

APPENDIX D. ANNUAL ENERGY SIMULATION INPUTS AND RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT

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APPENDIX D. ANNUAL ENERGY SIMULATION INPUTS AND RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT

D.1 INTRODUCTION

This appendix presents further details on annual energy simulation inputs and results discussed in chapter 7, Energy Use and End-Use Load Characterization. Section D.2 shows tables of assumptions and inputs used in annual energy simulation. Sections D.3 through D.7 present tables and figures of the simulations results for the commercial refrigeration equipment analyzed; this includes comparisons of CRE refrigeration load and daily energy consumption between the simulation results and the engineering analysis. Section D.8 summarizes the impact of different refrigeration system design options on whole building energy use. As discussed in chapter 7, the results shown in this appendix represent analysis conducted for the NOPR and do not represent analysis and results used in the final rule.

D.2 MODELED DESIGN OPTIONS AND EFFICIENCY LEVELS

Table D.2.1 Summary of Modeled Design Options for VOP.RC.M

Equipment Class		VOP.RC.M				
Efficiency Level		AD1	AD3	AD5	AD7	
Equipment Temperature (°F)		38				
Discharge Air Temperature (DAT) (°F)		32				
Saturated Evaporator Temperature (SET) (°F)		15.0	15.5	21.0	21.3	
Total Refrigeration Load (Btu/hr)		20727.2	20084.5	19958.3	19173.9	
Non-Electric Load	Infiltration Load (Btu/hr)	1338.9	1338.9	1338.9	1338.9	
	Conduction and Radiation Load (Btu/hr)	170.3	170.3	170.3	158.7	
Electric Load	Evaporator Fan	No. of Fans	6			
		Power Consumption per Fan (W)	45.0	13.6	13.6	13.6
		Fan Operating Hrs	24			
	Lighting	No. of Bulbs Inside Case	12			
		No. of Bulbs Outside Case	9			
		Power Consumption per Bulb (W)	30.1	30.1	27.8	16.4
		No. of Ballasts Inside Case	0			
		No. of Ballasts Outside Case	7			
		Power Consumption per Ballast (W)	1.4	1.4	1.7	0.0
	Defrost Heater	Defrost Mechanism	Off-time			
		Total Defrost Time per Day (hrs)	4.5			
		Defrost Heater Power (W)	0			
	Anti-Sweat Heater	Other Power (W)	0			
		Door Power (W)	0			
		Other Run Time per Day (hrs)	0			
		Door Run Time per Day (hrs)	0			

Table D.2.2 Summary of Modeled Design Options for SVO.RC.M

Equipment Class		SVO.RC.M				
Efficiency Level		AD1	AD3	AD5	AD6	
Equipment Temperature (°F)		38				
Discharge Air Temperature (DAT) (°F)		32				
Saturated Evaporator Temperature (SET) (°F)		15.0	15.4	21.0	21.3	
Total Refrigeration Load (Btu/hr)		14449.9	14021.5	13929.7	13370.7	
Non-Electric Load	Infiltration Load (Btu/hr)	918.5	918.5	918.5	918.5	
	Conduction and Radiation Load (Btu/hr)	121.7	121.7	121.7	114.2	
Electric Load	Evaporator Fan	No. of Fans	4			
		Power Consumption per Fan (W)	45.0	13.6	13.6	13.6
		Fan Operating Hrs	24			
	Lighting	No. of Bulbs Inside Case	9			
		No. of Bulbs Outside Case	6			
		Power Consumption per Bulb (W)	30.1	30.1	27.8	16.4
		No. of Ballasts Inside Case	0			
		No. of Ballasts Outside Case	5			
		Power Consumption per Ballast (W)	1.4	1.4	1.7	0.0
	Defrost Heater	Defrost Mechanism	Off-time			
		Total Defrost Time per Day (hrs)	3			
		Defrost Heater Power (W)	0			
	Anti-Sweat Heater	Other Power (W)	4.2			
		Door Power (W)	0			
		Other Run Time per Day (hrs)	24			
		Door Run Time per Day (hrs)	0			

Table D.2.3 Summary of Modeled Design Options for VCT.RC.M

Equipment Class		VCT.RC.M				
Efficiency Level		AD1	AD3	AD4	AD6	
Equipment Temperature (°F)		38				
Discharge Air Temperature (DAT) (°F)		32				
Saturated Evaporator Temperature (SET) (°F)		27.0	27.5	28.5	29.1	
Total Refrigeration Load (Btu/hr)		5506.5	5149.5	4338.6	3841.3	
Non-Electric Load	Infiltration Load (Btu/hr)	104.7	104.7	104.7	104.7	
	Conduction and Radiation Load (Btu/hr)	417.4	417.4	374.7	344.9	
Electric Load	Evaporator Fan	No. of Fans	5			
		Power Consumption per Fan (W)	30.0	9.1	9.1	9.1
		Fan Operating Hrs	24			
	Lighting	No. of Bulbs Inside Case	6			
		No. of Bulbs Outside Case	0			
		Power Consumption per Bulb (W)	58.0	58.0	58.0	41.0
		No. of Ballasts Inside Case	6			
		No. of Ballasts Outside Case	0			
		Power Consumption per Ballast (W)	0.0	0.0	0.0	0.0
	Defrost Heater	Defrost Mechanism	Off-time			
		Total Defrost Time per Day (hrs)	1			
		Defrost Heater Power (W)	0			
	Anti-Sweat Heater	Other Power (W)	0.0			
		Door Power (W)	100			
		Other Run Time per Day (hrs)	0			
		Door Run Time per Day (hrs)	24			

Table D.2.4 Summary of Modeled Design Options for HZO.RC.M

Equipment Class		HZO.RC.M				
Efficiency Level		AD1	AD2	AD3	AD4	
Equipment Temperature (°F)		38				
Discharge Air Temperature (DAT) (°F)		32				
Saturated Evaporator Temperature (SET) (°F)		15.0	15.4	15.9	21.2	
Total Refrigeration Load (Btu/hr)		6484.0	6301.1	6073.4	6073.4	
Non-Electric Load	Infiltration Load (Btu/hr)	389.2	389.2	389.2	389.2	
	Conduction and Radiation Load (Btu/hr)	99.7	99.7	99.7	99.7	
Electric Load	Evaporator Fan	No. of Fans	4			
		Power Consumption per Fan (W)	45.0	31.0	13.6	13.6
		Fan Operating Hrs	23			
	Lighting	No. of Bulbs Inside Case	0			
		No. of Bulbs Outside Case	0			
		Power Consumption per Bulb (W)	0.0	0.0	0.0	0.0
		No. of Ballasts Inside Case	0			
		No. of Ballasts Outside Case	0			
		Power Consumption per Ballast (W)	0.0	0.0	0.0	0.0
	Defrost Heater	Defrost Mechanism	Electric			
		Total Defrost Time per Day (hrs)	1			
		Defrost Heater Power (W)	1000			
	Anti-Sweat Heater	Other Power (W)	4.2			
		Door Power (W)	0			
		Other Run Time per Day (hrs)	24			
		Door Run Time per Day (hrs)	0			

Table D.2.5 Summary of Modeled Design Options for SOC.RC.M

Equipment Class		SOC.RC.M				
Efficiency Level		AD1	AD3	AD4	AD8	
Equipment Temperature (°F)		38				
Discharge Air Temperature (DAT) (°F)		32				
Saturated Evaporator Temperature (SET) (°F)		20.0	21.0	21.3	27.2	
Total Refrigeration Load (Btu/hr)		5279.2	4872.2	4757.4	3805.0	
Non-Electric Load	Infiltration Load (Btu/hr)	22.3	22.3	22.3	22.3	
	Conduction and Radiation Load (Btu/hr)	179.1	179.1	179.1	148.6	
Electric Load	Evaporator Fan	No. of Fans	4			
		Power Consumption per Fan (W)	45.0	13.6	13.6	13.6
		Fan Operating Hrs	22.8			
	Lighting	No. of Bulbs Inside Case	15			
		No. of Bulbs Outside Case	0			
		Power Consumption per Bulb (W)	30.1	30.1	27.8	16.4
		No. of Ballasts Inside Case	0			
		No. of Ballasts Outside Case	5			
		Power Consumption per Ballast (W)	1.4	1.4	1.7	0.0
	Defrost Heater	Defrost Mechanism	Electric			
		Total Defrost Time per Day (hrs)	1.2			
		Defrost Heater Power (W)	1600			
	Anti-Sweat Heater	Other Power (W)	16.7			
		Door Power (W)	0			
		Other Run Time per Day (hrs)	24			
		Door Run Time per Day (hrs)	0			

Table D.2.6 Summary of Modeled Design Options for VOP.RC.L

Equipment Class		VOP.RC.L				
Efficiency Level		AD1	AD3	AD4	AD6	
Equipment Temperature (°F)		38				
Discharge Air Temperature (DAT) (°F)		32				
Saturated Evaporator Temperature (SET) (°F)		-20.0	-19.2	-14.2	-14.0	
Total Refrigeration Load (Btu/hr)		24402.5	23027.9	22993.5	22624.5	
Non-Electric Load	Infiltration Load (Btu/hr)	1303.5	1303.5	1303.5	1303.5	
	Conduction and Radiation Load (Btu/hr)	252.8	252.8	252.8	236.7	
Electric Load	Evaporator Fan	No. of Fans	14			
		Power Consumption per Fan (W)	45.0	13.6	13.6	13.6
		Fan Operating Hrs	22			
	Lighting	No. of Bulbs Inside Case	0			
		No. of Bulbs Outside Case	9			
		Power Consumption per Bulb (W)	30.1	30.1	27.8	16.4
		No. of Ballasts Inside Case	0			
		No. of Ballasts Outside Case	3			
		Power Consumption per Ballast (W)	1.4	1.4	1.7	0.0
	Defrost Heater	Defrost Mechanism	Electric			
		Total Defrost Time per Day (hrs)	2			
		Defrost Heater Power (W)	8700			
	Anti-Sweat Heater	Other Power (W)	50.0			
		Door Power (W)	0			
		Other Run Time per Day (hrs)	24			
		Door Run Time per Day (hrs)	0			

Table D.2.7 Summary of Modeled Design Options for VCT.RC.L

Equipment Class		VCT.RC.L				
Efficiency Level		AD1	AD3	AD5	AD7	
Equipment Temperature (°F)		38				
Discharge Air Temperature (DAT) (°F)		32				
Saturated Evaporator Temperature (SET) (°F)		-11.0	-10.7	-8.6	-8.2	
Total Refrigeration Load (Btu/hr)		9282.9	8940.8	6499.8	5976.6	
Non-Electric Load	Infiltration Load (Btu/hr)	173.1	173.1	173.1	173.1	
	Conduction and Radiation Load (Btu/hr)	734.2	734.2	461.1	426.1	
Electric Load	Evaporator Fan	No. of Fans	5			
		Power Consumption per Fan (W)	30.0	9.1	9.1	9.1
		Fan Operating Hrs	23			
	Lighting	No. of Bulbs Inside Case	6			
		No. of Bulbs Outside Case	0			
		Power Consumption per Bulb (W)	58.0	58.0	58.0	41.0
		No. of Ballasts Inside Case	6			
		No. of Ballasts Outside Case	0			
		Power Consumption per Ballast (W)	0.0	0.0	0.0	0.0
	Defrost Heater	Defrost Mechanism	Electric			
		Total Defrost Time per Day (hrs)	1			
		Defrost Heater Power (W)	5000			
	Anti-Sweat Heater	Other Power (W)	0.0			
		Door Power (W)	200			
		Other Run Time per Day (hrs)	0			
		Door Run Time per Day (hrs)	24			

