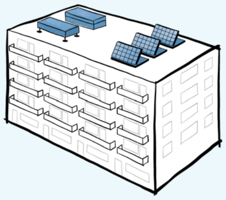
Recommendations to consider when updating guidelines

Common Guideline	Tension with High-performance Design Strategies	Recommended Guideline Improvements
The use of balconies is often encouraged in guidelines in order to provide an important source of private outdoor amenity space in multi-unit residential buildings.	» Balconies can be a significant source of thermal bridging, which can impact a project's ability to meet Energy Step Code TEDI targets. » Where balconies are used, detailing can be incorporated to minimize the thermal bridging to an acceptable level. However, there is a cost to this sort of detailing.	» Add language supporting balcony design strategies that limit thermal bridging (e.g., exterior supported, structural thermal breaks in slabs), as well as supportive and descriptive precedent imagery and diagrams. » Consider the energy implications of recessed balconies and review guidelines where these are encouraged, as they can be accommodated in simple building forms but can be challenging if they contribute to overly complex massing. **Example improved guideline:** *Incorporate and design balconies and other private outdoor amenity spaces to be an extension of interior living space to maximize usability and comfort, while balancing the significant potential for heat loss through thermal bridge connections which could impact energy performance. Consider strategies such as:* » *Balcony designs that reduce thermal bridging potential, such as exterior supported balconies, bolt-on balconies, and using structural thermal breaks for balcony connections.*

A variety of balcony strategies can be accommodated in high-performance buildings

See **Section 5.11** for an overview of high-performance balcony strategies.

3.4 Active strategies and low carbon mechanical systems



Overview

- Active strategies for high-performance tend to have less implications for building form and character, with the exception of some siting and visual impact considerations. These considerations are outlined below.

Illustrating mechanical and renewable energy design considerations

Photo: Ari Burling

The Goldin at Essex Crossing, New York City

Dattner Architects

Example of a podium rooftop with a green roof, outdoor amenity space, and rooftop mechanical system concealed by architectural screening strategy that addresses site lines from rooftop users and adjacent units/buildings.

Photo: Tom Arban

Daphne Cockwell Health Sciences Complex and Student Residence, Toronto ON

Perkins & Will

Example of a podium rooftop with a green roof, outdoor amenity space, and rooftop mechanical system concealed by architectural screening, illustrating a possible strategy for integrating and balancing competition for space.

Photo: Ben Guthrie

Daramu House, Sydney

Tzannes

Example of a rooftop with solar photovoltaic array as well as green roof and open space, illustrating a possible strategy for integrating and balancing competition for space.

Photo Credit: SPolarPV

Example of building integrated photovoltaics (BIPV), illustrating a possible strategy that could be used to reduce competition for outdoor amenity space.

4

Recommended additional areas to consider

4. Recommended additional areas to consider

4.1 Engaging Advisory Design Panels on high-performance design concepts

If applicable to your local government context, engaging with Advisory Design Panels (ADPs) as part of a DP Guideline review process is recommended to capture input and feedback on the approach and any proposed revisions. ADPs are often made up of design leaders in the community and they can provide unique insights on design challenges and opportunities in your community.

In particular, it is recommended to:

- Present on the purpose of the project, including drawing linkage to Climate Plan Objectives and/or Energy Step Code and Zero Carbon Step Code adoption schedules, as applicable to your local government context.
- Present on the key common high-performance design strategies found in **Section 1**, to level-set on knowledge and awareness so that ADP members are conversant in high-performance design strategies and can comment appropriately on high-performance building applications.
- Utilize the examples and visuals found in this Guide to demonstrate concepts and educate ADP members.
- Gather input on challenges and successes in implementing high-performance building design in the context of your local government.
- Gather input on design considerations or challenges that are unique to your local government.

4.2 Creating supplemental educational materials for staff, Councils, and applicants

The creation of supplemental materials to educate staff on high-performance design considerations is recommended to better support design conversations with applicants. This Guide is intended to partially serve that purpose, but local governments may wish to explore additional materials or opportunities to educate staff, Councils, and applicants on:

1. High-performance design considerations for meeting the requirements of the BC Energy Step Code and BC Zero Carbon Step Code, as well as embodied carbon reduction and resilient design considerations.
2. How high-performance building design strategies can align with form and character objectives found in the local government's Development Permit Area Design Guidelines.

Such a resource would be intended for staff, Councils, and applicants to support the development of well-designed high-performance buildings.

