Advanced Masonry Consulting, INC Dynamic Performance Modeling

NBRC 10102

Table 1 – Model Overview

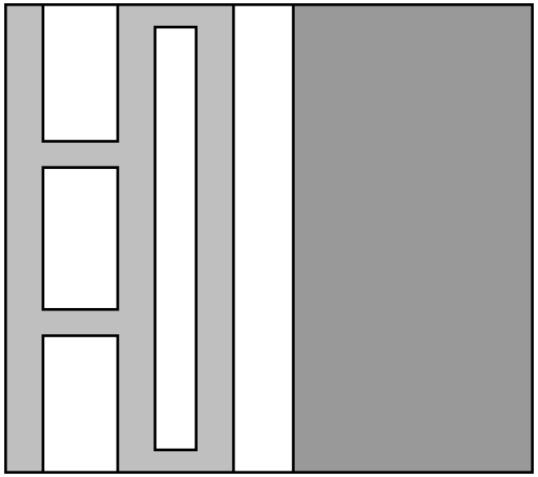
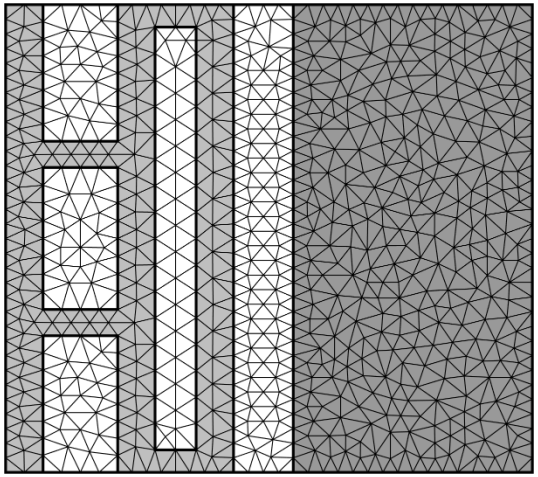
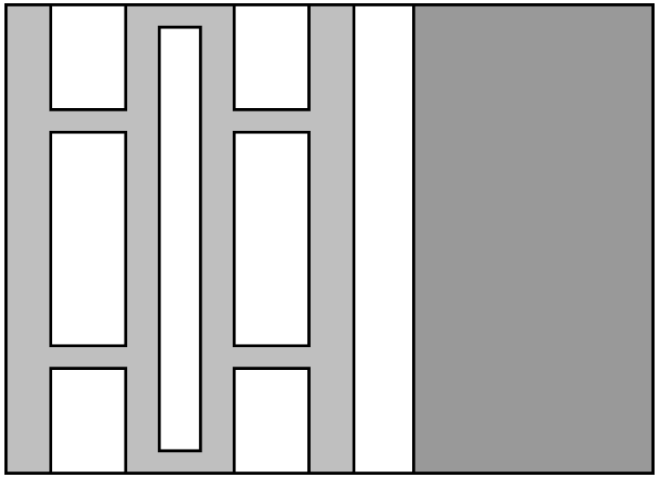
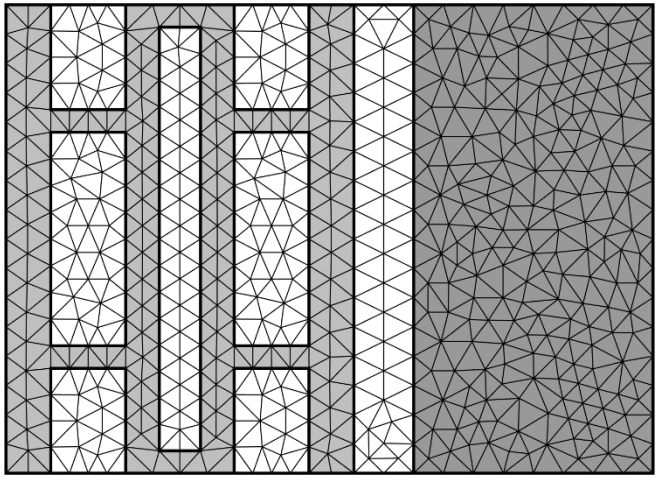
	Model	Mesh
8x8x16 Insul-Block with Concrete Wall		
12x8x16 Insul-Block with Concrete Wall		

