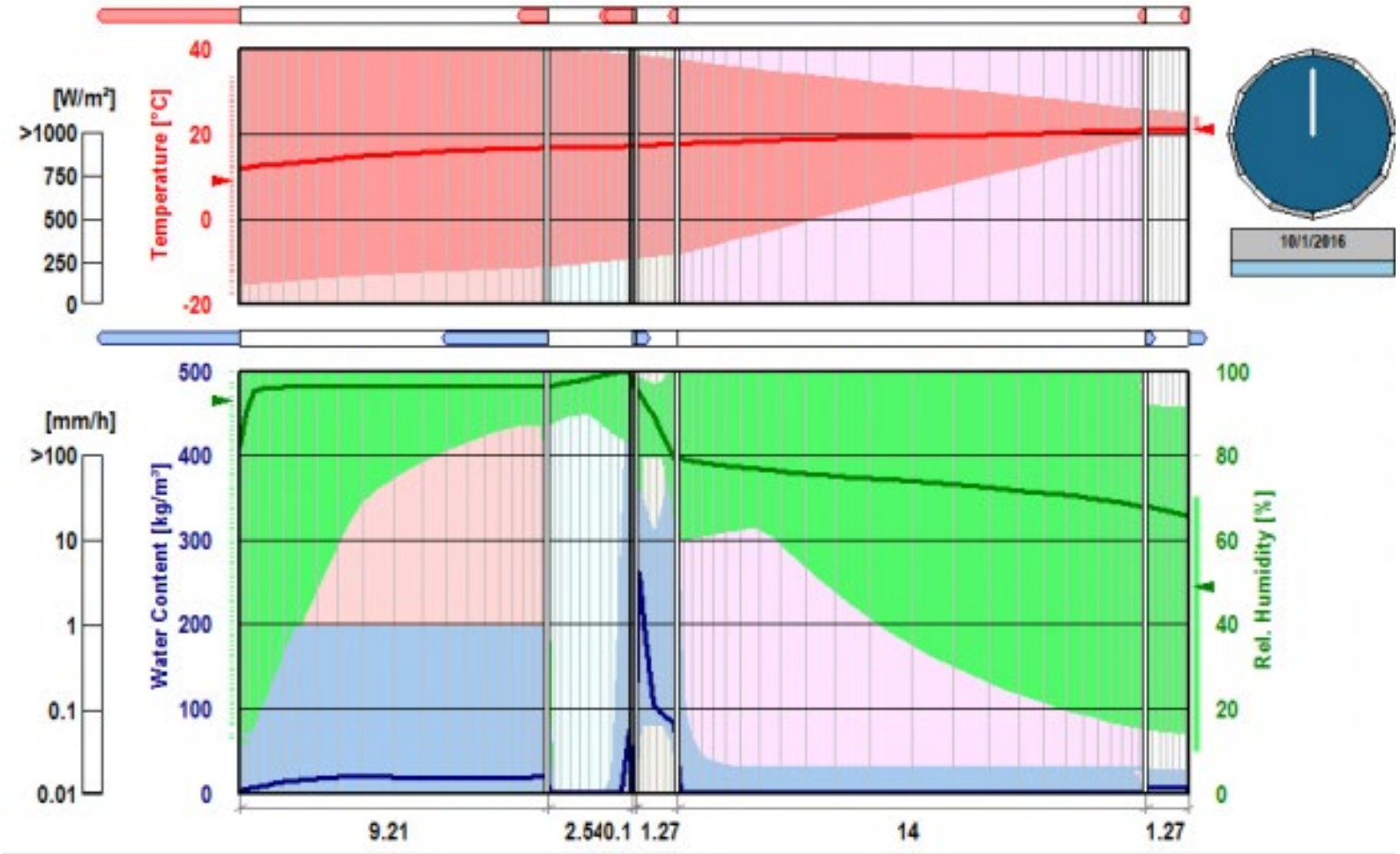
Moisture Risk and Heat Loss Analysis

For Wall Assemblies and Junctions



Qualitative Assessment Walk-through and Exercises

Working with Vapor flow:

- Permeability (perm in) is a material property independent of thickness – similar to R/inch

- Permeance (perms) is more like the performance of a layer or assembly, dependent on its thickness – similar to R-value
  - The reciprocal of vapor permeance is vapor resistance.

