

Chicago Center for Green Technology (CCGT)

445 N. Sacramento Ave., Chicago, Illinois

ECO-#	Energy Conservation Options - ECO	Million Btu/Hr/Year				Million Btu/Hr/Year				Million Btu/Hr/Year		KWH/yr		% Energy		Electric Cost \$ / Year			Nat-Gas \$/Year		% Costs	
		Lights	Equip	Heatng	Heatng	Coolng	Ht-Rej	Pumps	Fans	DHW	DHW	Total	Total	% of	%	Fixed/Month = \$600			\$	\$	% of	%
		Electric	Electric	Electric	Nat-Gas	Electric	Electric	Electric	Electric	Electric	Nat-Gas	Energy	Energy	Base	Svngs	Energy	Demand	Total	Nat-Gas	Total	Base	Svngs
ECO-EQ	Base - eQUEST Wizard Defaults	308.6	156.5		449.5	110.0		1.5	41.5		17.3	1,085	317,962	68	32	23,625	11,159	35,384	5,031	40,415	89	11
ECO-0	Base ASHRAE Std 90-89. OA-Econ	291.9	172.6		949.4	124.0		1.5	48.8		17.4	1,606	470,569	100	0	23,345	12,823	36,768	8,625	45,393	100	0
ECO-1	ECO-0 + Windw OvrHngs South	291.9	172.6		994.8	111.6		1.5	49.4		17.4	1,639	480,417	102	-2	22,877	12,500	35,977	8,949	44,926	99	1
ECO-2	ECO-1 + Std 90-04 Glass & Lights	248.9	172.6		941.7	97.8		1.5	44.7		17.4	1,525	446,830	95	5	20,696	11,120	32,416	8,571	40,987	90	10
ECO-3	ECO-2 + Day-Lighting	139.7	172.6		992.9	83.5		1.5	44.8		17.4	1,452	425,669	90	10	16,270	9,216	26,086	8,937	35,023	77	23
ECO-4	ECO-3 + PhotoVoltaics (S-Wall/Roof)	75.0	89.0		992.9	29.9		1.2	23.0		17.4	1,228	360,019	77	23	7,929	7,979	16,508	8,937	25,445	56	44
ECO-4a	ECO-3 + PhotoVoltaics (Fixed-Shade)	137.6	168.5		1,007.8	78.7		1.5	44.2		17.4	1,456	426,637	91	9	15,840	9,005	25,445	9,044	34,489	76	24
ECO-5	ECO-4 + GSHP (200' deep 8x4 config)	92.3	110.6		127.6	29.9		9.9	99.9		17.4	488	142,906	30	70	25,185	12,863	38,648	1,656	40,304	89	11
ECO-5a	ECO-4 + GSHP (100' deep 2x2 config)	88.5	105.8		77.5	40.4		8.4	93.6		17.4	432	126,493	27	73	14,931	13,683	29,214	1,657	30,871	68	32

How did the PV analysis determine these numbers ?? Distributed to End-Uses?? Does it adjust Demand Costs ??
 Is the solar light energy from the TMY weather file ?? Is it adjusted for Cloud-Cover & Atmospheric conditions ??
 ECO-4 KWH from PV attached to S-Wall & Roof= ECO-3 less ECO-4 =

425,669	360,019	65,650
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 ECO-4a KWH from PV attached to Fixed-Shades= ECO-3 less ECO-4a =

425,669	426,637	-967
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GSHP KWH Energy Decrease =	-217,114	% Decrease =	-60
GSHP Electric Cost Increase =	22,140	% Increase =	134
GSHP Nat-Gas Cost Decrease =	-7,281	% Decrease =	-81
GSHP Total Net Cost Increase =	14,859	% Increase =	58

200' deep 8x4 config uses more energy than 100' deep 2x2 config ??