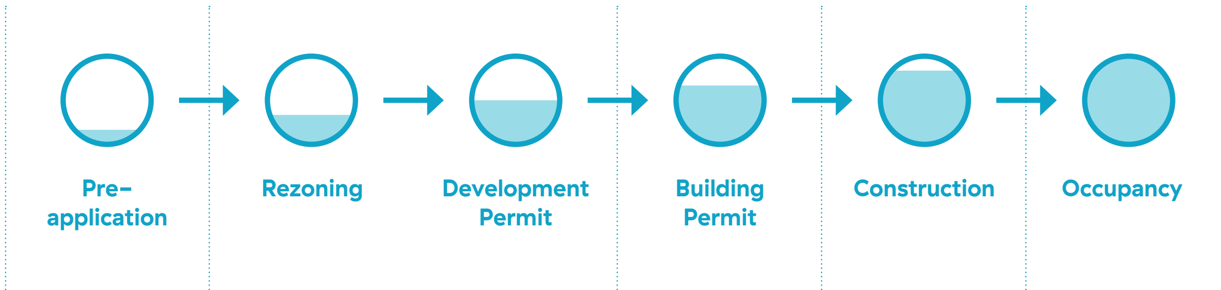
4.3 Coordinating internal processes to support high-performance buildings

Another common issue that local governments experience is a disconnect between high-performance design requirements and conversations at the Development Permit (DP) stage with those at the Building Permit (BP) and Occupancy Stage.

It is recommended that staff conduct meetings with development planning and building inspections staff to develop an internal process for ensuring a clean handoff of high-performance considerations throughout the development process. For example, processes for ensuring:

- Communication of high-performance design strategies and requirements of projects between DP and BP stage
- Consistency of high-performance design reporting at each stage of review process

The diagram below outlines some common local government sustainability requirements currently in practice, as well as some recommended additional areas to explore as high-performance touch points throughout the development application process.



Current Common Sustainability Requirements		Development Permit and/or Rezoning Application **acknowledges Zero Carbon Step Code and BC Energy Step Code requirements**; Energy Modeller works with the design team to ensure that the design meets these requirements		**Pre-Construction Energy and Zero Carbon Design Checklist** is completed by an Energy Modeller and submitted with the Building Permit Application with letters of assurance demonstrating compliance with the Zero Carbon Step Code and BC Energy Step Code requirements.	Construction complete and **whole-building air tightness testing** is undertaken	**As-Built Energy Design Report** is completed by an Energy Modeller and submitted with the Occupancy Permit application demonstrating compliance with the Zero Carbon Step Code and BC Energy Step Code requirements
Recommended new areas to consider		• **Embodied carbon reporting** requirements as part of rezoning application • Ensure **Zoning Bylaw is aligned** with high-performance design considerations	• Ensure **DP Guidelines are aligned** with high-performance design considerations • **Resilient design checklist** requirement as part of DP application	• **Embodied carbon reporting** requirements as part of building permit application		

4.4 Reviewing zoning bylaws concurrent to undertaking the guideline review

In addition to the guidance related to integrating high-performance design considerations into form and character guidelines, it is recommended that local government review zoning bylaws to identify potential barriers to high-performance building design strategies that may be present.

The BC Hydro Local Government Low Carbon Building Toolkit provides recommendations and model bylaw language for addressing barriers to high-performance buildings that may be present in existing zoning bylaws. These include:

- Floor Area Ratio definitions that do not discourage the use of thicker wall assemblies.
- Building Setback requirements that do not discourage thicker wall assemblies
- Building Setback requirements that do not limit exterior heat pump condensing unit siting
- Building height limits that do not discourage thicker roof assemblies
- Building height limits that do not discourage rooftop mechanical and renewable energy system installations, and
- Noise bylaws & interpretations that do not inappropriately penalize heat pumps.

Given the similar nature of this work, communities often establish a project where this Zoning Bylaw review is completed concurrently to a DP Guideline review.

5

Illustrative Case Studies

5.1 Illustrative Case Studies Overview

The purpose of the case studies in this section is to demonstrate how high-performance design can be achieved alongside form and character objectives.

In each, high-performance design strategies (for example, in order to meet the Higher Steps of the Step Code) are highlighted and described, as well as how the project is successful in meeting the design principles found in common municipal Development Permit Design Guidelines.

Case studies are provided for the typologies noted below. Additionally, 1-page summaries have been created to illustrate key high-performance design strategies.