Table 2 – Material Properties

Material	Thermal Conductivity [W/mK]	Density [kg/m^3]	Specific Heat Capacity [J/kgK]
Concrete – Mix Design Oven-dried	0.479[1]	1442	800
Type VIII EPS Cellofoam®	0.03675	18	1465[2]
Air	0.02624	1	1006
Concrete – 140pcf	1.19	2243	750

Table 3 – Boundary Conditions

Property	Interior	Exterior
Air Temperature [°C]	22.0	Climate Dependent
Convection Coefficient [W/m^{2}K]	2.8	Climate Dependent
Thermal Emissivity [-]	0.9	0.9
Solar Reflectance [-]	N/A	0.4

[1] Data obtained from ACI 122R-02

[2] Data obtained from ASHRAE Handbook of Fundamentals

Table 5 – Cities Used for Climate Zone Analysis

Climate Zone	City
1	Miami, FL
2	Houston, TX
3	Atlanta, GA
4	New York, NY
5	Buffalo, NY
6	Rochester, MN
7	International Falls, MN

Table 6 – Yearly Energy Results

Climate Zone	8x8 Insul-Block with Concrete Wall		12x8 Insul-Block with Concrete Wall	
	Thermal Energy Usage [kWhr/m^2]	Peak Heat Transfer [W/m^2]	Thermal Energy Usage [kWhr/m^2]	Peak Heat Transfer [W/m^2]
1	22.46	5.2	16.10	3.6
2	25.35	7.9	17.70	4.9
3	29.17	10.6	20.12	7.0
4	37.76	13.4	25.88	8.9
5	45.82	15.3	31.23	10.1
6	56.01	22.0	38.23	14.9
7	64.86	22.0	44.31	14.7

Table 7 – Reduction in Energy from Thermal Mass

Climate Zone	8x8 Insul-Block with Concrete Wall			12x8 Insul-Block with Concrete Wall		
	Energy Transfer [kWhr/m^2]	No Mass Energy Transfer [kWhr/m^2]	% Reduction	Energy Transfer [kWhr/m^2]	No Mass Energy Transfer [kWhr/m^2]	% Reduction
1	22.46	28.35	26.2%	16.10	20.59	27.9%
2	25.35	34.64	36.6%	17.70	24.80	40.4%
3	29.17	38.84	33.2%	20.12	27.56	37.0%
4	37.76	43.01	13.9%	25.88	30.06	16.1%
5	45.82	52.58	14.8%	31.23	36.61	17.2%
6	56.01	63.78	13.9%	38.23	44.35	16.0%
7	64.86	72.89	12.4%	44.31	50.72	14.5%

Table 8 – Reduction in Peak Thermal Energy Transfer from Thermal Mass

Climate Zone	8x8 Insul-Block with Concrete Wall			12x8 Insul-Block with Concrete Wall		
	Peak Thermal Energy Transfer [W/m^2]	No Mass Peak Thermal Energy Transfer [W/m^2]	% Reduction	Peak Thermal Energy Transfer [W/m^2]	No Mass Peak Thermal Energy Transfer [W/m^2]	% Reduction
1	5.2	11.5	54.5%	3.6	8.4	57.3%
2	7.9	13.7	42.6%	4.9	9.7	48.9%
3	10.6	16.4	35.4%	7.0	11.4	38.5%
4	13.4	17.4	22.9%	8.9	12.1	26.6%
5	15.3	18.5	17.3%	10.1	12.9	21.8%
6	22.0	26.8	17.8%	14.9	18.8	20.5%
7	22.0	26.3	16.3%	14.7	18.6	20.9%

