Infiltration in Tall Buildings

All energy and loads programs have the necessary input data (envelope & air systems) for analyzing the stack effect of tall buildings. The eQUEST program is ideal because the building can be modeled graphically by tracing AutoCAD drawings in shells (vertical sections of floors), each with different dimensional configurations and different design criteria. In the Design Development Wizard you can create vertical shells and assign different infiltration cfm/sqft of envelope area (Figure 2). In the Detailed Edit Mode you can use other methods to estimate infiltration but some the input parameters have to be calculated. In the Excel spreadsheet you have to estimate leakage and flow coefficient. In the Excel spreadsheet (Figures 3-6) you can get any infiltration you want by adjusting these two factors. http://bepan.info/engg-calcs 4b - Bldg Stack Effect, Wind Press + Envel Leakg Calcs The DOE2.1E method (the Building Description Language) is shown Figure 7

There was a public TV documentary about prefabricated curtain walls that are manufactured off-site and hoisted and snapped to place in the building. Examples were the Trump Tower in Chicago and some building in the Middle East. Construction workers worked from inside. In the case of a spherical shaped building, the surface panels are manufactured off-site. The panels are cut by numerical control machines using computers and software that generate the curved surfaces. The tolerances can be very small and therefore the leakage areas are small. A Stack Effect program needs data on leakage areas and flow coefficients for different types of envelopes. From the leakage measurement you can work backwards with the equation and get the percentage leakage areas for typical envelopes. I think it is easier and more accurate to measure envelope leakage areas and coefficients under lab test conditions and not on complete buildings especially in the case where whole sections of envelope are manufactured offsite. A more expensive method would be set up a lab test building of 3 (need a neutral level) or more floors and test different envelope types.

After writing the Excel spreadsheet Stack program, these are some of things I think need to be done. I am sure that there are lots of other features and refinements necessary. It would require a regular compiled program not an Excel spreadsheet. This is based on the High-Rise Mixed-Use Building. http://bepan.info/proj-bldgs Proj-13 - eQ-DOE21E - High-Rise-Multi-Use Bldg

All tall buildings typically have vertical sections with different foot prints, floor types and floor-to floor heights. The floors may not identical but they change by vertical sections of multiple floors. The ground floor has many openings and so does the mechanical floor (intakes and exhausts) and this affects the stack effect. Some floors are pressurized with sealed envelopes (offices) and others (hotels) are not. Offices have a return air ceiling plenum with a negative pressure relative to the space below. In the office section of the multi-use bldg example, every three floors there is a 3-level atrium in two corners. Hotel corridors are supplied with outdoor air which is exhausted from the rooms and is at a positive pressure relative to the rooms. Exhaust shafts in hotel rooms connect toilets and kitchens. In a hospital building every room has pressure relationship (negative or positive) with other rooms. Operating rooms require 25 air changes of outdoor air. Retail, restaurant, hotel services floors are different. In the core space (all building types), exhaust shafts connect electrical, telecom, janitor, storage, and mechanical rooms. Infiltration is affected by the type of HVAC system serving sections of the building. The stairwells are pressurized with outdoor air. All this affects the stack effect and wind pressure calculations of buildings. Tall building sections could be based on similar continuous floor types (offices, hotels) or the floors served by a mechanical floor.

