Vogel Haus, PHI Certified Olympia, Washington

Design Ethos

Simple home that sits lightly on the land and recedes into the landscape
Supports a small functioning farm
Lots of glass
An array of outdoor spaces embracing the garden both uncovered and covered
A Parti of articulated cubes
Vogel Haus

1,702 sf TFA
Passive House Specs

(Nerd Stuff)

• R-35 EPS foam under concrete slab
• R-31 dense pack fiberglass wall cavity insulation, 4” Neopor foam on outside; R-47 total wall
• R-99 blown cellulose in trusses
• Zehnder Comfo Air 350 HRV
• In floor hydronic radiant heating
• Sanden heat pump and tank DHW; space heating via Taco exchanger to hydronic fluid (in-floor radiant heat)
• Zola UPVC windows
• Approx. 5000 heating degree days
Passive House Verification

Building:
- Street: 8219 Woodward Bay Rd
- Postcode/City: 98506 Olympia
- Province/Country: WA US-United States of America
- Building type: Single Family Residence
- Climate data set: ud—01-US0099a-Olympia
- Climate zone: 3: Cool-temperate
- Altitude of location: 84 ft

Home owner / Client:
- Street: 8219 Woodward Bay Rd
- Postcode/City: 98506 Olympia
- Province/Country: WA US-United States of America

Mechanical system:
- Street: 
- Postcode/City: 
- Province/Country: 

Energy consultancy: Energy Systems Consultants (esco)
- Street: 3701 W Crescent Rim Dr Unit 308
- Postcode/City: 83706 Boise
- Province/Country: ID US-United States of America

Year of construction: 2016
- No. of dwelling units: 1
- No. of occupants: 3.0

Interior temperature winter [°F]: 68.0
Interior temp. summer [°F]: 77.0
Internal heat gains (IHG) heating case [BTU/(hr*ft²)]: 0.77
IHG cooling case [BTU/(hr*ft²)]: 0.77
Specific capacity [BTUF per ft² TFA]: 14.8
Mechanical cooling:

Treated floor area [ft²]: 1702

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Alternative criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heating Heating demand [kBTU/(ft²*yr)]</td>
<td>4.32</td>
</tr>
<tr>
<td>Heat load [BTU/(hr*ft²)]</td>
<td>3.84</td>
</tr>
<tr>
<td>Space cooling Cooling &amp; dehum. demand [kBTU/(ft²*yr)]</td>
<td>-</td>
</tr>
<tr>
<td>Cooling load [BTU/(hr*ft²)]</td>
<td>-</td>
</tr>
<tr>
<td>Frequency of overheating (&gt; 77 °F) [%]</td>
<td>6</td>
</tr>
<tr>
<td>Frequency excessively high humidity (&gt; 0.012 lb/lb) [%]</td>
<td>0.3</td>
</tr>
<tr>
<td>Airtightness Pressurization test result n50 1hr</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Moisture protection
- Smallest temperature factor f=1.0*: 0.90
- All requirements fulfilled?

Thermal Comfort
- R-value [hr*ft²*°F/BTU] R-value [hr*ft²*°F/BTU] R-value [hr*ft²*°F/BTU] R-value [hr*ft²*°F/BTU]
- All requirements fulfilled?

Non-renewable Primary Energy (PE)
- PE demand [kBTU/(ft²*yr)] 21.58
- ≤ 38.04

Fulfilled?
- yes
- yes
- yes
- yes

PHPP, Verification
PHPP_V6.5_IP_Schutz 2017_03_05.xlsx
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Passive House Specific Design Challenges

Sculpting the interior with light
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Passive House Specific Design Challenges

Floor to ceiling glass
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Passive House Specific Design Challenges

Floor to ceiling glass requires forethought on blocking out the concrete and attention to exactly what type of windows are specified.
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Passive House Specific Design Challenges

Instead of designing ceiling installation layers, or a full false ceiling, use the depth and run of your trusses to seal in an OSB box, and if you need to make runs perpendicular to the trusses consider designing into the trusses a few trusses with a bottom chord to create a chase way.
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Construction Lessons

Seal OSB “rips” installed above all interior walls prior to installing walls
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Passive House Specific Design Challenges

Simple is always best when planning building assemblies, but not always easy to achieve. Designers and field team should participate in planning out how the details will be handled during actual construction.
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Construction Lessons

Remember to continue field (SUB!) training as not all team members know every motivation behind Passive House!

