CPHC® Training Agenda – Yestermorrow Design/Build School

PLEASE NOTE: Minimum Requirements to obtain the CPHC credential
*Order of presentation subject to change

- ✓ Complete all assigned homework after each session and before the next (expect to add half hour per session for homework)

Day 1 – Passive Building Fundamentals

Session 1.0 – Introduction to Passive Building:

8.30 am-10.00 am
- Introduction & welcome
- The historical context of passive house
- Passive building metrics
- Energy use equity, energy and CO2 balance, economic balance

10.00 am-10.15 am **Short Break**

10.15 am-noon
- Passive building strategies & principles
- Recent Passive House Projects in the US
- European and North American passive building trends

Noon-1.00pm Lunch

Session 2.0 – The Thermal Enclosure

1.00pm-2.30pm
- Enclosure requirements
  - Materials
  - R-values to assure minimum/maximum surface temperatures
- Airtightness
  - Materials

2.30 pm-2.45 pm **Short Break**

2.45 pm-5.00 pm
- Hygrothermal concerns
  - Component characteristics
  - Climate characteristics
- Sample envelope assemblies
- Case Studies in various climates

30 Min Q&A

- Homework session 1, self-study (solutions are provided on the CD)
- Homework session 2, self-study (solutions are provided as part of the CD)

Day 2 – Thermal Bridges, Windows, Balanced Ventilation, Space Conditioning

Session 3.0 – Thermal Bridges and High Performance Windows

8.30 am-10.00 am

- Introduction to thermal bridging
  - Geometric thermal bridges
  - Construction thermal bridges
  - Special case: Point thermal bridges

10.00 am-10.15 am **Short Break**

10.15 am-noon

- The high performance window: an essential passive building component
- Requirements for transparent building components and their influence on comfort and space conditioning in various climates:
  - R-values, surface temperatures and solar heat gain coefficients for glazing, shading requirements
  - R-value requirements for frame and spacers
  - R-values for doors
  - Thermal bridge free and water tight installation

Noon-1.00pm Lunch

Session 4.0 – Passive Building Balanced Ventilation

1.00pm-2.30pm

- Introduction to balanced ventilation systems with heat/energy recovery
- Energy recovery versus heat recovery ventilation and climate concerns
- Cold climate defrost options: Earth tube heat exchangers/closed loop heat exchange systems
- Sizing ventilation systems and duct layout
- Available products in North America that meet the performance criteria

2.30 pm-2.45 pm **Short Break**

Session 5.0 – Passive Building Space Conditioning and Domestic Hot Water Systems

2.45 pm-5.00 pm

- Space heating options: heat pumps, bio-mass, fossil fuels, mini-hydronic, electric resistance
- Space cooling and dehumidification: Heat pumps, hydronic systems
- Compact heat pump systems for ventilation, heating, cooling and DHW
- Case Studies

30 Min Q&A

- Homework session 3, self-study (solutions are provided as part of the download)
- Homework session 4, self-study (solutions are provided as part of the download)
- Homework session 5, self-study (solutions are provided as part of the download)

Day 3 – Multifamily Commercial, Retrofits, Quality Assurance, Economics

Session 6.0 – Multifamily and Commercial Passive Buildings

8.30 am-10.00 am

- Multifamily passive project introduction
- Differences in design criteria and certification protocols
- Mechanical systems options: centralized versus decentralized, semi-decentralized, hot water loads
- Fire protection and acoustical issues

10.00 am-10.15 am **Short Break**

10.15 am-noon

- Introduction to commercial passive buildings and design and certification criteria (process loads)
- Ventilation schedules, ventilation and space conditioning zoning, fire protection and acoustical issues, electrical efficiency, day lighting, energy efficient lighting concepts
- First US passive school example: The BioHaus

Noon-1.00pm Lunch

Session 7.0 – Introduction to Passive Building Retrofits

1.00pm-2.30pm

- Big picture overview: PH retrofits and their savings potential
- PH retrofit metrics, building science, other challenges
- Strategies for wood frame – case studies
- Strategies for brick buildings – case studies
- Importance of quality assurance during design and implementation:
  - Assuring hygrothermal performance of assemblies/risk assessment/correct vapor control layer placement,
  - Mitigated thermal bridge analysis and accurate accounting for them in the energy balance

2.30 pm-2.45 pm **Short Break**

2.45 pm-5.00 pm

Session 8.0 – Importance of Quality Assurance and Economic Feasibility

- Quality assurance and control: PHIUS+ voluntary certification program
- Third party verification process for design and implementation
- PHIUS+ and Zero energy Ready Home check list

