AFFORDABLE, ENERGY EFFICIENT, ARCTIC HOUSING

Mike Anderson, NSAA

Passive Design Solutions

Passive Design Solutions

- Passive House/ Net-Zero design firm based in Halifax, Nova Scotia since 2009
- High-performance housing design, focused on affordable/attainable
- Working on 100+ projects a year in a wide range of climates.

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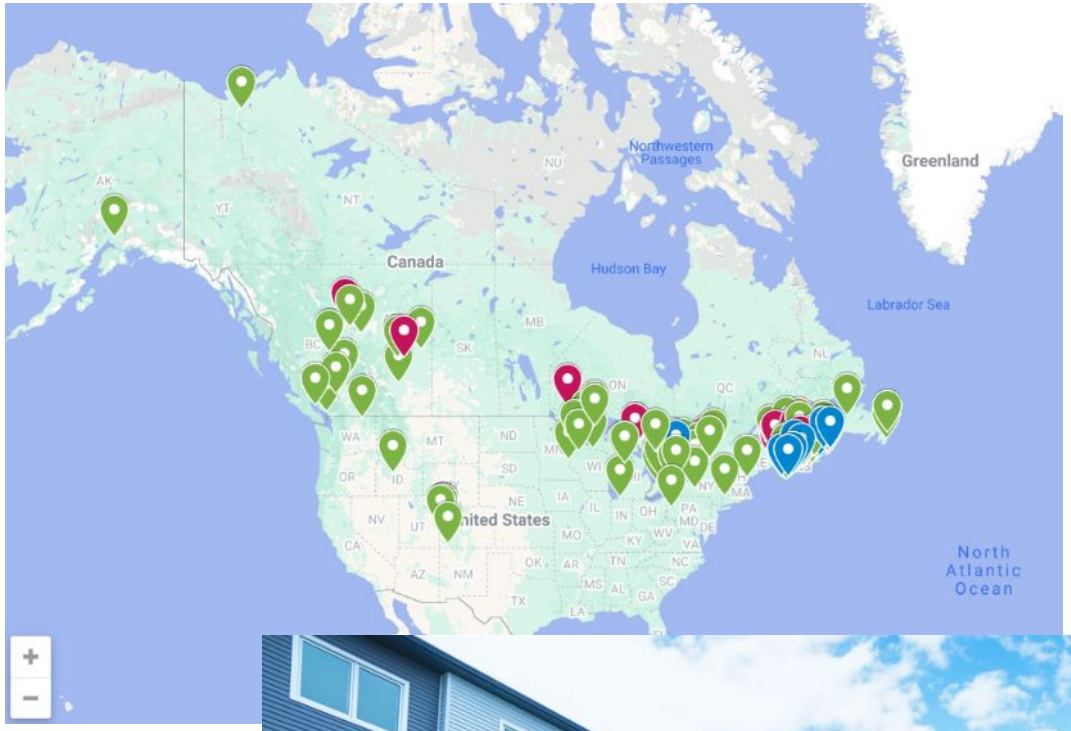

High Performance New Build Residential

- Work in any cold or cool climate
- Design for construction value and cost-efficiency
- Energy model to balance building improvements vs. energy cost or solar panels
- Specialize in wood construction (mid- and low-rise)
- Over 300 Passive House/Net-Zero designs completed.

