Passive House an ideal basis for energy efficient building design
…. new built and renovation (EnerPHit)

Dr. Berthold Kaufmann
Passive House Institute
2021-07-08
Passive House Building design in a nutshell......

Contents and Summary
what is essential for Energy Efficient Passive House buildings!

- thermal insulation layer (thick enough!) is absolutely needed
- thermal bridge optimized design, air-tightness and good windows
- fresh-air-ventilation system with heat recovery
- low power heating (AC) system including hot water preparation

everything is economically reasonable for new built and retrofit
EnerPHit retrofit plan for stepwise retrofits

- Quality control has to be done during realization:
- ... training of tradesperson is crucial!
- ... provide mock-up-installation for on-site-learning!
- Routine helps for Quality!.... repeat again, what you have learned once!
The five main features of PH buildings!

- Air-tightness
- Ventilation with heat recovery
- No thermal bridging
- Good windows
- Thermal insulation layer
Check with PHPP for all international climate zones

- Cooling load and dehumidification (latent cooling) is crucial in Climate Zone 4…7
- Detailed check with PHPP should be done for each individual building
Global EnerPHit Standard — use the same for retrofit

EnerPHit Standard
- Guideline and incentive for an optimal efficiency standard for retrofits
- Certification as quality assurance for building owners

Energy Retrofit with Passive House Components
Global EnerPHit Criteria

the building component method for retrofit:

<table>
<thead>
<tr>
<th>Climate zone according to PHPP</th>
<th>Opaque envelope (^1) against...</th>
<th>Windows (including exterior doors)</th>
<th>Ventilation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>...ground</td>
<td>Overall (^4)</td>
<td>Min. heat recovery rate (^7)</td>
</tr>
<tr>
<td></td>
<td>...ambient air</td>
<td>Glazing (^5)</td>
<td>Min. humidity recovery rate (^8)</td>
</tr>
<tr>
<td></td>
<td>Insulation</td>
<td>Solar load (^6)</td>
<td>%</td>
</tr>
<tr>
<td>Arctic</td>
<td>0.09</td>
<td>[kWh/(m²a)]</td>
<td></td>
</tr>
<tr>
<td>Cold</td>
<td>0.12</td>
<td>0.45 0.50 0.60</td>
<td></td>
</tr>
<tr>
<td>Cool-temperate</td>
<td>0.15</td>
<td>0.65 0.70 0.80</td>
<td>80%</td>
</tr>
<tr>
<td>Warm-temperate</td>
<td>0.30</td>
<td>0.85 1.00 1.10</td>
<td>75%</td>
</tr>
<tr>
<td>Warm</td>
<td>0.50</td>
<td>1.05 1.10 1.20</td>
<td>100</td>
</tr>
<tr>
<td>Hot</td>
<td>0.50</td>
<td>1.25 1.30 1.40</td>
<td></td>
</tr>
<tr>
<td>Very hot</td>
<td>0.25</td>
<td>Yes 1.05 1.10 1.20</td>
<td></td>
</tr>
</tbody>
</table>

or alternatively, energy demand method:

<table>
<thead>
<tr>
<th>Climate zone according to PHPP</th>
<th>Heating</th>
<th>Cooling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max. heating demand</td>
<td>Max. cooling + dehumidification demand</td>
</tr>
<tr>
<td></td>
<td>[kWh/(m²a)]</td>
<td>[kWh/(m²a)]</td>
</tr>
<tr>
<td>Arctic</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Cold</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Cool-temperate</td>
<td>25</td>
<td>equal to Passive House requirement</td>
</tr>
<tr>
<td>Warm-temperate</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Warm</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Hot</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Very hot</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

© PHI
Everything is economically reasonable: School building

- School building Baesweiler, retrofit 2012
- Total lifecycle costs are crucial!
- Investment to Energy Efficiency reduces operational costs!

Everything is economically reasonable: Office building

- Institut Wohnen Umwelt (IWU) Darmstadt
- Office building (1960) Retrofit in 2012
- Located at busy main city street (Noise reduction is crucial!)

thermal insulation layer and good window frame

... optimized positioning in wall (insulation layer)

\[
\Psi_o = 0,014 \, \text{W/(mK)}
\]

\[
\Psi_u = 0,050 \, \text{W/(mK)}
\]

\[
U_w = 0,79 \, \text{W/(m²K)}
\]

\[
U_{w,pos} = 0,85 \, \text{W/(m²K)}
\]

\[
15,3 \, ^\circ C
\]

\[
13,5 \, ^\circ C
\]

\[
15,1 \, ^\circ C
\]
windows pushed out...

.... into the insulation layer during renovation
Training of workers is essential for quality!

- mockup-installation: layers of EIFS and position and fixing of windows
Training of workers is essential for quality!

- mockup-installation: layers of EIFS and position and fixing of windows
Ventilation for EnerPHit: Airducts into the Insulation Layer

Supply air ducts integrated into the insulation layer
Step-by-step renovation – EnerPHit Retrofit Plan (ERP)
Think ahead: intermediate connections
Component Award 2015: Windows for step-by-step retrofits

CASE 1.
The window is installed in front of the existing wall, it remains in place when insulation is added.

CASE 2.
Window is installed in the same position, and moved into the insulation layer when the latter is installed.

1. New window is installed in the same position as the old window.
2. When the insulation layer is added, the window is moved to the ideal installation situation.
More information

Free online handbook, 120 pages
www.europhit.eu

PHI building criteria
Passive House Building design in a nutshell......

Contents and Summary
what is essential for Energy Efficient Passive House buildings!
- thermal insulation layer (thick enough!) is absolutely needed
- thermal bridge optimized design, air-tightness and good windows
- fresh-air-ventilation system with heat recovery
- low power heating (AC) system including hot water preparation

everything is economically reasonable for new built and retrofit
EnerPHit retrofit plan for stepwise retrofits

- Quality control has to be done during realization:
- … training of tradesperson is crucial!
- … provide mock-up-installation for on-site-learning!
- Routine helps for Quality!… repeat again, what you have learned once!
Thank you!

Further information
- www.passivehouse.com
- www.passipedia.org
- www.passivehouse-international.org
- www.europhit.eu

International Passive House Conference