ASHRAE Std 90 Base = 1989 Prop = 2004

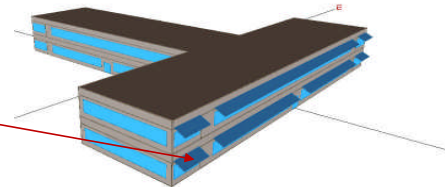
Building Model	Value
Flr-Flr Hgt (ft)	13.5
Flr-Ceilg Hgt (ft)	10.0
Window Hgt (ft)	6.0
Windw Wdth (ft)	
Window Percent	50.0

Properties	1989	2004
	Base	Prop
Wall - U	0.123	0.123
Roof - U	0.064	0.064
Glass - U	0.67	0.45
Glass - SC	0.40	0.30
Glass-VLT used	0.40	0.30

Internal Heat-Gains

Internal HGs	Perimeter		Inter/Core	
	Base	Prop	Base	Prop
Lights W/sf	1.3	1.1	0.8	0.7
Occup sf/P	144	144	200	200
Equip W/sf	0.7	0.7	0.3	0.3

PV-Modules are attached to OverHangs. Not possible with eQUEST. Some are on Roof



"PV-Mod L1-B-W Swall" = PV-MODULE

TYPE = MC-SI
 HEIGHT = 5
 WIDTH = 15
 VOLTS-OPEN-CKT = 110
 VOLTS/T-OPEN-CKT = -0.004
 AMPS-SHORT-CKT = 10
 AMPS/T-SHORT-CKT = -0.0015
 VOLTS-MAX-PWR = 75
 AMPS-MAX-PWR = 5

Required for each PV wall ??

"PV-GEN L1-B-W Swall PV-Shade-1" = ELEC-GENERATOR

TYPE = PV-ARR CAPACITY = 1
 MIN-TRACK-VOLTS = 0
 MAX-TRACK-VOLTS = 110
 PV-MODULE = "L1-B-W Swall-PV 165'W x 5'
 MOUNT-TYPE = BUILDING-SHADE
 BUILDING-SHADE = "Level-1 Bldg-B S-Wall PV Sha
 MOUNT-AZIMUTH = 180 MOUNT-TILT = 30

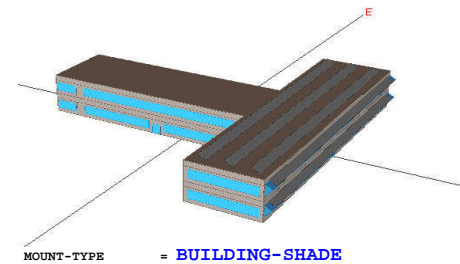
Need documentation on the meaning of all the terms used. Need examples, defaults. These are all guesses

"PV-GEN L1-B-W Surface" = ELEC-GENERATOR

TYPE = PV-ARR CAPACITY = 1
 MIN-TRACK-VOLTS = 0 MAX-TRACK-VOLTS = 110
 PV-MODULE = "PV L1-B-W Swall"
 MOUNT-TYPE = BUILDING-SURFACE
 EXTERIOR-WALL = "L1-B-W South Wall (G.W6.E6)"
 MOUNT-TILT = 30

Given a Building SURFACE or SHADE, how does the program determine the number of modules in series & parallel and the number of inverters ??

