

Appendix

Appendix A: Structural Analysis

Lateral System Distribution Check

Frame	NS-Load Direction			
	Total	Col	Brace	Wall
A	0	0	0	0
B	395.0119	5.6586	30.3466	359.0067
C	0.0457	0.0457	0	0
D	0.1928	0.1928	0	0
E	352.1036	5.5897	31.4656	315.0483
F	0.132	0.0335	0	0.0985
G	0	0	0	0
H	0.429	0.429	0	0
J	0.48	0.48	0	0
K	687.2726	4.686	6.271	676.3156
L	11.2206	0.031	0	11.1896
M	6.6218	0.2942	0	6.3276
N	0.1065	0.0102	0	0.0963
P	0.0675	0.0675	0	0
Q	0.6474	0.6474	0	0
R	0.5752	0.0027	0	0.5725
S	0	0	0	0
T	0.0023	0.0023	0	0
U	0.0178	0.0178	0	0
V	106.8865	1.8679	0	105.0186
W	0.022	0.022	0	0
X	0.0005	0.0005	0	0
Y	0.0003	0.0003	0	0
Z	0	0	0	0
AA	5.6249	0.5613	5.0637	
BB	0	0	0	0
Radial	0.7654	0.7654	0	0
Total	1568.2263			
Applied	1581			
% diff	0.81			



EW-Load Direction

Frame	Total	Col	Brace	Wall
1	0.4053	0.1355	0	0.2698
2	393.6461	5.2453	13.1252	375.2756
3	0.0374	0.0374	0	0
4	0.2228	0.2228	0	0
5	316.6231	4.9592	28.0517	283.6122
6	4.6241	0.0207	0	4.6034
7	0	0	0	0
8	0.1356	0.1356	0	0
9	0.3765	0.3765	0	0
10	666.1471	4.8363	5.5675	655.7433
11	7.4544	0.4752	6.9792	0
12	3.2325	0.0622	3.1703	0
13	0.0201	0.001	0	0.0191
14	0.0285	0.0285	0	0
15	83.525	2.2138	0	81.3112
16	0.07	0.07	0	0
17	0.00833	0.00833	0	0
18	0.00078	0.00078	0	0
19	0.0012	0.0012	0	0
20	15.7909	0.1521	0	15.6388
21	0	0	0	0
Radial	21.9897			21.9897
Total	1514.34			
Applied	1581			
% diff	4.22			

Torsional Irregularity/Drift Data

Max Displacement	Max Drift
0.0519 in @ Rf.	0.0103 %
0.0653 in @ Rf.	0.016 %
0.0679 in @ Rf.	0.0171 %

Check of Wall on Frame 2

Check Concrete Wall

$V_u =$	375	K	$l_w =$	44	ft
$V_c =$	1603	K	$h_w =$	56	ft
$\phi =$	0.75		$t_w =$	30	in

$$\phi V_c = 1202 > V_u, \text{ OK}$$

Check Braces

$$V_u = 13.13 \text{ K}$$

$$\phi V_n$$

$$W14 \times 90 \quad 185 \text{ K}$$

$$W14 \times 99 \quad 206 \text{ K}$$

$$W14 \times 120 \quad 256 \text{ K}$$

$$\text{Total} = 647 > V_u, \text{ OK}$$

Check Columns

$$V_u = 5.25 \text{ K}$$

$$\phi V_n$$

$$W14 \times 550 \quad 1450 \text{ K}$$

$$W14 \times 550 \quad 1450 \text{ K}$$

$$W14 \times 283 \quad 648 \text{ K}$$

$$W14 \times 283 \quad 648 \text{ K}$$

$$W14 \times 283 \quad 648 \text{ K}$$

$$\text{Total} = 4844 > V_u, \text{ OK}$$



Check of Wall on Frame 15

Check Concrete
Wall

$V_u =$	81	K	$l_w =$	22	ft
$V_c =$	481	K	$h_w =$	20	ft
$\phi =$	0.75		$t_w =$	18	in

$$\phi V_c = 361 > V_u, \text{OK}$$

Check Columns

$$V_u = 2.21 \text{ K}$$

$$\phi V_n$$

$$W14X99 \quad 206 \text{ K}$$

$$W14X99 \quad 206 \text{ K}$$

$$\text{Total} = 412 > V_u, \text{OK}$$

Check of Wall on Frame 10

Check Concrete Wall

$V_u =$	666	K	$l_w =$	66	ft
$V_c =$	1282	K	$h_w =$	56	ft
$\phi =$	0.75		$t_w =$	16	in

$$\phi V_c = 962 > V_u, \text{OK}$$

Check Columns

$$V_u = 4.84 \text{ K}$$

$$\phi V_n$$

$$W14x283 \quad 648 \text{ K}$$

$$W14x283 \quad 648 \text{ K}$$

$$W14x90 \quad 185 \text{ K}$$

$$W14x90 \quad 185 \text{ K}$$

$$\text{Total} = 1666 > V_u, \text{OK}$$

Lateral Loads

Design Seismic Base Shear (ASCE7-05)

$$V = C_s W \quad 12.8-1$$

W: Effective Weight- 12.7.2

Cs: Seismic Coeff.- 12.8.1.1

$$C_s = \min \left\{ \begin{array}{l} S_{ds}/(R/I) \\ S_{D1}/(T^*R/I) \\ S_{D1}*T1/(T^2*R/I) \end{array} \right\} > 0.01$$

In addition, where $S_1 > 0.6$

$$C_s > 0.5S_1/(R/I) \quad \text{Eq. 12.8-6}$$

Fa, Fv- Table 11.4-1, 11.4-2

Ss, S1- USGS website, using long./lat. of site location

R: Response Mod. Coeff.- Table 12.2-1

I: Importance Factor- 11.5

Occ. Cat.- Table 1-1

$$T = \min \left\{ \begin{array}{l} C_u * T_a \\ T_b \end{array} \right\} \quad \begin{array}{ll} S_{ds} = 2/3(S_{MS}) & S_{MS} = F_a * S_s \\ S_{D1} = 2/3(S_{M1}) & S_{M1} = F_v * S_1 \end{array}$$

Cu- Table 12.8-1

Ta- 12.8.2.1

Tb- Fundamental Mode of Vibration from Modal Analysis w/Mass input

Design Seismic Base Shear- MSC Complex, University Park, PA

Latitude: 40.802

Site Class: D

Longitude: -77.86

Occ. Cat: III

$$S_s = 0.147 \text{ g (Site Class B)}$$

$$S_1 = 0.049 \text{ g (Site Class B)}$$

$$F_a = 1.6$$

$$F_v = 2.4$$

$$S_{MS} = 0.2352 \text{ g}$$

$$S_{DS} = 0.1568 \text{ g}$$

$$S_{M1} = 0.1176 \text{ g}$$

$$S_{D1} = 0.0784 \text{ g}$$



Lateral Force Resisting System: Ordinary Steel Concentrically Braced Frames

$$R = 3.25$$

$$I = 1.25$$

SDC: B (No Limitations)

$$Tl = 6 \text{ s (Fig. 22-15)}$$

Design Base Shear

$$T_a = 0.512 \text{ s} \quad C_s = \text{Min} \left| \begin{array}{l} 0.0603 \\ 0.0346 \end{array} \right| = 0.0346$$

$$C_u = 1.7$$

$$C_u * T_a = 0.871 \text{ s} \quad \left| \begin{array}{l} 0.2386 \end{array} \right|$$

Floor Weights (slabs, beams, columns, façade)

	slabs(K)	columns(K)	beams(K)	braces(K)	façade(K)	W(K)
Level-2	4186.6	472.09	889.46	582.312 6	1331	7461.03
Level-3	4670.6	383.12	1011.99	935.059 7	1890	8890.80
Mech.	6258.12	280.02	762.95	1024.64 6	2213	10538.70
Roof	1771.44	147.31	481.01	761.485 7	2590	5751.22
					Total	32641.75

$$V = C_s * W$$

$$C_s = 0.0346$$

$$W = 45663 \text{ K}$$

$$V = 1581 \text{ K}$$

MWFRS Wind Analysis (ASCE7-05)- MSC Complex

Location:	University Park, PA
Topography:	Campus Setting. Buildings to North, North West, West, and South. Mostly open terrain to East with small obstructions
Bulding Dimensions:	L-Shaped. North Wing outside dimension = 550 ft, West Wing outside dimension = 440 ft. Building Heights (From Pollock Road): 85'-6" ft to Roof level, 66 ft to Mechanical Penthouse, 48 ft to Third Floor, 30 ft to second floor, 10 ft to first floor. Roof Step Backs: Roof steps to: North Wing- Steps Down to Mech. Penthouse level at 220 ft, Third Floor at 330 ft, and Second Floor at 440 ft. - Same on West Wing except the last step down does not exist
Framing:	Primarily Steel Framing- W-Flange columns, beams, and cross-bracing. The floor system is a composite beam and concrete slab on metal deck.
Cladding:	Alternate horizontal strips of precast concrete panels and exterior glazing for each floor of elevation. Assume no debris resistant glazing.
Roof Top:	Primary Roof consists of EPDM Walkway Pads and EODM Flooring Membrane tapered. The lower roofs are all green roofs. All roofs flat.

a) Basic Wind Speed (Fig. 6-1): $V = 90\text{mph}$

b) Exposure: (6.5.2.3) Exposure B: Urban/Suburban, wooded, numerous closely spaced obstructions- single family dwellings and larger.

c) Building Classification: Construction Type IIIB, Occ. Cat: B with special Occ. areas of H-5

d) Velocity Pressure: $q_z = 0.000256k_zk_zt k_d V^2 I$

k_z (Table 6-3) =	15	20	39	57	75.75	87	(ft)
	0.575	0.624	0.755	0.842	0.913	0.950	

k_{zt} (Fig. 6-4) =	1	, assume homo-topo	
k_d (Table 6-4) =	0.85	, buildings	
$V^2 = 90^2 =$	8100		
I (Table 6-1) =	1.15		
$q_z =$	20.27	*k_z	psf *depends on height

e) Gust Effect Factor: $G = 0.85$ (Rigid Structure $T < 1.0\text{s}$, refer to Seismic Analysis)

f) Internal Pressure Coefficient: $GC_{pi} = \pm 0.18$ (assume Enclosed Building)



g) Design Wind Pressures: $P = qGC_p - q_i(GC_{pi})$

$q = q_z$ (windward, depends on height)

$q = q_h$ (leeward, taken at height-h)

$G = 0.85$

$q_i = q_h$ (windward, leeward, and roofs for enclosed buildings)

$GC_{pi} = +/- 0.18$

Cp values determined:

h) Wall Cp: (Fig. 6-6 cont'd)

Cpw =	0.8	(windward, with q_z)
Cpsw =	-0.07	(side walls, with q_h)
Cpl =	-0.5	L/B = 0-1 (Leeward, with q_h)
	-0.3	L/B = 2
	-0.2	L/B = > 4

i) Roof Cp: (Fig. 6-6 cont'd)

angle < 10deg., $h/L < 0.5$

Hor. Dist. From Wind. Edge		Cp (1st)	Cp (2nd)
0-h/2, h/2-h		-0.9	-0.18
h-2h		-0.5	-0.18
> 2h		-0.3	-0.18

j) MWFRS Pressures $P = qGC_p - q_i(GC_{pi})$

Terrain Exposure Constants

Exposure	α	Zg(ft)	$\hat{a}$	$b^{\wedge}$	$\alpha-$	b-	c
B	7.00	1200.00	0.14	0.84	0.25	0.45	0.30

l (ft)	ϵ	Zmin (ft)
320.00	0.33	30.00

Windward Walls

Height	q_z	G	C_p	q_zGC_p
z= 15ft	11.65	0.85	0.8	7.92
z= 20ft	12.65	0.85	0.8	8.60
z= 39ft	15.31	0.85	0.8	10.41
z= 57ft	17.06	0.85	0.8	11.60
z= 75.75ft	18.50	0.85	0.8	12.58
z= 87ft	19.25	0.85	0.8	13.09

Leeward Walls

	qh	G	Cp	qhGCp
Wind- short side	19.25	0.85	-0.2	-3.27
Wind-Long Side	19.25	0.85	-0.5	-8.18
Side Walls	19.25	0.85	-0.7	-11.45

Roof- First Value

Length	qh	G	Cp	qzGCp
0-h	19.25	0.85	-0.9	-14.73
h-2h	19.25	0.85	-0.5	-8.18
>2h	19.25	0.85	-0.3	-4.91

Roof- Second Value

	qh	G	Cp	qzGCp
all lengths	19.25	0.85	-0.18	-2.95

Wall Areas

	Windward			Leeward-Long Side		Leeward-Short Side
Height	E/W(SF)	N/S(SF)		E/W(SF)	N/S(SF)	E/W=N/S(SF)
z= 0-15ft	6398	8335		4638	6571	1760
z= 15-20ft	2136	2778		1549	2195	587
z= 20-39ft	8444	10141		6215	7911	2229
z= 39-57ft	7564	7564		5452	5452	2112
z= 57-75.75ft	5753	5753		3553	3553	2200
z= 75.75-87ft	2740	2740		1420	1420	1320

Floor Loads by Area

	Windward		Leeward-Long Side		Leeward-Short Side
Floor Level	E/W(K)	N/S(K)	E/W(K)	N/S(K)	E/W=N/S(SK)
First Floor	52.2	67.9	38.0	53.8	5.8
Second Floor	87.9	105.5	50.8	64.7	7.3
Third Floor	87.7	87.7	44.6	44.6	6.9
Mech. Pent.	72.4	72.4	29.1	29.1	7.2
Roof	35.9	35.9	11.6	11.6	4.3



Final Story Forces		y	x				
		Load		Shear		Moment	
Floor Level		E/W(K)	N/S(K)	E/W(K)	N/S(K)	E/W(K-ft)	N/S(K-ft)
First Floor		153	204	867	968	1534	2040
Second Floor		234	284	713	764	7009	8523
Third Floor		223	223	480	480	10694	10694
Mech. Pent.		174	174	257	257	11473	11473
Roof		83	83	83	83	7087	7087
Totals*(1.6)				867	968	37798	39817

Components and Cladding		Wall Panels			p = q(GCp) – qh (GCpi) (lb/ft ²)		
Windward					Area 4/5		
Floor Level	Wall Area	h	qz	qh	GCp	Gcpi	P(psf)
First Floor	440	20	12.65	19.25	0.638	0.18	11.53
Second Floor	418	39	15.31	19.25	0.651	0.18	13.43
Third Floor	396	57	17.06	19.25	0.665	0.18	14.81
Mech. Pent.	412.5	75.75	18.50	19.25	0.655	0.18	15.58
Roof	214.5	87	19.25	19.25	0.778	0.18	18.45

Leeward					Area 4	Area 5			
Floor Level	Wall Area	h	qz	qh	GCp	GCp	Gcpi	P4(psf)	P5(psf)
First Floor	440	20	12.65	19.25	-0.725	-1.100	0.18	-17.42	-24.64
Second Floor	418	39	15.31	19.25	-0.734	-1.137	0.18	-17.60	-25.35
Third Floor	396	57	17.06	19.25	-0.743	-1.173	0.18	-17.77	-26.05
Mech. Pent.	412.5	75.75	18.50	19.25	-0.736	-1.146	0.18	-17.64	-25.52
Roof	214.5	87	19.25	19.25	-0.819	-1.476	0.18	-19.23	-31.87

Moment Due to Wind - ASCE7-05

	X	Y		
	Length	Length	MTx	MTy
First Floor	5120	6668	117814.6	203993.9
Second Floor	5468	6916	191627.7	294721.3
Third Floor	5596	5596	187014.5	187014.5
Mech. Penthouse	4276	4276	111496.1	111496.1
Roof	2956	2956	36754.47	36754.47

Gravity Systems Check

PAUL KUEHNEL

BUILDING STIMULUS

GRAVITY SYSTEM - MEMBER SIZE CONFIRMATION (TYP. BEAM)

$$\text{ASSUME } a = 1' : y_2 = t - \frac{a}{2} = 5.5"$$

$$M_u = 258.7 \text{ k} \cdot \text{ft} \quad - \text{FROM GRAVITY LOAD SPREADSHEET}$$

TRY W14x22 - TABLE 3-19

$$\phi M_n = 266 \text{ k} \cdot \text{ft} \quad \lambda_{cn} = 241 \rightarrow 241/17.2 = 14.0 \rightarrow 28 \text{ studs}$$

$$a = \frac{241}{.85(4)(66)} = 1.07 \quad y_2 = 6.25 - \frac{1.07}{2} = 5.715 > 5.5 : \text{OK}$$

UNSUPPORTED STRENGTH

$$M_u = 258.7 \leq \phi M_n = 266 : \text{OK}$$

$$V_u = 47.0 \leq \phi V_n = 94.8 : \text{OK}$$

$$W14x22 \quad \phi_b M_p = 125 \text{ k} \cdot \text{ft} \quad - \text{TABLE 3-19}$$

$$w_u = 1.4(.05(11) + .022) = 0.801 \text{ k/ft}$$

$$w_u = 1.2(.05(11) + .022) + 1.6(0.02(11)) = 1.038 \text{ k/ft}$$

$$M_u = \frac{w_u L^2}{8} = \frac{1.038(22)^2}{8} = 62.80 \text{ k} \cdot \text{ft} \leq \phi_b M_p = 125 \text{ k} \cdot \text{ft} : \text{OK}$$

DEFLECTION CHECK

$$I = 199 \text{ in}^4$$

$$I_{LB} = 622 \text{ in}^4 \quad \text{TABLE 3-20}$$

$$\Delta_{LL} = \frac{5w_{LL}L^4}{384EI_{LB}} = \frac{5(0.15)(11)(22)^4(1728)}{384(29000)(622)} = 0.482 \text{ in} \leq \Delta_{LL} = \frac{L}{360} = 0.73 : \text{OK}$$

$$\Delta_{DBL} = \frac{5w_{DBL}L^4}{384EI} = \frac{5(0.05+0.022)(11)(22)^4(1728)}{384(29000)(199)} = 0.723 \leq \Delta_{DBL} = \frac{L}{240} = 1.10 : \text{OK}$$

W14x22 MIN. BEAM REQUIRED FOR GRAVITY SYSTEM.

W21x44 ← BEAM USED FOR VIB CONTROL.

PAUL KUEHNEL

BUILDING STIMULUS

2

TYP. GIRDER W24 x 76

$$\text{assume } a \approx 1'' \quad \therefore V_2 = + - \frac{a}{2} = 5.5''$$

$$M_u = 1040.6 \text{ 'K} \quad - \text{GRAVITY LOAD SPREADSHEET}$$

TRY W24 x 62 TABLE 3-19

$$\phi M_n = 1050 \text{ 'K} \quad \Sigma Q_n = 600 \rightarrow \frac{600}{21.2} = 28.3 \rightarrow 58 \text{ studs}$$

$$a = \frac{600}{.85(4)(66)} = 2.67 \quad V_2 = 6.25 - \frac{2.67}{2} = 4.92'' < 5.5'' \therefore \text{NG}$$

Try W24 x 68

$$\phi M_n = 1050 \text{ 'K} \quad \Sigma Q_n = 479 \rightarrow \frac{479}{21.2} = 22.6 \rightarrow 46 \text{ studs}$$

$$a = \frac{479}{.85(4)(66)} = 2.13 \rightarrow V_2 = 6.25 - \frac{2.13}{2} = 5.18 < 5.5'' \therefore \text{NG}$$

$\therefore$ USE W24 x 76 $\rightarrow$ CHECKED FOR ADEQUACY IN GIRDER CHECK TABLE

Loading Schedule

Floor Loading Schedule							Confirmed Loads	
Floor	Elevation (ft.-in.)	Occupancy	Slab Type	Loads			ASCE7-05 LL	USD - DL
				Slab (PSF)	SDL (PSF)	LL (PSF)		
Level Roof	1245'-6"	Roof	S1	50	25	30	30	48.8
Mechanical Penthouse	1226'-0"	Mechanical	S2	110	25	150		106
Third Floor	1208'-0"	Green Roof	S3	76	120	30		75.8
		Office	S1	50	30	50	50	48.8
		Material Science Labs	S1	50	30	150		48.8
		Life Science Labs	S1	50	30	150		48.8
		Corridors	S1	50	30	Area Served	Area Served	48.8
		Elevator Lobbies	S1	50	30	100	100	48.8
Second Floor	1190'-0"	Green Roof	S3	76	120	30		75.8
		Office	S1	50	30	50	50	48.8
		Material Science Labs	S1	50	30	150		48.8
		Life Science Labs	S1	50	30	100		48.8
		Corridors	S1	50	30	Area Served	Area Served	48.8
		Elevator Lobbies	S1	50	30	100	100	48.8
First Floor	1170'-0"	Plaza Landscape	S2	110	300	100	100	106
		Office	S1	50	30	50	50	48.8
		Material Science Labs	S1	50	30	150		48.8
		Life Science Labs	S1	50	30	100		48.8
		Corridors	S1	50	30	100	100	48.8
		Mechanical Mezzanine	Grating	10	10	150		
		Elevator Lobbies	S1	50	30	100	100	48.8
Basement Mezzanine	1160'-0"	Retail	S1	50	30	50		48.8



Beam Check

Bay 12-13,B-C 3rd Floor							
Member ID	W21x44						
	Shear Studs	22					
Concrete	f' _c	4	ksi				
	Density	115	pcf				
Beam	F _y	50	ksi				
	F _u	65	ksi				
	E	29000	ksi				
	I	843	in ⁴				
	I _{LB}	1490	in ⁴				
	spacing	11	ft				
	span	22	ft				
	b _{eff}	66	in				
	t	6.25	in				
	Assumed a	1	in				
	Y ₂ =t-a/2	5.5					
Loads	Dead Load						
	Slab SW	0.0500	ksf				
	Beam SW	0.0440	klf				
	SDL	0.0300	ksf				
	Total DL	0.1240					
	Live Load						
	floors supporting	1					
	L _o	0.150	ksf				
	K _{LL}	2					
	A _T	242	sf				
	K _{LL} A _T	484					
	Reduction Coeff.	Unreducible					
	L	0.150	ksf				
	Construction LL	0.02					
	Check Member Strength						
	w _u =1.2D+1.6L	4.2768	klf				
	V _u =w _u L/2	47.0	≤	φV _n	217	OK	Table 3-2
	M _u =w _u L ² /8	258.7	≤	φM _n	522	OK	Table 3-19

Check Shear Studs

$$\Sigma Q_n = 162$$

$$Q_n = 17.2$$

$$\# \text{ of Studs} = (\Sigma Q_n / Q_n) * 2$$

$$20 \leq$$

Studs Specified

22

OK

Check a

$$a = 0.721925134$$

$$\leq$$

assumed a

1

OK

Check Unshored Strength

$$w_u = 1.4D = 0.832 \text{ klf}$$

$$w_u = 1.2D + 1.6L = 1.065 \text{ klf}$$

$$M_u = w_u L^2 / 8 = 64.4 \leq$$

$\phi_b M_p$

358

OK

Deflection Check

$$\Delta_{LL} = 5w_{LL} L^4 / 384EI_{LB} = 0.201 \leq$$

$\Delta_{LL} = L/360$

0.73

OK

$$\Delta_{CDL} = 5w_{CDL} L^4 / 384EI = 0.223 \leq$$

$\Delta_{LL} = L/240$

1.10

OK

Table 3-19
Table 3-21

Table 3-19



Girder Check

Bay 12-13,B-C 3rd Floor			
Member ID		W24x76	
Shear Studs		22	
Concrete	f'_c	4	ksi
	Density	115	pcf
Steel	F_y	50	ksi
	F_u	65	ksi
	E	29000	ksi
Girder	I	2100	in ⁴
	I_{LB}	3470	in ⁴
	b_{eff}	66	in
	t	6.25	in
	span	22	ft
	Assumed a	1.25	in
	$Y_2=t-a/2$	5.5	
Beam	spacing	11	ft
	span	22	ft
Loads	Dead Load		
	Slab SW	0.0500	ksf
	Girder SW	0.0760	klf
	SDL	0.0300	ksf
	Total DL	0.1560	
	Live Load		
	floors supporting	1	
	L_o	0.150	ksf
	K_{LL}	2	
	A_T	484	sf
	$K_{LL}A_T$	968	
	Reduction Coeff.	Unreducible	
	L	0.150	ksf
	Construction LL	0.02	ksf
	Construction DL (on beam)	0.594	klf
	Check Member Strength		

$$P_u = w_{u\text{Beam}} L_{\text{Beam}}$$

94.6 k

$$V_u = P_u / 2$$

47.3

$\leq$

$$\phi V_n$$

316 k

OK

Table 3-2

$$M_u = P_u L / 4$$

1040.6

$\leq$

$$\phi M_n$$

1050 ft-k

OK

Table 3-19

Check Shear Studs

$$\Sigma Q_n$$

280

k

Table 3-19

$$Q_n$$

21.2

k

Table 3-21

$$\# \text{ of Studs} = (\Sigma Q_n / Q_n) * 2$$

28

$>$

Studs Specified

22

No Good

Check a

$$a$$

1.248

$\leq$

assumed a

1.25 in

OK

Check Unshored Strength

$$w_u = 1.4D$$

0.143 klf

$$P_u =$$

23.4 k

$$M_u = (w_u L^2 / 8) + (P_u L / 4)$$

137.5

$\leq$

$$\phi_b M_p$$

750 ft-k

OK

Table 3-19

Deflection Check

$$\Delta_{LL} = PL^3 / 48EI_{LB}$$

0.360

$\leq$

$$\Delta_{LL} = L / 360$$

0.73 in

OK

$$\Delta_{CDL} = PL^3 / 48EI$$

0.083

$\leq$

$$\Delta_{CDL} = L / 240$$

1.10 in

OK



Column Check

B-13 Supporting FL3	W14x68	
F_y	50	ksi
L	18	ft
KL_x	18.0	ft
KL_y	18.0	ft
P_u	298.1	k
ϕP_n	512 @ $KL=8$	k
$P_u = 301.08 \leq \phi P_n = 512$	OK	
Min W14	W14x61	
ϕP_n	457	k

Cantilever Redesign

Existing Strength Calculations

TABLE: ElementForces - EXISTING																				
Frame	Section	Station	OutputCase	P	V2	V3	M2	M3	L	K	KL	P _r	P _c	P/P _c	M2	M3	px10 ³	bx10 ³	bx10 ³ interaction Eqn.	
Text	In	Text	Kip	Kip	Kip	Kip-in	Kip-in	Kip-in												
Frame 2.1	W14X99	377.44	Design Loads	-171.566	3.275	-0.031	9.931	-131.806	377.44	0.8	25.16267	-179.51	806.7899	0.222499	0.827583	-30.2596	1.2395	1.6	2.85	0.273273009 <1.0 OK
Frame 2.1	W14X99		0 Design Loads	-179.51	-4.5	-0.031	-1.831	-363.115												
Frame 2.9	W14X193		0 Design Loads	-128.765	-7.952	1.468	298.985	-644.097	341.104	0.8	22.7	-141.187	1834.002	0.076983	24.91542	-53.6748	1.24	0.709	1.32	0.131869735 <1.0 OK
Frame 2.9	W14X193	341.104	Design Loads	-141.187	7.23	1.468	-201.667	-520.955												
Frame 2.14	W14X193	338.742	Design Loads	-1137.76	16.651	-3.284	693.381	-1856.62	338.742	0.8	22.5828	-1149.97	1842.423	0.62416	57.78175	-154.719	0.5428	0.709	1.32	0.8101027349 <1.0 OK
Frame 2.14	W14X193		0 Design Loads	-1169.97	1.469	-3.284	-419.04	1212.347												
Frame 2.23	W14X145	355.276	Design Loads	-420.371	6.804	-0.892	116.679	-190.77	355.276	0.8	23.68507	-430.634	1323.433	0.325392	-16.6772	16.84717	0.7556	0.989	1.78	0.371738798 <1.0 OK
Frame 2.23	W14X145		0 Design Loads	-430.634	-4.592	-0.892	-200.126	202.166												
Frame 2.25	W14X145	355.276	Design Loads	-789.607	6.3	-2.606	472.301	-491.139	355.276	0.8	23.7	-799.871	1323.433	0.604391	39.35842	-40.9283	0.76	0.989	1.78	0.650109737 <1.0 OK
Frame 2.25	W14X145		0 Design Loads	-799.871	-5.096	-2.606	-453.467	-277.364												
Frame 2.26	W14X145	355.276	Design Loads	-632.415	7.55	-1.527	357.061	-728.315	355.276	0.8	23.7	-642.678	1323.433	0.468514	29.75508	-60.6929	1.30	0.989	1.78	0.898185585 <1.0 OK
Frame 2.26	W14X145		0 Design Loads	-642.678	-3.847	-1.527	-185.287	-70.501												
Frame 5.1	W14X109	377.44	Design Loads	-132.716	-3.796	-0.07	19.937	-185.755	377.44	0.8	25.16267	-141.432	891.7993	0.138992	1.661417	-30.2424	1.1213	1.43	2.56	0.132733239 <1.0 OK
Frame 5.1	W14X109		0 Design Loads	-141.432	-4.735	-0.07	-6.497	-362.909												
Frame 5.13	W14X90	300.719	Design Loads	-846.997	-3.582	-0.189	-56.775	-20.641	300.719	0.8	20.04793	-846.997	875.411	0.967542	-4.73125	-1.72008	1.1423	1.65	3.26	0.985804069 <1.0 OK
Frame 5.13	W14X90		0 Design Loads	-843.164	3.446	-0.189	2.84E-14	4.55E-13												
Frame 5.16	W14X90	338.742	Design Loads	-137.337	-3.513	0	0	0	338.742	0.8	22.5828	-137.337	805.5964	0.170479	0	-2.8E-14	1.2413	1.74	3.26	0.085289336 <1.0 OK
Frame 5.16	W14X90		0 Design Loads	-131.688	3.513	0	0	-3.4E-13												
Frame 5.18	W14X90	338.742	Design Loads	-394.91	-3.513	0	0	-3.4E-13	338.742	0.8	22.5828	-400.559	805.5964	0.46722	0	-2.8E-14	1.2413	1.74	3.26	0.497220461 <1.0 OK
Frame 5.18	W14X90		0 Design Loads	-400.559	-3.513	0	0	0												
Frame 5.25	W14X90		0 Design Loads	-260.69	-3.513	0	0	0	355.276	0.8	23.68507	-260.69	774.6098	0.336544	0	1.9E-14	1.291	1.74	3.26	0.336545628 <1.0 OK
Frame 5.25	W14X90	355.276	Design Loads	-254.362	3.513	0	0	2.27E-13												
Frame 5.26	W14X90	355.276	Design Loads	590.951	3.513	0	0	2.27E-13	355.276	0.8	23.68507	590.951	774.6098	0.762902	0	1.9E-14	1.03	1.74	3.26	0.60867953 <1.0 OK
Frame 5.26	W14X90		0 Design Loads	584.623	-3.513	0	0	0												
Frame 5.27	W14X90	355.276	Design Loads	173.791	3.513	0	0	2.27E-13	355.276	0.8	23.68507	173.791	774.6098	0.224359	0	1.9E-14	1.03	1.74	3.26	0.17900473 <1.0 OK
Frame 5.28	W14X90		0 Design Loads	-67.993	-3.513	0	0	0	355.276	0.8	23.68507	-67.993	774.6098	0.0877	0	1.9E-14	1.291	1.74	3.26	0.043849818 <1.0 OK
Frame 5.28	W14X90	355.276	Design Loads	-61.605	3.513	0	0	2.27E-13												

