Basement Floor

• Bedrock Site
  – Shallow soil depth
  – Blasting required
  – Limited floor options

• Typical approach: pinned footings
  – Numerous penetrations of floor insulation

• ICF Foundation Wall
  – Lots of site work cutting EPS
Baseline Floor

- **Solution**: continuous insulated raft
  - Engineered to avoid footings
  - Blasting fill provided level base
  - Slab edge element for continuous insulation
  - No penetrations
  - Includes elevator pit
Basement Floor

Cold Climate Passive House Production Facility
Walls

- **Basement**
  - Poured concrete with 12” exterior EPS:
- **Main**
  - 2x8 structural wall with mineral wool batts
  - 7” one-sided SIPs
  - Gypsum board for fire rating
Intermediate Floors

- **Ground Floor**
  - 10” core slab
- **Second and Third**
  - CLT
  - Foam filled
  - Acts as finish
Roofs

• Top Floor
  – Truss
  – 24” dense pack cellulose

• Terraces
  – 11” CLT
  – EPS above
  – sloped insulation (various thicknesses)
# Assembly Performance Summary

<table>
<thead>
<tr>
<th>Element</th>
<th>U-value [W/m²K]</th>
<th>R-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor Slab</td>
<td>0.11</td>
<td>R52</td>
</tr>
<tr>
<td>Basement Wall</td>
<td>0.11</td>
<td>R52</td>
</tr>
<tr>
<td>Main Wall</td>
<td>0.12</td>
<td>R47</td>
</tr>
<tr>
<td>CLT Roof</td>
<td>0.07 – 0.11</td>
<td>R52-R81</td>
</tr>
<tr>
<td>Top Roof</td>
<td>0.07</td>
<td>R81</td>
</tr>
</tbody>
</table>
Terraces

- CLT prevents insulation above if flush threshold is desired

Psi-value = 0.064 W/mK
(0.037 BTU)
Terraces

- **Solution**: raised floor above CLT
- **Issues**:
  - Lose CLT floor finish
  - Additional construction
  - Deemed acceptable
Airtightness Strategy

- **Basement Floors & Walls**
  - Taped 15 mil Stego membrane

- **Main Walls**
  - Intello – required to avoid dew point issues
  - Protected by service cavity where services are installed
  - Wrapped around intermediate floors

- **Roofs**
  - Taped Plywood
  - Intello wrapper around CLT (exposed floors)

- **Windows**
  - Intello taped to frames or plywood buck
Windows

- Comfort Requirement: $U_{w,\text{installed}} \leq 0.70 \text{ W/m}^2\text{K (0.12 BTU)}$
- Only one certified cold climate window available
  - Price premium
- Could relax performance by including heat source by window
  - Layout and heating system not conducive for this
  - Baseboard heaters would cause issues with total electrical capacity
Ventilation

- Building Layout facilitated centralized approach
- Flow rates controlled based on occupancy
  - Working hours $\rightarrow$ office & production
  - Lunch $\rightarrow$ shift to canteen
- Extract in production rooms enable more balanced flow
- Only one damper pair per floor required
Ventilation

Issues:
• Floor Layout only allowed for heating/cooling ducting in suspended ceiling, not additional ventilation ducting
• Engineer and designer were hesitant to rely on single machine
• Opted for semi-decentralized with 7 HRVs
  – Numerous issues...
Decentralized Ventilation

Issues

• Overventilation
  – Extract rooms → Supply rooms
  – Code rates much higher
• No humidity recovery (HRV)
• Uncertified Performance
  – 75% agreed with PHI
• Longer ducts
  – Up to 10.5m (35 ft)!
  – Up to 6% ↓ in HRE
• Ducts shared with heating/cooling system
  – Mismatch in flow rates
Heating & Cooling

• Residential VRF system
  – Heads installed in suspended ceiling above corridors
• Total Electrical Capacity limited by utility company
  – Process, elevator loads
• No products of small enough capacity
• HP system
  – Manufacturer claimed it could operate below design temperature
  – Code requires backup system for peak loads
  – Electric resistance not possible, due to capacity limit
  – **Solution:** Propane-fired boiler
  – Also used for DHW (small demand)
Summary

• Think through the details early
  – Initial thermal bridging modelling

• Simplified approach critical in cold climates

• Find engineers who are willing to explore options

• Cold climate production innovation required
Questions?

Thank you for your attention

Andrew Peel
Peel Passive House Consulting
t:  905 483 9925
e:  andrew@peelpassivehouse.ca