

Passive House Design and Construction Training Course

Course Outline and Learning Goals

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Module 6	Airtightness & Thermal Imaging
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Module 9	Heating Systems for Passive Houses
Module 10	Summer Cooling
Module 11	Developing Confidence with the PHPP
Module 12	Economics
Module 13	Quality Control and Certification
Module 14	Primary Energy
Module 15	Renovation
Module 16	Case Studies: Passive Houses in Canada (8)

Module 1 Passive House History and Design Principles

1. Big Picture: CO₂ and climate change
2. Historical perspective of Passive design
3. Canadian context / R-2000, Energy Star, ERS etc.
4. Net Zero Energy concept and its relation to PH
5. Correlation between energy consumption and environmental impact
6. Passive House: development and spread of the concept
7. Current status of Passive House approach worldwide
8. Passive Design basics: e.g. building orientation and solar gain sensitivity



Module 2 *Passive House Definition and Criteria*

1. The climate-independent definition of a Passive House and how this is derived
2. Heating load definition and derivation
3. Annual space heat requirement for a Passive House
4. Building envelope and airtightness
5. Yearly primary energy demand and energy services component
6. Winter comfort criteria / stratification and radiation
7. Summer comfort: Frequency of excess temperature
8. Summary of all Passive House terminology
9. Definition, calculation and importance of the treated floor area (A_{TFA})
10. Certification requirements for Passive House buildings

Module 3 *Building Envelope*

1. Principle of a highly insulating thermal envelope suitable for Passive House
2. Definitions of U-value, R-value and their measurement
3. Insulating performance values for typical Canadian building elements
4. Heat flow calculation principles
5. Insulation types and performance characteristics
6. Examples of calculated heat flow through building elements
7. Shape Factor of a building – calculation and impact on energy efficiency
8. Using the PHPP for simple, rapid heat flow calculations
9. Link between U-value & surface temperature; preventing condensation/mould
10. Ensuring vapour condensation safety in Passive House building assemblies
11. Typical U-value requirements for Passive House building elements in Canada
12. Building assemblies suitable for Passive House: Foundation/Floor
13. Building assemblies suitable for Passive House: Walls
Building assemblies suitable for Passive House

Module 4 *Thermal Bridging*

1. Concept and importance of thermal bridging
2. Types of thermal bridge
3. Principles of thermal bridge-free construction & overall impact
4. Qualitative analysis of building envelopes for thermal bridges
5. PH requirement to use external measurements only and reason for this
6. Thermal bridge calculation using THERM or HEAT
7. Typical thermal bridge values and calculated examples
8. Entering thermal bridges in the PHPP & their overall impact
9. Common examples of thermal bridges, and avoidance strategies
10. Examples: thermal bridge-free assemblies in wood frame



Module 5 *Windows*

1. The critical importance of window performance in a low energy building
2. Thermal comfort criteria in a Passive House; influence of windows
3. Window U-values – Passive House criteria and measurement
4. Definitions and handling of window thermal values
5. Proportional influence of the four primary thermal coefficients
6. Designing window frames for improved thermal performance
7. PH glazing energy criterion; heat transfer through triple pane low-e-glazing
8. Design and purpose of spacer systems
9. Placement of windows in an optimal thermal plane: pros and cons
10. Calculation of window installation coefficient & examples
11. Confident use of the PHPP window sheet
12. SHGC and g-value definitions; direct and diffuse radiation components
13. How to assess non-Certified windows?
14. Relative performance of PH-Certified and non-Certified products
15. Calculation of total energy flows through windows: winter & summer
16. How to quantify the influence of orientation on solar gain
17. Use of the PHPP shading calculation sheet and its importance

Module 6 *Airtightness and Thermal Imaging*

1. Why the PH airtightness requirement is so stringent; consequences of air leakage
2. Principle of “one airtight envelope” and need for detailed airtightness planning
3. Importance of placing the airtight layer on the warm side
4. Appropriate PH airtightness strategies in wood frame construction
5. Airtightness/vapor transportation/consequences
6. Suitable air sealing methods and airtight joints for wood frame construction
7. Potential airtightness weak spots & strategies
8. Blower door test procedures and requirements
9. Understanding common leakage points/problem areas & solutions
10. Airtightness in PHPP; effect on overall performance
11. Thermography – basics
12. Use of thermal imaging in PH construction and as a QC tool

