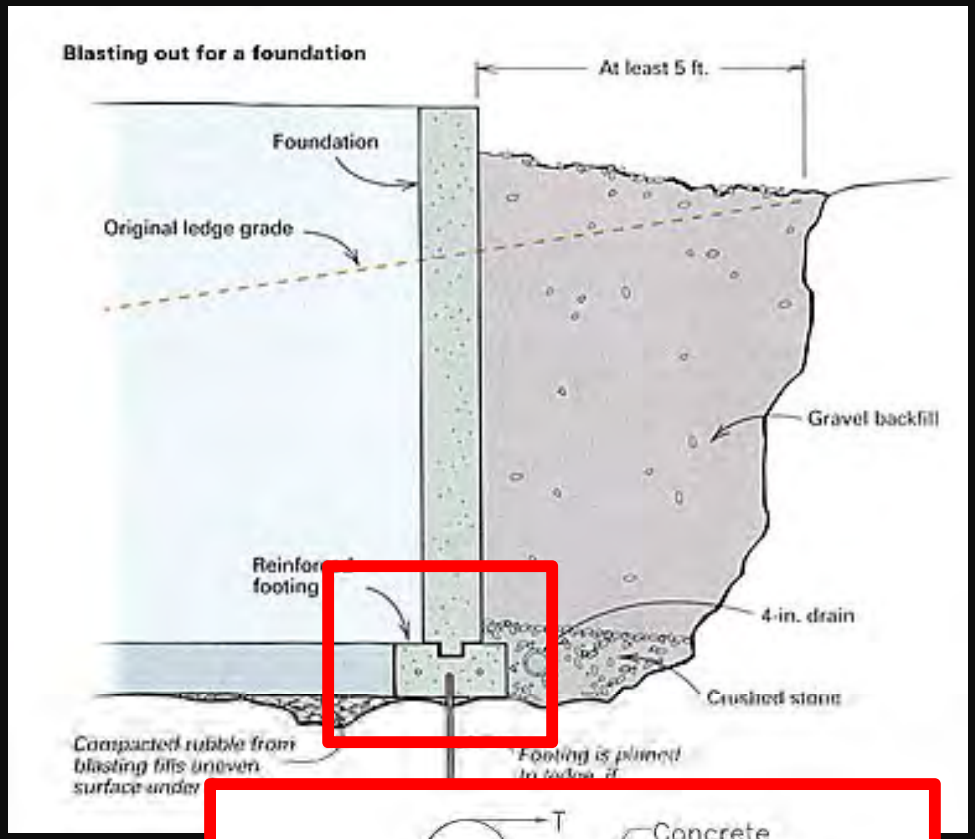
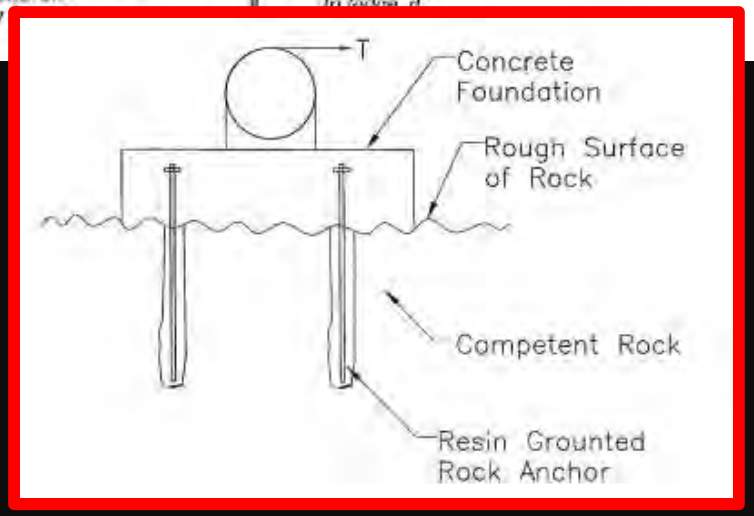
Basement Floor