Qualitative Assessment Walk-through and Exercises

Working with Vapor flow:

- Permeability (perm in) is a material property independent of thickness – similar to R/inch

- Permeance (perms) is more like the performance of a layer or assembly, dependent on its thickness – similar to R-value

- It is not possible to add the permeability (perm in) of different materials in an assembly and arrive at a value that makes sense…
- Rather, the permeance (perms) of each layer is calculated, then its reciprocal (i.e, its vapor resistance) is added, just like thermal resistance (R-value), to arrive at a total vapor resistance.

Qualitative Assessment Walk-through and Exercises

Converting units:

- Permeability (perm in) to Permeance (perms)
  perm in / thickness (in) = perms at that thickness
- Permeance (perms at tested thickness) to Permeability (perm in)
  perms x tested thickness (in) = perm in

- Permeance (perms) = 1/vapor resistance
- Vapor resistance (reps) = 1/permeance

Qualitative Assessment Walk-through and Exercises

Converting units:

1) Find the perm rating of a vapor retarder membrane listed as 0.00393 perm in, given the membrane will be 0.039 inches thick.

Qualitative Assessment Walk-through and Exercises

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   0.00393 perm in / 0.039 in = 0.1 perms

   (This is equivalent to 6 mil poly)

Qualitative Assessment Walk-through and Exercises

Converting units:

2) Find the permeability (perm in) of brick which tested at 2 perms @ 4 inches thick.

Qualitative Assessment Walk-through and Exercises

Converting units:

2) Find the permeability (perm in) of brick which tested at 2 perms @ 4 inches thick.

   2 perms x 4 inches = 8 perm in

Qualitative Assessment Walk-through and Exercises

Calculating the total permeance of an assembly:

3) Find the total permeance of a SIP panel –

OSB @ 1/2” = 1.2 perms
EPS @ 5 1/2” = 0.64 perms
OSB @ 1/2“ = 1.2 perms

Total permeance = 1/(1/1.2 + 1/0.64 + 1/1.2) = 0.31 perms

We add the inverses (vapor resistances), then invert the result to convert back to perms.

Notice how the perm rating goes down as more layers are added, indicating the assembly is more vapor closed than its individual layers.

Qualitative Assessment Walk-through and Exercises

Calculating the total permeance of an assembly:

4) Find the total permeance of a 2x6 stud wall–

2 layers latex paint = 10 perms
1/2” gypsum board (18.25 perm in)
6 mil poly = 0.1 perms
5 1/2” fiberglass (106 perm in)
1/2” OSB (0.5 perm in)
Tyvek = 49 perms

Qualitative Assessment Walk-through and Exercises

Calculating the total permeance of an assembly:

4) Find the total permeance of a 2x6 stud wall–

2 layers latex paint = 10 perms
gypsum board @ 1/2” = 36.5 perms (converted to perms)
6 mil poly = 0.1 perms
fiberglass @ 5 1/2” = 19.4 perms (converted to perms)
OSB @ 1/2” = 1.2 perms (converted to perms)
Tyvek = 49 perms

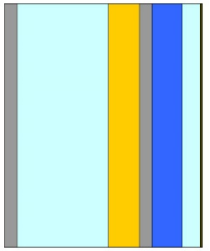
Total permeance = 1/(1/10 + 1/36.5 + 1/0.1 + 1/19.4 + 1/1.2 + 1/49) = 0.09 perms

Barely lower than the 6 mil poly alone!