Module 7 *Ventilation fundamentals*

1. Reason for mechanical ventilation systems in low-energy buildings
2. Air contaminants inside a building / CO₂ criterion & consequences
3. Determining optimum fresh air flow rates
4. Estimating the driving forces of wind and stack effects.
5. Relationship between rate of fresh air supply and external temp/humidity
6. Reasons for limiting air flow during winter



Module 8 *Ventilation Systems*

1. General requirements for PH ventilation systems
2. Defining air supply, transfer air and air extraction zones
3. Knowledge of PH Certification criteria for HRVs / performance comparisons
4. Suitable ducting systems: planning & layout
5. Example of ventilation system design, including flow rate calculations
6. Air extraction fans (bathroom, kitchen, etc) in low-energy buildings
7. Air circulation and mixing; the Coanda effect.
8. How to eliminate ventilation noise in a Passive House
9. Required air filter qualities and reasons for filtration
10. How to balance ventilation systems and reasons for doing this
11. Frost protection options for ventilation systems
12. Placement of exterior air inlets
13. Electric efficiency in ventilation units; examples
14. Overall impact of ventilation system performance; correct entry in the PHPP

Module 9 *Heating systems for Passive Houses*

1. Definition of Heating Load and how it is calculated
2. Reason for the 10 W/m² Passive House heating load criterion
3. Difference between building efficiency and overall heating efficiency
4. Thermal comfort requirements used in Passive House design
5. Limits on radiant temperature asymmetry in a PH, and design implications
6. Typical heat distribution strategies and systems in a PH
7. Suitable heat sources and systems for PH design
8. Evaluating the possibility of supply air heating using the PHPP
9. Defining the upper and lower limits of supply air flow rates
10. How PHPP calculates heating loads (both scenarios)
11. Temperature differences and zoning within a Passive House

Module 10 *Summer Cooling*

1. Summer thermal comfort standards used in PH design
2. Impact of shading systems on overheating
3. Assessing cooling load & natural ventilation via the PHPP
4. Use of the PHPP summer shading sheet
5. Impact of interior heat sources and how they can be reduced
6. Impact of exterior materials and input into the PHPP
7. Impact of insulation on summer overheating.
8. Evaluation and impact of thermal masses inside the building
9. Impact of internal vs. external summer shading



Module 11 ***Developing Confidence with the PHPP***

1. Overview of the PHPP
2. Monitoring and verification of Passive House buildings
3. Principles of energy balance calculations/ losses and gains
4. Design approach using the PHPP
5. Entry of values in the PHPP: common mistakes
6. Dealing with non- certified components / products
7. Common difficulties with the PHPP

Module 12 ***Economics***

1. Defining and assessing incremental costs of investment for a PH
2. Payback period, present value method, annuity methods
3. Life cycle assessment /monthly financial balances
4. Assessing economically effective insulation/efficiency levels
5. Calculating the most cost-effective efficiency measures

Module 13 ***Quality Control and Certification***

1. Overview of affected trade sectors
2. Pre-construction information for workers
3. Appropriate invitations to tender
4. Services/performance which need to be tested and how to do it
5. Future Passive House tradesperson course
6. Certification of Buildings – requirements and approach
7. Certification of Professionals – options

Module 14 ***Primary Energy***

1. Definition and characteristics of Primary Energy in a PH
2. Typical electricity consumption of domestic devices
3. Understanding “primary energy” factors

Module 15 ***Renovation***

1. Viability of renovating Canadian residential buildings to PH Standard
2. Advantages of using Passive House components
3. EnerPHIT Certification program
4. Current Canadian Examples

Module 16 ***Passive House Case Studies in Canada***

1. Eastern Canada – 4 Case Study examples
2. Western Canada – 4 Case Study examples
3. CanPHI Passive House monitoring program: objectives and data collection