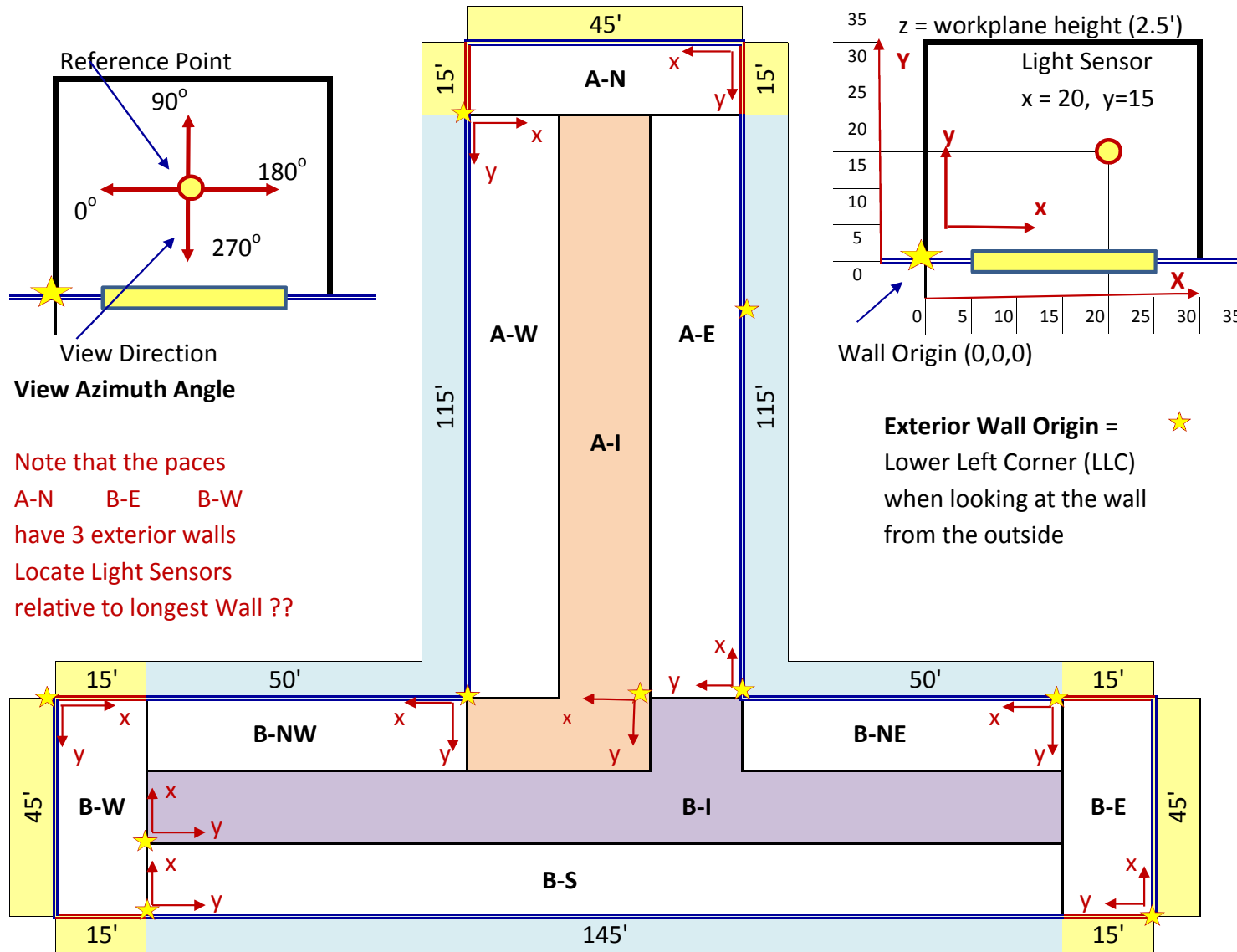
MOUNT-TYPE = BUILDING-SURFACE



Light Sensors for Daylighting

(Default Locations from eQUEST)