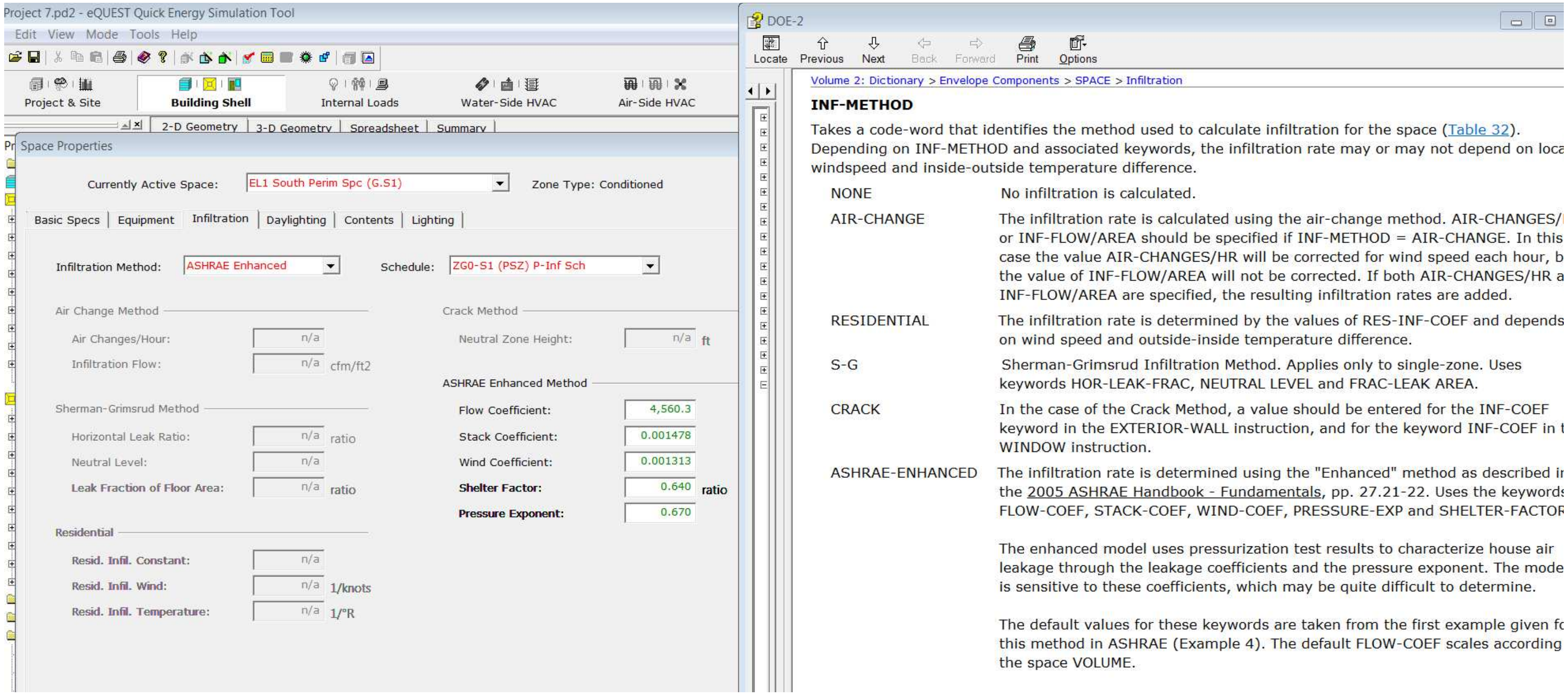
