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

1,962 sf TFA
Vogel Haus

Passive House Specific Design Challenges

Sculpting the interior with light
Vogel Haus

Passive House Specific Design Challenges

Floor to ceiling glass
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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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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.
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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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
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Detailed Thermal Bridge Analysis

Wall Assembly Analysis
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
Vogel Haus

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
# Detailed Thermal Bridge Analysis

Wall Assembly Analysis w/ Framing Factors

<table>
<thead>
<tr>
<th>Assembly no.</th>
<th>Building assembly description</th>
<th>Orientation of building element</th>
<th>Heat transmission resistance [hr*ft²°F/BTU]</th>
<th>Interior Rᵢ</th>
<th>Exterior Rₑ</th>
</tr>
</thead>
<tbody>
<tr>
<td>07ud</td>
<td>Wall</td>
<td>2-Wall</td>
<td>0.74</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area section 1</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>1.25</td>
<td></td>
<td></td>
<td>7.25</td>
</tr>
<tr>
<td>OSB</td>
<td>1.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
<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>

Percentage of sec. 1: 75%
Percentage of sec. 2: 25.0%
Percentage of sec. 3: 100%
Total: 12.25 in

U-value supplement: [BTU/hr*ft²°F]

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

### Wall Assembly Analysis w/ Framing Factors

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness [in]</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>Total</th>
</tr>
</thead>
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<tr>
<td>Gypsum Board</td>
<td>0.50</td>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HD Fiberglass</td>
<td>7.25</td>
<td>4.30</td>
<td>2x8 Framing</td>
<td>1.28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSB</td>
<td>0.50</td>
<td>1.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neopor Type II</td>
<td>4.00</td>
<td>4.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Percentage of sec. 1**: 85%
**Percentage of sec. 2**: 15.0%
**Percentage of sec. 3**: 0%

**U-value supplement**

**R-value**: 45.62 hr*ft²°F/BTU
### 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>
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<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>1.280</td>
<td></td>
<td></td>
<td>7.25</td>
</tr>
<tr>
<td>OSB</td>
<td>1.390</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
<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>

- **Percentage of sec. 1**: 88%
- **Percentage of sec. 2**: 12.0%
- **Percentage of sec. 3**: 0%
- **Total Thickness**: 12.25 in

**U-value supplement**: 0.0214 BTU/hr.ft².°F

**R-value**: 46.72 hr.ft².°F/BTU
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Detailed Thermal Bridge Analysis

Wall Assembly Analysis 2D w/ HTflux

\[
\begin{align*}
R &= 48.291 \text{ h.ft}^2\text{F/BTU} \\
R_{1c} &= 52.240 \text{ h.ft}^2\text{F/BTU} \\
R_{\text{top,2c}} &= 48.291 \text{ h.ft}^2\text{F/BTU} \\
R_{\text{bottom,2c}} &= 48.291 \text{ h.ft}^2\text{F/BTU} \\
I_{\text{top}} &= 56.00 \text{ in} / I_{\text{bottom}} = 56.00 \text{ in} \\
\Phi_{\text{top}} &= -5.218 \text{ BTU/h-ft} \\
\Phi_{\text{bottom}} &= 5.218 \text{ BTU/h-ft} \\
\Delta T &= -54.0 \text{ °F} \\
\text{Layers} \\
\mid Rs 0.738 \text{ h.ft}^2\text{F/BTU} \\
4.00 \text{ in} & \text{ EPS Neopor R-4.61, } R/\text{in}=4.61 \text{ h.ft}^2\text{F/BTU.in} \\
0.50 \text{ in} & \text{ Oriented strand board (OSB) R-1.39, } R/\text{in}=1.3908 \text{ h.ft}^2\text{F/BTU.in} \\
7.25 \text{ in} & \text{ Fiberglass R-4.3, } R/\text{in}=4.3 \text{ h.ft}^2\text{F/BTU.in} \\
0.50 \text{ in} & \text{ Gypsum R-0.91, } R/\text{in}=0.9071 \text{ h.ft}^2\text{F/BTU.in} \\
\mid Rs 0.738 \text{ h.ft}^2\text{F/BTU}
\end{align*}
\]
### Detailed Thermal Bridge Analysis