P_c Calculation

Frame 2.1	W14X99	P	806.7899	Frame 5.1	W14X109	P	891.7993	Frame 5.27	W14X90	P	774.6098
A	29.1			A	32			A	26.5		
K	0.8			K	0.8			K	0.8		
L	377.44			L	377.44			L	355.276		
r _y	3.71			r _y	3.73			r _y	3.7		
E	29000 ksi			E	29000 ksi			E	29000 ksi		
F _y	50 ksi			F _y	50 ksi			F _y	50 ksi		
K _{L/r}	81.38868 ≤	4.71sqrt(E/F _y)	113.4318	K _{L/r}	80.95228 ≤	4.71sqrt(E/F _y)	113.4318	K _{L/r}	76.81643 ≤	4.71sqrt(E/F _y)	113.4318
Fe = pi2E/(k _{L/r})^2	43.20855 ksi			Fe = pi2E/(k _{L/r})^2	43.67567 ksi			Fe = pi2E/(k _{L/r})^2	48.50533 ksi		
F _{cr}	30.80527 YES	P	806.7899	F _{cr}	30.96525 YES	P	891.7993	F _{cr}	32.4784 YES	P	774.6098
F _{cr}	37.8939 NO	P	992.4413	F _{cr}	38.30356 NO	P	1103.143	F _{cr}	42.53918 NO	P	1014.559
Frame 2.9	W14X193	P	1834.002	Frame 5.13	W14X90	P	875.411	Frame 5.28	W14X90	P	774.6098
A	56.8			A	26.5			A	26.5		
K	0.8			K	0.8			K	0.8		
L	341.104			L	300.719			L	355.276		
r _y	4.05			r _y	3.7			r _y	3.7		
E	29000 ksi			E	29000 ksi			E	29000 ksi		
F _y	50 ksi			F _y	50 ksi			F _y	50 ksi		
K _{L/r}	67.37857 ≤	4.71sqrt(E/F _y)	113.4318	K _{L/r}	65.02032 ≤	4.71sqrt(E/F _y)	113.4318	K _{L/r}	76.81643 ≤	4.71sqrt(E/F _y)	113.4318
Fe = pi2E/(k _{L/r})^2	63.04551 ksi			Fe = pi2E/(k _{L/r})^2	67.70169 ksi			Fe = pi2E/(k _{L/r})^2	48.50533 ksi		
F _{cr}	35.87641 YES	P	1834.002	F _{cr}	36.70487 YES	P	875.411	F _{cr}	32.4784 YES	P	774.6098
F _{cr}	55.29092 NO	P	2826.472	F _{cr}	59.37438 NO	P	1416.079	F _{cr}	42.53918 NO	P	1014.559
Frame 2.14	W14X193	P	1842.423	Frame 5.16	W14X90	P	805.5964				
A	56.8			A	26.5						
K	0.8			K	0.8						
L	338.742			L	338.742						
r _y	4.05			r _y	3.7						
E	29000 ksi			E	29000 ksi						
F _y	50 ksi			F _y	50 ksi						
K _{L/r}	66.912 ≤	4.71sqrt(E/F _y)	113.4318	K _{L/r}	73.24151 ≤	4.71sqrt(E/F _y)	113.4318				
Fe = pi2E/(k _{L/r})^2	63.92779 ksi			Fe = pi2E/(k _{L/r})^2	53.35598 ksi						
F _{cr}	36.04115 YES	P	1842.423	F _{cr}	33.77763 YES	P	805.5964				
F _{cr}	56.06468 NO	P	2866.026	F _{cr}	46.7932 NO	P	1116.018				
Frame 2.23	W14X145	P	1323.433	Frame 5.18	W14X90	P	805.5964				
A	42.7			A	26.5						
K	0.8			K	0.8						
L	355.276			L	338.742						
r _y	3.98			r _y	3.7						
E	29000 ksi			E	29000 ksi						
F _y	50 ksi			F _y	50 ksi						
K _{L/r}	71.41226 ≤	4.71sqrt(E/F _y)	113.4318	K _{L/r}	73.24151 ≤	4.71sqrt(E/F _y)	113.4318				
Fe = pi2E/(k _{L/r})^2	56.12446 ksi			Fe = pi2E/(k _{L/r})^2	53.35598 ksi						
F _{cr}	34.4375 YES	P	1323.433	F _{cr}	33.77763 YES	P	805.5964				
F _{cr}	49.22115 NO	P	1891.569	F _{cr}	46.7932 NO	P	1116.018				
Frame 2.25	W14X145	P	1323.433	Frame 5.25	W14X90	P	774.6098				
A	42.7			A	26.5						
K	0.8			K	0.8						
L	355.276			L	355.276						
r _y	3.98			r _y	3.7						
E	29000 ksi			E	29000 ksi						
F _y	50 ksi			F _y	50 ksi						
K _{L/r}	71.41226 ≤	4.71sqrt(E/F _y)	113.4318	K _{L/r}	76.81643 ≤	4.71sqrt(E/F _y)	113.4318				
Fe = pi2E/(k _{L/r})^2	56.12446 ksi			Fe = pi2E/(k _{L/r})^2	48.50533 ksi						
F _{cr}	34.4375 YES	P	1323.433	F _{cr}	32.4784 YES	P	774.6098				
F _{cr}	49.22115 NO	P	1891.569	F _{cr}	42.53918 NO	P	1014.559				
Frame 2.26	W14X145	P	1323.433	Frame 5.26	W14X90	P	774.6098				
A	42.7			A	26.5						
K	0.8			K	0.8						
L	355.276			L	355.276						
r _y	3.98			r _y	3.7						
E	29000 ksi			E	29000 ksi						
F _y	50 ksi			F _y	50 ksi						
K _{L/r}	71.41226 ≤	4.71sqrt(E/F _y)	113.4318	K _{L/r}	76.81643 ≤	4.71sqrt(E/F _y)	113.4318				
Fe = pi2E/(k _{L/r})^2	56.12446 ksi			Fe = pi2E/(k _{L/r})^2	48.50533 ksi						
F _{cr}	34.4375 YES	P	1323.433	F _{cr}	32.4784 YES	P	774.6098				
F _{cr}	49.22115 NO	P	1891.569	F _{cr}	42.53918 NO	P	1014.559				

Redesign Strength Calculations

TABLE: Element Forces - REDESIGN																					
Frame	Section	Station	Output/Case	P	V2	V3	M2	M3	L	K	KL	P _r	P _c	P _r /P _c	M2	M3	p×10 ³	b _x ×10 ³	b _y ×10 ³	Interaction Eqn.	
Text		In	Text	Kip	Kip	Kip	Kip-in	Kip-in	In						Kip-ft	Kip-ft					
Frame 2.1	W14X90	377.44	Design Loads	-107.691	3.206	0.006006	-0.306	-168.981	377.44	0.8	25.16267	-114.871	732.782	0.15676	H1-1b	0.163417	-23.7634	1.3647	1.79	3.26	0.126832972 <1.0 OK
Frame 2.1	W14X257	341.104	Design Loads	-1882.07	8.275	4.529	-999.241	-832.527	341.104	0.8	22.74027	-1898.65	2472.317	0.767965	H1-1a	-83.2701	-122.266	0.4045	0.508	0.964	0.910347941 <1.0 OK
Frame 2.8	W14X90	0	Design Loads	-1898.65	-11.997	4.529	545.488	-1467.19	341.104	0.8	22.74027	-1898.65	2472.317	0.767965	H1-1a	-83.2701	-122.266	0.4045	0.508	0.964	0.910347941 <1.0 OK
Frame 2.14	W14X193	338.742	Design Loads	-1099.33	15.892	-3.255	685.908	-1788.41	338.742	0.8	22.5828	-1111.53	1842.423	0.603298	H1-1a	57.159	-149.034	0.5428	0.709	1.32	0.784413176 <1.0 OK
Frame 2.14	W14X193	0	Design Loads	-1111.53	0.71	-3.255	-416.785	1023.536	338.742	0.8	22.5828	-1111.53	1842.423	0.603298	H1-1a	57.159	-149.034	0.5428	0.709	1.32	0.784413176 <1.0 OK
Frame 2.23	W14X90	355.276	Design Loads	-374.391	-3.245	-0.571	-127.359	-17.352	355.276	0.8	23.68507	-374.391	774.6098	0.483328	H1-1a	-10.6133	6.49675	1.291	1.74	3.26	0.529232036 <1.0 OK
Frame 2.23	W14X90	355.276	Design Loads	-368.063	3.782	-0.571	75.379	-17.352	355.276	0.8	23.68507	-374.391	774.6098	0.483328	H1-1a	-10.6133	6.49675	1.291	1.74	3.26	0.529232036 <1.0 OK
Frame 2.27	W14X159	355.276	Design Loads	-1319.88	6.719	1.189	-136.346	-481.328	355.276	0.8	23.68507	-1331.15	1452.802	0.916266	H1-1a	23.83575	-40.1107	0.6883	0.889	1.62	0.990538459 <1.0 OK
Frame 2.27	W14X159	0	Design Loads	-1331.15	-5.796	1.189	286.029	-317.328	355.276	0.8	23.68507	-1331.15	1452.802	0.916266	H1-1a	23.83575	-40.1107	0.6883	0.889	1.62	0.990538459 <1.0 OK
Frame 2.28	W14X145	355.276	Design Loads	-708.703	6.298	2.547	-389.671	-582.687	355.276	0.8	23.68507	-718.966	1323.433	0.543258	H1-1a	42.94092	-48.5573	0.7556	0.989	1.78	0.667716247 <1.0 OK
Frame 2.28	W14X145	0	Design Loads	-718.966	-5.098	2.547	515.291	-369.61	355.276	0.8	23.68507	-718.966	1323.433	0.543258	H1-1a	42.94092	-48.5573	0.7556	0.989	1.78	0.667716247 <1.0 OK
Frame 2.33	W14X550	269.75	Design Loads	-3666.73	-14.115	-8.21	-1914.26	-1125.62	269.75	0.8	17.98333	-3711.06	6157.084	0.602713	H1-1a	-159.521	223.4977	0.1624	0.202	0.407	0.712801835 <1.0 OK
Frame 2.33	W14X550	312	Design Loads	-3666.73	-14.115	-8.21	-1914.26	-1125.62	269.75	0.8	17.98333	-3711.06	6157.084	0.602713	H1-1a	-159.521	223.4977	0.1624	0.202	0.407	0.712801835 <1.0 OK
Frame 2.34	W14X550	0	Design Loads	-3676.57	43.756	-8.778	300.026	4631.015	312	0.8	20.8	-3676.57	5815.643	0.632186	H1-1a	253.2261	-751.744	0.172	0.204	0.407	0.888604502 <1.0 OK
Frame 2.34	W14X550	0	Design Loads	-3676.57	43.756	-8.778	300.026	4631.015	312	0.8	20.8	-3676.57	5815.643	0.632186	H1-1a	253.2261	-751.744	0.172	0.204	0.407	0.888604502 <1.0 OK
Frame 5.1	W14X90	377.44	Design Loads	-81.372	-3.704	-0.047	-7.78	-264.548	377.44	0.8	25.16267	-81.372	732.782	0.111045	H1-1b	1.0945	-22.0457	1.3647	1.6	2.85	0.098714091 <1.0 OK
Frame 5.1	W14X109	341.104	Design Loads	-570.872	-5.871	0.065	22.318	3.41E-13	341.104	0.8	22.74027	-570.872	973.6549	0.586319	H1-1a	1.859833	-45.6569	1.0271	1.39	2.56	0.65454293 <1.0 OK
Frame 5.8	W14X109	341.104	Design Loads	-563.892	2.659	0.065	22.318	3.41E-13	341.104	0.8	22.74027	-570.872	973.6549	0.586319	H1-1a	1.859833	-45.6569	1.0271	1.39	2.56	0.65454293 <1.0 OK
Frame 5.13	W14X145	300.719	Design Loads	-1221.27	-10.147	-0.881	-264.918	-1337.98	300.719	0.8	20.04793	-1221.27	1471.02	0.830222	H1-1a	-22.0765	-111.498	0.6798	0.956	1.78	0.976110568 <1.0 OK
Frame 5.13	W14X145	0	Design Loads	-1221.27	-10.147	-0.881	-264.918	-1337.98	300.719	0.8	20.04793	-1221.27	1471.02	0.830222	H1-1a	-22.0765	-111.498	0.6798	0.956	1.78	0.976110568 <1.0 OK
Frame 5.16	W14X120	338.742	Design Loads	-151.973	4.718	0	0	0	338.742	0.8	22.5828	-159.559	1082.108	0.447452	H1-1b	0	-5.7E-14	0.9241	0.971	2.32	0.073726023 <1.0 OK
Frame 5.16	W14X120	0	Design Loads	-151.973	4.718	0	0	0	338.742	0.8	22.5828	-159.559	1082.108	0.447452	H1-1b	0	-5.7E-14	0.9241	0.971	2.32	0.073726023 <1.0 OK
Frame 5.18	W14X145	338.742	Design Loads	-625.828	-5.698	0	0	4.55E-13	338.742	0.8	22.5828	-634.99	1369.065	0.463813	H1-1a	0	3.79E-14	0.7304	0.989	1.78	0.463812982 <1.0 OK
Frame 5.18	W14X145	0	Design Loads	-634.99	5.698	0	0	0	338.742	0.8	22.5828	-634.99	1369.065	0.463813	H1-1a	0	3.79E-14	0.7304	0.989	1.78	0.463812982 <1.0 OK
Frame 5.25	W14X120	355.276	Design Loads	-403.419	-4.718	0	0	0	355.276	0.8	23.68507	-403.419	1041.354	0.387398	H1-1a	0	-1.9E-14	0.9603	1.25	2.32	0.387398488 <1.0 OK
Frame 5.25	W14X120	0	Design Loads	-403.419	-4.718	0	0	0	355.276	0.8	23.68507	-403.419	1041.354	0.387398	H1-1a	0	-1.9E-14	0.9603	1.25	2.32	0.387398488 <1.0 OK
Frame 5.26	W14X90	355.276	Design Loads	542.576	-3.513	0	0	0	355.276	0.8	23.68507	548.904	774.6098	0.70862	H1-1a	0	1.9E-14	1.03	0.709	3.26	0.56537112 <1.0 OK
Frame 5.26	W14X90	0	Design Loads	542.576	-3.513	0	0	0	355.276	0.8	23.68507	548.904	774.6098	0.70862	H1-1a	0	1.9E-14	1.03	0.709	3.26	0.56537112 <1.0 OK
Frame 5.27	W14X90	355.276	Design Loads	141.835	-3.513	0	0	0	355.276	0.8	23.68507	148.164	774.6098	0.191276	H1-1b	0	-1.9E-14	0.9603	1.25	2.32	0.07630446 <1.0 OK
Frame 5.27	W14X90	0	Design Loads	141.835	-3.513	0	0	0	355.276	0.8	23.68507	148.164	774.6098	0.191276	H1-1b	0	-1.9E-14	0.9603	1.25	2.32	0.07630446 <1.0 OK
Frame 5.28	W14X120	355.276	Design Loads	-144.27	4.718	0	0	0	355.276	0.8	23.68507	-152.768	1041.354	0.146701	H1-1b	0	-1.9E-14	0.9603	1.25	2.32	0.07330651 <1.0 OK
Frame 5.28	W14X120	0	Design Loads	-144.27	4.718	0	0	0	355.276	0.8	23.68507	-152.768	1041.354	0.146701	H1-1b	0	-1.9E-14	0.9603	1.25	2.32	0.07330651 <1.0 OK
Frame 5.35	W14X550	269.75	Design Loads	-2914.69	-7.761	8.504	-273.57	1451.941	269.75	0.8	17.98333	-2959.02	6157.084	0.480588	H1-1a	168.3751	-120.9951	0.1624	0.791	1.32	0.798550083 <1.0 OK
Frame 5.35	W14X550	0	Design Loads	-2959.02	-7.761	8.504	-273.57	1451.941	269.75	0.8	17.98333	-2959.02	6157.084	0.480588	H1-1a	168.3751	-120.9951	0.1624	0.791	1.32	0.798550083 <1.0 OK
Frame 5.36	W14X550	312	Design Loads	-2868.84	27.531	9.059	-309.66	-5910.57	312	0.8	20.8	-2920.11	5815.643	0.502113	H1-1a	-258.305	-492.548	0.172	0.202	0.407	0.70673795 <1.0 OK
Frame 5.36	W14X550	0	Design Loads	-2920.11	27.531	9.059	-309.66	-5910.57	312	0.8	20.8	-2920.11	5815.643	0.502113	H1-1a	-258.305	-492.548	0.172	0.202	0.407	0.70673795 <1.0 OK

P_c Calculation

Frame 2.1	W14X90		P	732.782	Frame 5.1	W14X90		P	732.782	Frame 5.28	W14X120		P	1041.354
A	26.5				A	26.5				A	35.3			
K	0.8				K	0.8				K	0.8			
L	377.44				L	377.44				L	355.276			
r _y	3.7				r _y	3.7				r _y	3.74			
E	29000 ksi				E	29000 ksi				E	29000 ksi			
F _y	50 ksi				F _y	50 ksi				F _y	50 ksi			
K _L /r	81.60865 ≤	4.71sqrt(E	113.4318		K _L /r	81.60865 ≤	4.71sqrt(E	113.4318		K _L /r	75.99487 ≤	4.71sqrt(E	113.4318	
Fe = pi ² E/(k _L	42.97594 ksi				Fe = pi ² E/(k _L	42.97594 ksi				Fe = pi ² E/(k _L	49.55976 ksi			
F _{cr}	30.72461 YES	P	732.782		F _{cr}	30.72461 YES	P	732.782		F _{cr}	32.77791 YES	P	1041.354	
F _{cr}	37.6899 NO	P	898.9041		F _{cr}	37.6899 NO	P	898.9041		F _{cr}	43.46391 NO	P	1380.849	
Frame 2.8	W14X257		P	2472.317	Frame 5.8	W14X109		P	973.6549	Frame 5.35	W14X550		P	6157.084
A	75.6				A	32				A	162			
K	0.8				K	0.8				K	0.8			
L	341.104				L	341.104				L	269.75			
r _y	4.13				r _y	3.73				r _y	4.49			
E	29000 ksi				E	29000 ksi				E	29000 ksi			
F _y	50 ksi				F _y	50 ksi				F _y	50 ksi			
K _L /r	66.07341 ≤	4.71sqrt(E	113.4318		K _L /r	73.15903 ≤	4.71sqrt(E	113.4318		K _L /r	48.06236 ≤	4.71sqrt(E	113.4318	
Fe = pi ² E/(k _L	65.5608 ksi				Fe = pi ² E/(k _L	53.47636 ksi				Fe = pi ² E/(k _L	123.9046 ksi			
F _{cr}	36.33623 YES	P	2472.317		F _{cr}	33.80746 YES	P	973.6549		F _{cr}	42.22966 YES	P	6157.084	
F _{cr}	57.49682 NO	P	3912.084		F _{cr}	46.89876 NO	P	1350.684		F _{cr}	108.6644 NO	P	15843.26	
Frame 2.14	W14X193		P	1842.423	Frame 5.13	W14X145		P	1471.02	Frame 5.36	W14X550		P	5815.643
A	56.8				A	42.7				A	162			
K	0.8				K	0.8				K	0.8			
L	338.742				L	300.719				L	312			
r _y	4.05				r _y	3.98				r _y	4.49			
E	29000 ksi				E	29000 ksi				E	29000 ksi			
F _y	50 ksi				F _y	50 ksi				F _y	50 ksi			
K _L /r	66.912 ≤	4.71sqrt(E	113.4318		K _L /r	60.44603 ≤	4.71sqrt(E	113.4318		K _L /r	55.5902 ≤	4.71sqrt(E	113.4318	
Fe = pi ² E/(k _L	63.92779 ksi				Fe = pi ² E/(k _L	78.33614 ksi				Fe = pi ² E/(k _L	92.61925 ksi			
F _{cr}	36.04115 YES	P	1842.423		F _{cr}	38.2779 YES	P	1471.02		F _{cr}	39.88781 YES	P	5815.643	
F _{cr}	56.06468 NO	P	2866.026		F _{cr}	68.7008 NO	P	2640.172		F _{cr}	81.22708 NO	P	11842.91	

Frame 2.23	W14X90		P	774.6098	Frame 5.16	W14X120		P	1082.108
A	26.5				A	35.3			
K	0.8				K	0.8			
L	355.276				L	338.742			
ry	3.7				ry	3.74			
E	29000 ksi				E	29000 ksi			
Fy	50 ksi				Fy	50 ksi			
Kl/r	76.81643 ≤		4.71sqrt(E	113.4318	Kl/r	72.45818 ≤		4.71sqrt(E	113.4318
Fe = pi2E/(kl	48.50533 ksi				Fe = pi2E/(kl	54.51586 ksi			
Fcr	32.4784 YES	P		774.6098	Fcr	34.06068 YES	P		1082.108
Fcr	42.53918 NO	P		1014.559	Fcr	47.81041 NO	P		1518.937
Frame 2.27	W14X159		P	1452.802	Frame 5.18	W14X145		P	1369.065
A	46.7				A	42.7			
K	0.8				K	0.8			
L	355.276				L	338.742			
ry	4				ry	3.98			
E	29000 ksi				E	29000 ksi			
Fy	50 ksi				Fy	50 ksi			
Kl/r	71.0552 ≤		4.71sqrt(E	113.4318	Kl/r	68.08884 ≤		4.71sqrt(E	113.4318
Fe = pi2E/(kl	56.68994 ksi				Fe = pi2E/(kl	61.73704 ksi			
Fcr	34.56583 YES	P		1452.802	Fcr	35.6249 YES	P		1369.065
Fcr	49.71708 NO	P		2089.609	Fcr	54.14339 NO	P		2080.73
Frame 2.28	W14X145		P	1323.433	Frame 5.25	W14X120		P	1041.354
A	42.7				A	35.3			
K	0.8				K	0.8			
L	355.276				L	355.276			
ry	3.98				ry	3.74			
E	29000 ksi				E	29000 ksi			
Fy	50 ksi				Fy	50 ksi			
Kl/r	71.41226 ≤		4.71sqrt(E	113.4318	Kl/r	75.99487 ≤		4.71sqrt(E	113.4318
Fe = pi2E/(kl	56.12446 ksi				Fe = pi2E/(kl	49.55976 ksi			
Fcr	34.4375 YES	P		1323.433	Fcr	32.77791 YES	P		1041.354
Fcr	49.22115 NO	P		1891.569	Fcr	43.46391 NO	P		1380.849
Frame 2.33	W14X550		P	6157.084	Frame 5.26	W14X90		P	774.6098
A	162				A	26.5			
K	0.8				K	0.8			
L	269.75				L	355.276			
ry	4.49				ry	3.7			
E	29000 ksi				E	29000 ksi			
Fy	50 ksi				Fy	50 ksi			
Kl/r	48.06236 ≤		4.71sqrt(E	113.4318	Kl/r	76.81643 ≤		4.71sqrt(E	113.4318
Fe = pi2E/(kl	123.9046 ksi				Fe = pi2E/(kl	48.50533 ksi			
Fcr	42.22966 YES	P		6157.084	Fcr	32.4784 YES	P		774.6098
Fcr	108.6644 NO	P		15843.26	Fcr	42.53918 NO	P		1014.559
Frame 2.34	W14X550		P	5815.643	Frame 5.27	W14X90		P	774.6098
A	162				A	26.5			
K	0.8				K	0.8			
L	312				L	355.276			
ry	4.49				ry	3.7			
E	29000 ksi				E	29000 ksi			
Fy	50 ksi				Fy	50 ksi			
Kl/r	55.5902 ≤		4.71sqrt(E	113.4318	Kl/r	76.81643 ≤		4.71sqrt(E	113.4318
Fe = pi2E/(kl	92.61925 ksi				Fe = pi2E/(kl	48.50533 ksi			
Fcr	39.88781 YES	P		5815.643	Fcr	32.4784 YES	P		774.6098
Fcr	81.22708 NO	P		11842.91	Fcr	42.53918 NO	P		1014.559



Appendix B: Enclosure Analysis

FACADE	GLAZING DESIGN																			
	4' x 11' → 1220 mm x 3350 mm LAMINATED - ANNEALED GLASS LITE $A = 4.087 m^2$ $AR = \frac{3350}{1220} = 2.75$ → Try 8mm (5/16 in) NFL = 1.50 LS = 0 ← E 1300 - 04 p 35 <table border="1"> <thead> <tr> <th>LOADING</th><th>GTF</th><th>TL</th></tr> </thead> <tbody> <tr> <td>SHORT DURATION -</td><td>1.0</td><td>$1.50(1.0) = 1.50 kPa \rightarrow 31.33 psf < 31.87 psf$</td></tr> <tr> <td>LONG DURATION -</td><td>0.5</td><td>$1.50(0.5) = .75 kPa \rightarrow 15.66 psf$</td></tr> </tbody> </table> → Try 10 mm (3/8 in) NFL = 2.0 LS = 0 <table border="1"> <thead> <tr> <th>LOADING</th><th>GTF</th><th>TL</th></tr> </thead> <tbody> <tr> <td>SD -</td><td>1.0</td><td>$2.0(1.0) = 2.0 kPa \rightarrow 41.77 psf > 31.87 psf \therefore OK \checkmark$</td></tr> <tr> <td>LD -</td><td>0.5</td><td>$2.0(0.5) = 1.0 kPa \rightarrow 20.89 psf$</td></tr> </tbody> </table>	LOADING	GTF	TL	SHORT DURATION -	1.0	$1.50(1.0) = 1.50 kPa \rightarrow 31.33 psf < 31.87 psf$	LONG DURATION -	0.5	$1.50(0.5) = .75 kPa \rightarrow 15.66 psf$	LOADING	GTF	TL	SD -	1.0	$2.0(1.0) = 2.0 kPa \rightarrow 41.77 psf > 31.87 psf \therefore OK \checkmark$	LD -	0.5	$2.0(0.5) = 1.0 kPa \rightarrow 20.89 psf$	Components and Cladding wind press as per ASCE 7-05 : 31.87 psf NG X
LOADING	GTF	TL																		
SHORT DURATION -	1.0	$1.50(1.0) = 1.50 kPa \rightarrow 31.33 psf < 31.87 psf$																		
LONG DURATION -	0.5	$1.50(0.5) = .75 kPa \rightarrow 15.66 psf$																		
LOADING	GTF	TL																		
SD -	1.0	$2.0(1.0) = 2.0 kPa \rightarrow 41.77 psf > 31.87 psf \therefore OK \checkmark$																		
LD -	0.5	$2.0(0.5) = 1.0 kPa \rightarrow 20.89 psf$																		