Table D.2.8 DOE-2.2R Input Parameters for Modeled Display Cases

Equipment Class	Efficiency Levels	SET (°F)	Temperature Difference between SET and DAT (°F)	Infiltration (Btu/hr-ft)*	Conduction & Radiation (Btu/hr-ft)*	Evaporator Fan (kW/ft)*	Lighting (kW/ft)*	Ratio of Lighting Load to HVAC Zone	Anti-Sweat (kW/ft)*
VOP.RC.M	AD1	15.0	10.0	1,338.9	170.3	0.0225	0.0535	0.23	0
	AD3	15.5	9.5	1,338.9	170.3	0.0068	0.0535	0.23	0
	AD5	21.0	4.0	1,338.9	170.3	0.0068	0.0497	0.23	0
	AD7	21.3	3.7	1,338.9	158.7	0.0068	0.0287	0.21	0
SVO.RC.M	AD1	15.0	10.0	918.5	121.7	0.0150	0.0382	0.21	0.0042
	AD3	15.4	9.6	918.5	121.7	0.0045	0.0382	0.21	0.0042
	AD5	21.0	4.0	918.5	121.7	0.0045	0.0355	0.22	0.0042
	AD6	21.3	3.7	918.5	114.2	0.0045	0.0205	0.20	0.0042
VCT.RC.M	AD1	27.0	5.0	104.7	417.4	0.0300	0.0696	0.00	0.1000
	AD3	27.5	4.5	104.7	417.4	0.0091	0.0696	0.00	0.1000
	AD4	28.5	3.5	104.7	374.7	0.0091	0.0696	0.00	0.0500
	AD6	29.1	2.9	104.7	344.9	0.0091	0.0492	0.00	0.0500
HZO.RC.M	AD1	15.0	10.0	389.2	99.7	0.0150	0	0.00	0.0042
	AD2	15.4	9.6	389.2	99.7	0.0103	0	0.00	0.0042
	AD3	15.9	9.1	389.2	99.7	0.0045	0	0.00	0.0042
	AD4	21.2	3.8	389.2	99.7	0.0045	0	0.00	0.0042
SOC.RC.M	AD1	20.0	10.0	22.3	179.1	0.0150	0.0382	0.02	0.0167
	AD3	21.0	9.0	22.3	179.1	0.0045	0.0382	0.02	0.0167
	AD4	21.3	8.7	22.3	179.1	0.0045	0.0355	0.02	0.0167
	AD8	27.2	2.8	22.3	148.6	0.0045	0.0205	0.00	0.0167
VOP.RC.L	AD1	-20.0	10.0	1,303.5	252.8	0.0525	0.0229	0.51	0.0500
	AD3	-19.2	9.2	1,303.5	252.8	0.0159	0.0229	0.51	0.0500
	AD5	-14.2	4.2	1,303.5	252.8	0.0159	0.0213	0.51	0.0500
	AD7	-14.0	4.0	1,303.5	236.7	0.0159	0.0123	0.50	0.0500
VCT.RC.L	AD1	-11.0	6.0	173.1	734.2	0.0300	0.0696	0.00	0.2000
	AD3	-10.7	5.7	173.1	734.2	0.0091	0.0696	0.00	0.2000
	AD4	-8.6	3.6	173.1	461.1	0.0091	0.0696	0.00	0.1100
	AD6	-8.2	3.2	173.1	426.1	0.0091	0.0492	0.00	0.1100

* For display cases with doors, unit is Btu/hr-door or kW/door.

D.3 TABLES OF ANNUAL ENERGY SIMULATION RESULTS AND ENGINEERING ANALYSIS

Table D.3.1 Comparison of Annual Energy Simulation and Engineering Analysis for VOP.RC.M

Efficiency Level	Location	Annual Simulation Results			Engineering Analysis Results		
		Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)	Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)
AD1	Baltimore	14,368	21.9	33.8	20,727	21.9	36.0
	Chicago	13,970		32.0			
	Houston	16,095		42.0			
	Los Angeles	14,749		31.8			
	Memphis	15,080		38.0			
AD3	Baltimore	13,740	17.4	32.1	20,085	17.4	34.6
	Chicago	13,341		30.2			
	Houston	15,465		40.0			
	Los Angeles	14,117		30.2			
	Memphis	14,453		36.3			
AD5	Baltimore	13,642	16.3	28.5	19,958	16.3	31.4
	Chicago	13,245		26.9			
	Houston	15,374		35.9			
	Los Angeles	14,021		26.9			
	Memphis	14,356		32.3			
AD7	Baltimore	12,898	10.2	26.9	19,174	10.2	30.0
	Chicago	12,500		25.1			
	Houston	14,628		34.0			
	Los Angeles	13,271		25.3			
	Memphis	13,610		30.5			

Table D.3.2 Comparison of Annual Energy Simulation and Engineering Analysis for SVO.RC.M

Efficiency Level	Location	Annual Simulation Results			Engineering Analysis Results		
		Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)	Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)
AD1	Baltimore	10,160	16.5	24.8	14,450	16.5	27.0
	Chicago	9,876		23.1			
	Houston	11,391		30.8			
	Los Angeles	10,437		23.8			
	Memphis	10,669		27.8			
AD3	Baltimore	9,742	13.5	23.6	14,021	13.5	26.1
	Chicago	9,459		22.0			
	Houston	10,970		29.5			
	Los Angeles	10,018		22.6			
	Memphis	10,248		26.6			
AD5	Baltimore	9,672	12.7	21.0	13,930	12.7	23.6
	Chicago	9,388		19.6			
	Houston	10,910		26.5			
	Los Angeles	9,946		20.0			
	Memphis	10,181		23.7			
AD6	Baltimore	9,142	8.4	19.8	13,371	8.4	22.6
	Chicago	8,858		18.4			
	Houston	10,375		25.1			
	Los Angeles	9,413		18.9			
	Memphis	9,648		22.4			

Table D.3.3 Comparison of Annual Energy Simulation and Engineering Analysis for VCT.RC.M

Efficiency Level	Location	Annual Simulation Results			Engineering Analysis Results		
		Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)	Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)
AD1	Baltimore	5,063	24.0	9.6	5,507	24.0	9.2
	Chicago	5,040		9.0			
	Houston	5,148		10.7			
	Los Angeles	5,074		8.8			
	Memphis	5,103		10.1			
AD3	Baltimore	4,703	21.4	8.8	5,149	21.4	8.6
	Chicago	4,686		8.6			
	Houston	4,789		9.9			
	Los Angeles	4,715		7.9			
	Memphis	4,743		9.3			
AD4	Baltimore	3,927	15.4	7.3	4,339	15.4	7.1
	Chicago	3,898		6.9			
	Houston	4,007		8.2			
	Los Angeles	3,938		6.7			
	Memphis	3,967		7.7			
AD6	Baltimore	3,447	13.0	6.3	3,841	12.5	6.2
	Chicago	3,425		6.1			
	Houston	3,527		7.1			
	Los Angeles	3,459		5.7			
	Memphis	3,487		6.7			

Table D.3.4 Comparison of Annual Energy Simulation and Engineering Analysis for HZO.RC.M

Efficiency Level	Location	Annual Simulation Results			Engineering Analysis Results		
		Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)	Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)
AD1	Baltimore	4,966	6.4	12.1	6,484	6.3	13.3
	Chicago	4,829		11.3			
	Houston	5,542		15.4			
	Los Angeles	5,097		11.6			
	Memphis	5,205		13.7			
AD2	Baltimore	4,777	5.1	11.6	6,301	5.1	12.8
	Chicago	4,646		10.8			
	Houston	5,354		14.7			
	Los Angeles	4,909		11.1			
	Memphis	5,017		13.1			
AD3	Baltimore	4,566	3.6	11.0	6,073	3.5	12.3
	Chicago	4,435		10.2			
	Houston	5,137		14.0			
	Los Angeles	4,703		10.5			
	Memphis	4,800		12.5			
AD4	Baltimore	4,555	3.5	9.9	6,073	3.5	11.2
	Chicago	4,424		9.2			
	Houston	5,137		12.6			
	Los Angeles	4,686		9.3			
	Memphis	4,795		11.2			

Table D.3.5 Comparison of Annual Energy Simulation and Engineering Analysis for SOC.RC.M

Efficiency Level	Location	Annual Simulation Results			Engineering Analysis Results		
		Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)	Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)
AD1	Baltimore	4,932	21.8	10.9	5,279	21.8	9.9
	Chicago	4,914		10.0			
	Houston	4,994		12.0			
	Los Angeles	4,937		9.4			
	Memphis	4,960		11.4			
AD3	Baltimore	4,503	19.0	9.7	4,872	19.0	9.0
	Chicago	4,492		9.1			
	Houston	4,566		10.7			
	Los Angeles	4,521		8.6			
	Memphis	4,538		10.1			
AD4	Baltimore	4,395	18.2	9.4	4,757	18.2	8.7
	Chicago	4,378		8.9			
	Houston	4,452		10.3			
	Los Angeles	4,406		8.5			
	Memphis	4,424		9.9			
AD8	Baltimore	3,487	13.9	6.6	3,805	13.9	6.3
	Chicago	3,476		6.3			
	Houston	3,539		7.3			
	Los Angeles	3,499		6.0			
	Memphis	3,516		7.0			

Table D.3.6 Comparison of Annual Energy Simulation and Engineering Analysis for VOP.RC.L

Efficiency Level	Location	Annual Simulation Results			Engineering Analysis Results		
		Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)	Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)
AD1	Baltimore	20,953	52.3	89.8	24,403	52.3	81.3
	Chicago	20,696		85.9			
	Houston	22,129		101.4			
	Los Angeles	21,290		85.4			
	Memphis	21,461		96.0			
AD3	Baltimore	19,492	42.6	82.3	23,028	42.6	75.8
	Chicago	19,229		78.7			
	Houston	20,662		93.3			
	Los Angeles	19,823		78.4			
	Memphis	19,994		88.2			
AD5	Baltimore	19,475	42.1	74.4	22,993	42.1	70.6
	Chicago	19,218		71.2			
	Houston	20,651		85.0			
	Los Angeles	19,834		70.8			
	Memphis	19,989		79.8			
AD7	Baltimore	19,121	39.6	72.9	22,625	39.5	69.2
	Chicago	18,858		69.8			
	Houston	20,297		83.3			
	Los Angeles	19,475		69.5			
	Memphis	19,629		78.1			

Table D.3.7 Comparison of Annual Energy Simulation and Engineering Analysis for VCT.RC.L

Efficiency Level	Location	Annual Simulation Results			Engineering Analysis Results		
		Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)	Case Refrigeration Load (Btu/hr)	Case Daily Direct Electric Use (kWh/day)	Compressor Daily Energy Use (kWh/day)
AD1	Baltimore	8,781	40.8	31.1	9,283	40.8	28.5
	Chicago	8,754		29.6			
	Houston	8,851		33.8			
	Los Angeles	8,771		28.8			
	Memphis	8,816		32.6			
AD3	Baltimore	8,429	38.4	29.7	8,941	38.4	27.3
	Chicago	8,402		28.3			
	Houston	8,507		32.4			
	Los Angeles	8,424		27.4			
	Memphis	8,462		31.4			
AD4	Baltimore	6,030	27.6	20.5	6,500	27.6	19.3
	Chicago	6,003		19.5			
	Houston	6,094		22.3			
	Los Angeles	6,030		18.7			
	Memphis	6,061		21.6			
AD6	Baltimore	5,501	25.2	18.6	5,977	24.7	17.7
	Chicago	5,479		17.7			
	Houston	5,568		20.2			
	Los Angeles	5,509		16.8			
	Memphis	5,532		19.6			

Table D.3.8 Comparison of Daily Energy Savings from Annual Simulation and from Engineering Analysis