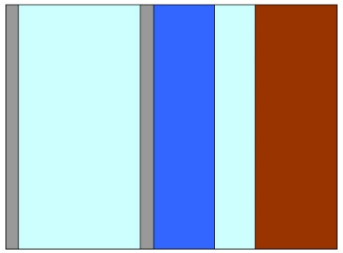
Qualitative Assessment Walk-through and Exercises

Select one of three enclosures to evaluate:

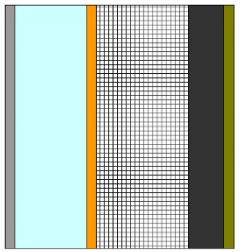
1. Steel Stud with hybrid insulation & metal panel



2. Steel Stud with exterior insulation & brick



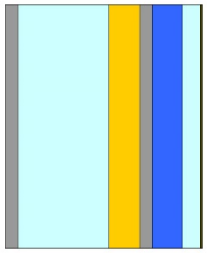
3. Concrete tilt-up panel



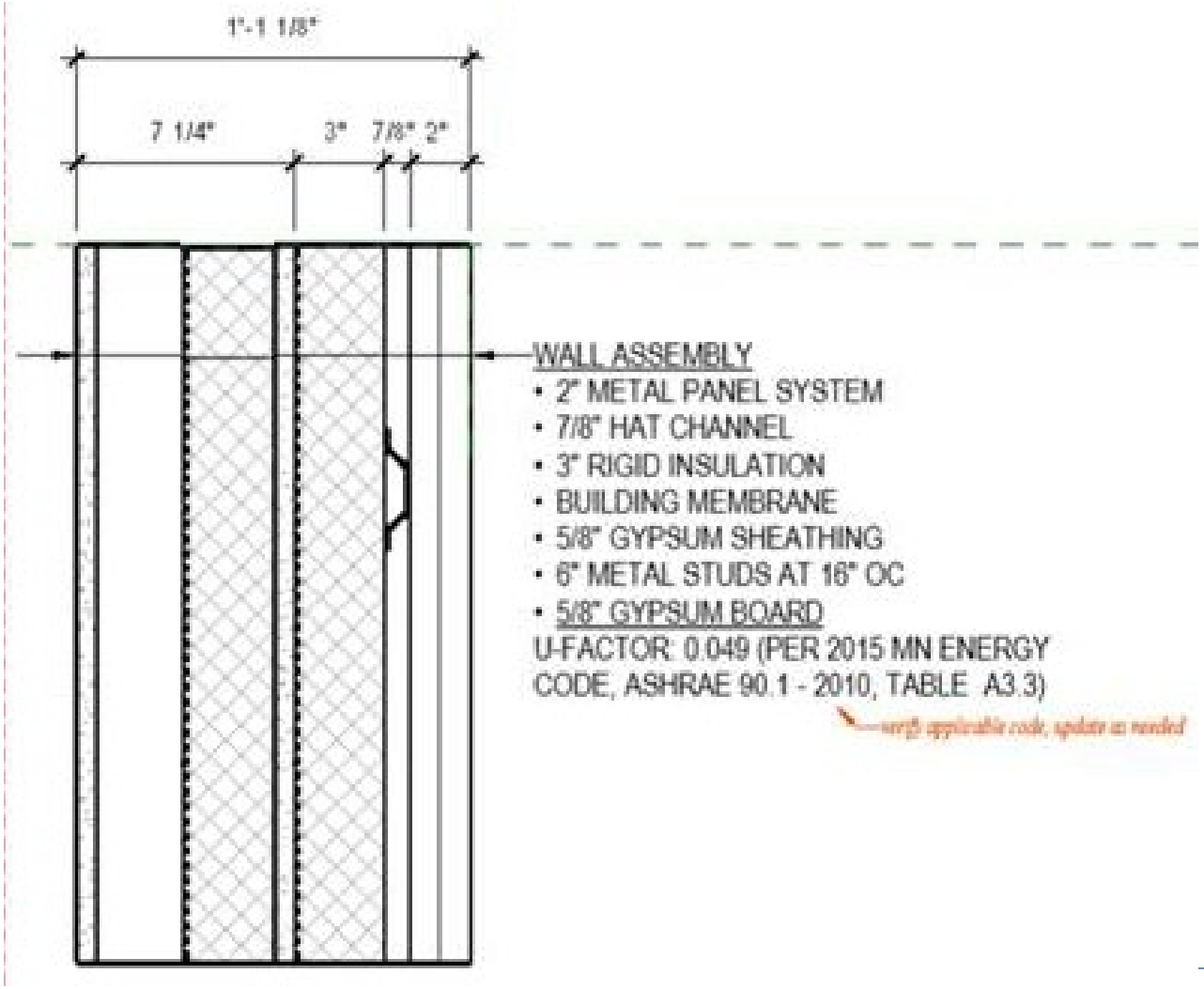
Option 1 - Steel Stud with hybrid insulation & metal panel