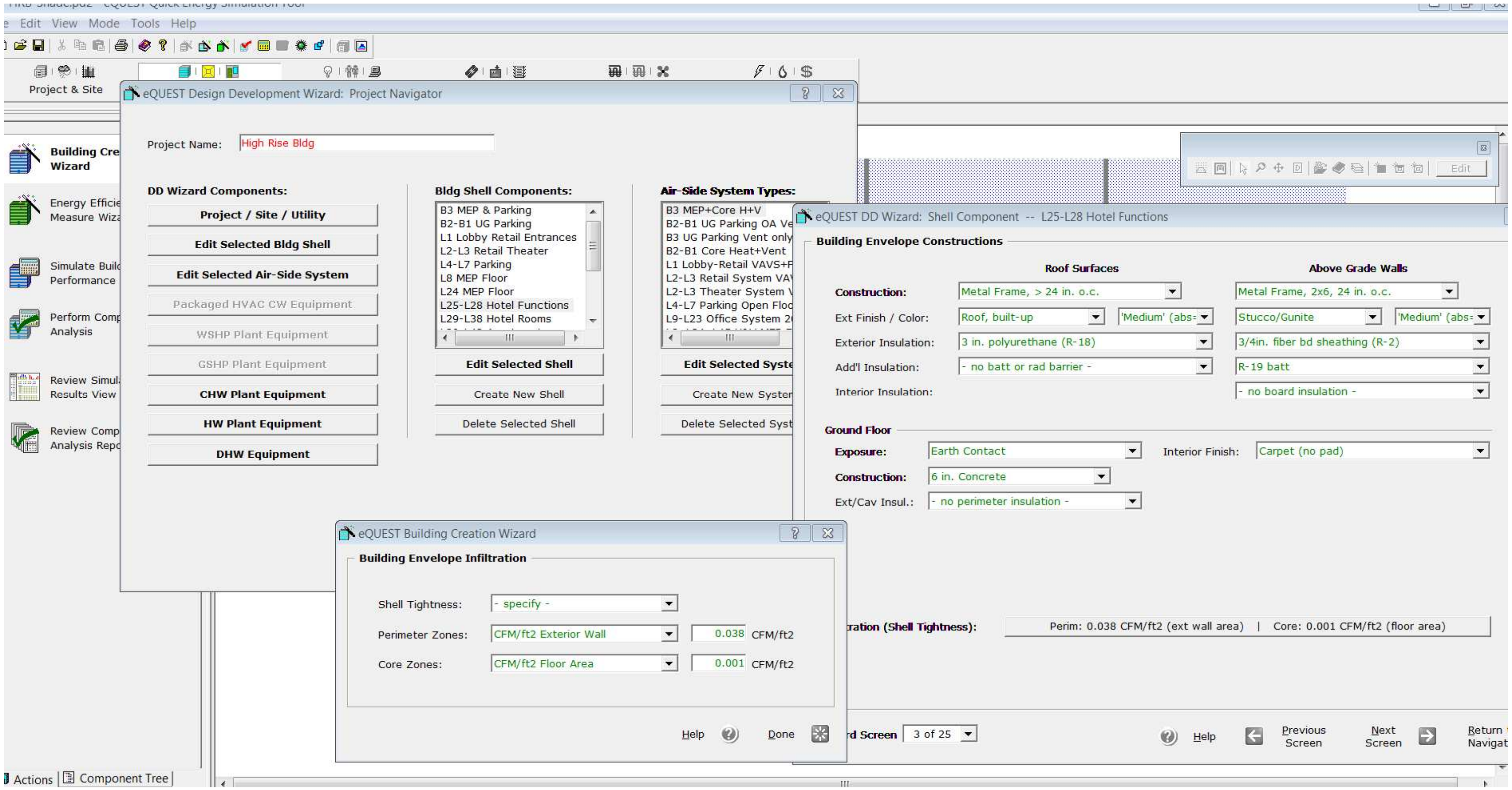