Equipment Class Symbol	Efficiency Level	Annual Simulation Results (kWh/day)					Engineering Analysis Results (kWh/day)
		Baltimore	Chicago	Houston	Los Angeles	Memphis	
VOP.RC.M	AD3	6.3	6.3	6.5	6.1	6.2	5.9
	AD5	10.9	10.7	11.7	10.5	11.2	10.2
	AD7	18.6	18.5	19.7	18.1	19.1	17.6
SVO.RC.M	AD3	4.2	4.2	4.4	4.2	4.2	4.0
	AD5	7.5	7.4	8.2	7.6	7.8	7.2
	AD6	13.1	12.9	13.9	13.0	13.5	12.6
VCT.RC.M	AD3	3.3	3.5	3.3	3.4	3.3	3.2
	AD4	10.8	10.9	11.0	10.6	10.9	10.6
	AD6	14.3	14.1	14.5	14.1	14.4	14.5
HZO.RC.M	AD2	1.8	1.8	1.9	1.8	1.9	1.7
	AD3	4.1	4.0	4.2	4.0	4.1	3.9
	AD4	5.2	5.1	5.7	5.2	5.4	4.9
SOC.RC.M	AD3	4.1	3.7	4.2	3.7	4.2	3.8
	AD4	5.1	4.7	5.3	4.6	5.1	4.8
	AD8	12.3	11.6	12.7	11.4	12.4	11.5
VOP.RC.L	AD3	17.1	16.9	17.7	16.7	17.5	15.2
	AD5	25.5	24.8	26.5	24.6	26.4	20.9
	AD7	29.6	28.9	30.8	28.6	30.6	24.8
VCT.RC.L	AD3	3.8	3.8	3.8	3.8	3.6	3.6
	AD4	23.8	23.4	24.7	23.3	24.2	22.4
	AD6	28.2	27.6	29.3	27.7	28.7	27.0

