City of Richmond

Report to Committee

To:	General Purposes Committee	**Date:**	May 9, 2022
From:	Peter Russell, Director, Sustainability and District Energy	**File:**	10-6125-07-02/2022-Vol 01
Re:	**2022 BC Energy Step Code and GHG Requirements for New Buildings**		

Staff Recommendation

1. That Building Regulation Bylaw 7230, Amendment Bylaw 10365, which amends Sections 10.1.1 and 16.1 regarding updates to existing BC Energy Step Code and greenhouse gas intensity (GHGI) requirements for Part 9 residential buildings and Part 3 residential, hotel, commercial and office buildings, be introduced and given first reading;
2. That for buildings requiring a Development Permit, notwithstanding the adoption of Building Regulation Bylaw 7230, Amendment Bylaw 10365:
   (a) If a Development Permit is issued prior to July 1, 2022, the owner may, while their Development Permit remains valid, apply for a Building Permit in compliance with energy efficiency requirements applicable prior to the adoption of Bylaw 10365; or
   (b) If an acceptable Development Permit application has been submitted to the City prior to adoption of Bylaw 10365, is considered and endorsed by the Development Permit Panel prior to July 1, 2023, and has a complete Building Permit application acceptable to the City submitted prior to July 1, 2023, the owner may apply for a Building Permit in compliance with energy efficiency requirements applicable prior to adoption of Bylaw 10365.
3. That Official Community Plan Bylaw 9000, Amendment Bylaw 10364, which amends Section 14.2.10 to Schedule 1 (Development Permit Guidelines) regarding the use of design approaches that improve the energy performance of buildings, be introduced and given first reading;
4. That Richmond Official Community Plan Bylaw 9000, Amendment Bylaw 10364, having been considered in conjunction with:
   a. the City's Financial Plan and Capital Program; and
   b. the Greater Vancouver Regional District Solid Waste and Liquid Waste Management Plans;

   is hereby found to be consistent with said program and plans, in accordance with Section 477(3)(a) of the Local Government Act; and
5. That Richmond Official Community Plan Bylaw 9000, Amendment Bylaw 10364, having been considered in accordance with Section 475 of the Local Government Act and the City's Official Community Plan Bylaw Preparation Consultation Policy 5043, is found not to require further consultation.

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Director, Sustainability and District Energy
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Att. 4

REPORT CONCURRENCE			
ROUTED TO:		CONCURRENCE	CONCURRENCE OF GENERAL MANAGER
Law Building Approvals Development Applications Policy Planning		☑ ☑ ☑ ☑	
SENIOR STAFF REPORT REVIEW	INITIALS:		APPROVED BY CAO

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Staff Report

Origin

This report includes a proposed amendment to the Building Regulation Bylaw 7230 to achieve Step Code requirements for new Part 9 residential buildings and Part 3 buildings, including multi-unit residential buildings and hotels/motels, offices and commercial uses as well as retail uses. The proposed amendment continues to expand the two-option approach, under which builders and developers have the choice to build to the prescribed Step Code performance requirement or request a one-Step relaxation if the new building will be installed with, or connected to, or connected to a District Energy Utility owned by the City (LCES). More information can be found in Attachment 1 regarding Richmond's implementation of the Step Code to date.

This report also includes a proposed amendment to the City's Official Community Plan (OCP) with respect to Development Permit (DP) Guidelines encouraging design approaches and technologies that improve the energy performance of buildings. This amendment addresses the expected influence of higher levels of energy performance on building design and clarifies that compliance with a given Step of the BC Energy Step Code shall not compromise the intent of the City's well-established form and character guidelines.

This report supports Council's Strategic Plan 2018-2022 Strategy #2 A Sustainable and Environmentally Conscious City:

> *2.1 Continued leadership in addressing climate change and promoting circular economic principles.*

This report supports the implementation of Richmond's Community Energy and Emissions Plan 2050, and OCP emission reduction policies through:

Strategic Direction 3:	Carbon Neutral New Buildings
Action Categories:	☑ Accelerate Transition to the Top Level of Building Performance
	☑ Support Continuous Improvement to the BC Energy Step Code
	☑ Advance Implementation of Low Carbon Energy Systems

Analysis

The following section details proposed changes to the Building Regulation Bylaw for Part 9 and Part 3 buildings in Richmond. Attachment 1 has more information on implementation of the Step Code in Richmond to date. Part 9 buildings include single family dwellings, duplexes and multiplexes including townhomes, small apartments whereas Part 3 buildings include large wood frame and concrete residential buildings, offices and hotels. Anticipated provincial opt-in greenhouse gas (GHG) emission requirements are also considered for future bylaw changes for both Part 9 and Part 3 buildings; based on developer feedback, providing advance notice of future proposed bylaw changes is essential for project planning. Recommended changes to form and character guidelines, as set out in the DP Guidelines within the City's OCP, that support a transition to higher levels of the Step Code are also outlined below.

Proposed Building Regulation Bylaw Amendment for Part 9 Residential Buildings

The proposed Bylaw Amendment for July 1, 2022 (Table 1) uniformly raises minimum BC Energy Step Code performance requirements for all Part 9 residential buildings. Staff engaged Richmond's design and construction community on these proposed changes at a series of virtual Builder Breakfast workshops held from mid-2021 to early 2022. The proposed amendment would include an administrative requirement limiting the use of the Percent Better than Reference House metric only to buildings reaching the highest Step Code level (Step 5), consistent with Council direction. This approach is consistent with the City's ability to administratively set special performance conditions at various stages of Step Code implementation, if at each stage there is at least one option with no such condition.

Table 1 shows current and proposed requirements for Part 9 residential buildings for July 2022, as well as current thinking about timing of future increases from 2023 to 2027. As a first step in transitioning to the Province's forthcoming greenhouse gas intensity (GHGI) requirements, staff recommend that for all applications accepted on or after July 1, 2022, the City implement a new LCES definition identical to the Province's forthcoming "Low" GHGI standard. Attachment 2 has more details on the Province's proposed opt-in GHGI requirements.

Table 1: Current, Proposed and Future Step Code Requirements for Part 9 Residential Buildings

	Current Bylaw	Proposed Bylaw	Future Bylaw Amendments Subject to Council Approval		
	Dec. 2020	*July 2022*	*July 2023*	*Jan. 2025*	*Jan. 2027*
Single Family Dwellings, Duplexes and Multiplexes including Townhomes & Apartments	Step **3** *-or-* Step **2** + LCES <6 kg/m^2	Step **5** *-or-* Step **4** *-or-* Step **3** + LCES <2.5 kg/m^2	Step **5** + BC GHGI: Mid Carbon *-or-* Step **4** + BC GHGI: Low Carbon *-or-* Step **3** + BC GHGI: Zero Carbon Ready	Step **5** + BC GHGI: Low Carbon *-or-* Step **4** + BC GHGI: Zero Carbon Ready	Step **5** + BC GHGI: Zero Carbon Ready

Consultation

Staff undertook extensive online consultation with Part 9 homebuilders, designers and energy advisors, starting with an information session in May 2021, followed by two workshops (September 8, 2021 and March 3, 2022) to assess and review proposed 2022 Building Regulation Bylaw changes. This engaged 200 participants in total, with live polling on three potential options for proposed 2022 residential requirements.

Proposed Building Regulation Bylaw Amendment for Part 3 Buildings

The proposed Bylaw Amendment for July 2022 also sets requirements for all Part 3 buildings in Richmond regulated by the BC Energy Step Code. These changes are in general agreement with proposed future Step Code requirements signalled in a Report to General Purposes Committee on October 19, 2020. These requirements include an optional one-Step relaxation in Step Code levels available to applicants that install an on-site renewable energy system providing a minimum 70% of the building's annual heating, cooling and domestic hot water energy demand, or that connect to a low carbon energy system, including the City's district energy utility. With approval of the proposed amendment, this relaxation option would be available to all Part 3 Step Code regulated buildings.

Table 2 shows proposed July 1, 2022 requirements for Part 3 buildings and current thinking about future energy and GHG emission requirements for each building type from 2023 to 2027.

Table 2: Current, Proposed and Future Step Code Requirements for Part 3 Buildings

	Current Bylaw	Proposed Bylaw	Future Bylaw Amendments Subject to Council Approval		
	Dec. 2020	*July 2022*	*July 2023*	*Jan. 2025*	*Jan. 2027*
Office and Retail	Step **2**	Step **3** -or- Step **2** + LCES	Step **3** + BC GHGI -or- Step **2** + BC GHGI	Step **3** + BC GHGI	Step **3** + BC GHGI
Residential: Wood Frame (mid-rise)	Step **3**	Step **4** -or- Step **3** + LCES	Step **4** + BC GHGI -or- Step **3** + BC GHGI	Step **4** + BC GHGI	Step **4** + BC GHGI
Residential: Concrete Frame	Step **3** -or- Step **2** + LCES	Step **3** -or- Step **2** + LCES	Step **3** + BC GHGI -or- Step **2** + BC GHGI	Step **4** + BC GHGI -or- Step **3** + BC GHGI	Step **4** + BC GHGI
Hotels and Motels	Step **3** -or- Step **2** + LCES	Step **3** -or- Step **2** + LCES	Step **4** + BC GHGI -or- Step **3** + BC GHGI	Step **4** + BC GHGI -or- Step **3** + BC GHGI	Step **4** + BC GHGI

Consultation

For Part 3 developers, staff provided updates on proposed 2022 Energy Step Code requirements and relaxations for low carbon energy systems at UDI-Richmond Liaison Committee meetings on September 28, 2021 and January 19, 2022. These bylaw requirements were covered again during a 90-minute workshop with UDI members on March 8, 2022, which included a review of findings from Richmond's building form and character review, as well as expected timing of adoption of the GHGI framework in 2023. Presentations for feedback were also made to Richmond's Advisory Design Panel on August 18, 2021 and on March 23, 2022.

In-Stream Provisions for Development Permit Applications

When Richmond introduced new BC Energy Step Code requirements in September 2018, and December 2020, Council approved in-stream provisions for buildings requiring a Development Permit (DP). Staff recommend similar in-stream provisions with respect to the proposed bylaw amendment, such that an owner would be permitted to submit a Building Permit application in compliance with prior requirements if:

a) a DP was issued prior to July 1, 2022, and remains valid; or
b) an acceptable DP application is submitted prior to adoption of Amendment Bylaw No. 10365, and, prior to July 1, 2023, the DP is considered and endorsed by the Development Permit Panel and an acceptable Building Permit application is submitted to the City. The Building Permit application must include architectural drawings showing envelope details and schedule of mechanical systems in compliance with Part 10 (Step Code section) of the BC Building Code (BCBC).

High-Performance Building Standards and Richmond's Development Permit Guidelines

As the City implements higher Step Code levels, building design is expected to increasingly favour simpler massing, lower window-to-wall ratios, increased use of sun shades, increased attention to solar orientation, better insulated wall and window systems, and thermally-broken balconies. This design shift will affect building types differently. For example:

- Townhouses already achieve the lower window-to-wall ratio encouraged by Step Code, but often have highly articulated building envelopes (e.g., dormers and bay windows) that can negatively impact energy performance; and
- High-rise and mid-rise buildings typically have the simpler massing encouraged by Step Code, but office buildings often have high-window-to-wall ratios and multi-family residential buildings have balconies, both of which can pose challenges for efficient heating and cooling.

Staff compared current form and character guidelines with high-performance building standards such as Passive House, Net Zero Energy Ready. Potential conflicts between high-performance building standards and the City's guidelines are negligible but staff recommend amending the guidelines to better support development proponents and general public as the City transitions to higher levels of the Step Code. Like the Step Code, Richmond's form and character DP Guidelines are generally performance-based and not prescriptive, which provides opportunities to explore alternative ways of satisfying energy requirements without compromising other City objectives. For example:

- Townhouses may choose between bay windows and dormers (rather than including both) and/or may choose to include decorative porches, changes in materials or colour, or other means of articulation that do not compromise energy performance;
- Office buildings may choose to use better insulated window systems rather than reducing their window-to-wall ratio; and

- Larger residential buildings may choose balcony designs that limit heat loss through the envelope by using thermally-broken concrete slabs, hung, pinned or self-supported balconies.

Attachment 3 provides further insight into potential built form changes, which staff have summarized into a table of possible friction points and design trends for each building type subject to the Step Code. In addition, resource sheets have been developed highlighting the range of potential design and technology options for achieving high performance in typical new buildings in Richmond (see Attachment 4).