		SetPnt	ContrlId	MnPwr	MnLgt	Max	View-	Ref-1	Ref-1	Ref-1	View-	Ref-2	Ref-2	Ref-2
Space Name		Systm	KW Frct	Fract	Fract	Glare	AZ 1	X (ft)	Y (ft)	Z (ft)	AZ 2	X (ft)	Y (ft)	Z (ft)
A-L1 North (G.N1)		50	0.5	0.3	0.3	100		22.5	4.95	2.5		22.5	9.9	2.5
A-L1 East (G.E2)		50	0.5	0.3	0.3	100		57.5	4.95	2.5		57.5	9.9	2.5
A-L1 West (G.W3)		50	0.5	0.3	0.3	100		4.95	57.5	2.5		9.9	57.5	2.5
B-L1 West (G.W4)		50	0.5	0.3	0.3	100		4.95	12.45	2.5		9.5	12.45	2.5
B-L1 East (G.E5)		50	0.5	0.3	0.3	100		22.5	4.95	2.5		22.5	9.9	2.5
B-L1 South (G.S6)		50	0.5	0.3	0.3	100		72.5	4.95	2.5		72.5	9.9	2.5
B-L1 North-W (G.N7)		50	0.5	0.3	0.3	100		18.75	4.95	2.5		18.75	9.9	2.5
B-L1 North-E (G.N8)		50	0.5	0.3	0.3	100		18.75	4.95	2.5		18.75	9.9	2.5
A-L1 Inter (G.C9)		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
B-L1 Inter (G.C10)		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
L1 Plenum (G.11)		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A-L2 North (T.N12)		50	0.5	0.3	0.3	100		22.5	4.95	2.5		22.5	12.45	2.5
A-L2 East (T.E13)		50	0.5	0.3	0.3	100		57.5	4.95	2.5		57.5	12.45	2.5
A-L2 West (T.W14)		50	0.5	0.3	0.3	100		4.95	57.5	2.5		12.45	57.5	2.5
B-L2 West (T.W15)		50	0.5	0.3	0.3	100		7.5	4.95	2.5		7.5	12.45	2.5
B-L2 East (T.E16)		50	0.5	0.3	0.3	100		22.5	4.95	2.5		22.5	12.45	2.5
B-L2 South (T.S17)		50	0.5	0.3	0.3	100		72.5	4.95	2.5		72.5	12.45	2.5
B-L2 North-W (T.N18)		50	0.5	0.3	0.3	100		18.75	4.95	2.5		18.75	12.45	2.5
B-L2 North-E (T.N19)		50	0.5	0.3	0.3	100		18.75	4.95	2.5		18.75	12.45	2.5
A-L2 Inter (T.C20)		50	1	0.3	0.3	100		20	-47.8	2.5		n/a	n/a	2.5
B-L2 Inter (T.C21)		50	1	0.3	0.3	100		25	30	2.5		n/a	n/a	2.5
L2 Plenum (T.22)		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a



Midwest Center for Green Technology (MCGT)

445 N. Sacramento, Chicago, Illinois

First Floor Plan

Approximate Scale
 3' x 3' (9 ft2)

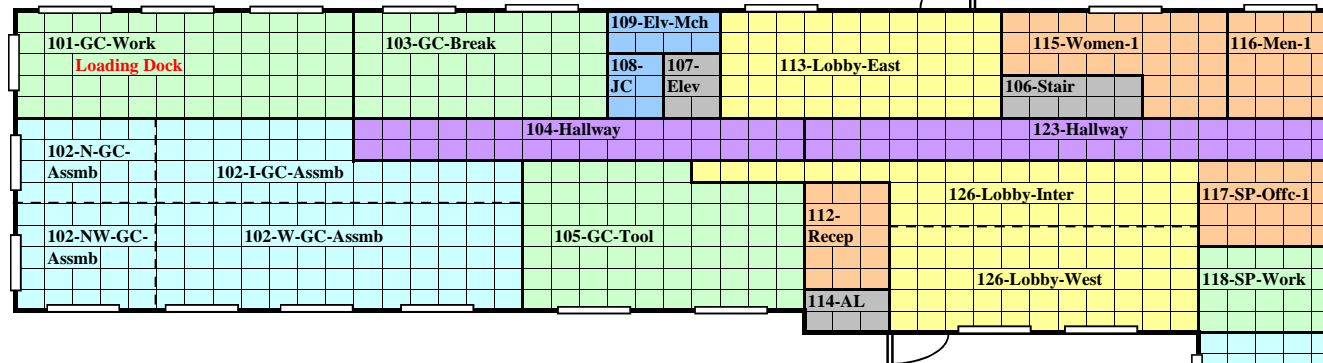


Wall Height = 13.54'
 Window Height = 5.3'
 Window Width = 10.7'