D.4 COMPARISON OF CASE REFRIGERATION LOAD BETWEEN SIMULATION AND ENGINEERING ANALYSIS

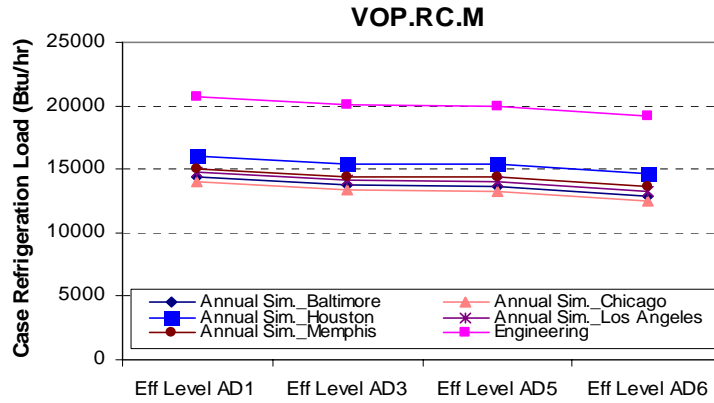


Figure D.4.1 Case Refrigeration Load for VOP.RC.M

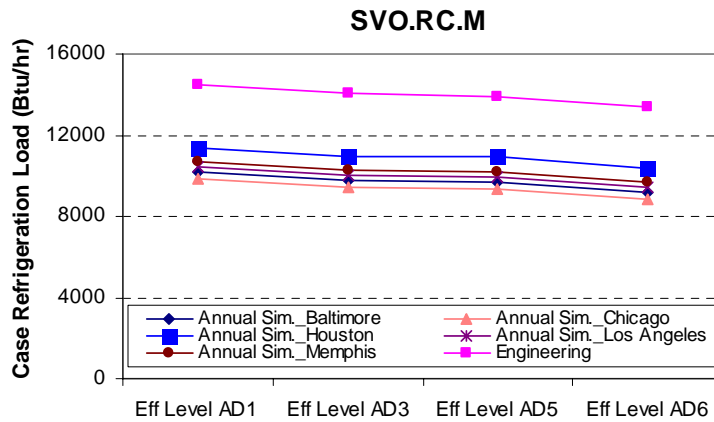


Figure D.4.2 Case Refrigeration Load for SVO.RC.M

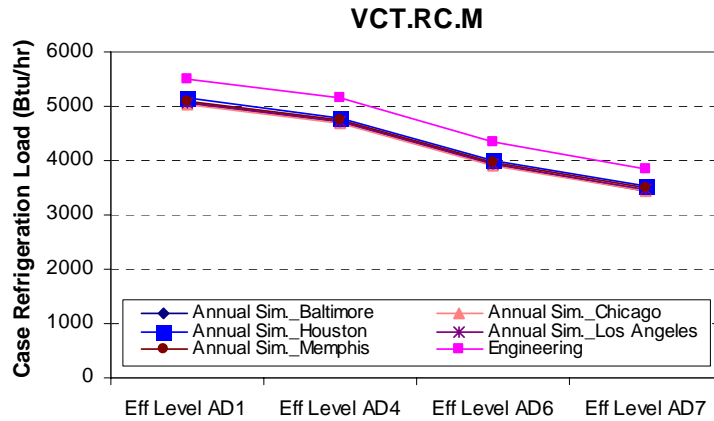


Figure D.4.3 Case Refrigeration Load for VCT.RC.M

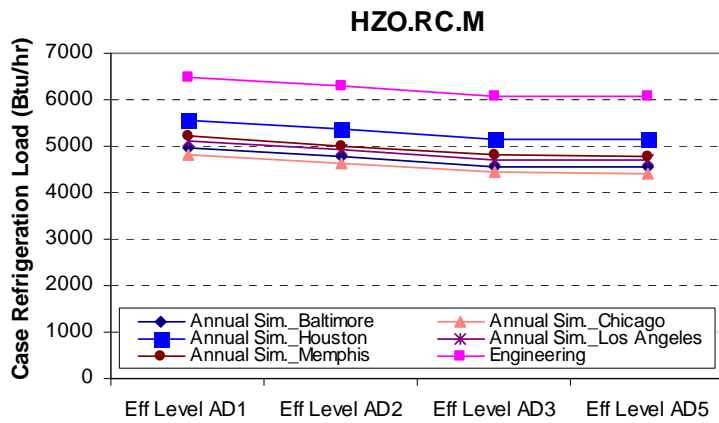


Figure D.4.4 Case Refrigeration Load for HZO.RC.M

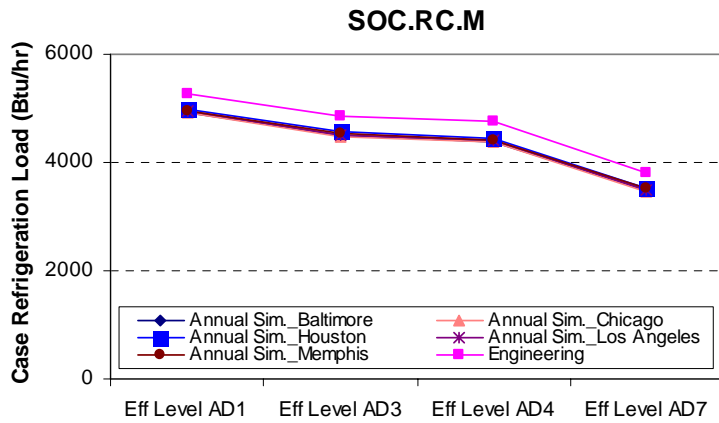


Figure D.4.5 Case Refrigeration Load for SOC.RC.M

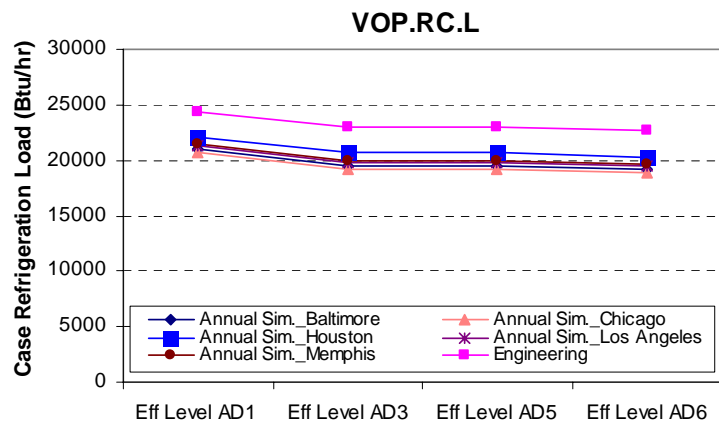


Figure D.4.6 Case Refrigeration Load for VOP.RC.L

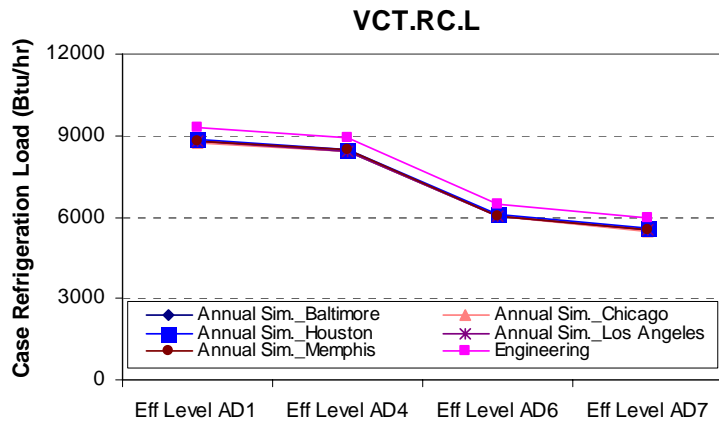


Figure D.4.7 Case Refrigeration Load for VCT.RC.L

D.5 DAILY ENERGY CONSUMPTION FOR BASELINE EFFICIENCY FOR FIVE CLIMATE LOCATIONS

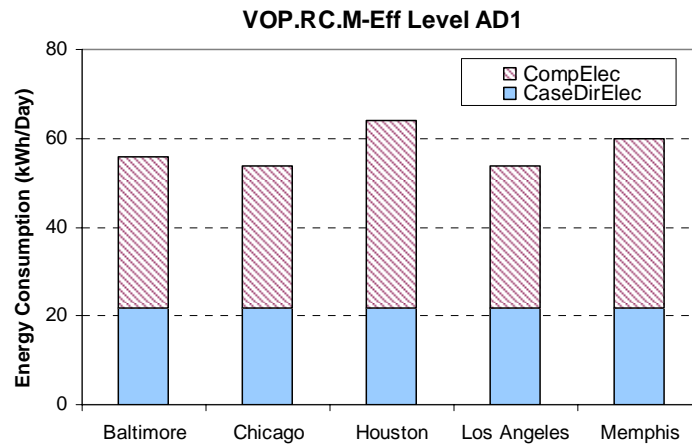


Figure D.5.1 Daily Energy Consumption for Baseline Efficiency for VOP.RC.M

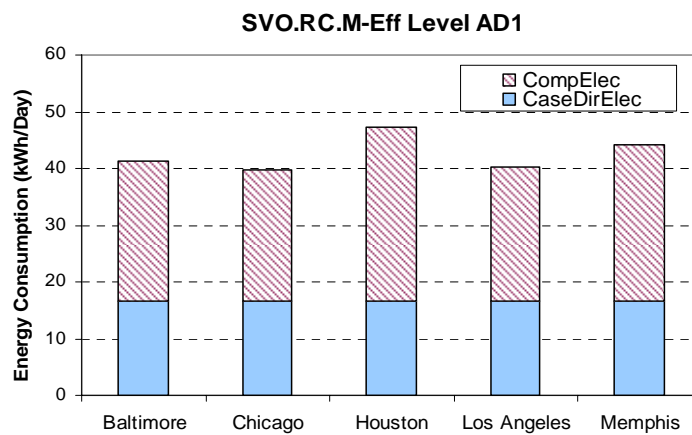


Figure D.5.2 Daily Energy Consumption for Baseline Efficiency for SVO.RC.M

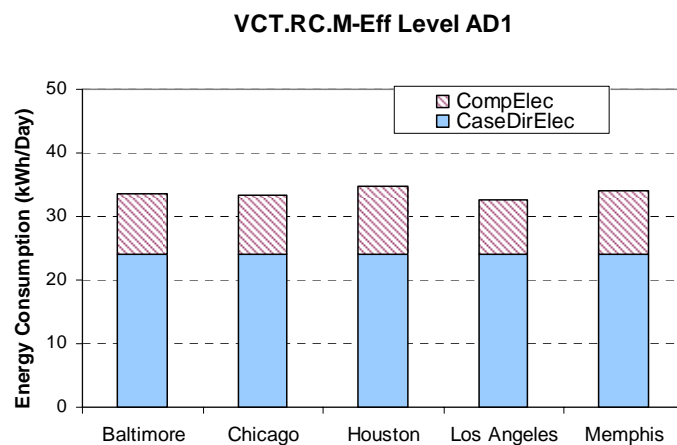


Figure D.5.3 Daily Energy Consumption for Baseline Efficiency for VCT.RC.M

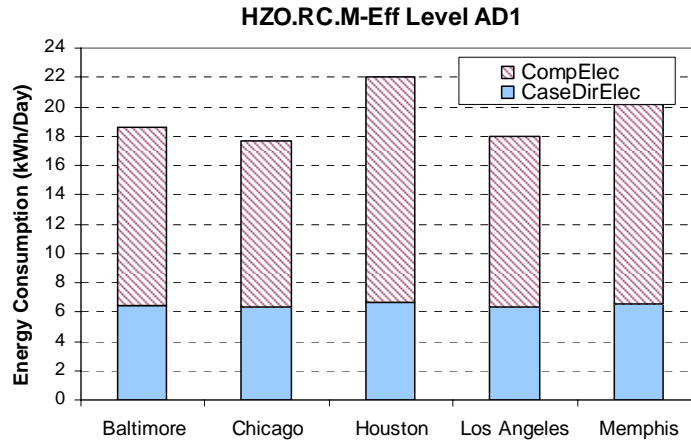


Figure D.5.4 Daily Energy Consumption for Baseline Efficiency for HZO.RC.M

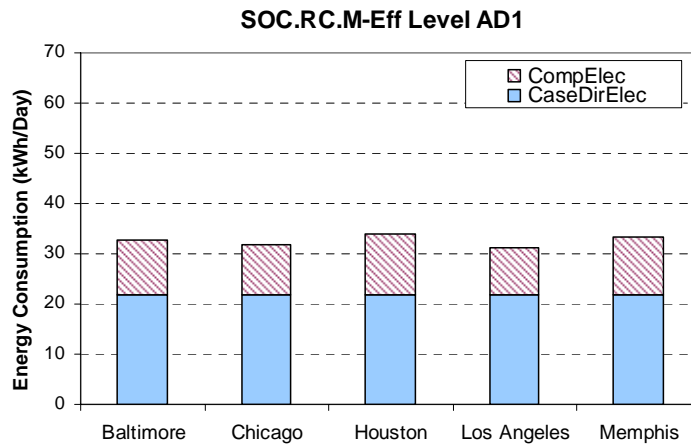


Figure D.5.5 Daily Energy Consumption for Baseline Efficiency for SOC.RC.M