Proposed OCP (Schedule 1) DP Guidelines Amendment Bylaw

To help clarify the City's intent, staff recommend that sub-section 14.2.10 (Green Buildings and Sustainable Infrastructure) within Section 14 (Development Permit Guidelines), of the OCP be amended by:

- Removing wording qualifying "green building and sustainable infrastructure" as a "voluntary undertaking, where feasible";
- Stating that "applicable new buildings will be designed and constructed to meet the BC Energy Step Code" and including a reference table of high-performance building design considerations;
- Strengthening existing language on the need to integrate energy performance considerations at the start of the building design process, stating that "through rezoning, Development Permit and other permit approval processes, proposed buildings shall demonstrate compliance with the applicable requirements of the BC Energy Step Code to the satisfaction of the City (e.g. by providing energy modelling outputs)"; and,
- Clarifying that compliance with the Step Code will not compromise the intent of any of the Development Permit Guidelines contained in Schedules 1 or 2 of the OCP, and that any remedial actions taken during construction to achieve compliance with the Step Code shall not compromise the intent of the Development Permit Guidelines applicable to the building.

OCP Consultation Policy

Should Council grant first reading to the amendment bylaws, the amendment bylaws will be forwarded to a Public Hearing where any resident or interested party will have an opportunity to comment. The public will have the opportunity to comment further on all proposed bylaw amendments at the Public Hearing. Public notification for the Public Hearing will be provided in accord with the *Local Government Act*.

Staff have reviewed the proposed OCP amendments with respect to the *Local Government Act* and the City's OCP Bylaw Preparation Consultation Policy 5043 requirements, and recommend that this report does not require referral to external stakeholders. Richmond Official Community Plan Bylaw 9000, Amendment Bylaw 10364, having been considered in accordance with OCP Bylaw Preparation Consultation Policy 5043, is hereby found to not require further consultation.

Next Steps

Staff will monitor compliance with new Step Code and forthcoming GHGI requirements to understand the impact on permitting procedures and address any building performance, market or regulatory issues that may arise during the construction phase. Staff will also monitor the affects of high performance standards on the form and character of buildings. The Province of BC has indicated that an opt-in framework for Provincial greenhouse gas emissions limits should be available for use by local governments in 2023. To support the transition toward high performance, low-emissions new buildings, staff will continue to offer knowledge and capacity-building opportunities through virtual Builder Breakfast events, UDI-Richmond developer webinars, and other educational opportunities.

Finally, staff will update the following bulletins to include the July 1, 2022 Energy Step Code requirements: Building-37 Energy Step Code: Part 9 Buildings Overview; and Building-40 Energy Step Code: Part 3 Buildings. Staff will also create a new bulletin regarding revisions to Development Permit Guidelines (Section 14.2.10) on form and character consideration for low carbon, highly energy efficient new buildings using materials found in Attachment 4.

Financial Impact

None.

Conclusion

Implementing new BC Energy Step Code requirements for Part 9 and Part 3 buildings in July 2022 will advance the City's policy objectives for higher energy efficiency and reduce greenhouse gas emissions in new construction. The proposed Building Regulation Bylaw amendments provide a platform to integrate anticipated Provincial GHGI standards when they become available.

Council policy direction is for Richmond to reach the top performance level of the Energy Step Code, and achieve near zero emissions several years ahead of the Provincial target in the CleanBC Roadmap. To support a successful transition to high-performance buildings, staff recommend that the existing Green Buildings and Sustainable Infrastructure subsection of the General Considerations be amended within the form and character section of the Development Permit Guidelines in the Official Community Plan Bylaw No. 9000, included in this report.

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Att. **1**: Step Code Implementation in Richmond
2: Proposed Provincial Opt-in Greenhouse Gas Emissions Intensity (GHGI) Standards
3: Step Code / Possible Development Trends / February 14, 2022
4: Key Considerations for High Performance Buildings

Step Code Implementation in Richmond

The City's implementation of the BC Energy Step Code is nested within Provincial policy initiated by the 2018 CleanBC Plan signaling that a "net zero energy-ready" level of efficiency would be required for all new buildings in the 2032 BC Building Code, specifically:

Compared to the current base BC Building Code, new buildings will be:

- *20 per cent more energy efficient by 2022,*
- *40 per cent more energy efficient by 2027, and*
- *80 per cent more energy efficient by 2032, the net-zero energy ready standard.*

Richmond was one of the first municipalities to adopt the BC Energy Step Code into local regulation. In July 2018, Council amended Building Regulation Bylaw 7230 to implement energy efficiency requirements of the BC Energy Step Code for new Part 9 residential buildings that included single detached houses, townhouses and small apartment buildings, and Part 3 multi-unit residential, office and commercial buildings. Council also approved amendments to the Official Community Plan (Schedule 1, Section 12.4, Energy) that included a schedule of future Building Regulation Bylaw amendments for 2020, 2022 and 2025, subject to future Council approvals, signaling the expected timing of higher BC Energy Step Code requirements and the City's greenhouse gas (GHG) reduction targets.

Richmond pioneered a two-option approach for Step Code implementation, under which builders and developers have the choice to build to the prescribed Step Code performance requirement or request a one-Step relaxation if the new building will be installed with, or connected to, a low-carbon energy system (LCES). This approach was first introduced for residential concrete towers in 2018, extended to Part 9 residential buildings and hotels/motels in 2020, and with Council approval, would be extended to mid-rise, wood-frame multi-unit residential buildings, commercial office and retail buildings on July 1, 2022.

In December 2020, Council approved amendments to Building Regulation Bylaw 7230 to implement incrementally higher Step Code requirements for new Part 9 residential buildings (per OCP direction), and added hotel and motel uses to Richmond's Step Code regulation.

Builders and developers have been regularly consulted with regarding the proposed timing of Step Code requirements in Richmond. Staff continue to receive positive feedback on Richmond's innovative options approach to Step Code regulation, which offers a relaxation in the default Step requirement to help drive installation of, or connection to, a low carbon energy system.

In 2022, City Council endorsed deeper GHG emission reduction targets for 2030 and 2050, through the renewed Community Energy and Emissions Plan 2050, and adopted the Official Community Plan Amendment Bylaw 10328, with a commitment to reduce citywide carbon emissions to 50% below 2007 levels by 2030, and achieve net zero GHG emissions by 2050.

Proposed Provincial Opt-in Greenhouse Gas Emissions Intensity (GHGI) Standards

In November 2020, a mandate letter from Premier John Horgan directed the Minister Responsible for Housing, David Eby, to "*build on our government's work to require new buildings and retrofits to be more energy efficient and cleaner by supporting local governments to set their own carbon pollution performance standards for new buildings*." Correspondingly, the Province has been developing opt-in standards limiting GHG emissions in new buildings that would be included in a forthcoming revision to the BC Building Code in December 2022.

In 2021, the Province of BC brought forward a plan to accelerate climate action at the provincial scale through the CleanBC Roadmap to 2030. The following target was set for new buildings:

> *By 2030, all new buildings will be zero carbon, and all new space and water heating equipment will meet the highest standards for efficiency.*

The 2022 BC Building Code update is expected to enter into force in mid-December 2022. The 20% more energy efficient Code requirement will apply to all Building Permit applications submitted after the in-force date, and will apply to all new buildings. For Step Code regulated Part 9 residential buildings, Step 3 is 20% more efficient, while for Part 3 buildings, Step 2 achieves 20% more energy efficiency across all building types.

Orderly transition to mandatory GHGI limits for new buildings

The Provincial process to introduce an opt-in framework of GHGI requirements for new buildings has been slower than expected. Staff understand that the proposed framework will be available for use by local governments in early 2023.

Having both BC Energy Step Code and a GHGI framework in the BC Building Code enables local governments to set both energy performance levels and carbon emission limits for most new buildings, eliminating the need to offer a Step Code relaxation as an incentive. Accordingly, Tables 1 and 2 and Figure 1 show how the City will integrate forthcoming Provincial greenhouse gas emission limits with Step Code requirements for new buildings, starting in 2023.

The GHGI framework uses a stepped approach similar to the BC Energy Step Code, providing local governments with flexibility to phase the transition to near zero emission buildings, with easier GHGI performance levels set initially, followed by incrementally higher performance requirements over time. This framework also allows local governments to set both energy performance levels via the BC Energy Step Code, as well as carbon emission limits for new buildings using the new GHGI framework.

A summary of the framework is included below, with three GHGI levels and the performance range (kilograms of CO2e emitted per square meter annually) indicated for each level:

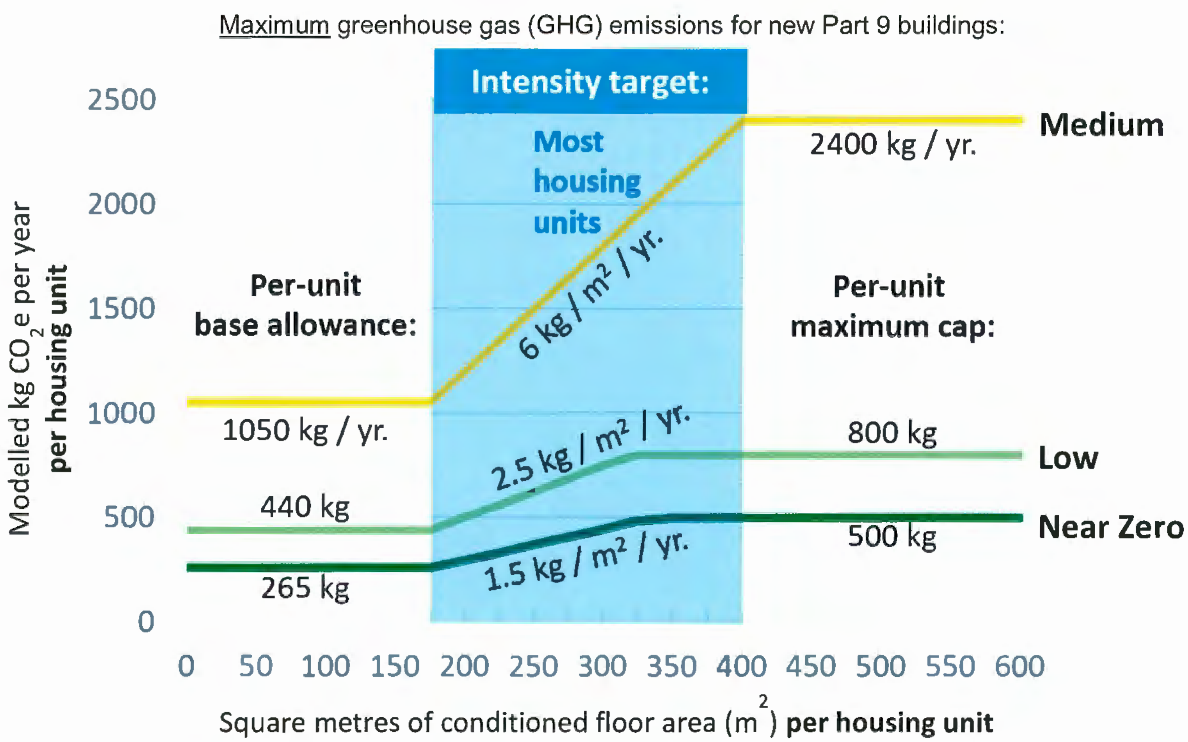
Table A-1: Proposed BC GHGI Framework – Intended Outcomes

Medium Carbon Emissions (*'Mid Carbon'*)	**Low Carbon Emissions** (*'Low Carbon'*)	**Near Zero Carbon Emissions** (*'Zero Carbon Ready'*)
At least one major heating system is fully decarbonized; domestic hot water or space heating.	Both domestic hot water and space heating are fully decarbonized; natural gas may be used for cooking or peak heating.	All electric building; no natural gas uses.

Table A-2: Proposed BC GHGI Framework - Performance Requirements for Part 3 Buildings

Medium Carbon Emissions (*'Mid Carbon'*)	**Low Carbon Emissions** (*'Low Carbon'*)	**Near Zero Carbon Emissions** (*'Zero Carbon Ready'*)
5 kg to **9 kg** CO_2e / m^2 / year (depending upon archetype)	**2.5 kg** to **4 kg** CO_2e / m^2 / year (depending upon archetype)	**1.5 kg** to **2 kg** CO_2e / m^2 / year (depending upon archetype)

Figure A-1: Proposed BC GHGI Framework - Performance Requirements for Part 9 Buildings



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Per-unit base allowance: Even when their per-resident and total GHG emissions are relatively low, the limited floor space of small housing units means they often have higher GHG emissions *per square metre of conditioned floor space* than larger homes. Having a modest base allowance of GHG emissions for housing units levels the playing field for more-affordable small homes while ensuring overall GHG emissions remain low.