GC : Greencorps
 SP : Spire
 Spec : Speculative

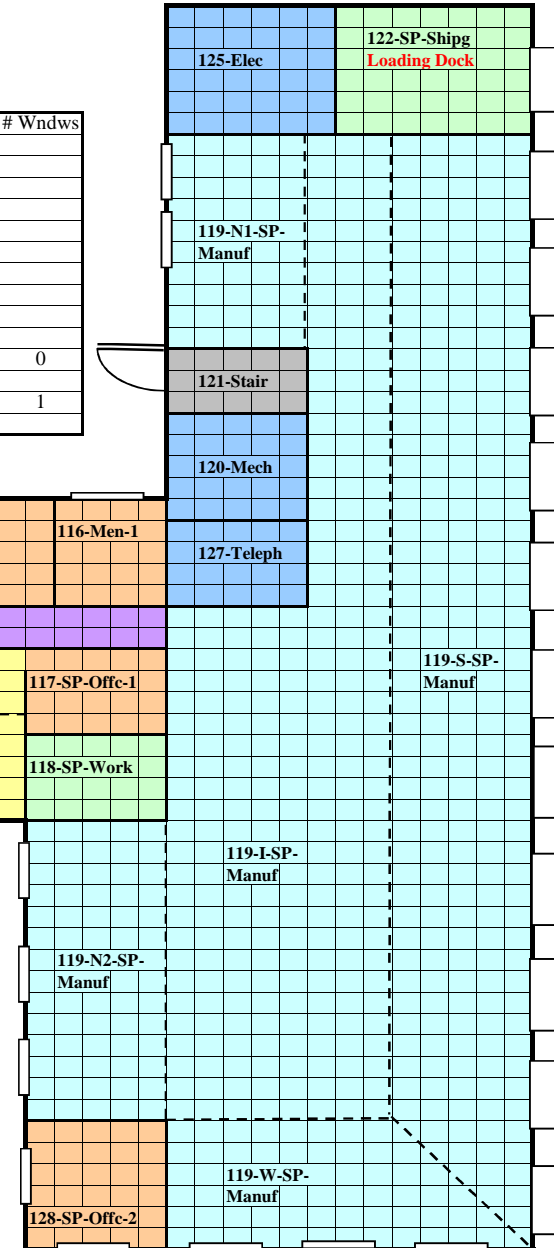
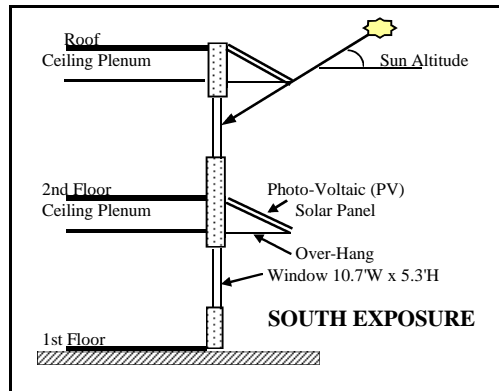
HP-1-1	Area-sf	Wall-1'	# Wndws	Wall-2'	# Wndws
101-GC-Work	360	36-E	3	15-N	1
102-I-GC-Asmb	360				
102-N-GC-Asmb	180	12-N	1		
102-NW-GC-Asmb	225	15-N	1	15-W	1
102-W-GC-Asmb	585	36-W	3		
103-GC-Break	405	27-E	2		
104-GC-Hall	285				
105-GC-Tool	595	30-W	2		
106-Stairs	90				
107-Elevator	55				
108-Jan-Closet	55				
109-GC-Mech	70	12-E	0		
Total (HP-1-1)	3,265				

HP-1-2	Area-sf	Wall-1'	# Wndws	Wall-2'	# Wndws
117-SP-Office-1	180				
118-SP-Work	180				
119-I-SP-Manuf	2,275				
119-N1-SP-Manuf	450	30-N	2		
119-N2-SP-Manuf	630	42-N	3		
119-W-SP-Manuf	565	39-W	3		
119-S-SP-Manuf	2,410	168-S	11		
120-Mechanical	220	12-N			
121-Stairs	155	9-N			
123-SP-Hall	295				
125-Electrical	270	18-N	0	18-E	0
127-Telephone	150				
128-SP-Office-2	235	8-N	1	15-W	1
Total (HP-1-2)	7,475				



HP-2-5 (1st Flr)	Area-sf	Wall-1'	# Wndws
112-Reception	135		
113-Lobby-East	450	30-E	2
114-Air-Lock	55		
115-Women	270	24-E	1
116-Men	180	12-E	1
123-Hallway-1	215		
124-Hallway-2	80		
126-Lobby-Inter	360		
126-Lobby-West	495	33-W	2
Total (HP-2-5)-1st	2,240		

HP-1-2	Area-sf	Wall-1'	# Doors	Wall-2'	# Doors
Loading Docks-HV	180	6-E	1	6-N	1
101-GC-Loading					
122-SP-Loading	380	21-E	1	18-S	1
Total (HP-1-2)	560				