FACADE

MULLION DESIGN

TRANSOMS - Mid

DESIGN WIND PRESSURE = 32 psf

$$w = 32(4) = 128 \text{ psf}$$

$$M = \frac{wl^2}{8} = \frac{.128 \text{ klf}(11')^2}{8} = 1.936 \text{ k'$$

$$V = \frac{wl}{2} = \frac{.128(11)}{2} = 0.704 \text{ k} = 3.132 \text{ kN}$$

$$\Delta = \frac{5wl^4}{384EI} = \frac{5(.128)(11')^4(1728)}{384EI} = \frac{42166}{EI}$$

TS ALUMINUM

$$1 \text{ psi} = 6.895 \times 10^{-3} \text{ N/mm}^2$$

allowable stresses

$$\sigma_{\text{axial}} = 62 \text{ N/mm}^2 = 8.99 \text{ ksi}$$

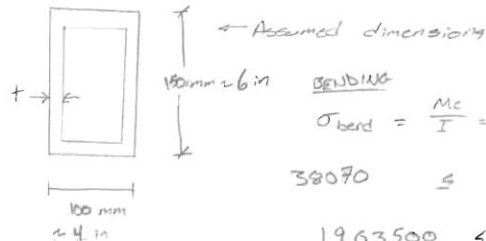
$$\sigma_{\text{bending}} = 69 \text{ N/mm}^2 = 10 \text{ ksi}$$

$$\sigma_{\text{shear}} = 37 \text{ N/mm}^2 = 5.37 \text{ ksi}$$

$$\sigma_{\text{bearing}} = 117 \text{ N/mm}^2 = 16.97 \text{ ksi}$$

$$\Delta_{\text{allow}} = \frac{3 \text{ span}}{180} \leq 20 \text{ mm}$$

$$= \frac{11(12)}{180} = 0.73 \text{ in} = 18.63 \text{ mm}$$



$$\sigma_{\text{bend}} = \frac{Mc}{I} = \frac{M}{S} \rightarrow S_{\text{req}} = \frac{M}{\sigma_{\text{bend}}} = \frac{1.936(12)}{10} = 2.32 \text{ in}^3$$

$$38070 \leq \frac{\frac{1}{12}(20)(150)^3 - \frac{1}{12}(100-2t)(150-2t)^3}{50} = 38070 \text{ mm}^3$$

$$1963500 \leq$$

$$(100-2t)(150-2t)^3 \leq 314658000$$

$$t_{\text{try}} = 5 \text{ mm}$$

$$246,960,000 \leq 314658000 \therefore \text{OK}$$

$$t_{\text{req}} = 5 \text{ mm} \text{ - for bending}$$

FACADE

MULLION DESIGN

2

SHEAR

$$\tau = \frac{3}{2} \frac{V}{A} \rightarrow 37 = \frac{3}{2} \frac{3132}{A_{req}} \rightarrow A_{req} = 127 \text{ mm}^2$$

$$127 \leq (100)(150) - (100-2t)(150-2t)$$

$$(100-2t)(150-2t) \leq 14873$$

$$\text{try } t = 4 \text{ mm}$$

$$13916 \leq 14873 \quad \therefore \text{OK} \quad \text{BENDING STILL CONTROLS}$$

DEFLECTION

$$\Delta_{allow} = 18.63 \text{ mm}$$

$$\text{CHECK @ } t = 5 \text{ mm}$$

$$\Delta = \frac{42166 (\text{mm}^3) (254 \text{ mm})^3 \left(\frac{1000 \text{ N}}{0.22481 \text{ lbf}} \right)}{7000 \text{ N/mm}^2 \left(\frac{1}{12} (100)(150)^3 - \frac{1}{12} (100-2t)(150-2t)^3 \right)} = 5.82 \text{ mm} < 18.63 \text{ mm}$$

7545000

OK ✓

BEARINGS

2 bolts

$$\text{Shear Force per bolt } \frac{3132}{2} = 1566 \text{ N}$$

EACH BOLT WILL HAVE 2 BEARING SURFACES

$$\sigma_{bearing} = 117 \text{ N/mm}^2$$

$$117 = \frac{1566}{2(5)D} \rightarrow D = 1.34 \text{ mm (very low)}$$

→ Use a standard, 12 mm (1/2) diam. steel bolt

FACADE

MULLION DESIGN

3

MULLION

$$M = \frac{P_L}{4} = \frac{3.132 (6)(12)(25.4)}{4} = 1909 \text{ kNmm}$$

$$V = \frac{P}{2} = \frac{3.132}{2} = 1.57 \text{ kV}$$

$$\Delta = \frac{P_L^3}{48EI} = \frac{3.132 (6)(12)(25.4)^3}{48EI} = \frac{946009211 \text{ kNmm}^3}{EI}$$

$$\Delta_{\text{allow}} = \frac{8(12)}{150} = 0.53 \text{ in} = 13.46 \text{ mm}$$

BENDING

$$S_{\text{req}} = \frac{1909(1000)}{69} = 27657 \text{ mm}^3 < S_{\text{req Transom}} \therefore \text{OK} \checkmark$$

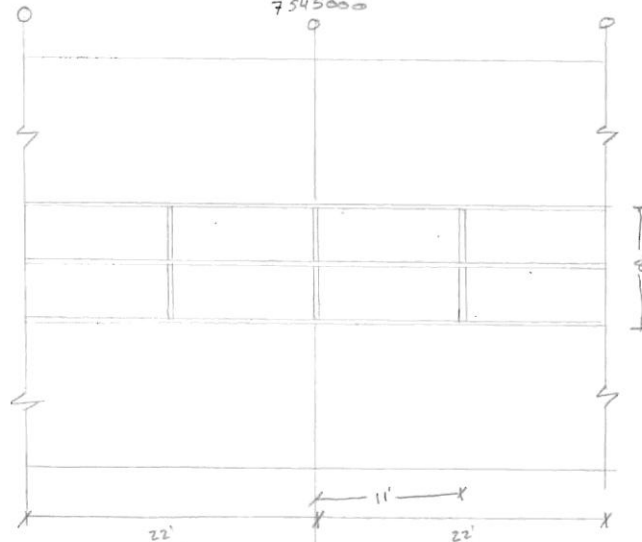
SHEAR

$$\tau = \frac{V}{2} \left(\frac{1.57(1000)}{A_{\text{req}}} \right) = 37 \rightarrow A_{\text{req}} = 63.6 \text{ mm}^2 < A_{\text{req Transom}} \therefore \text{OK} \checkmark$$

DEFLECTION

$$\Delta = \frac{946009211 \text{ kNmm}^3 (1000)}{70000 \frac{1}{\text{mm}^2} \left(\frac{1}{12} (100)(150)^3 - \frac{1}{12} (100-2t)(150-2t)^3 \right)} = 1.79 \leq 13.46 \text{ mm} \therefore \text{OK} \checkmark$$

7545000



Panel					
fc	5000				
E	4030509				
fr	353.55 FoS =1.5 p363 pci				
Wind	SW				
b	12.00	b	12.00		
t	6.00	t	6.00		
wu	32.00 lb/ft	wu	75.00 lb/ft		
Mu	wuL2/8	0.77 ftk/ft	Mu	wuL2/8	1.59 ftk/ft
pMn	frl0.9/c	1.91	pMn	frl0.9/c	1.91

Long Rib Wind					
b	6.00	A	1968		
t	18.00	I	216		
wu	352.00 lb/ft	I hung	665.5		
Mu	wuL2/8	8.52 ftk	Wp	13	
pMn	frl0.9/c	8.59 ftk	V	150.33ft ³	5.57yd ³

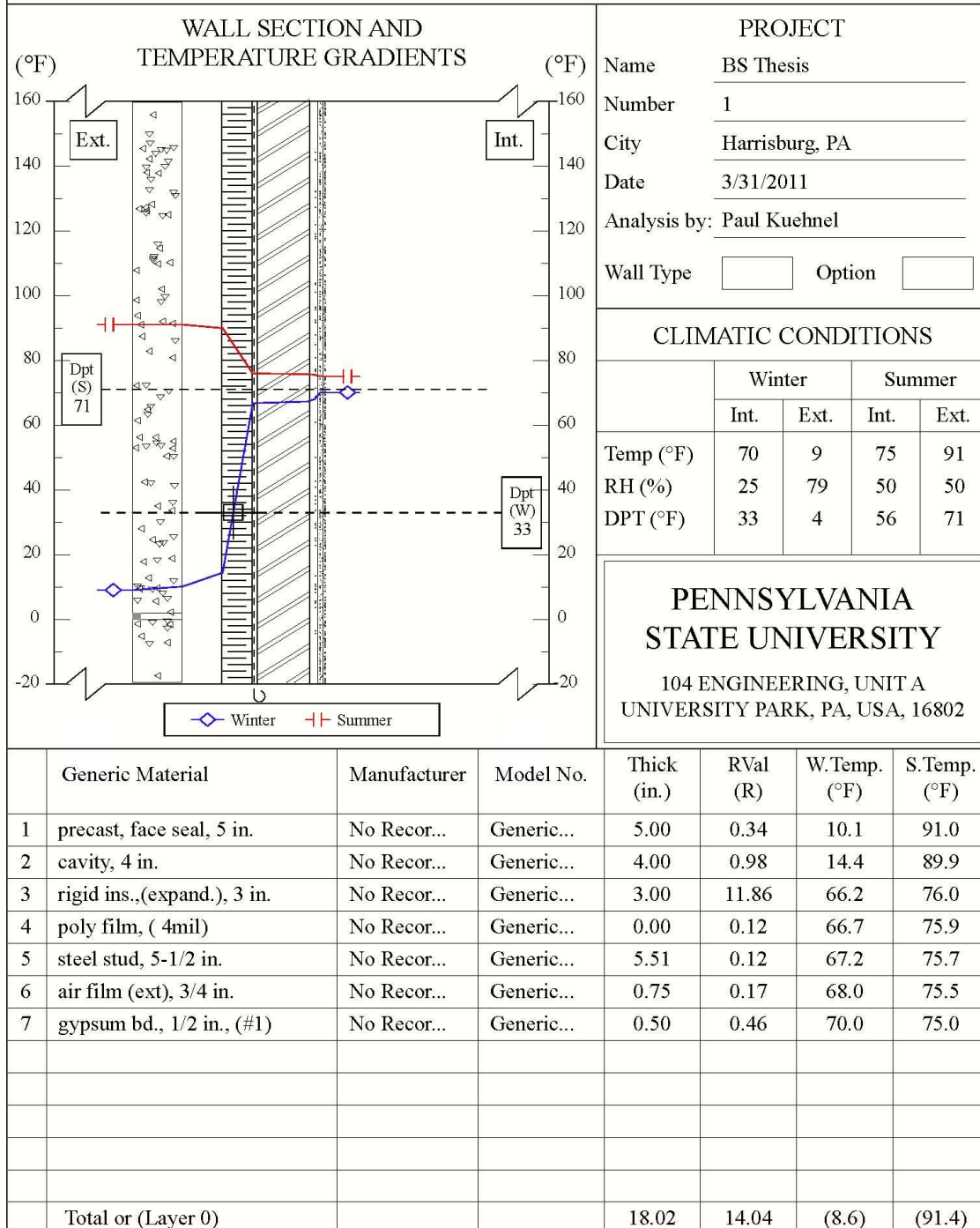
Long Rib sw 3 (end)					
b	8.00	b	16.00		
t	18.00	t	18.00		
wu	512.50 lb/ft	wu	1025.00 lb/ft		
Mu	wuL2/8	10.85 ftk	Mu	wuL2/8	21.70 ftk
pMn	frl0.9/c	11.46 ftk	pMn	frl0.9/c	22.91 ftk

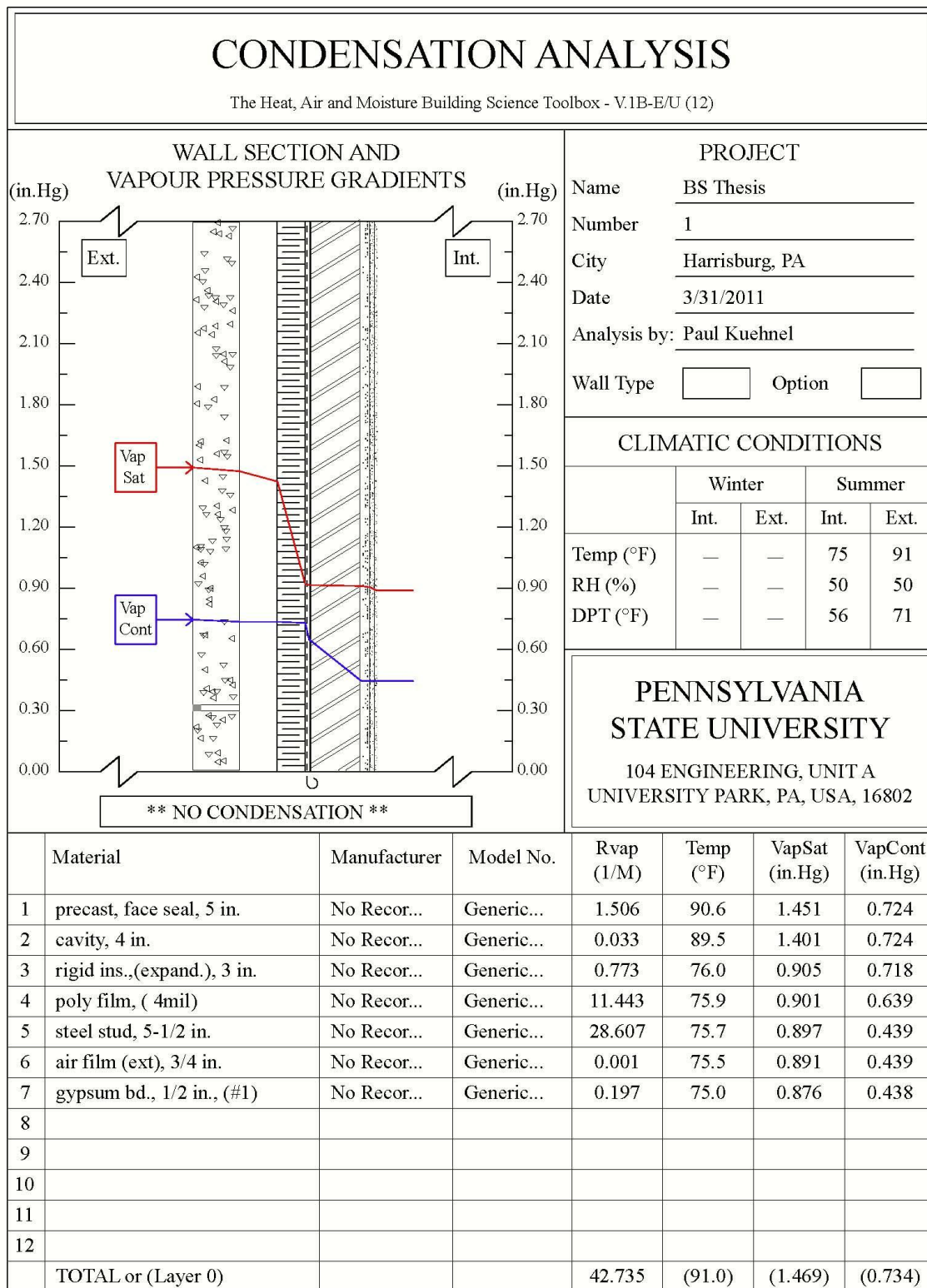
Deflection 3				
delta sw trans	5wl4/384EI	0.012501	L/360	0.366667
delta wind	5wl4/384EI	0.193736	L/360	0.733333
delta sw hung	5wl4/384EI	0.000938	L/360	0.733333

Enclosure R-Value Analysis 4 in cavity

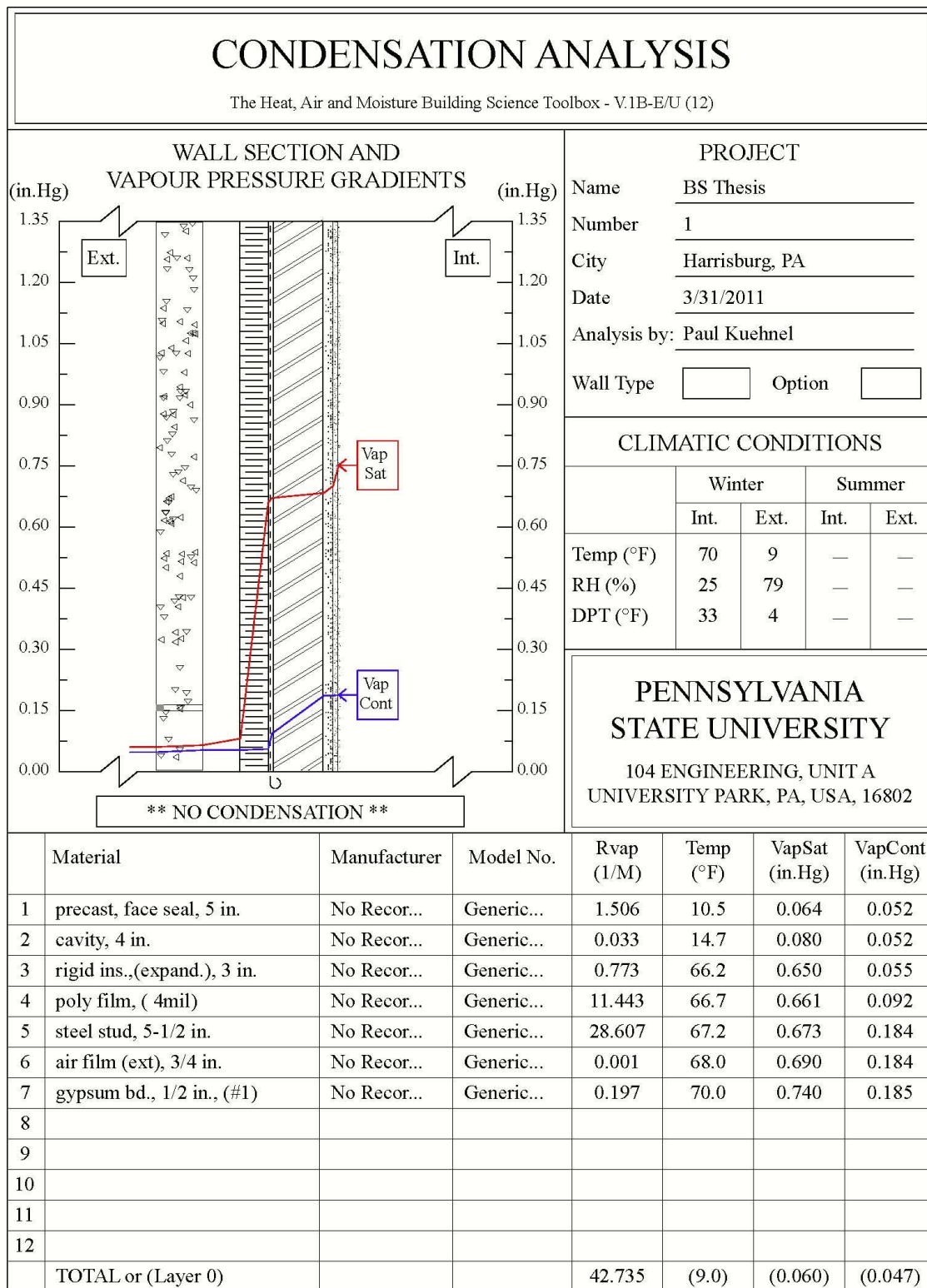
R VALUE ANALYSIS

The Heat, Air and Moisture Building Science Toolbox - V.1B-E/U (12)

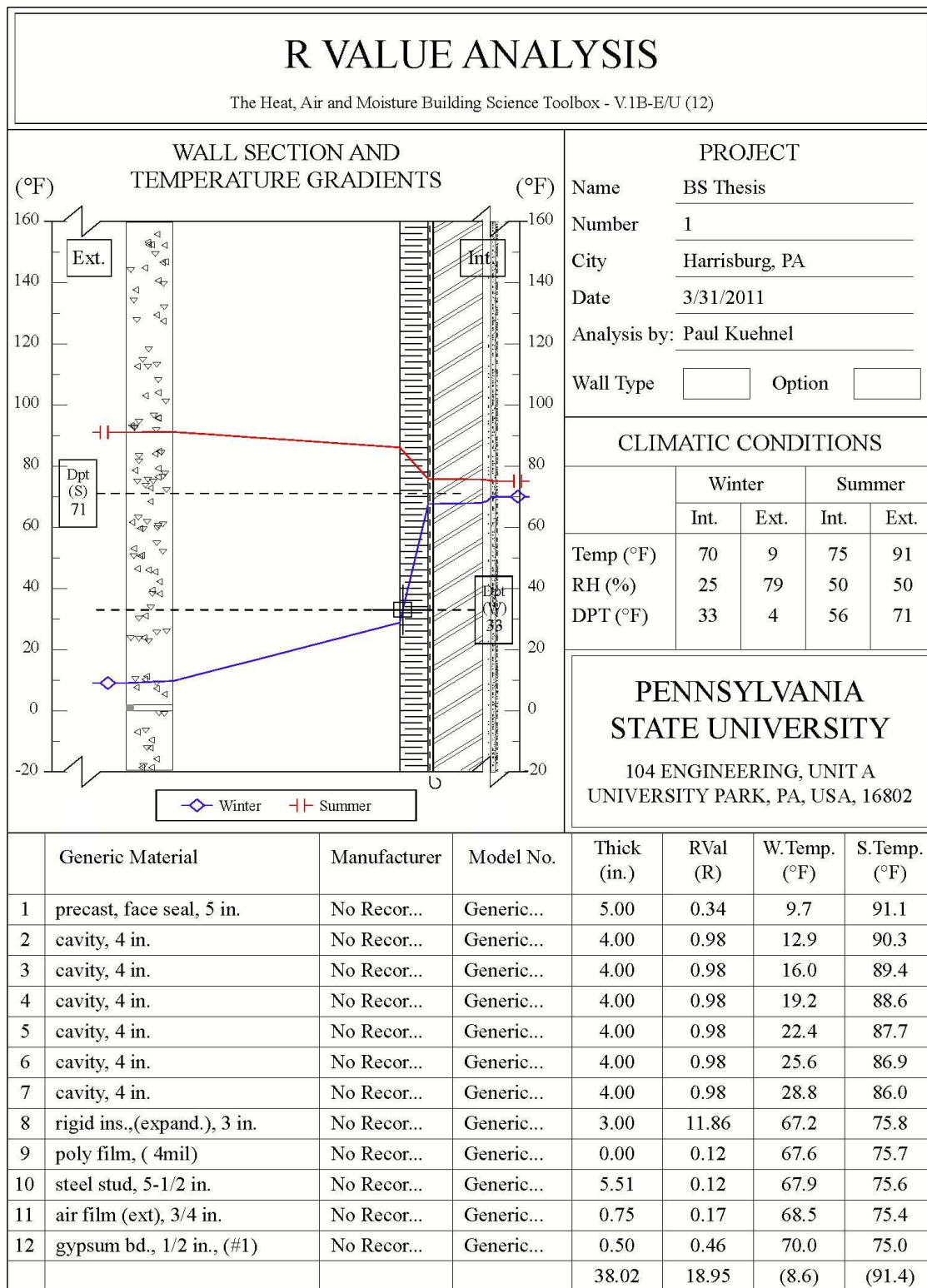




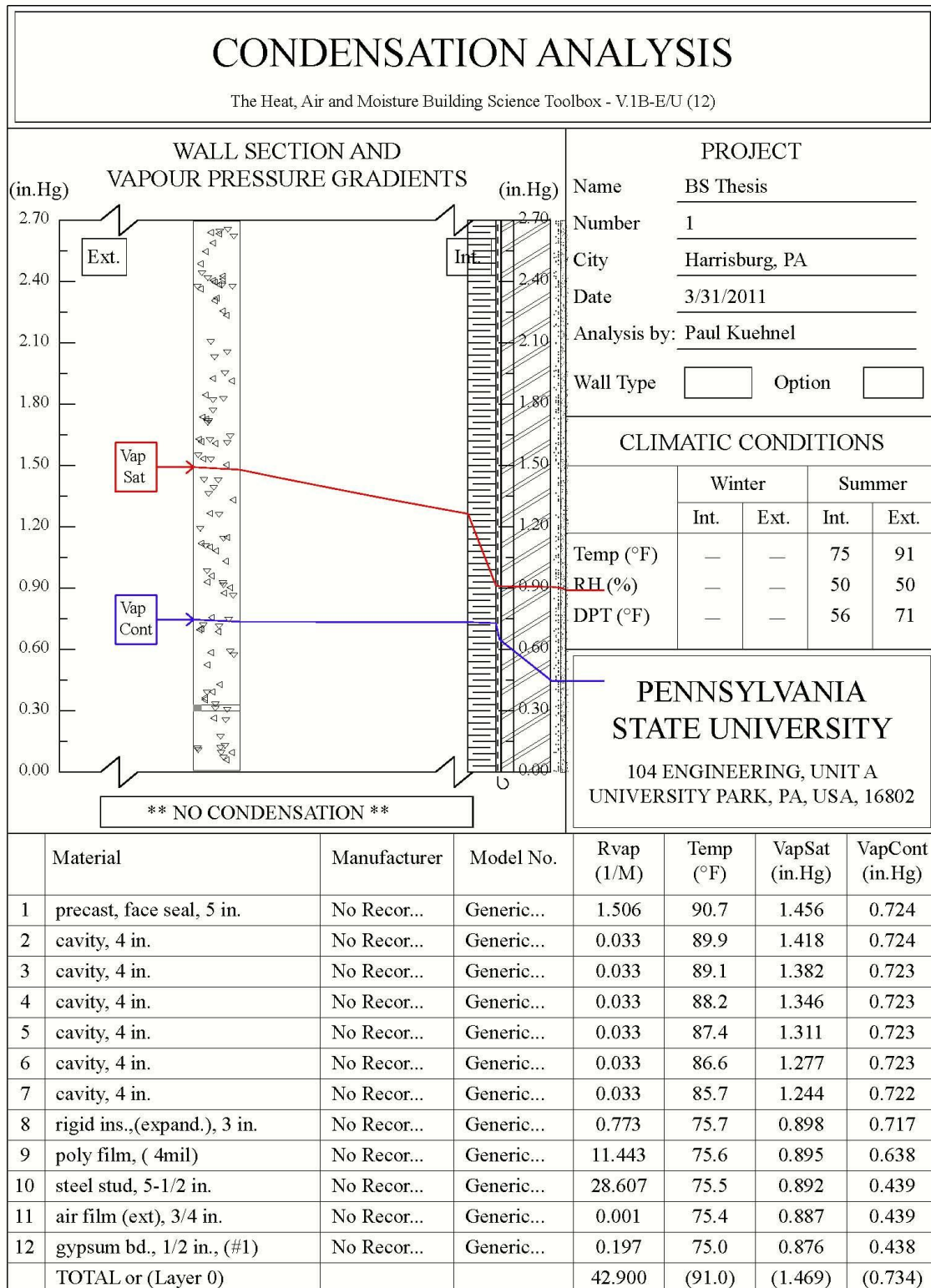
Enclosure Condensation Analysis – 4 in cavity winter

