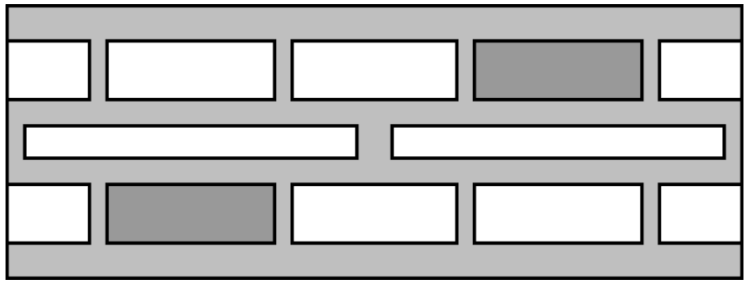
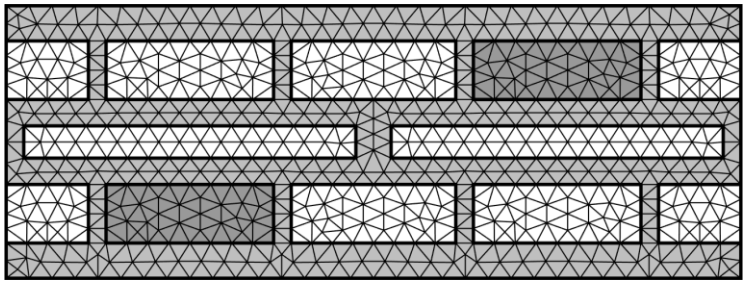
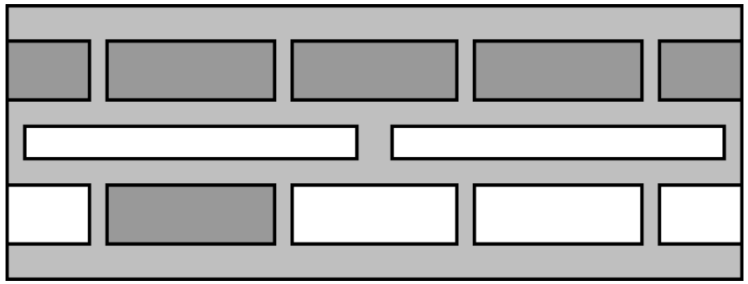
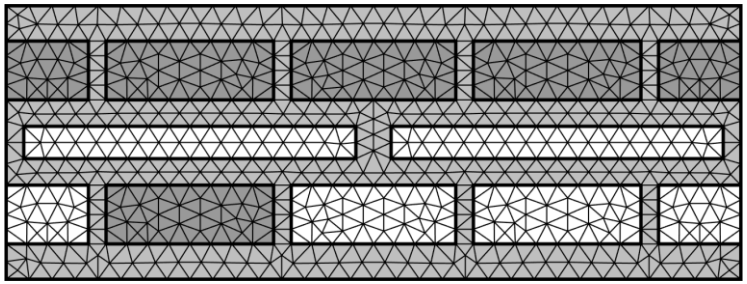
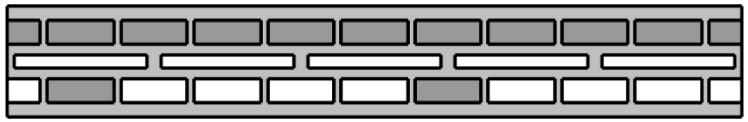
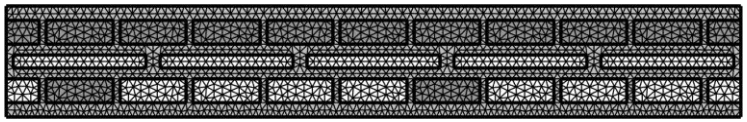
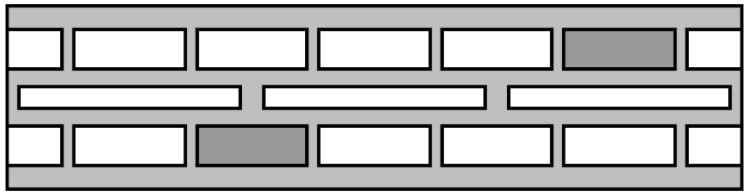
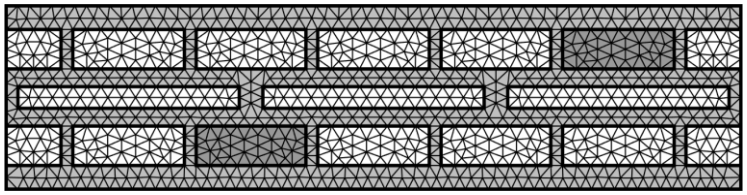
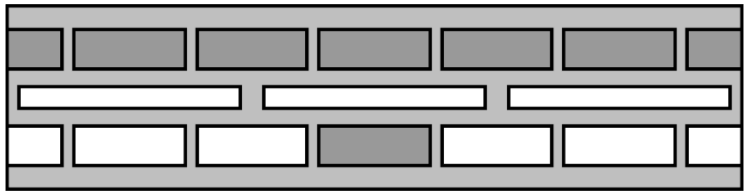
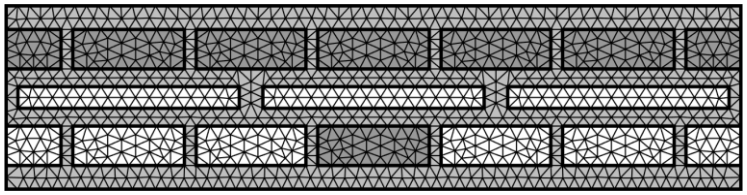
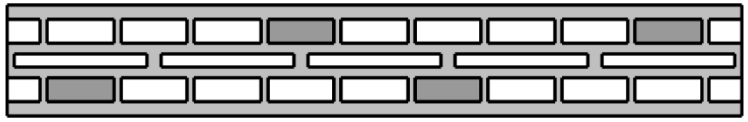
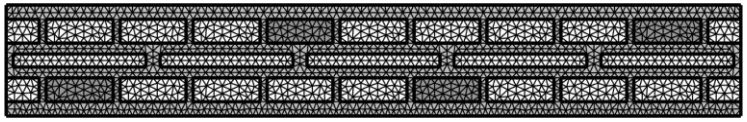
Advanced Masonry Consulting, INC Dynamic Performance Modeling