- 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

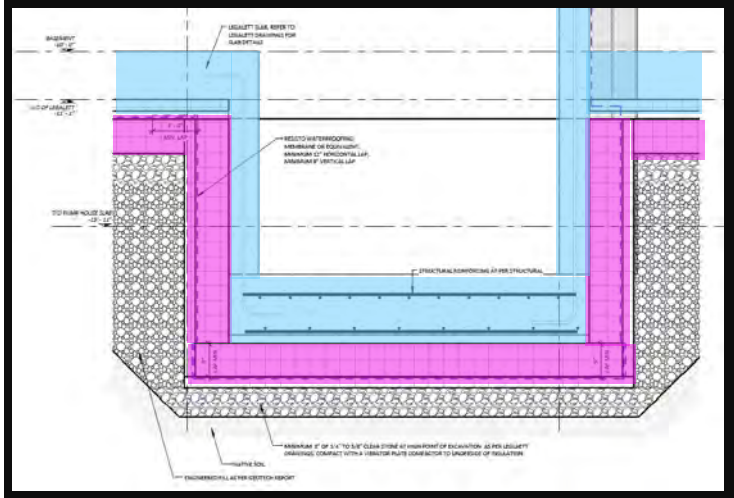


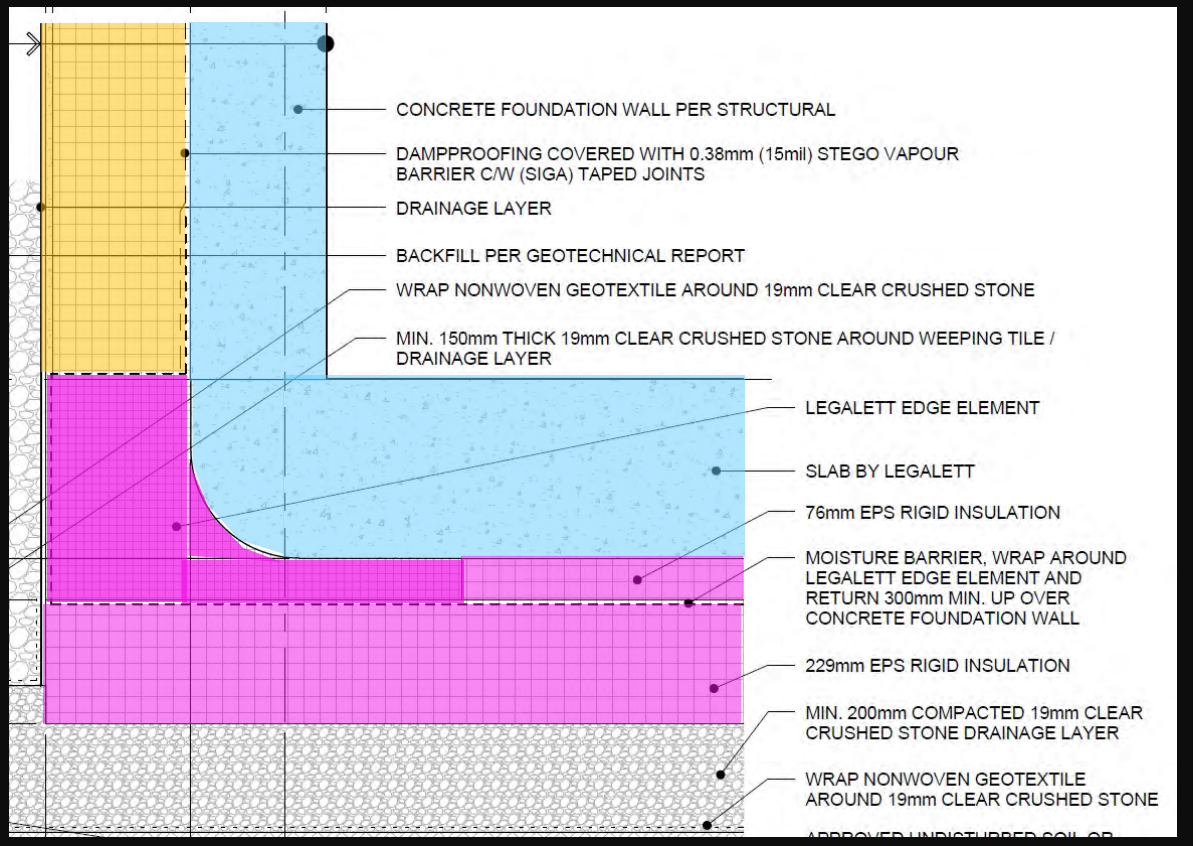


Cold Climate Passive House Production Facility

Basement 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

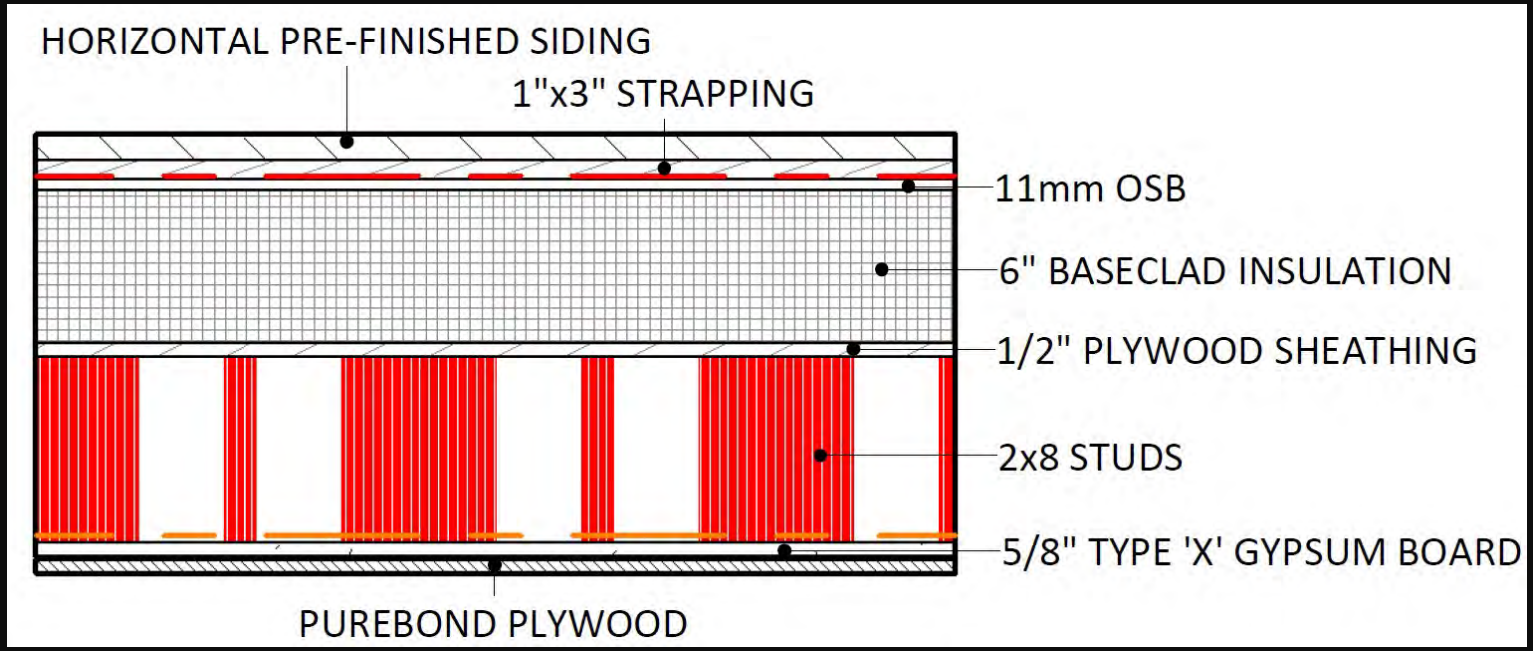




