CAPACES Leadership Institute

Progress Towards America’s First Passive House Office Building

Dylan Lamar, CPHC – Design Consultant
Gene Wixson – Construction Consultant
- PCUN – farmworkers union founded over 25 years ago
- Latino movement has grown into multiple organizations over the decades
- Leadership development and organizational succession has been a weakness
- 9 organizations come together to form CLI
- Built with no debt, thanks to volunteer labor, donated or discounted materials and services
- Dedicated to engaging community leaders—current and future
- About the values and big ideas that guide the farmworker movement and equipping those leaders with the skills to put the big ideas to use
Design Consultation
• Interviewed for sustainability and construction consultation services
• Presented Passive House Concept
• Question of Donor support
• Try for Passive House but have Fallback Option
• Fairly compact form
• Two basic occupancy zones
• Intermittent occupancy in Meeting Rooms
• Clerestory windows for Meeting Rooms
• View/Transom elsewhere (view windows fixed for security concerns)
• Larger south windows
• North/Street façade helped by Mural painting
Envelope Assemblies

- Thickened Edge Slab – 8”+ EPS Foam
- 2x6 w/ Curtain Truss (14–18” wall thickness)
- Dense Pack Cellulose Insulation
- 30” Parallel Chord Roof Truss w/ service chase
- Earthen Roof (ventilation channel below)
- Continuity of air-tightness layer throughout
Window Details

- Insulated Fiberglass Frame Windows
- EPS Foam lining window opening
Door Details?

• Very limited commercial-grade Passive House door options in US
Summer Conditioning

• Client isn’t overly concerned with overheating
• Enable natural cross ventilation (night flush operation)
• Massive floor and interior walls (CMU w/ grouted cores)
• Ceiling fans (w/ EC motors) throughout to increase comfort range
• Heat Pump system ultimately chosen for supplemental cooling
Heating and Ventilation

• Loads don’t match
  • Max ventilation demand concurrent with max internal heat gains
  • PH reduces heat demand swings
  • But ventilation demand still very dynamic

• Single or Multiple Zones?

Heating Options:
• Heat Pump, mini-split
• Pellet Stove
• Vented Gas Heaters
• Direct Electric

Ventilation Options:
• Ultimate Air Commercial Unit
• Multiple Residential Units
Heating and Ventilation Planning...
Heating and Ventilation Planning...
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Proper Ventilation?

<table>
<thead>
<tr>
<th>Minimum Ventilation Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Occupancy</td>
</tr>
<tr>
<td>ppl/1000sf</td>
</tr>
<tr>
<td>Conference Room</td>
</tr>
<tr>
<td>Oregon Code 2010</td>
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<tr>
<td>ASHRAE 62.2-2010</td>
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<tr>
<td>Oregon Code 2007</td>
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<tr>
<td>ASHRAE 62.2-2001</td>
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<td>PHI rec for Schools</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Oregon Code 2010</td>
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Construction Consultation
What am I here to talk about?

- Permitting Challenges
- Making it buildable by volunteers
- Value Engineering

Building specifics
Permitting Challenges

- Foam under footing
- Loads related to the living roof + solar
- Interpersonal friction between architect & building official
- Planning commission wants street facing glazing and complex roof shape
Foam under footings
- EPS Geofoam has been used for a long time
- Pioneering work was done in Scandinavia
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Foam under footings
- EPS Geofoam has been used for a long time
- Pioneering work was done in Scandinavia
- Road work, stadiums, and poor soil are primary US applications
- No ICC report, only ASTM tests
- ASTM standard C-578 is for Thermal Insulation Foam
- ASTM standard D6817 is for Geofoam
- 1% Compression is the important number
- Must be stronger than the soil on your site
- Educate yourself & your building official, work with a good structural engineer
## Typical Physical Properties of Insulfoam GF*