Layers from inside to outside:

1.	2-coats latex paint	10 perms	R-0
2.	5/8” gypsum board	29.2 perms @ 5/8”	R-0.9/inch
3.	4 ½” still air space	120 perm in	R-1.0
4.	1 ½” closed cell SPF	1.39 perm in	R-6.7/inch
5.	Fiberglass facer	60 perms	R-0
6.	5/8” gypsum board	29.2 perms @ 5/8”	R-0.9/inch
7.	Fiberglass facer	60 perms	R-0
8.	Tyvek	60 perms	R-0
9.	1 ½” XPS (extruded polystyrene)	1 perm @ 1 ½”	R-5.0/inch
10.	7/8” ventilated air gap	120 perm in	R-1.0
11.	0.03” Metal panel	0.05 perms	R-0



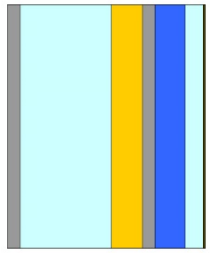
Option 1 - Steel Stud with hybrid insulation & metal panel



WALL ASSEMBLY
- 2" METAL PANEL SYSTEM
- 7/8" HAT CHANNEL
- 3" RIGID INSULATION
- BUILDING MEMBRANE
- 5/8" GYPSUM SHEATHING
- 6" METAL STUDS AT 16" OC
- 5/8" GYPSUM BOARD

U-FACTOR: 0.049 (PER 2015 MN ENERGY CODE, ASHRAE 90.1 - 2010, TABLE A3.3)

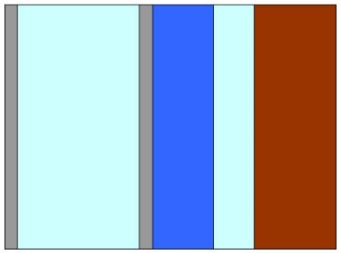
verify applicable code, update as needed