Intensity target: Larger housing units tend to have higher GHG emissions; there is more space to heat and cool, and they often have additional energy-consuming bathrooms. An intensity target based on the conditioned floor area (i.e. excluding unheated indoor spaces like garages) ensures a wide range of homes achieve comparable levels of GHG reductions performance.

Per-unit maximum cap: Experience shows that it is easier for very large housing units to meet a given GHG intensity target than mid-sized units, and even low per-metre intensity targets can produce large homes with high total and per-resident GHG emissions. Adding a maximum cap to GHG emissions per housing unit limits total and per capita GHGs from large homes without increasing compliance costs relative to smaller housing units.

STEP CODE / POSSIBLE DEVELOPMENT TRENDS / FEBRUARY 14 2022

		GENERAL (COMMERCIAL & RESIDENTIAL)		
Features	**High Performance (HP) Building Directions**	**OCP Form/Character Objectives**	**Friction with HP Directions**	**Possible Trends**
Massing & Roofs	• More compact massing to reduce the overall size of the thermal envelope • Simpler building and roof forms to enhance thermal performance • Fewer architectural features with complex junctions that can contribute to heat loss (e.g., less bay windows, dormers, recesses, and stepping)	• Varied forms (e.g., more complex residential and simpler commercial forms) • Massing is visually broken up with recesses, stepping, and decorative projections	• Complex massing and projections can cause heat loss due to thermal bridging and/or increased wall area	• Move away from complex massing to simpler forms and strategic/limited use of stepping, recesses, and projections
Orientation & Shading	• Strategic building and window orientation for more effective winter solar heat gain and summer shading • External shading devices on key south and west facades (e.g., balconies, fins, blinds, shutters, and deciduous trees) • Operable windows for natural ventilation	• Street oriented uses at grade and lower floors • Tower form/orientation considers site-specific factors • Tower separation protects sun, views, and privacy	• No OCP conflict, **BUT** street orientation plus typical building layouts and shading may not optimize heating and cooling for all tenants	• Increased distinction between sunny and shady building facades • Increased use of shading devices for shading and visual interest
Windows & Daylighting	• Lower window-to-wall-ratio (WWR) to lessen heat gain (i.e. 40% encouraged) • A few larger windows (rather than more smaller or multi-pane windows) to minimize heat loss through window frames (e.g., mullions, muntins, etc.) • Higher sills to reduce window size without compromising daylighting	• Window treatments vary with use, ranging from towers with floor-to-ceiling glass to multi-pane and smaller windows in traditional-character housing	• No OCP conflict, **BUT** 40% WWR and higher sills may be contrary to accepted market norms • Multi-pane and smaller windows may increase heat loss due to more frame area	• More strategic window use to better balance heating, cooling, livability, views, and daylighting • Decreased use of multi-pane and smaller windows • Higher WWR as needed to satisfy market demands
Balconies & Roof Decks	• Thermally broken designs (e.g., modified slab, pinned, hanging, and self-supported) to reduce heat loss at balcony connection points • Fewer and/or stacked recessed balconies to reduce the heat loss associated with this balcony type (due to more wall area, corners, and connection points) • Where appropriate, use of roof decks in place of balconies	• Residential units must have balconies, decks, patios, and/or gardens	• Balconies and complex deck designs can cause heat loss due to thermal bridging	• Thermally-broken, projecting and stacked balconies will provide required open space and add visual interest
Envelope Materials & Design	• Increase insulation (e.g., thicker exterior wall assemblies and triple glazing), especially where heat loss is unavoidable (e.g., due to a high WWR) • Reduced use of lower performing window/wall systems (e.g., curtain wall) • Increased variation in colour, materials, and pattern in place of other building articulation (i.e. instead of more complex massing or architectural features)	• Light, glassy towers • Colour/material/pattern variation visually breaks up massing and enhances building features	No OCP conflict, **BUT** typical curtain/window wall and spandrel systems perform poorly compared to alternative window/wall designs	• Less curtain/window wall • Use of panel systems may lead to more colourful, patterned buildings • Use of materials/detailing in lieu of complex forms (particularly in traditional-character housing areas)

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FORM AND CHARACTER IMPLICATIONS FOR HIGH PERFORMANCE BUILDINGS – CITY STAFF SUMMARY

(PART 3) COMMERCIAL BUILDINGS

Features	High Performance (HP) Building Directions	OCP Form/Character Objectives	Friction with HP Directions	Possible Trends
Massing & Roofs	• More compact massing to reduce the overall size of the thermal envelope • Simpler building and roof forms to enhance thermal performance • Fewer architectural features with complex junctions that can contribute to heat loss (e.g., less bay windows, dormers, recesses, and stepping)	• Varied building types (e.g., low, mid, and high-rise retail, office, and hotel) • Typically simple forms with limited recesses, stepping, and decorative projections	• No OCP conflict	• No specific change
Orientation & Shading	• Strategic building and window orientation for more effective winter solar heat gain and summer shading • External shading devices on key south and west facades (e.g., balconies, fins, blinds, shutters, and deciduous trees) • Operable windows for natural ventilation	• Street oriented uses at grade and lower floors • Tower form/orientation considers site-specific factors • Tower separation protects sun, views, and privacy	• No OCP conflict, BUT street orientation plus typical building layouts and shading may not optimize heating and cooling for all tenants	• Increased distinction between sunny and shady building facades • Increased use of shading devices for shading and visual interest
Windows & Daylighting	• Lower window-to-wall-ratio (WWR) to lessen heat gain (i.e. 40% encouraged) • A few larger windows (rather than more smaller or multi-pane windows) to minimize heat loss through window frames (e.g., mullions, muntins, etc.) • Higher sills to reduce window size without compromising daylighting	• Transparency required at grade on street frontages • Window treatment must enhance appearance • Operable windows	• No OCP conflict, **BUT** 40% WWR and higher sills may be contrary to accepted market norms (e.g., flexible multi-tenant space)	• More strategic window use to better balance heating, cooling, livability, views, and daylighting • Higher than 40% WWR to as needed to meet market demand, combined with mitigating measures (e.g., tinted/coated glass and more shading devices)
Balconies & Roof Decks	• Thermally broken designs (e.g., modified slab, pinned, hanging, and self-supported) to reduce heat loss at balcony connection points • Fewer and/or stacked recessed balconies to reduce the heat loss associated with this balcony type (due to more wall area, corners, and connection points) • Where appropriate, use of roof decks in place of balconies	• Not required	• No OCP conflict	• No specific change
Envelope Materials & Design	• Increase insulation (e.g., thicker exterior wall assemblies and triple glazing), especially where heat loss is unavoidable (e.g., due to a high WWR) • Reduced use of lower performing window/wall systems (e.g., curtain wall) • Increased variation in colour, materials, and pattern in place of other building articulation (i.e. instead of more complex massing or architectural features)	• Light, glassy towers • Colour/material/pattern variation visually breaks up massing and enhances building features	• Typical curtain/window wall and spandrel systems perform poorly compared to alternative window/wall designs	• Less curtain/window wall • Use of panel systems may lead to more colourful, patterned buildings

FORM AND CHARACTER IMPLICATIONS FOR HIGH PERFORMANCE BUILDINGS – CITY STAFF SUMMARY

(PART 3) HIGH-RISE MIXED-USE/RESIDENTIAL

Features	High Performance (HP) Building Directions	OCP Form/Character Objectives	Friction with HP Directions	Possible Trends
Massing & Roofs	• More compact massing to reduce the overall size of the thermal envelope • Simpler building and roof forms to enhance thermal performance • Few architectural features with complex junctions that can contribute to heat loss (e.g., less bay windows, dormers, recesses, and stepping)	• Small floorplate towers (650 m^2), landscaped podiums, and low/mid-rise streetwalls • Massing is visually broken up with recesses, stepping, and decorative projections	• Complex massing and projections can cause heat loss due to thermal bridging and/or increased wall area	• Move away from complex massing to simpler forms and strategic/limited use of stepping, recesses, bay windows, and projections
Orientation & Shading	• Strategic building and window orientation for more effective winter solar heat gain and summer shading • External shading devices on key south and west facades (e.g., balconies, fins, blinds, shutters, and deciduous trees)	• Street oriented uses at grade and lower floors • Tower form/orientation considers site-specific factors • Tower separation protects sun, views, and privacy	• No OCP conflict, **BUT** street orientation plus typical building layouts and shading may not optimize heating and cooling for all tenants	• Increased distinction between sunny and shady tower facades • Increased use of shading devices for shading and visual interest
Windows & Daylighting	• Lower window-to-wall-ratio (WWR) to lessen heat gain (i.e. 40% encouraged) • A few larger windows (rather than more smaller or multi-pane windows) to minimize heat loss through window frames (e.g., mullions, muntins, etc.) • Higher sills to reduce window size without compromising daylighting • Operable windows for natural ventilation	• Transparency required at grade along street frontages • Window treatment must enhance appearance • Operable windows	• No OCP conflict, **BUT** 40% WWR and higher sills may be contrary to accepted market norms (e.g., floor-to-ceiling windows)	• More strategic window use to better balance heating, cooling, livability, views, and daylighting • Use of tinted/coated glass to reduce solar heat gain
Balconies & Roof Decks	• Thermally broken designs (e.g., modified slab, pinned, hanging, and self-supported) to reduce heat loss at balcony connection points • Fewer and/or stacked recessed balconies to reduce the heat loss associated with this balcony type (due to more wall area, corners, and connection points) • Where appropriate, use of roof decks in place of balconies	• Units must have balconies, decks, and/or patios (i.e. min. 6 – 9 m^2 /apartment)	• Balconies can cause heat loss due to thermal bridging	• Hung and pinned balconies likely preferred • Projecting and stacked recessed balconies may give visual interest in lieu of massing articulation
Envelope Materials & Design	• Increase insulation (e.g., thicker exterior wall assemblies and triple glazing), especially where heat loss is unavoidable (e.g., due to a high WWR) • Reduced use of lower performing window/wall systems (e.g., curtain wall) • Increased variation in colour, materials, and pattern in place of other building articulation (i.e. instead of more complex massing or architectural features)	• Light, glassy towers • Colour/material/pattern variation visually breaks up massing and enhances building features	• Typical curtain/window wall and spandrel systems perform poorly compared to alternative window/wall designs	• Less curtain/window wall • Use of panel systems may lead to more colourful, patterned buildings

FORM AND CHARACTER IMPLICATIONS FOR HIGH PERFORMANCE BUILDINGS – CITY STAFF SUMMARY

(PART 3) MID-RISE RESIDENTIAL

Features	High Performance (HP) Building Directions	OCP Form/Character Objectives	Friction with HP Directions	Possible Trends
Massing & Roofs	• More compact massing to reduce the overall size of the thermal envelope • Simpler building and roof forms to enhance thermal performance • Few architectural features with complex junctions that can contribute to heat loss (e.g., less bay windows, dormers, recesses, and stepping)	• Typically, block-like forms with flat roofs (3 – 6 storeys) • Massing is visually broken up with recesses, stepping, bay windows, and decorative projections	• Complex massing and projections can cause heat loss due to thermal bridging and/or increased wall area	• Move away from complex massing to simpler forms and strategic/limited use of stepping, recesses, bay windows, and projections
Orientation & Shading	• Strategic building and window orientation for more effective winter solar heat gain and summer shading • External shading devices on key south and west facades (e.g., balconies, fins, blinds, shutters, and deciduous trees)	• Street orientation preferred • Roof overhangs, decorative projections (e.g., frames and fins), and trees provide weather protection and enhance character	• No OCP conflict, **BUT** street orientation plus typical building layouts and shading may not optimize heating and cooling for all tenants	• Increased distinction between sunny and shady building facades • Increased use of shading devices for shading and visual interest
Windows & Daylighting	• Lower window-to-wall-ratio (WWR) to lessen heat gain (i.e. 40% encouraged) • A few larger windows (rather than more smaller or multi-pane windows) to minimize heat loss through window frames (e.g., mullions, muntins, etc.) • Higher sills to reduce window size without compromising daylighting • Operable windows for natural ventilation	• Residential window patterns (i.e. varied shapes and sizes), including multi-pane and smaller windows in traditional-character areas • Operable windows	• No OCP conflict, **BUT** multi-pane and smaller windows may increase heat loss due to more frame area	• More strategic window use to better balance heating, cooling, livability, views, and daylighting
Balconies & Roof Decks	• Thermally broken designs (e.g., modified slab, hanging, and self-supported) to reduce heat loss at balcony connection points • Fewer and/or stacked recessed balconies to reduce the heat loss associated with this balcony type (due to more wall area, corners, and connection points) • Where appropriate, use of roof decks in place of balconies	• Units must have balconies, decks, and/or patios (i.e. min. 6 – 9 m^2 /apartment)	• Balconies and complex deck designs can cause heat loss due to thermal bridging	• Self-supported balconies likely preferred (possibly creating opportunities for larger/deeper balconies) • Stacked recessed balconies may give visual interest in lieu of massing articulation
Envelope Materials & Design	• Increase insulation (e.g., thicker exterior wall assemblies and triple glazing), especially where heat loss is unavoidable (e.g., due to a high WWR) • Reduced use of lower performing window/wall systems (e.g., curtain wall) • Increased variation in colour, materials, and pattern in place of other building articulation (i.e. instead of more complex massing or architectural features)	• Colour/material/pattern variation visually breaks up massing and enhances building features	• No OCP conflict	• Particularly in traditional-character areas, increased use of materials/detailing to achieve desired character (in lieu of complex forms)