#### Wall Assembly Analysis w/ Framing Factors

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Building assembly description</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></td>
<td></td>
<td>0.91</td>
<td>HD Fiberglass</td>
<td>4.30</td>
<td>2x8 Framing</td>
<td>1.280</td>
<td>7.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.390</td>
<td>OSB</td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.61</td>
<td>Neopor Type II</td>
<td></td>
<td></td>
<td></td>
<td>4.00</td>
</tr>
</tbody>
</table>

- **Percentage of sec. 1**: 92%
- **Percentage of sec. 2**: 8.1%
- **Percentage of sec. 3**: 0%
- **Total**: 12.25 in

**U-value supplement**: [BTU/hr\(\cdot\)ft\(^2\)\cdot\)°F]

**R-value**: 48.29 hr\(\cdot\)ft\(^2\)\cdot\)°F/ BTU
**Vogel Haus**

**Detailed Thermal Bridge Analysis**

Create Composite Material for 2D Simulations of Construction Details

Use PHPP 8.5 IP to Zero Out Surface Film Resistance Values

<table>
<thead>
<tr>
<th>Area section 1</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>
</tr>
</thead>
<tbody>
<tr>
<td>HD Fiberglass</td>
<td>4.30</td>
<td>2x8 Framing</td>
<td>1.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Percentage of sec. 1     | 88%        | Percentage of sec. 2     | 12.0%      | Percentage of sec. 3     | 0.0%       |

**Total**: 1.00 in

**R-Value**: 3.351 hr*ft²/F/BTU
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Detailed Thermal Bridge Analysis

Create Composite Material for 2D Simulations of Construction Details

Use PHPP 8.5 IP to Zero Out Surface Film Resistance Values

<table>
<thead>
<tr>
<th>Assembly no.</th>
<th>Building assembly description</th>
<th>Surface Film Resistance [hr<em>ft²</em>F/BTU]</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>2</td>
<td>Composite Cavity Insulation R-Value For 2D Calcs</td>
<td>0.00</td>
<td>4.30</td>
<td>2x8 Framing</td>
<td>1.28</td>
<td>3.18</td>
<td>1.00 in</td>
<td></td>
</tr>
</tbody>
</table>

Percentage of sec. 1: 85%
Percentage of sec. 2: 15.00%
R-Value: 3.18 hr*ft²*F/BTU
**Vogel Haus**

**Detailed Thermal Bridge Analysis**

Create Composite Material for 2D Simulations of Construction Details

Use PHPP 8.5 IP to Zero Out Surface Film Resistance Values
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Detailed Thermal Bridge Analysis

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

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

Window Sill Analysis 2D w/ HTflux
Vogel Haus

Detailed Thermal Bridge Analysis

Slab Edge Analysis 2D w/ Htflux PHIUS Method

Ψ = 0.036 W/(mK)
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Detailed Thermal Bridge Analysis

Slab Edge Analysis 2D w/ Htflux ISO 10211
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Detailed Thermal Bridge Analysis

Slab Edge Analysis 2D w/ Htflux ISO 10211
Vogel Haus

Detailed Thermal Bridge Analysis

Slab Edge Analysis 2D w/ Htflux ISO 10211

(0.001 W/mK vs 0.030 W/mK) Heating Demand 4.60 to 4.75 kBTU/(ft²yr)
Delphi Haus, PHIUS Certified
Artisans Group, Olympia Washington
Delphi Haus 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

Passive House Specific Design Challenges

Sculpting the interior with light, this is diffused, non direct light
Passive House Specific Design Challenges

Sculpting the interior with light, this is diffused, non direct light
Delphi Haus
2,265 sf TFA
Delphi Haus

Construction Lessons

Walk your slab insulation before forming for concrete
Construction Lessons

Walk your slab insulation before forming for concrete
Delphi Haus

Construction Lessons

Walk your slab insulation before forming for concrete
Walk your slab insulation before forming for concrete
Delphi Haus

Construction Lessons

Walk your slab insulation before forming for concrete
WE MUST PUSH THE BOUNDARIES OF SCIENCE.

SOME BOUNDARIES ARE THERE FOR A REASON, TIM.

I CAN'T THINK OF A SINGLE TIME THAT WOULD BE TRUE.

LATER...
Queen Anne Passive, PHIUS Certified, Seattle Washington

Design Ethos
Sculptural home that respects scale of neighborhood
Lots of glass to views of the sounds
Flexible for a growing family

A Parti of cantilevered forms with heavy patterns and rhythms
Queen Anne Passive
2,386 sf TFA
Passive House Specific Design Challenges

Creating complex cantilevers that ARE NOT thermal bridges