Basement Floor

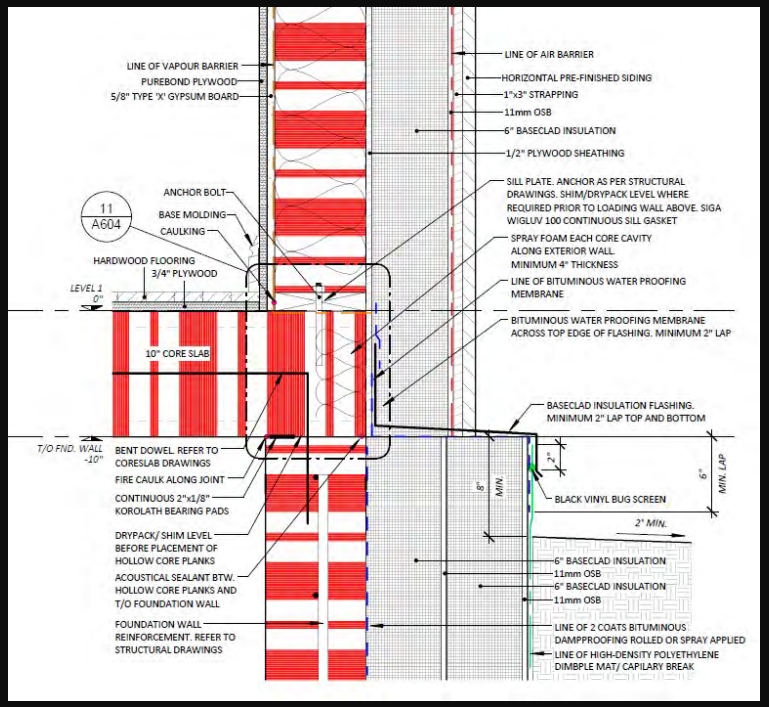
Walls

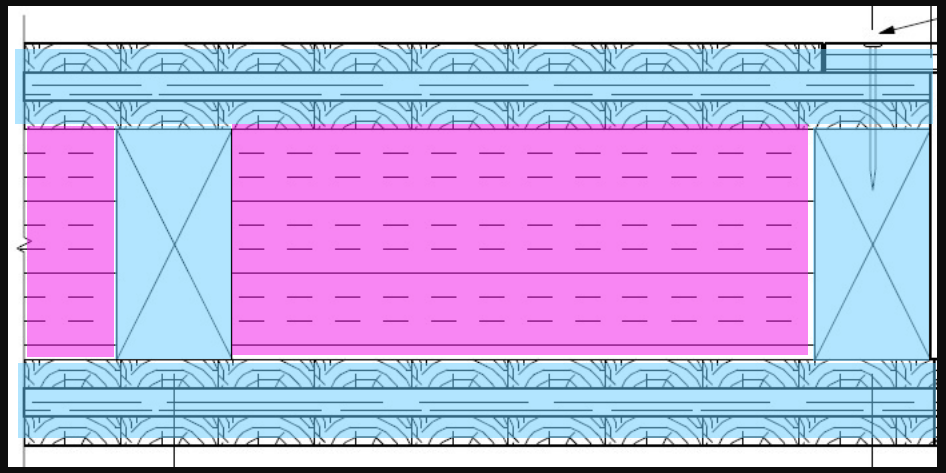
- Basement
  - Poured concrete with 12” exterior EPS:
- Main
  - 2x8 structural wall with mineral wool batts
  - 7” one-sided SIPs
  - Gypsum board for fire rating