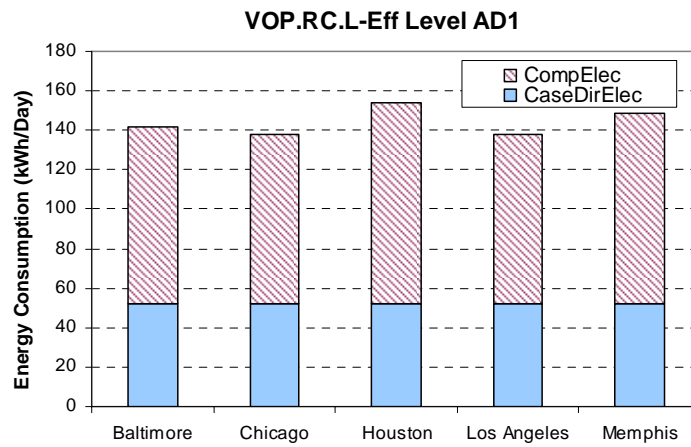


Figure D.5.6 Daily Energy Consumption for Baseline Efficiency for VOP.RC.L

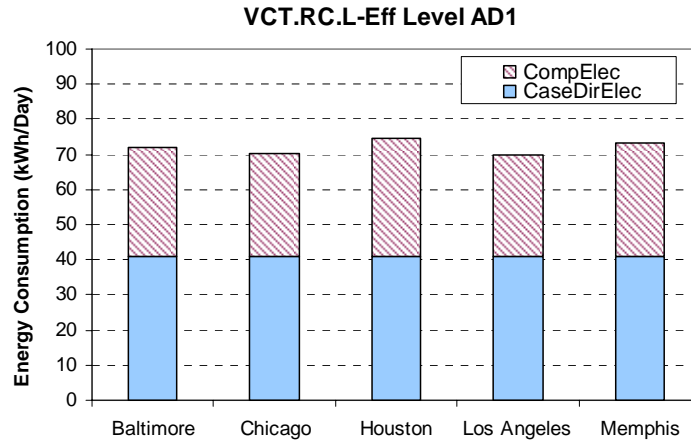


Figure D.5.7 Daily Energy Consumption for Baseline Efficiency for VCT.RC.L

D.6 COMPARISON OF DAILY ENERGY CONSUMPTION BETWEEN SIMULATION RESULTS AND ENGINEERING ANALYSIS

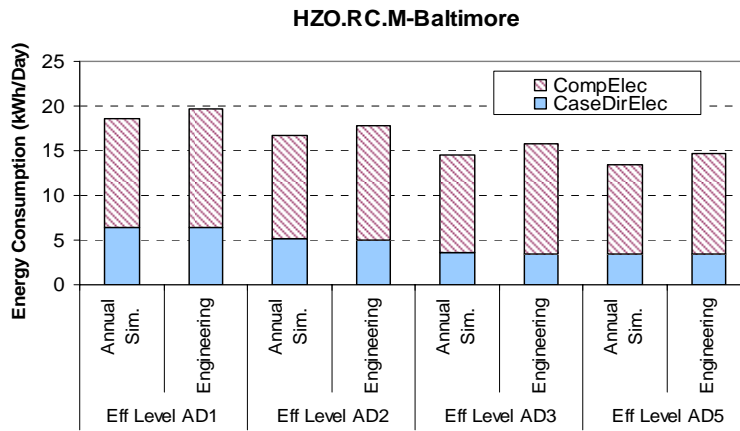


Figure D.6.1 Daily Energy Consumption for VOP.RC.M for Baltimore

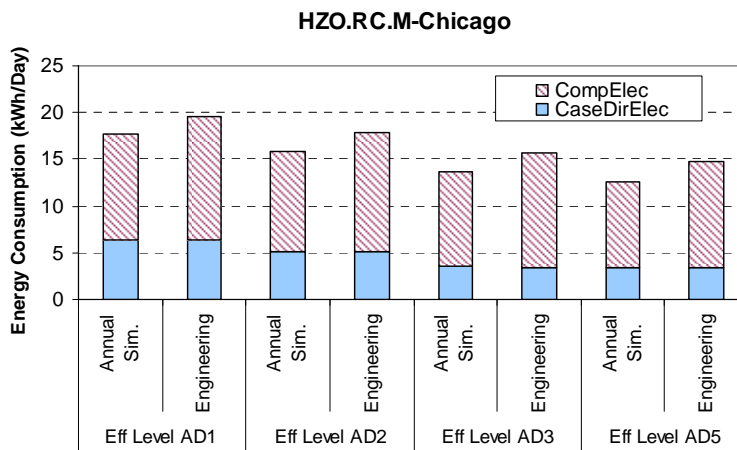


Figure D.6.2 Daily Energy Consumption for VOP.RC.M for Chicago

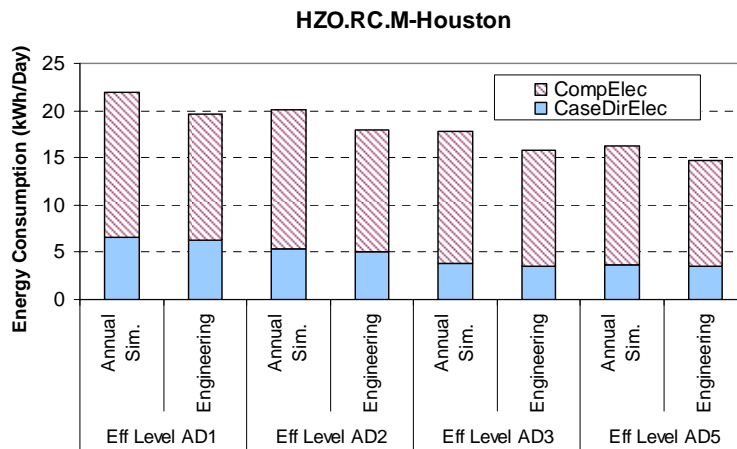


Figure D.6.3 Daily Energy Consumption for VOP.RC.M for Houston

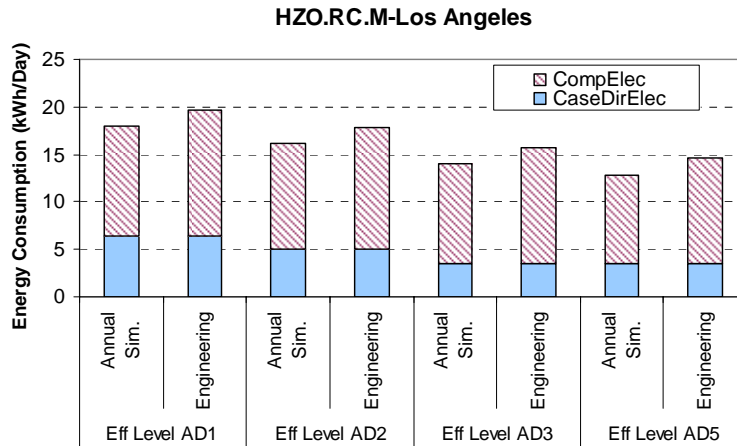


Figure D.6.4 Daily Energy Consumption for VOP.RC.M for Los Angeles

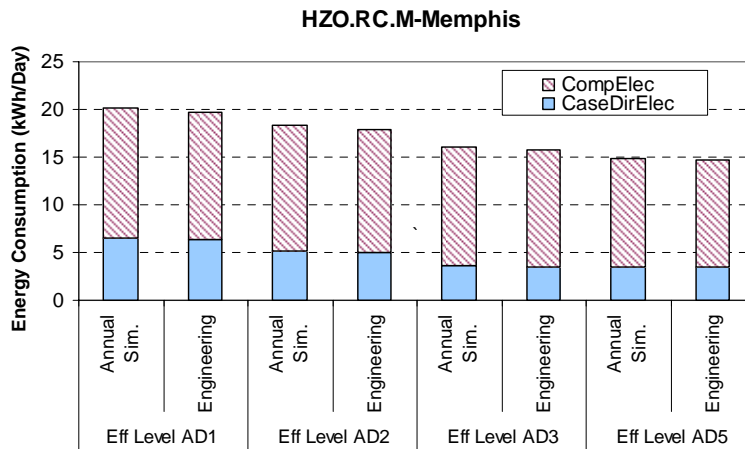


Figure D.6.5 Daily Energy Consumption for VOP.RC.M for Memphis

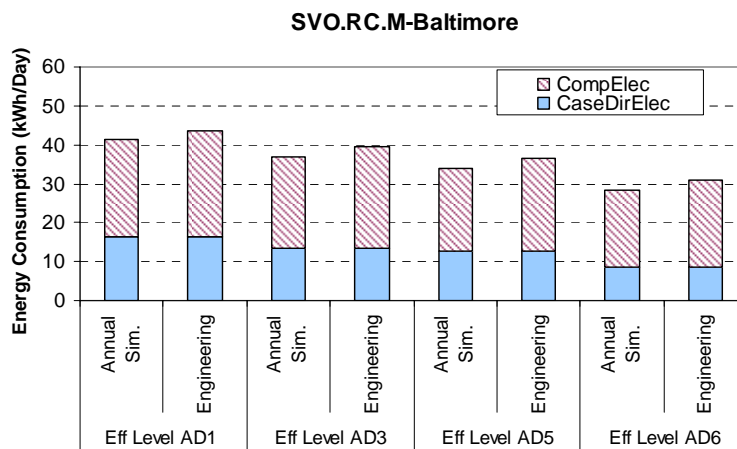


Figure D.6.6 Daily Energy Consumption for SVO.RC.M for Baltimore

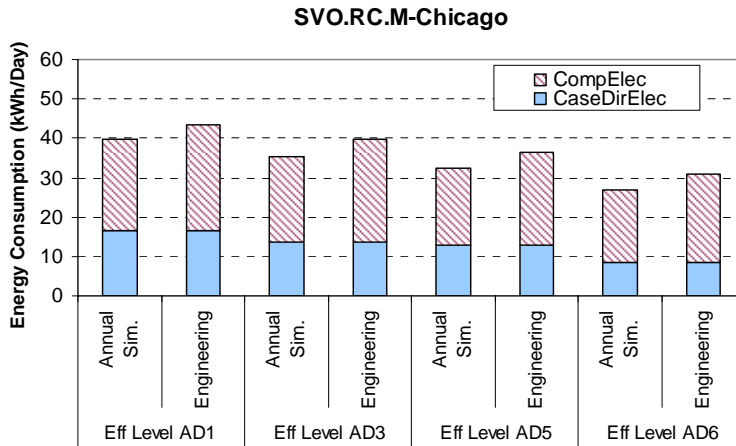


Figure D.6.7 Daily Energy Consumption for SVO.RC.M for Chicago

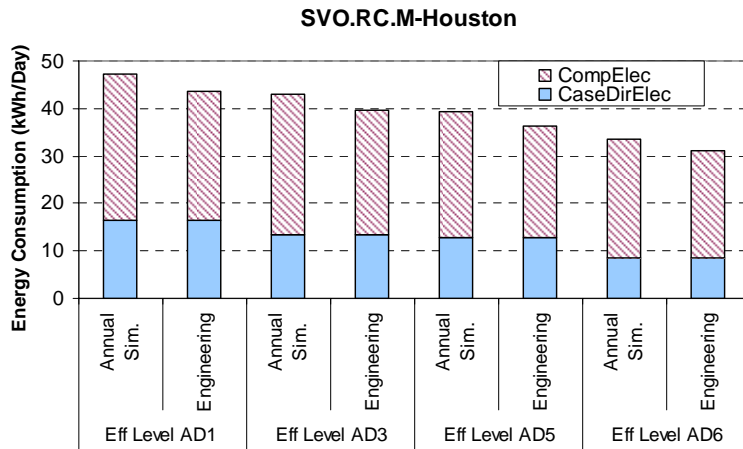


Figure D.6.8 Daily Energy Consumption for SVO.RC.M for Houston

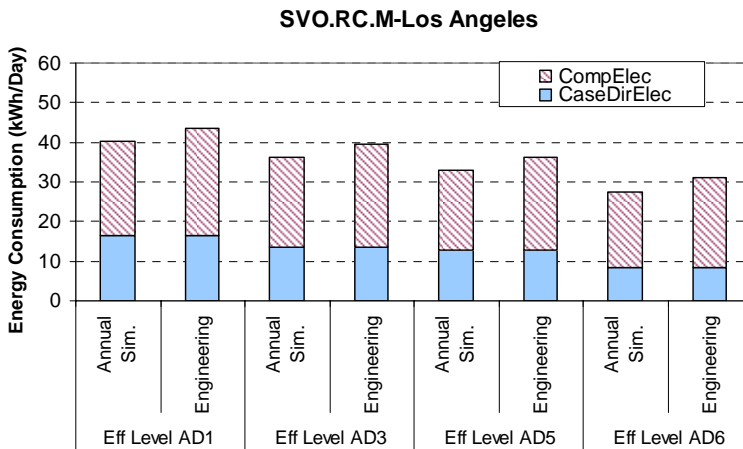


Figure D.6.9 Daily Energy Consumption for SVO.RC.M for Los Angeles

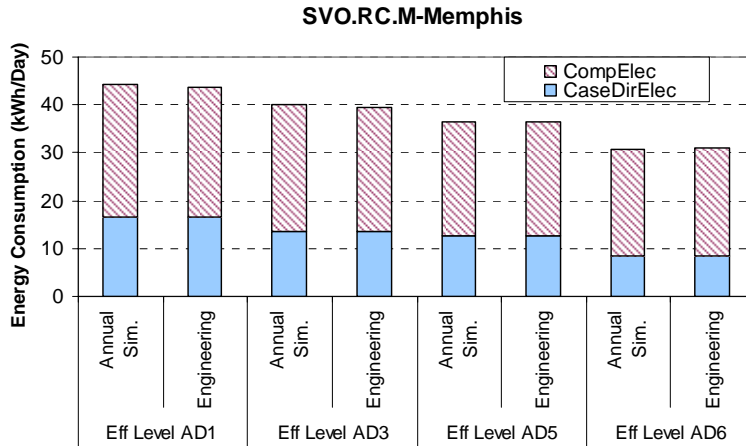


Figure D.6.10 Daily Energy Consumption for SVO.RC.M for Memphis