Multiplex Case Study

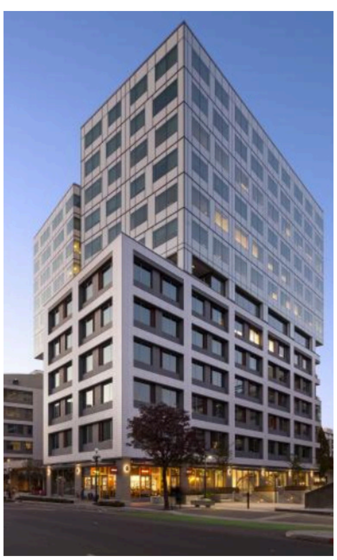
Futrhaus: Vancouver BC

Mid-Rise Case Studies

The Heights, VancouverBC

Evolve, Vancouver BC

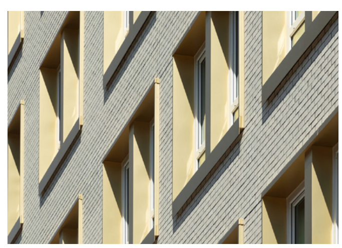
High-Rise Case Studies



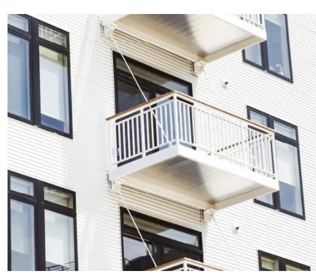
750 Pandora, Victoria BC

981 Davie, Vancouver BC

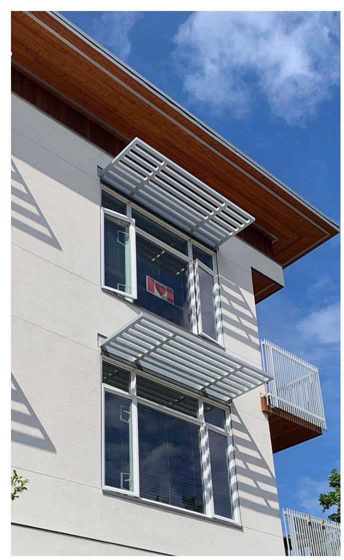
Core Concept Case Studies



High-performance **articulation** strategies



High-performance **balcony** strategies



High-performance **glazing and shading** strategies

5.2 High-performance Multiplex Case Study

Futrhaus, Vancouver BC

b Squared Architecture Inc. | Passive House project

This townhouse project consists of three separate three storey units. The building uses increased insulation, minimal thermal bridging, strong airtightness, and efficient mechanical systems to meet the Passive House standard (exceeding performance requirements of the top Step of the Step Code).

Photo: EIC Media

ALIGNMENT WITH FORM + CHARACTER OBJECTIVES

HIGH-PERFORMANCE DESIGN STRATEGY

Photo: Lee + Perry Real Estate Group

Photo: Lee + Perry Real Estate Group

This project demonstrates the following design outcomes outlined in common DPA guidelines:

1. Clearly visible primary entries, with front stoop, detailing, and weather protection
2. Semi-private transition zone from street to building entry
3. Compatible massing with adjacent buildings
4. Traditional (pitched) roof form to reinforce neighbourhood character
5. Private outdoor amenity space (both at grade and with rooftop patio)
6. Green outdoor amenity space and access from rear lane

This project demonstrates the following high-performance design strategies:

7. Efficient window placement and technology (triple-pane window assemblies)
8. Simplified form and massing, while accommodating pitched roof form and some facade modulation

Super well-insulated and airtight building envelope and highly efficient mechanical systems (note that these high-performance design strategies do not impact form & character)

5.3 High-performance Mid-Rise Case Study

The Heights, Vancouver BC

Eighth Avenue Developments | Cornerstone Architecture

Passive House project | Rental

This building is a good example of how a simple, compact building form with modest facade articulation can be aesthetically pleasing. This building also has a transparent, active frontage, contributing positively to the streetscape.

Photo: Christian Laub, Eighth Avenue Developments

ALIGNMENT WITH FORM + CHARACTER OBJECTIVES

HIGH-PERFORMANCE DESIGN STRATEGY

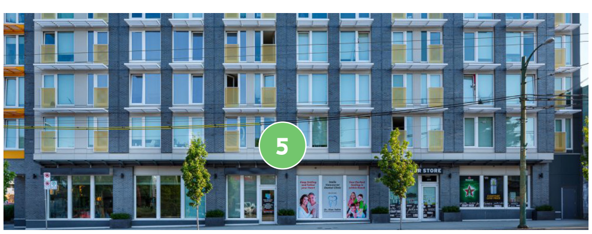


Photo: Christian Laub, Eighth Avenue Developments

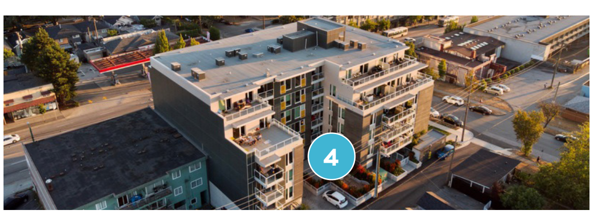


Photo: Christian Laub, Eighth Avenue Developments

This project demonstrates the following design outcomes outlined in common DPA guidelines:

1. Clearly visible primary entry, with architectural detailing and weather protection
2. Active and transparent frontage, with architecturally-integrated weather protection
3. High-quality, durable material use, and use of accent colour and change in materiality as an articulation strategy
4. Use of (thermally-broken) balconies and terraced roof for private outdoor amenity space

This project demonstrates the following high-performance design strategies:

5. Low overall window-to-wall ratio, with active and transparent frontage. Exterior shading devices balance solar gain
6. Compact building form with simplified massing, relying on modest shifts in massing and change in materials for articulation

5.4 High-performance Mid-Rise Case Study

Evolve, Vancouver BC

UBC Properties Trust | ZGF Architects

This residential building is a good example of a compact building form with simplified massing, that uses architectural detailing and materials for articulation. It also demonstrates strong relationship to the street with clear entries, and includes rooftop photovoltaic panels as an active design strategy for on-site energy generation.

