HVAC DESIGN PACKAGES FOR BC STANDARDIZED HOUSING

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Disclaimer

Consultation and design that comply with these guidelines will not necessarily be acceptable if, when examined and tested, such construction and design are found to have other features which impair the results contemplated by these guidelines, or where local building requirements may differ from these guidelines. It is important to confirm local requirements prior to engaging in design and/or installation.

The authors and editors assume no responsibility and accept no liability for the application of the principles or techniques contained in these guidelines, or for any errors or omissions, and expressly disclaim any such responsibility.

National & BC Building Code Requirements & Bylaws

At the time of publication, the National (NBC) and the British Columbia (BCBC) code requirements in sections 9.32., 9.33., and 9.36. differ substantially. Although there is overlap between the two codes, and there are plans to harmonize the differences in the future, ensure that local codes are followed. This publication is designed for BC, so the BCBC will be referenced.

Municipal bylaws may supersede the requirements of the BCBC and the NBC. It is strongly recommended that HVAC designers and installers have a strong understanding of their local requirements, in addition to the governing building code.

Contents

Submittals & Coordination

The following HVAC equipment must have specification sheets, commonly referred to as spec sheets, to coordinate the project work.

- Air handler units (AHU)
  - Complete with indoor heat pump coil
  - A furnace may act as the air handler and a backup heat source
  - Note any auxiliary or supplemental heaters
- Outdoor heat pump unit or Condenser unit (CU)
- Ventilator, either a Heat recovery ventilator (HRV) or an Energy recovery ventilator (ERV)
- Electric baseboard heaters (EBB)
- Supply air grilles (SG)
- Return air grilles (RA)
- Exhaust grilles (EG)
- Intake and Exhaust hoods
- Water heater (outside project scope)
- Any hydronic equipment such as pumps (outside project scope)
- If a gas appliance is used, such as a furnace or water heater, the mechanical designer must note the route and size of the intake and combustion piping and ensure that it is vented sufficiently far from intake hoods and operable windows.

Equipment Schedules

The last page on the associated standard HVAC plans contains equipment schedules, which are to be completed by the mechanical contractor.

Electrical Coordination

The electrical designers and tradespeople should receive the specifications on the air handlers, any electrical heaters, all heat pump equipment, and the water heaters. They require the amperage, voltage and phase of the equipment to properly size their electrical service and panel.

Below is a clip of an equipment specifications from a nominal 18,000 BTUH heat pump that includes the Power (electrical) requirements of this unit.

Power	Voltage	ø / V / Hz	1 / 208-230 / 60
	Working Voltage Range (VAC)		187 - 253
	Operating Current (min. / std. / max.)	Cooling (A)	2.5 / 6.2 / 11.2
		Heating (A)	2.6 / 7.0 / 18.0
	Max. Breaker	Amps	30
	Min. Circuit Ampacity (A)		21

This design information should be provided as early in the project as possible to save cost. Coordinating with the electrical designer might impact the mechanical equipment selection, so it is in the best interest of everyone on the project to coordinate these items in the early planning phase. The required electrical information is on the equipment schedules, which should be sent to the electrical contractor as early as possible in the project.

Fire Separation

Fire separation is critical to the safety of the dwelling and its occupants. Maintaining continuous fire separation assemblies simplifies the project, which is one of the reasons that communal HVAC systems are often avoided. Additional penetrations through fire separations typically necessitate fire and smoke damper installations, adding complexity and additional costs.

Water Heaters: Location & Electrical Loads

Due to the limited mechanical space, consider that a conventional tank-type water heater may not fit in the heated crawlspace. Either space for this equipment must be made where sufficient ceiling height is available, or a smaller unit, such as a tankless water heater should be considered. Be aware that electric tankless water heaters have significant power draw, which is critical information for the electrical designer.

Interpreting the HVAC Plans

These HVAC plans and HLHG reports are intended to facilitate the HVAC design and installation. It is critical that the mechanical designer on the project take responsibility for the work on the actual project. Without structural plans, coordination on site or specific equipment selection, the attached plans and reports cannot be solely relied upon to be accurate.

The most referenced sections of the National and British Columbia Building Code for residential HVAC work are sections 9.32 Ventilation, and 9.33 Heating and Air-conditioning. All sections of the code must be followed but reviewing those two sections are critical for HVAC contractors. The units of measure in both codes are metric, many contractors prefer imperial units, verify that the units in calculations are correct.