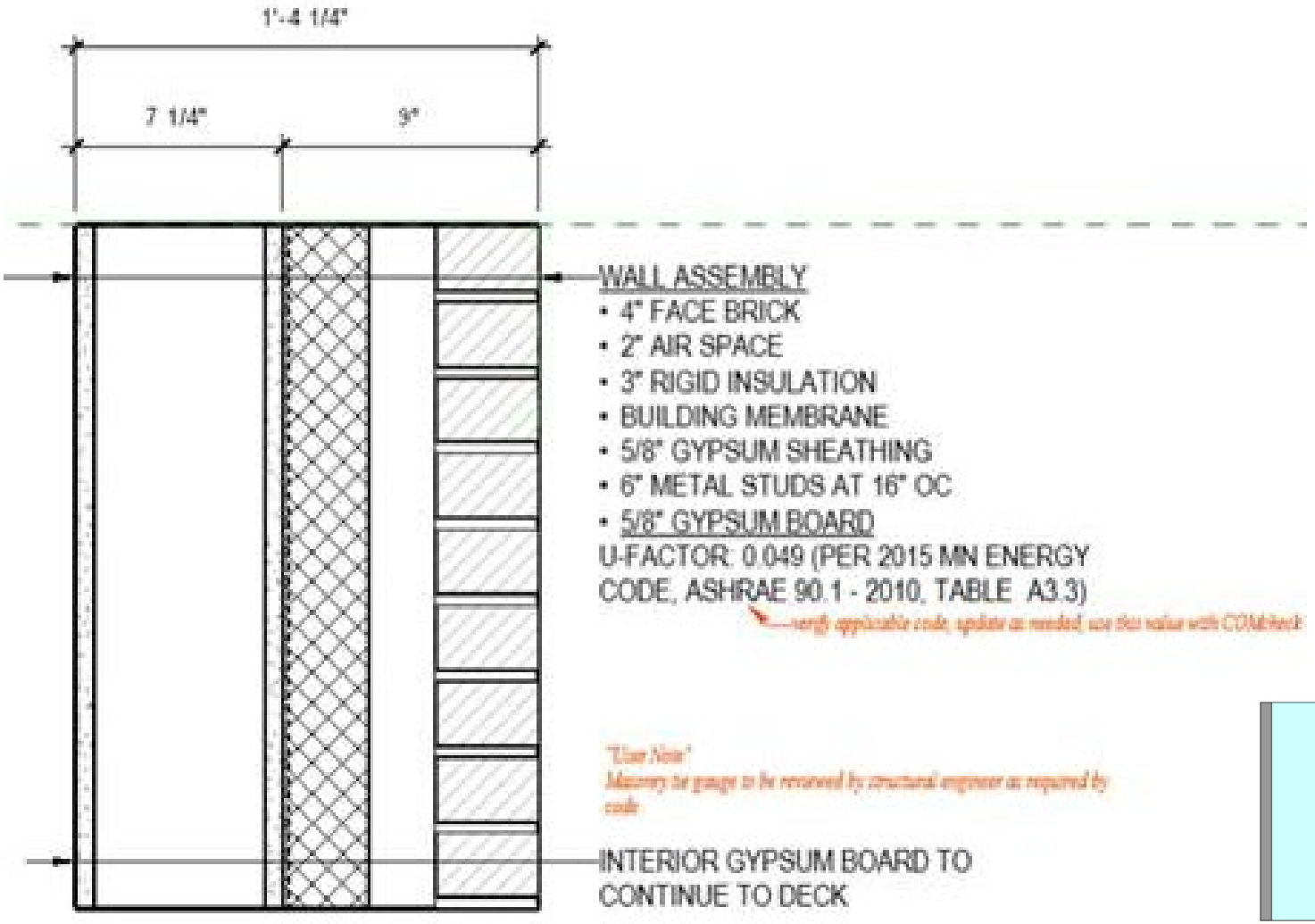
Option 2 - Steel Stud with exterior insulation & brick

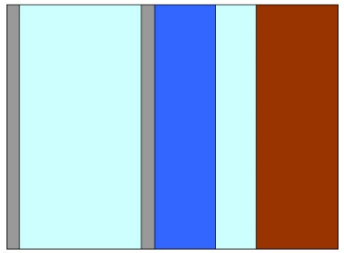
Layers from inside to outside:

1.	2-coats latex paint	10 perms	R-0
2.	5/8” gypsum board	29.2 perms @ 5/8”	R-0.9/inch
3.	6” still air space	120 perm in	R-1.0
4.	Fiberglass facer	60 perms	R-0
5.	5/8” gypsum board	29.2 perms @ 5/8”	R-0.9/inch
6.	Fiberglass facer	60 perms	R-0
7.	Perm-a-Barrier	0.047 perms	R-0
8.	3” XPS (extruded polystyrene)	0.5 perms @ 3”	R-5.0/inch
9.	2” vented air gap	120 perm in	R-1.0
10.	4” brick cladding	3.2 perm in	R-0.11/inch



Option 2 - Steel Stud with exterior insulation & brick

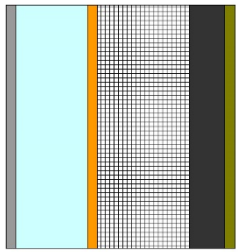




Option 3 – Concrete tilt-up panel

Layers from inside to outside:

1.	2-coats latex paint	10 perms	R-0
2.	1/2” gypsum board	36.5 perms @ 1/2”	R-0.9/inch
3.	3 1/2” air space	120 perm in	R-1.0
4.	Foil facer	0.05 perms	R-0
5.	1/2” DOW Thermax	3 perm in	R-6.6/inch
6.	Foil facer	0.05 perms	R-0
7.	4 1/2” EPS	3.5 perm in	R-4.0/inch
8.	1 3/4” concrete shell (5000 psi)	0.1 perm in	R-0.1/inch
9.	1/2” portland stucco	0.36 perm in	R-0.4/inch



Option 3 – Concrete tilt-up panel wall