Photo: ZGF Architects

ALIGNMENT WITH FORM + CHARACTER OBJECTIVES

HIGH-PERFORMANCE DESIGN STRATEGY

Photo: ZGF Architects

This project demonstrates the following design outcomes outlined in common DPA guidelines:

1. Clearly visible primary entry, with architectural detailing and weather protection
2. High-quality, durable material use, and use of accent colour and change in materiality as an articulation strategy
3. Use of (thermally-broken) balconies and terraced roof for private outdoor amenity space

This project demonstrates the following high-performance design strategies:

4. Low overall window-to-wall ratio, with active and transparent frontage
5. Compact building form with simplified massing, relying on architectural detailing and materials for articulation
6. Passive and active shading elements
7. On-site renewable energy (rooftop photovoltaic panels)

5.5 High-performance High-Rise Case Study

750 Pandora, Victoria BC

Jawl Properties | D'Ambrosio Architecture + Urbanism | Highest level of Step Code

This commercial building is a good example of strategic glazing on a large, high-rise building project. It has an attractive, active frontage with frequent entries, while maintaining a lower overall window-to-wall ratio. It also has a relatively simplified massing within its podium/tower arrangement.

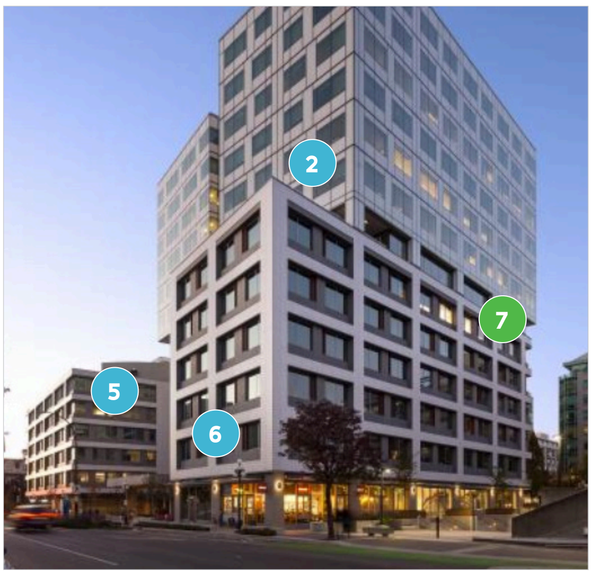


Photo: Jawl Properties

ALIGNMENT WITH FORM + CHARACTER OBJECTIVES

HIGH-PERFORMANCE DESIGN STRATEGY

This project demonstrates the following design outcomes outlined in common DPA guidelines:

1. Active and transparent frontage, with architecturally-integrated weather protection
2. Step-back to limit massing impact on solar access to adjacent streets
3. High-quality, durable material use, and use of detailing around windows as an articulation strategy
4. Ample pedestrian right of way with street trees and furniture, as well as on-site plaza
5. Facade modulation to break up building mass

This project demonstrates the following high-performance design strategies:

6. Low overall window-to-wall ratio, with active and transparent frontage
7. Compact building form with simplified massing, relying on architectural detailing and materials for articulation

Super well-insulated and airtight building envelope and highly efficient mechanical systems (note that these high-performance design strategies do not impact form & character)

5.6 High-performance Mass Timber High-Rise Case Study

981 Davie, Vancouver BC

New Commons Development and Community Land Trust on behalf of VAHA | Targetting Passive House

This mass timber building is a good example of simplified massing on a high-rise building form, with the use of materiality, thermally-broken balconies, and glazing detailing as an articulation strategy. The building also includes a welcoming and active frontage and high quality amenity space for residents.

Photo: ZGF Architects

ALIGNMENT WITH FORM + CHARACTER OBJECTIVES

HIGH-PERFORMANCE DESIGN STRATEGY

Photo: ZGF Architects

This project demonstrates the following design outcomes outlined in common DPA guidelines:

1. Clearly visible primary entry, with architectural detailing and weather protection
2. Active and transparent frontage, with architecturally-integrated weather protection
3. High-quality, durable material use, and use of detailing around windows as an articulation strategy
4. Terraced roof for private outdoor amenity space

This project demonstrates the following high-performance design strategies:

5. Mass Timber construction
6. Use of (thermally-broken) balconies

5.7 Illustrating a high-performance articulation strategy (Part 9)

The use of simplified massing is a common high-performance design strategy. However, this does not mean that high-performance buildings cannot be visually appealing or use strategies to minimize the visual bulk of the building.

The purpose of this Case Study is to illustrate an articulation strategy that was used in a high-performance building.

Photo: EIC Media

ALIGNMENT WITH FORM + CHARACTER OBJECTIVES

HIGH-PERFORMANCE DESIGN STRATEGY

Photo: Lee + Perry Real Estate Group

Photo: Lee + Perry Real Estate Group

Futrhaus, Vancouver bc

b Squared Architecture Inc.

Passive House (exceeds highest level of the Energy Step Code).

This triplex project consists of three separate three storey units. The building uses increased insulation, minimal thermal bridging, strong airtightness, and efficient mechanical systems to meet the Passive House standard (exceeding performance requirements of the top Step of the Energy Step Code).

This project demonstrates the following design outcomes outlined in common DPA guidelines:

1. Clearly visible primary entries, with front stoop, detailing, and weather protection.
2. Semi-private transition zone from street to building entry.
3. Compatible massing with adjacent buildings.
4. Traditional (pitched) roof form to reinforce neighbourhood character, and use of carefully detailed dormers.
5. Private outdoor amenity space (both at grade and with rooftop patio).
6. Green outdoor amenity space with access from rear lane.