- Economic Feasibility Basics
- Assessment tools

- No homework for session 6, 7 and 8
- Begin review of session material 1-8

Day 4 –Exercises and Intro to Underlying Physics Principles of Energy Balancing

Morning 4 – Exercise 1 & 2 - Passive Home Design and Retrofit

8.30 am-10.00 am

- ***½ of Class: Group Exercise 1*** **-** sketch the design for a typical Passive Home for a family of four
- Form groups of three (please no larger groups than that!)
- Instructor to assign a distinctly different climate to each group
- Group to identify and list the five main passive design principles
- Group to specify the general envelope and mechanical systems components/requirements according to the assigned climate in form of sketches and drawings with notations

- ***½ of Class Retrofit Group Exercise 2*** – see exercise 2 handout for more information
- Form groups of three (please no larger groups than that!)
- Instructor to assign one envelope details that poses thermal bridge challenges in existing construction to each group:
    - wall-window-roof vaulted "chainsaw style" (note: vented not recommended, airtight layer and vapor control layer design too problematic!),
    - wall-window-2nd floor,
    - wall-door-1st floor above crawl included in thermal envelope,
    - wall-door-1st floor above crawl excluded from thermal envelope,
    - wall-window-1st floor above basement included in thermal envelope,
    - wall-window-1st floor above basement excluded from thermal envelope,
    - wall-window-slab on grade
- Group to identify and list all critical layers of the wall assembly (i.e. WRB, airtight layer, vapor control layer etc.)

10.00 am-10.15 am **Short Break**

10.15 am-Noon

- Review and critique of group projects
  Evaluate each project in discussion with the whole group

Noon-1.00pm Lunch

Afternoon 4 – Introduction to Underlying Physics Principles of Energy Balancing

1.00pm-2.30pm

- Overview of the next 5 days of software training and online exam/take home design portion
- Passive building energy balance

2.30pm-2.45pm **Short Break**

2.45 pm-5.00 pm

- Passive building energy balance continued

30 Min Q&A

- Homework: Review study guide "PH Physics" (provided in print in folder)

Day 5 – Passive House Verification - Design, Optimization, Certification

Morning 5 – Introduction to the Modeling Software WUFI Passive

Course Requirements:

1. Your own laptop, you need administrative rights to your computer to install various software tools
2. 2 GB to install WUFI Passive, 2 GB to run the software

The WUFI Passive software is a design as well as a verification and certification tool. It allows the designer to optimize his/her design decisions based on the effectiveness of various energy performance measures. The Passive House Verification mode of the software, which we will be focusing on for the next 2 days, uses a simplified static energy balancing methodology based on monthly climate data that was specifically developed for extremely low load homes to quickly yet accurately predict the space conditioning demands of buildings.

The software offers various ways to enter the geometry of a building. It offers a simple drawing interface as part of the software, an import function from another drawing program such as Sketchup as well as the option of entering the geometry strictly numerically without 3D representation of the object.

Each envelope component then can be defined and associated with appropriate materials properties to calculate the accurate overall U-values of the composite assembly. The course over the next two days will take the participants through each step by entering a sample project and by providing an in-depth overview of the underlying calculation methodology.

8.30am-10.00am

- Why an all-in-one static, dynamic, hygrothermal verification tool is need, especially in North America
- Overview of the capabilities now
- Outlook of what will be soon

10.00am-10.15am **Short Break**

10.15am-Noon

- Review of energy targets for the passive energy balance and certification criteria
  - Metrics defined per square foot of conditioned floor area / per person recommendation
    - Annual heating and cooling demand
    - Peak Loads
    - Primary energy demand

        - Airtightness
    - Review of boundary conditions for the calculations and implementation in software:
        - Energy balancing of envelope/losses and gains:
            - Building condition -
                - Definition of the thermal boundary - building geometry and areas
                - Components of the envelope: walls above and below ground, slab, roof, windows etc.
                - Interior set points based on one comfort zone, interior loads/gains based on building type
                - Ventilation requirements
            - Exterior climate conditions -
                - Differing exterior temperature zones: heat loss to ambient, to ground, attached garage etc.
                - Monthly climate data
                - Definition and calculation of the interior conditioned energy reference area

Noon-1.00pm Lunch

Afternoon 5 – Passive House Verification with WUFI Passive: *Exercise 3* Dublin House

1.00pm-2.30pm

- Install WUFI Passive!
- Overview of the general software interface
- Overview Input climate data

