Sustainable Roof Systems
THE PLANETEERS
In collaboration with LionForce Systems
Dr. Diana Glawe
Professor Kimberly Drennan
LionForce Systems

❖ Panelized Pre-Fabricated Houses

❖ Goals:

– 1. Create structural support and environmental seal
– 2. Increase 14-ft roof span → 20 ft
– 3. Increase 2-ft overhang → 4 ft
Roof-to-wall Joint & Span

Notice the air gap!
Overhang
Design Overview
Pro Engineer Drawings
Simulation with Pro Mechanica
Wedge Critical Load

Critical Load ($P_{cr}$) vs. Length

- $P_{cr}$ (lbf) vs. Length (in)
- Critical Load ($P_{cr}$) decreases as length increases.
Load Calculations
Load Calculations

- **Code:** $L \sim 30 \text{ psf}$

- **For:** 6 in. thickness, 20 ft. span, 2 ft. overhang, 8:12 pitch
  - Max stress: 177 psi
  - Yield stress: 25 to 200 ksi
Overhang Recommendations

Overhang with Truss Support
Overhang FBDs

External FBD of Overhang Support Bracket

Internal FBD for member AC
Thermal Considerations

<table>
<thead>
<tr>
<th>Total R-Value of Panel</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trancon Delta Stud</td>
<td>2.24</td>
</tr>
<tr>
<td>Typical C-Stud</td>
<td>1.63</td>
</tr>
</tbody>
</table>

### Thermal Considerations

<table>
<thead>
<tr>
<th>Component</th>
<th>R-Value</th>
<th>Depth</th>
<th>R-Value * Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Air Film</td>
<td>0.17</td>
<td>N/A</td>
<td>0.17</td>
</tr>
<tr>
<td>Steel Roof</td>
<td>0</td>
<td>2&quot;</td>
<td>0</td>
</tr>
<tr>
<td>Fiberboard</td>
<td>2.78</td>
<td>1.5&quot;</td>
<td>4.17</td>
</tr>
<tr>
<td>Roof Panel</td>
<td>2.24</td>
<td>4&quot;</td>
<td>8.96</td>
</tr>
<tr>
<td>1/2&quot; Insulation Sheathing</td>
<td>3.2</td>
<td>1/2&quot;</td>
<td>3.2</td>
</tr>
<tr>
<td>1/2&quot; Drywall</td>
<td>0.45</td>
<td>N/A</td>
<td>0.45</td>
</tr>
<tr>
<td>Inside Air Film</td>
<td>0.92</td>
<td>N/A</td>
<td>0.92</td>
</tr>
</tbody>
</table>

**TOTAL** 17.87
Fit Tests

Mechanical Fit tests – ABT wall panel, Transcon Roof panel
Evaluation of Objectives

LionForce goals v. our success

- Structural support & environmental seal in wall joint
  - Success!
- Increase span
  - Success!
- Increase overhang
  - Partial success
Thank you!

Dr. Glawe
Dr. Nickels
Professor Drennan
Manuel
Lionforce Systems
Geoffrey Jennings & Transcon Steel
Robert Ross & Accelerated Building Technologies