This project demonstrates the following high-performance design strategies:

7. Efficient window placement (fewer large windows located to optimize envelope efficiency and maximize daylight) and technology (triple-pane window assemblies).
8. Simplified form and massing, while accommodating pitched roof form, dormers and some modest facade modulation. Super well-insulated and airtight building envelope and highly efficient mechanical systems (note that these high-performance design strategies do not impact form & character).

5.8 Illustrating a high-performance articulation strategy (Part 3)

The use of simplified massing is a common high-performance design strategy. However, this does not mean that high-performance buildings cannot be visually appealing or use strategies to minimize the visual bulk of the building.

The purpose of this Case Study is to illustrate an articulation strategy that was used in a high-performance building.

Photo: GMC Projects

ALIGNMENT WITH FORM + CHARACTER OBJECTIVES

HIGH-PERFORMANCE DESIGN STRATEGY

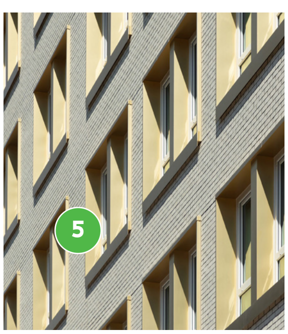


Photo: Gair Williamson Architect

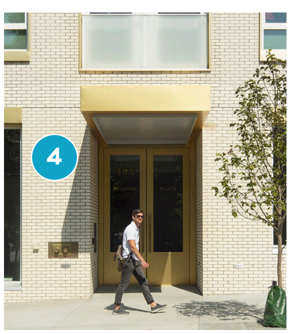


Photo: GMC Projects

Brixton Flats, Vancouver BC

GMC Projects

Passive House (exceeds highest level of the Energy Step Code).

This building is a good example of how a simple, compact building form with minimal articulation can be aesthetically pleasing. This building also has a transparent, active frontage, contributing positively to the streetscape.

This project demonstrates the following design outcomes outlined in common DPA guidelines:

1. Clearly visible primary entry, with architectural detailing and weather protection.
2. Active and transparent frontage, with architecturally-integrated weather protection.
3. Strong window alignment with adjacent buildings.
4. High quality, durable material use, and use of detailing around windows and doors as well as cornice lines as an articulation strategy.

This project demonstrates the following high-performance design strategies:

5. Low overall window-to-wall ratio, with active and transparent frontage. Recessed windows serve as solar shading devices to balance solar gain.
6. Compact building form with simplified massing, relying on architectural detailing and materials for articulation.
7. Use of juliet balconies for access to outdoors, as well as shared rooftop amenity space.

5.9 Illustrating high-performance glazing strategies

The purpose of the images below is to demonstrate effective use of glazing strategies that align with high-performance design as well as form and character design strategies.

HIGH-RISE COMMERCIAL BUILDING

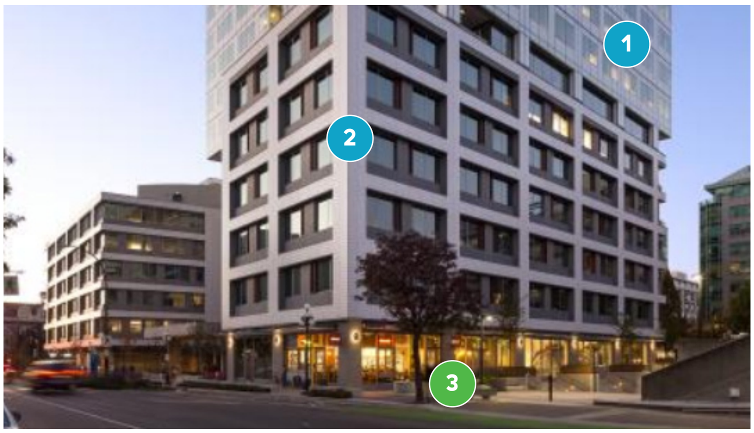


Photo: Jawl Properties

ALIGNMENT WITH FORM + CHARACTER OBJECTIVES

HIGH-PERFORMANCE DESIGN STRATEGY

750 Pandora, Victoria bc

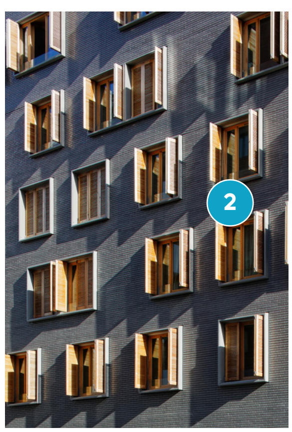
D'Ambrosio Architecture + Urbanism

Highest Level of the Energy Step Code

This building is a good example of strategic glazing on a large, high-rise commercial building project. It has an attractive, active frontage with frequent entries, while maintaining a lower overall window-to-wall ratio. It also has a relatively simplified massing within its podium/tower arrangement.