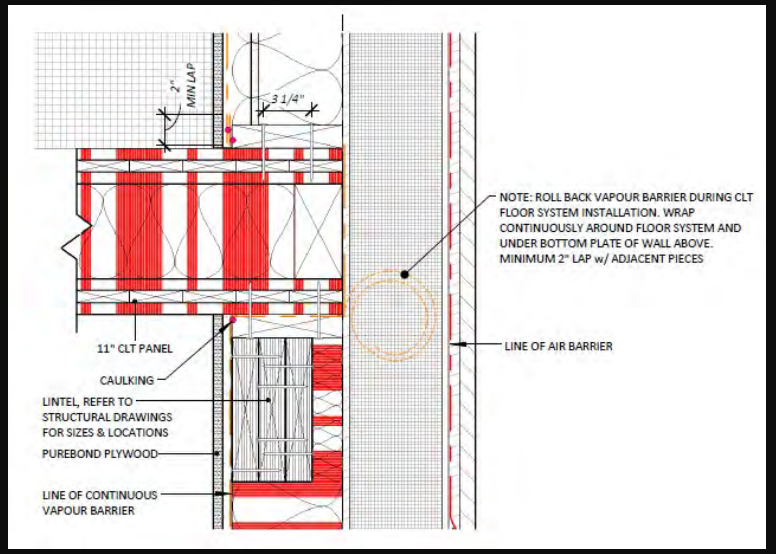


Intermediate Floors

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

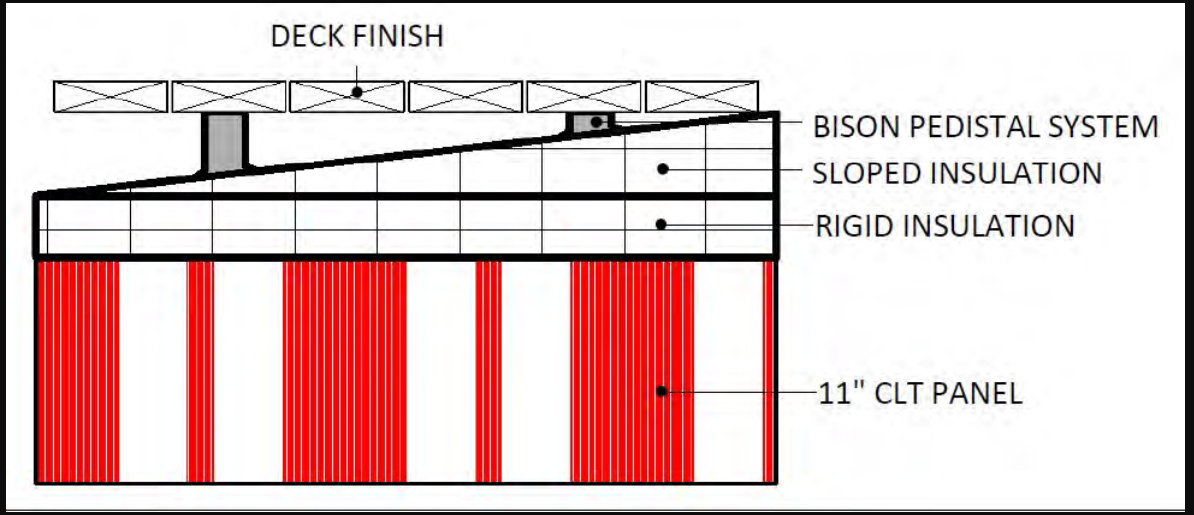






Roofs

- Top Floor
  - Truss
  - 24” dense pack cellulose



- Terraces
  - 11” CLT
  - EPS above
  - sloped insulation (various thicknesses)