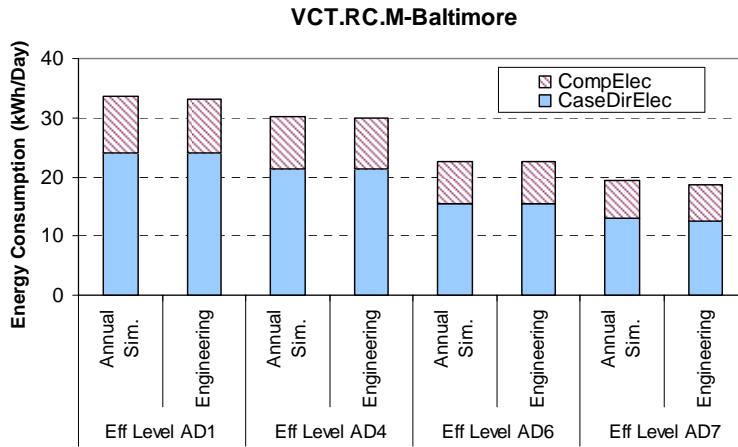


Figure D.6.11 Daily Energy Consumption for VCT.RC.M for Baltimore

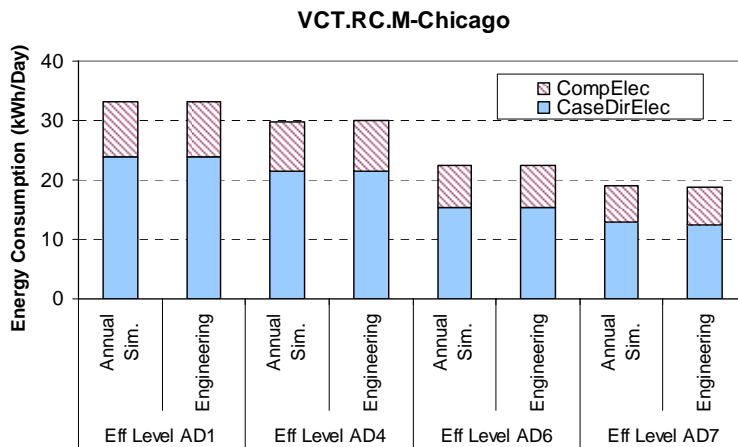


Figure D.6.12 Daily Energy Consumption for VCT.RC.M for Chicago

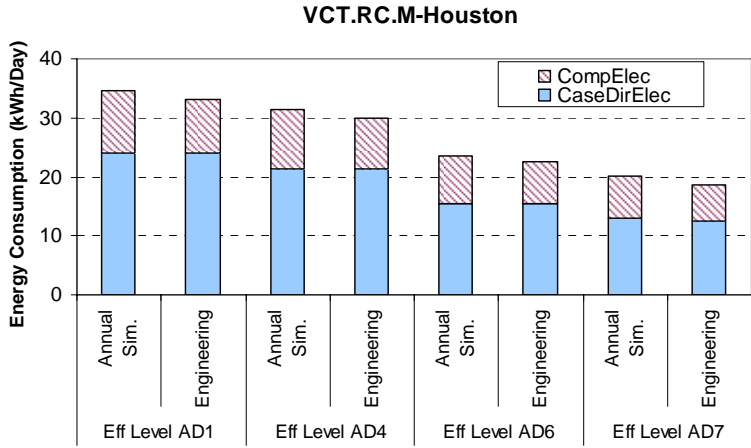


Figure D.6.13 Daily Energy Consumption for VCT.RC.M for Houston

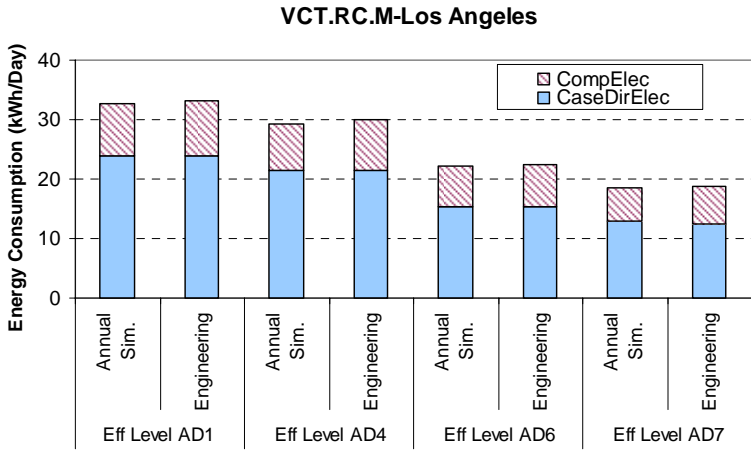


Figure D.6.14 Daily Energy Consumption for VCT.RC.M for Los Angeles

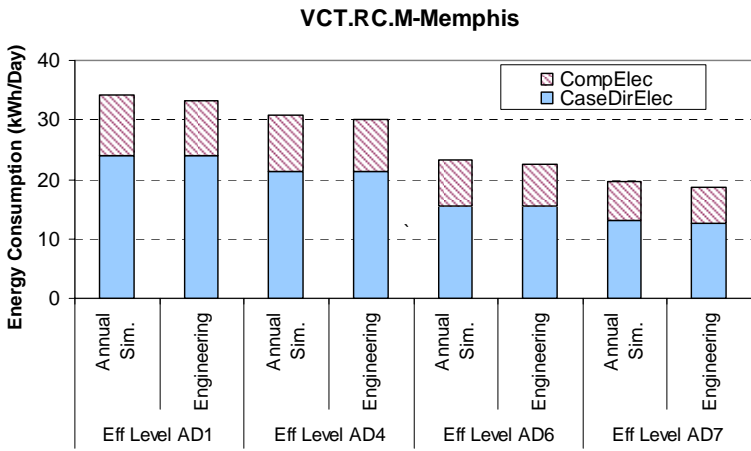


Figure D.6.15 Daily Energy Consumption for VCT.RC.M for Memphis

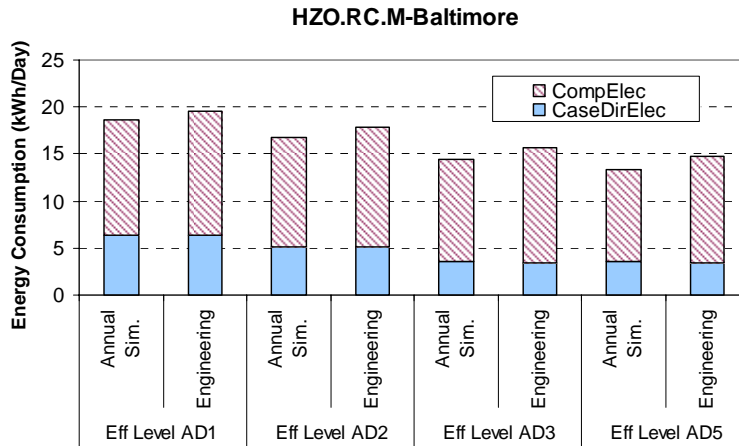


Figure D.6.16 Daily Energy Consumption for HZO.RC.M for Baltimore

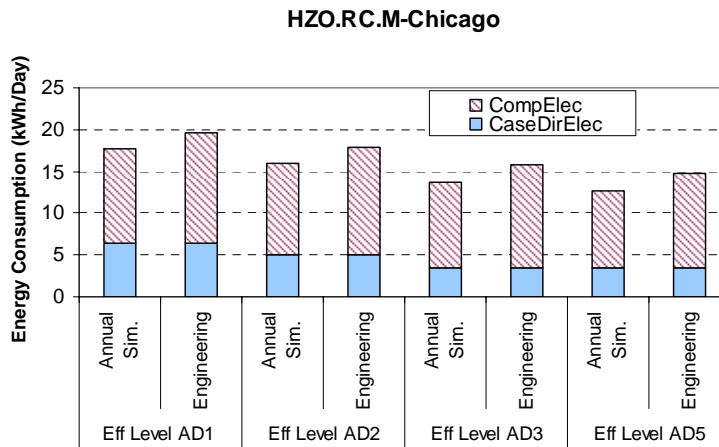


Figure D.6.17 Daily Energy Consumption for HZO.RC.M for Chicago

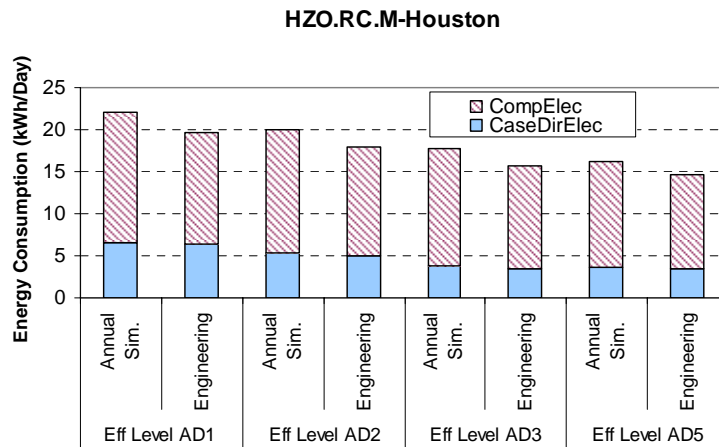


Figure D.6.18 Daily Energy Consumption for HZO.RC.M for Houston

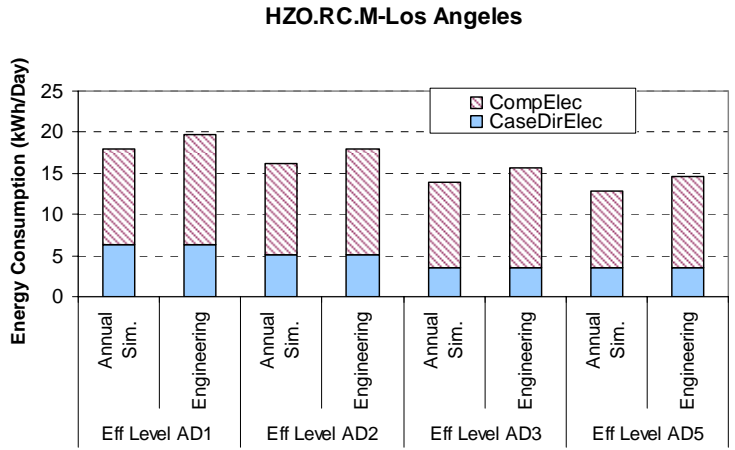


Figure D.6.19 Daily Energy Consumption for HZO.RC.M for Los Angeles

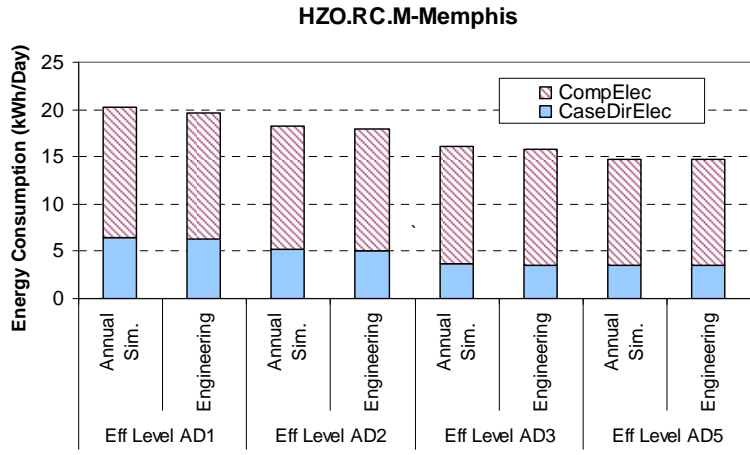


Figure D.6.20 Daily Energy Consumption for HZO.RC.M for Memphis

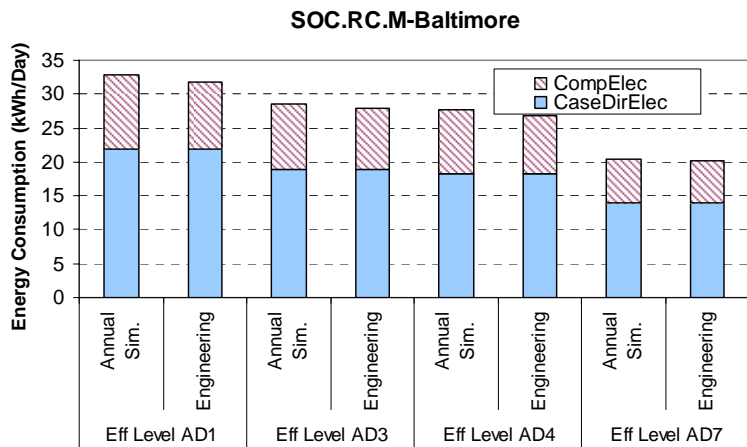


Figure D.6.21 Daily Energy Consumption for SOC.RC.M for Baltimore

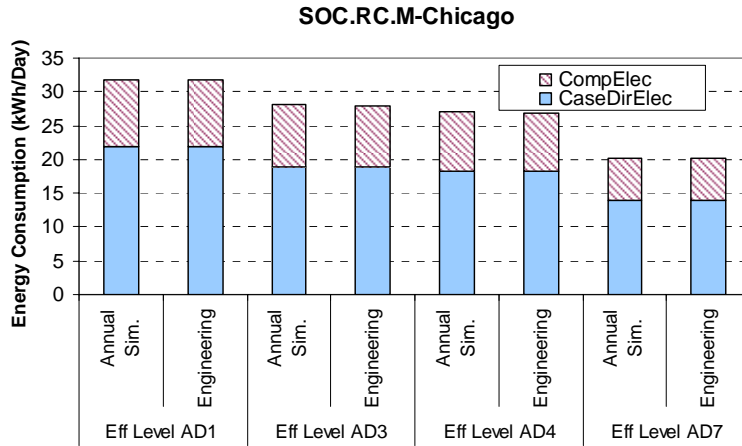


Figure D.6.22 Daily Energy Consumption for SOC.RC.M for Chicago

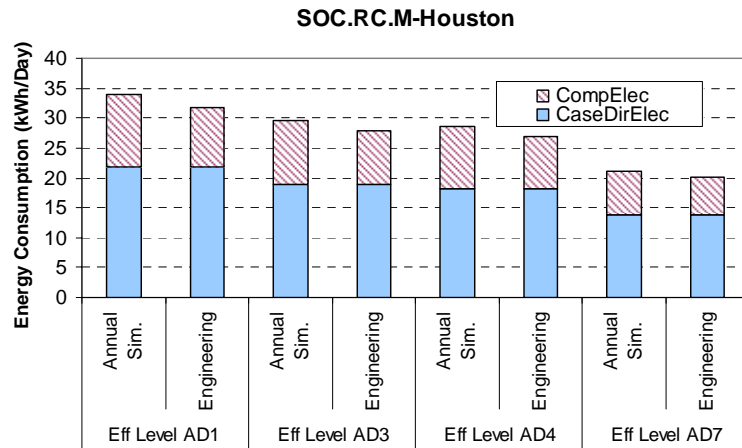


Figure D.6.23 Daily Energy Consumption for SOC.RC.M for Houston