Figure 1



eQUEST Design Development Wizard: Project Navigator
Project Name:
High Rise Bldg
DD Wizard Components:
Project / Site / Utility
Edit Selected Bldg Shell
Edit Selected Air-Side System
Packaged HVAC CW Equipment
WSHP Plant Equipment
GSHP Plant Equipment
CHW Plant Equipment
HW Plant Equipment
DHW Equipment
Bldg Shell Components:
B3 MEP & Parking
B2-B1 UG Parking
L1 Lobby Retail Entrances
L2-L3 Retail Theater
L4-L7 Parking
L8 MEP Floor
L24 MEP Floor
L25-L28 Hotel Functions
L29-L38 Hotel Rooms
Edit Selected Shell
Create New Shell
Delete Selected Shell
Air-Side System Types:
eQUEST DD Wizard: Shell Component -- L25-L28 Hotel Functions
Building Envelope Constructions
Roof Surfaces
Above Grade Walls
Construction:
Metal Frame, > 24 in. o.c.
Metal Frame, 2x6, 24 in. o.c.
Ext Finish / Color:
Roof, built-up
Stucco/Gunite
Exterior Insulation:
3 in. polyurethane (R-18)
3/4in. fiber bd sheathing (R-2)
Add'l Insulation:
- no batt or rad barrier -
R-19 batt
Interior Insulation:
- no board insulation -
Ground Floor
Exposure:
Earth Contact
Interior Finish:
Carpet (no pad)
Construction:
6 in. Concrete
Ext/Cav Insul.:
- no perimeter insulation -
Perim: 0.038 CFM/ft2 (ext wall area) | Core: 0.001 CFM/ft2 (floor area)
3 of 25
Help
Previous Screen
Next Screen
eQUEST Building Creation Wizard
Building Envelope Infiltration
Shell Tightness:
- specify -
Perimeter Zones:
CFM/ft2 Exterior Wall
0.038
CFM/ft2
Core Zones:
CFM/ft2 Floor Area
0.001
CFM/ft2
Help
Done

Figure 2

2.0 8.0 8.0 8.0 8.6 8.6 8.6 8.6 8.6 8.6 8.6 8.6 2.0 5.5 5.5 5.5 5.5 5.5 2

Bldg Pressurization - Stack Effect & Wind Press Inflt

USER INPUT | descriptions | CALCULATED

PROJECT DATA	Description	DESIGN (INPUT)	SMMR	WNTR
Project Name	Very Tall Mixed-Use Building (Description)	Wnd (mph) Grnd	5	15
Project Analyst	VCT (Description)	Wnd (mph) Roof	10	20
Bldg Type (Office, Hotel)	Mixed Use High Rise (Description)	Outdoor DB (F)	95	-16
Location (City, State)	Minneapolis, MN, USA (Description)	Outdoor WB (F)	75	-16
		Degree-Days	2,680	7,981
Site Altit. (ft) ref Sea Level	500	Mech/Grd Flr-Flr-H 20 / Indoor DB (F)	75	72
Mech/Grd % Envel Leakg	0.60	Mech/Grd Flow C 0.60 / Indoor WB (F)	62	55

# Flrs	Bldg-H	Ntrl-H	Site-Alt	Total Bldg-Area	Total Envel-Area	Total Leakg-Area	% Avg Lkg
102	1,309	654.5	500	2,782,800	584,440	1,633	0.28

SECTION (max = 5 chars) >>	1	2-A	3	4-k	5	6 (x)	7	8
Flr Type (Retl, Offc,)	Lobby	Retail	Tradg	Office	Htl-Srvc	Hotel	Condos	Dining
Typical Floor Length (ft)	320	280	240	220	200	180	180	180
Typical Floor Width (ft)	240	200	160	140	120	100	100	100
Floor-Floor Height (ft)	20.00	18.00	15.00	13.50	15.00	10.00	10.00	15.00
Number of Typical Floors	2	3	6	40	5	25	15	2
Mech Flr above Sctn (Y/N)	N	Y	N	Y	N	N	Y	Y
Leakage Area as % of Envel	0.40	0.35	0.30	0.25	0.30	0.35	0.40	0.30
Envel Leakage Flow Coeff	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
In-Out PD (in.wg) $P_I - P_O$	0.000	0.005	0.005	0.005	0.005	0.005	0.005	0.005