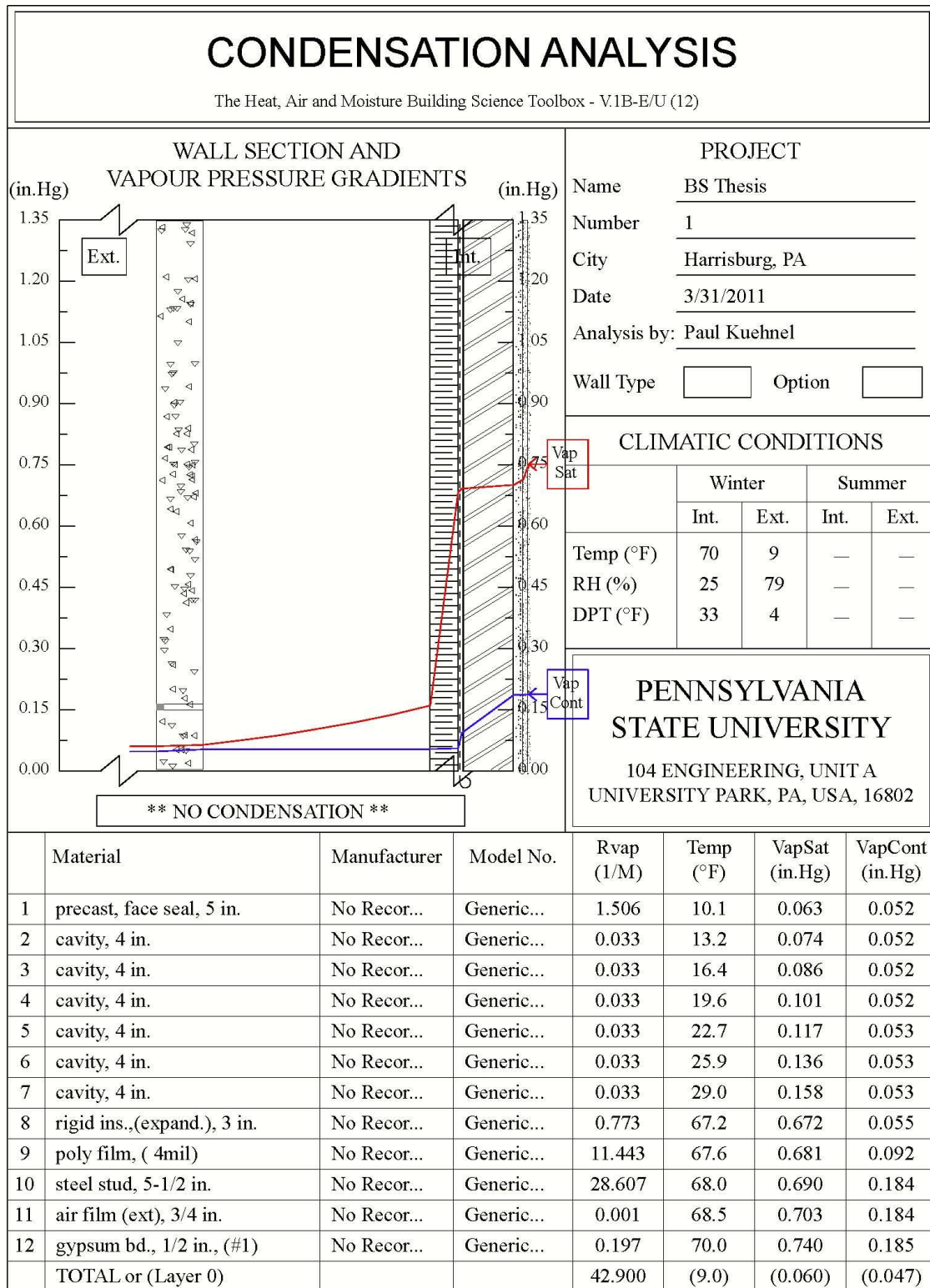


Enclosure R-Value Analysis – 24 in cavity



Enclosure Condensation Analysis – 24 in cavity summer

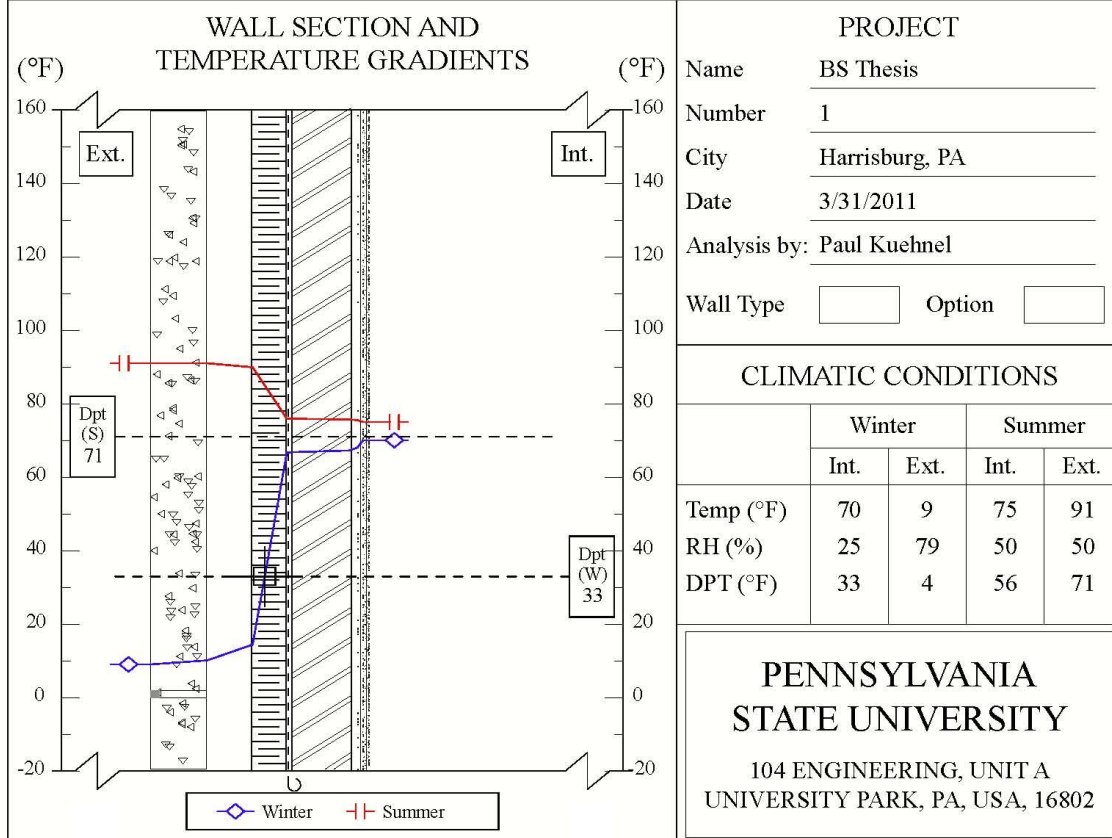




Enclosure R-Value Analysis – 24 in adjusted

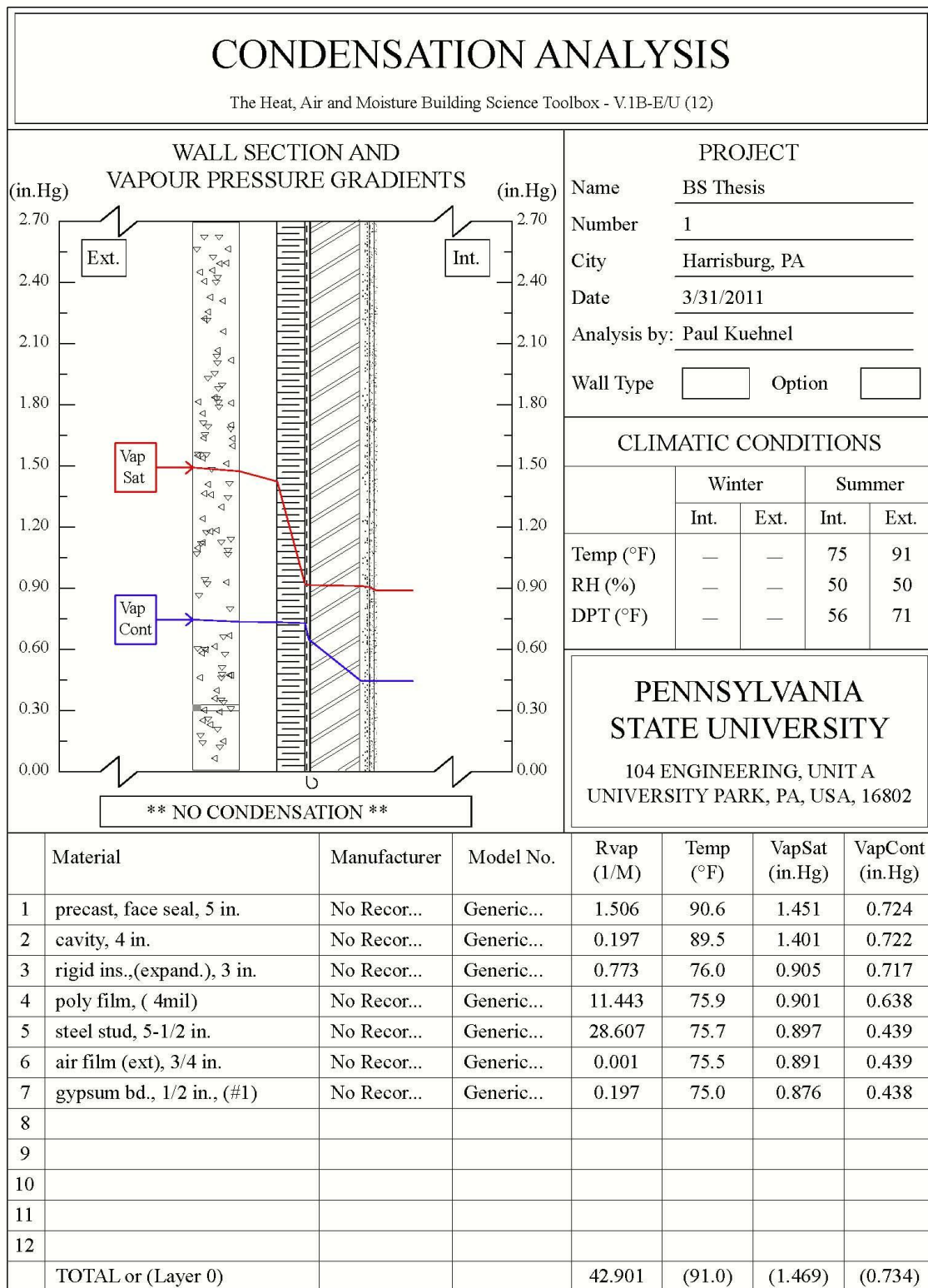
R VALUE ANALYSIS

The Heat, Air and Moisture Building Science Toolbox - V.1B-E/U (12)

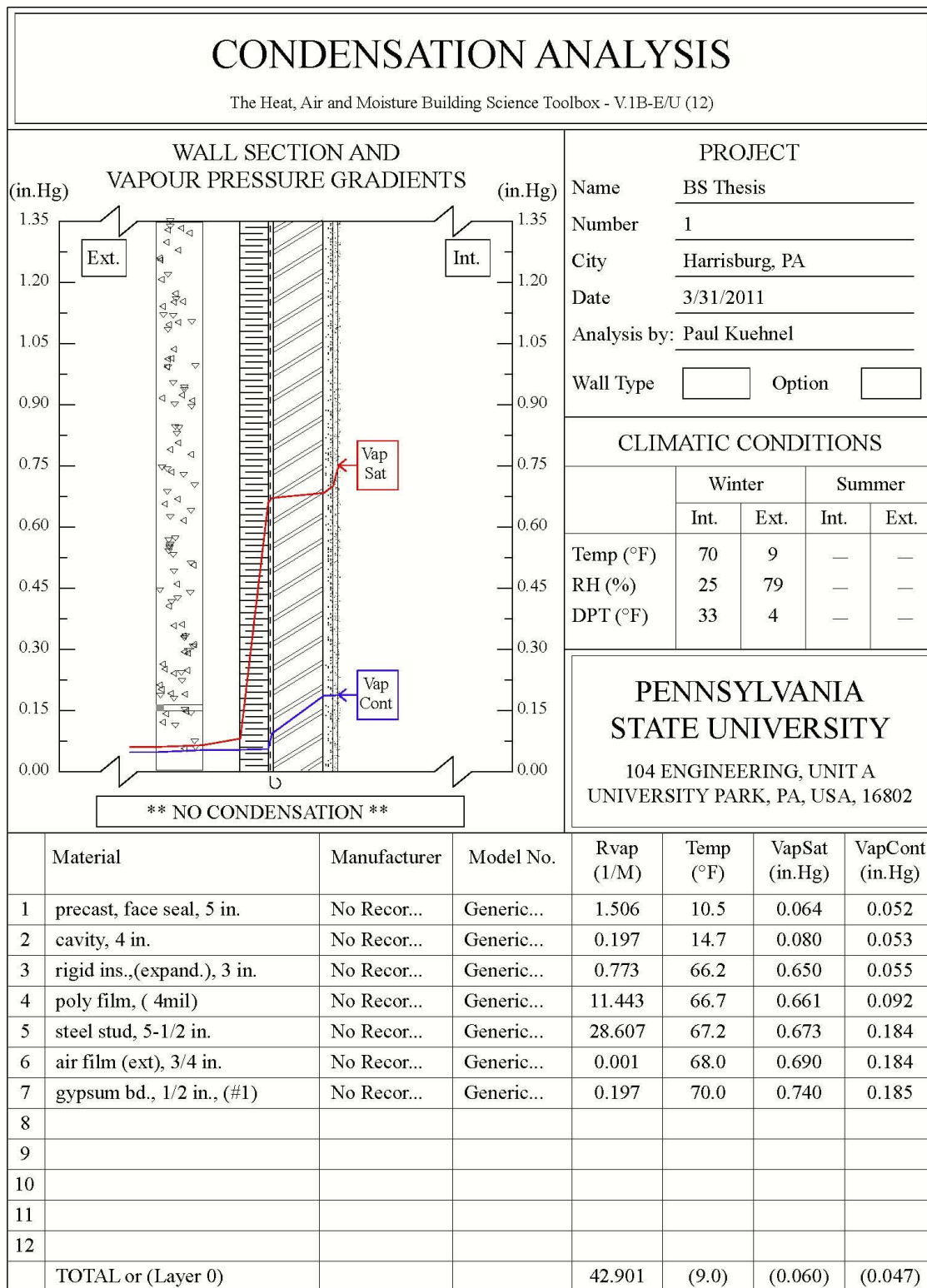


	Generic Material	Manufacturer	Model No.	Thick (in.)	RVal (R)	W.Temp. (°F)	S.Temp. (°F)
1	precast, face seal, 5 in.	No Recor...	Generic...	5.00	0.34	10.1	91.0
2	cavity, 4 in.	No Recor...	Generic...	4.00	0.98	14.4	89.9
3	rigid ins.,(expand.), 3 in.	No Recor...	Generic...	3.00	11.86	66.2	76.0
4	poly film, (4mil)	No Recor...	Generic...	0.00	0.12	66.7	75.9
5	steel stud, 5-1/2 in.	No Recor...	Generic...	5.51	0.12	67.2	75.7
6	air film (ext), 3/4 in.	No Recor...	Generic...	0.75	0.17	68.0	75.5
7	gypsum bd., 1/2 in., (#1)	No Recor...	Generic...	0.50	0.46	70.0	75.0
	Total or (Layer 0)			18.02	14.04	(8.6)	(91.4)





Enclosure Condensation Analysis – 24 in adjusted winter



Appendix C: Energy Analysis

Glazing Configuration Thermal and Solar Performance Analysis

Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:06:12

ID : 15
Name : Double Skin 3 with Shading
Tilt : 90.0
Glazings: 4
KEFF : 0.3787
Width : 25.168
Uvalue : 0.12
SHGCc : 0.17
SCc : 0.20
Vtc : 0.22
RHG : 40.66

Layer Data for Glazing System '15 Double Skin 3 with Shading'

ID	Name	D(")	Tsol	1	Rsol	2	Tvis	1	Rvis	2	Tir	1	Emis	2

- Outside														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578	1 Air	6.343												
.017	23 Double Skin Sha	0.024	.000	.700	.700	.000	.700	.700	.320	.638	.638			
92.4	ding													
	1 Air	6.343												
.626	6046 VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578	1 Air	0.500												
.016	6046 VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
Inside														

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00

Temperature Distribution (degrees F)

	Winter		Summer	
	Out	In	Out	In
	----	----	----	----
Lay1	1.3	1.6	120.6	122.8
Lay2	18.2	18.2	167.0	167.0
Lay3	25.6	25.8	161.1	160.7
Lay4	48.7	49.0	123.0	122.3

Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:15:37

ID : 15
Name : Double Skin 3 with Shading
Tilt : 90.0
Glazings: 4
KEFF : 0.3787
Width : 25.168
Uvalue : 0.12
SHGCc : 0.17
SCc : 0.20
Vtc : 0.22
RHG : 40.66

Layer Data for Glazing System '15 Double Skin 3 with Shading'

ID	Name	D(")	Tsol	1	Rsol	2	Tvis	1	Rvis	2	Tir	1	Emis	2
Keff														
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-														
Outside														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
	1 Air	6.343												
.017														
23	Double Skin Sha	0.024	.000	.700	.700	.000	.700	.700	.320	.638	.638			
92.4														
	ding													
	1 Air	6.343												
.626														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
	1 Air	0.500												
.016														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
Inside														

Environmental Conditions: 1 NFRC 100-2010

Tout	Tin	WndSpd	Wnd Dir	Solar	Tsky	Esky
(F)	(F)	(mph)		(Btu/h-ft2)		(F)
-----	-----	-----	-----	-----	-----	-----



	Paul Kuehnel			Mike Lucas		Sara Pace		Jon Brangan
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00	
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00	

Temperature Distribution (degrees F)

	Winter		Summer	
	Out	In	Out	In
Lay1	1.3	1.6	120.6	122.8
Lay2	18.2	18.2	167.0	167.0
Lay3	25.6	25.8	161.1	160.7
Lay4	48.7	49.0	123.0	122.3

Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:16:00

ID : 15
Name : Double Skin 3 with Shading
Tilt : 90.0
Glazings: 4
KEFF : 0.3787
Width : 25.168
Uvalue : 0.12
SHGCc : 0.17
SCc : 0.20
Vtc : 0.22
RHG : 40.66

Layer Data for Glazing System '15 Double Skin 3 with Shading'

ID	Name	D(")	Tsol	1	Rsol	2	Tvis	1	Rvis	2	Tir	1	Emis	2
Keff														

-														
Outside														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
	1 Air		6.343											
.017														
23	Double Skin Sha	0.024	.000	.700	.700	.000	.700	.700	.320	.638	.638			
92.4														
	ding													
	1 Air		6.343											
.626														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
	1 Air		0.500											
.016														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
Inside														

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00

Temperature Distribution (degrees F)				
Winter		Summer		
Out	In	Out	In	
Lay1	1.3	1.6	120.6	122.8
Lay2	18.2	18.2	167.0	167.0
Lay3	25.6	25.8	161.1	160.7
Lay4	48.7	49.0	123.0	122.3



ID : 14
Name : Double Skin 2 with Shading
Tilt : 90.0
Glazings: 4
KEFF : 0.3772
Width : 25.168
Uvalue : 0.12
SHGCc : 0.14
SCc : 0.16
Vtc : 0.19
RHG : 32.49

Layer Data for Glazing System '14 Double Skin 2 with Shading'

ID	Name	D(")	Tsol	1 Rsol	2 Tvis	1 Rvis	2 Tir	1 Emis	2
Keff									

-									
Outside									
6261	VNE163.VIR	#0.223	.281	.359	.511	.701	.061	.031	.000 .840 .032
.578									
	1 Air	6.343							
.017									
23	Double Skin Sha	0.024	.000	.700	.700	.000	.700	.700	.320 .638 .638
92.4									
	ding								
	1 Air	6.343							
.626									
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000 .840 .040
.578									
	1 Air	0.500							
.016									
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000 .840 .040
.578									
Inside									

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00

Temperature Distribution (degrees F)

Winter		Summer	
Out	In	Out	In

	----	----	----	----
Lay1	1.3	1.6	120.0	122.0
Lay2	18.3	18.4	151.4	151.4
Lay3	25.7	26.0	145.2	144.9
Lay4	48.7	49.0	114.0	113.5

Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:14:04

ID : 14
Name : Double Skin 2 with Shading
Tilt : 90.0
Glazings: 4
KEFF : 0.3772
Width : 25.168
Uvalue : 0.12
SHGCc : 0.14
SCc : 0.16
Vtc : 0.19
RHG : 32.49

Layer Data for Glazing System '14 Double Skin 2 with Shading'

ID	Name	D(")	Tsol	1	Rsol	2	Tvis	1	Rvis	2	Tir	1	Emis	2

-														
Outside														
6261	VNE163.VIR	#0.223	.281	.359	.511	.701	.061	.031	.000	.840	.032			
.578	1 Air	6.343												
.017	23 Double Skin Sha	0.024	.000	.700	.700	.000	.700	.700	.320	.638	.638			
92.4	ding													
	1 Air	6.343												
.626	6046 VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578	1 Air	0.500												
.016	6046 VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
Inside														

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
	-----	-----	-----	-----	-----	-----	-----
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00



	Temperature Distribution (degrees F)			
	Winter		Summer	
	Out	In	Out	In
Lay1	1.3	1.6	120.0	122.0
Lay2	18.3	18.4	151.4	151.4
Lay3	25.7	26.0	145.2	144.9
Lay4	48.7	49.0	114.0	113.5

Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:14:21

ID : 14
Name : Double Skin 2 with Shading
Tilt : 90.0
Glazings: 4
KEFF : 0.3772
Width : 25.168
Uvalue : 0.12
SHGCc : 0.14
SCc : 0.16
Vtc : 0.19
RHG : 32.49

Layer Data for Glazing System '14 Double Skin 2 with Shading'

ID	Name	D(")	Tsol	1 Rsol	2 Tvis	1 Rvis	2 Tir	1 Emis	2
Keff									
-									
Outside									
6261	VNE163.VIR	#0.223	.281	.359	.511	.701	.061	.031	.000 .840 .032
.578									
1	Air	6.343							
.017									
23	Double Skin Sha	0.024	.000	.700	.700	.000	.700	.700	.320 .638 .638
92.4									
ding									
1	Air	6.343							
.626									
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000 .840 .040
.578									
1	Air	0.500							
.016									
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000 .840 .040
.578									
Inside									

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
	-----	-----	-----	-----	-----	-----	-----
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00

Temperature Distribution (degrees F)

	Winter		Summer	
	Out	In	Out	In
	----	----	----	----
Lay1	1.3	1.6	120.0	122.0
Lay2	18.3	18.4	151.4	151.4
Lay3	25.7	26.0	145.2	144.9
Lay4	48.7	49.0	114.0	113.5



Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:08:06

ID : 13
Name : Double Skin 1 with Shading
Tilt : 90.0
Glazings: 4
KEFF : 0.3787
Width : 25.168
Uvalue : 0.12
SHGCc : 0.15
SCc : 0.17
Vtc : 0.18
RHG : 35.32

Layer Data for Glazing System '13 Double Skin 1 with Shading'

ID	Name	D(")	Tsol	1	Rsol	2	Tvis	1	Rvis	2	Tir	1	Emis	2
Keff														
-														
Outside														
6071	VE62M.VIR	#0.223	.290	.110	.445	.675	.059	.039	.000	.840	.040			
.578														
	1 Air	6.343												
.017														
23	Double Skin Sha	0.024	.000	.700	.700	.000	.700	.700	.320	.638	.638			
92.4														
	ding													
	1 Air	6.343												
.626														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
	1 Air	0.500												
.016														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
Inside														

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00

Temperature Distribution (degrees F)

Winter		Summer	
Out	In	Out	In
----	----	----	----



Lay1	1.3	1.6	135.3	138.3
Lay2	18.2	18.2	165.0	165.0
Lay3	25.6	25.8	157.7	157.3
Lay4	48.7	49.0	119.8	119.2

Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:11:20

ID : 13
Name : Double Skin 1 with Shading
Tilt : 90.0
Glazings: 4
KEFF : 0.3787
Width : 25.168
Uvalue : 0.12
SHGCC : 0.15
SCc : 0.17
Vtc : 0.18
RHG : 35.32

Layer Data for Glazing System '13 Double Skin 1 with Shading'

ID	Name	D(")	Tsol	1	Rsol	2	Tvis	1	Rvis	2	Tir	1	Emis	2
Keff														

-														
Outside														
6071	VE62M.VIR	#0.223	.290	.110	.445	.675	.059	.039	.000	.840	.040			
.578														
	1 Air	6.343												
.017														
23	Double Skin Sha	0.024	.000	.700	.700	.000	.700	.700	.320	.638	.638			
92.4														
	ding													
	1 Air	6.343												
.626														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
	1 Air	0.500												
.016														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
Inside														

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00



	Temperature Distribution (degrees F)			
	Winter		Summer	
	Out	In	Out	In
Lay1	1.3	1.6	135.3	138.3
Lay2	18.2	18.2	165.0	165.0
Lay3	25.6	25.8	157.7	157.3
Lay4	48.7	49.0	119.8	119.2

Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:12:48

ID : 13
Name : Double Skin 1 with Shading
Tilt : 90.0
Glazings: 4
KEFF : 0.3787
Width : 25.168
Uvalue : 0.12
SHGCc : 0.15
SCc : 0.17
Vtc : 0.18
RHG : 35.32

Layer Data for Glazing System '13 Double Skin 1 with Shading'

ID	Name	D(")	Tsol	1 Rsol	2 Tvis	1 Rvis	2 Tir	1 Emis	2
Keff									
-									
Outside									
6071	VE62M.VIR	#0.223	.290	.110	.445	.675	.059	.039	.000 .840 .040
.578									
1	Air	6.343							
.017									
23	Double Skin Sha	0.024	.000	.700	.700	.000	.700	.700	.320 .638 .638
92.4									
ding									
1	Air	6.343							
.626									
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000 .840 .040
.578									
1	Air	0.500							
.016									
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000 .840 .040
.578									
Inside									

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
	-----	-----	-----	-----	-----	-----	-----
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00

Temperature Distribution (degrees F)				
Winter		Summer		
Out	In	Out	In	
----	----	----	----	
Lay1	1.3	1.6	135.3	138.3
Lay2	18.2	18.2	165.0	165.0
Lay3	25.6	25.8	157.7	157.3
Lay4	48.7	49.0	119.8	119.2



ID : 12
 Name : MSC Original
 Tilt : 90.0
 Glazings: 2
 KEFF : 0.0166
 Width : 0.946
 Uvalue : 0.22
 SHGCc : 0.34
 SCc : 0.39
 Vtc : 0.63
 RHG : 80.31

Layer Data for Glazing System '12 MSC Original'

ID	Name	D (")	Tsol	1 Rsol	2 Tvis	1 Rvis	2 Tir	1 Emis	2
Keff									

-									
Outside									
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000 .840 .040
.578									
	1 Air	0.500							
.017									
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000 .840 .040
.578									
Inside									

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00

Optical Properties for Glazing System '12 MSC Original'

Angle	0	10	20	30	40	50	60	70	80	90	Hemis
Vtc	: 0.630	0.637	0.621	0.602	0.580	0.541	0.459	0.314	0.136	0.000	0.504
Rf	: 0.098	0.086	0.082	0.086	0.102	0.127	0.171	0.273	0.511	0.999	0.154
Rb	: 0.076	0.064	0.060	0.065	0.081	0.107	0.152	0.259	0.502	0.999	0.135
Tsol	: 0.255	0.259	0.252	0.244	0.235	0.220	0.187	0.128	0.056	0.000	0.205
Rf	: 0.309	0.301	0.299	0.302	0.311	0.328	0.356	0.428	0.608	0.999	0.345
Rb	: 0.472	0.466	0.464	0.466	0.474	0.487	0.510	0.566	0.704	0.999	0.498
Abs1	: 0.341	0.344	0.350	0.354	0.354	0.354	0.360	0.356	0.282	0.001	0.346
Abs2	: 0.095	0.096	0.099	0.100	0.099	0.098	0.097	0.087	0.054	0.000	0.093



SHGCc: 0.338 0.342 0.338 0.331 0.322 0.306 0.272 0.207 0.108 0.000 0.287

Tdw-K : 0.200

Tdw-ISO: 0.414

Tuv : 0.027

	Temperature Distribution (degrees F)			
	Winter		Summer	
	Out	In	Out	In
	----	----	----	----
Lay1	2.6	3.1	112.6	114.0
Lay2	41.4	41.9	114.6	114.3

Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:10:08

ID : 12
Name : MSC Original
Tilt : 90.0
Glazings: 2
KEFF : 0.0166
Width : 0.946
Uvalue : 0.22
SHGCc : 0.34
SCc : 0.39
Vtc : 0.63
RHG : 80.31

Layer Data for Glazing System '12 MSC Original'

ID	Name	D(")	Tsol	1	Rsol	2	Tvis	1	Rvis	2	Tir	1	Emis	2
Keff														
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-														
Outside														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
1	Air	0.500												
.017														
6046	VE12M.VIR	#0.223	.383	.286	.449	.792	.060	.047	.000	.840	.040			
.578														
Inside														

Environmental Conditions: 1 NFRC 100-2010

Tout	Tin	WndSpd	Wnd Dir	Solar	Tsky	Esky
------	-----	--------	---------	-------	------	------



Paul Kuehnel

Mike Lucas

Sara Pace

Jon Brangan

	(F)	(F)	(mph)		(Btu/h-ft2)	(F)
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4
Solar	89.6	75.2	6.26	Windward	248.2	89.6

Optical Properties for Glazing System '12 MSC Original'

Angle	0	10	20	30	40	50	60	70	80	90	Hemis
Vtc	: 0.630	0.637	0.621	0.602	0.580	0.541	0.459	0.314	0.136	0.000	0.504
Rf	: 0.098	0.086	0.082	0.086	0.102	0.127	0.171	0.273	0.511	0.999	0.154
Rb	: 0.076	0.064	0.060	0.065	0.081	0.107	0.152	0.259	0.502	0.999	0.135
Tsol	: 0.255	0.259	0.252	0.244	0.235	0.220	0.187	0.128	0.056	0.000	0.205
Rf	: 0.309	0.301	0.299	0.302	0.311	0.328	0.356	0.428	0.608	0.999	0.345
Rb	: 0.472	0.466	0.464	0.466	0.474	0.487	0.510	0.566	0.704	0.999	0.498
Abs1	: 0.341	0.344	0.350	0.354	0.354	0.354	0.360	0.356	0.282	0.001	0.346
Abs2	: 0.095	0.096	0.099	0.100	0.099	0.098	0.097	0.087	0.054	0.000	0.093
SHGCCc	: 0.338	0.342	0.338	0.331	0.322	0.306	0.272	0.207	0.108	0.000	0.287
Tdw-K	: 0.200										
Tdw-ISO	: 0.414										
Tuv	: 0.027										