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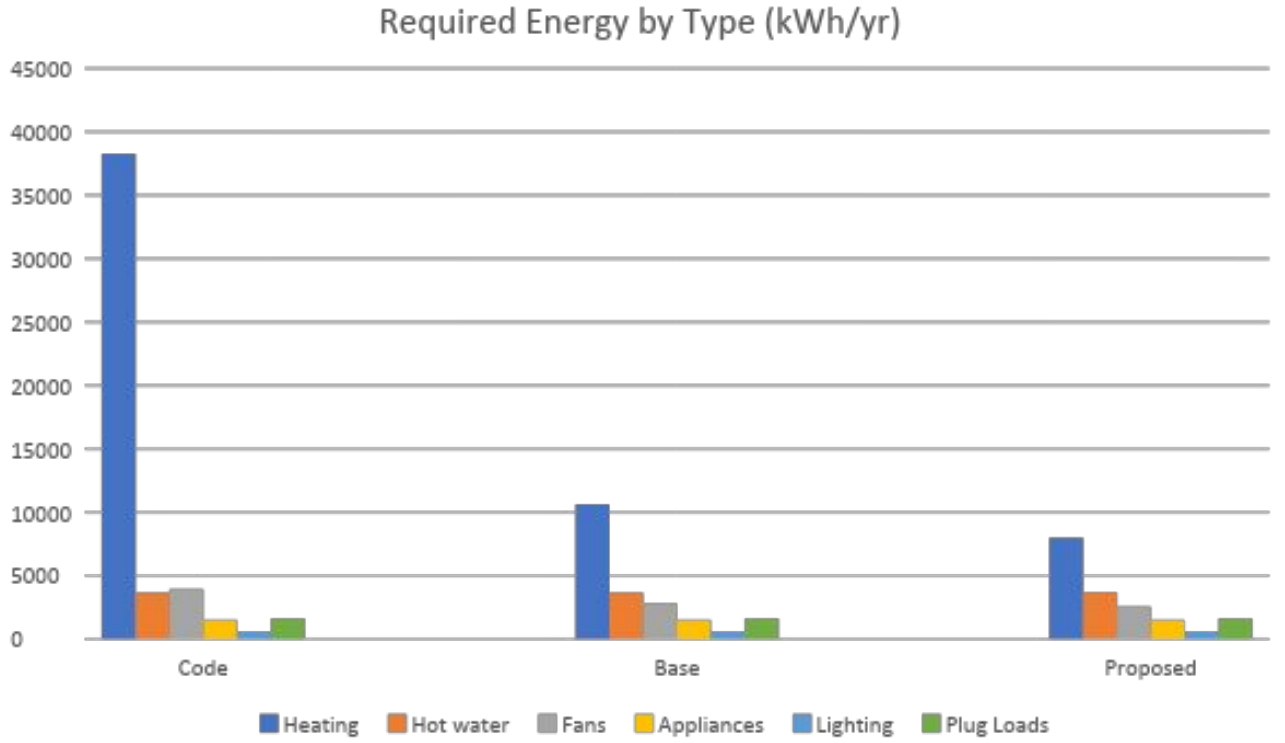
What does “high-performance” mean:

- Dramatic reduction in heating loss
- Achieved through envelope upgrades, not appliances or mechanicals
- If all electric at $0.75/kWh, this is $22,000 in annual savings (gas much less of course)
- Not dependent on mechanical systems- no moving parts required.
- Conservation is much cheaper than production!



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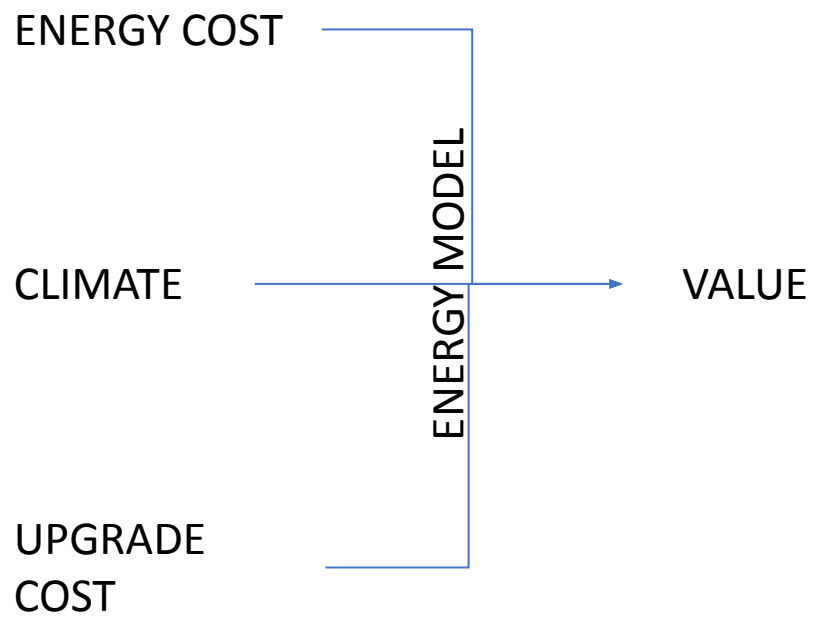
But isn't that expensive?

Energy-efficiency that is also cheaper up front:

- Appropriate design
- Geometry and Scale
- Airtightness

Energy-efficiency that is more expensive up front:

- High performance windows and doors
- Super-insulation
- "Interesting" mechanical systems
- Renewable technologies



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What is appropriate design and how can you do it remotely?