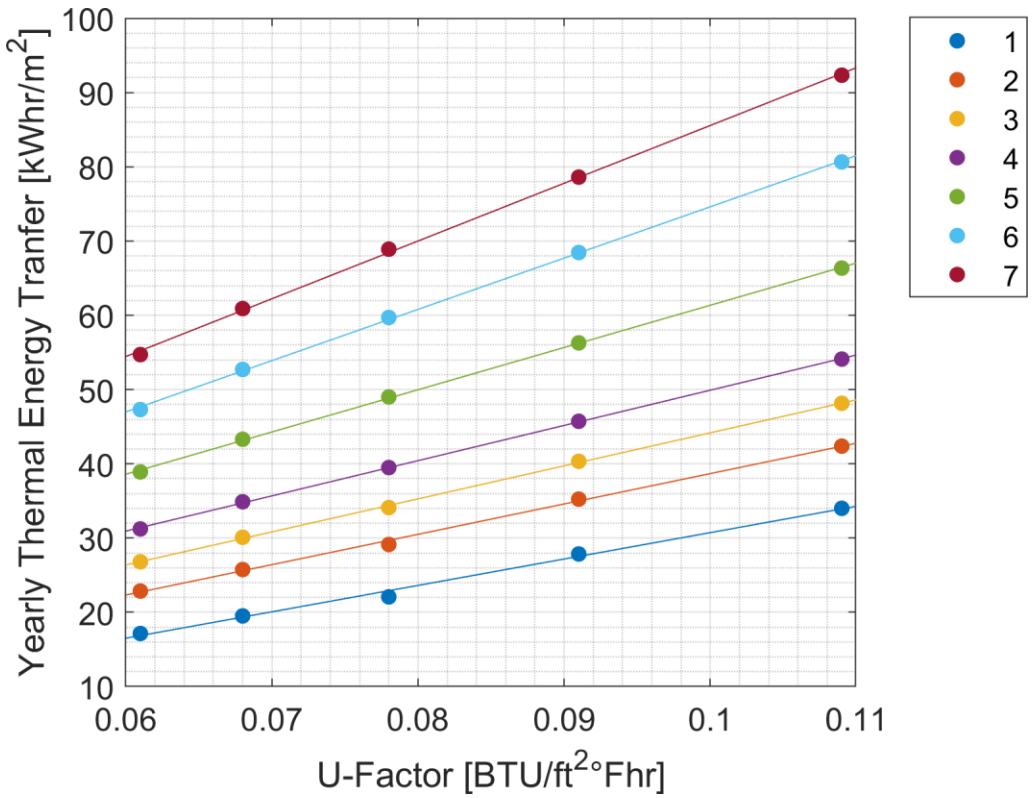


Figure 6 – Thermal Energy Transfer vs. U-factor for a Reference Wall with No Thermal Mass in Climate Zones 1-7

Table 9 – Calculated Equivalent U-factors and Equivalent R-values

Climate Zone	8x8 Insul-Block with Concrete Wall		12x8 Insul-Block with Concrete Wall	
	U_{eq}-factor – With Air Film[3]	R_{eq}-value – With Air Film	U_{eq}-factor - With Air Film	R_{eq}-value With Air Film
1	0.07195	13.90	0.05588	17.90
2	0.06363	15.71	0.04654	21.48
3	0.06257	15.98	0.04391	22.77
4	0.06987	14.31	0.04716	21.21
5	0.06836	14.63	0.04502	22.21
6	0.06873	14.55	0.04533	22.06
7	0.06902	14.49	0.04500	22.22

Table 10 – Equivalent R-value Improvement over Steady-State R-value

Climate Zone	8x8 Insul-Block with Concrete Wall	12x8 Insul-Block with Concrete Wall
1	1.32	-0.45
2	3.13	3.13
3	3.40	4.42
4	1.73	2.86
5	2.05	3.86
6	1.97	3.71
7	1.91	3.87

[3] Air film values are taken from ASHRAE handbook of fundamentals chapter 26. Interior air film resistance of R-0.68 and exterior air film resistance of R-0.17 were used.