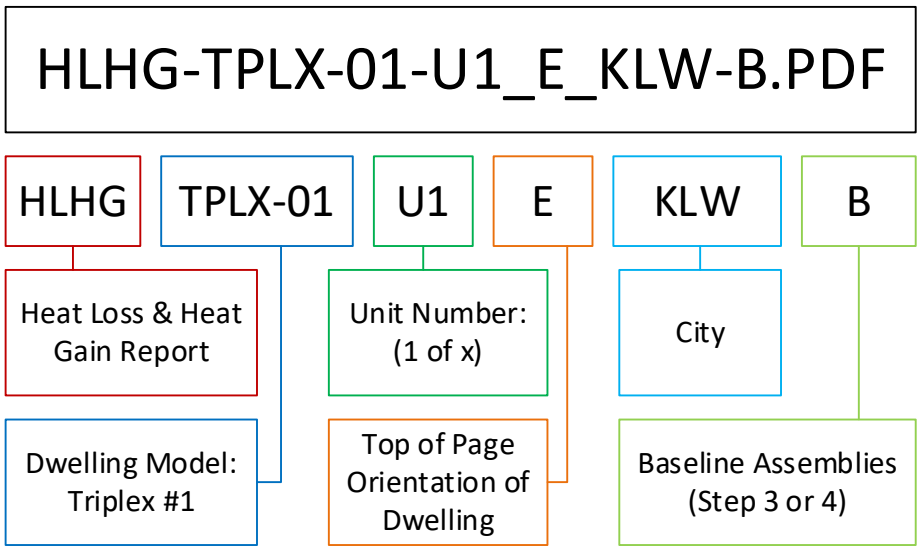
Changes to building assemblies, window/door assemblies, the addition or removal of skylights, and other architectural elements greatly impact the heating and cooling loads and the overall HVAC design. Confirm all assumptions made in the HLHG calculations and ensure that the ductwork is appropriately sized for the selected equipment.

The lack of structural plans needs to be considered in the HVAC distribution system design, and the routing of the pipes will require adjustment to minimize drops. An effort has been made to have most of the cross overs in ductwork in the heated crawlspace to minimize drops in the living areas.

Some drops will be required, coordinating those drops early in the project is advised to maximize ceiling heights and architectural appeal. Consider selecting a ceiling height that is greater than 8 feet so that any drops can be accommodated without a significant impact on the finished ceiling height. The type of joist can also impact the available space for mechanical systems.

Heat Loss & Heat Gain (HLHG) Reports

The names of the heat loss and heat gain report files are used to determine the appropriate model for the project. The diagram below is an example of this format for a Triplex unit in Kelowna.



Two forms of the same report are included in the project files. A standard CSA format of the HLHG report includes -CSA in the title. The report without this -CSA tag is a more detailed breakdown that includes components information in each room. This allows for specific assemblies to be reviewed in much more detail, which is helpful if considering using a higher quality window or a wall assembly with a greater R-value.

The room numbers and room names on the HLHG reports match the numbers and names printed on the mechanical plans, the room numbers should be used to determine the appropriate unit for the report.

For Example, on TPLX-01-U1, the bottom unit is unit #1, and the entry way is noted a 100-ENTRY on the HLHG report, which can be seen in the low left corner of the mechanical plans. The unit numbering convention starts from left to right and bottom to top floor. Therefore, the bottom floor unit on the left will be U1. Typically, the units are numbered starting at #1 on the left of the page, incrementing as the units move to the right.

Building Assemblies

The building assemblies that are noted on the architectural plans meet Step 3 and EL-3 in all four of the specified cities. Some dwelling meet Step 4 and EL-4. BCIT commissioned a report by E3 Eco Group Inc. titled “PREDICTED STEP CODE REPORT -STUDY OF BC ENERGY STEP CODE OF 10 BUILDING ARCHETYPES FOR BCIT” which confirms these findings. There are plans to add Step 5 assemblies and include the corresponding heat loss and heat gain reports. This work is beyond the scope of the original project.

Overhangs & Window Shadings

No overhangs or window shadings were assumed in the heat gain calculations. This is acceptable under the CSA F280 standard because it will lead to a higher heat gain load. The assumption of no overhangs was required because the installed roof style will vary. If overhangs above the windows and doors are included, the actual heat gain will be reduced because some of the solar radiation will be shaded by the overhang.