Temperature Distribution (degrees F)

	Winter		Summer	
	Out	In	Out	In
Lay1	2.6	3.1	112.6	114.0
Lay2	41.4	41.9	114.6	114.3

Window v6.3.9.0 Glazing System Thermal and Optical Properties 02/22/11
00:10:38

ID : 12
Name : MSC Original
Tilt : 90.0
Glazings: 2
KEFF : 0.0166
Width : 0.946
Uvalue : 0.22
SHGCCc : 0.34
SCc : 0.39
Vtc : 0.63
RHG : 80.31

Layer Data for Glazing System '12 MSC Original'

ID	Name	D(")	Tsol	1	Rsol	2	Tvis	1	Rvis	2	Tir	1	Emis	2
Keff														

```

-----
-
Outside
  6046 VE12M.VIR      #0.223 .383 .286 .449 .792 .060 .047 .000 .840 .040
.578
      1 Air           0.500
.017
  6046 VE12M.VIR      #0.223 .383 .286 .449 .792 .060 .047 .000 .840 .040
.578
Inside
  
```

Environmental Conditions: 1 NFRC 100-2010

	Tout (F)	Tin (F)	WndSpd (mph)	Wnd Dir	Solar (Btu/h-ft2)	Tsky (F)	Esky (F)
Uvalue	-0.4	69.8	12.30	Windward	0.0	-0.4	1.00
Solar	89.6	75.2	6.26	Windward	248.2	89.6	1.00

Optical Properties for Glazing System '12 MSC Original'

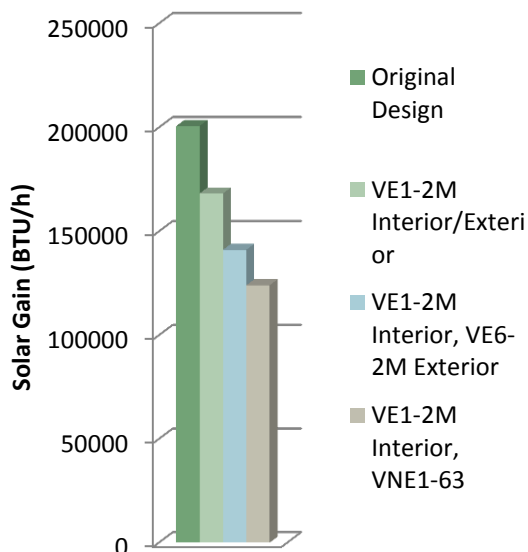
Angle	0	10	20	30	40	50	60	70	80	90	Hemis
Vtc	: 0.630	0.637	0.621	0.602	0.580	0.541	0.459	0.314	0.136	0.000	0.504
Rf	: 0.098	0.086	0.082	0.086	0.102	0.127	0.171	0.273	0.511	0.999	0.154
Rb	: 0.076	0.064	0.060	0.065	0.081	0.107	0.152	0.259	0.502	0.999	0.135
Tsol	: 0.255	0.259	0.252	0.244	0.235	0.220	0.187	0.128	0.056	0.000	0.205
Rf	: 0.309	0.301	0.299	0.302	0.311	0.328	0.356	0.428	0.608	0.999	0.345
Rb	: 0.472	0.466	0.464	0.466	0.474	0.487	0.510	0.566	0.704	0.999	0.498
Abs1	: 0.341	0.344	0.350	0.354	0.354	0.354	0.360	0.356	0.282	0.001	0.346
Abs2	: 0.095	0.096	0.099	0.100	0.099	0.098	0.097	0.087	0.054	0.000	0.093
SHGCc	: 0.338	0.342	0.338	0.331	0.322	0.306	0.272	0.207	0.108	0.000	0.287
Tdw-K	: 0.200										
Tdw-ISO	: 0.414										
Tuv	: 0.027										

	Temperature Distribution (degrees F)			
	Winter		Summer	
	Out	In	Out	In
Lay1	2.6	3.1	112.6	114.0
Lay2	41.4	41.9	114.6	114.3

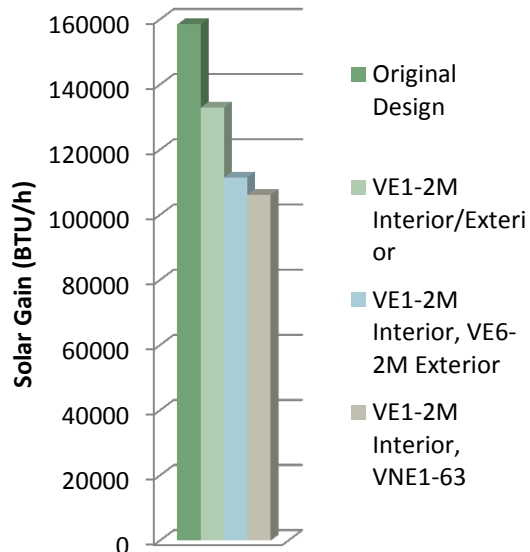


U-factor (Summer) (BTU/hr ft ² F)	0.107	0.106	0.104	0.29
SC	0.326	0.273	0.260	0.388
SHGC	0.283	0.237	0.226	0.338
Solar Transmissibility	0.185	0.150	0.153	0.256
Visible Transmissibility	0.502	0.428	0.444	0.630
Solar Reflectivity, Inside	0.481	0.480	0.481	0.472
Visible Reflectivity, Inside	0.0949	0.0919	0.0886	0.0762
Keff (BTU/hr ft F)	0.3966	0.3966	0.3883	-0.2297
Air Gap Keff (BTU/hr ft F)	0.7874	0.7874	0.1988	-

Office Zone Solar Gain



Lab Zone Solar Gain



System Checksums

By ACADEMIC

Lab	Variable Volume Reheat (30% Min Flow Default)									
	COOLING COIL PEAK					CLG SPACE PEAK				
	Peaked at Time: Outside Air:	MoHr: 7/17	MoHr: 3/17	MoHr: Heating Design	MoHr: Heating Design					
		OADBWB/Hr: 88/72/92	OADB: 54	OADB: 11	OADB: 11					
Envelope Loads	Space Sens. + Lat.	Plenum	Net	Space Sensible	Space Peak	Coil Peak	Percent	Percent	Percent	Percent
Sens. + Lat.	Sens. + Lat.	Sens. + Lat.	Total	Sensible	Space Sens	Tot Sens	Of Total	Of Total	Of Total	Of Total
Btu/h	Btu/h	Btu/h	Btu/h	Btu/h	Btu/h	Btu/h	(%)	(%)	(%)	(%)
Envelope Loads										
Skyline Solar	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Skyline Cond	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Roof Cond	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Glass Solar	175,386	0	175,386	21	220,940	-114,604	4.63	4.63	4.63	4.63
Glass/Door Cond	16,456	0	16,456	2	-20,351	-62,449	2.52	2.52	2.52	2.52
Wall Cond	233	840	1,074	0	-219	-3,710	0.15	0.15	0.15	0.15
Partition/Door	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Floor	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Adjacent Floor	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Infiltration	31,046	0	31,046	4	-55,694	-55,694	2.25	2.25	2.25	2.25
Sub Total ==>	223,121	127,704	350,826	43	-118,864	-236,458	9.56	9.56	9.56	9.56
Internal Loads										
Lights	51,927	13,353	65,280	8	51,927	0	0.00	0.00	0.00	0.00
People	121,283	0	121,283	15	60,841	0	0.00	0.00	0.00	0.00
Misc	71,548	0	71,548	9	71,548	0	0.00	0.00	0.00	0.00
Sub Total ==>	244,758	13,353	258,109	31	184,115	0	0.00	0.00	0.00	0.00
Ceiling Load	17,184	-17,184	0	0	5,631	-14,177	0.00	0.00	0.00	0.00
Ventilation Load	-231,094	0	-231,094	-28	-170,882	-142,485	5.76	5.76	5.76	5.76
Adj Air Trans Heat	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Dehumid. Ov Strng	0	0	0	0	0	0	0.00	0.00	0.00	0.00
OvUnder Sizing	355,844	-26,201	329,643	43	315,958	-294,412	11.90	11.90	11.90	11.90
Exhaust Heat	-25,201	0	-25,201	-3	-17,763	-17,763	0.72	0.72	0.72	0.72
Sup. Fan Heat	114,907	0	114,907	14	-1,349,940	-1,349,940	54.57	54.57	54.57	54.57
Ret. Fan Heat	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Duct Heat PkUp	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Underm. Sup Ht PkUp	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Supply Air Leakage	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Grand Total ==>	608,811	97,672	822,390	100.00	515,930	-2,473,880	100.00	100.00	100.00	100.00
Internal Loads										
Lights	51,927	13,353	65,280	8	51,927	0	0.00	0.00	0.00	0.00
People	121,283	0	121,283	15	60,841	0	0.00	0.00	0.00	0.00
Misc	71,548	0	71,548	9	71,548	0	0.00	0.00	0.00	0.00
Sub Total ==>	244,758	13,353	258,109	31	184,115	0	0.00	0.00	0.00	0.00
Ceiling Load	17,184	-17,184	0	0	5,631	-14,177	0.00	0.00	0.00	0.00
Ventilation Load	-231,094	0	-231,094	-28	-170,882	-142,485	5.76	5.76	5.76	5.76
Adj Air Trans Heat	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Dehumid. Ov Strng	0	0	0	0	0	0	0.00	0.00	0.00	0.00
OvUnder Sizing	355,844	-26,201	329,643	43	315,958	-294,412	11.90	11.90	11.90	11.90
Exhaust Heat	-25,201	0	-25,201	-3	-17,763	-17,763	0.72	0.72	0.72	0.72
Sup. Fan Heat	114,907	0	114,907	14	-1,349,940	-1,349,940	54.57	54.57	54.57	54.57
Ret. Fan Heat	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Duct Heat PkUp	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Underm. Sup Ht PkUp	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Supply Air Leakage	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Grand Total ==>	608,811	97,672	822,390	100.00	515,930	-2,473,880	100.00	100.00	100.00	100.00

Project Name: Millennium Science Complex
Dataset Name: PSU MSC_DSIF.txc

Project Name: Millennium Science Complex
Dataset Name: PSU MSC_DSIF.txc

Project Name: Millennium Science Complex
Dataset Name: PSU MSC_DSIF.txc

Project Name: Millennium Science Complex
Dataset Name: PSU MSC_DSIF.txc

Project Name: Millennium Science Complex
Dataset Name: PSU MSC_DSIF.txc

Project Name: Millennium Science Complex
Dataset Name: PSU MSC_DSIF.txc



System Checksums

By ACADEMIC

BY ACADEMIC

Office

Variable Volume Reheat (30% Min Flow Default)

[illegible]

Project Name:	Millennium Science Complex
Dataset Name:	PSU MSC_DSf.trc

TRACE® 700 v6.2.6.5 calculated at 10:10 PM on 03/27/2011
Alternative - 3 System Checksums Report Page 2 of 2

Double Skin Facade

System Checksums

By ACADEMIC

Office									
Variable Volume Reheat (30% Min Flow Default)									
TEMPERATURES									
SADB	55.0	Heating	90.0						
Ra Plenum	75.7								
Return	77.0								
Ret/OA	80.1								
Fm MTD	0.3								
Fm BUID	0.7								
Fm Frict	2.2								
AIRFLOWS									
Diffuser	27.589	Heating	11.029						
Terminal	27.589								
Main Fan	27.589								
Sec Fan	0								
Nom Vent	6.506								
AHU Vent	6.506								
Infil	1.576								
MinStopRh	11.029								
Return	29.165								
Exhaust	8.083								
Rm Exh	0								
Auxiliary	0								
Leakage Dwn	0								
Leakage Ups	0								
ENGINEERING CKS									
% OA	23.6	Heating	46.3						
cm/ft ²	0.96								
cfm/ton	293.43								
ft ³ /ton	304.84								
Btu/hr-ft ²	39.36								
No. People	384								
HEATING COIL SELECTION									
Capacity	464.2	Coil Airflow	11.029	Ent	51.8	Lvg	90.0		
MBH		cfm		ft ³		ft			
Main Htg	464.2								
Aux Htg	0								
Preheat	-282.1								
Humidif	0								
Opt Vent	0								
Total	-756.3								
AREAS									
Gross Total	28,662	Glass	0						
Floor	28,662	ft ²							
Part	0								
Int Door	0								
ExFlr	0								
Roof	11,570								
Wall	12,852								
Ext Door	0								
COOLING COIL SELECTION									
Total Capacity	672.641	Coil Airflow	1,128.251	Ent	577.181	Lvg	100.00		
ton		cfm		ft ³		ft			
Main Clg	94.0								
Aux Clg	0.0								
Opt Vent	0.0								
Total	94.0								

Project Name: Millennium Science Complex
Dataset Name: PSU MSC_PDSF.irc

TRAC@ 700 v6.2.6.5 calculated at 09:23 PM on 04/02/2011
Alternative - 4 System Checksums Report Page 2 of 2





Chilled Beams

System Checksums
By ACADEMIC

Office

COOLING COIL PEAK

Peaked at Time: Outside Air:

MoHr: 7/1/12

OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING COIL PEAK

MoHr: 7/1/12

OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING COIL PEAK

MoHr: 7/1/12

OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING COIL PEAK

MoHr: 7/1/12

OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING COIL PEAK

MoHr: 7/1/12

OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING COIL PEAK

MoHr: 7/1/12

OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING COIL PEAK

MoHr: 7/1/12

OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING COIL PEAK

MoHr: 7/1/12

OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING COIL PEAK

MoHr: 7/1/12

OADB/MBHR: 87/73/101

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OADB/MBHR: 87/73/101

OADB: 81

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MoHr: 9/1/13

OADB: 81

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MoHr: Heating Design

OADB: 11

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CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING COIL PEAK

MoHr: 7/1/12

OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

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OADB/MBHR: 87/73/101

OADB: 81

CLG SPACE PEAK

MoHr: 9/1/13

OADB: 81

HEATING COIL PEAK

MoHr: Heating Design

OADB: 11

COOLING CO

Summarized Redesign Analysis-Base Model

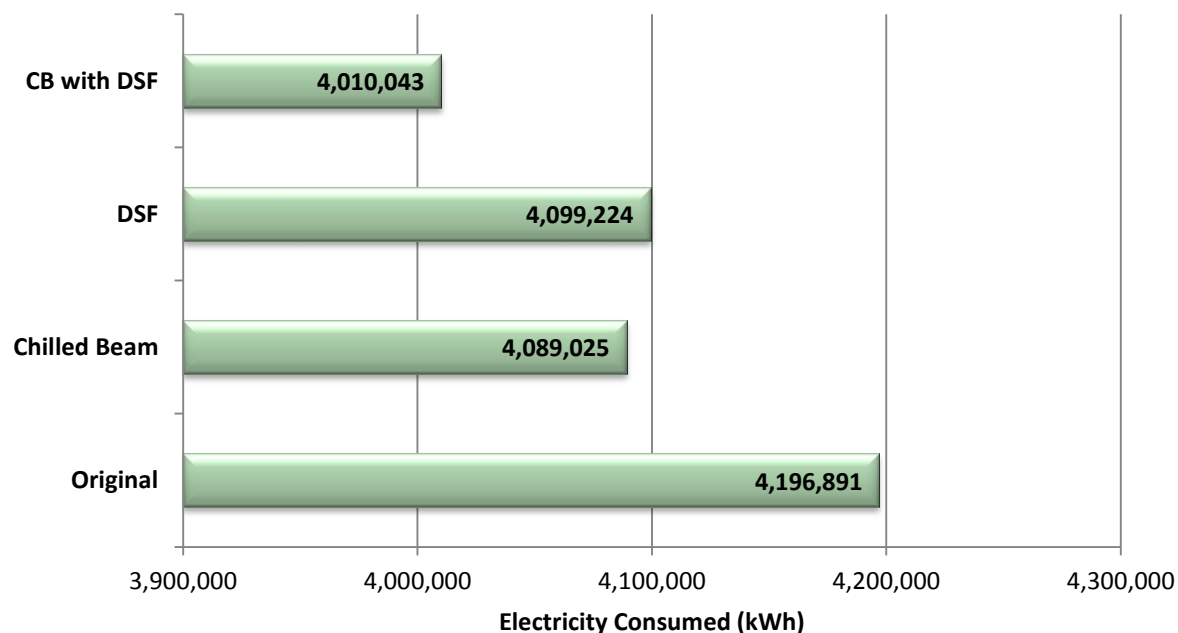
Total Building Energy Consumption for Final Design Parameters.

	Building (MBtu)	Source (MBtu)
Original	46,724	76,243
Chilled Beam	45,638	75,041
Double Skin Facade	42,578	71,410
CB with DSF	41,412	69,797
Total Savings for Combined System	5,311	6,446

Building HVAC Associated Emissions for Final Design.

	CO ₂	SO _x	NO _x
Original	16,649,602	128,726	25,877
Chilled Beam	16,263,067	125,739	25,275
Double Skin Façade	15,173,621	117,312	23,583
Chilled Beam w/ DSF	14,757,205	114,092	22,933
Total Savings	1,892,397	14,634	2,944

Building Electricity Consumption



Building Electricity Consumption Comparison for Design Parameters.

Comparison of Yearly Utility Cost for Design Parameters.

	Electricity kWh	Electricity Cost	Purchased Chilled Water (therms)	Purchased CW Cost	Purchased Steam (therms)	Purchased Steam (cost)	Total Cost
Original	4,196,917	\$315,480	176,057	\$322,184	147,933	\$121,305	\$758,969
Chilled Beam	4,088,983	\$307,372	136,773	\$250,295	127,910	\$104,886	\$662,553
Double Skin Façade	4,099,207	\$308,139	147,163	\$269,309	136,609	\$112,019	\$689,467
Chilled Beam w/ DSF	4,010,041	\$301,435	132,044	\$241,641	123,198	\$101,022	\$644,098
Total Savings	186,876	\$14,045	44,013	\$80,543	23,735	\$20,283	\$114,871

Revised Plug Loads

System Checksums

By ACADEMIC

Lab	COOLING COIL PEAK				CLG SPACE PEAK				HEATING COIL PEAK				TEMPERATURES			
	Peaked at Time: Outside Air:	MoHr: 7/17 OADBWB/Hr: 89/72.192	MoHr: 12/15 OADB: 46	MoHr: Heating Design OADB: 11	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat. Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)	Envelope Loads Btu/h	Space Peak Sens. Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)	SADB Cooling 55.0	Heating 90.0
Envelope Loads																
Skyline Solar																
Skyline Cond																
Roof Cond																
Glass Solar																
Glass Cond																
GlassDoor Cond																
Wall Cond																
Partition/Door																
Floor																
Adjacent Floor																
Infiltration																
Sub Total ==>																
Internal Loads																
Lights																
People																
Misc																
Sub Total ==>																
Ceiling Load																
Ventilation Load																
Adj Air Trans Heat																
Dehumid. Ov Sizing																
OvUndr Sizing																
Exhaust Heat																
Sup. Fan Heat																
Ret. Fan Heat																
Duct Heat PkUp																
Underfir Sup Ht PkUp																
Supply Air Leakage																
Grand Total ==>																
AIRFLOWS																
Diffuser																
Terminal																
Main Fan																
Sec Fan																
Nom Vent																
AHU Vent																
Infil																
MinStop/Rh																
Return																
Exhaust																
Rm Exh																
Auxiliary																
Leakage Dwn																
Leakage Ups																
ENGINEERING CKS																
% OA																
cfm/ft ²																
cfm/ton																
ft ² /ton																
Btu/ft ²																
No. People																
HEATING COIL SELECTION																
Total Capacity																
Sens Cap.																
coil airflow																
MBh																
Main Ctg																
Aux Ctg																
Opt Vent																
Total																
AREAS																
Gross Total																
Floor																
Part																
Int Door																
Exfir																
Roof																
Wall																
Ext Door																
HEATING COIL SELECTION																
Capacity																
coil airflow																
MBh																
Main Htg																
Aux Htg																
Preheat																
Humidif																
Opt Vent																
Total																

TRACE® 700 v6.2.6.5 calculated at 12:49 PM on 03/27/2011
Alternative - 4 - System Checksums Report Page 1 of 2Project Name: Millennium Science Complex
Dataset Name: PSU MSC NewPlug LoadsBASE.trc

System Checksums

By ACADEMIC

Office

Variable Volume Reheat (30% Min Flow Default)

[illegible]

TRACE® 700 v6.2.6.5 calculated at 12:49 PM on 03/27/2011
Alternative - 4 System Checksums Report Page 2 of 2

Project Name: Millennium Science Complex
Dataset Name: PSU MSC NewPlug LoadsBASE.trc

Revised Plug Loads with Chilled Beams

System Checksums
By ACADEMIC

Office

Active Chilled Beams

COOLING COIL PEAK										CLG SPACE PEAK										HEATING COIL PEAK										
Peaked at Time: Outside Air:										MoHr: 7/12 OADBWBHR: 87/73/101										MoHr: 9/13 OADB: 81										
Sens. + Lat.		Space	Plenum	Net		Percent	Space		Percent	Space		Percent	Space		Percent	Space		Percent	Space		Percent	Space		Percent	Space		Percent	Space		Percent
Btu/h		Btu/h	Btu/h	Btu/h		(%)	Btu/h		(%)	Btu/h		(%)	Btu/h		(%)	Btu/h		(%)	Btu/h		(%)	Btu/h		(%)	Btu/h		(%)	Btu/h		(%)
Envelope Loads																														
Skyline Solar																														
Skyline Cond																														
Roof Cond																														
Glass Solar																														
Glass/Door Cond																														
Wall Cond																														
Partition/Door																														
Floor																														
Adjacent Floor																														
Infiltration																														
Sub Total ==>																														
Internal Loads																														
Lights																														
People																														
Misc																														
Sub Total ==>																														
Ceiling Load																														
Ventilation Load																														
Adj Air Trans Heat																														
Dehumid. Ov Sizing																														
Ov/Under Sizing																														
Exhaust Heat																														
Sup. Fan Heat																														
Ret. Fan Heat																														
Duct Heat PkUp																														
Underftr Sup Ht PkUp																														
Supply Air Leakage																														
Grand Total ==>																														
COOLING COIL SELECTION																														
Total Capacity		Sens Cap.		Coil Airflow		Enter		DBWBHR		Leave		DBWBHR		F		F		g/rb		g/rb		F		F		g/rb		g/rb		
ton		MBh		cfm		°F		°F		°F		°F		°F		°F		°F		°F		°F		°F		°F		°F		
10.6		43.0		6,506		80.1		65.3		70.8		63.4		59.1		69.0		63.4		59.1		69.0		63.4		59.1		69.0		
107.5		1,290.5		1,290.5		172.073		74.0		61.7		63.6		67.2		59.2		63.6		67.2		59.2		63.6		67.2		59.2		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
118.2		1,418.2		1,351,579		13,379		1,415,680		100.00		42,985		100.00		42,985		100.00		42,985		100.00		42,985		100.00		42,985		
HEATING COIL SELECTION																														
Capacity		Coil Airflow		Lvg		Ent		°F		°F		°F		°F		°F		°F		°F		°F		°F		°F		°F		
MBh		cfm		°F		°F		°F		°F		°F		°F		°F		°F		°F		°F		°F		°F		°F		
-140.6		6,506		83.4		83.0		83.0		83.0		83.0		83.0		83.0		83.0		83.0		83.0		83.0		83.0		83.0		
-2,675.1		172.073		70.0		84.1		84.1		84.1		84.1		84.1		84.1		84.1		84.1		84.1		84.1		84.1		84.1		
-100.4		6,506		49.4		63.4		63.4		63.4		63.4		63.4		63.4		63.4		63.4		63.4		63.4		63.4		63.4		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
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0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
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0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
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0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
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0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
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0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
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0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		
0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0						

COOLING COIL SELECTION										HEATING COIL SELECTION									
Total Capacity	Sens Cap.	Coil Airflow	Enter DBWBHR	Exit DBWBHR	Capacity	Coil Airflow	Enter DBWBHR	Exit DBWBHR	Lvg	Capacity	Coil Airflow	Enter DBWBHR	Exit DBWBHR	Capacity	Coil Airflow	Enter DBWBHR	Exit DBWBHR	Lvg	Lvg
ton	MBH	cfm	F	F	ton	MBH	cfm	F	F	ton	MBH	cfm	F	ton	MBH	cfm	F	F	F
Main Cig	10.6	127.7	43.0	60.1	65.3	70.8	63.4	59.1	69.0	Main Htg	-140.6	6,506	63.4	83.0	-140.6	6,506	63.4	83.0	83.0
Aux Cig	107.5	1,290.5	1,290.5	74.0	61.7	63.6	67.2	59.2	63.6	Aux Htg	-2,675.1	172,073	70.0	84.1	-2,675.1	172,073	70.0	84.1	84.1
Opt Vent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Preheat	-100.4	6,506	49.4	63.4	-100.4	6,506	49.4	63.4	63.4
Total	118.2	1,418.2								Humidif	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
										Opt Vent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
										Total	-2,916.1				-2,916.1				

TRACE 700 v6.2.6.5 calculated at 01:35 AM on 04/03/2011
Alternative -4 System Checksums Report Page 2 of 2Project Name: Millennium Science Complex
Dataset Name: PSU MSC NewPlug CB.trc



The Building Stimulus

Paul Kuehn

Mike Lucas

Sara Pace

Jon Brangan

Millennium Science Complex
University Park, PA

Revised Plug Loads with Chilled Beams and Double Skin

System Checksums

By ACADEMIC

Variable Volume Reheat (30% Min Flow Default)									
COOLING COIL PEAK					HEATING COIL PEAK				
Peaked at Time: Outside Air: MoHr: 7/17 OADB: 89 / 72 / 92					MoHr: 12/15 OADB: 46				
Sens. + Lat.		Plenum	Net	Percent	Space		Percent		
Btu/h	Btu/h	Btu/h	Total	Of Total	Sensible	Space	Of Total		
					Btu/h	Btu/h			
Envelope Loads									
Sky/Solar	0	0	0	0	0	0	0	0	0.00
Sky/Cond	0	0	0	0	0	0	0	0	0.00
Roof Cond	0	131,717	0	8	0	0	-118,595	2.33	0.00
Glass Solar	149,434	0	149,434	9	205,094	0	16	0.00	0.00
Glass/Door Cond	13,205	0	13,205	1	-23,888	-2	-50,029	0.98	0.00
Wall Cond	233	962	1,195	0	-362	0	-720	0.07	0.00
Partition/Door	0	0	0	0	0	0	0	0.00	0.00
Floor	0	0	0	0	0	0	0	0.00	0.00
Adjacent Floor	31,046	0	31,046	2	-26,431	0	-55,694	1.09	0.00
Infiltration	193,918	132,679	326,597	19	154,412	12	-228,133	4.48	0.00
Sub Total ==>									
Internal Loads									
Lights	51,257	13,180	64,437	4	51,257	0	0	0.00	0.00
People	121,283	0	121,283	7	60,641	0	0	0.00	0.00
Misc	1,370,518	0	1,370,518	80	1,370,518	0	0	0.00	0.00
Sub Total ==>									
1,543,057 13,180 1,556,238 90					1,482,416 116				
Celling Load									
Ventilation Load	5,444	-5,444	0	0	-1,383	-4,522	0	0.00	0.00
Adj Air Trans Heat	-603,910	0	-603,910	-35	-446,823	-372,353	-372,353	7.32	0.00
Dehumid. Ov Sizing	0	0	0	0	0	0	0	0.00	0.00
Ov/Undr Sizing	226,863	0	226,863	13	89,025	-1,006,091	-1,006,091	19.78	-0.83
Exhaust Heat	0	0	0	0	0	0	0	0.00	0.00
Sup. Fan Heat	-58,981	0	-58,981	-3	0	0	0	0.00	0.00
Ret. Fan Heat	1	0	1	0	0	0	0	0.00	0.00
Duct Heat Pk Up	0	0	0	0	0	0	0	0.00	0.00
Underfr Sup Ht Pk Up	0	0	0	0	0	0	0	0.00	0.00
Supply Air Leakage	0	0	0	0	0	0	0	0.00	0.00
Grand Total ==>					Grand Total ==>				
1,365,373 81,435 1,723,650 100.00					-1,489,410 -5,087,615 100.00				
COOLING COIL SELECTION									
Total Capacity	Sens Cap.	Coil Airflow	Enter DB/MBHR	Leave DB/MBHR					
ton	MBh	cfm	°F	°F					
143.6	1,723.7	1,580.0	58,397	75.1 62.1 63.6	50.7 50.6 55.5				
0.0	0.0	0.0	0.0	0.0 0.0 0.0	0.0 0.0 0.0				
226.0	2,712.0	1,881.3	67,633	82.0 68.1 82.4	56.8 55.6 65.0				
Total					Total				
369.6	4,435.6				3,539.6 64				
HEATING COIL SELECTION									
Capacity	Coil Airflow	Ent	Lvg						
MBh	cfm	°F	°F						
-2,927.1	67,633	50.7	90.0	Main Htg					
0.0	0.0	0.0	0.0	Aux Htg					
0.0	0.0	0.0	0.0	Preheat					
Total				Total					
-2,153.9	67,633	39.1	68.0	Humidif					
-5,087.6				Opt Vent					