SECTION No. >>	1	2-A	3	4-k	5	6 (x)	7	8
No. of Flrs (Incl Mech Flr)	2	4	6	41	5	25	16	3
Area per Flr (ft2)	76,800	56,000	38,400	30,800	24,000	18,000	18,000	18,000
Envelope Length (ft)	1,120	960	800	720	640	560	560	560
Envelope Area per Flr (ft2)	22,400	17,280	12,000	9,720	9,600	5,600	5,600	8,400
Envel Leakage Area (ft2)	90	60	36	24	29	20	22	25
SECTION-Height (ft)	40	74	90	560	75	250	170	50
Total Section Flr Area (ft2)	153,600	224,000	230,400	1,262,800	120,000	450,000	288,000	54,000
Totl Section Envel Area (ft2)	44,800	69,120	72,000	398,520	48,000	140,000	89,600	25,200
Totl Section Leakg Area (ft2)	179	242	216	996	144	490	358	76

Calc ID #	Sctn Flr #	Bldg Flr-#	Flr-H + Sea-Lvl feet	meters
Section >>		8	# flrs >>	3
24	2	101	1,789	545
23	1	100	1,774	541
Section >>		7	# flrs >>	16
22	0	XX	XX	XX
21	10	93	1,689	515
20	5	88	1,639	500
Section >>		6 (x)	# flrs >>	25
19	0	XX	XX	XX
18	25	83	1,589	484
17	15	73	1,489	454
16	5	63	1,389	423
Section >>		5	# flrs >>	5
15	5	58	1,339	408
14	3	56	1,309	399
13	1	54	1,279	390
Section >>		4-k	# flrs >>	41
12	30	36	1,109	338
11	25	31	1,042	317
10	20	26	974	297
9	15	21	907	276
8	5	17	772	235
Section >>		3	# flrs >>	6
7	0	XX	XX	XX
6	2	8	644	196
5	1	7	629	192
Section >>		2-A	# flrs >>	4
4	0	XX	XX	XX
3	2	4	576	176
2	1	3	558	170
Section >>		1	# flrs >>	2
2	2	2	520	158
1	1	1	500	152

Figure 3

Calc ID #	Floor Lvl #	Floor Hgt	Flr Lk-A	From Sheet 'SMMR-Calcs'				SUMMER		Annual Tons Cooling
Section >>		8	25.2	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	Tons
24	101	1,289		13.770	9.92	90.41	0.0664	722	0.086	174
23	100	1,274		13.778	9.87	90.46	0.0664	713	0.085	172
Section >>		7	22.4	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	Tons
22	XX	XX		XX	XX	XX	XX	XX	XX	XX
21	93	1,189		13.821	9.54	90.77	0.0666	582	0.069	140
20	88	1,139		13.846	9.35	90.95	0.0667	548	0.065	132
Section >>		6 (x)	19.6	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	Tons
19	XX	XX		XX	XX	XX	XX	XX	XX	XX
18	83	1,089		13.872	9.16	91.12	0.0668	448	0.053	108
17	73	989		13.922	8.78	91.48	0.0670	372	0.044	90
16	63	889		13.973	8.40	91.84	0.0672	271	0.032	65
Section >>		5	28.8	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	Tons
15	58	839		13.999	8.20	92.01	0.0673	293	0.035	71
14	56	809		14.014	8.09	92.12	0.0673	204	0.024	49
13	54	779		14.029	7.98	92.23	0.0674	-59	-0.007	-14
Section >>		4-k	24.3	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	Tons
12	36	609		14.117	7.33	92.83	0.0677	-438	-0.052	-106
11	31	542		14.151	7.07	93.07	0.0678	-520	-0.062	-125
10	26	474		14.186	6.81	93.31	0.0679	-593	-0.071	-143
9	21	407		14.221	6.55	93.55	0.0681	-659	-0.078	-159
8	17	272		14.291	6.04	94.03	0.0683	-779	-0.093	-188
Section >>		3	36.0	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	Tons
7	XX	XX		XX	XX	XX	XX	XX	XX	XX
6	8	144		14.357	5.55	94.49	0.0686	-1,306	-0.156	-315
5	7	129		14.365	5.49	94.54	0.0686	-1,324	-0.158	-319
Section >>		2-A	60.5	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	Tons
4	XX	XX		XX	XX	XX	XX	XX	XX	XX
3	4	76		14.393	5.29	94.73	0.0687	-2,324	-0.277	-561
2	3	58		14.402	5.22	94.79	0.0687	-2,357	-0.281	-569
Section >>		1	89.6	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	Tons
2	2	20		14.422	5.08	94.93	0.0688	-3,340	-0.398	-806
1	1	0		14.432	5.00	95.00	0.0688	-3,397	-0.404	-819