It is common practice to not model that blinds are active when calculating heat gain. Since many homeowners prefer to keep the blinds open on sunny days, it is a reasonable assumption for the model. Thick curtains or blinds, especially on the sides of the dwelling that are exposed to the sun can have a strong impact on reducing the solar gains. When an unusually warm weather front occurs, closing the blinds will assist the cooling system in maintaining a comfortable temperature in the dwelling by mitigating solar load gains.

Mechanical Room & Heated Crawlspace

It is not ideal to have the crawlspace as the mechanical room. When attempting to maximize the living space in a dwelling, it can be challenging to accommodate a mechanical room in the living area. The heated crawlspace is integral to the attached plans. Heating must be provided in the crawlspace, which must remain within the plane of insulation.

The mechanical equipment has been located as near to the crawlspace access as possible, with the front of the equipment accessible. The manufacturer’s specifications will note requirements for service access. Always maintain the recommended service access clearances! If the service access is relocated, consider moving the mechanical equipment closer to the access point to facilitate service and maintenance.

Some regions do not build below grade crawlspaces. In these dwellings, consider HVAC systems that minimize space requirements for indoor equipment, such as ductless mini-splits and tankless water heaters.

Condensate Drains

Heat recovery ventilators (HRV), air handling units (AHU), and fan coil units (FCU) have condensate drains that need to connect to the sanitary drain by indirect connection according to the Plumbing Code. Avoid condensate pumps whenever possible, condensate pumps are less reliable than a gravity drainage system and require more frequent maintenance.

Mini-Split System Requirements

Using mini-split systems effectively requires specific considerations. The mini-split fan coil units (FCU) allow for zone control, but areas that are far from the FCU might not be able to maintain as even a temperature because they can struggle to circulate the indoor air effectively. In large areas, such as the kitchen, living, and dining rooms, a ceiling fan will help circulate the air, providing a more balanced temperature on the floor level.

Many mini-split models will not allow different FCUs to be operating in different modes. This means that an FCU heating in one location will not allow a different FCU to be cooling at the same time. This simultaneous heating and cooling feature requires an additional mode control unit and is typically more expensive to purchase and install. The mode control unit also requires an electrical connection and service access, which are often overlooked. Without the simultaneous heating and cooling, the spring and the fall can be challenging to maintain a comfortable temperature in all rooms as when there is a call for heat, no cooling can be provided, and vice versa. To improve thermal comfort, it is recommended design mini-split systems for simultaneous heating and cooling. The different loading requirements that desire simultaneous heating and cooling is the same reason that designers typically do not recommend having more than one dwelling unit served by a shared outdoor unit.

Bathrooms do not require a dedicated FCU, but some heating makes the room much more comfortable and building code requires that it can maintain 22°C at winter design conditions. Since the HRV is designed to exhaust air continuously, some indirect temperature control will occur, but in the winter, the bathroom may feel cold to the occupant. An electric baseboard will mitigate this thermal comfort issue as cooling is not the primary concern. Alternatively, the electrically heated floors with a dedicated thermostat is an excellent solution, as it provides zoned, radiant heat that does not require additional floor space for mechanical equipment, nor does it create what many customers consider to be an ugly aesthetic feature of the electric baseboard mounted to a wall.

The attached plans show only the wall mounted FCUs, which is the most common style. There are a wide variety of styles, including wall, floor, and ceiling mounted units. Alternatively, there are many different styles of small air handler units that could be considered.

Forced Air System Requirements

Not all dwellings are conveniently served by centrally ducted forced air systems. Units with small heat loss and heat gain loads will often have to up-size to 1-1/2 ton or 18,000 BTUH nominal capacity systems because that is the smallest common centrally ducted heat pump system. This is not necessary a bad thing, as long as the heat pump has a variable capacity, it can run on a lower speed and meet the heating and cooling demands of the dwelling.

A centrally ducted forced air system has the benefit of better circulation than mini-split systems. Effective circulation will maintain a more even temperature throughout the dwelling.

Centrally ducted systems often require drops and furred out walls to act as mechanical chases. Oval piping can be also used when running the duct up a wall to save space, but round pipe is preferable because of its superior performance.

Because there are no structural plans provided with the architectural designs, carefully consider the ductwork on all of the living floors. Depending on the orientation of the joists and the location of beams, some drops may be required. Coordination between structural and mechanical plans prior to construction will reduce drops.