1. Simplified massing.
2. Low window-to-wall ratio (WWR).
3. Active frontage with higher WWR.

MID-RISE RESIDENTIAL / MIXED USE



Zac Boucicaut, Paris

Michel Guthmann Architecture et Urbanisme

This building demonstrates a low overall window-to-wall ratio with the use of punched windows as well as the use of different shading strategies on different facades (movable shutters on one, overhangs/extensions on another), as well as the use of operable windows. The building also provides on-site outdoor amenity space via an interior courtyard.

1. Simplified massing with minimal articulation.
2. Low overall WWR, with transparent frontage and use of different exterior shading strategies on different facades (movable shutters on one, overhands/extensions on another).
3. Perimeter block form with active frontage.

5.10 Illustrating high-performance shading strategies

The purpose of the images below is to demonstrate effective use of shading strategies that align with high-performance design as well as form and character design strategies.

EXTERIOR SHADING STRATEGIES

Photo: Trait Architects

Photo: Trait Architects

École Mariemont-bonne, Brussels

Trait Architects | Passive House

This unique mixed use project (13 social housing units + school and daycare) provides a good example of the use of exterior shading and lower WWR on a unique mixed use project.

Photo: Eduard Hueber

Student Residence, Vienna

Baumslager + Eberle Architects | Passive House

This student residence has a low WWR and takes a unique approach to exterior shading, using movable copper panels.

Photo: Devon Miller

The Clive, Victoria bc

Cascadia Architects

This mixed use project demonstrates effective use of horizontal shading devices on the south-facing facade, and a low overall WWR.

Photo: Devon Miller

5.11 Illustrating high-performance balcony strategies

The purpose of the images below is to demonstrate three common high-performance balcony strategies that can be used to limit thermal bridging associated with more typical balcony designs. Externally supported balconies look differently than cantilevered balconies due to the external supports, and guidelines should acknowledge and accommodate this. There are building products designed to create structural thermal breaks for balcony connections. Such thermally broken balconies, including externally supported balconies, currently cost more than conventional construction - with thermally broken concrete being the most expensive approach. However, they do limit thermal bridging and should be accommodated in guidelines as a strategy to consider.

Self-supported balconies

Photo: www.copal-balcony.com

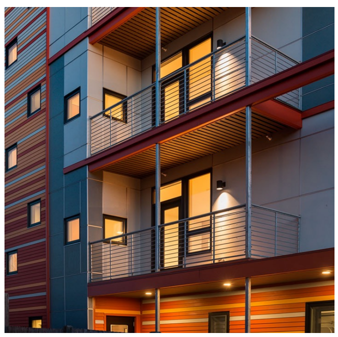


Photo: www.wright-ryan.com

Hung Balconies

Photo: www.gbdmagazine.com

Photo: Tim Van de Velde

Thermally-broken steel balconies

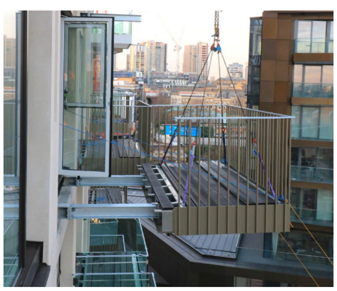


Photo: Sapphire Balconies

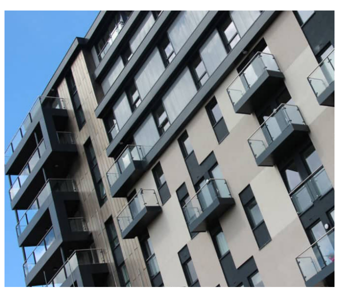


Photo: Sapphire Balconies

Photo: Sapphire Balconies

Photo: Sapphire Balconies

Thermally-broken concrete slab balconies

Photo: Schock

Photo: Schock

Candela Lofts Passive House, Hoboken NY. Photo: Schock

Lido, Vancouver. Photo: Schock

6

Best practices and resources

6. Best practices and resources

This section provides an overview of Best Practices and Resources for integrating high-performance design considerations in DP guidelines.

- **Best Practices** draw from recent relevant projects undertaken by local governments to provide examples of the successful integration of high-performance building design considerations into planning processes.
- **Resources** include recent design guides and policy toolkits that provide additional content and recommendations to support this type of work.

6.1 Local government project summaries

The table below summarizes relevant projects that local governments in BC have undertaken to integrate high-performance building design considerations into development permit guidelines, zoning bylaws and development policies.

These project descriptions and understandings are based on recent project experience as well as interviews conducted with local government staff. The projects are listed in order of recency, with additional commentary on the stage of implementation provided in the right column.

Table 3: Relevant Local Government Project Overviews

Local Government	Project Description	Relevant Documents	Year Completed and Stage of Implementation
City of Vancouver Chris Higgins, *Senior Green Building Planner* Patrick Enright, *Senior Green Building Engineer* Sailen Black, *Senior Green Building Planner*	Vancouver has developed several policies and bulletins to support applications for high-performance buildings, including the Zero Emissions Building Catalyst Policy and Zero Emissions Building Catalyst Bulletins (2023). These documents include relaxation for frontage, floor plate, balconies and built form. In terms of implementation, the policy provides the director of planning to power to give variances or relaxations to building design for buildings that will be certified Passive House or better in terms of performance.	• Zero Emissions Building Catalyst Policy • Guidelines for the Administration of Variances for Zero Emission Buildings in RS, RT and RA Districts • Guidelines for the Administration of Variance in Larger Zero Emission Buildings	Project completed in **January, 2018**. **Stage of implementation:** The Guidelines and Policy were adopted by Council in January 2018 and have been in use by staff since.