- Figure out what the project needs, don't build more than needed
- Define project goals
- Listen to people who know the area – builders are critical
- Make an energy model
- Detail ahead of time

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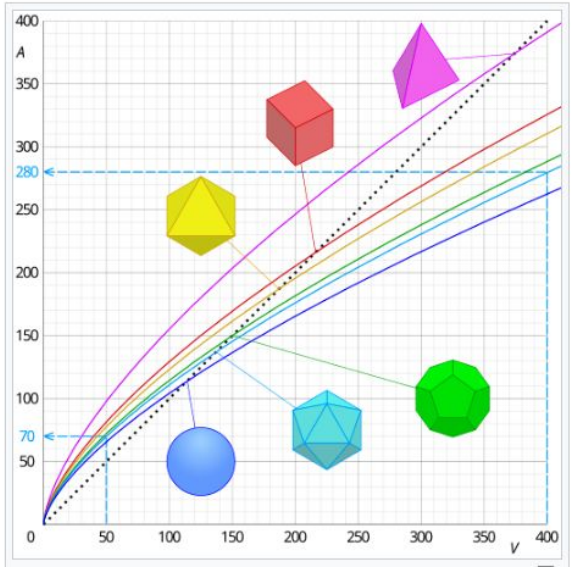
Defining project goals (from energy perspective):

- Who is occupant?
- Who is paying energy bills? Maintaining systems?
- How is project funded? Is operational funding secured or is it easier to get capital funding?
- How long is the building expected to be relevant?

Geometry and Scale

- Shape and size are at least as important to energy performance as anything else.
- Heat loss through envelope is via surface area- whereas program usually fits within volume
- More compact shapes are generally less expensive as well as more efficient
- But not all project types are really that flexible on geometry

Buckminster Fuller



$$Q = U * A * \Delta T$$

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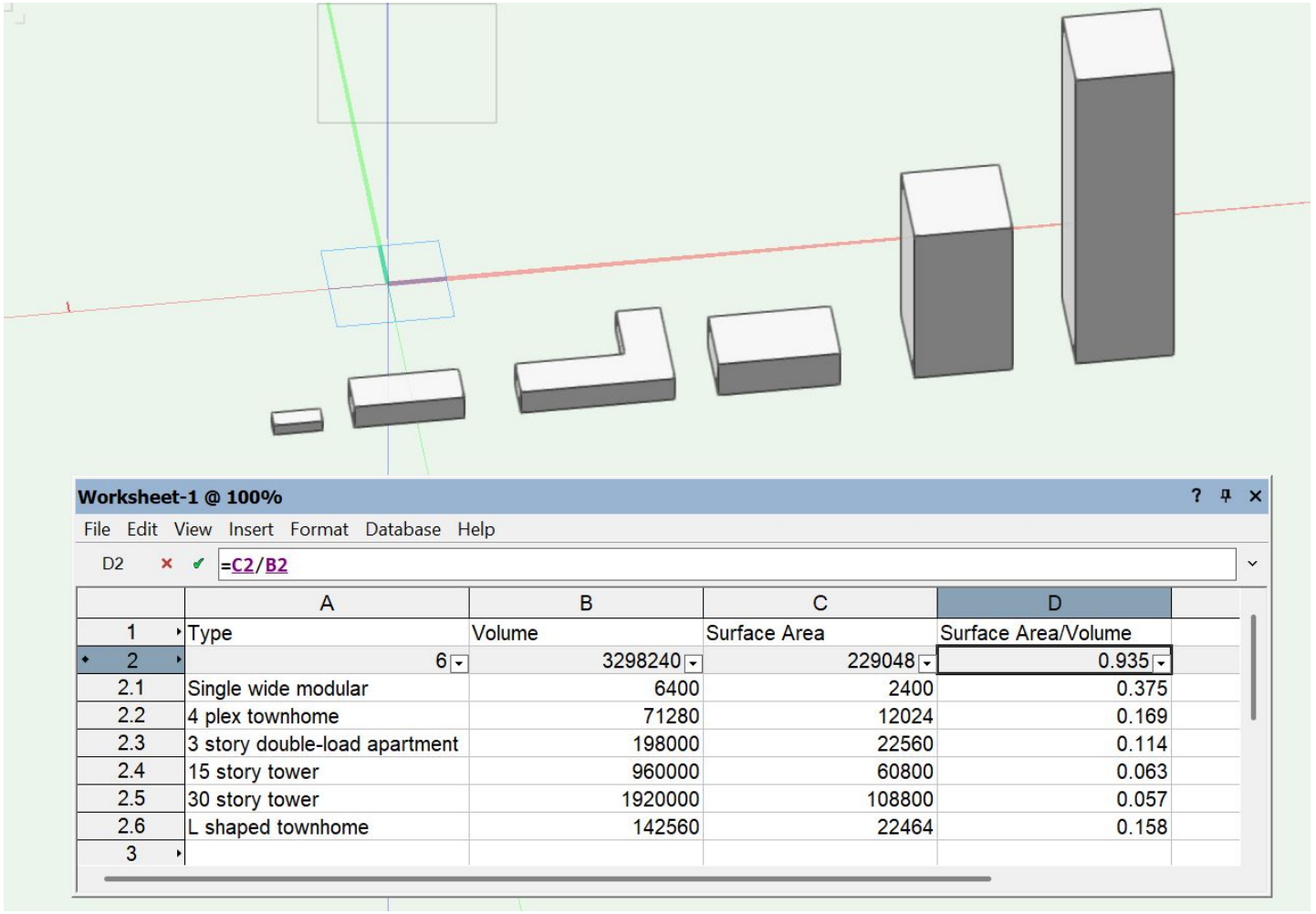
Geometry in real life:

- Comparing surface area to volume for some reasonable housing typologies
- Small, stand-alone homes are fast and meet privacy needs but present a lot of area for heat loss
- To achieve the same heat loss/unit, a small modular single family needs more than 3.25x the insulation compared to a mid-rise apartment building.
- Lots of additional factors to consider with shared hallways, stairs etc. Not always cheaper…
- For discussion- What are impediments to living together in larger buildings?



Worksheet-1 @ 100%

File Edit View Insert Format Database Help

D2 =C2/B2

	A	B	C	D
1	Type	Volume	Surface Area	Surface Area/Volume
2	6	3298240	229048	0.935
2.1	Single wide modular	6400	2400	0.375
2.2	4 plex townhome	71280	12024	0.169
2.3	3 story double-load apartment	198000	22560	0.114
2.4	15 story tower	960000	60800	0.063
2.5	30 story tower	1920000	108800	0.057
2.6	L shaped townhome	142560	22464	0.158
3				

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Airtightness:

- Required for superinsulation because science
- Recommended for building durability generally
- Noticeable impact in South, huge in Arctic climates
- Almost 40% of all savings on the project in Inuvik from air-tightness!
- We don’t breathe though our skins- dedicated ventilation is critical

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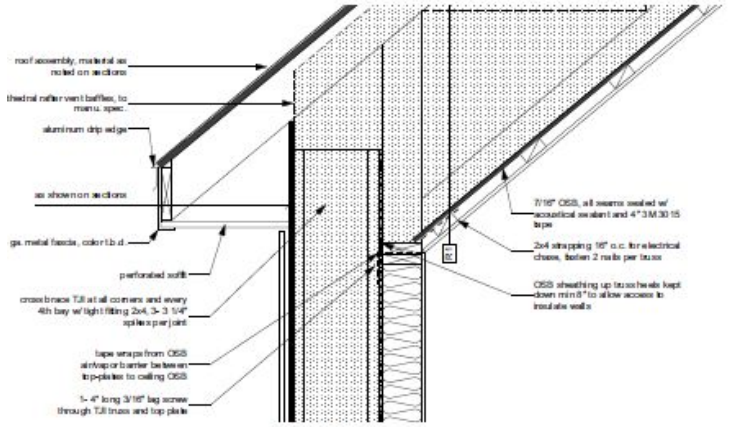
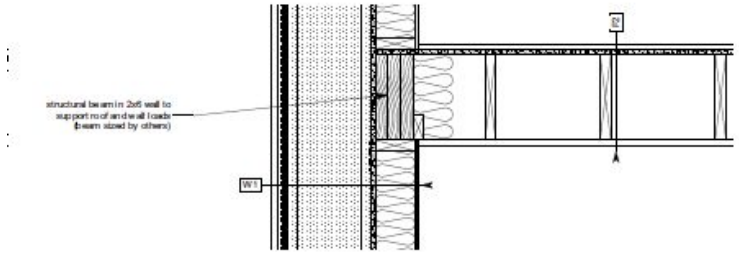
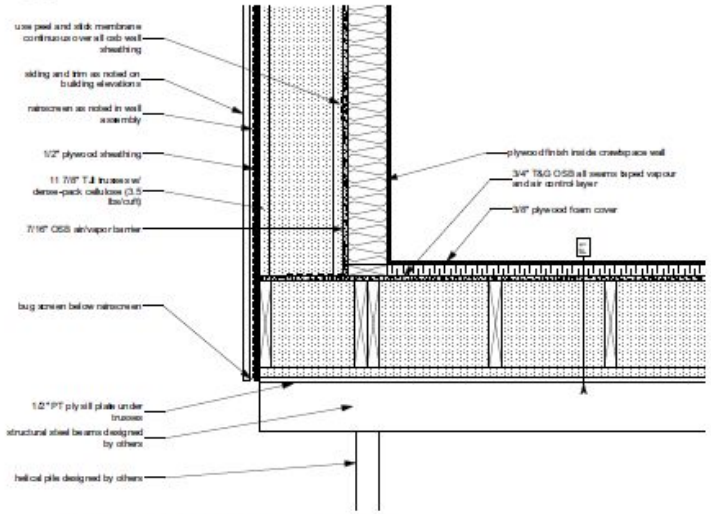