System Checksums

Office

Active Chilled Beams

COOLING COIL PEAK										CLG SPACE PEAK										HEATING COIL PEAK										TEMPERATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Peaked at Time: MoHr: 7/12 Outside Air: OADBWB/Hr: 87 / 73 / 101										MoHr: 9/12 OADB: 78										MoHr: Heating Design OADB: 11										Cooling Heating SADB Ra Plenum Return Re/OA Fm MtrTD Fm BlrTD Fm Frict																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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TRACE® 700 v6.2.6.5 calculated at 01:01 AM on 04/03/2011
Alternative - 4 System Checksums Report Page 4 of 4

Project Name: Millennium Science Complex
Dataset Name: PSU MSC NewPlug_DSF_CB.trc

Penn State Utility Data**Utility Charge Rates**

Some Departments pay the cost of their utility usage to OPP. These are Departments such as Housing and Food Service and Athletics. The following chart shows the billable rates charged as well as our avoidable costs that are used for Energy Savings Projects for FY 09-10:

Utility	Avoided Costs	Billable Rate	Units	Comments
Electricity	\$1.09	\$1.09	KW	5 sub-stations only, 1 st half
	\$0.07781	\$0.09648	KWH	5 sub-stations only, 1 st half
Electricity	\$1.09	\$1.09	KW	5 sub-stations only, 2 nd half
	\$0.07517	\$0.09481	KWH	5 sub-stations only, 2 nd half
Natural Gas	\$8.66	\$9.83	MCF	Blended Rate
Steam	\$9.85	\$21.65	1000 pounds	
Water & Wastewater	\$3.32	\$8.39	1000 gallons	
Chilled Water	\$0.22	\$0.22	Ton-Hour	Estimated Cost

ALTOONA BLAIR CO ARPT, PA, USA

WMO#: 725126

Lat: 40.30N

Long: 78.32W

Elev: 1470

StdP: 13.93

Time Zone: -5.00 (NAE)

Period: 82-06

WBAN: 14736

Annual Heating and Humidification Design Conditions

Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest month WS/MCDB				MCWS/PCWD to 99.6% DB	
			99.6%			99%			0.4%		1%			
	99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD
1	4.7	9.6	-6.4	4.1	7.5	-1.7	5.3	11.9	27.5	29.4	24.9	27.1	8.9	260

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

Hottest Month	Hottest Month DB Range	Cooling DB/MCWB						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB	
		0.4%		1%		2%		0.4%		1%		2%			
		DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	WB	MCDB	MCWS	PCWD
7	19.3	88.5	72.0	85.7	70.7	83.0	69.6	74.7	83.9	73.2	82.0	71.6	79.8	8.0	280
Dehumidification DP/MCDB and HR									Enthalpy/MCDB						Hours 8 to 4 & 55/69
0.4%			1%			2%			0.4%		1%		2%		
DP	HR	MCDB	DP	HR	MCDB	DP	HR	MCDB	Enth	MCDB	Enth	MCDB	Enth	MCDB	
72.0	125.0	79.6	70.3	118.0	77.7	69.1	112.9	76.2	39.1	83.9	37.6	82.0	36.3	79.9	731

Extreme Annual Design Conditions

Extreme Annual WS			Extreme Max WB	Extreme Annual DB				n-Year Return Period Values of Extreme DB							
				Mean		Standard deviation		n=5 years		n=10 years		n=20 years		n=50 years	
1%	2.5%	5%		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
21.9	18.8	17.2	82.4	-2.6	92.5	8.1	3.5	-8.4	95.0	-13.2	97.1	-17.7	99.1	-23.6	101.6

Monthly Climatic Design Conditions

		Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperatures, Degree-Days and Degree-Hours	Tavg	50.4	27.9	30.6	38.1	49.5	58.8	67.5	71.7	70.0	62.6	52.2	42.6	31.9
	Sd	11.40	9.59	10.63	9.41	8.00	6.47	5.14	5.14	5.51	7.30	8.33	9.28	10.28
	HDD50	2679	690	546	398	121	15	0	0	4	76	259	570	
	HDD65	5959	1150	964	837	472	226	50	7	19	130	404	673	1027
	CDD50	2810	4	2	28	105	287	526	672	619	381	143	36	7
	CDD65	617	0	0	2	6	33	126	214	173	56	7	0	0
	CDH74	4899	0	0	16	76	336	1003	1711	1299	417	40	1	0
	CDH80	1333	0	0	2	10	67	260	524	375	94	1	0	0
Monthly Design Dry Bulb and Mean Coincident Wet Bulb Temperatures	0.4%	DB	61.1	61.4	75.6	81.4	85.5	89.8	92.3	91.5	87.4	78.5	70.7	64.4
		MCWB	55.9	50.0	59.6	63.6	68.3	72.5	73.0	73.5	69.5	64.5	58.6	56.9
	2%	DB	55.1	53.8	67.5	75.5	81.6	86.0	88.8	87.5	82.4	74.2	65.0	57.8
		MCWB	49.5	45.7	54.8	59.4	65.7	70.6	72.8	71.6	67.8	62.6	55.3	52.0
	5%	DB	48.4	48.6	60.8	70.2	78.0	83.1	85.7	84.0	78.9	70.2	61.1	51.7
		MCWB	43.2	41.9	51.2	57.2	64.0	69.5	71.5	70.4	66.3	60.5	54.1	46.1
	10%	DB	42.5	44.4	54.4	65.1	73.3	80.2	82.4	81.2	75.2	66.2	57.0	45.7
		MCWB	37.8	39.3	46.6	54.0	61.5	68.0	70.4	69.2	65.5	58.5	51.2	40.8
Monthly Design Wet Bulb and Mean Coincident Dry Bulb Temperatures	0.4%	WB	57.3	52.5	61.6	65.7	71.4	76.1	77.4	76.2	73.2	68.2	61.4	58.5
		MCDB	60.2	58.5	72.5	75.9	81.9	84.2	87.2	85.9	81.4	75.3	66.5	64.2
	2%	WB	51.0	46.8	56.5	62.0	68.5	73.4	74.9	74.1	70.7	65.2	58.4	53.5
		MCDB	54.4	52.2	64.8	71.7	77.8	81.7	84.4	83.5	78.0	70.2	63.1	57.6
	5%	WB	43.5	43.1	51.6	59.1	66.1	71.4	73.3	72.5	68.9	62.4	55.4	46.9
		MCDB	47.4	47.8	59.5	68.0	74.7	79.6	82.3	81.0	75.2	68.2	59.3	50.5
	10%	WB	38.0	39.5	47.1	55.9	63.6	69.8	71.8	70.9	67.2	59.5	51.7	41.6
		MCDB	42.3	43.8	53.9	64.0	71.2	77.6	80.0	78.4	72.8	65.4	56.6	45.8
Mean Daily Temperature Range	5% DB	MDBR	12.9	14.5	16.7	19.5	19.6	19.2	19.3	19.6	19.3	18.3	14.9	13.0
		MCDBR	18.8	21.3	25.0	26.0	25.5	22.6	22.8	23.3	24.0	23.7	20.6	19.3
		MCWBR	15.1	15.8	15.9	15.0	12.7	10.9	10.1	10.7	12.0	13.7	14.4	15.1
	5% WB	MCDBR	17.2	18.8	22.5	22.9	21.6	19.6	19.0	19.8	18.1	19.6	17.6	17.9
		MCWBR	14.9	14.9	15.8	14.9	12.3	10.7	9.6	10.3	10.6	12.8	14.8	15.6
Clear Sky Solar Irradiance	taub		0.301	0.324	0.361	0.361	0.415	0.473	0.482	0.486	0.392	0.349	0.318	0.300
	taud		2.397	2.247	2.155	2.248	2.059	1.910	1.913	1.879	2.215	2.330	2.438	2.472
	Ebn,noon		274	281	281	289	274	258	254	248	268	269	265	265
	Edh,noon		29	37	44	43	52	61	60	60	41	34	28	26

CDDn Cooling degree-days base n°F, °F-day

CDHn Cooling degree-hours base n°F, °F-hour

DB Dry bulb temperature, °F

DP Dew point temperature, °F

Ebn,noon } Clear sky beam normal and diffuse hori-

Edh,noon } zonal irradiances at solar noon, Btu/h/ft2

Elev Elevation, ft

Enth Enthalpy, Btu/lb

HDDn Heating degree-days base n°F, °F-day

Hours 8/4 & 55/69 Number of hours between 8 a.m. and 4 p.m. with DB between 55 and 69 °F

HR Humidity ratio, grains of moisture per lb of dry air

Lat Latitude, °

Long Longitude, °

MCDB Mean coincident dry bulb temperature, °F

MCDBR Mean coincident dry bulb temp. range, °F

MCDBP Mean coincident dew point temperature, °F

MCWB Mean coincident wet bulb temperature, °F

MCWBR Mean coincident wet bulb temp. range, °F

MCWS Mean coincident wind speed, mph

MCDBR Mean dry bulb temp. range, °F

MDBR Prevailing coincident wind direction, °

PCWD 0 = North, 90 = East

Period Years used to calculate the design conditions

Sd Standard deviation of daily average temperature, °F

StdP Standard pressure at station elevation, psi

taub Clear sky optical depth for beam irradiance

taud Clear sky optical depth for diffuse irradiance

Tavg Average temperature, °F

Time Zone Hours ahead or behind UTC, and time zone code

WB Wet bulb temperature, °F

WBAN Weather Bureau Army Navy number

WMO# World Meteorological Organization number

WS Wind speed, mph

AA CHILLED BEAMS

AHC | Active, Adaptable, High-Capacity



Chilled Beams



Introduction: AHC

Designed with adaptability in mind, the AHC incorporates a manual or motorized VAV valve which allows additional air into the space as needed to handle varying room loads. Additionally, the AHC is capable of higher capacity than its ADC counterpart.

MODEL

AHC - Adaptable / Adjustable Active Chilled Beam

FEATURES

- Combined cooling, heating, and supply air unit for flush installation within a suspended ceiling.
- Well suited for spaces with high cooling loads, low humidity load, and variable ventilation requirements.
- Ideal solution for applications where high-quality environmental conditions, demand-based ventilation, and individual room control are appreciated.
- Individually adjustable velocity conditions with *Krueger by Halton* Velocity Control (HVC).
- Built-in flexibility of operation for partition wall relocations with *Krueger by Halton* Velocity Control.
- Individually adjustable supply airflow rate for changes in space layout using *Krueger by Halton* Air Quality (HAQ) control.
- Demand based control of supply airflow rate for efficient use of energy in constant-pressure ductwork zone applications; when the airflow rate changes have no effect on the coil cooling/heating capacities of the chilled beam.
- Enhanced life cycle performance with optimized low air and water flow rates.

OPTIONS

- Combined cooling and heating coil, or model with electric heating foil.
- Manual or motorized *Krueger by Halton* Air Quality (HAQ).
- Integrated exhaust valve.
- Direct light fittings.
- Adapted to Damp ceiling installation.
- Flush mounted T5 luminaires integrated with the chilled beam. Luminaires are equipped with high-quality optics suitable for working using computer monitors.

FINISHES

- Standard finish is Polyester Painted White (RAL 9010).
- Custom colors available.



Office Application



Patient Care Application

AHC

AA-14

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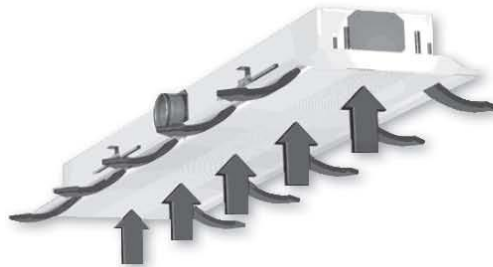
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CHILLED BEAMS AA

AHC | Active, Adaptable, High-Capacity

AHC Application & Installation



FUNCTION

The AHC chilled beam is designed to be installed flush with a suspended ceiling. The primary supply air enters the plenum of the active chilled beam. From there it is diffused into the room through nozzles and the diffuser of the HAQ- control. Supply slots located at the bottom of the beam.

The supply air nozzle jets efficiently induce ambient room air. The induced air flows through the heat exchanger, where it is either cooled or heated. The supply air jet is directed horizontally along the ceiling surface.

AIR QUALITY AND TEMPERATURE CONTROLS

The cooling and heating capacities of the chilled beam are controlled by regulating the water flow rate according to the control signal of the room temperature controller.

Air quality control for a room space can be arranged using, e.g., a CO₂ sensor when room air temperature is controlled separately by regulating the water flow rate. Alternatively, a temperature sensor can be used for air quality control, with the airflow rate modulated in the first sequence and, if the temperature exceeds the set point, the water valve starting to open in the second sequence.

In heating mode, it is recommended that the temperature difference between the jet outlet and room air would not be greater than 6°F. The inlet water temperature of the heat exchanger should not be higher than 95°F. Optimal heating performance requires an appropriate primary airflow rate. Thus, the air handling unit shall operate during heating periods to ensure proper heating performance.

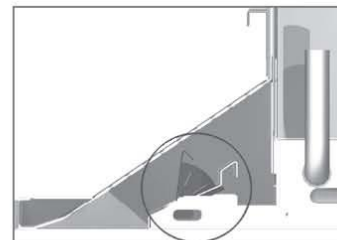
VELOCITY CONTROL IN OCCUPIED ZONE

Krueger by Halton Velocity Control (HVC) is used for adjusting room air velocity conditions either when room layout is changed (e.g., in cases where the partition wall is located near the chilled beam) or when local, individual velocity conditions need to be altered. HVC adjustment has an impact on the induced room air flow through the heat exchanger, and therefore it either increases or decreases both the velocities in the occupied zone and the cooling/heating capacity of the chilled beam.

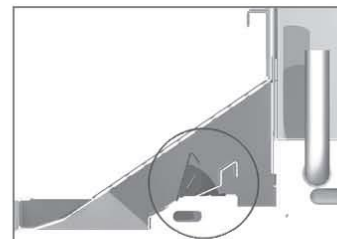
Krueger by Halton Velocity Control uses manual velocity adjustment with three settings:

- 1 = Throttle Position
- 2 = Normal Position
- 3 = Boost Position

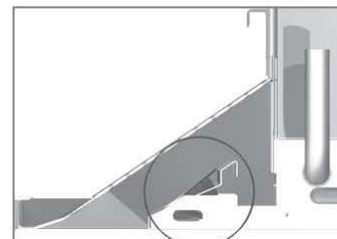
The HVC damper is divided into sections to enable the adjustment of conditions in different parts of the occupied zone. It is recommended to design the chilled beam in the normal position in order to allow both throttle and boost functions during the building's life cycle.



Position 1 = Throttle Position



Position 2 = Normal Position



Position 3 = Boost Position

Chilled Beams

AHC



AA CHILLED BEAMS

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AHC Application & Installation

AIRFLOW RATE CONTROL

The supply airflow of the chilled beam nozzle jets are dependent on effective length and static chamber pressure, which can be adjusted e.g. using separate airflow adjustment damper.

Optional *Krueger by Halton* Air Quality control (HAQ) is used for adjusting and/or controlling the outdoor airflow rate in a room space. The airflow rate is dependent on the opening position of the control damper and the static chamber pressure.

Airflow rate adjustment is needed when the use of the space is changed and there is need to adapt the supply airflows. Airflow rate can be adjusted either manually or automatically, on the basis of demand, with a motorized control damper.

A chilled beam equipped with HAQ manual airflow rate adjustment can be retrofitted to motorized version for demand based ventilation.

It is recommended that chilled beams for demand based airflows should be connected to constant pressure ductwork zone, when

- * the HAQ adjustment has no impact on nozzle jet airflow.
- * the HAQ adjustment has no impact on either the coil cooling or heating capacities.
- * the HAQ airflow control has not significant impact to ductwork pressure conditions and respectively to airflow rates of other chilled beams in the same ductwork zone.

The appearance of different units - with constant, adjustable, or variable airflow - is identical.

The *Krueger by Halton* Air Quality control unit's position and the selection of chilled beam nozzle size allow adjustment of the primary airflow rate in the space. The separate airflow adjustment damper installed in the duct branch is used for balancing the airflow in the ductwork.

When a motorized air quality control (HAQ) unit is used, the maximum and minimum airflow rates are adjusted with the stroke limiters of the damper.

The primary airflow rate of each beam is adjusted using the *Krueger by Halton* Air Quality control unit during the installation and commissioning. There is no need to change or plug nozzles of the chilled beam.



Duct installation of the exhaust valve.

INSTALLATION

The AHC active chilled beam is especially suitable for ceiling mounting running parallel to exterior wall of the room. When selecting of the chilled beam orientation, the location of the supply air and water circuit connections are taken into account.

The chilled beam can be attached directly to the ceiling surface ($H1 = 9"$) or suspended using threaded drop rods ($5/16"$). Each beam is equipped with movable brackets fixed to both sides of the beam. It is recommended that the brackets be positioned one quarter of the unit length ($L/4$) away from the end of the beam.

Install the main pipelines of the cooling and heating water circuits above the level of the chilled beam in order to enable venting of the pipework.

The duct connection is at the same end of the chilled beam as the pipe connections. Relocation of the duct connection to either side of the chilled beam can be done easily on-site by using a screw driver.

An optional exhaust valve is installed in the front. Only left and right supply air duct connections are possible. By choosing the exhaust valve option, the active length is total length (L) - $16"$.



Duct installation of the exhaust valve.



Replacing manual HAQ with a motorized HAQ.

AA-16

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Chilled Beams

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H
C

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CHILLED BEAMS AA

AHC | Active, Adaptable, High-Capacity

AHC Application & Installation

ELECTRIC HEATING INSTALLATION AND SAFETY INSTRUCTIONS

Final circuit design criteria (the more restrictive must be applied):

The total power of a single final circuit shall not exceed 2000 W.

The total number of chilled beam units in a single final circuit shall not exceed 6 pieces.

Electric Connections

Beams shall be connected to protective earth, PE.

The final circuit shall include a fuse, max. 10 A.

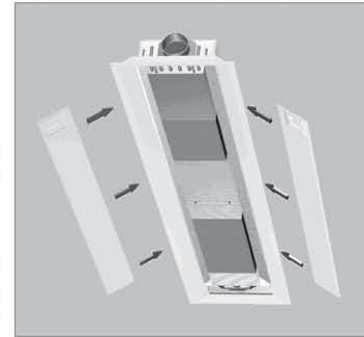
The power supply shall be protected with a ground fault circuit interrupter, 30 mA.

Operation:

The electric heating power supply shall be switched off if there is no air flow through the chilled beam (for example, if the air handling unit is switched off or the fire damper is closed).

Electric Heating Foil

The luminaires within a single chilled beam are interconnected in the factory as standard. The power supply is connected using a plug connector (Enstonet) located at the connection end of the beam. An extra cable with or without plug is delivered upon request. Plug types are standard Schuko, Enstonet and Wieland.



Chilled Beams

ADJUSTMENT

Cooling

The recommended cooling water mass flow rate is 0.32 - 1.58 gpm, resulting in a temperature rise of 2 - 8°F in the heat exchanger. To avoid condensation, the recommended inlet water temperature of the heat exchanger is 57 - 61°F.

Heating

The recommended heating water mass flow rate is 0.16 - 0.63 gpm, resulting in a temperature drop of 10 - 30°F in the heat exchanger. The maximum temperature of the inlet water for the heat exchanger is 95°F.

Balancing and Control of Water Flow Rates

Balance the water flow rates of the chilled beam with adjustment valves installed on the outlet side of the cooling and heating water loops. The cooling capacity and heating capacity of the chilled beam are controlled by regulating the water mass flow rate. The water mass flow rate can be controlled by using an ON/OFF valve or a two- or three-way proportional valve.

Adjustment of Supply Airflow Rate

Connect a manometer in the measurement tap and measure the static pressure in the chilled beam. The airflow rate is calculated according to the formula below.

Total Air Flow Rate qv

$$qv = qv1 + qv2$$

Where

qv = Total Airflow Rate, l/s or m³/h

qv1 = Nozzle Jet Airflow Rate, l/s or m³/h

qv2 = Air Quality Control Diffuser Airflow Rate l/s or m³/h

Nozzle Jet Airflow Rate qv1

$$qv = k * l_{eff} * \sqrt{\Delta p_m}$$

l_{eff} = Length of the Coil, m

Δp_m = Measured Static Chamber Pressure, Pa

k (l/s)	k (m³/h)
1.38	4.97

Air Quality Control Diffuser Airflow Rate qv2

$$qv = a * k * \sqrt{\Delta p_m}$$

a = HAQ Position

Δp_m = Measured Static Chamber Pressure, Pa

k (l/s)	k (m³/h)
0.17	0.61



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Adjustment of the Airflow Range in Constant Airflow Applications

Define the position of HAQ in millimeters that correspond to airflow rate at the actual chamber pressure level. Adjustment of HAQ is done manually with the help of position scale by adjusting the opening of the unit. It is possible to verify the opening in millimeters on the position scale.

In order to ensure accurate adjustment it is recommended to adjust HAQ-position and in the same time read the targeted chamber pressure using the manometer. It is also possible to remove the HAQ-unit from the frame by opening two knurled-head screws (4) for the adjustment.

Adjustment of the Airflow Range in Variable Airflow Applications

1. Release of the actuator
2. Restriction of the max. opening
3. Restriction of the min. opening

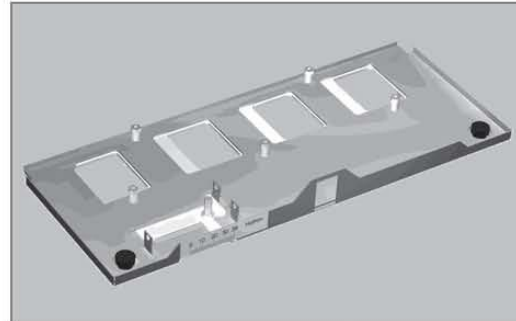
Switch-off the power supply of the actuator. Disengage the actuator gear into manual override position by releasing the knob. Define the maximum and minimum positions, in millimeters that correspond to maximum and minimum airflow rates at the actual chamber pressure level. The maximum and minimum positions are adjusted with two knurled-head screws (2,3). It is possible to verify the opening in millimeters on the position scale.

Switch on the power supply (24 VAC) of the actuator. The actuator calibrates the min. and max. positions automatically according to the set limits. The actuator can be controlled from this point on by using a 0 - 10VDC control signal (0 VDC=min. position, 10 VDC = max. position). It is also possible to remove the HAQ-unit from the frame by opening two knurled-head screws (4) for the adjustment.

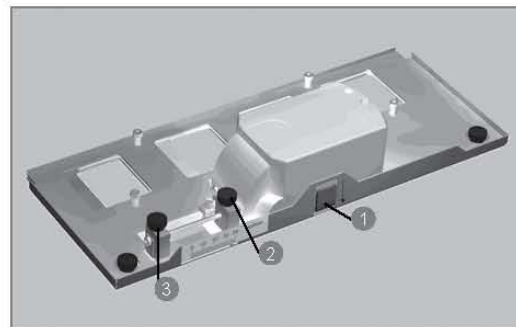
Adjustment of Exhaust Airflow Rate

The valve is adjusted by rotating the central cone. Measure (A) the opening position (in mm) of the central cone. There is a special tool available from Krueger for accurate opening position measurement. Set a pressure probe inside the valve, and measure the differential pressure with a manometer. The airflow rate is calculated using the formula below, using k-factors presented in the table. After the adjustment, lock the central cone with the locking nut.

$$q_v = k \cdot \sqrt{\Delta p_m}$$



Manual HAQ



Motorized HAQ

URH125	
A	k
-15	0,65
-12	0,92
-9	1,22
-6	1,53
-3	1,84
0	2,17
3	2,52
6	2,83
9	3,14
12	3,46
15	3,77

Chilled Beams

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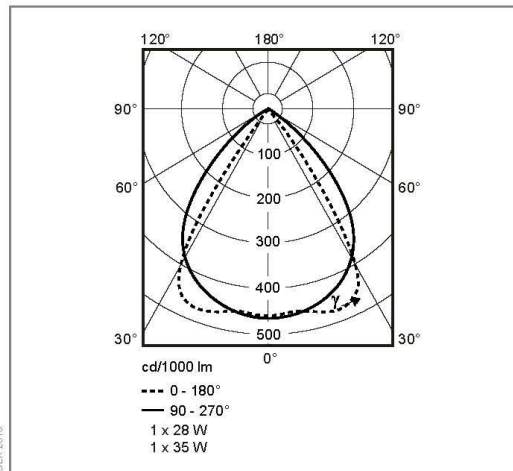
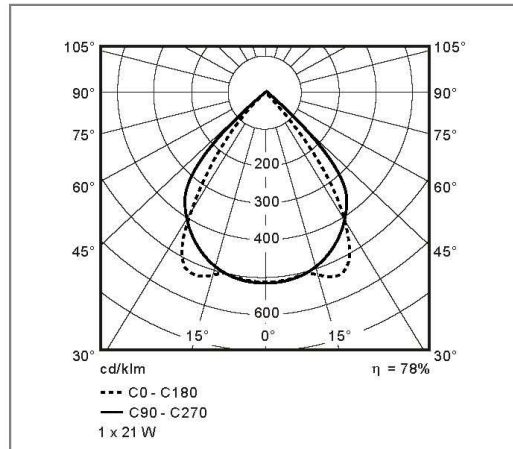
LIGHTING

The chilled beams can be optionally equipped with luminaires. The luminaires have fluorescent tubes and optics based on T5 technology providing good lighting conditions for office work performed using computer monitors. The luminaires (21 W, 28 W or 35 W) are integrated into the bottom panel of the beam. The chilled beam can be equipped with up to 2 pieces of direct light fittings, depending on the beam length and luminaire type.

A connecting cable with a plug can be delivered factory-installed upon request. The luminaires are delivered with either a standard or a dimmable electronic ballast.

NOTE: UL listing not available on lighted models.

LIGHTING DISTRIBUTION CURVES



LUMINAIRE PROPERTIES

Lamp T5	W	21	28	35
Lamps / Luminaire	pcs	1	1	1
Light Flux	lm	1900	2600	3300
Light Output Ratio	-	0.74	0.7	0.72
Ballast	-	Electronic	Electronic	Electronic

ALTERNATIVE NUMBERS OF LUMINAIRES IN CHILLED BEAMS

Luminaire Type	W	21	28	35
Luminaire Nominal Length	mm	900	1200	1500
Reflector Length	mm	878	1178	1478

Beam Nominal Length				
One-piece	1200	-	-	-
	1300	-	-	-
	1400	1	-	-
	1500	1	-	-
	1600	1	-	-
	1700	-	1	-
	1720	-	1	-
	1800	-	1	-
	1900	-	1	-
	2000	-	-	1
	2100	-	-	1
	2200	-	-	1
Two-piece	2300	-	-	1
	2400	-	-	1
	2500	-	-	-
	2600	-	-	-
	2700	2	-	-
	2800	2	-	-
	2900	2	-	-
	3000	2	-	-
	3100	2	-	-
	3200	2	-	-
	3300	-	2	-
	3400	-	2	-
	3500	-	2	-
	3600	-	2	-

Chilled Beams

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AA CHILLED BEAMS

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AHC Service & Maintenance

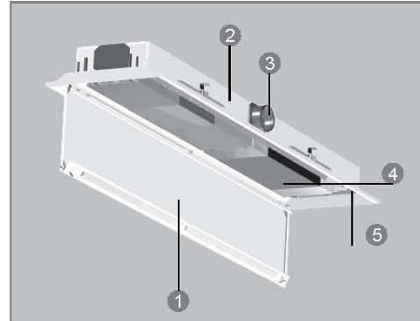
SERVICING

Open the front panel of the supply air plenum, the ductwork, and the heat exchanger. In beams longer than 96", the front panel can be opened in two sections. Clean the supply air plenum and finned coils of the heat exchanger with a vacuum cleaner, taking care not to damage the finned coils. Clean the front panel and, if required, the side plates, using a damp cloth.

The *Krueger by Halton* Air Quality control unit (HAQ) is removable for chamber cleaning. Unscrew the screws for removing the HAQ.

The fluorescent lamp of the luminaire can be changed and the reflector cleaned from below the beam, by removing the luminaire grid.

When opening the front panel, pay attention to the cables of units equipped with integrated light fittings.

