

Exterior Wall Design

Mechanical Breadth



Exterior Wall Design (Mechanical Breadth):

Given the new structural design, the use of masonry for exterior wall was no longer needed. It is because of this that I decided to alter the exterior wall to be a steel stud wall. The new design of the construction of the exterior wall is to be a brick veneer with a 1" air space before a 2" layer of rigid insulation. On the interior side of the insulation is the vapor barrier, followed by the 2"x4" steel studs sheathed with 5/8" gypsum wall board.

Using the ASHRAE Handbook of Fundamentals 2001 I gathered the outdoor design conditions for Lancaster, Pennsylvania (Lancaster and Willow Street are less than 5 miles apart). The summer design conditions are a dry bulb temperature of 93.2°F at the 1% condition. During winter, the dry bulb temperature is 9°F at the 99% condition. Also, using a psychrometric chart, I was able to determine that my dew point temperatures. During summer conditions of 75°F and 50% relative humidity, the dew point is at 55°F. During winter conditions of 70°F and 50% relative humidity, the dew point is at 51°F.

Spring Run Assisted Living falls in climate zone 5A. Therefore, table 5.5-5 in ASHRAE std. 90.1 – 2004, which is based on building construction and use, was used to determine that the building needs to maintain a u-value no greater than 0.064. I used Carrier's Hourly Analysis Program v4.20 to determine the R-values of my materials. Using an excel spreadsheet I was able to determine the temperature drop over each material as well as the location of condensation. The location of condensation is on the exterior side of the vapor barrier thus eliminating the opportunity for mold growth on the gypsum wall board.

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Architectural Engineering @ The Pennsylvania State University

EXTERIOR WALL						
MATERIAL	THICKNESS, IN.	R-VALUE	DELTA T		TEMPERATURE	
			WINTER	SUMMER	WINTER	SUMMER
OUTSIDE AIR SR	0.00	0.33	1.15	0.34	9.00	93.20
BRICK VENEER	4.00	0.43	1.49	0.44	10.15	92.86
AIR SPACE	1.00	0.91	3.13	0.93	11.64	92.41
BOARD INSULATION	2.00	13.89	47.81	14.27	14.77	91.48
VAPOR BARRIER	0.01	0.00	0.00	0.00	62.58	77.21
AIR SPACE	3.50	0.91	3.13	0.93	62.58	77.21
GWB	0.63	0.56	1.93	0.58	65.71	76.28
INSIDE AIR	0.00	0.69	2.36	0.70	67.64	75.70
Totals	11.14	17.72			70.00	75.00

Max allowable U-value	0.064
Wall Constr. U-value	0.056

Q-WINTER(MAN. WALL)	3.44
Q-SUMMER(MAN. WALL)	1.03

WINTER OUTDOOR TEMP.	9
SUMMER OUTDOOR TEMP.	93.2
Summer INDOOR TEMP.	75
Winter Indoor Temp	70

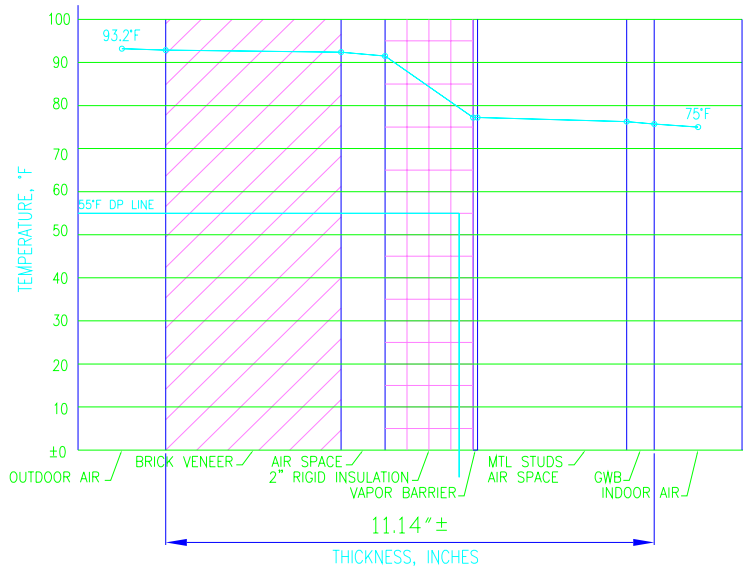
Figure 6: Excel Spreadsheet used for Exterior Wall Design

WALL HEAT TRANSFER DIAGRAMS

WALL

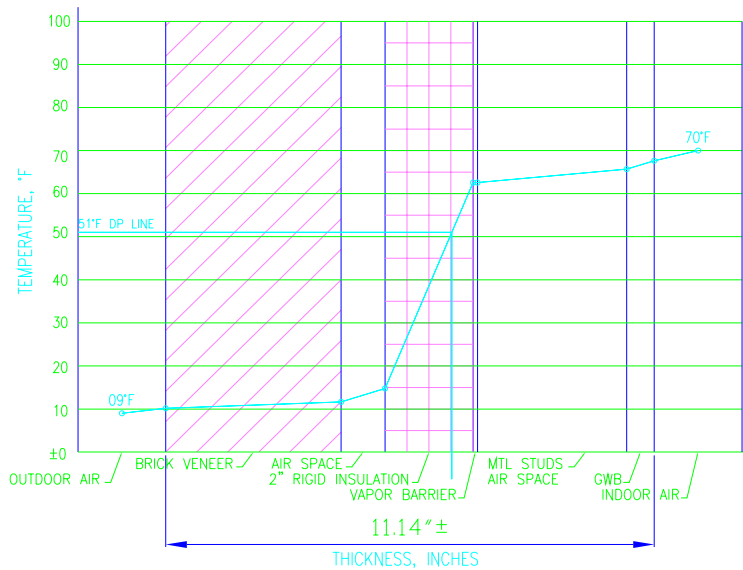
MATERIAL	THICKNESS, IN.	MATERIAL	THICKNESS, IN.
BRICK VENEER:	4.00	VAPOR BARRIER:	0.01
AIR SPACE:	1.00	AIR SPACE:	3.50
RIGID INSULATION:	2.00	GYPSUM WALL BOARD:	0.63

SUMMER WEATHER CONDITIONS



AT 75° AND 50%RH, DEW POINT TEMP. IS 55°F.

WINTER WEATHER CONDITIONS



AT 70° AND 50%RH, DEW POINT TEMP. IS 51°F.

Figure 7: Heat Loss and Vapor Barrier Placement