Local Government	Project Description	Relevant Documents	Year Completed and Stage of Implementation
City of Victoria Joaquin Karakas, *Senior Urban Designer*	Victoria undertook a review and recommendations process for improving alignment between the City of Victoria's development permit guidelines and high-performance design considerations. The final report included recommendations for strengthening guideline language to remove barriers and improve support for high-performance buildings in Victoria, including a particular focus on integration considerations for heritage buildings.	Downtown Core Area Plan Guidelines See Appendix 4 – Design Guidelines, Section 4 – Alignment with High Performance Buildings (page 148A)	Project completed in **February, 2021**. **Stage of implementation:** Project included reviewing and making recommendations for Section 4 – Alignment with High Performance Buildings in the Downtown Core Area Plan Guidelines, which were adopted by Council in July, 2022 and have been in use by staff since.
Township of Langley Kevin Ramlu, *Green Buildings Manager*	During a revamp of their GHG DPA Guidelines in 2019, the Township identified some potential conflicts with their form and character guidelines. These elements were flagged for future review, and this will likely be addressed in a future project where they will consolidate 15 separate form and character guidelines into one guidance document going forward.	Energy conservation and GHG emission reduction Development Permit Area (GHG DPAs) requirements	Project Completed in **July, 2021**. **Stage of implementation:** No regulatory changes have been implemented as of yet. The result of the project was a report that identified regulations that limit the effectiveness or viability of the proposed GHG DPA guidelines or other energy efficiency/GHG reducing measures.
City of Kelowna Danielle Noble-Brandt, *Department Manager of Policy & Planning*	Kelowna updated its Development Permit Area (DPA) Design Guidelines as part of a broader OCP Update Process in 2020. This project included the creation of a consolidated and modernized set of Guidelines for projects across the City. The new DPA Guidelines document also includes a section on High-Performance Buildings, which outlines design strategies for achieving the highest Steps of the Energy Step Code.	Form & Character Development Permit Guidelines: General Residential & Mixed Use See Section 2.2 Achieving High Performance	Project Completed in **August, 2021**. **Stage of implementation:** The "Achieving High Performance" section was included in the DPA Guidelines adopted by Council. Staff have been using the guidelines on new development projects since then. Staff did note that they could use some additional education on using/implementing these guidelines.

Local Government	Project Description	Relevant Documents	Year Completed and Stage of Implementation
City of Richmond Nicholas Heap, *Sustainability Projects Manager*	Richmond undertook a review and recommendations process for improving alignment between existing development permit guidelines and high-performance design considerations for various common building typologies, with a focus on high-performance balcony designs and alternative building articulation strategies. The process concluded that, like Step Code, Richmond's DP Guidelines are generally performance-based and not prescriptive, which provides opportunities for alternative ways of satisfying energy requirements without compromising the City's form and character objectives.	Council Report (Pages 71-106)	Project Completed in **May, 2022**. **Stage of implementation:** As part of a Council report bringing forward Energy Step Code and GHG requirements for new buildings, Richmond's Development Permit Guidelines regarding green buildings and sustainable infrastructure were updated to encourage innovative, high-performance design strategies that meet both Step Code requirements and desired form and character outcomes.
District of Saanich Rebecca Newlove, *Manager of Sustainability*	Saanich is currently in the process of updating its Development Permit Area (DPA) Design Guidelines as part of a broader OCP Update Process. This project has included the creation of a consolidated and modernized set of guidelines for projects across the District. The new DPA Design Guidelines document also includes a section on Zero Carbon, Resilient, and High-Performance Buildings, which outlines design strategies for achieving the highest Steps of the Energy Step Code, the Zero Carbon Step Code, as well as embodied carbon considerations.	Draft Development Permit Area Guidelines See Section 3.3 - Zero Carbon, Resilient, High-Performance Buildings	**Project currently ongoing.** **Stage of implementation:** Draft Guidelines will be presented to Council for adoption on November 27, 2023. Additional meetings with staff are to be held in Q1 2024 along with supplementary materials to support education on high-performance design strategies.

6.2 Local Government Low Carbon Building Policy Toolkit summary

The Low Carbon Building Policy Toolkit ('Toolkit') provides local governments with recommended policies, guidelines, and bylaws to support the transition to low carbon buildings in their communities as soon as possible.

Most pertinent to this Guide, the Toolkit provides an overview of common high-performance design strategies and potential tension areas with typical form and character guidelines. The Toolkit provides recommendations for improving Guideline alignment with high-performance design strategies organized by four sections that represent common guideline areas that present tension with high-performance design strategies:

- Site Planning and Orientation
- Massing and Articulation
- Shading and Glazing, and
- Envelope Efficiency and Thermal Bridging

For more detailed information on these approaches, including pros and cons, see Page 23 of the Toolkit.