Above photo is an example of extra 2x8’s in Vogel walls, even though the plans called for staggered 2x4’s
Vogel Haus

Construction Lessons Learned

We have started wrapping our footings with a heavy butyl membrane, and taping our wall sealing layer down to this foundation wrapping.
6.1.4 Energy model inputs requiring additional documentation

- Ground Thermal Resistivity >0.1 hr.ft².F/BTU.in.
- Window psi Installation
  - For mid mounted, over-insulated window <0.015 BTU/hr.ft.F.
  - For mid mounted window <0.020 BTU/hr.ft.F.
- Subsoil Heat Exchanger efficiency >60%.
- Framing factors
  - Down to 15% for advanced framing, 24 in. OC.
  - Down to 12% if window psi-installation calculations are done, because some of the framing is accounted for in this calculation.

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Detailed Thermal Bridge Analysis

Wall Assembly Analysis
### Detailed Thermal Bridge Analysis

#### Wall Assembly Analysis w/ Framing Factors

<table>
<thead>
<tr>
<th>Material</th>
<th>R per inch</th>
<th>Area section 2 (optional)</th>
<th>R per inch</th>
<th>Area section 3 (optional)</th>
<th>R per inch</th>
<th>Thickness [in]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gypsum Board</td>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td>HD Fiberglass</td>
<td>4.30</td>
<td>2x8 Framing</td>
<td>1.28</td>
<td></td>
<td></td>
<td>7.25</td>
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<tr>
<td>OSB</td>
<td>1.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
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<tr>
<td>Neopor Type II</td>
<td>4.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage of sec. 1</th>
<th>Percentage of sec. 2</th>
<th>Percentage of sec. 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>75%</td>
<td>25.0%</td>
<td></td>
<td>12.25</td>
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</tbody>
</table>

U-value supplement: [BTU/hr.ft.°F]

R-value: **42.47** [hr.ft².°F/ BTU]
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Detailed Thermal Bridge Analysis

Center of Cavity Assembly Analysis

1.8 pcf fiberglass must be specified to achieve R-4.3/in
NOT standard practice
Use 75° F values for EPS
1.5 pcf R-4.2/in
2.0 pcf R-4.4/in
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Detailed Thermal Bridge Analysis

Wall Assembly Analysis
Detailed Thermal Bridge Analysis

Wall Assembly Analysis 2D w/ HTflux

R = 48.291 h.ft²°F/BTU
R_{1a} = 52.240 h.ft²°F/BTU
R_{top,2d} = 48.291 h.ft²°F/BTU
R_{bottom,2d} = 48.291 h.ft²°F/BTU

l_{top} = 56.00 in / l_{bottom} = 56.00 in
\Phi_{top} = -5.218 BTU/h·ft
\Phi_{bottom} = 5.218 BTU/h·ft
\Delta T = -54.0 °F

Layers

<table>
<thead>
<tr>
<th>Rs h.ft²°F/BTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.00 in EPS Neopor R-4.61, R/in=4.61 h.ft²°F/BTU.in</td>
</tr>
<tr>
<td>0.50 in Oriented strand board (OSB) R-1.39, R/in=1.3909 h.ft²°F/BTU.in</td>
</tr>
<tr>
<td>7.25 in Fiberglass R-4.3, R/in=4.3 h.ft²°F/BTU.in</td>
</tr>
<tr>
<td>0.50 in Gypsum R-0.91, R/in=0.9071 h.ft²°F/BTU.in</td>
</tr>
<tr>
<td>0.738 h.ft²°F/BTU</td>
</tr>
</tbody>
</table>