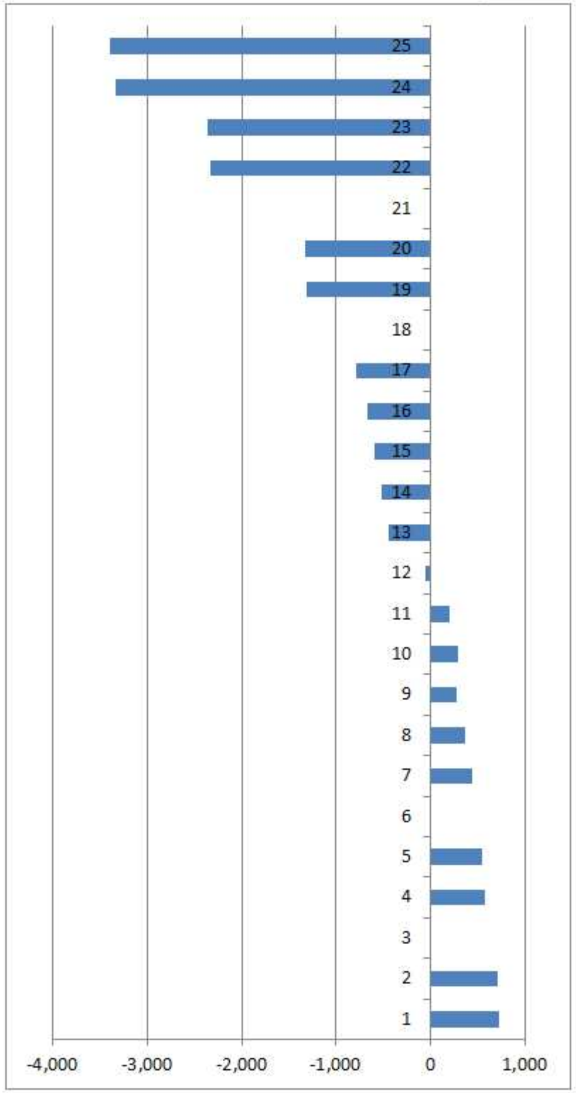


Figure 4

Calc ID #	Floor Lvl #	Floor Hgt	Flr Lk-A	From Sheet 'WNTR-Calcs'				WINTER		Annual KWH Heating
Section >>		8	25.2	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	KWH
24	101	1,289		13.770	19.92	-20.59	0.0848	-2,093	-0.25	-18,042
23	100	1,274		13.778	19.87	-20.54	0.0849	-2,069	-0.25	-17,830
Section >>		7	22.4	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	KWH
22	XX	XX		XX	XX	F	XX	XX	XX	XX
21	93	1,189		XX	XX	-20.59	XX	-1,710	-0.20	-14,740
20	88	1,139		13.821	19.542	-20.54	0.0851	-1,630	-0.19	-14,051
Section >>		6 (x)	19.6	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	KWH
19	XX	XX		XX	XX	XX	XX	XX	XX	XX
18	83	1,089		XX	XX	XX	XX	-1,353	-0.16	-11,663
17	73	989		13.872	19.160	-19.877	0.0853	-1,194	-0.14	-10,291
16	63	889		13.922	18.778	-19.521	0.0856	-1,012	-0.12	-8,719
Section >>		5	28.8	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	KWH
15	58	839		13.999	18.205	-18.987	0.0859	-1,333	-0.16	-11,492
14	56	809		13.999	18.205	-18.987	0.0859	-1,233	-0.15	-10,624
13	54	779		14.014	18.090	-18.880	0.0860	-1,123	-0.13	-9,681
Section >>		4-k	24.3	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	KWH
12	36	609		14.117	17.326	-18.168	0.0865	-438	-0.05	-3,773
11	31	542		14.117	17.326	-18.168	0.0865	-520	-0.06	-4,483
10	26	474		14.151	17.068	-17.928	0.0866	-593	-0.07	-5,110
9	21	407		14.186	16.811	-17.687	0.0868	-659	-0.08	-5,682
8	17	272		14.221	16.553	-17.447	0.0870	-779	-0.09	-6,716
Section >>		3	36.0	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	KWH
7	XX	XX		XX	XX	XX	XX	XX	XX	XX
6	8	144		14.357	15.550	-16.513	0.0876	2,517	0.30	21,698
5	7	129		14.365	15.493	-16.459	0.0877	2,555	0.30	22,023
Section >>		2-A	60.5	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	KWH
4	XX	XX		XX	XX	XX	XX	XX	XX	XX
3	4	76		XX	XX	XX	XX	2,684	0.32	23,132
2	3	58		14.393	15.290	-16.271	0.0878	2,726	0.32	23,496
Section >>		1	89.6	Alt psi	Wnd-V	OA-DB	OA-d	Q cfm	Q/Env-A	KWH
2	2	20		14.422	15.076	-16.071	0.0879	7,099	0.85	61,191
1	1	0		14.422	15.076	-16.071	0.0879	7,208	0.86	62,132