FORM AND CHARACTER IMPLICATIONS FOR HIGH PERFORMANCE BUILDINGS – CITY STAFF SUMMARY

(PART 9) TOWNHOUSES

Features	High Performance (HP) Building Directions	OCP Form/Character Objectives	Friction with HP Directions	Possible Trends
Massing & Roofs	• More compact massing to reduce the overall size of the thermal envelope • Simpler building and roof forms to enhance thermal performance • Few architectural features with complex junctions that can contribute to heat loss (e.g., less bay windows, dormers, recesses, and stepping)	• House-like forms that may be articulated (particularly in traditional-character areas) with complex roofs, dormers, bay windows, and decorative projections • Generally, 2-3 storey buildings (2-6 units each) with the larger buildings along street frontages	• Complex massing and projections can cause heat loss due to thermal bridging and/or increased wall area • Larger buildings (e.g., 6 units) preferred for energy efficiency	• Move away from complex massing to simpler forms and strategic/limited use of stepping, recesses, bay windows, and projections • Decreasing acceptance of smaller (2 unit) buildings
Orientation & Shading	• Strategic building and window orientation for more effective winter solar heat gain and summer shading • External shading devices on key south and west facades (e.g., balconies, fins, blinds, shutters, and deciduous trees)	• Street orientation preferred • Roof overhangs, decorative projections, and trees provide weather protection and enhance character	• No OCP conflict, **BUT** street orientation plus typical building layouts and shading may not optimize heating and cooling for all tenants	• Increased distinction between sunny and shady building facades • Increased use of shading devices for shading and visual interest
Windows & Daylighting	• Lower window-to-wall-ratio (WWR) to lessen heat gain (i.e. 40% encouraged) • A few larger windows (rather than more smaller or multi-pane windows) to minimize heat loss through window frames (e.g., mullions, muntins, etc.) • Higher sills to reduce window size without compromising daylighting • Operable windows for natural ventilation	• House-like window patterns, including multi-pane and smaller windows in traditional-character areas • Operable windows	• Multi-pane and smaller windows may increase heat loss due to more frame area	• Decreased use of multi-pane and smaller windows in favour of alternative traditional-character and modern window styles
Balconies & Roof Decks	• Thermally broken designs (e.g., modified slab, hanging, and self-supported) to reduce heat loss at balcony connection points • Fewer and/or stacked recessed balconies to reduce heat loss associated with this balcony type (due to more wall area, corners, and connection points) • Where appropriate, use of roof decks in place of balconies	• Units must have balconies, decks, and/or gardens (i.e. min. 30 – 37 m^2 /unit) • Inward site orientation preferred (i.e. away from neighbours and street noise)	• Balconies and complex deck designs can cause heat loss due to thermal bridging	• Self-supported balconies and roof decks preferred • Street-fronting balconies (e.g., porches) may give visual interest in lieu of massing articulation
Envelope Materials & Design	• Increase insulation (e.g., thicker exterior wall assemblies and triple glazing), especially where heat loss is unavoidable (e.g., due to a high WWR) • Reduced use of lower performing window/wall systems (e.g., curtain wall) • Increased variation in colour, materials, and pattern in place of other building articulation (i.e. instead of more complex massing or architectural features)	• Colour/material/pattern variation visually breaks up massing and enhances building features	• No OCP conflict	• Use of materials/detailing in lieu of complex forms (particularly in traditional-character housing areas)

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FORM AND CHARACTER IMPLICATIONS FOR HIGH PERFORMANCE BUILDINGS – CITY STAFF SUMMARY

(PART 9) DUPLEXES

Features	High Performance (HP) Building Directions	OCP Form/Character Objectives	Friction with HP Directions	Possible Trends
Massing & Roofs	• More compact massing to reduce the overall size of the thermal envelope • Simpler building and roof forms to enhance thermal performance • Few architectural features with complex junctions that can contribute to heat loss (e.g., less bay windows, dormers, recesses, and stepping)	• House-like form (2 storeys) • Massing/roof variations mitigate adjacency issues (e.g., scale and overlook) • Traditional SF features (e.g., bay windows) enhance neighbourhood fit	• Complex massing and projections can cause heat loss due to thermal bridging and/or increased wall area	• Move away from complex massing to simpler forms and strategic/limited use of stepping, recesses, bay windows, and projections
Orientation & Shading	• Strategic building and window orientation for more effective winter solar heat gain and summer shading • External shading devices on key south and west facades (e.g., balconies, fins, blinds, shutters, and deciduous trees)	• Street orientation preferred • Roof overhangs, decorative projections, and trees provide weather protection and enhance character	• No OCP conflict, **BUT** street orientation plus typical building layouts and shading may not optimize heating and cooling for all tenants	• Increased distinction between sunny and shady building facades • Increased use of shading devices for shading and visual interest
Windows & Daylighting	• Lower window-to-wall-ratio (WWR) to lessen heat gain (i.e. 40% encouraged) • A few larger windows (rather than more smaller or multi-pane windows) to minimize heat loss through window frames (e.g., mullions, muntins, etc.) • Higher sills to reduce window size without compromising daylighting • Operable windows for natural ventilation	• House-like window patterns • Operable windows	• No OCP conflict, **BUT** multi-pane and smaller windows may cause heat loss due to more frame area	• Decreased use of multi-pane and smaller windows in favour of alternative traditional-character and modern window styles
Balconies & Roof Decks	• Thermally broken designs (e.g., modified slab, hanging, and self-supported) to reduce heat loss at balcony connection points • Fewer and/or stacked recessed balconies to reduce the heat loss associated with this balcony type (due to more wall area, corners, and connection points) • Where appropriate, use of roof decks in place of balconies	• Units must have gardens • Balconies/decks must not overlook neighbours	• Balconies and complex deck designs can cause heat loss due to thermal bridging	• Move away from balconies and complex deck designs where adequate open space can be provided at grade
Envelope Materials & Design	• Increase insulation (e.g., thicker exterior wall assemblies and triple glazing), especially where heat loss is unavoidable (e.g., due to a high WWR) • Reduced use of lower performing window/wall systems (e.g., curtain wall) • Increased variation in colour, materials, and pattern in place of other building articulation (i.e. instead of more complex massing or architectural features)	• Colour/material/pattern variation visually breaks up massing and enhances building features	• No OCP conflict	• No specific change

ATTACHMENT 4

This document presents the key concepts and considerations for high performance building design, as well as common design strategies and implications for form and character on common Richmond archetypes.

KEY CONSIDERATIONS FOR HIGH PERFORMANCE BUILDINGS

The following design strategies, which relate to building form and character, are considered **best practice** and the most cost-effective way to achieve the higher steps of the BC Energy Step Code. Following these best practices closely may not always be feasible due to project-specific context, such as site constraints and regulations. Similar performance outcomes can be achieved with various combinations of high performance strategies. For example, a building with a somewhat more complex massing may achieve the same energy target as a building with simple massing, if the wall and/or window performance is increased. Designers can use energy models to explore different trade-offs and validate the appropriate set of strategies to meet multiple project objectives and balance various considerations, including form and character guidelines. Energy models help inform design decision making including cost-benefit considerations, and best-value options.

MASSING AND ARTICULATION

Focus on creating a **compact building** with simple massing. This approach helps to reduce thermal losses through the building envelope. Simpler massing with fewer details and complex junctions reduce the number of points at which thermal bridging often occurs, and make it easier to achieve a continuous air barrier.

Tip: As an alternative to building forms requiring a complex building envelope, consider using colours, textures and/or building elements external to the thermal envelope to articulate the facade with minimal impact on thermal performance.

ORIENTATION AND SHADING

Orient buildings and distribute fenestration to maximize solar gains in winter and maximize daylighting, while allowing for natural ventilation. Consider the shading effect of adjacent buildings or trees on the building's solar gains.

Maximize **glazing area** on the south to benefit from the best potential for solar gains in the winter. Windows on the south can be shaded effectively to manage the potential for overheating during the summer months, with minimal impact on winter heat gains. This approach is key to addressing increased summer temperatures in future climate conditions. Consider reducing excess window area on north-facing building elevations as available solar gains are limited for this orientation, while balancing the benefit of daylighting in reducing artificial lighting energy consumption.

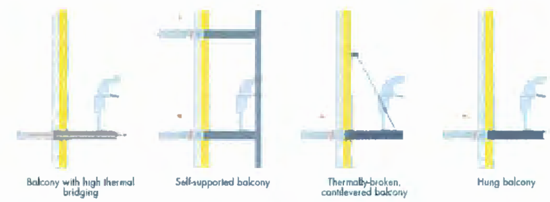
Ensure **shading** strategies are implemented on the south and west orientations. **Deciduous trees**, for example, can provide shading in the summer, when it is most useful, and minimize shading in the winter when additional light and heat is of maximum benefit. **Operable windows** on multiple facades can also contribute to natural ventilation, reducing the energy used by the active ventilation system.

Tips: Solar shading devices can take many forms and help articulate the building, including fixed horizontal overhangs, vertical fins, sliding or folding louvers, motorized blinds, dynamic glass, and/or deciduous trees.

SPECIFIC CONSIDERATIONS FOR BALCONIES

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 through well-insulated building envelopes.

Use thermally broken balconies, hung balconies, or self-supported structures to minimize unwanted heat losses/gains through the building envelope. These strategies will have an impact on project cost and may affect the building aesthetic.

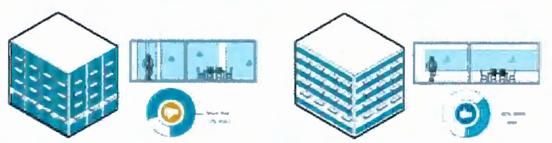


Recessed balconies may pose an additional challenge for efficient envelope performance, compared to extended balconies; they increase building envelope area, and often create complex junctions and corners all of which lead to more heat losses through the envelope. Stacking recessed balconies to reduce the number of complex junctions in the building envelope, can minimize those impacts.

GLAZING

Use **triple glazing** in a high performance frame, vertically centered on the insulation layer in order to maximize continuity of the building's thermal envelope. The frame is the weakest point of a window assembly so it is important to minimize the number of framing elements. Avoid intermediate mullions where not required, and opt for fewer larger windows rather than more smaller ones.

Even high-performance windows have have a much lower thermal resistance than opaque walls. To minimize heat losses, consider targeting an overall **window-to-wall ratio** of 40%.



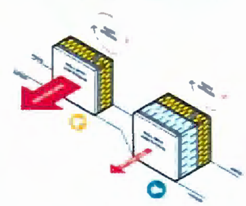
Tips: Consider raising window sills to a least 2' (600mm) above the floor. This will reduce the heat losses through the glazing, reduce risk of glare and improve comfort without compromising daylighting and views.

BUILDING ENVELOPE MATERIALS AND DESIGN

Increase insulation levels and consider building designs with thicker envelope assemblies, as there is no loss of total calculated floor space when doing so.

Reduce **thermal bridging** from design elements like exposed slab balconies. Where thermal bridging cannot be avoided, use lower thermal conductivity materials to help reduce heat transfer.