Midwest Center for Green Technology (MCGT)

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Second Floor Plan

Approximate Scale
3' x 3' (9 ft²)



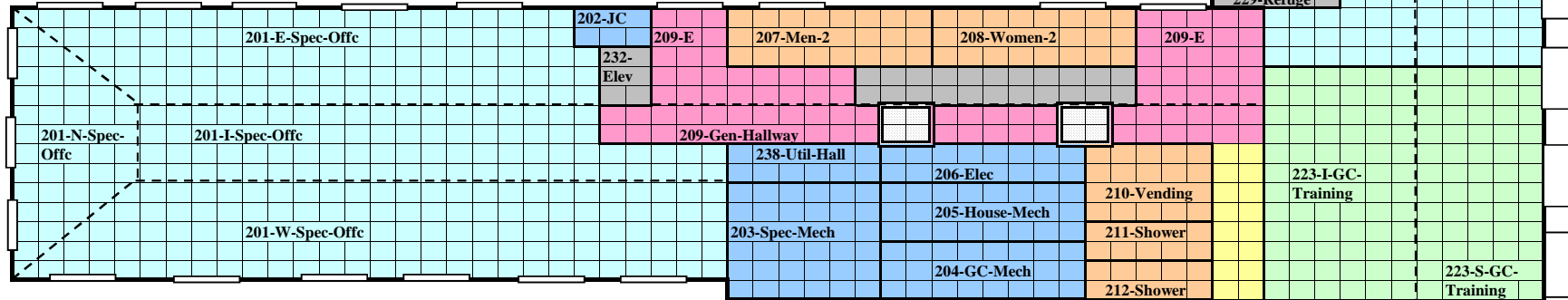
Wall Height = 13.54'
Window Height = 5.3'
Window Width = 10.7'

GC : Greencorps
SP : Spire
Spec : Speculative

HP-2-1	Area-sf	Wall-1'	# Wndws
201-I-Spec-Offc	735		
201-E-Spec-Offc	900	66-E	5
201-N-Spec-Offc	405	42-N	3
201-W-Spec-Offc	1145	84-W	6
Total (HP-2-1)	3,185		

HP-2-2	Area-sf	Wall-1'	# Wndws
225-I-SP-Offc	645		
225-N-SP-Offc	510	42-N	3
225-E-SP-Offc	315	39-E	3
225-S-SP-Offc	1,080	78-S	6
226-SP-Priv-Offc	80	9-N	0.5
227-SP-Storage	30		
228-Firestair	180	12-N	0.5
229-Refuge	90	6-N	0.5
Total (HP-2-2)	2,930		

HP-2-3	Area-sf	Wall-1'	# Wndws	Wall-2'	# Wndws
204-GC-Mech	215.0	24-W	0		
211-GC-Shower	90.0				
213-GC-Pr-Offc-1	225.0	15-N	1		
214-GC-Pr-Offc-2	225.0	15-N	1		
215-GC-Hallway	305.0				
216-GC-Library	270.0				
217A-GC-Gn-Ofc1	360.0	24-S	1.5		
217B-GC-Gn-Ofc2	360.0	24-S	1.5	15-W	1
218-GC-Confernc	225.0	15-N	1	15-W	1
219-GC-Kitchen	180.0	15-W	1		
220-GC-Pr-Bath	105.0	9-W	1		
221-GC-Copy-Rm	105.0				
222-GC-Pr-Offc-3	225.0	15-N	1		
230-Reception	145.0				
231-GC-Circulate	360.0				
Total (HP-2-3)	3,395				