NBRC 10102

Table 1 – Model Overview

	Model	Mesh
Insul-Block Partially Grouted Configuration 1		
Insul-Block Partially Grouted Configuration 2		

Insul-Block Partially Grouted Configuration 3		
Insul-Block Partially Grouted Configuration 4		

Insul-Block Partially Grouted Configuration 5		
Insul-Block Partially Grouted Configuration 6		

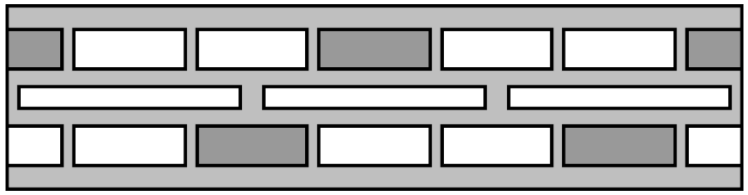
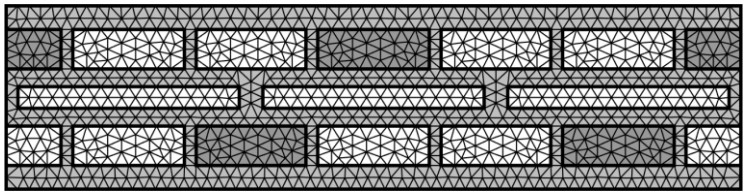
Insul-Block Partially Grouted Configuration 7		

Table 2 – Material Properties

Material	Thermal Conductivity [W/mK]	Density [kg/m^3]	Specific Heat Capacity [J/kgK]
Concrete – Mix Design	0.479[1]	1442	850
Grout – Concrete	0.532	1601	800
Type VIII EPS Cellofoam®	0.03675	19.2	1465

Table 3 –Boundary Conditions

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

[1] Data obtained from ACI 122R-02 – practical design values.