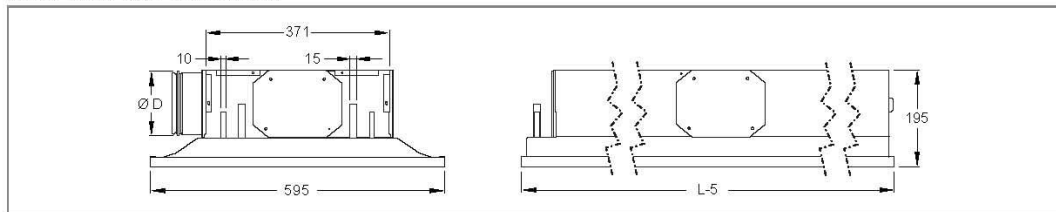


Code	Description
1	Front Panel
2	Side Plate
3	Supply Air Connection

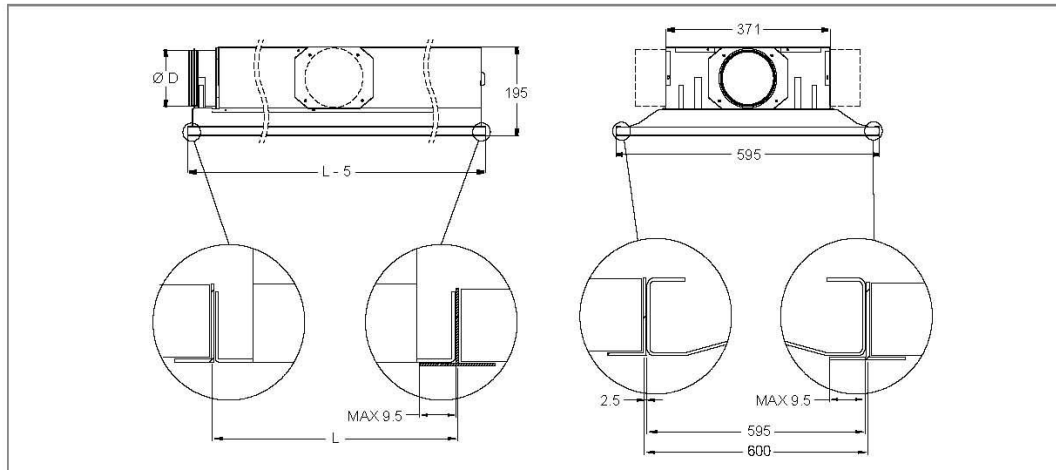
Code	Description
4	Heat Exchanger
5	Access Panel

AHC Dimensional Information

AHC FRONT AND SIDE VIEWS



AHC SUSPENDED CEILING INTEGRATION INSTALLATION



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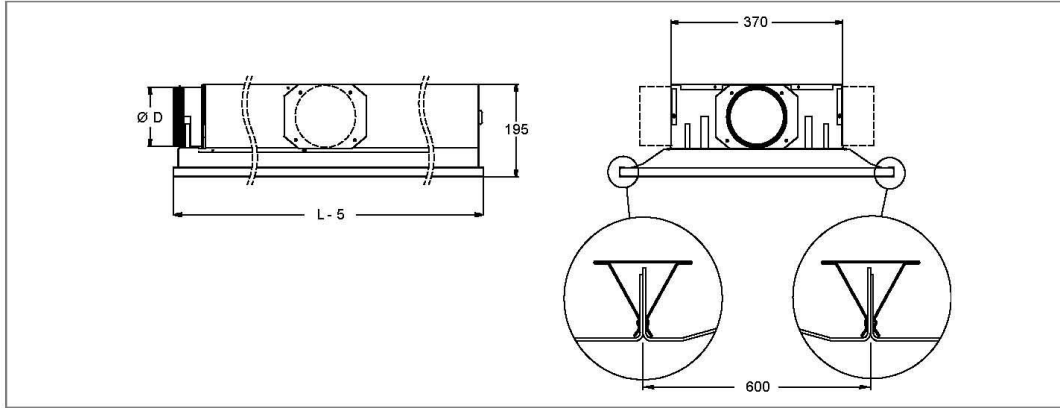


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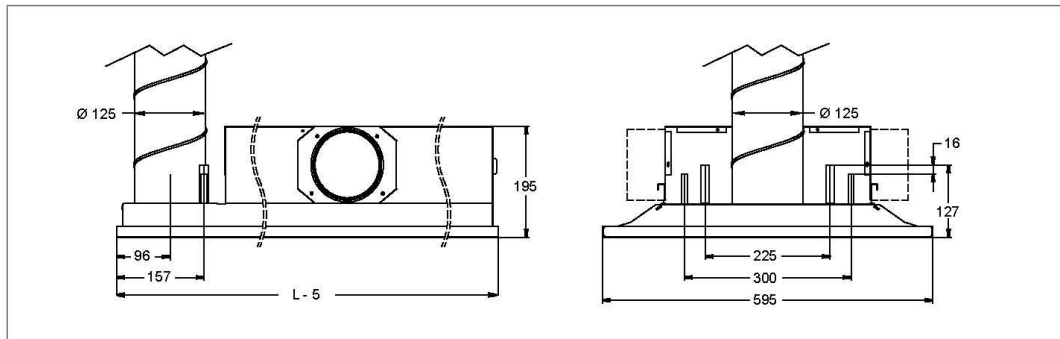
AHC Dimensional Information

AHC DAMPA CEILING INSTALLATION

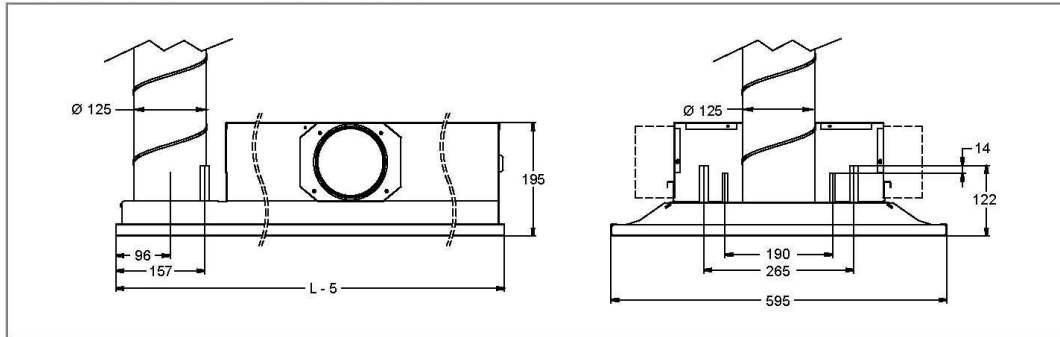


Chilled Beams

AHC INSTALLATION WITH EXHAUST



AHC INSTALLATION WITH EXHAUST AND LIGHT



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Providing You With Air Distribution Solutions

AA-21



AA CHILLED BEAMS

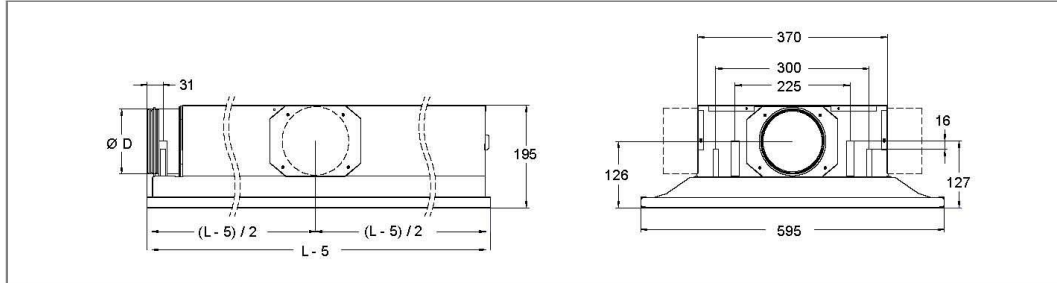
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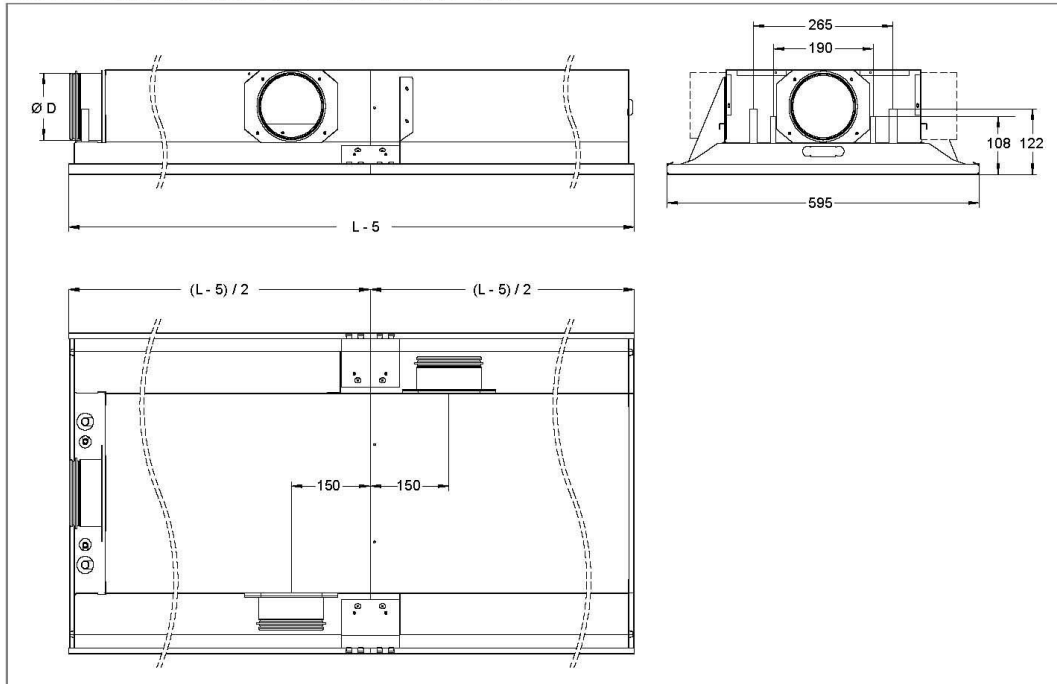
AHC Dimensional Information

AHC PIPE AND DUCT CONNECTIONS (SIZES 1200 - 2400)

Chilled Beams



AHC PIPE AND DUCT CONNECTIONS (SIZES 2500 - 3600)



NOTE: All dimensions in inches. Cooling/heating water pipe connections are copper 1/2" and 3/8" with wall thickness of 0.04". The maximum chilled/hot water circuit operating pressure is 150 psi. The supply air duct connection is D5 inches. MSM damper removable through access panel. Krueger by Halton Air Quality Control Damper (HAQ) takes 12" of the total beam length, decreasing the effective length.

AHC

AA-22

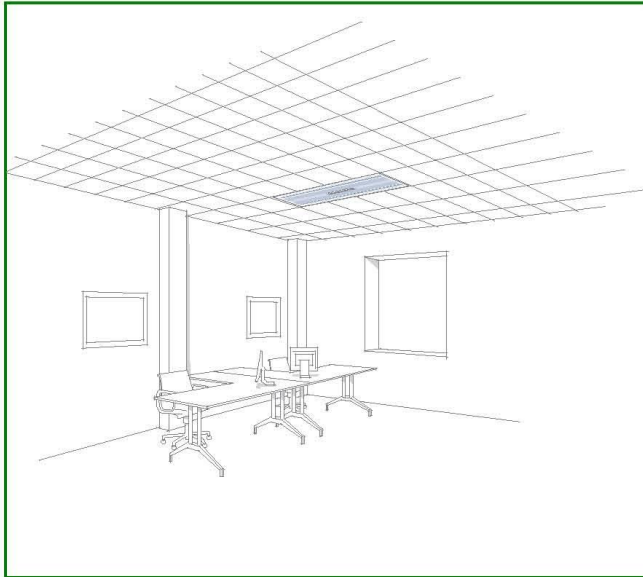
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Chilled beam Flexicool® IQID

Chilled beam Flexicool® IQID



Functions

- FPC
- High air flow
- Controls
- Lighting
- Comfort control
- Heating
- Sprinkler



The chilled beam Flexicool® IQID is an integrated system for ventilation, cooling and heating, fulfilling most needs for indoor climate. The IQID chilled beam is a very flexible chilled beam that is available as a basic model, but can also be equipped with a number of functions to provide a multifunctional chilled beam. The following functions are available for IQID: heat, comfort setting, Flow Pattern Control (FPC air deflector), function for high air flow, control and regulation equipment, lighting and provision for a sprinkler system. These various functions are described in separate parts in the catalogue.

IQID has a covered upper side and is intended for flush-mounting in false ceilings and has dimensions adapted to a false ceiling module of 23.62 inch

Quick Selection

Cooling effect in btu/h incl supply air



The diagram shows the approximate cooling effect P_{tot} in btu/h with water flow $q_w = 0.11$ cfm, temperature difference between room air and supply air $\Delta t = 46.4$ °F, pressure drop 0.28 inWG on the air side and max. sound pressure level $LA_{10} = 30$ dB(A).

Product Facts

- IQID chilled beam for flushmounting in false ceilings
- Very flexible - available in a wide range of executions from basic to multifunctional
- Adapted for standard 23.62 inch false ceiling module
- Fastening brackets for rapid and simple installation - lift up - snap in place
- Available with the following functions: heating, comfort control, Flow Pattern Control (FPC air deflector), function for high air flow, control equipment, lighting and provision for a sprinkler system

Product code example

Covered chilled beam
IQID-240-1-1-01, standard.



Chilled beam Flexicool® IQID

Application and function, material

Function

The chilled beam IQID is designed for ceiling mounting, and it is suited for ceiling modules of size 23.62 inch both in length and width, which means that it is flush with the ceiling surface. The IQID chilled beam is a very flexible chilled beam that is available as a basic model, but can also be equipped with a number of functions to provide a multifunctional chilled beam. The following functions are available for IQID: heating, comfort control, Flow Pattern Control (FPC air deflector), function for high air flow, control equipment, lighting and provision for a sprinkler system. The air flow can be adjusted by means of the patented adjusting rails (Comfort control, optional function, read more in separate catalogue section) with which the length of the holes in the supply air duct is changed. This can easily be done with normal adjustments. A regulating damper is normally not required. The adjustable hole lengths allow different air distribution (two-way, one-way and middle positions). The simple adjustment of air distribution and capacity makes it possible to adapt to changing conditions in the future. Before delivery, the hole lengths of standard beams are preset at the longest possible position to provide a starting position for later adjustment (if the beam have comfort control). The beam can be supplied with a coil for heating water, read more in separate catalogue section Heating. The purging nipple is a choice in the product code.

Material

The casing is mainly made of galvanized steel sheet. The frontplate is powder painted in white. The standard colour RAL 9010, which corresponds to NCS 0502-Y, gloss level 30. Coil made of copper pipe with connection, Øout = 0.59 inch, and aluminium fins. Maximum working pressure 6423.12 inWG.

MAE Technical requirement: Wind Turbine Analysis

Architectural Wind™

AVX1000

Building Integrated Wind Turbine



Modular and Scalable Design

- Optional canopy for avian protection
- For commercial use only, not sold separately
- System includes standard UL approved equipment
 - AC disconnect
 - High voltage DC disconnect
 - UL approved inverter

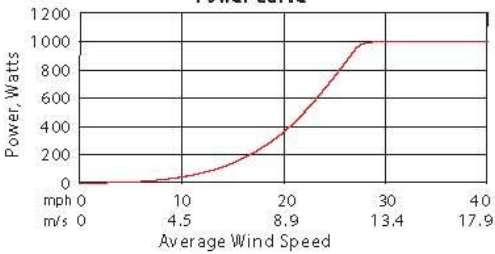
AVX1000




TURBINE SPECIFICATIONS *Preliminary*

- Weight: 130 lbs
- Height and width: 8.5'x 6'
- Number of blades: 5
- Rated power: 1000 W
- Start up wind speed: 2.2m/s (5 mph)
- Output voltage: 250 VDC
- Designed for installation on concrete tilt-up or pre-cast building construction
- Designed to withstand 120 mph winds

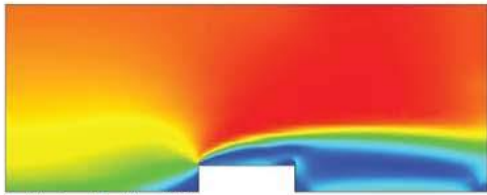
Power Curve



Technology Patents

Architectural Wind has been granted 3 utility patents for its innovative design that is specifically engineered to take advantage of the acceleration effect of wind as it passes over the building parapet.

Wind Velocity Contours



Min=0 m/s Max=14.25
Time=228.289 s

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Energy Technology Center 1960 Walker Avenue, Monrovia, CA 91016
626.357.9983 • www.avinc.com/wind • wind@avinc.com





TECHNICAL SPECIFICATIONS

Type	Upwind, horizontal axis, structure or pole-mountable wind turbine
Power Output	Over 1.5 kW @ peak production 1.0 kW @ 11 m/s (24.6 mph)
Annual Energy Production	Approximately - 1,200 kWh @ 5 m/s (11.2 mph) annual average wind speed 1,900 kWh @ 6 m/s (13.4 mph) annual average wind speed
Electrical Power	240VAC, 60Hz output voltage
Electrical Connection	Grid-tied system
Inverter	7 amp AC, custom designed brushless PMG
Rotor (Blade/Ring) Diameter	7 ft
Braking System	Dynamic & mechanical over-speed protection
Meat for Structure Mount	16 ft, aluminum (to BS1387, ISO65 specifications)
Mounting Brackets	Specifically designed mounting system with damping to reduce vibration
Lateral Loading	600 lbs @ 40.2 m/s (90 mph) 400 RPM maximum in a 20.1 m/s (45 mph) wind
Minimum Clearance Above Roof Line	2 ft above highest peak
Standard Pole Heights	30, 45, & 60 ft
Distance Between Multiple Units	Recommended 25 ft
Unit Weight	Approximately 250 lbs
Cut-In Speed	3.58 m/s (8 mph)
Maximum Designed Wind Speed	64.8 m/s (145 mph)
Product Design Life	20 yrs*
Acoustic Emissions	Less than 35 dB (A) for all wind speeds
EMI (Electromagnetic Emissions)	CE certified, BS EN 6100
Safety, Electrical & Reliability Standards	Certified to - UL 1741 IEEE 1547 & 1547.1 CSA C22.2 NO 107.1-01
Maintenance	Sealed component system, recommended annual visual inspection
Warranty	Parts - 5 yrs**

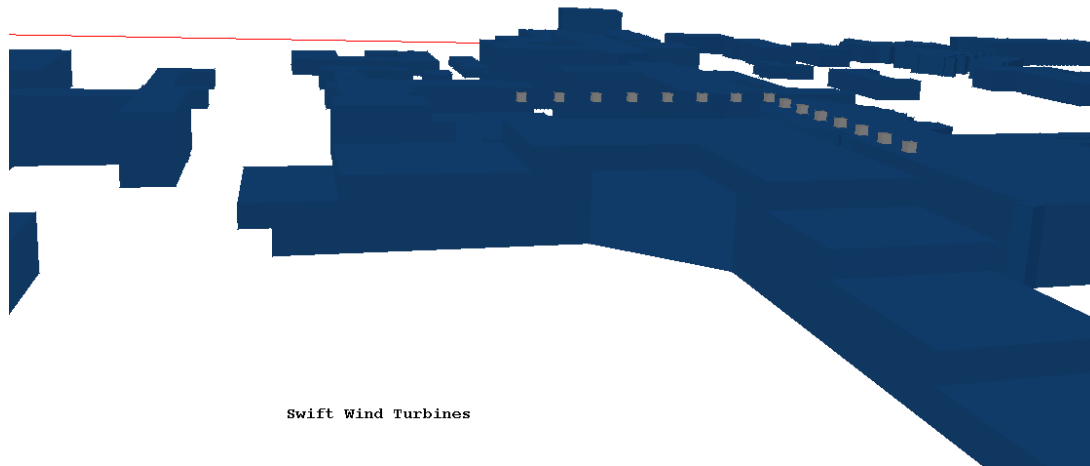
* Design Life is not a guarantee of a specific units performance
** See full warranty for details and limitations

The SWIFT Wind Turbine has been designed to be environmentally sustainable. The product produces more energy in its lifetime than is incorporated in the material and processes used to manufacture it, therefore making the turbine 'harm neutral.'



Cascade Renewable Energy
a division of Cascade Engineering, Inc.
North American Marketer & Manufacturer
3400 Innovation Court SE
Grand Rapids, MI 49512
P 866.544.5520
F 616.975.4717
info@swiftwindturbine.com
www.swiftwindturbine.com

Using the manufacturer's data for the size of the turbines, the turbines were modeled in the simulation as simple blocks. The table below summarizes the object dimension and sizes in the simulation domain for Cascade's Swift turbines and the image below shows the turbines simulated as blocks. These turbines are required to be mounted 4.9 meters above the roofline for building integration



Swift Turbine Addition to Building

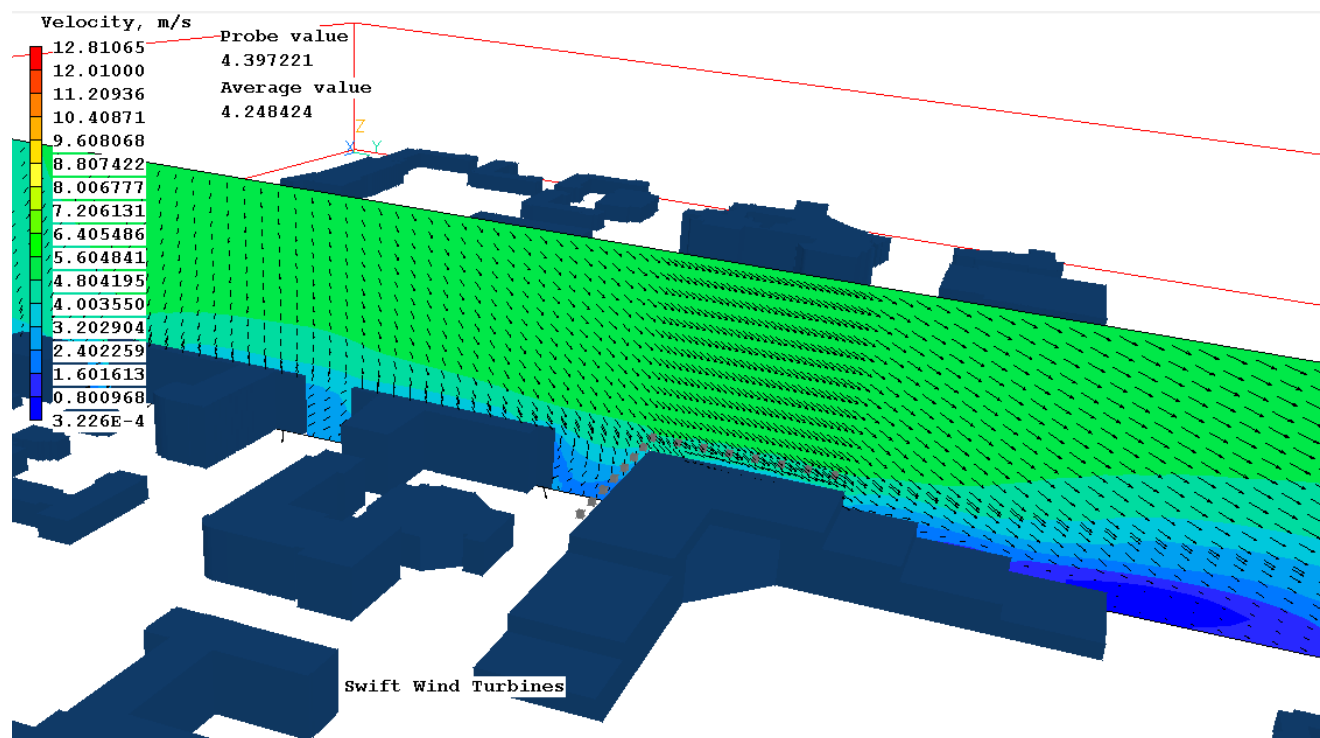
Dimensions and Positions of Swift Turbines in Simulation Domain

	Size			Location		
	delta x [m]	delta y [m]	delta z [m]	x [m]	y [m]	z [m]
Buildings	850.138	881.4054	36.1442	0.0	0.0	0.0
Turbine1	2.13	2.13	2.13	500.0	430.0	28.9
Turbine2	2.13	2.13	2.13	509.76	430.0	28.9
Turbine3	2.13	2.13	2.13	519.52	430.0	28.9
Turbine4	2.13	2.13	2.13	529.28	430.0	28.9
Turbine5	2.13	2.13	2.13	539.04	430.0	28.9
Turbine6	2.13	2.13	2.13	548.80	430.0	28.9
Turbine7	2.13	2.13	2.13	558.56	430.0	28.9
Turbine8	2.13	2.13	2.13	568.32	430.0	28.9
Turbine9	2.13	2.13	2.13	500.00	439.76	28.9
Turbine10	2.13	2.13	2.13	500.00	449.52	28.9
Turbine11	2.13	2.13	2.13	500.00	459.28	28.9
Turbine12	2.13	2.13	2.13	500.00	469.04	28.9
Turbine13	2.13	2.13	2.13	500.00	478.80	28.9
Turbine14	2.13	2.13	2.13	500.00	488.56	28.9
Turbine15	2.13	2.13	2.13	500.00	498.32	28.9

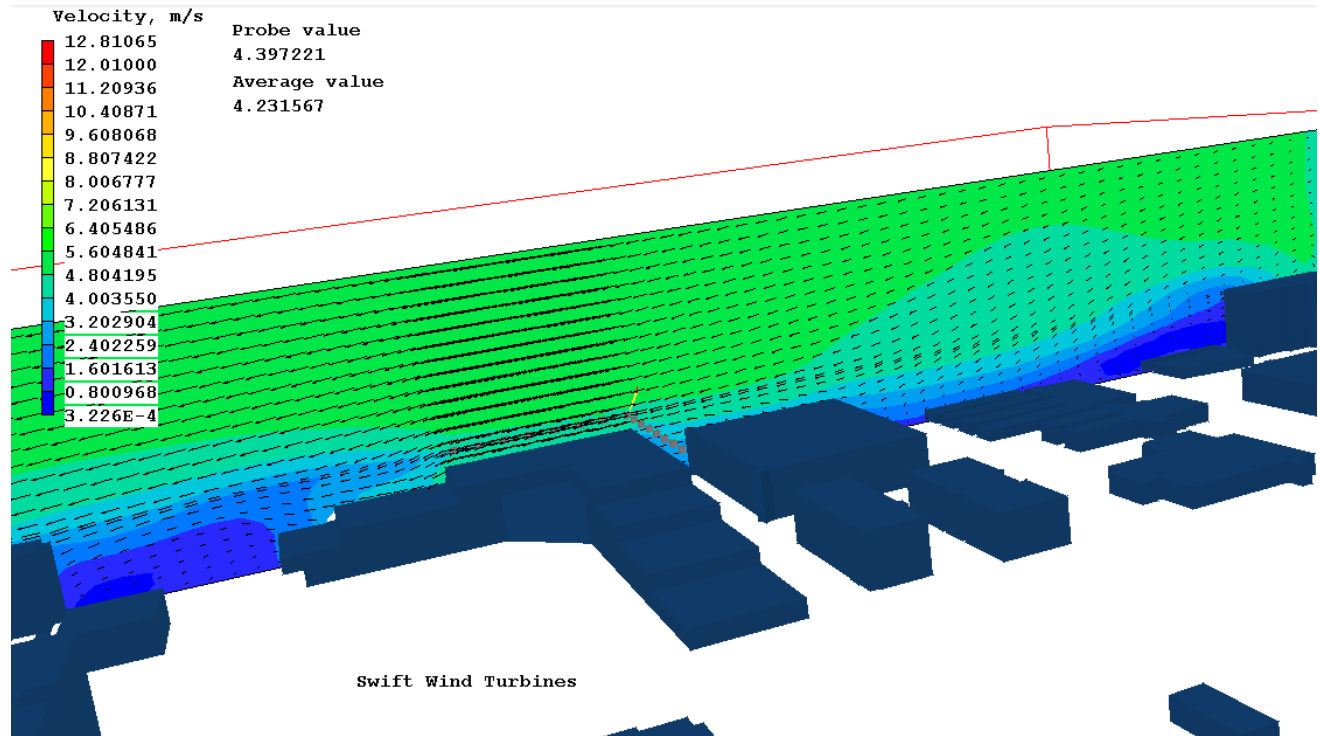
The addition of the turbines in the simulation domain caused the mesh grid to be altered due to new constraints. This resulted in an increased grid size of X=123, Y=134, and Z=22. Using the same turbulence model and numerical



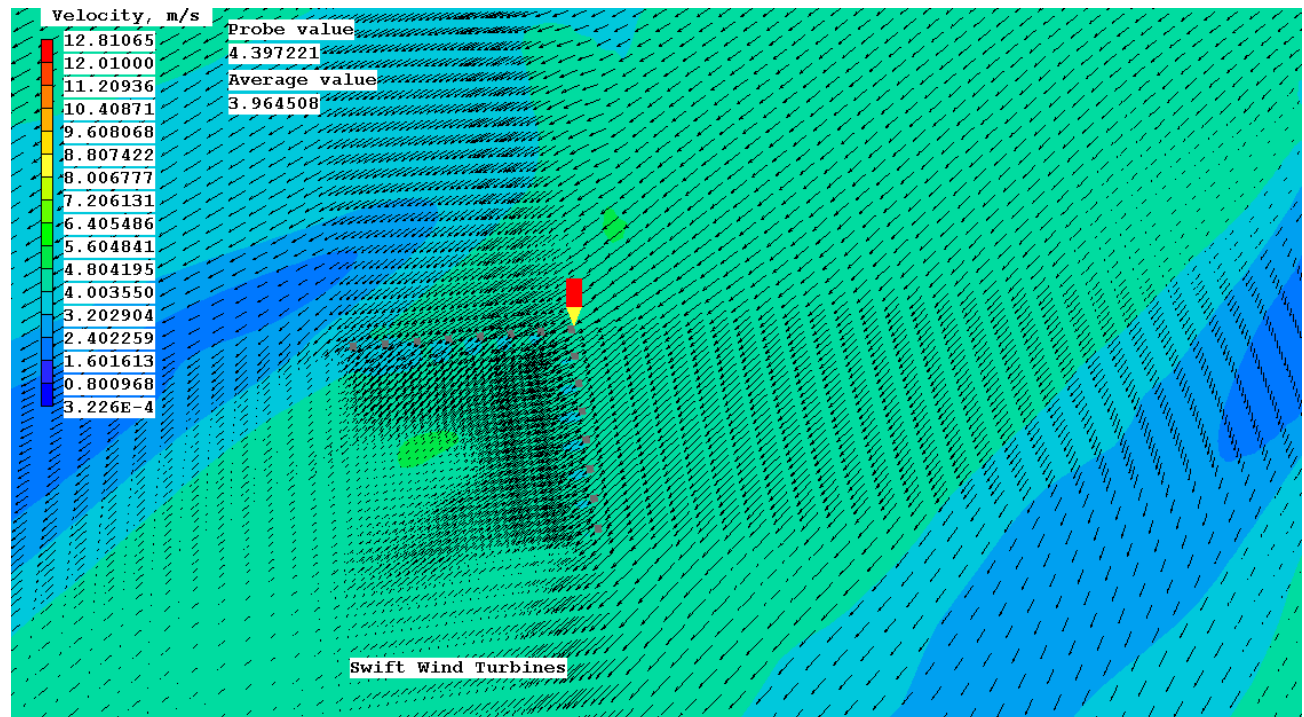
scheme as earlier, the simulation time for 3000 iterations was 4 hours 48 minutes. The mass residual for the simulation was 1.033×10^3 kg/s and the total mass inflow was 6.040584×10^5 kg/s which is 0.166% mass residual. While this is slightly larger than the recommended percent residual of 0.1%, it is still much less than the 1% allowed for this project. Therefore, it can be assumed that the solution was able to reach convergence. The three images below show the X-, Y-, and Z-plane velocity profiles for the resulting turbine additions.