Plenum sizes are not noted on the HVAC plans because they vary depending on the selected air handler model.

Return Air

Return air grilles must be provided for each floor as per the BCBC-2024, clause 9.33.6.12. (2) and the doors shall be undercut per 9.33.6.12. (3). The undercut is important to ensure that the system can properly circulate the air.

Do not undersize the return air. It is a common misconception that return air is not critical to the system which results in insufficient airflow, which is particularly problematic for heat pumps.

It is common practice to transfer return air through joist spaces. Performance through a duct is higher, but transferring through joists can save ceiling heights.

Air Handler Filters

Install equipment should be designed to handle at a minimum, MERV 8 filtration. The standard 1” wide filters will result in significant static pressure losses, it is recommended to use a 4” wide pleated filter, which often requires a third-party filter rack, and to locate it in the return air plenum. Use duct transitions to reduce the air velocity at the filter face to 400 feet per minute or less. Filters should be changed regularly, wider filters are most expensive, but last longer and allow for lower external static pressure losses, especially as they are loaded with debris.

Ventilation Requirements

National vs BC Code Requirements

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This publication is designed for BC, so the BCBC will be referenced.

Principal Ventilation System Exhaust Fan

Section 9.32.3.5. of the BCBC contains specific code clauses for the principal ventilation system exhaust fan, including the minimum code requirements for this equipment in BCBC Table 9.32.3.5. The minimum duct sizes for the ventilation system are prescribed in BCBC Table 9.32.3.8.

Some of the mechanical designs for the dwellings in this project include HRVs that are greater than the minimum requirements according to the BCBC. The design values are closer to the ASHRAE recommendations.

The mechanical plans note high and low settings on the HRV, which follows best practices of the HRV meeting the continuous ventilation requirements on low speed, with controllers at the point of exhaust that activates the high speed for an intermittent ventilation requirement. This helps address odor and moisture reduction when required, without continuously over-ventilating the dwelling.

Kitchen Exhaust Fans

Confirm the airflow rate (CFM) and the acceptable external static pressure (“wc) and size exhaust duct to match. The plans show 6” diameter pipe, which is an acceptable size to meet the requirements of code minimum kitchen exhaust fans. Confirm the venting requirements with the manufacturer’s specifications.

Some of the units have challenging structural elements that prevent a convenient path for venting the kitchen exhaust fan, in particular, when the range backs against the stairs. Consider a down-draft kitchen exhaust fan, which allows for the exhaust vent to be located adjacent to the HRV/ERV exhaust vent at the crawlspace level. Alternatively, running the pipe parallel to the stairs may be acceptable, but will likely require a substantial drop.

Cold Climate Considerations

Cold climate heat pumps should be considered, particularly if the dwelling has a heat loss load that is significantly higher than the heat gain load. Cold climate heat pumps are typically mostly costly to purchase, but they're usually more efficient and can be more cost effective when the operating costs are considered over the life of the dwelling.

Before over-sizing a heat pump die to the heat loss loads, consider adding a backup or auxiliary heater to the heat pump system. This allows for the cooling load to be more appropriately sized to the heat pump. A backup or auxiliary heater will deliver a higher temperature rise, which allows for the duct sizing as per plans. If the client wants to increase to a larger heat pump, review the heat loss & heat gain calculation and increase the duct sizing as required to meet the additional CFM for the larger air handler.

Common forms of backup or supplemental heating include a furnace (electric or gas), electric baseboards, or a combi boiler that serves heat emitters such as a hydronic coil in a centrally ducted system.

Reference Material

TECA Homepage:
https://www.teca.ca/

British Columbia Building Code (BCBC) Homepage:
www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/bc-codes/2024-bc-codes

BCBC 2024 PDF:
https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/construction-industry/building-codes-and-standards/revisions-and-mo/bcbc-revision-3/bcbc-revision-4/bcbc_2024_web_version_20240409.pdf

National Building Code (NBC) Homepage:
https://nrc.canada.ca/en/certifications-evaluations-standards/codes-canada/codes-canada-publications/national-building-code-canada-2025

NBC 2025 PDF Download:
https://nrc-publications.canada.ca/eng/view/object/?id=adf1ad94-7ea8-4b08-a19f-653ebb7f45f6

ASHRAE Homepage:
https://www.ashrae.org/