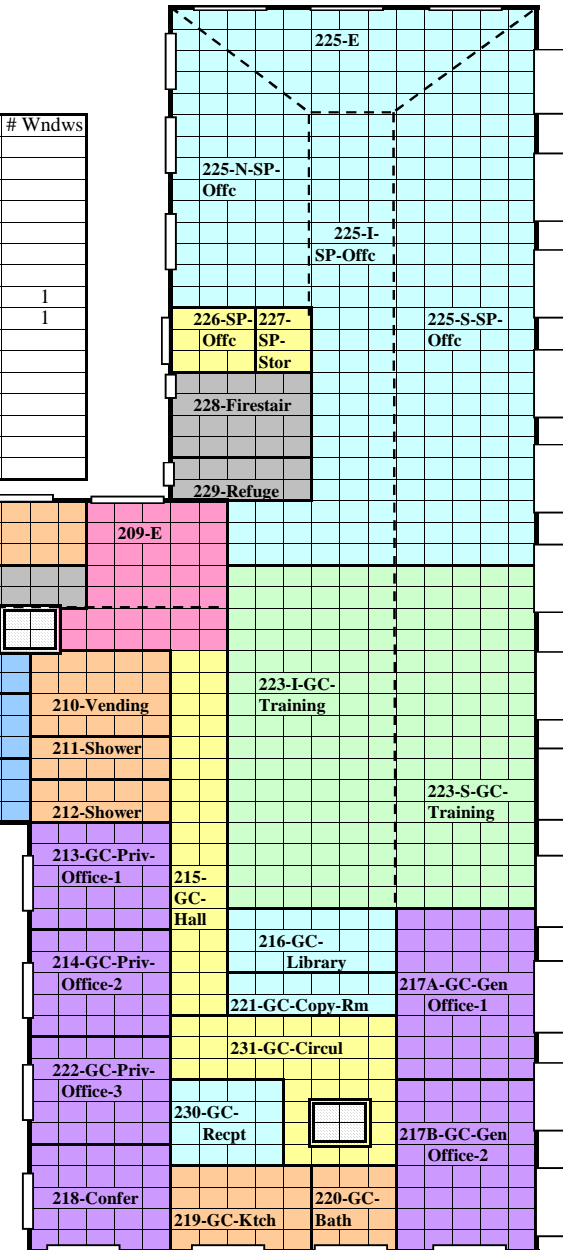


HP-2-4	Area-sf	Wall-1'	# Wndws
205-House-Mech	215		
206-Electrical	145		
210-Kitch-Vend	180		
223-I-GC-Training	864		
223-S-GC-Training	720	48-S	4
Total (HP-2-4)	2,124		

HP-2-5 (2nd Flr)	Area-sf	Wall-1'	# Wndws
202-Jan-Closet	50	9-E	0
203-Spec-Mech	325	3-N	0
207-Men	215	24-E	1
208-Women	215	24-E	1
209-I-Hallway	485		
209-E-Hallway	450	24-E	2
232-Elev-Shaft	55		
233-Util-Hall	105		
Total (HP-2-5)-2nd	1,900		
Total (HP-2-5)-1+2	2,115		

Coefficient of Performance (COP) : Rate of Heat removed (cooling) or delivered (heating) to rate of energy input in consistent units		
Energy Efficiency Ratio (EER) : Ratio of net equipment cooling capacity (btu/hr) to total rate of electric energy input (watts)		
Electric Input Ratio (EIR) : Ratio of Electric Energy Input in btu/hr (KW * 3.412) to Heating or Cooling Energy Output in btu/hr		
Heat Input Ratio (HIR) : Ratio of Fuel Energy Input to Heating Energy Output		
KW / Ton = 3.517 / COP	EER = 3.412 * COP	COP = 0.293 * EER
KW / Ton = 12 / EER	KW / Ton = 3.517 * EIR	COP = 1 / EIR
Ton = 12,000 btu/hr	KW = 3,412 btu/hr	Heating: HIR = EIR

EQUIPMENT	COOLING				HEATING	
	EIR	COP	EER	Kw/Ton	HIR	% Effic
Existing HP	0.367	2.725	9.297	1.291	0.263	380
Proposed HP	0.303	3.300	11.261	1.066	0.250	400
Existing Boiler					1.250	80
Proposed Boiler					1.110	90
Existing DHW					1.282	78
Proposed DHW					1.110	90