Design the building envelope to facilitate installation of a continuous air barrier; this not only minimizes air leakage (improving indoor air quality and occupant comfort), but also reduces thermal losses. Limiting the number of junctions, intersections and recesses in the envelope will make a continuous airtight layer easier to build.



Tips: Use materials with low thermal conductivity (such as wood, fiberglass, etc.) for any elements penetrating the insulation layer. For example, using wood studs in an exterior wall with insulated stud cavities will greatly reduce thermal bridging relative to using steel studs.

BUILDING SCALE AND DENSITY

Larger buildings tend to be more compact, with a smaller ratio of building envelope surface to floor area. This helps to reduce the impact of envelope heat losses on overall building performance.

Buildings with a higher density of occupants and/or other heat-emitting features (kitchen, server room, etc) can benefit from the additional "free heat" provided by people and equipment. These buildings may find it easier to meet the envelope performance requirements (TEDI target) of the BC Energy Step Code, since heat losses through the envelope are typically less critical where more internal gains are available. For example, a MURB with a more complex massing may achieve the same level of energy performance as a single family home with a simple massing, as the MURB's high internal gains can compensate for some of the additional heat losses through the envelope.

However, buildings with higher internal gains may face additional cooling loads to be considered in the project design, in order to ensure thermal comfort in summer.

PART 3 MIXED-USE / RESIDENTIAL HIGH-RISE BUILDINGS

The purpose of this page is to describe the main potential tension points between high performance design strategies and form and character objectives for **Part 3 mixed-use / residential high-rise buildings**. For each potential tension point, issues are summarized, and strategies to consider are presented which balance high performance design and form and character objectives.

BALCONIES AND THERMAL BRIDGING

Conventional balconies are created by extending the concrete floor slab through the thermal envelope. As reinforced concrete is a good thermal conductor, the slab penetrating the insulation layer functions like a radiator fin, transferring heat from the building interior to the outdoors. When designing balconies, consider the following strategies to limit heat losses:

CANTILEVERED BALCONIES (CONCRETE AND METAL CLIP-ON STRUCTURES)

A thermal break is used to separate the building and balcony structures. The thermal break should be placed in line with the insulation layer in the wall assembly. While thermally broken concrete balconies appear the same as typical cantilevered balconies, metal clip-on balconies can have a different aesthetic.

HUNG BALCONIES

Steel tension cables and rods are used to suspend the balcony and greatly reduce the total area of the thermal connections passing through the thermal envelope to the building structure. These have a different look than typical cantilevered balconies and may have limitations on size.

SELF-SUPPORTED BALCONIES

An external structure extending to the ground supports the balcony (instead of the building's structure), thus limiting thermal envelope penetrations. While this approach is more commonly used on mid-rise buildings, some high-rise buildings have also been built with self-supported balconies.

COMPACT MASSING AND ARTICULATION

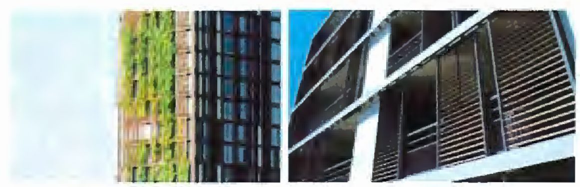
Compact massing is key to limiting heat losses from the envelope since the complex corners and detailing resulting from a more complex building envelope is often a significant source of thermal bridging. Although simple shifts in massing can often be accomodated in high performance buildings, the following strategies create articulation and visual interest with no or minimal impact on energy performance:

COLOUR, MATERIALS AND TEXTURES

Changes in exterior cladding material, colour or textures can create architectural interest while maintaining simple building volume.

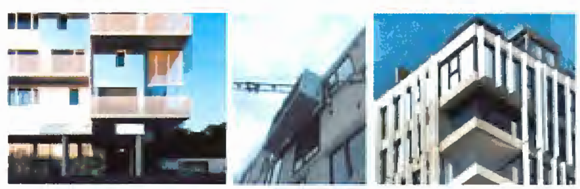
SHADING DEVICES

Shading is critical to avoid overheating in summer, on the south and west elevations. Shading devices can provide interest by providing external detailing and enabling the creation and varying of patterns across the elevation.



ELEMENTS OUTSIDE THE THERMAL ENVELOPE

A simple, efficient thermal envelope can be independent of the outer appearance of the building. Elements such as balconies, shading devices, and cladding with various depths or materials can create visual interest with minimal impact on the building thermal envelope, if carefully detailed.



GLAZING AND HEAT LOSS

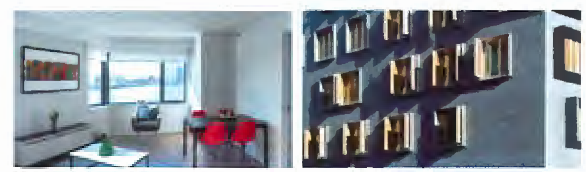
Even the most efficient triple-glazed windows have much less thermal resistance than insulated solid walls. It is therefore important to limit the overall glazing area and distribute it where it is most needed, to allow for views, daylighting, connection to the street, etc. The following solutions can be adopted to reduce heat losses through windows and window frames:

TRANSPARENCY AT GRADE, LESS GLAZING ON UPPER FLOORS

High-performance buildings can achieve an active/tranparent frontage at grade while achieving a lower overall window-to-wall ratio by reducing glazing on the upper floors. The increased heat losses from the ground floor glazing are compensated for with less heat losses from the upper floors.

RAISE WINDOW SILLS

Although floor to ceiling windows are popular, the lower part of the glazing does not contribute to views or daylighting. Consider raising the height of the window sill to at least 2' (600mm) to benefit from reduced glazing area without impacting daylighting or access to views by occupants.



CONSIDER SOLAR ORIENTATION FOR WINDOWS

Glazing area on the south orientation can be increased to maximize solar gains, with appropriate shading to mitigate the summertime overheating risks (now and in the future, as the local climate warms). Optimize glazing on the north orientation to maximize daylighting for occupants while minimizing heat losses.

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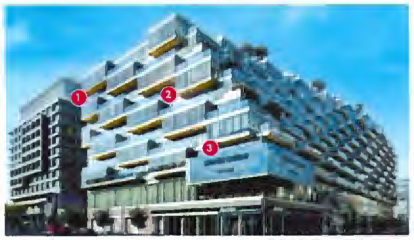
PART 3 MIXED-USE/RESIDENTIAL HIGH-RISE
CASE STUDIES

CONVENTIONAL STRATEGIES

These projects demonstrate conventional design approaches (listed below) that would be challenging to accommodate in high-performance buildings.



West Half, Washington - US
Architects: ODA New York

1. Very high window-to-wall ratio
2. Complex massing with large amount of thermal bridging
3. Minimal shading relative to the amount of glass, increasing overheating risk in summer.

6900 Pearson Way, Richmond - Canada

1. Very high window-to-wall ratio
2. Similar window-to-wall ratio on all orientations
3. Minimal shading provided
4. Extensive use of inefficient curtain wall and spandrels
5. Recessed balconies increases building envelope area

HIGH PERFORMANCE STRATEGIES

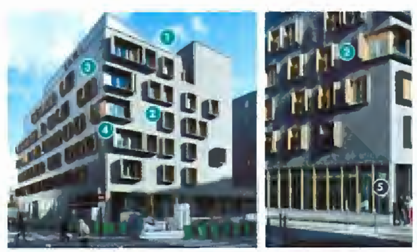
Although these projects have not reached high levels of energy performance, the following features demonstrate design practices aligned with high performance.

Couch9, Portland - US
Architect: Vallaster Corl Architects

1. Overall simple and compact massing, although the recessed balconies would affect building energy performance.
2. Self-supported balconies on the west, and clip-on balconies on the east limit thermal bridging
3. West-oriented glazing shaded by balconies
4. Higher window-to-wall ratio on the south

Other form and character objectives:

5. Higher transparency at grade



ZAC Boucicaut, Paris - France
Architect: MG-AU

1. Simple and compact massing
2. Folding shutters and deep window frames provide visual interest with minimal impact on performance
3. Low window-to-wall ratio
4. Large windows with minimal framing

Other form and character objectives:

5. Highly glazed ground floor

HIGH PERFORMANCE ACHIEVED

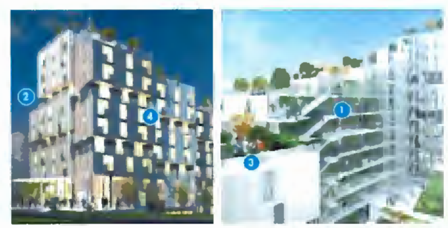
These projects demonstrate design approaches (listed below) that have been used to achieve high performance.

Buggi 50, Freiburg - Germany
PASSIVE HOUSE

1. Compact and simple massing
2. Cantilevered thermally-broken balconies
3. Low window-to-wall ratio
4. Largest windows shaded by balconies
5. Large windows with minimal framing

Boyen Street, Berlin - Germany
Architect: Deimel Oelschlager
PASSIVE HOUSE, ZERO EMISSIONS

1. Low window-to-wall ratio
2. Simple and compact massing overall (note that the building envelope is sufficiently high-performance to allow for several bump-outs on the north elevation)
3. Self-supported balconies on the south, to limit thermal bridging
4. South-facing windows shaded by folding shutters on balconies and retractable shades on upper floor



Corvette Landing, Admirals Road & Constance Avenue, Victoria - Canada
Architect: LWPAC
PASSIVE HOUSE

1. Conditioned area of the building reduced by pushing the hallways and stairways outdoors
2. Relatively complex massing is offset by the large scale of the project, which reduces the surface-area-to-volume ratio
3. Outdoor amenity space provided on the rooftop to avoid thermal bridging impact of balconies (note that balconies for all units are required in Richmond)
4. Fairly low window-to-wall ratio

Solis Passive House, Seattle - US
Architect: Weber Thompson
PASSIVE HOUSE PHIUS CERTIFIED

1. Simple massing
2. Low window-to-wall ratio
3. Thermally broken balconies
4. Lobby, stair and elevator shaft are located outside of thermal envelope
5. Ground floor windows shaded by canopy with building integrated PV's

Other form and character objectives:

6. Higher transparency at grade to create visual connection to the street

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PART 3 MID-RISE RESIDENTIAL BUILDINGS

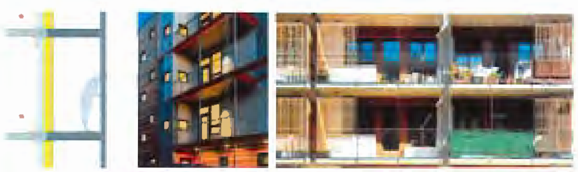
The purpose of this page is to describe the main potential tension points between high performance design strategies and form and character objectives for **Part 3 mid-rise residential buildings**. For each potential tension point, issues are summarized, and strategies to achieve both high performance design and form and character objectives are presented for consideration.

BALCONIES AND THERMAL BRIDGES

Conventional balconies are created by extending the concrete floor slab through the thermal envelope. As reinforced concrete is a good thermal conductor, the slab penetrating the insulation layer functions like a radiator fin, transferring heat from the building interior to the outdoors. When designing balconies, consider the following strategies to limit heat losses:

SELF-SUPPORTED BALCONIES

An external structure extending to the ground supports the balcony (instead of the building's structure), thus limiting thermal envelope penetrations. These types of balconies work well on mid-rise buildings.



CANTILEVERED BALCONIES (CONCRETE AND METAL CLIP-ON STRUCTURES)

A thermal break is used to separate the building and balcony structures. The thermal break should be placed in line with the insulation layer in the wall assembly. While thermally broken concrete balconies appear the same as typical cantilevered balconies, metal clip-on balconies can have a different aesthetic.

HUNG BALCONIES

Steel tension cables and rods are used to suspend the balcony and greatly reduce the total area of the thermal connections passing through the thermal envelope to the building structure. These have a different look than typical cantilevered balconies and may have limitations on size.

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COMPACT MASSING AND ARTICULATION

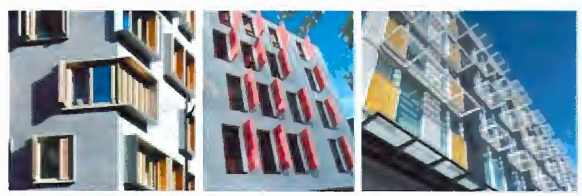
Compact massing is key to limiting heat losses from the envelope and helps to avoid complex detailing which can be a source of thermal bridging and air leakage. Although simple shifts in massing can often be accomodated in high performance buildings, the following strategies create articulation and visual interest with no or minimal impact on energy performance:

COLOUR, MATERIALS AND TEXTURES

Changes in exterior cladding material, colour or textures can create architectural interest while maintaining simple building volume.