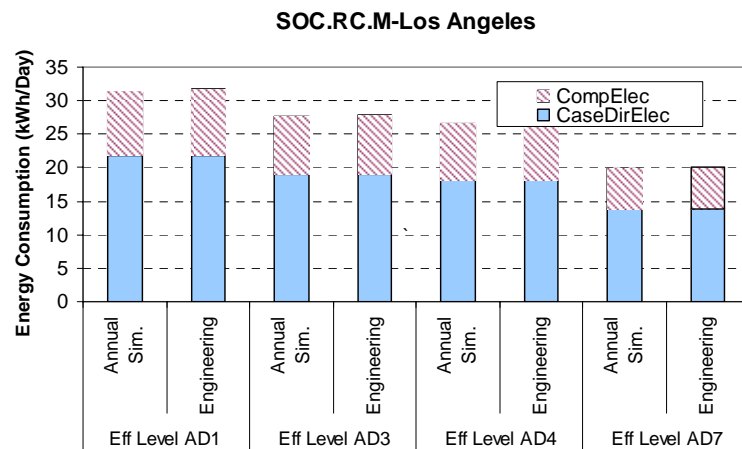


Figure D.6.24 Daily Energy Consumption for SOC.RC.M for Los Angeles

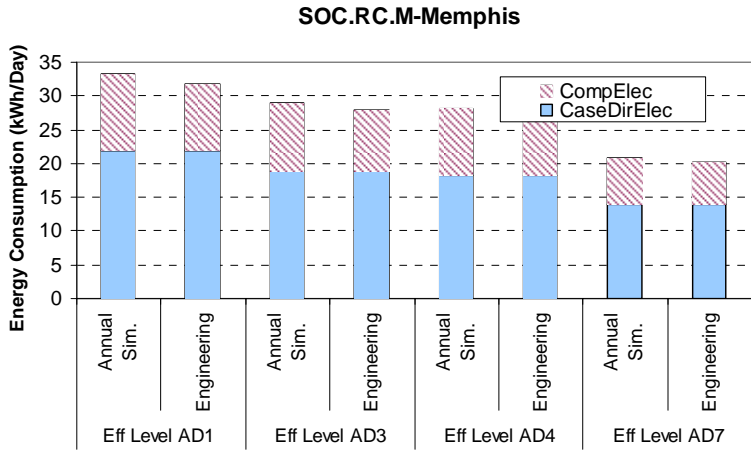


Figure D.6.25 Daily Energy Consumption for SOC.RC.M for Memphis

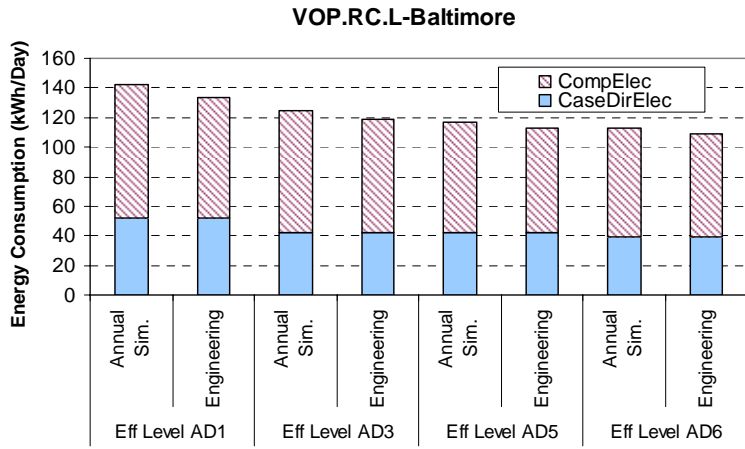


Figure D.6.26 Daily Energy Consumption for VOP.RC.L for Baltimore

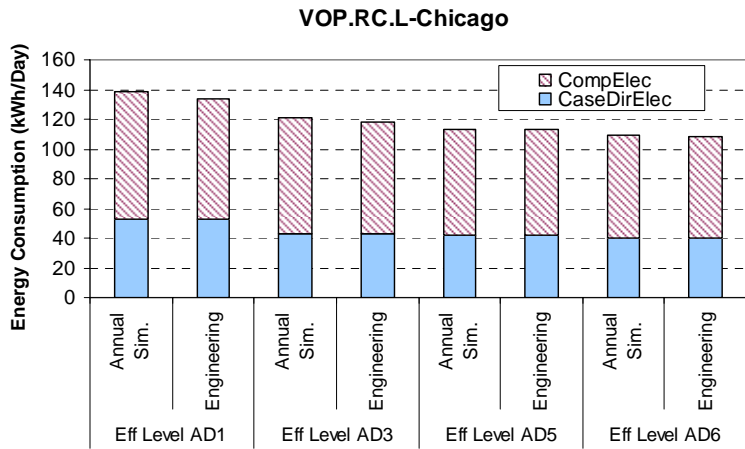


Figure D.6.27 Daily Energy Consumption for VOP.RC.L for Chicago

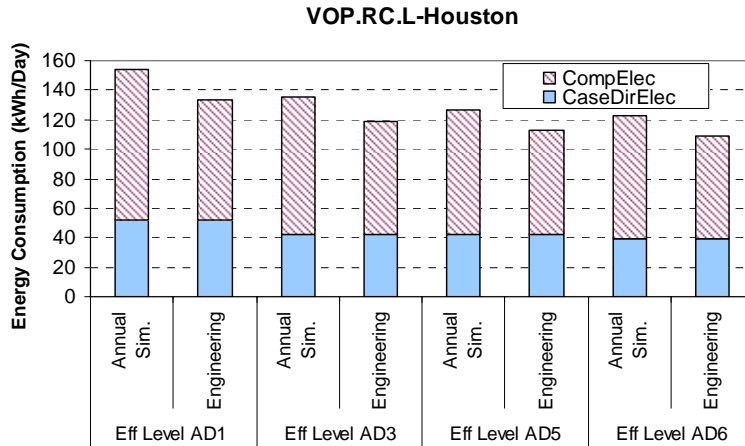


Figure D.6.28 Daily Energy Consumption for VOP.RC.L for Houston

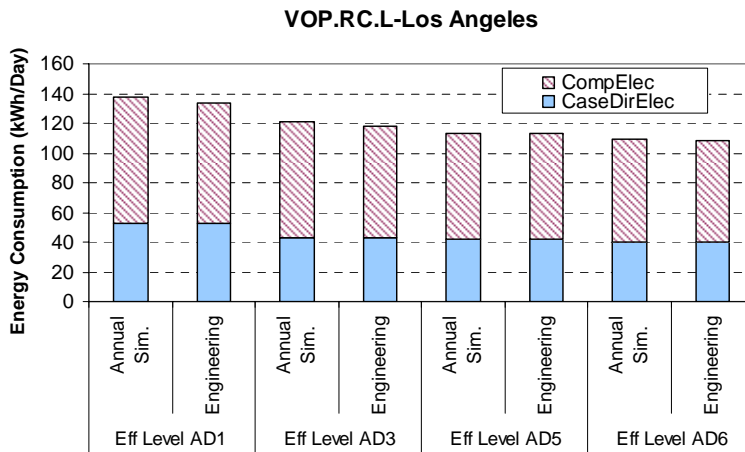


Figure D.6.29 Daily Energy Consumption for VOP.RC.L for Los Angeles

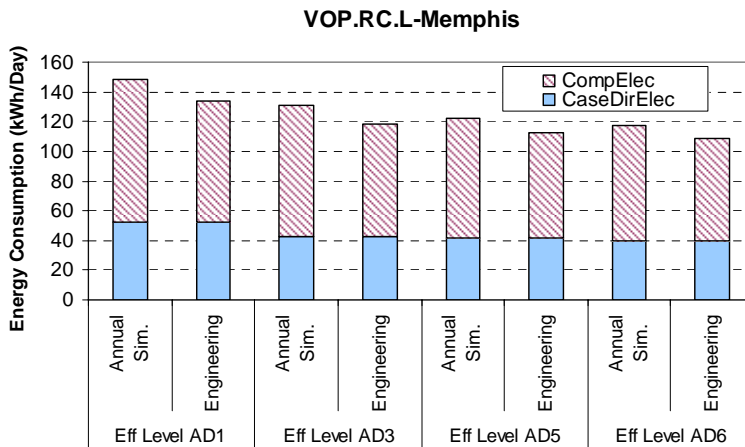


Figure D.6.30 Daily Energy Consumption for VOP.RC.L for Memphis

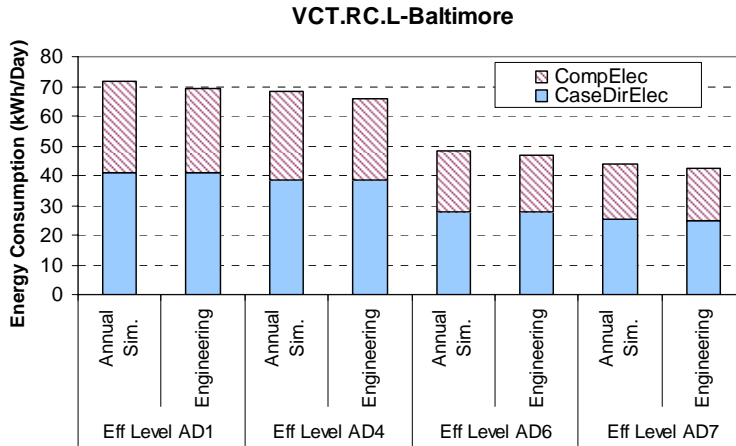


Figure D.6.31 Daily Energy Consumption for VCT.RC.L for Baltimore

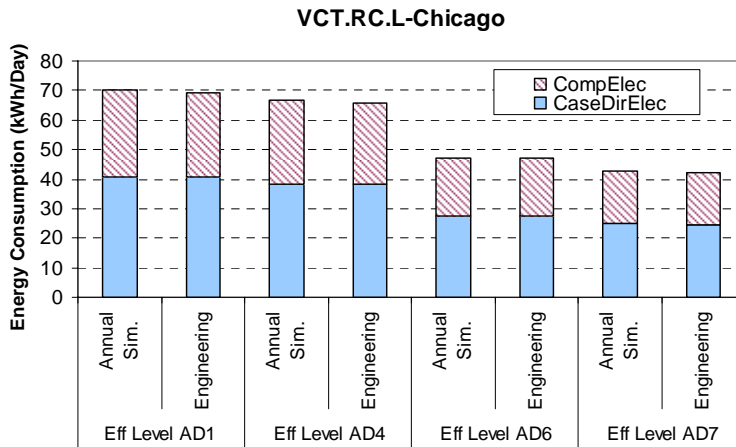


Figure D.6.32 Daily Energy Consumption for VCT.RC.L for Chicago

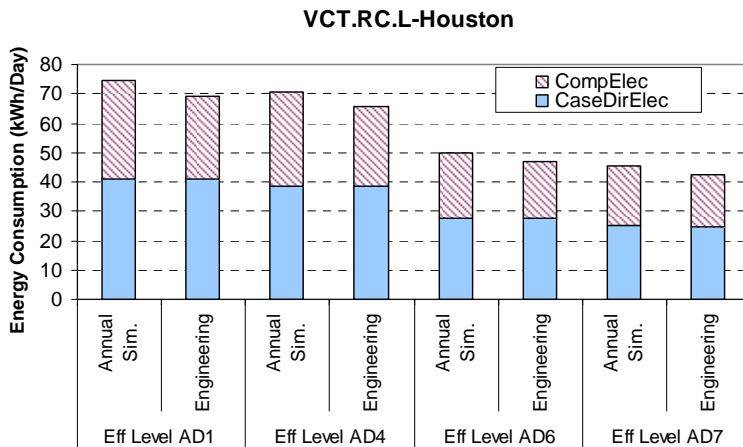


Figure D.6.33 Daily Energy Consumption for VCT.RC.L for Houston

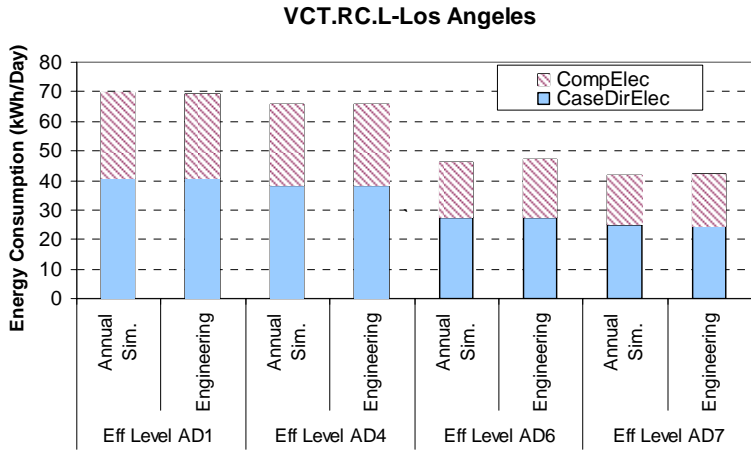


Figure D.6.34 Daily Energy Consumption for VCT.RC.L for Los Angeles

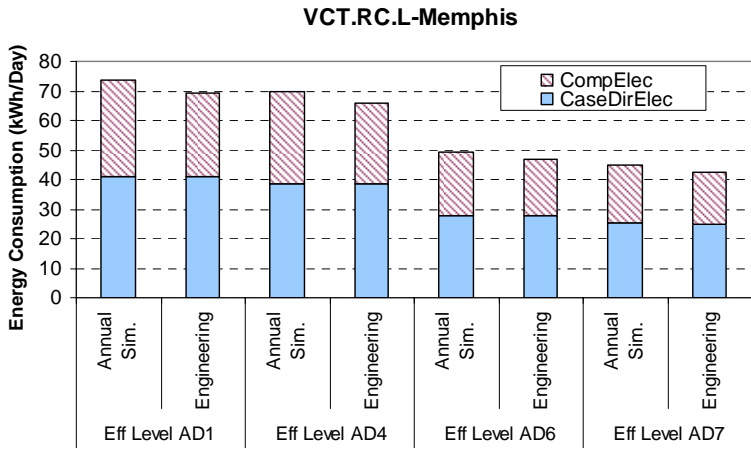


Figure D.6.35 Daily Energy Consumption for VCT.RC.L for Memphis

D.7 COMPARISON OF DAILY ENERGY SAVINGS BETWEEN SIMULATION RESULTS AND ENGINEERING ANALYSIS