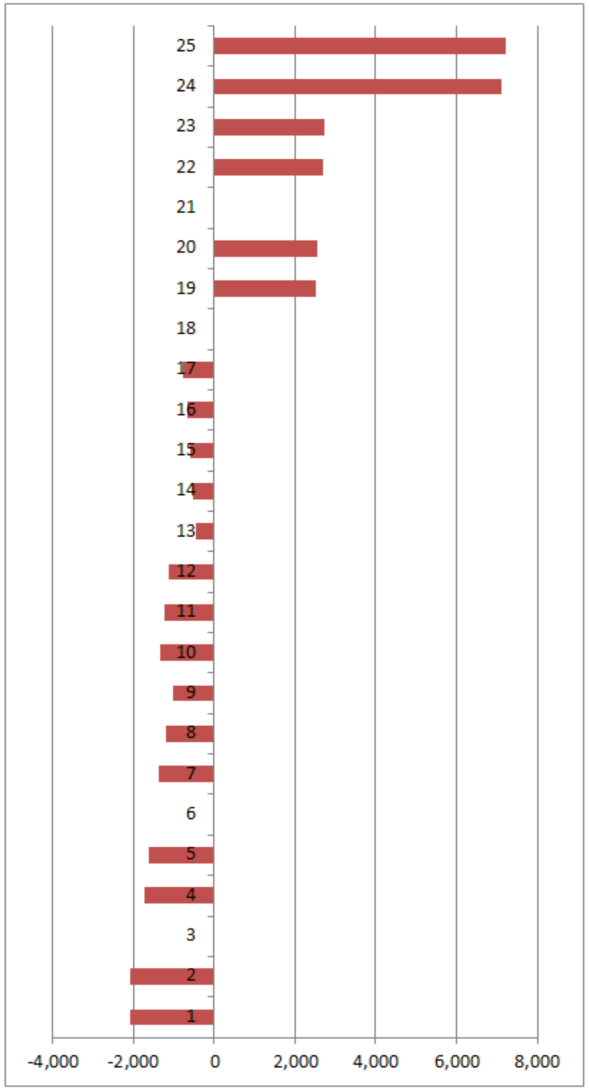


Figure 5

5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	7.5	7.5	6.0	6.0	6.0	6.0	6.0	7.5	7.5
Calc ID #	Floor Lvl #	Floor Hgt	Flr Lk-A	From Sheet 'SMMR-Calcs'					Infltr SHG	Cooling Energy/Yr	From Sheet 'WNTR-Calcs'					Infltr SHL	Heating Energy/Yr
		8	25.2	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btuh/yr
24	101	1289		90.41	15.06	35.41	722	2,878	**12,018**	**2,090**	-20.59	11.79	-4.56	-2,093	-10,653	**209,303**	**-18,042**
23	100	1274		90.46	15.05	35.45	713	2,841	**11,902**	**2,309**	-20.54	11.78	-4.55	-2,069	-10,533	**206,726**	**-6,702**
		7	22.4	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr
22	XX	XX		XX	XX	XX	XX	XX	**XX**	**XX**	XX	XX	XX	XX	XX	**XX**	**XX**
21	93	1189		90.77	15.01	35.66	582	2,326	**9,912**	**1,886**	-20.23	15.01	-4.47	-1,710	-6,834	**170,345**	**-5,541**
20	88	1139		90.95	14.99	35.79	548	2,195	**9,445**	**1,777**	-20.05	14.99	-4.43	-1,630	-6,524	**162,066**	**-5,282**
		6 (x)	19.6	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr
19	XX	XX		XX	XX	XX	XX	XX	**XX**	**XX**	XX	XX	XX	XX	XX	**XX**	**XX**
18	83	1089		91.12	14.97	35.91	448	1,794	**7,796**	**1,451**	-19.88	11.72	-4.38	-1,353	-6,926	**134,259**	**-4,384**
17	73	989		91.48	14.93	36.17	372	1,495	**6,622**	**1,206**	-19.52	11.69	-4.29	-1,194	-6,129	**118,012**	**-3,868**
16	63	889		91.84	14.89	36.42	271	1,092	**4,927**	**878**	-19.16	11.66	-4.20	-1,012	-5,207	**99,596**	**-3,277**
		5	28.8	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr
15	58	839		92.01	14.87	36.55	293	1,183	**5,385**	**950**	-18.99	11.64	-4.15	-1,333	-6,873	**131,012**	**-4,320**
14	56	809		92.12	14.86	36.62	204	823	**3,768**	**660**	-18.88	11.63	-4.12	-1,233	-6,359	**120,977**	**-3,994**
13	54	779		92.23	14.84	36.70	-59	-236	**-1,089**	**-190**	-18.77	11.62	-4.10	-1,123	-5,800	**110,111**	**-3,639**
		4-k	24.3	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr
12	36	609		92.83	14.77	37.14	-438	-1,778	**-8,431**	**-1,418**	-18.17	11.56	-3.94	-438	-2,272	**-35,601**	**1,185**
11	31	542		93.07	73.07	37.31	-520	-427	**-10,151**	**-1,685**	-17.93	11.54	-3.88	-520	-2,704	**-71,344**	**2,380**
10	26	474		93.31	73.31	37.48	-593	-485	**-11,725**	**-1,921**	-17.69	11.52	-3.82	-593	-3,088	**-94,083**	**3,147**
9	21	407		93.55	73.55	37.66	-659	-538	**-13,208**	**-2,136**	-17.45	11.50	-3.75	-659	-3,440	**-112,041**	**3,758**
8	17	272		94.03	74.03	38.01	-779	-631	**-16,016**	**-2,524**	-16.97	11.45	-3.63	-779	-4,081	**-140,633**	**4,742**
		3	36.0	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr
7	XX	XX		XX	XX	XX	XX	XX	**XX**	**XX**	XX	XX	XX	XX	XX	**XX**	**XX**
6	8	144		94.49	14.59	38.35	-1,306	-5,374	**-27,496**	**-4,233**	-16.51	11.41	-3.51	2,517	13,234	**-240,643**	**8,156**
5	7	129		94.54	14.58	38.38	-1,324	-5,447	**-27,934**	**-4,289**	-16.46	11.41	-3.50	2,555	13,438	**-244,101**	**8,278**
		2-A	60.5	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr
4	XX	XX		XX	XX	XX	XX	XX	**XX**	**XX**	XX	XX	XX	XX	XX	**XX**	**XX**
3	4	76		94.73	14.56	38.52	-2,324	-9,576	**-49,516**	**-7,529**	-16.27	11.39	-3.45	2,684	14,136	**-255,846**	**8,695**
2	3	58		94.79	14.55	38.57	-2,357	-9,719	**-50,392**	**-7,638**	-16.21	11.39	-3.43	2,726	14,366	**-259,681**	**8,832**
		1	89.6	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr	OA-DB	V_o ft3/lb	H_o bu/lb	Q ft3/min	Q lbs/hr	btuh	K-btu/yr
2	2	20		94.93	14.54	38.67	-3,340	-13,783	**-71,879**	**-10,820**	-16.07	11.37	-3.40	7,099	37,452	**-675,246**	**23,001**
1	1	0		95.00	14.53	38.73	-3,397	-14,030	**-73,385**	**-11,008**	-16.00	11.37	-3.38	7,208	38,050	**-685,084**	**23,355**