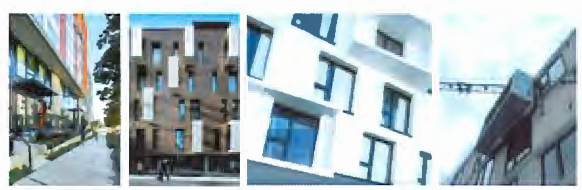
SHADING DEVICES

Shading is critical to avoid overheating in summer, on the south and west elevations. Shading devices can provide interest by providing external detailing and enabling the creation and varying of patterns across the elevation.



ELEMENTS OUTSIDE THE THERMAL ENVELOPE

A simple, efficient thermal envelope can be independent of the outer appearance of the building. Elements such as balconies, shading devices, and cladding with various depths or materials can create visual interest with minimal impact on the building thermal envelope, if carefully detailed.



GLAZING AND HEAT LOSS

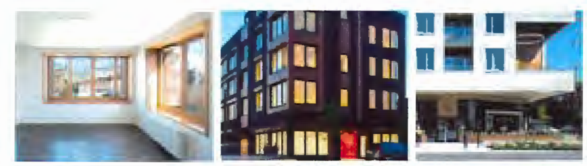
Even the most efficient triple-glazed windows have much less thermal resistance than insulated solid walls. It is therefore important to limit the overall glazing area and distribute it where it is most needed, to allow for views, daylighting, connection to the street, etc. The following solutions can be adopted to reduce heat losses through windows and window frames:

TRANSPARENCY AT GRADE, LESS GLAZING ON UPPER FLOORS

High-performance buildings can achieve an active/tranparent frontage at grade while achieving a lower overall window-to-wall ratio by reducing glazing on the upper floors. The increased heat losses from the ground floor glazing are compensated for with less heat losses from the upper floors.

RAISE WINDOW SILLS

Although floor to ceiling windows are popular, the lower part of the glazing does not contribute to views or daylighting. Consider raising the height of the window sill to at least 2' (600mm) to benefit from reduced glazing area without impacting daylighting or access to views by occupants.



CONSIDER SOLAR ORIENTATION FOR WINDOWS

Glazing area on the south orientation can be increased to maximize solar gains, with appropriate shading to mitigate the summertime overheating risks (now and in the future, as the local climate warms). Optimize glazing on the north orientation to maximize daylighting for occupants while minimizing heat losses.

PART 3 MID-RISE RESIDENTIAL BUILDINGS
CASE STUDIES

CONVENTIONAL STRATEGIES

These projects demonstrate conventional design approaches (listed below) that would be challenging to accommodate in high-performance buildings.

The Village, 4211 Bayview Street, Richmond - Canada
Architect: Yamamoto Architecture Inc.
1. Complex massing, roof forms and building articulations
2. High window-to-wall ratio
3. Extensive use of non thermally-broken concrete balconies increases thermal bridging.

Mandalay, 9371 Hemlock Drive, Richmond - Canada
1. High window-to-wall ratio on all orientations maximizes thermal losses in winter and overheating in summer.
2. Extensive use of non thermally-broken concrete balconies increases thermal bridging.
3. Multiple window mullions increase transmission heat losses.

HIGH PERFORMANCE STRATEGIES

Although these projects have not reached high levels of energy performance, the following features demonstrate design practices aligned with high performance.

The Black and White, 1033 Cook Street, Victoria - Canada
Architect: Architects
1. Compact and simple massing
2. Low window-to-wall ratio on upper floors
3. Large windows with limited framing
4. Color and materials used to emphasize building articulation with no impact on building performance.

Other form and character objectives:

5. Highly glazed ground floor allows connection to the street.

Mercy, 2239 West 7th Ave, Vancouver - Canada
Builder: Kindred Construction
1. Low window-to-wall ratio. Large windows with minimal framing
2. Relatively simple massing
3. Windows shaded by roof overhang and balconies
4. Exterior front canopy minimizes thermal bridging.

Other form and character objectives:

5. Balconies or private outdoor space provided for each unit

HIGH PERFORMANCE ACHIEVED

These projects demonstrate design approaches (listed below) that have been used to achieve high performance.

Residence Ardea, rue v, Brussels, Belgium
Architect: A2M
PASSIVE HOUSE
1. South oriented windows shaded by balconies
2. Self-supported balconies
3. Thermal envelope with a very simple volumetry, with all elements contributing to articulation located outboard
4. High window-to-wall ratio on the south (this building has a lower window-to-wall ratio on its north elevation)

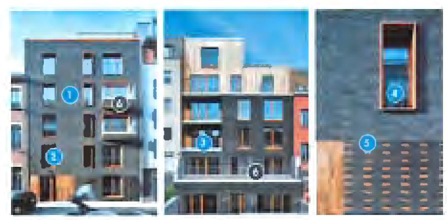
Other form and character objectives:

5. Generous south-oriented balconies or private outdoor space for every unit

Dubrucq Escaut, Brussels, Belgium
Architect: R²D²
PASSIVE HOUSE CERTIFIED
1. Compact massing
2. Visual interest from pattern variation in the wood cladding, thus with no or minimal impact on thermal performance
3. Limited window-to-wall ratio on upper floors
4. Windows shaded by balconies and wood slats
5. Large windows with minimal framing

Other form and character objectives:

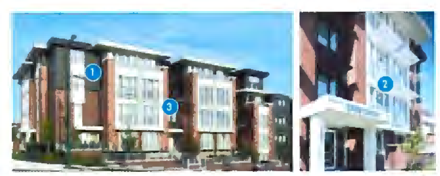
6. Balconies or rooftop terrace provided for each unit
7. Higher transparency at grade to create visual connection to the street



Orient, Brussels, Belgium
Architect: R²D²
PASSIVE HOUSE
1. Compact massing
2. Lower window-to-wall ratio on the north
3. Higher window-to-wall ratio on the south
4. Large windows with minimal framing
5. Use of colour and materials provides articulation with no impact on energy performance.

Other form and character objectives:

6. Balconies or rooftop terrace provided for all units



Spire Landing, 706E 57th Ave, Vancouver - Canada
Architect: Cornerstone Architecture
PASSIVE HOUSE CERTIFIED
1. Relatively simple massing for a building of this scale
2. Fixed horizontal sunshades on the south facing windows
3. Use of various materials, shading devices and some volumetric shifts create articulation, with minimal impact on thermal envelope.

PART 3 COMMERCIAL BUILDINGS

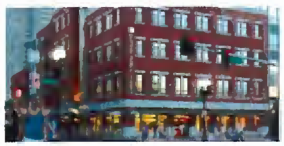
The purpose of this page is to describe the main potential tension points between high performance design strategies and form and character objectives for **Part 3 commercial buildings.** For each potential tension point, issues are summarized, and strategies to consider are presented which balance high performance design and form and character objectives.

GLAZING AND HEAT LOSS

Even the most efficient triple-glazed windows have much less thermal resistance than insulated solid walls. It is therefore important to limit the overall glazing area and distribute it where it is most needed, to allow for views, daylighting, connection to the street, etc. The following solutions can be adopted to reduce heat losses through windows and window frames:

TRANSPARENCY AT GRADE, LESS GLAZING ON UPPER FLOORS

High-performance buildings can achieve an active/tranparent frontage at grade while achieving a lower overall window-to-wall ratio by reducing glazing on the upper floors. The increased heat losses from the ground floor can be balanced with less heat losses from the upper floors.




RAISE WINDOW SILLS

Although floor to ceiling windows are popular, the lower part of the glazing does not contribute to views or daylighting. Consider raising the height of the window sill to at least 2' (600mm) to benefit from reduced glazing area without impacting daylighting or access to views by occupants.



CONSIDER SOLAR ORIENTATION FOR WINDOWS

Glazing area on the south orientation can be increased to maximize solar gains, with appropriate shading to mitigate the summertime overheating risks (now and in the future, as the local climate warms). Optimize glazing on the north orientation to maximize daylighting for occupants while minimizing heat losses.

North Elevation (less glazing)

South Elevation (more glazing)

COMPACT MASSING AND ARTICULATION

Compact massing is key to limiting heat losses from the envelope and helps to avoid complex detailing which can be a source of thermal bridging and air leakage. Although simple shifts in massing can often be accomodated in high performance buildings, the following strategies create articulation and visual interest with no or minimal impact on energy performance:

COLOUR, MATERIALS AND TEXTURES

Shading is critical to avoid overheating in summer, on the south and west elevations. Shading devices can provide interest by providing external detailing and enabling the creation and varying of patterns across the elevation.


SHADING DEVICES

Shading is critical to avoid overheating in summer, on the south and west elevations. Shading devices can provide interest by varying patterns across the elevation.


ELEMENTS OUTSIDE THE THERMAL ENVELOPE

A simple, efficient thermal envelope can be independent of the outer appearance of the building. Elements such as balconies, shading devices, and cladding with various depths or materials can create visual interest with minimal impact on the building thermal envelope, if carefully detailed.


CURTAIN WALLS AND SPANDRELS

While used on several building types, curtain wall systems are commonly used as the building envelope on commercial office buildings. These systems consist of floor to ceiling glass with opaque panels at floor slabs or other service spaces.

Curtain walls perform relatively poorly compared to other window wall systems, and spandrel panels perform significantly worse than a well-insulated opaque wall. Selecting a building envelope that can deliver the performance required is a critical choice for achieving overall energy efficiency targets.

If the building will incorporate a curtain call system, a second key determinant of energy performance is optimizing the window-to-wall ratio in order to limit heat transfer.

Consider limiting the amount of spandrel panels in the envelope, and using insulated walls where transparency is not required.

6081 No 3 Rd. Richmond office building with extensive curtain wall and spandrels

Capital Park, office building, Victoria BC

Appropriate window-to-wall ratio with punched windows and less curtain wall areas

PART 3 COMMERCIAL BUILDINGS
CASE STUDIES

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CONVENTIONAL STRATEGIES

These projects demonstrate conventional design approaches (listed below) that would be challenging to accommodate in high-performance buildings.

3820 Cessna Drive, Richmond - Canada

1. Building fully glazed on all facades
2. Building oriented on the north-south axis (main elevations on the east and west) with no shading, increasing the risk of overheating in summer
3. Exterior concrete columns supporting the overhang produce significant thermal bridging

5951 No. 3 Road, Richmond, Canada

1. High window-to-wall ratio on all elevations, including on the north orientation
2. Exterior glazing flush with face of cladding is not in line with the mid-point of the insulation layer, increasing thermal bridging at window perimeters.

HIGH PERFORMANCE STRATEGIES

Although these projects have not reached high levels of energy performance, the following features demonstrate design practices aligned with high performance.

1515 Douglas Street & 750 Pandora Avenue, Victoria, Canada

Architect: D'Ambrosio Architecture + Urbanism

1. Limited window-to-wall ratio on upper floors
2. Compact massing
3. Use of different colours and cladding materials to create articulation with no impact on energy performance
4. Shading and weather protection provided by exterior canopy at grade, fully outside the thermal envelope

Other form and character objectives:

5. Higher transparency at grade to create visual connection to the street.

111 East Grand and St. Kilda Surf & Turf, Des Moines, US

Architect: Neumann Monson Architects

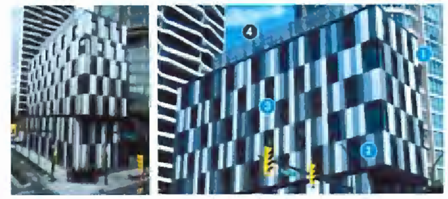
1. Simple massing
2. Articulation created by the use of different colours and materials, with no impact on energy performance.
3. Thermal bridging minimized by the use of wood exterior columns, rather than a concrete or steel structure with increased heat transfer
4. Limited window to wall ratio on upper floors
5. Balconies appear to be recessed, but are strategically stacked at the corner so that they do not increase the total surface area of the building envelope
6. Large overhang provides shading to the large windows.

Other form and character objectives:

7. Higher transparency at grade to create visual connection to the street.

HIGH PERFORMANCE ACHIEVED

These projects demonstrate design approaches (listed below) that have been used to achieve high performance.