3 Eave Wall at [R1] Roof Truss Detail
SCALE: 1" = 1'-0"



5 Eave Wall at [F2] Main Floor Detail
SCALE: 1" = 1'-0"



5 Eave Wall at [F1] Crawlspace Floor Detail
SCALE: 1" = 1'-0"

Airtightness in reality

- Details!
- The builder needs to trust it can be done, and has been thought through
- And the builder needs to want to do it

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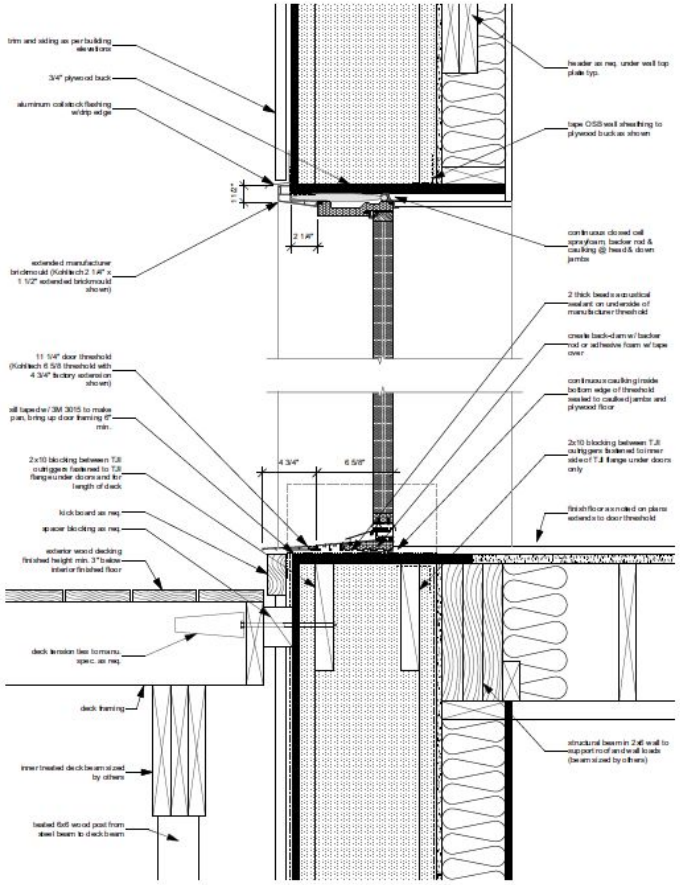
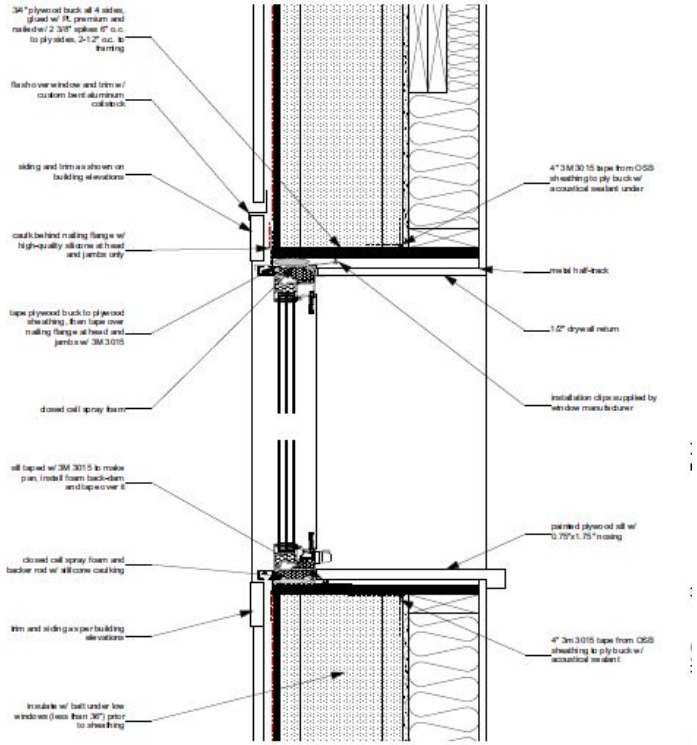