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 Transfer [kWhr/m^2]

	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5	Climate Zone 6	Climate Zone 7
Insul-Block Partially Grouted Configuration 1	22.38	24.80	28.15	36.12	43.67	53.59	61.77
Insul-Block Partially Grouted Configuration 2	29.24	32.40	36.80	47.23	57.10	70.09	80.56
Insul-Block Partially Grouted Configuration 3	30.19	33.03	37.30	47.74	57.57	70.74	81.19
Insul-Block Partially Grouted Configuration 4	18.01	22.61	27.11	35.32	43.83	53.23	62.20
Insul-Block Partially Grouted Configuration 5	23.65	29.54	35.37	46.08	57.14	69.43	80.91
Insul-Block Partially Grouted Configuration 6	20.14	23.81	27.82	36.05	44.21	53.94	62.65
Insul-Block Partially Grouted Configuration 7	21.52	27.02	32.42	42.27	52.44	63.69	74.25

Table 6 – Peak Heat Transfer [W/m^2]

	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5	Climate Zone 6	Climate Zone 7
Insul-Block Partially Grouted Configuration 1	5.60	8.88	11.1	13.5	15.3	21.5	21.8
Insul-Block Partially Grouted Configuration 2	7.4	11.7	14.7	17.9	20.0	28.1	28.4
Insul-Block Partially Grouted Configuration 3	7.6	11.8	14.9	18.1	20.3	28.4	28.7
Insul-Block Partially Grouted Configuration 4	4.5	9.0	11.0	13.2	14.8	21.1	21.3
Insul-Block Partially Grouted Configuration 5	6.0	11.9	14.5	17.4	19.3	27.5	27.7
Insul-Block Partially Grouted Configuration 6	5.1	9.1	11.2	13.5	15.2	21.5	21.8
Insul-Block Partially Grouted Configuration 7	5.4	10.9	13.3	15.9	17.7	25.2	25.4