825 Pacific Street, Vancouver - Canada

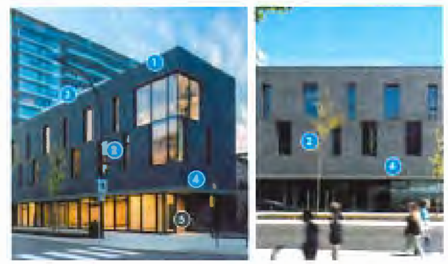
Architect: IBI Group

PASSIVE HOUSE

1. Compact massing
2. Use of various colours of cladding to create visual interest with no impact on thermal performance
3. Limited window-to-wall ratio, with a few large glazed units

Other form and character objectives:

4. Architectural screens concealing rooftop mechanical equipment



Lonsdale Avenue Commercial Building, Vancouver, Canada

Architect: Hemsworth Architecture

PASSIVE HOUSE

1. Compact and simple massing
2. Limited window-to-wall ratio on upper floors
3. Most glazing is south facing. No glazing on the north
4. Exterior canopy hung from the exterior wall and independent of the thermal envelope, provides shading for the glazed ground floor with minimal thermal bridging.

Other form and character objectives:

5. Higher transparency at grade to create visual connection to the street

Maison de l'Emploi, Brussels, Belgium

Architect: A2M

PASSIVE HOUSE

1. Limited window-to-wall ratio. Glazing with a raised sill.
2. Simple volumetry with interior courtyard to maximize daylighting
3. More glazing at street level, placed strategically where most beneficial
4. Varied cladding materials create articulation with no impact on massing.
5. Green roofs provide additional insulation on the roofs
6. Rooftop PV array

Other form and character objectives:

7. Rooftop and interior courtyard offer exterior common amenity space for occupants

The Genesis, Braine-l'Alleud, Belgium

Architect: A2M

PASSIVE DESIGN, BREEAM CERTIFIED: EXCELLENT

1. Two compact boxes connected by an atrium
2. Glazed atrium height is maximized on the (south facing) entrance side, but reduced to a single story on the (north facing) rear elevation to limit heat losses.
3. Wood fins outside the thermal envelope create articulation with no impact on the building enclosure.

Other form and character objectives:

4. Large overhang at main entrance creates protected outdoor space.

PART 9 TOWNHOUSES AND DUPLEXES

The purpose of this page is to describe the main potential tension points between high performance design strategies and form and character objectives for **Part 9 townhouses and duplexes**. These are included together because they have similar considerations. For each potential tension point, issues are summarized, and strategies to consider are presented which balance high performance design and form and character objectives.

COMPACT MASSING AND ARTICULATION

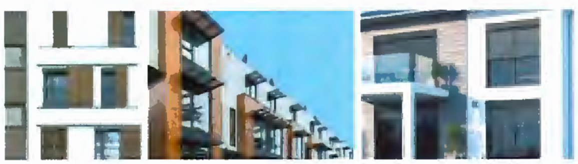
Compact massing is key to limiting the heat losses from the envelope since the complex corners and increased surface area resulting from a detailed building envelope is often a significant source of thermal bridging and air leakage. Dormers, pitched roofs and bay windows typically add complex junctions and increase the overall surface area of the building envelope, increasing heat transfer. The following strategies allow for articulation and visual interest with minimal impact on energy performance:

COLOUR, MATERIALS AND TEXTURES

Changes in exterior cladding material, colour or textures can create architectural interest while maintaining simple building volume.

SHADING DEVICES

Shading is critical to avoid overheating in summer, on the south and west elevations. Shading devices can provide interest by varying patterns across the elevation.



ELEMENTS OUTSIDE THE THERMAL ENVELOPE

A simple, efficient thermal envelope can be independent of the outer appearance of the building. Elements such as balconies, shading devices, and cladding with various depths or materials can create visual interest with minimal impact on the building thermal envelope, if carefully detailed.

BALCONIES AND THERMAL BRIDGING

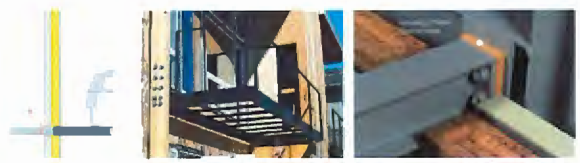
Conventional balconies are created by extending the concrete floor slab outside the thermal envelope. As reinforced concrete is a good thermal conductor, the slab penetrating the insulation layer function as radiator fins, transferring heat from the building interior to the outdoors. When designing balconies, consider the following strategies to limit heat losses:

SELF-SUPPORTED BALCONIES

An external structure extending to the ground supports the balcony (instead of the building's structure), thus limiting thermal envelope penetrations. These types of balconies work well on low-rise buildings.

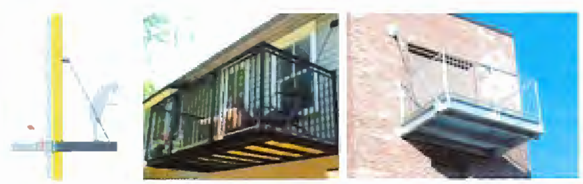
CANTILEVERED BALCONIES (METAL CLIP-ON STRUCTURES)

A thermal break is used to separate the building and balcony structures. The thermal break should be placed in line with the insulation layer in the wall assembly. Metal clip-on balconies are more common than concrete balconies for Part 9 buildings.



HUNG BALCONIES

Steel tension cables and rods are used to suspend the balcony and greatly reduce the total area of the thermal connections passing through the thermal envelope to the building structure. These have a different look than typical cantilevered balconies and may have limitations on size.



OTHER HIGH PERFORMANCE DESIGN CONSIDERATIONS UNIQUE TO SMALL RESIDENTIAL BUILDINGS

Townhouses are small buildings with a relatively high ratio of building envelope to gross floor area. In smaller buildings, complex geometries can significantly decrease the building performance. Although achieving an energy efficient design with a complex volumetry is technically feasible, these designs tend to cost more and use more materials than a simpler building. Complex massing also results in increased numbers of complex junctions, making thermal bridging and airtightness difficult to manage and optimize. A simple thermal envelope volume is key for success. Designers should be strategic about trade-offs between different design elements.

BAY WINDOWS AND DORMERS

The addition of bay windows and dormers add envelope area and increase heat losses. It is also typical that these features necessitate more small windows increasing heat losses through the additional window frames.

PITCHED ROOFS

Pitched roofs tend to increase the surface area of the thermal envelope compared to a flat roof when the attic space is conditioned. If the attic space is not heated, it may be more challenging to maintain a continuous air barrier and continuous insulation between the exterior wall and the attic floor. Careful detailing can help minimize heat losses and air leakage.

SHARED WALLS

Maximizing the contact surface between adjacent units helps to reduce heat losses where shared walls between townhouses separate two conditioned spaces. Keeping the townhouses aligned at the front and back minimizes the building envelope area exposed to the outside. Adjacent units can be differentiated by materials or texture rather than relying on modulation of the building facade.

GP- 36

PART 9 TOWNHOUSES - CASE STUDIES

CONVENTIONAL STRATEGIES

These projects demonstrate conventional design approaches (listed below) that would be challenging to accommodate in high-performance buildings.

Tigris Garden, 7471 No 4 Road, Richmond - Canada

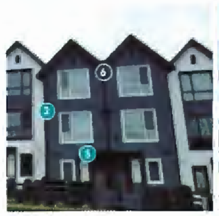
1. Complex massing created by dormers, bay windows and canopies increases heat losses through the increased surface area of the building envelope
2. Numerous complex junctions introduce additional thermal bridging

22888 Windsor Court, Richmond - Canada

1. Complex massing with bay windows and multiple roof shapes increases heat losses through the increased surface area of the building envelope
2. Recessed balconies create more opportunities for thermal bridging
3. Many small windows increase amount of window framing and associated heat losses

HIGH PERFORMANCE STRATEGIES

Although these projects have not reached high levels of energy performance, the following features demonstrate design practices aligned with high performance.



19159 Watkins Drive, Surrey - Canada

Builder: Mosaic

1. Compact massing and simple thermal envelope
2. Visual interest created by the use of various colours and cladding treatments, with no impact on energy performance
3. Limited window-to-wall ratio
4. Externally supported balconies to minimize thermal bridging
5. Exterior canopies with minimal thermal bridging

Other form and character objectives:

6. Pitched roofs create a visual separation between units.

Tilley Row Homes, Austin - US

Architect: Michael Hsu

1. Compact massing
2. Small size balconies minimize thermal bridging
3. Deep grey window frames and wood elements provide articulation and contrast with the white cladding, with no impact on energy performance.
4. Limited window-to-wall ratio

Other form and character objectives:

5. Small recesses highlight the entrances, provide weather protection and private outdoor spaces. Townhouses facing the street
6. Pitched roofs create a visual separation between units.

HIGH PERFORMANCE ACHIEVED

These projects demonstrate design approaches (listed below) that have been used to achieve high performance.

The Walk, Bainbridge Island - US

Architect: Davis Studio Architecture + Design

NET ZERO ENERGY

1. Compact massing
2. Limited window-to-wall ratio, with a few large glazed units
3. Visual interest created by the use of different materials and colours with no impact on thermal performance

Other form and character objectives:

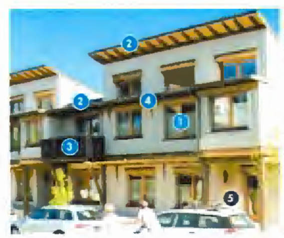
4. Entrances facing the street, with weather protection

Tillamook Row, Portland - US

Architect: Green Hammer

ZERO ENERGY, PASSIVE HOUSE

1. Fixed horizontal sunshades and roof overhangs for shading on the south elevation
2. Sliding shutters on east and west elevations for shading and visual interest
3. Individual units have a compact massing.
4. Balconies and canopies with self-supported structure to reduce thermal bridging.
5. Articulation created by the use of different materials, colours and patterns, with no impact on thermal performance.
6. Limited window-to-wall ratio with minimal window framing
7. Rooftop PV array



Ankeny Row Cohousing, Portland - US

Architect: Green Hammer

PASSIVE HOUSE

1. Limited window-to-wall ratio
2. Roof overhangs provide shading
3. Balconies with structure braced back to the exterior wall to minimize thermal bridging.
4. Articulation provided by elements outside of the thermal envelope.

Other form and character objectives

5. Entrances facing the street, with weather protection

Skagen, 606 Foster Avenue, Coquitlam - Canada

Architect: Cornerstone Architecture

PASSIVE HOUSE

1. Compact massing
2. Limited window-to-wall ratio
3. Use of various colours and cladding materials to create articulation with no impact on thermal performance
4. Front canopy outside the thermal envelope
5. Fixed horizontal sunshades on south and west elevations

Other form and character objectives:

6. Entrances facing the street, with weather protection

PART 9 DUPLEXES - CASE STUDIES

CONVENTIONAL STRATEGIES

These projects demonstrate conventional design approaches (listed below) that would be challenging to accommodate in high-performance buildings.

The Bridge Lynn Valley Homes, 1163 Harold Road, North Vancouver - Canada

1. Very complex roof lines and overall massing increase heat losses through the additional building envelope area
2. Numerous complex junctions introduce additional thermal bridging and make it more challenging to achieve a high level of airtightness
3. Window-to-wall ratio similar for all orientations
4. Small windows increase heat losses through window frames

310 11th Street East, North Vancouver - Canada

1. Complex massing and roof lines increase heat losses through the additional building envelope area
2. Numerous complex junctions introduce additional thermal bridging and make it more challenging to achieve a high level of airtightness.

HIGH PERFORMANCE STRATEGIES

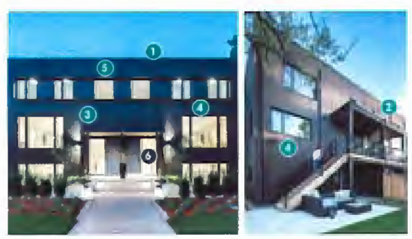
Although these projects have not reached high levels of energy performance, the following features demonstrate design practices aligned with high performance.

4236 Inverness Street, Vancouver - Canada

1. Simple and compact massing
2. Exterior canopy outside of thermal envelope, minimizing thermal bridging
3. Low window to wall ratio

Other form and character objectives:

4. Entrances facing the street, with weather protection



Dickens, 1041 East 16th Avenue, Vancouver - Canada

Architect: Evoke International Design

1. Simple and compact 'box' massing
2. Patios and canopies supported by external structure to limit thermal bridging
3. Overall low window-to-wall ratio
4. Higher window-to-wall ratio on the south, lower on the north
5. Deep frame around upper south windows provide summertime shading

Other form and character objectives:

6. Entrances facing the street, with weather protection

HIGH PERFORMANCE ACHIEVED

These projects demonstrate design approaches (listed below) that have been used to achieve high performance.