6.3 BC Housing Step Code Design Guide

BC Housing's Energy Step Code Design Guide is an excellent resource that provides detailed guidance to the industry on how to design Part 3 buildings to achieve the performance requirements of the higher steps of the Step Code.

The **BC Energy Step Code Design Guide** covers form & character strategies aligned with high-performance design, including:

- Building siting and orientation,
- Massing, articulation, and form factor, and
- Glazing and shading.

It also includes guidance on active or technical approaches to reducing energy demand in buildings, including:

- mechanical system design,
- envelope detailing, and
- air tightness strategies.

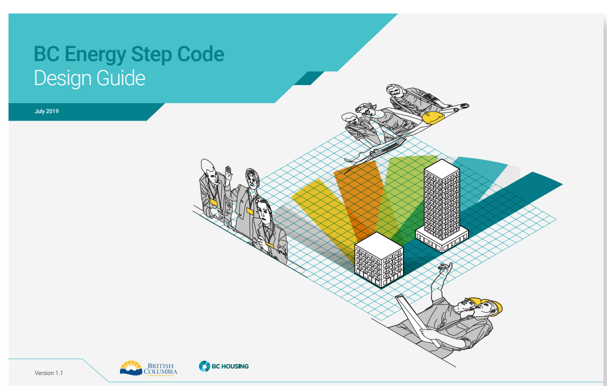
It is worth noting that the Design Guide doesn't cover Part 9 buildings that are subject to DP Form and Character guidelines in the city.

The **Design Guide Supplement on Overheating and Air Quality** was published by BC Housing in collaboration with BC Hydro, the City of Vancouver, the City of New Westminster, and the Province of BC. It provides information on the key strategies and approaches necessary to reduce the impacts of a warmer climate on mid- and high-rise (Part 3) wood-frame and non-combustible residential buildings within BC.

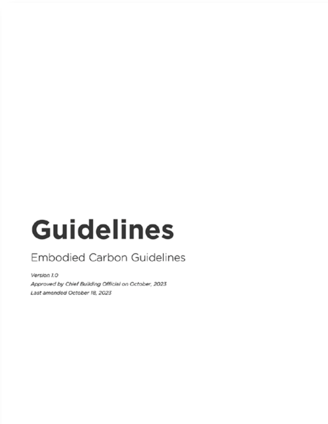
It is intended to provide local governments, public sector organizations, architects, and developers, with an accessible source of information on the key means of addressing issues of overheating and indoor air quality. The Supplement includes guidance on key design strategies to mitigate issues of overheating and indoor air quality, such as:

- Strategies for passively cooling buildings
- How to use shading to block solar heat gains
- Strategies for cooling via natural ventilation
- How to couple passive cooling with active approaches to cooling
- Best strategies for adding a source of cooling
- Best strategies for filtering indoor air, and
- Include a refuge area in the building design.

Elements referenced in the supplemental can be addressed and captured through a review of your local governments' Guideline review process.

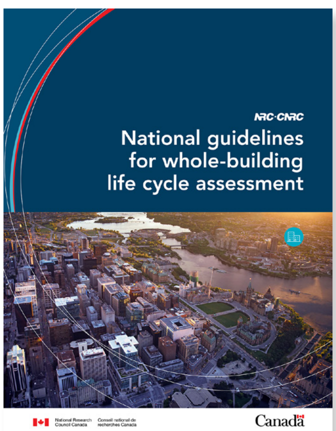


6.4 City of Vancouver's Embodied Carbon Guidelines



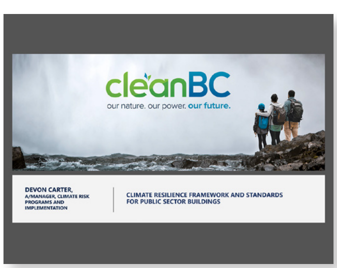
The City of Vancouver's Embodied Carbon Guidelines offer actionable steps to reduce carbon emissions in construction projects. These guidelines offer a robust framework for evaluating embodied carbon in construction projects and can be adapted to suit the specific needs of other municipalities. Please note that the City of Vancouver is going through a major update to their guidelines, which are expected to be published in Q2 / Q3 of 2024.

6.5 National Guidelines for Whole-building Life Cycle Assessment



The National Guidelines for Whole-building Life Cycle Assessment provides guidance on how to assess and demonstrate reductions in the estimated embodied carbon of designs for the new construction or renovation of buildings in Canada. The National Research Council Canada and Treasury Board of Canada Secretariat are developing additional guidance for Compliance Reporting of Embodied Carbon in Canadian Building Construction, which is based on the City of Vancouver Embodied Carbon Guidelines and looking to make these available as a national set of guidelines that can be used by municipalities throughout Canada. They are expected to be released in Q2 / Q3 of 2024.

6.6 British Columbia's Climate Resilience Framework and Standards for Public Sector Buildings



British Columbia's Climate Resilience Framework and Standards for Public Sector Buildings offers a systematic and consistent approach to assessing climate risk and implementing climate resilience strategies in buildings. Requirements include; completing a climate exposure screening, completing a climate risk assessment and applying minimum resilience standards.

BC Hydro

ORIGIN Introba ZGF