1 Exterior Door Section Detail
SCALE: 2" = 1'-0"



1 Typical Window Section Detail
SCALE: 2" = 1'-0"

Detailing

- Just more construction details- the devil is in the openings

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Triple pane windows (and doors):

- Very likely worth it- but not always
- Depends on geometry, climate, energy cost
- A simple product change, no added labor or change of best practice
- Most larger manufacturers offer them
- Getting cheaper- less added cost than black windows
- Double the seals to fail

VETTA Windows

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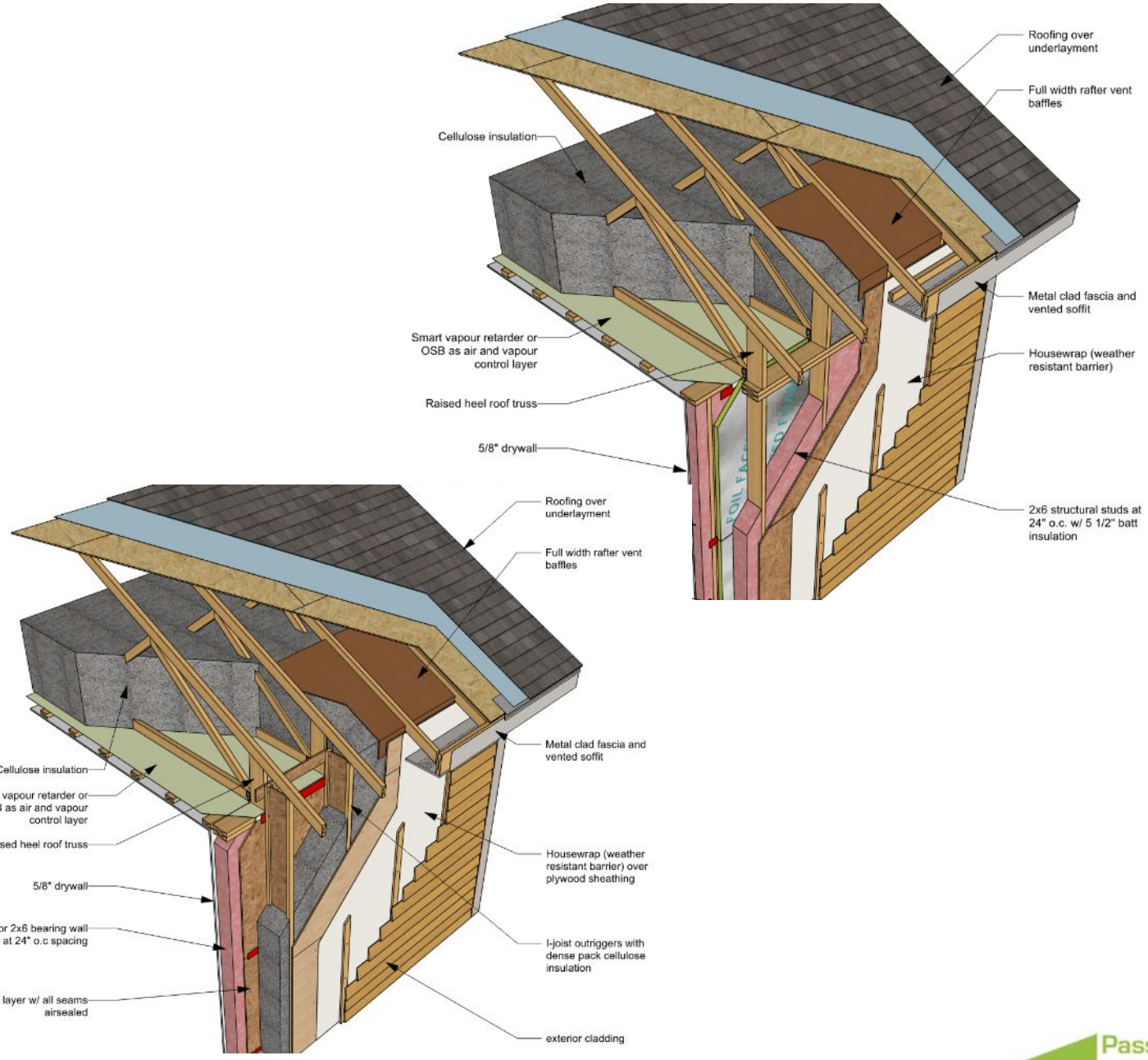
Superinsulation:

- Sometimes worth it- but not always
- Depends on geometry, climate, energy cost
- Requires the largest departure from common practice, so costs more
- Can be risky- more prone to failure than pouring heat out to keep things dry
- But may have non-financial benefits- resilience in energy scarcity, acoustics, feeling solid etc.



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Mechanical upgrades:

- Maybe worth it, but really depends
- Easiest place to save at larger scales, particularly if services can be shared
- Ongoing service, maintenance
- Heat pumps are great, but not for arctic- cooling and cold outdoor temps
- Much shorter payback periods due to shorter lifespan of equipment
- Who can fix it?

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All-electric systems:

- Really depends on the community
- If produced using diesel, why bother?
- Future micro grids might be much cleaner than currently (NS still burns coal…)
- Use simple, familiar systems- electric baseboards are great if there's a home hardware nearby
- Electricity is precious, heat is easier to come by
- For discussion- pellets? Or other more-locally available energy sources?

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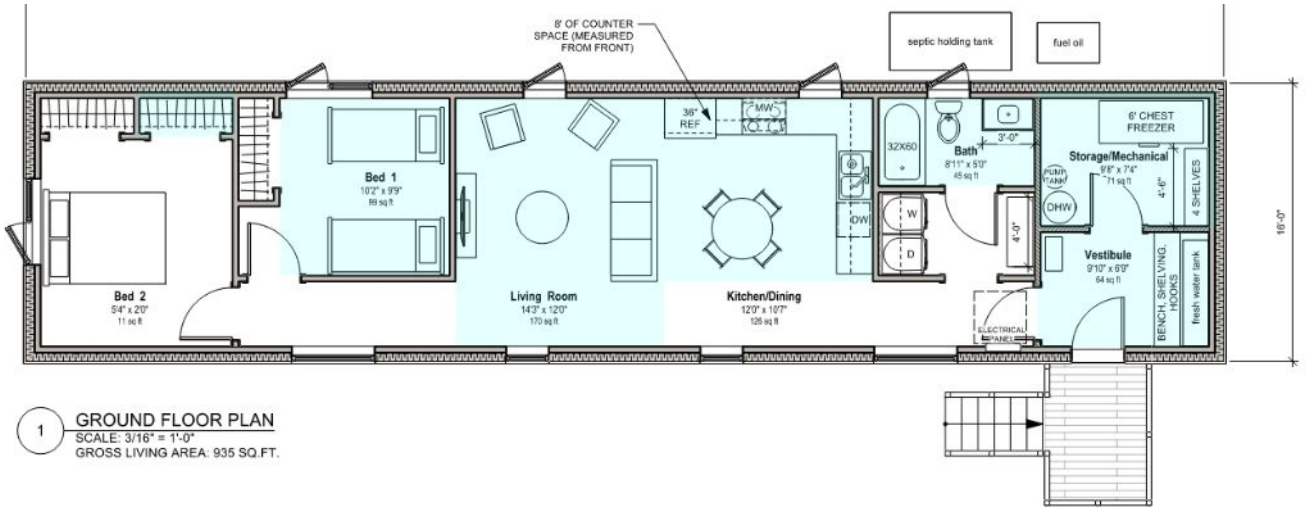
Is modular housing right for the North?

For discussion:

- Speed and convenience vs capacity building and ongoing repairability
- Race to the bottom of cost (and quality?)
- Shipping mostly empty space



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Thank you!

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