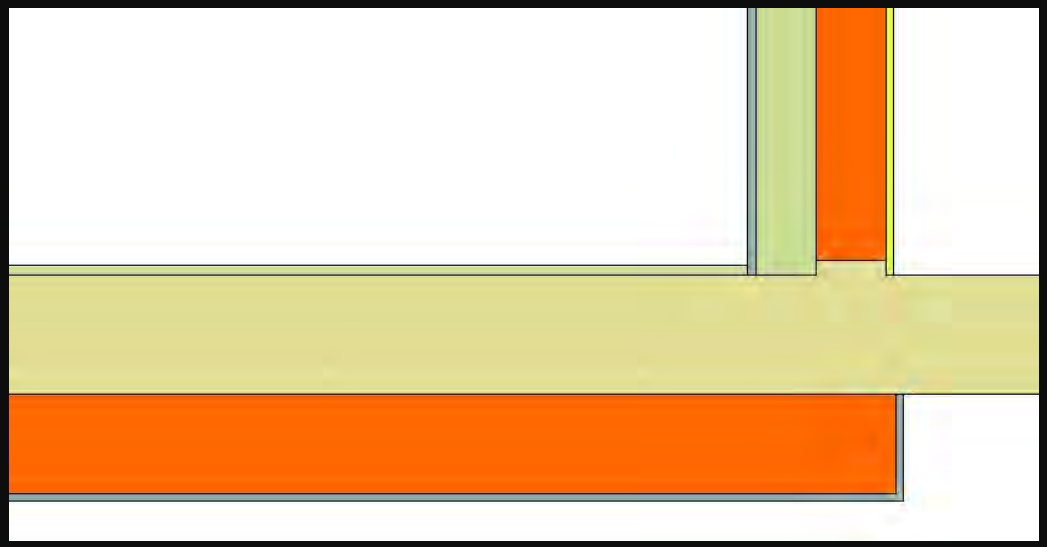
Assembly Performance Summary

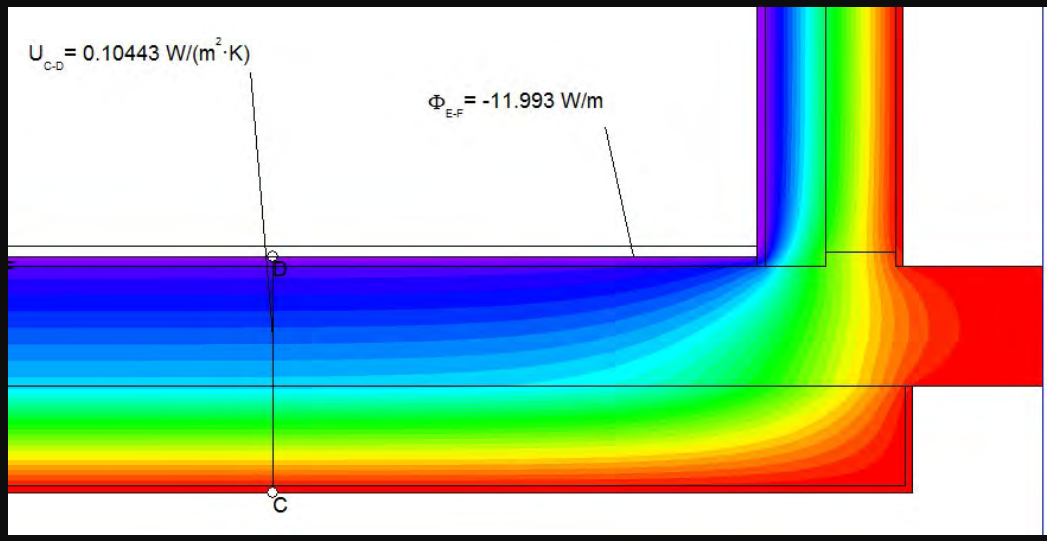
Element	U-value [W/m^{2}K]	R-value
Floor Slab	0.11	R52
Basement Wall	0.11	R52
Main Wall	0.12	R47
CLT Roof	0.07 – 0.11	R52-R81
Top Roof	0.07	R81

Terraces

- CLT prevents insulation above if flush threshold is desired

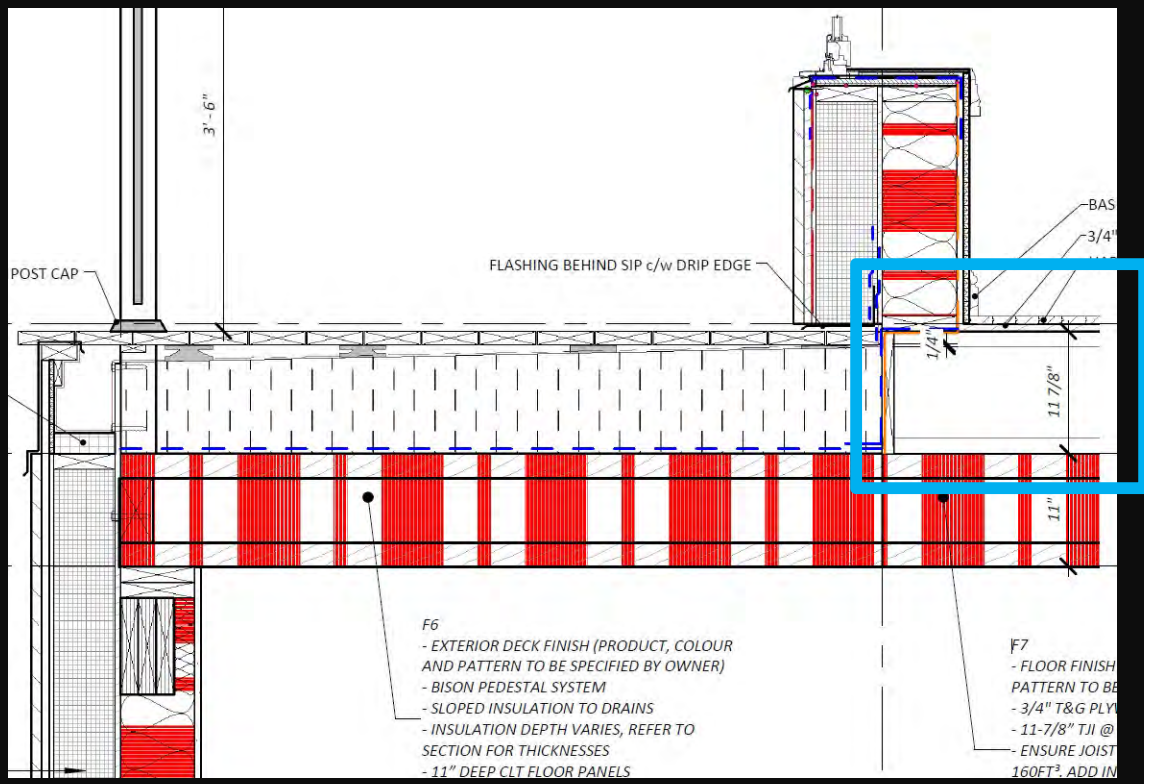
Psi-value = 0.064 W/mK
(0.037 BTU)