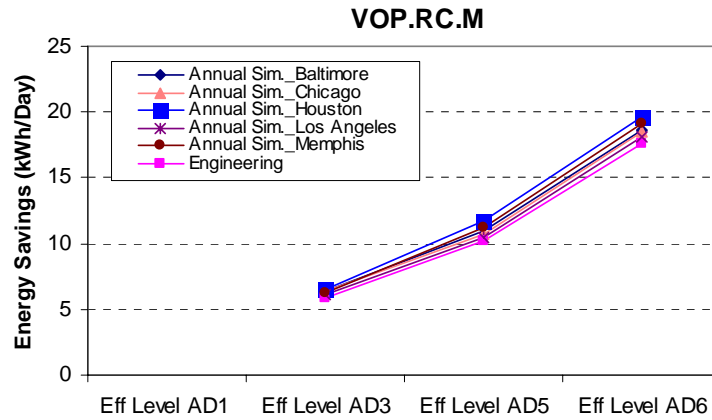


Figure D.7.1 Daily Energy Savings for VOP.RC.M

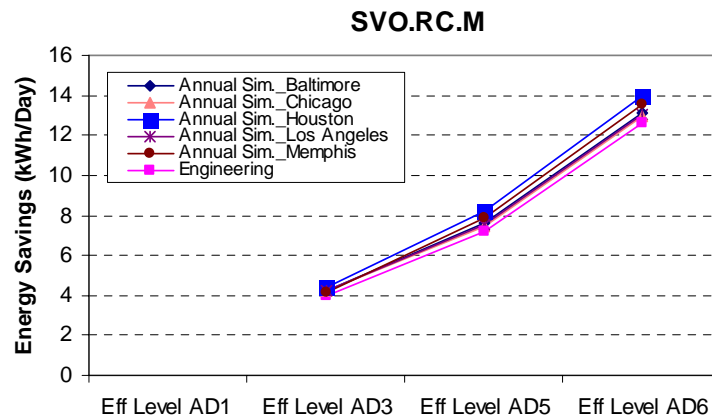


Figure D.7.2 Daily Energy Savings for SVO.RC.M

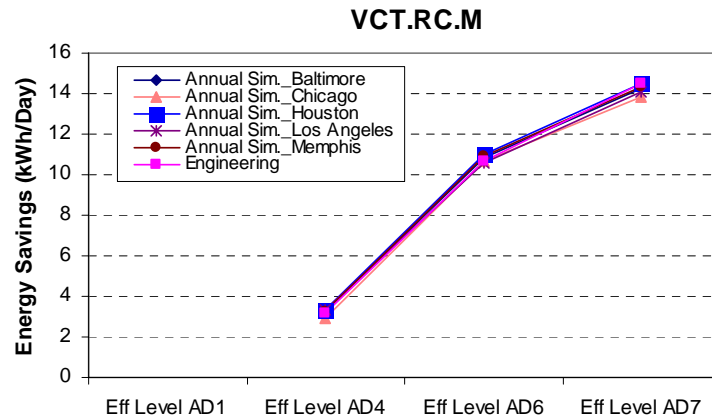


Figure D.7.3 Daily Energy Savings for VCT.RC.M

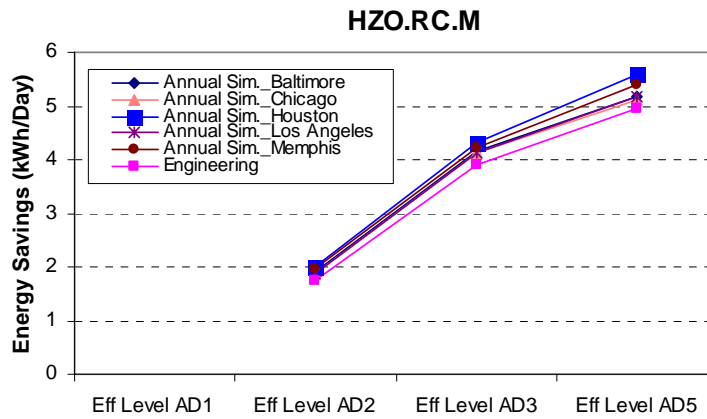


Figure D.7.4 Daily Energy Savings for HZO.RC.M

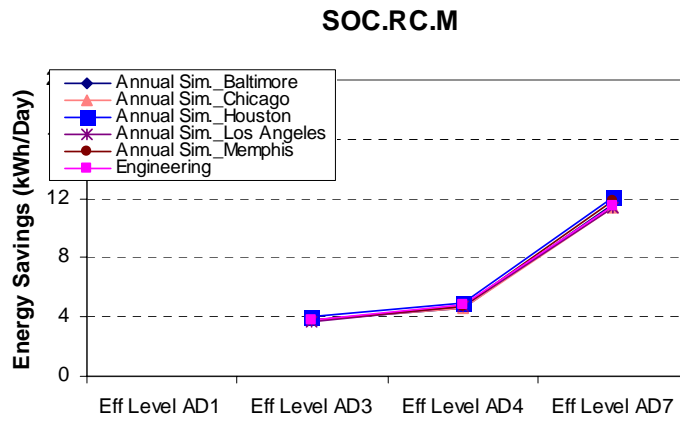


Figure D.7.5 Daily Energy Savings for SOC.RC.M

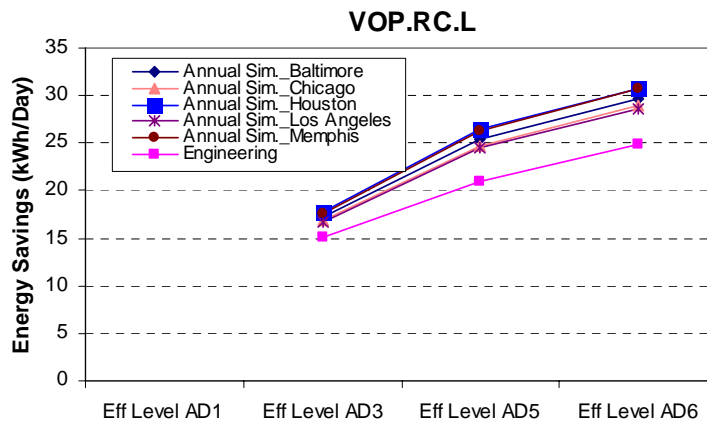


Figure D.7.6 Daily Energy Savings for VOP.RC.L

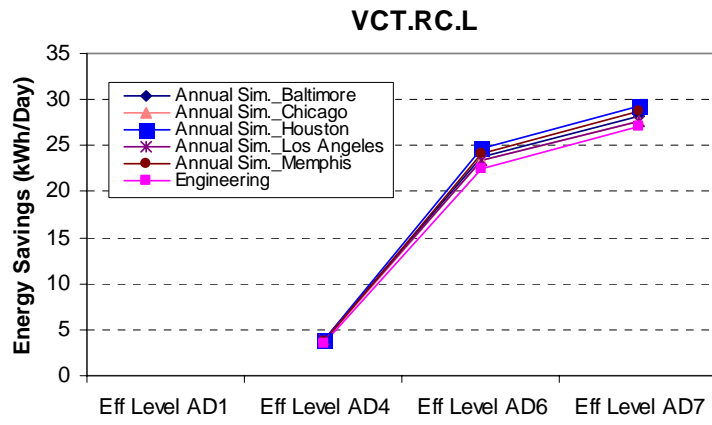


Figure D.7.7 Daily Energy Savings for VCT.RC.L

D.8 COMPARISON OF ENERGY SAVINGS BETWEEN REFRIGERATION SYSTEM AND WHOLE BUILDING

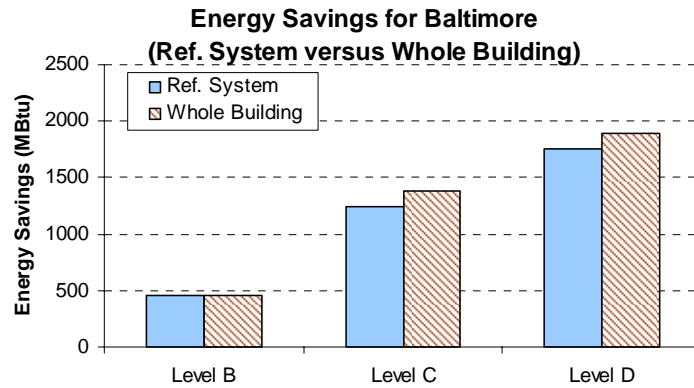


Figure D.8.1 Daily Energy Savings for Baltimore (Refrigeration System versus Whole Building)

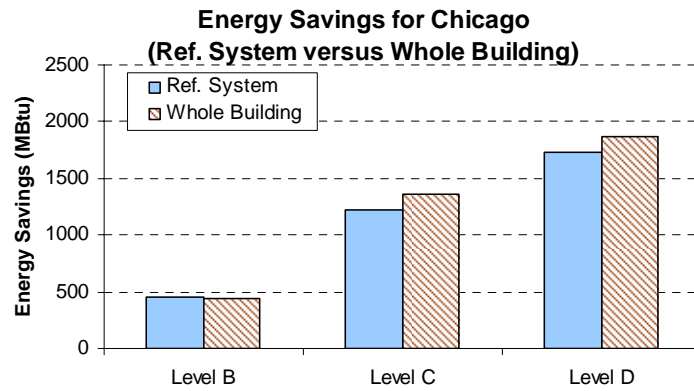


Figure D.8.2 Daily Energy Savings for Chicago (Refrigeration System versus Whole Building)

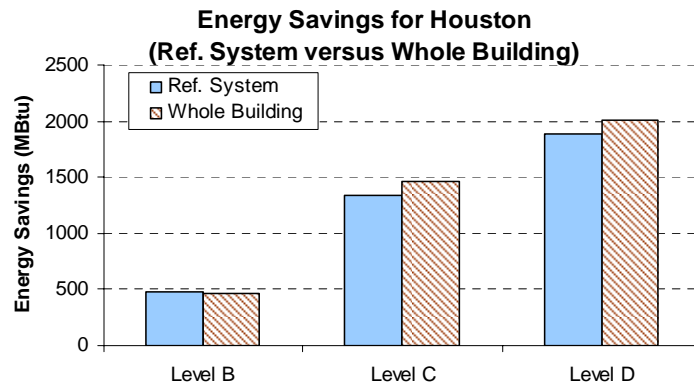


Figure D.8.3 Daily Energy Savings for Houston (Refrigeration System versus Whole Building)

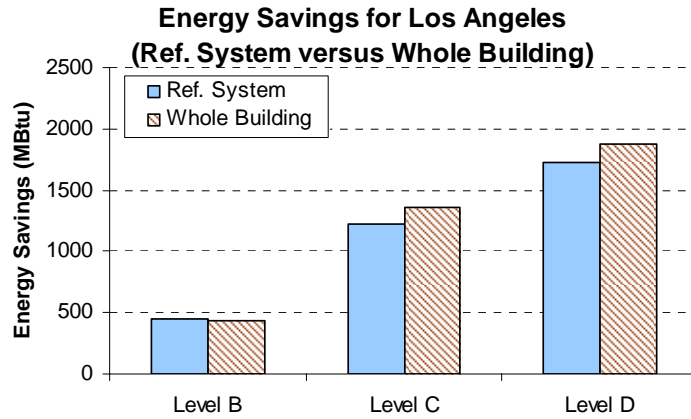


Figure D.8.4 Daily Energy Savings for Los Angeles (Refrigeration System versus Whole Building)

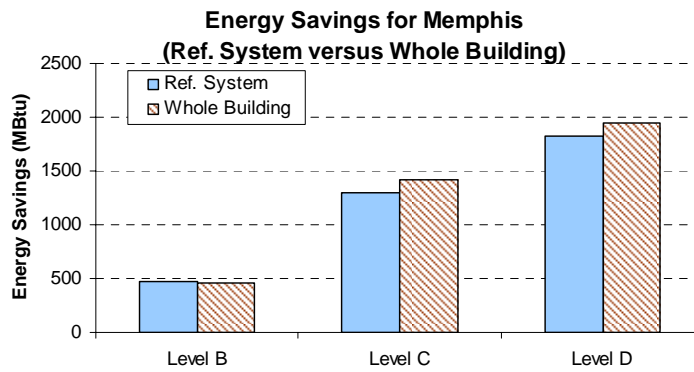


Figure D.8.5 Daily Energy Savings for Memphis (Refrigeration System versus Whole Building)