Mary Street Duplex, Victoria - Canada

Architect: hcma

PASSIVE HOUSE CERTIFIED

1. Compact massing
2. South-facing clerestory glazing provides solar gains and daylighting on north side of building
3. Use of different cladding materials and colours to create articulation with no impact on thermal performance
4. Large overhang on south elevation provides summertime shading
5. East and west facades shaded with exterior blinds and vegetated structure
6. Balcony supported by exterior structure

Other form and character objectives:

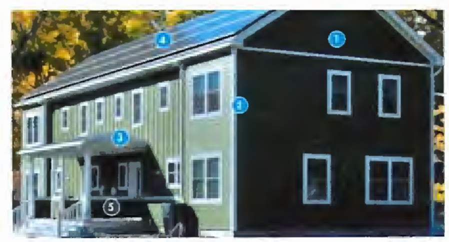
7. Entrances facing the street

Futrhaus, 1152 East 13th Avenue, Vancouver - Canada

Architect: b Squared Architecture

PASSIVE HOUSE

1. Roof overhang and fixed horizontal sunshades over south-facing windows provide summertime shading
2. Exterior canopies outside the thermal envelope provide shading.
3. Limited window-to-wall ratio
4. Compact volumetry
5. Large windows with minimal framing



South Deerfield Net Zero Energy Duplex, South Deerfield - US

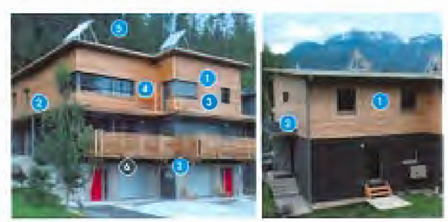
Architect: Fitch Architecture & Community Design

NET ZERO ENERGY, TIER 3 ENERGY STAR

1. Simple and compact massing
2. Limited window-to-wall ratio
3. Front canopy outside the thermal envelope with minimal thermal bridging
4. Rooftop PV array

Other form and character objectives:

5. Entrances facing the street, with weather protection



Rainbow Passive House Duplex, Whistler - Canada

Architect: Marken Design + Consulting

PASSIVE HOUSE

1. Low window-to-wall ratio
2. Balconies and canopies supported by external structure limit thermal bridging
3. Fixed horizontal sunshades over windows
4. Exterior blinds on the south
5. Rooftop solar thermal array

Other form and character objectives:

6. Entrances facing the street, with weather protection

Building Regulation Bylaw No. 7230, Amendment Bylaw No. 10365 (Energy Step Code requirements)

The Council of the City of Richmond, in open meeting assembled, enacts as follows:

1. *Building Regulation Bylaw No. 7230*, as amended, is further amended by replacing the table in Section 10.1.1 with the following table:

Buildings subject to Part 9 of the Building Code			
Building Type	**Building permit** application filed on or after September 1, 2018	**Building permit** application filed on or after December 15, 2020	**Building permit** application filed on or after July 1, 2022
Townhomes and **apartments**	Step 3	Step 3 OR Step 2 for **buildings** that implement a **low carbon building energy system.**	Step 5 OR Step 4 for **buildings** that comply with the **building envelope performance requirement** using **absolute metrics** OR Step 3 for buildings that comply with the **building envelope performance requirement** using **absolute metrics,** and that implement a **low carbon building energy system.**
Single family, duplex and other **dwelling units**	Step 1		

Buildings subject to Part 3 of the Building Code			
Building Type	**Building permit** application filed on or after September 1, 2018	**Building permit** application filed on or after December 15, 2020	**Building permit** application filed on or after July 1, 2022
Hotels and Motels	n.a.	Step 3 OR Step 2 for **buildings** that implement a **low carbon building energy system.**	Step 3 OR Step 2 for **buildings** that implement a **low carbon building energy system.**
Other Group C Residential occupancies greater than 6 stories or **non-combustible construction** (not including hotel and motel occupancies)	Step 3 OR Step 2 for **buildings** that implement a **low carbon building energy system.**		Step 3 OR Step 2 for **buildings** that implement a **low carbon building energy system.**
Other Group C Residential occupancies 6 stories or less and **combustible construction** (not including hotel and motel occupancies)	Step 3		Step 4 OR Step 3 for **buildings** that implement a **low carbon building energy system.**
Group D Business and personal services occupancies or **Group E mercantile occupancies**	Step 2		Step 3 OR Step 2 for **buildings** that implement a **low carbon building energy system.**

2. *Building Regulation Bylaw No. 7230*, as amended, is further amended at Section 16.1 by adding the following definitions in alphabetical order:

ABSOLUTE METRICS	means: a) the thermal energy demand intensity listed under the "Performance Requirement of Building Envelope" column of Table 9.36.6.3.A in the British Columbia Building Code, or b) the thermal energy demand intensity requirement calculated using the formula in Sentence 4 of Section 9.36.6.3 in the British Columbia Building Code.
BUILDING ENERGY USE	means the total modelled annual energy requirements of an occupied building, including space heating, cooling, hot water heating, ventilation, appliances and electrical plug loads.
BUILDING ENVELOPE PERFORMANCE REQUIREMENT	means the requirements listed under the "Performance Requirement of Building Envelope" column of Table 9.36.6.3.A in the British Columbia Building Code.

3. *Building Regulation Bylaw No. 7230*, as amended, is further amended at Section 16.1 by removing the definition of "Low Carbon Building Energy System" and replacing it with:

LOW CARBON BUILDING ENERGY SYSTEM means:

a) for buildings subject to Part 3 of the Building Code, a building's space heating, cooling and domestic hot water heating mechanical system that is supplied energy through:

(i) a connection to a district energy utility system owned by the City or a corporate subsidiary of the City; or

(ii) on-site energy supply equipment designed to meet a minimum 70% of each of the building's A) annual heating demand, B) annual cooling demand, and C) domestic hot water energy demand, from a renewable energy source, approved by the City's General Manager of Engineering and Public Works. Applicable renewable energy source technologies include, but are not limited to, air and ground source heat pump systems, waste heat recovery systems, solar collectors, or other systems as approved by the City's General Manager of Engineering and Public Works. The building's energy system must be designed and constructed such that it is ready to connect to a future district energy utility system owned by the City or a corporate subsidiary of the City. For sites outside district energy utility service areas and the City Centre Area (as defined in Bylaw No. 9000, Official Community Plan), the City's General Manager of Engineering and Public Works may exempt the building's energy system from the requirement to be ready to connect to a future district energy utility system.

b) for buildings subject to Part 9 of the Building Code, annual GHG emissions from building energy use, per metre of conditioned floor space, of no more than the amount defined below:

	Submission date of complete Building Permit Application	
	On or after December 15, 2020, and before July 1, 2022	On or after July 1, 2022
Part 9 Residential buildings	1200 kg CO_2e per dwelling unit per year OR no more than 6 kg CO2e per spare meter of conditioned floor space per year	440 kg CO_2e per dwelling unit per year OR no more than 2.5 kg CO2e per spare meter of conditioned floor space per year, <u>and</u> no more than 800 kg CO_2e per dwelling unit per year

4. This Bylaw may be cited as **"Building Regulation Bylaw No. 7230, Amendment Bylaw No. 10365".**

FIRST READING ______________________

SECOND READING ______________________

THIRD READING ______________________

ADOPTED ______________________

CITY OF RICHMOND

APPROVED by

APPROVED by Manager or Solicitor

______________________ MAYOR

______________________ CORPORATE OFFICER

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Richmond Official Community Plan Bylaw 9000, Amendment Bylaw 10364 (Development Permit Guidelines for Low Carbon, Energy Efficient Buildings)

The Council of the City of Richmond, in open meeting assembled, enacts as follows:

1) Richmond Official Community Plan Bylaw 9000, as amended, is further amended at Section 14.2.10 Green Buildings and Sustainable Infrastructure, by deleting the words:

"The intent is to provide general direction in regards to the voluntary undertaking, where feasible, of green building and sustainable infrastructure to support City of Richmond sustainability objectives and help reduce the demand for energy and resources."

and replacing them with:

"The intent is to provide general direction in regards to the undertaking of green building and sustainable infrastructure to support City of Richmond greenhouse gas (GHG) emission reduction and sustainability objectives and help reduce the demand for energy and resources."

2) Richmond Official Community Plan Bylaw 9000, as amended, is further amended at Section 14.2.10 Green Buildings and Sustainable Infrastructure, by deleting the text of subsection 14.2.10.A Low Carbon, Energy Efficient Buildings in its entirety and replacing it with the following:

14.2.10.A Low Carbon, Energy Efficient Buildings

a) New buildings are encouraged to be designed to achieve low or zero GHG emissions in their operations.

b) As required in the Building Regulation Bylaw, applicable new buildings will be designed and constructed to meet the BC Energy Step Code to support more energy efficient development, which may include, but may not be limited to, the high-performance building considerations set out in the table below.

- Through rezoning, Development Permit and other permit approval processes, proposed buildings shall demonstrate compliance with the applicable requirements of the BC Energy Step Code to the satisfaction of the City (for example, by providing energy modelling outputs).

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- Compliance with a given Step of the BC Energy Step Code shall not compromise the intent of any of the Development Permit Guidelines contained in Schedule 1 or Schedule 2 of the OCP.

- In the event that, during the Building Permit process, a new building subject to an approved Development Permit requires remedial actions to achieve compliance with the applicable step of the BC Energy Step Code, any such remedial actions shall not compromise the intent of the Development Permit Guidelines applicable to the building.

Features	High-Performance Building Considerations
Massing & Roofs	• Consider compact massing to reduce the overall size of the building envelope[1]. • Consider simple building and roof forms to enhance thermal performance. • Use fewer architectural features with complex junctions that may contribute to heat loss due to thermal bridges[2] and/or increased building envelope area (e.g., bay windows, dormers, recesses, and stepping).
Orientation & Shading	• Consider strategic building and window orientations that enhance opportunities for winter solar heat gain and summer shading. • Provide external shading devices on key south and west facades (e.g., balconies, fins, blinds, shutters, and deciduous trees). • Include operable windows to enable natural ventilation.
Windows & Daylighting	• Limit the window-to-wall-ratio (WWR)[3] to reduce solar heat gain (i.e. typically 40% or less, as applicable). • Consider fewer, larger windows (rather than more smaller or multi-pane windows) to minimize thermal bridging through window frames, mullions, and muntins. • Raise window sills to reduce window size without compromising daylighting.
Balconies & Roof Decks	• Use thermally-broken[4] balcony designs (e.g., modified slab, pinned, hanging, and self-supported) to reduce thermal bridging at building connection points. • Avoid recessed balconies and/or consider stacking recessed balconies to reduce thermal bridging due to increased wall area, corners, and connection points. • Where appropriate, consider using roof decks in place of balconies.

Envelope Materials & Design	• Increase insulation (e.g., thicker exterior wall assemblies and triple glazing), especially where heat loss is unavoidable (e.g., due to a high WWR). • Reduce use of lower-performing window/wall systems (e.g., curtain wall). • Where appropriate, consider enhancing thermal performance of the building envelope by utilizing variation in colour, materials, and pattern as building articulation strategies in lieu of complex massing and architectural features.

[1] "Building envelope" means the connected system of foundations, floors, windows, walls, ceilings and/or roofs, which provide an air, moisture and heat insulation barrier separating the conditioned interior spaces of a building from unconditioned interior spaces (for example, an unheated garage or attic) and/or the outdoors.

[2] "Thermal bridge" means a building component or system that permits a greater heat transfer through the building envelope than surrounding materials.

[3] "Window-to-wall ratio (WWR)" means, for a given building, the total surface area of windows, divided by the total wall area (including windows).

[4] "Thermally-broken" means use of a building component or system to minimize heat transfer through the building envelope by mitigating potential thermal bridges.

3) This Bylaw is cited as **"Richmond Official Community Plan Bylaw 9000, Amendment Bylaw 10364".**

FIRST READING ______________________

PUBLIC HEARING ______________________

SECOND READING ______________________

THIRD READING ______________________

ADOPTED ______________________

Ready for

CITY OF RICHMOND

APPROVED for content by originating dept.

APPROVED for legality by Solicitor

______________________ ______________________

MAYOR CORPORATE OFFICER

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