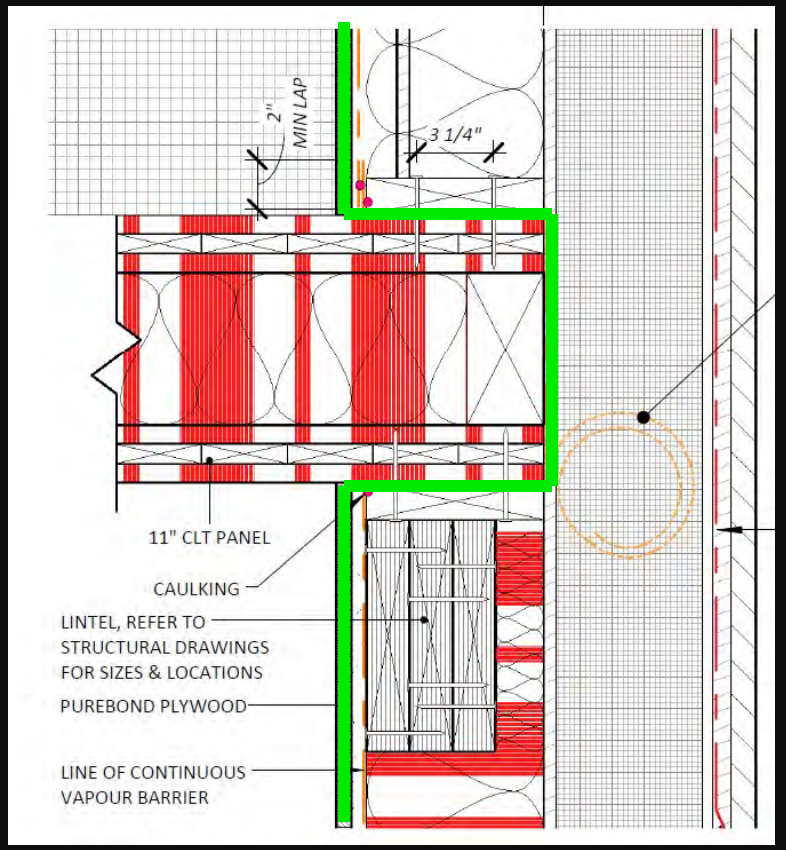
Terraces

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



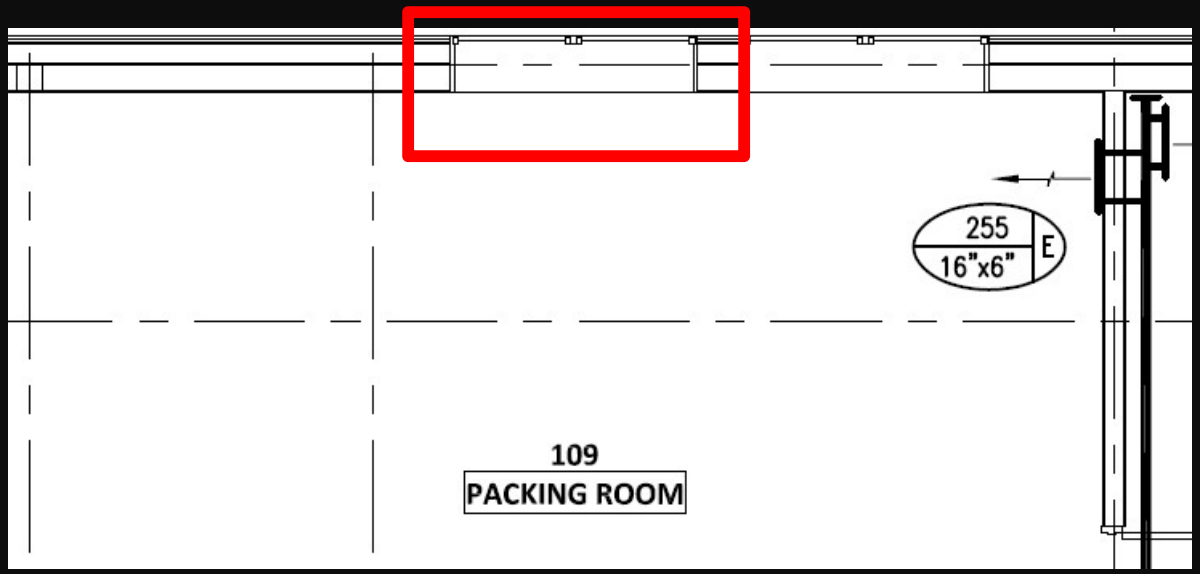
Airtightness Strategy

- **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: $U_{w,installed} \leq 0.70$ W/m^{2}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