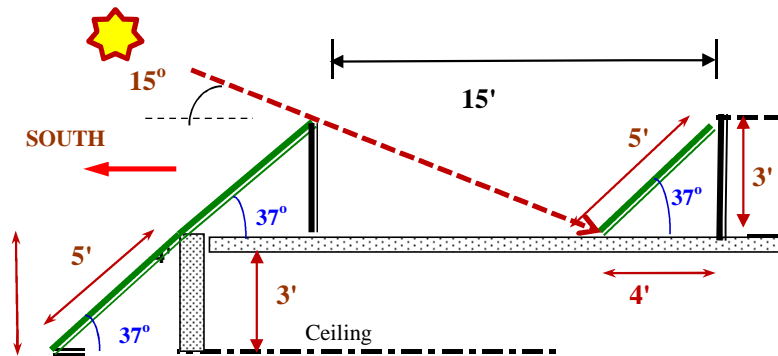
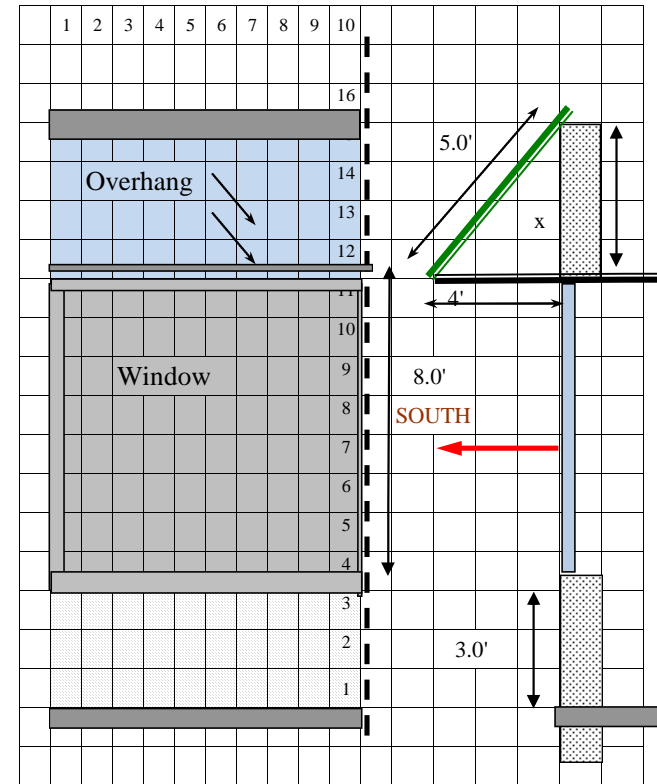
Middle School and Community Center

Solar (includes Cloud Cover) Analysis to Determine Optimum PV Tilt Angle

Based on Chicago (42° latitude) & Weather (CC)

From DOE2.1E Run "PV-Chi42.inp" **Total PV Surface Area = 51,000**

TILT Angle	Solar Rad.	M-btuh/ft2 for 8,760 Hou			10% of SUM	M-btuh / ft2 / Yr	KW / ft2/Yr	Total kwh/Yr	Total Mbtuh/Y
		MAX	AVG	SUM					
15°	Total	325.4	56.2	491,925	49,193	0.049	14.4	735,293	2,509
	Direct	267.5	34.0	297,878	29,788	0.030	8.7	445,245	1,519
30°	Total	333.6	58.9	516,044	51,604	0.052	15.1	771,343	2,632
	Direct	276.9	36.1	315,875	31,587	0.032	9.3	472,146	1,611
45°	Total	337.9	58.5	512,382	51,238	0.051	15.0	765,870	2,613
	Direct	275.4	35.7	312,507	31,251	0.031	9.2	467,112	1,594
60°	Total	330.7	54.9	481,217	48,122	0.048	14.1	719,287	2,454
	Direct	271.4	32.9	287,940	28,794	0.029	8.4	430,391	1,468
75°	Total	311.5	48.6	425,678	42,568	0.043	12.5	636,271	2,171
	Direct	260.2	27.9	244,699	24,470	0.024	7.2	365,758	1,248



Optimum Tilt Angle for PV-Panel facing South = between 30 and 45 degrees

PV Length = E-W Width *

of PV Panels = Block N-S Length / 10 = Y / 10

PV Area = PV-Length * 5 * (# PV % Net Area = 75%)

PV-Eff (light to 110V) = 15%