2.30pm-2.45pm **Short Break**

2.45 pm-5.00 pm

- Overview wizard building entry option
- Overview WUFI Passive drawing tool
- SketchUp import of Dublin House geometry:
    - Watch movie tutorial for SketchUp import
    - Load SketchUp onto computer if not already loaded
    - Open WUFI Passive and install WUFI Plus Plug-in (under options)
    - Close WUFI Passive
    - Open provided SketchUp file for Dublin and assign zone, exterior conditions and components
    - Export file to WUFI Passive which reopens automatically at that point
    - Assure that project came in correctly, if not fix in SketchUp file and repeat process

➢ Homework day 5: Practice using the Wizard and drawing interface –in a new WUFI Passive file enter a dog house 4x4 feet, pitched roof, with one door opening and a 1x1 ft window in each of the other walls using the Wizard and the drawing tool.

Day 6 – Passive House Verification with WUFI Passive

Morning 6 – Dublin House *Exercise 3* Continued

8.30am-10.00am

- General inputs required for passive verification: setting the stage
  - Dublin case created in tree structure
  - Location and climate data: import Illinois, University of Illinois Willard, climate file (***change unit setting of software to SI when importing!***)
  - Building general project data entry
  - PH Case: type of occupancy
  - Simulated zone

10.00am-10.15am **Short Break**

10.15am-Noon

- Components
  - Definition of visualized opaque and transparent envelope components
    - Create assemblies
    - Specify windows
    - Shading

Noon-1.00pm Lunch

Afternoon 6 – Dublin House *Exercise 3* Continued

1.00pm-2.30pm

- Components continued
  - Definition of non-visualized components
    - Inner loads
    - Ventilation
    - Thermal bridges

2.30pm-2.45pm **Short Break**

2.45 pm-5.00 pm

- Attached zones
- Systems (distribution)
  - Hydronic heating
  - DHW
  - Ventilation
  - Auxilary systems
- Devices (equipment)
  - Space conditioning
  - DHW
  - Ventilation
- Outputs and results

➢ Homework day 6: "Save as" the Day 3 Dublin file and create a duplicate case 2 of Dublin in this new file. Import new climate data for a location of your choice for this new case (from climate data file provided to you on the CD). Optimize assemblies to meet the standard criteria for this new climate condition. Record your changes.

Day 7 –Mechanical Exercise and THERM Tutorial

Morning 7 – Kerr Avenue Townhouse Development Mechanical *Exercise 4*

8.30am-10.00am

- Climate exercise: Review of homework moving Dublin to a climate of your choice – exchange of experiences

10.00am-10.15am **Short Break**

10.15am-Noon

- ***Group Exercise 4:*** Kerr Avenue townhouse mechanicals – see exercise 4 Powerpoint for more specific instructions
  - Climate specific choice of systems design
  - Choose and size the equipment
  - Design duct layout and distribution
  - Sketch hot water system and distribution
  - Note *ALL* necessary components and additional provisions/specifications, materials necessary for the system of your choice

Noon-1.00pm Lunch

Afternoon 7 – THERM Tutorial: Exercise 5 Dublin House Corner Psi-Value Calculation

1.00pm-2.30pm

- Review and critique of group projects
  - *Follow the mechanical exercise check list and evaluate each project accordingly in discussion with the whole group*

2.30pm-2.45pm **Short Break**

2.45 pm-5.00 pm

- ***Individual Exercise 5:*** THERM model
  - Install THERM if not loaded yet or if the wrong version has been loaded (you must first uninstall before re-installing correct version provided on CD)
  - Open THERM
  - Underlay provided dxf detail file
  - Autoconvert
  - Assign materials and boundary conditions
  - Run model and extract results
  - Review select sample THERM files (i.e. window frame-wall connection and resulting thermal bridge)
- Use THERM results and WUFI Passive component R-values in provided calculator to generate Psi-value entry for the Passive House Verification mode in WUFI Passive
- Enter result in WUFI Passive file
- Q&A and discussion

- Homework Day 4: Review remaining sample THERM files provided on the training CD. Exam prep –review the study guide again

Day 8 – WUFI Plus Hygrothermal Assessment, Brief Overview Dynamic Model

Morning 8 – Overview Hygrothermal and Dynamic Assessment of Components in WUFI Plus

8.30am-10.00am

- Brief heat and moisture transfer review
- Introduction hygrothermal assessment of wall assemblies

10.00am-10.15am **Short Break**

10.15am-Noon

- Overview dynamic simulation and comfort assessment

Noon-1.00pm Lunch

Afternoon 8 – Prometric Exam

1.00pm-1.30pm

- Exam set-up

1.30 pm-4.30 pm

- Prometric Exam, 3 hrs total