<table>
<thead>
<tr>
<th>Type- ASTM D6817</th>
<th>Units</th>
<th>EPS12</th>
<th>EPS15</th>
<th>EPS19</th>
<th>EPS22</th>
<th>EPS29</th>
<th>EPS39</th>
<th>EPS46</th>
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<tbody>
<tr>
<td>Density, min.</td>
<td>lb/ft³ (kg/m³)</td>
<td>0.70</td>
<td>0.90</td>
<td>1.15</td>
<td>1.35</td>
<td>1.80</td>
<td>2.40</td>
<td>2.85</td>
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<tr>
<td>Compressive Resistance** min. @ 1% deformation</td>
<td>psi (kPa)</td>
<td>2.2 (15)</td>
<td>3.6 (25)</td>
<td>5.8 (40)</td>
<td>7.3 (50)</td>
<td>10.9 (75)</td>
<td>15.0 (103)</td>
<td>18.6 (128)</td>
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<tr>
<td>Compressive Resistance** min. @ 5% deformation</td>
<td>psi (kPa)</td>
<td>5.1 (35)</td>
<td>8.0 (55)</td>
<td>13.1 (90)</td>
<td>16.7 (115)</td>
<td>24.7 (170)</td>
<td>35.0 (241)</td>
<td>43.5 (300)</td>
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<td>Compressive Resistance** min. @ 10% deformation</td>
<td>psi (kPa)</td>
<td>5.8 (40)</td>
<td>10.2 (70)</td>
<td>16.0 (110)</td>
<td>19.6 (135)</td>
<td>29.0 (200)</td>
<td>40.0 (276)</td>
<td>50.0 (345)</td>
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<tr>
<td>Flexural Strength, min.</td>
<td>psi (kPa)</td>
<td>10.0 (69)</td>
<td>25.0 (172)</td>
<td>30.0 (207)</td>
<td>40.0 (276)</td>
<td>50.0 (345)</td>
<td>60.0 (414)</td>
<td>75.0 (517)</td>
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<tr>
<td>Oxygen Index, min.</td>
<td>volume %</td>
<td>24.0</td>
<td>24.0</td>
<td>24.0</td>
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<tr>
<td>Dimensional Stability</td>
<td>(max. %)</td>
<td>&lt; 2%</td>
<td>&lt; 2%</td>
<td>&lt; 2%</td>
<td>&lt; 2%</td>
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<tr>
<td>Buoyancy Force</td>
<td>lb/ft³ (kg/m³)</td>
<td>61.7 (990)</td>
<td>61.5 (980)</td>
<td>61.3 (980)</td>
<td>61.1 (980)</td>
<td>60.6 (970)</td>
<td>60.0 (960)</td>
<td>59.5 (950)</td>
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<tr>
<td>Poisson's Ratio</td>
<td>–</td>
<td>.05</td>
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<td>Coefficient of Friction</td>
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<tr>
<td>Absorption</td>
<td>volume %</td>
<td>&lt; 4.0</td>
<td>&lt; 4.0</td>
<td>&lt; 3.0</td>
<td>&lt; 3.0</td>
<td>&lt; 2.0</td>
<td>&lt; 2.0</td>
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<tr>
<td>Elastic Modulus, min.</td>
<td>psi (kPa)</td>
<td>220 (1500)</td>
<td>360 (2500)</td>
<td>580 (4000)</td>
<td>730 (5000)</td>
<td>1090 (7500)</td>
<td>1500 (10300)</td>
<td>1860 (12800)</td>
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* Properties are based on data provided by resin manufacturers, independent test agencies and Insulfoam.
** For Insulfoam CF applications the design load stresses should not exceed 1% strain for combined live and dead loads.
Know your numbers

<table>
<thead>
<tr>
<th>Norwegian bridge example</th>
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<tr>
<td></td>
<td>kpa to</td>
<td>psi</td>
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<tr>
<td><em>#kpa</em> conversion psi</td>
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<tr>
<td>100</td>
<td>0.14503774</td>
<td>14.5037738</td>
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<td>psi</td>
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<td><em>#kpa</em> conversion psi</td>
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<tr>
<td>180</td>
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|                         |          |          |
|                         | psi to kpa |          |
| *#psi* conversion kpa   |          |          |
| 10                       | 6.89475729 | 68.9475729 |

|                         |          |          |
|                         | psi to psf |          |
| *#psi* conversion psf   |          |          |
| 15                       | 144      | 2160     |

|                         |          |          |
|                         | psf to psi |          |
|                         | 1500      | 144      | 10.4166667 |
Foam detail on this project
- 12” foam under footing
- 8” on Perimeter
- 8” under slab
Sketchup makes ordering complex foam shapes very simple
Color code different densities
Isometrics make it clear what you want
Insulfoam will fabricate exact sizes
Pre-cut foam leads to a trouble free installation
And a great looking slab
Walls framed on slab by volunteers while waiting for structural permit
And then stood up using wall jacks
Interior walls made from CMU
And filled with grout for thermal mass
Wall construction

- Diligent air sealing
- Siga tapes and Tremco sealants by Albert Rooks and Small Planet Workshop
- Volunteers build Larsen trusses (netting & fireblocking preinstalled)
- Attach with SDS screws
- DensShield exterior sheathing
  - Vapor open
  - Rated as sheathing
  - High embodied energy
  - Would rather use North American wood fiber panel
- Dense Pack cellulose or fiberglass insulation
- High performance windows & doors with frames over-insulated
- ADA issues are problematic
Roof System
- Living roof with future solar installation
- Dead Loads
  - 20 lbs/SF roof construction
  - 30 lbs/SF for 4” of saturated growing media
  - 5 lbs/SF for solar panels
- Live Loads
  - 20 lbs/SF vegetation as required by Oregon code
  - 25 lbs/SF Snow Load

100 lbs/SF load * 3,488 SF roof area = 348,800 lbs of (design)roof weight

- 10,000-17,000 lb point loads to deal with
  - Difficult to manage with a parallel chord truss and minimal thermal bridging
- Parallel chord trusses much more cost effective than big TGIs
- Get a good truss designer
- Understand the design limitations
- Girders eliminate headers, but introduce assembly issues
One girder over 6 windows
45 foot long trusses
- Span over bearing wall or middle girders
- Top chords provide overhang
- Crane speeds installation time
- Beware location of mid-span girders
Hand framed portions
- Carefully design gable end overhangs
- Trusses must accommodate uplift
Ventilated space below roof deck

¼” DensDeck protected with vapor open roofing membrane

30” of loose fill applied from top side

Air Barrier (and diaphragm) is interior OSB ceiling
We expect the roof will look like this when finished
Building Performance Targets
- First certified Passive Office Building in US
- Earth Advantage Gold
- Site net positive energy (if PV system is funded)
- Empowering tremendous human potential
- Brown brings green to Woodburn

Come and Visit for the grand opening
- July 14th 2012
- Labor Secretary Hilda Solis will officially open the Institute
Here is what we did the past two days
Resources:
- “Long term performance and durability of EPS as a lightweight filling material”
- Insulfoam Geofoam specialists
- Structural Engineers
- Carissa Farkas: http://cfarkasstructural.com/

Questions:
http://capacesleadershipinstitute.org

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Thanks!