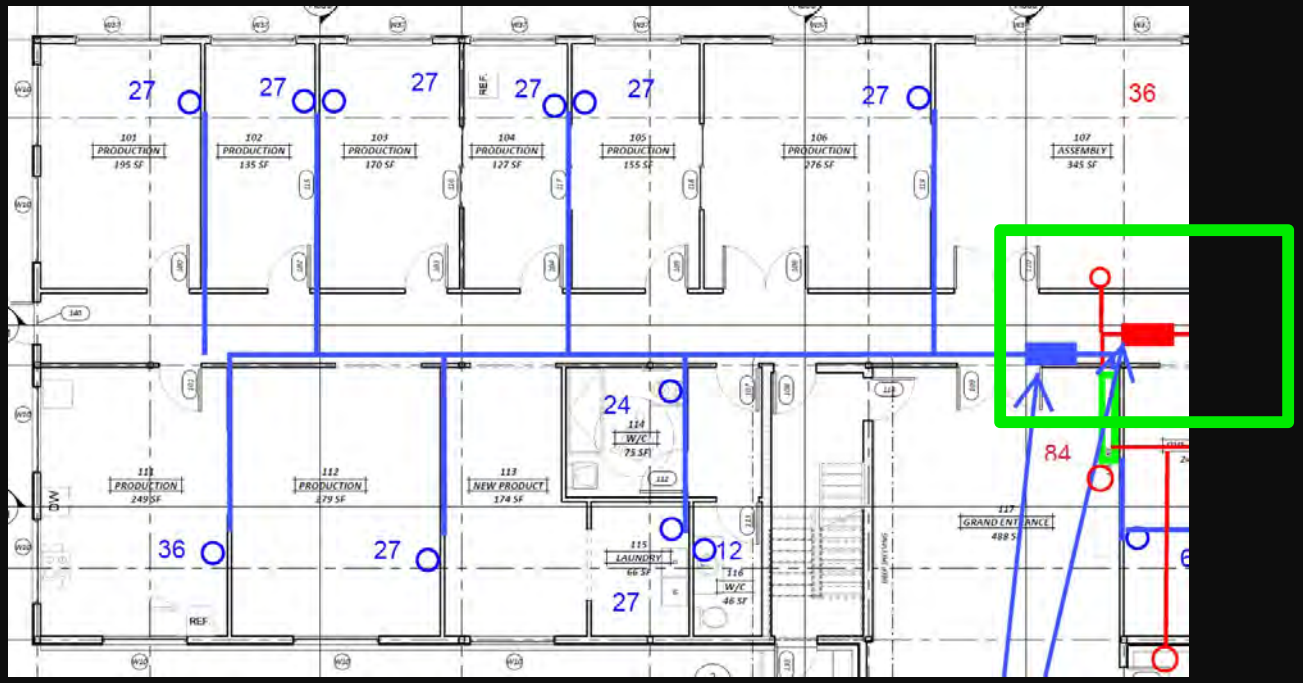
HVAC

Cold Climate Passive House
Production Facility

Author: Andrew W. Peel © 2016

Ventilation

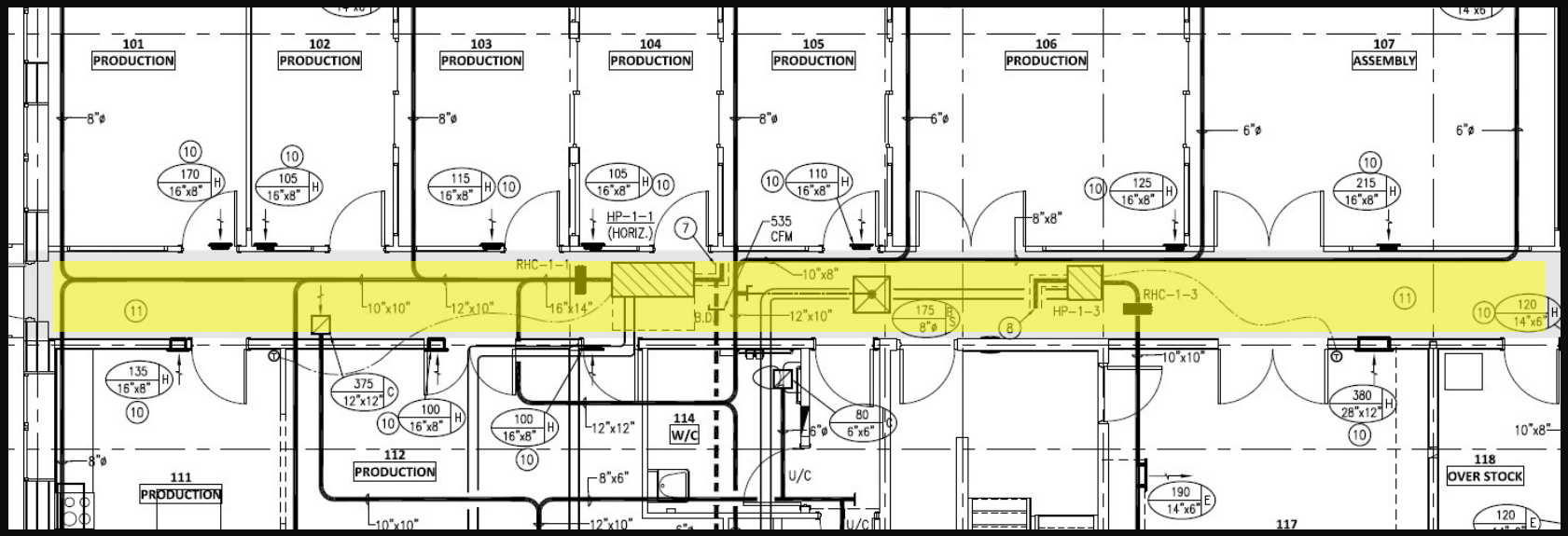
- Building Layout facilitated centralized approach
- Flow rates controlled based on occupancy
  - Working hours → office & production
  - Lunch → shift to canteen
- Extract in production rooms enable more balanced flow
- Only one damper pair per floor required



Ventilation

Issues:

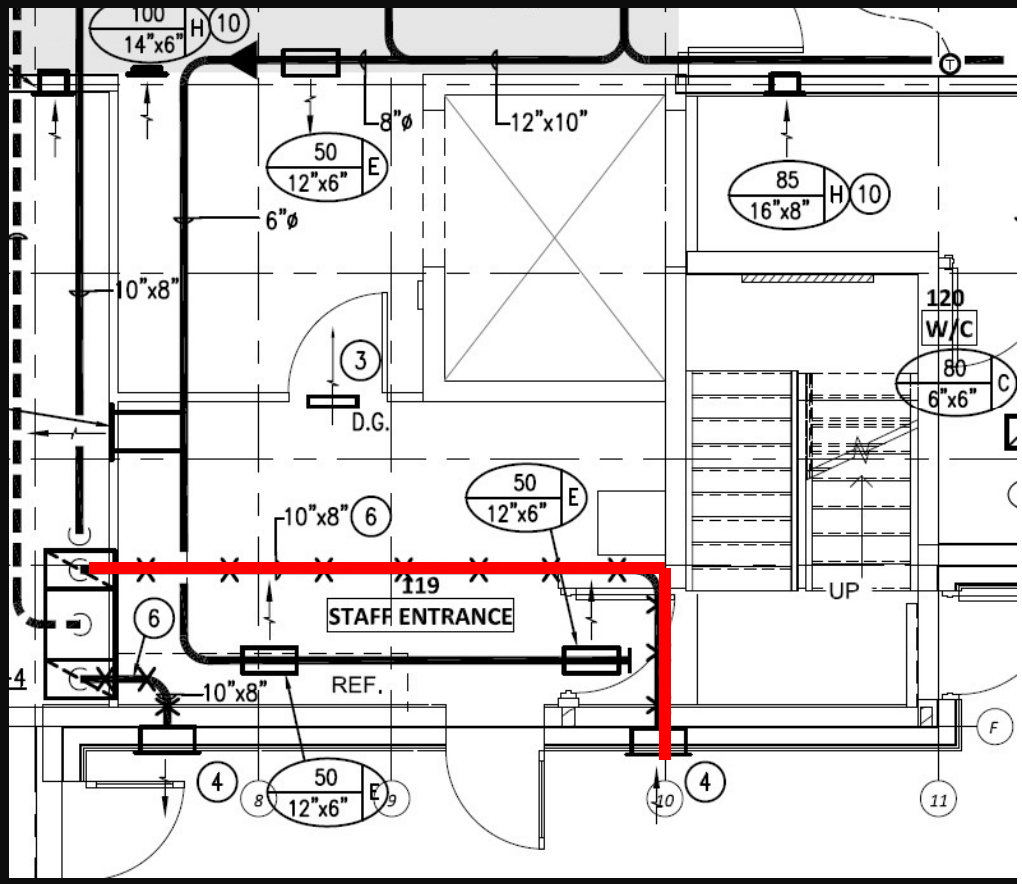
- Floor Layout only allowed for heating/cooling ducting in suspended ceiling, not additional ventilation ducting
- Engineer and designer were hesitant to rely on single machine
- Opted for semi-decentralized with 7 HRVs
  - Numerous issues...



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 operated 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

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