Figure 6

$ Stack Effect Infiltration DOE21E $

```
$-----------------------------------------------------------------------------$
$ --Wall/Window/Door Infltr CFMs are added to Space Infltr CFM (ACH or CFM/SF) $
                        $ Typical Infiltration Coefficients for Exterior Walls $
$ 13" Brick Wall with Plastered Surface      cfh/ft2 = 0.01  Inf-Coeff = 0.002 $
$ 8" Brick Wall Plain                        cfh/ft2 = 5.00  Inf-Coeff = 0.915 $
$ Curtain Wall, Pressurized Building                         Inf-Coeff = 0.005 $
                               $ Typical Infiltration Coefficients for Windows $
$ Sealed Windows (Curtain Wall) Pressurized Building         Inf-Coeff = 0.5   $
$ 1/8" Crack (Wall or Window)                 cfm/ft = 0.30  Inf-Coeff = 1.342 $
$ 1/4" Crack (Wall or Window)                 cfm/ft = 0.50  Inf-Coeff = 2.236 $
$ 1/2" Crack (Wall or Window)                 cfm/ft = 1.10  Inf-Coeff = 4.919 $
                                 $ Typical Infiltration Coefficients for Doors $
$ 3' x 7' Closed Door Residential with Weather Stripping     Inf-Coeff = 2.400 $
$ 3' x 7' Closed Door Residential without Weather Stripping  Inf-Coeff = 12.00 $
$ 3.5' x 7' Closed Door OFFC                                 Inf-Coeff = 3.100 $
$ 3.5' x 7' Closed Door OFFC Open 10%                        Inf-Coeff = 13.50 $
$ 3.5' x 7' Closed Door OFFC Open 25%                        Inf-Coeff = 55.00 $
$ 3.5' x 7' Closed Door OFFC Open 50%                        Inf-Coeff = 153.0 $
$ 3.5' x 7' Closed Door OFFC Open 10% + Vestibule            Inf-Coeff = 9.300 $
$ Revolving Door (average use)                               Inf-Coeff = 12.00 $
$ Garage or Shipping Room Door (average use)                 Inf-Coeff = 60.00 $
$-----------------------------------------------------------------------------$

PARAMETER         $ Use this Command to vary design criteria, dimensions, etc. $
   OFC-BLDG-HEIGHT = 400                                       $ Building Height $
   BLDG-NEUTRAL-LVL = 0.5            $ Neutral Level (fraction of Bldg Hgt) $
   OFC-WALL-INFL-C = 0.005                                  $ Wall Infiltr Coeff $
   OFC-WNDW-INFL-C = 0.5           $ Window Infiltr Coeff. Sealed Pressurized $
   OFC-DOOR-INFL-C = 20                                     $ Door Infiltr Coeff $
     $ Infiltration at 2 cfm/LF of window perimeter =  [2x(220+9)]x2 = 916 cfm $
                  $ ACH = (916 x 60)/40000 = 1.37.  cfm/SF = 916/4000 = 0.23 $
   OFC-INFL-ACH = 1.37                 $ Space Infiltr Air Changes per Hour $
   OFC-INFL-CFM/SF = 0.23                      $ Space Infiltr CFM per SQFT $
   OFC-PLEN-ACH = 0.1       $ Infiltr Air Changes per Hour into Ceiling Plenum $
..                                                  $ End of Parameter Command $
```

```
$-----------Infiltration Schedules---------------------------------------------$
SCH-INFL-WNDW = SCHEDULE    $ Inflt_CFM = Design_Infltr_CFM x Infltr_Fraction $
   THRU FEB 28  (ALL) (1,24)=(1.0)
   THRU APR 30  (ALL) (1,24)=(0.7)
   THRU OCT 31  (ALL) (1,24)=(0.5)
   THRU NOV 30  (ALL) (1,24)=(0.7)
   THRU DEC 31  (ALL) (1,24)=(1.0)
..
SCH-INFL-WALL = SCHEDULE
   THRU FEB 28  (ALL) (1,24)=(1.0)
   THRU APR 30  (ALL) (1,24)=(0.7)
   THRU OCT 31  (ALL) (1,24)=(0.2)
   THRU NOV 30  (ALL) (1,24)=(0.7)
   THRU DEC 31  (ALL) (1,24)=(1.0)
..
SCH-INFL-DOOR = SCHEDULE
   THRU FEB 28
             (WD) (1,7)=(2) (8,10)=(3) (10,12)=(2) (12,13)=(3) (14,16)=(2)
                                 (17,18)=(3) (19,24)=(2)
                 (WEH) (1,24)=(2)
   THRU APR 30
             (WD) (1,7)=(1.5) (8,10)=(2) (10,12)=(1.5) (12,13)=(2) (14,16)=(1.5)
                                 (17,18)=(2) (19,24)=(1.5)
                (WEH) (1,24)=(1.5)
   THRU OCT 31
             (WD) (1,7)=(0.5) (8,10)=(1) (10,12)=(0.5) (12,13)=(1) (14,16)=(0.5)
                                 (17,18)=(1) (19,24)=(0.5)
                (WEH) (1,24)=(0.5)
   THRU NOV 30
             (WD) (1,7)=(1.5) (8,10)=(2) (10,12)=(1.5) (12,13)=(2) (14,16)=(1.5)
                                 (17,18)=(2) (19,24)=(1.5)
                (WEH) (1,24)=(1.5)
   THRU DEC 31
             (WD) (1,7)=(2) (8,10)=(3) (10,12)=(2) (12,13)=(3) (14,16)=(2)
                                 (17,18)=(3) (19,24)=(2)
                (WEH) (1,24)=(2)
..
```

```
$---------------------Space Conditions-------------------------------------$
SC-OFC-EXT = SPACE-CONDITIONS    $ Office Design Criteria for Perimeter Spaces $
ZONE-TYPE = CONDITIONED                        $ or = UNCONDITIONED, = PLENUM $
INF-METHOD = CRACK               $ Wall/Window/Door Infl based on Po, Pi diffr $
                                  $ Enter INF-COEF in WALL/WINDOW/DOOR Command $
 $ INF-CFM/SQFT = OFC-INFL-CFM/SF  Added to values by other methods if entered $
INF-SCHEDULE = SCH-INFL-WNDW
NEUTRAL-ZONE-HT = OFC-BLDG-HEIGHT       $ Abbrev = N-Z-H = Hi-Rise Bldg height $
NEUTRAL-LEVEL = BLDG-NEUTRAL-LVL  $ Default = 0.5 (0.5 x N-Z-H). Limits: (0,1) $
..
$---------------------Wall and Window Defaults------------------------------$

SET-DEFAULT FOR EXTERIOR-WALL      $ Exposed Widths of all 4 Bldg Sides = 220' $
    INF-COEF = OFC-WALL-INFL-C  $ Infilt CFM = Coeff x (Pi-Po)^0.8 x Wall Area $
                                            $ Pi,Po = Inside, Outside Pressure $
..
SET-DEFAULT FOR WINDOW                             $ Applies to all 4 Bldg Sides $
    INF-COEF = OFC-WNDW-INFL-C $ Infilt CFM = Coeff x (Pi-Po)^0.5 x Wndw Perim $
                                            $ Pi,Po = Inside, Outside Pressure $
..
$--------------------------------------------------------------------------$
```