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Detailed Thermal Bridge Analysis

Window Head Analysis 2D w/ HTflux
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Detailed Thermal Bridge Analysis

Window Jamb Analysis 2D w/ HTflux
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Detailed Thermal Bridge Analysis

Window Sill Analysis 2D w/ HTflux
Delphi Haus, PHIUS Certified  Olympia, Washington

Design Ethos

Modern home that takes full advantage of views of Mt. St Helens and Mt. Rainier
Designed to maintain independence decreases
Designed to be glowing with natural light but have little direct light
Lots of glass
An array of outdoor spaces both uncovered and covered and some with wind protection
A Parti of flying soffits that seemingly extend from inside the house to out
Delphi Haus
2,265 sf TFA
Passive House Specs
(Nerd Stuff)

• R-28 foam under concrete slab
• R-24 dense pack fiberglass wall cavity insulation, 6” foam on outside, total wall R-48
• R-100 cellulose in trusses
• Zehnder Novus 300 HRV
• In floor hydronic radiant heating
• Intellihot combi boiler for DHW; hydronic in-floor radiant space heating via integral heat exchange within Intellihot
• Zola wood windows w/ aluminum cladding
• Approx. 5000 heating degree days
<table>
<thead>
<tr>
<th>Architecture:</th>
<th>The Artisans Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street Address:</td>
<td>1508 4th Ave NE</td>
</tr>
<tr>
<td>City, State, Zip:</td>
<td>Olympia, WA 98506</td>
</tr>
<tr>
<td>Mechanical system:</td>
<td>The Artisans Group</td>
</tr>
<tr>
<td>Street Address:</td>
<td>1508 4th Ave NE</td>
</tr>
<tr>
<td>City, State, Zip:</td>
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</tr>
</tbody>
</table>

### Specific building demands with reference to the treated floor area

<table>
<thead>
<tr>
<th>Space heating</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated floor area</td>
<td>2288 ft²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating demand</td>
<td>5.57 kBTU/(ft²·yr)</td>
<td>93% of 6.00 kBTU/(ft²·yr)</td>
<td>-</td>
</tr>
<tr>
<td>Heating load</td>
<td>2.66 BTU/(hr·ft²)</td>
<td>68% of 3.90 BTU/(hr·ft²)</td>
<td>yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Space cooling</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall specif. space cooling demand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of overheating (&gt; 77 °F)</td>
<td>0.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Primary energy | Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances |  |  |
|----------------|------------------------------------------------------------------------------------------------|
| DHW, space heating and auxiliary electricity | 36.2 kBTU/(ft²·yr) | 98% of 36.98 kBTU/(ft²·yr) | yes |

| Specific primary energy reduction through solar electricity | 13.0 kBTU/(ft²·yr) |  |  |

| Airtightness | Pressurization test result n₅₀ | 0.4 l/h | 0.6 l/h | yes |

### Passive House? yes
Delphi Haus

Passive House Specific Design Challenges

Sculpting the interior with light, this is diffused, non direct light
Delphi Haus

Passive House Specific Design Challenges

Sculpting the interior with light, this is diffused, non direct light
Delphi Haus

Construction Lessons

Walk your slab insulation before forming for concrete
Delphi Haus

Construction Lessons

We used the Henry system on this project, it worked fine but we are leaning towards using ZIP walls on our next home
Delphi Haus

Construction Lessons

Siga taped OSB on the ceiling, use the primer.

Insulation batts for sound proofing.
Delphi Haus

Construction Lessons

Used dropped ceilings and soffits to travel HRV tubes around the house
Delphi Haus

Construction Lessons

The outside porch is a separate structure from the house, reduced complexity of thermal bridge free detailing

Always test blown in insulation density