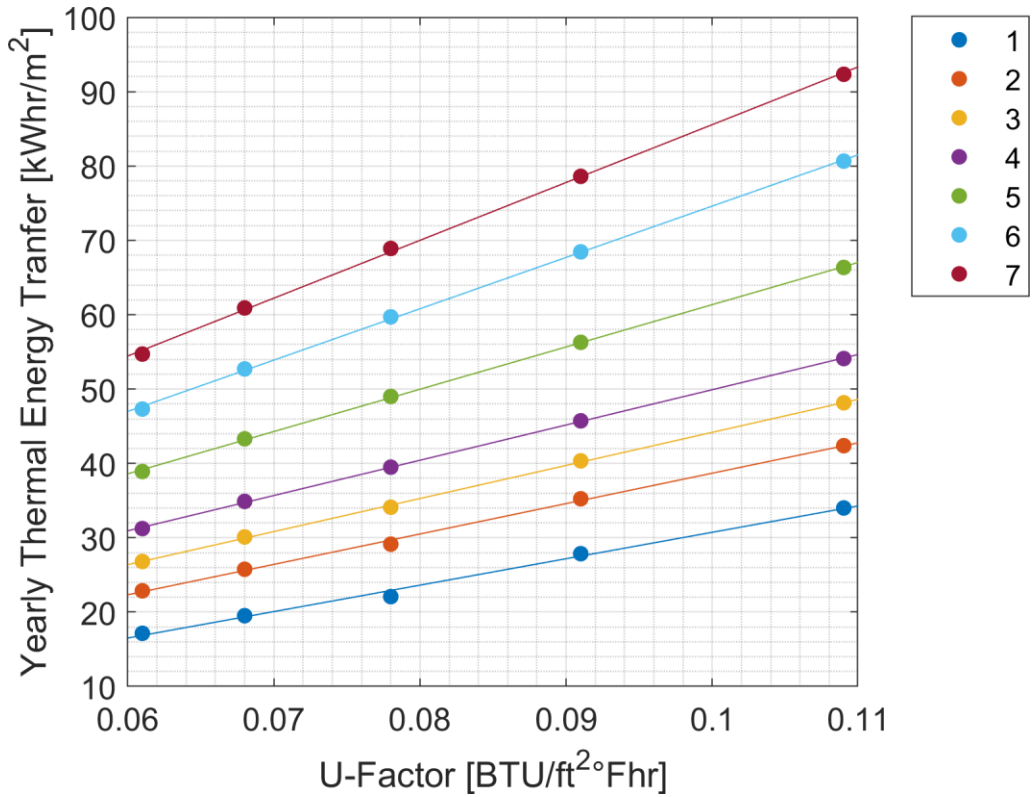


Figure 6 – Thermal Energy Transfer vs. U-factor for a Reference Wall with No Thermal Mass in Climate Zones 1-7

Table 9 – Calculated Equivalent U-factors with Air Film

	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5	Climate Zone 6	Climate Zone 7
Insul-Block Partially Grouted Configuration 1	0.07175	0.06241	0.06050	0.06679	0.06498	0.06560	0.06547
Insul-Block Partially Grouted Configuration 2	0.08859	0.07891	0.07783	0.08734	0.08575	0.08658	0.08668
Insul-Block Partially Grouted Configuration 3	0.09088	0.08026	0.07882	0.08826	0.08646	0.08739	0.08737
Insul-Block Partially Grouted Configuration 4	0.06076	0.05757	0.05838	0.06528	0.06523	0.06513	0.06596
Insul-Block Partially Grouted Configuration 5	0.07491	0.07276	0.07501	0.08525	0.08581	0.08576	0.08706
Insul-Block Partially	0.06614	0.06023	0.05983	0.06666	0.06583	0.06605	0.06648

Grouted Configuration 6							
Insul-Block Partially Grouted Configuration 7	0.06961	0.06728	0.06913	0.07826	0.07863	0.07854	0.07964

Table 9 – Calculated Equivalent R-Values with Air Film

	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5	Climate Zone 6	Climate Zone 7
Insul-Block Partially Grouted Configuration 1	13.94	16.02	16.53	14.97	15.39	15.24	15.28
Insul-Block Partially Grouted Configuration 2	11.29	12.67	12.85	11.45	11.66	11.55	11.54
Insul-Block Partially Grouted Configuration 3	11.00	12.46	12.69	11.33	11.57	11.44	11.45
Insul-Block Partially Grouted Configuration 4	16.46	17.37	17.13	15.32	15.33	15.35	15.16
Insul-Block Partially Grouted Configuration 5	13.35	13.74	13.33	11.73	11.65	11.66	11.49
Insul-Block Partially Grouted Configuration 6	15.12	16.60	16.71	15.00	15.19	15.14	15.04
Insul-Block Partially Grouted Configuration 7	14.37	14.86	14.47	12.78	12.72	12.73	12.56

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

	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5	Climate Zone 6	Climate Zone 7
Insul-Block Partially Grouted Configuration 1	0.63	2.71	3.22	1.66	2.08	1.93	1.97
Insul-Block Partially Grouted Configuration 2	1.16	2.54	2.72	1.32	1.53	1.42	1.41
Insul-Block Partially Grouted Configuration 3	0.84	2.30	2.53	1.17	1.41	1.28	1.29
Insul-Block Partially Grouted Configuration 4	2.52	3.43	3.19	1.38	1.39	1.41	1.22
Insul-Block Partially Grouted Configuration 5	2.72	3.11	2.70	1.10	1.02	1.03	0.86
Insul-Block Partially Grouted Configuration 6	1.63	3.11	3.22	1.51	1.70	1.65	1.55
Insul-Block Partially Grouted Configuration 7	2.74	3.23	2.84	1.15	1.09	1.10	0.93