Swift Wind Turbine Addition, X-velocity profile at (500, 430, 30)



Swift Wind Turbine Addition, Y-Velocity Profile at (500, 430, 30)



Swift Wind Turbine Z-Velocity Profile at (500, 430, 30)



Based on these resulting face velocities, the average velocity for each turbine is approximately between 4.4 m/s and 4.9 m/s.

AeroVironment's Architectural Wind turbines were modeled in the simulation domain as well. The table below summarizes the input values for the objects.

Dimensions and Positions of Architectural Wind Turbines in Simulation Domain

	Size			Location		
	delta x [m]	delta y [m]	delta z [m]	x [m]	y [m]	z [m]
Buildings	850.138	881.4054	36.1442	0.0	0.0	0.0
Turbine1	1.83	1.83	2.59	500.0	430.00	240.0
Turbine2	1.83	1.83	2.59	500.0	432.33	28.9
Turbine3	1.83	1.83	2.59	500.0	434.66	28.9
Turbine4	1.83	1.83	2.59	500.0	436.99	28.9
Turbine5	1.83	1.83	2.59	500.0	439.32	28.9
Turbine6	1.83	1.83	2.59	500.0	441.65	28.9
Turbine7	1.83	1.83	2.59	500.0	443.98	28.9
Turbine8	1.83	1.83	2.59	500.0	446.31	28.9
Turbine9	1.83	1.83	2.59	500.0	448.64	28.9
Turbine10	1.83	1.83	2.59	500.0	450.97	28.9
Turbine11	1.83	1.83	2.59	500.0	453.30	28.9
Turbine12	1.83	1.83	2.59	500.0	455.63	28.9
Turbine13	1.83	1.83	2.59	500.0	457.96	28.9
Turbine14	1.83	1.83	2.59	500.0	460.29	28.9
Turbine15	1.83	1.83	2.59	500.0	462.62	28.9
Turbine16	1.83	1.83	2.59	500.0	464.95	28.9
Turbine17	1.83	1.83	2.59	500.0	467.28	28.9
Turbine18	1.83	1.83	2.59	500.0	469.61	28.9
Turbine19	1.83	1.83	2.59	500.0	471.94	28.9
Turbine20	1.83	1.83	2.59	500.0	474.27	28.9
Turbine21	1.83	1.83	2.59	500.0	476.60	28.9
Turbine22	1.83	1.83	2.59	500.0	478.93	28.9
Turbine23	1.83	1.83	2.59	500.0	481.26	28.9
Turbine24	1.83	1.83	2.59	500.0	483.59	28.9
Turbine25	1.83	1.83	2.59	500.0	485.92	28.9
Turbine26	1.83	1.83	2.59	500.0	488.25	28.9
Turbine27	1.83	1.83	2.59	500.0	490.58	28.9
Turbine28	1.83	1.83	2.59	500.0	492.91	28.9
Turbine29	1.83	1.83	2.59	500.0	495.24	28.9
Turbine30	1.83	1.83	2.59	500.0	497.57	28.9
Turbine31	1.83	1.83	2.59	500.0	499.90	28.9
Turbine32	1.83	1.83	2.59	502.33	430.00	28.9

Turbine33	1.83	1.83	2.59	504.66	430.00	28.9
Turbine34	1.83	1.83	2.59	506.99	430.00	28.9
Turbine35	1.83	1.83	2.59	509.32	430.00	28.9
Turbine36	1.83	1.83	2.59	511.65	430.00	28.9
Turbine37	1.83	1.83	2.59	513.98	430.00	28.9
Turbine38	1.83	1.83	2.59	516.31	430.00	28.9
Turbine39	1.83	1.83	2.59	518.64	430.00	28.9
Turbine40	1.83	1.83	2.59	520.97	430.00	28.9
Turbine41	1.83	1.83	2.59	523.30	430.00	28.9
Turbine42	1.83	1.83	2.59	525.63	430.00	28.9
Turbine43	1.83	1.83	2.59	527.96	430.00	28.9
Turbine44	1.83	1.83	2.59	530.29	430.00	28.9
Turbine45	1.83	1.83	2.59	532.62	430.00	28.9
Turbine46	1.83	1.83	2.59	534.95	430.00	28.9
Turbine47	1.83	1.83	2.59	537.28	430.00	28.9
Turbine48	1.83	1.83	2.59	539.61	430.00	28.9
Turbine49	1.83	1.83	2.59	541.94	430.00	28.9
Turbine50	1.83	1.83	2.59	544.27	430.00	28.9
Turbine51	1.83	1.83	2.59	546.60	430.00	28.9
Turbine52	1.83	1.83	2.59	548.93	430.00	28.9
Turbine53	1.83	1.83	2.59	551.26	430.00	28.9
Turbine54	1.83	1.83	2.59	553.59	430.00	28.9
Turbine55	1.83	1.83	2.59	555.92	430.00	28.9
Turbine56	1.83	1.83	2.59	558.25	430.00	28.9
Turbine57	1.83	1.83	2.59	560.58	430.00	28.9
Turbine58	1.83	1.83	2.59	562.91	430.00	28.9
Turbine59	1.83	1.83	2.59	565.24	430.00	28.9
Turbine60	1.83	1.83	2.59	567.57	430.00	28.9
Turbine61	1.83	1.83	2.59	569.90	430.00	28.9

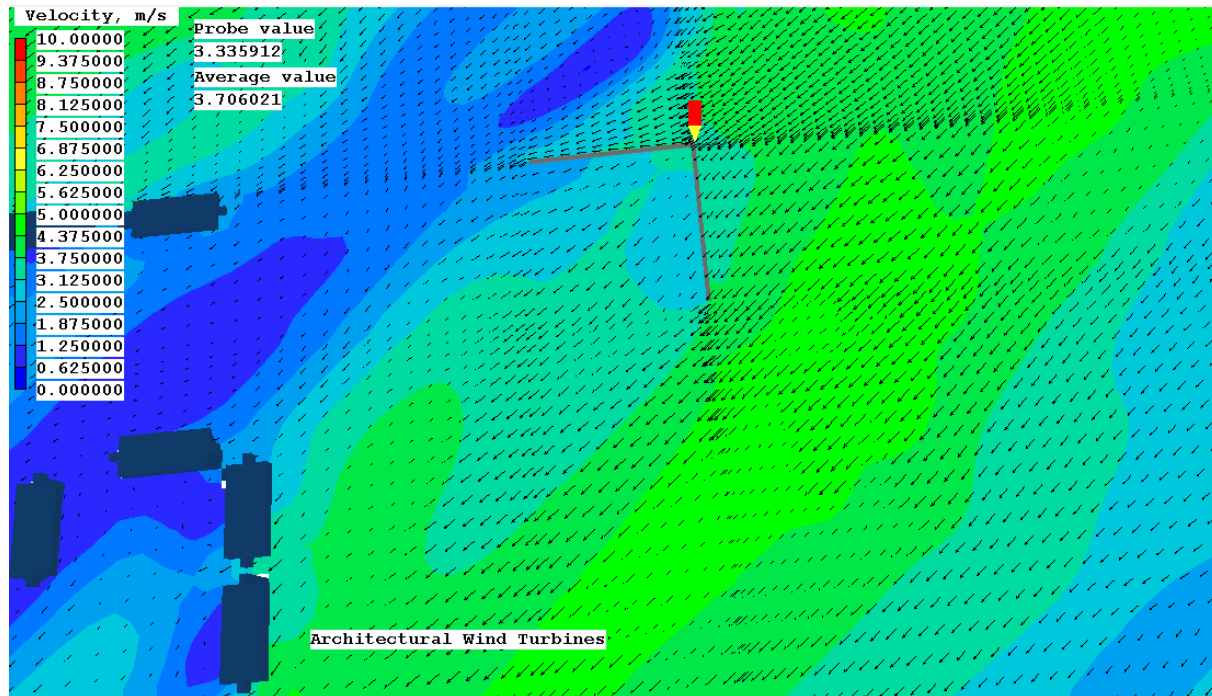
The mesh was also affected by added objects, resulting in a new grid size of X=215, Y=170, and Z=23. Again, using the same turbulence model and numerical scheme (hybrid), the simulation took 4 hours 47 minutes to complete 1000 iterations. The mass residual for the simulation was 5.553×10^5 kg/s and the total mass inflow was 1.526797×10^6 kg/s which is 36.37% mass residual. This mass residual was very high, much larger than the minimum recommendation of 1.0%. Therefore, the solution was not able to reach convergence and did not provide an accurate representation of the airflow for the added turbines.

Since the objects were so small and the spacing between them was also very small as well, it had negative effects on the simulation. This was very similar to the previous modeling errors that had occurred in the initial setup of the campus model. Therefore, in order to remedy it, the Architectural Wind turbines were revised and simulated as two long strips along the roofline. The following table summarizes the revised turbine modeled blocks.

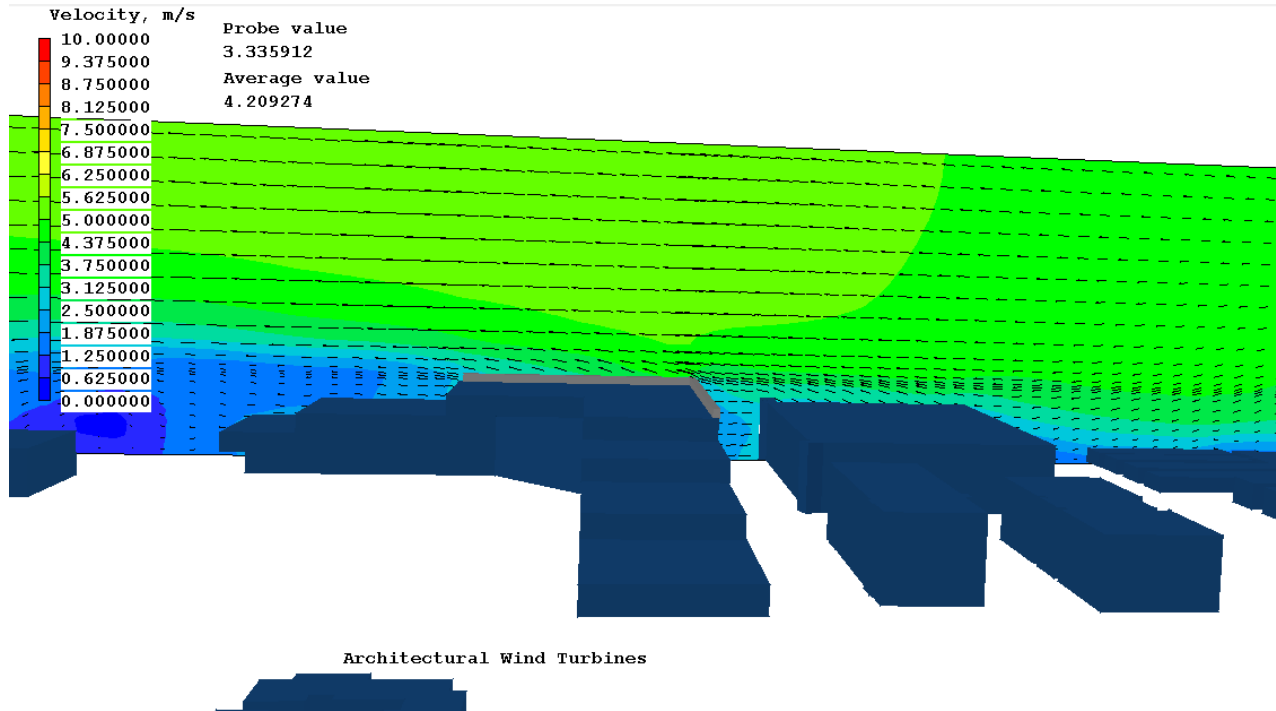


	Size			Location		
	delta x [m]	delta y [m]	delta z [m]	x [m]	y [m]	z [m]
Buildings	850.138	881.4054	36.1442	0.0	0.0	0.0
Turbine1	1.83	7.233	2.59	500.0	430.0	240.0
Turbine2	7.04	1.83	2.59	501.83	430.0	240.0

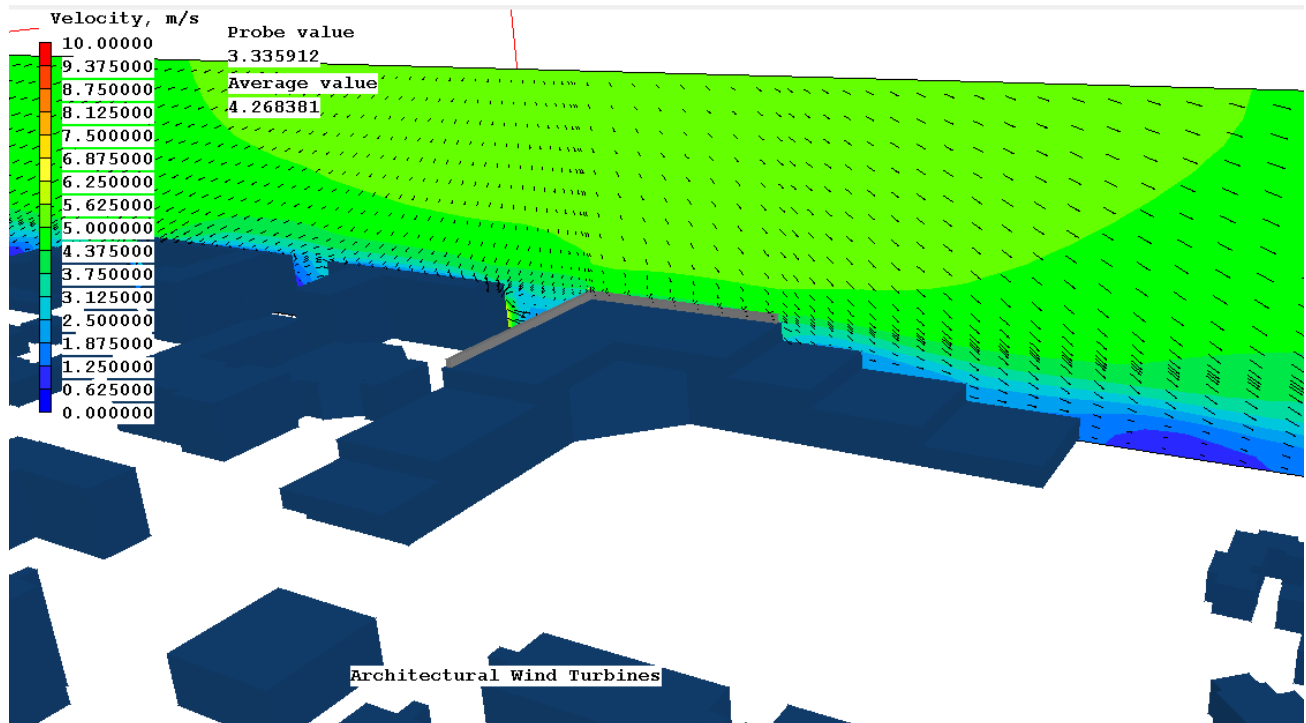
The mesh was revised for a final time to be X=117, Y=111, Z=22. Using the number of iterations set to 5000, it took 5 hours 59 minutes to complete the simulation. This resulted in mass residual of 5197×10^2 kg/s and the total mass inflow was 6.039137×10^5 kg/s, which is 0.086% mass residual. Therefore, the solution was able to reach convergence, indicating that revision proved to be successful. Not only is the percent residual less than 0.1%, but also less than the convergence value for the simulation done without the turbine additions. The below figures illustrate the velocity profiles for each direction around the added wind turbines.



Architectural Wind Turbine (simplified) Z-Velocity Profile (500, 430, 26)



Architectural Wind Turbine (Simplified) Y-Velocity Profile (500, 430, 26)



Architectural Wind Turbine (simplified) X-plane Velocity Profile (500, 430, 26)



Appendix D: Construction Management

Existing Schedule and Revised Schedule



ID		Task Mode	Task Name	Duration	Start		2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1	H2
1			Design/Bid & Award/ Procurement	663 days	Mon 3/24/08									
2			Design Phase	426 days	Mon 3/24/08									
3			Bid/Award	376 days	Fri 5/30/08									
4			Notice To Proceed	0 days	Thu 7/3/08									
5			Submittal/Fabrication/Procurement	590 days	Thu 7/3/08									
6			Material Science Coordination Drawings	319 days	Mon 6/1/09									
7			Life Sciences Coordination Drawings	204 days	Mon 8/24/09									
8			Foundation	399 days	Tue 11 / 4 / 0									
9			Material Sciences Excavation and Shoring	75 days	Tue 11/11/08									
10			Life Sciences Excavation and Shoring	78 days	Tue 11/4/08									
11			Material Sciences Mini-Piles	87 days	Mon 11/24/08									
12			Life Sciences Mini Piles	111 days	Mon 11/17/08									
13			Foundation's & Slab - On - Grade	325 days	Mon 2/16/09									
14			CL BB - Y5	101 days	Mon 2/16/09									
15			CL Y5 - S5	137 days	Fri 5/1/09									
16			CL J - S5	228 days	Sat 3/21/09									
17			CL T - L	136 days	Tue 6/23/09									
18			Areaways & Cleanrooms	275 days	Mon 4/27/09									
19			CL 13 - 20	171 days	Fri 7/3/09									
20			Superstructure	204 days	Tue 7/7/09									
21			Material Sciences	159 days	Tue 7/7/09									
22			CL BB - W	26 days	Tue 7/7/09									
23			CL W - R	29 days	Tue 7/21/09									
24			CL R - J	24 days	Thu 8/20/09									
25			Shear Wall	130 days	Tue 8/18/09									
26			Life Sciences	105 days	Mon 10/19/09									
27			Shear Walls	99 days	Tue 10/27/09									
28			CL 12 - 16	21 days	Mon 10/19/0									
29			CL 16 - 21	36 days	Tue 11/17/09									
30			Core/Areaway	69 days	Tue 1/12/10									
31			Concrete Slabs	244 days	Tue 8/18/09									
32			Tunnel Phase CL A1 - LS	66 days	Fri 4/23/10									
33			Material Sciences	155 days	Tue 8/18/09									
34			CL BB - R	92 days	Tue 8/18/09									
35			CL R - M	117 days	Fri 10/9/09									
36			CL M - H	37 days	Thu 1/28/10									
37			Life Sciences	83 days	Mon 12/28/09									
38			CL 12 - 16	83 days	Mon 12/28/0									
39			CL 16 - 21	56 days	Wed 1/13/10									
40			CL 12 - 8	14 days	Fri 3/5/10									

Project: Existing Schedule Summa
Date: Tue 4/5/11

Task

Split

Milestone

Summary









Project Summary

External Tasks

External Milestone

Inactive Task









Inactive Milestone

Inactive Summary

Manual Task

Duration-only









Manual Summary Rollup

Manual Summary

Start-only

Finish-only









Deadline

Progress





ID	Task Mode	Task Name	Duration	Start	2008		2009		2010		2011	
					H2	H1	H2	H1	H2	H1	H2	H1
41		Areaway Lv1 & Lv2	49 days	Mon 1/4/10								
42		Areaway Lv3	19 days	Fri 3/5/10								
43		Areaway Lv4	4 days	Tue 3/23/10								
44		Areaway Roof	30 days	Mon 4/19/10								
45		Material Sciences Enclosure	185 days	Mon 11/9/09								
46		North Elevation	165 days	Mon 11/9/09								
47		Precast Attach Steel	5 days	Mon 11/9/09								
48		Precast Panels	20 days	Mon 11/16/0								
49		Insulation/Air Barrier Precast Panels	38 days	Thu 3/4/10								
50		Ribbon Windows	130 days	Mon 12/28/0								
51		East Elevation	169 days	Wed 11/18/09								
52		Precast Attach Steel	1 day	Wed 11/18/0								
53		Precast Panels	5 days	Mon 11/23/0								
54		Insulation/Air Barrier Precast Panels	5 days	Mon 11/30/0								
55		Ribbon Windows	73 days	Tue 1/26/10								
56		PH Louvers	8 days	Wed 5/19/10								
57		Sunshade	3 days	Thu 7/8/10								
58		South Elevation	177 days	Thu 11/19/09								
59		Precast Attach Steel	52 days	Thu 11/19/09								
60		Precast Panels	83 days	Mon 12/7/09								
61		PH Louvers	11 days	Tue 6/1/10								
62		Insulation/Air Barrier Precast Panels	80 days	Mon 3/8/10								
63		Ribbon Windows	133 days	Mon 12/28/0								
64		Sunshade	30 days	Mon 6/14/10								
65		Roofing	65 days	Mon 1/18/10								
66		Level 2 Green Roof	41 days	Mon 1/18/10								
67		Level 3 Green Roof	12 days	Wed 3/17/10								
68		Level 4 Green Roof	8 days	Thu 4/8/10								
69		Life Sciences Enclosure	303 days	Mon 11/9/09								
70		East Elevation	179 days	Mon 11/9/09								
71		Precast Attach Steel	10 days	Mon 11/9/09								
72		Precast Panels	5 days	Wed 3/24/10								
73		PH Louvers	6 days	Tue 6/15/10								
74		Ribbon Windows	68 days	Mon 3/29/10								
75		Insulation/Air Barrier Precast Panels	65 days	Thu 4/1/10								
76		Sunshade	7 days	Wed 7/7/10								
77		South Elevation	118 days	Mon 2/1/10								
78		Precast Attach Steel	5 days	Mon 2/1/10								
79		Precast Panels	5 days	Mon 3/22/10								
80		Insulation/Air Barrier Precast Panels	9 days	Mon 5/3/10								
Project: Existing Schedule Summary Date: Tue 4/5/11 Task Split Milestone Summary Project Summary External Tasks External Milestone Inactive Task Inactive Milestone Inactive Summary Manual Task Duration-only Manual Summary Rollup Manual Summary Start-only Finish-only Deadline Progress												
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ID		Task Mode	Task Name	Duration	Start	2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1
81			PH Louvers	7 days	Mon 5/10/10								
82			Ribbon Windows	48 days	Mon 4/26/10								
83			Sunshade	7 days	Tue 7/6/10								
84			West Elevation	132 days	Mon 1/18/10								
85			Precast Attach Steel	5 days	Mon 1/18/10								
86			Precast Panels	40 days	Mon 3/15/10								
87			Ribbon Windows	62 days	Mon 3/22/10								
88			Insulation/Air Barrier Precast Panels	55 days	Mon 4/5/10								
89			Sunshade	4 days	Thu 7/15/10								
90			Areaway Enclosure	215 days	Thu 3/11/10								
91			North Elevation	86 days	Fri 3/26/10								
92			Precast Attach Steel	4 days	Fri 3/26/10								
93			Precast Panels	4 days	Fri 5/14/10								
94			Ribbon Windows	15 days	Mon 5/31/10								
95			PH Louvers	31 days	Tue 6/1/10								
96			Insulation/Air Barrier Precast Panels	30 days	Mon 6/7/10								
97			Sunshade	3 days	Wed 7/21/10								
98			Soffit Exterior	182 days	Thu 3/11/10								
99			Exterior Miscellaneous Steel Frame	59 days	Thu 3/11/10								
100			Exterior Frame/Sheath	23 days	Wed 9/1/10								
101			Exterior Metal Panels	34 days	Tue 10/5/10								
102			Areaway Entrance Exterior	181 days	Wed 4/28/10								
103			Miscellaneous Steel Frame	5 days	Tue 6/1/10								
104			2nd Floor Windows	49 days	Tue 5/18/10								
105			Exterior Frame/Sheath	6 days	Wed 9/1/10								
106			Waterproofing	3 days	Thu 9/9/10								
107			Storefront	100 days	Wed 4/28/10								
108			Exterior Metal Panels	6 days	Wed 12/29/1								
109			Areaway Lightwell	151 days	Tue 6/1/10								
110			Exterior Miscellaneous Steel Frame	5 days	Tue 6/1/10								
111			Exterior Frame/Sheath	34 days	Thu 7/1/10								
112			Waterproofing	11 days	Wed 8/18/10								
113			Exterior Metal Panels	27 days	Mon 11/22/1								
114			West Elevation	80 days	Tue 3/30/10								
115			Precast Attach Steel	2 days	Tue 3/30/10								
116			Precast Panels	6 days	Mon 5/10/10								
117			Ribbon Windows	19 days	Fri 5/28/10								
118			PH Louvers	17 days	Tue 6/8/10								
119			Insulation/Air Barrier Precast Panels	26 days	Mon 6/14/10								
120			Areaway Roofing	65 days	Mon 6/7/10								

Project: Existing Schedule Summa

Date: Tue 4/5/11

Task

Split

Milestone

Summary

Project Summary

External Tasks

External Milestone

Inactive Task

Inactive Milestone

Inactive Summary

Manual Task

Duration-only

Manual Summary Rollup

Manual Summary

Start-only

Finish-only

Deadline

Progress

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ID		Task Mode	Task Name	Duration	Start	2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1
121			Stair/Core Level 6 Roofing	4 days	Tue 6/15/10								
122			PH/Areaaway Level 5 Roofing	40 days	Mon 6/7/10								
123			PH/Areaaway Level 5 Roof Trimout	9 days	Tue 8/24/10								
124			Life Sciences Rough-In & Finishes	318 days	Wed 1/20/10								
125			Lv3 Lab Rough-In	144 days	Fri 3/5/10								
126			Interior Walls	5 days	Fri 3/5/10								
127			Perimeter Walls	16 days	Wed 6/16/10								
128			Fireproofing	5 days	Tue 3/30/10								
129			VAV Installation	11 days	Fri 5/21/10								
130			Plumbing Rough-In	19 days	Fri 7/23/10								
131			Electrical/Power Rough-In	8 days	Tue 7/20/10								
132			Drywall	8 days	Mon 9/13/10								
133			Lv3 Core Rough-In	162 days	Fri 3/5/10								
134			Interior Walls	28 days	Fri 3/5/10								
135			Perimeter Walls	62 days	Fri 5/7/10								
136			VAV Installation	18 days	Mon 5/17/10								
137			Fireproofing	5 days	Tue 3/30/10								
138			Electrical/Power Rough-In	37 days	Tue 7/20/10								
139			Plumbing Rough-In	8 days	Tue 8/3/10								
140			Drywall	12 days	Fri 10/1/10								
141			Lv3 Finishes	127 days	Thu 9/23/10								
142			Lab Finishes	92 days	Thu 9/23/10								
143			Core Finishes	109 days	Tue 10/19/10								
144			Lv2 Lab Rough-In	198 days	Wed 1/20/10								
145			Interior Walls	5 days	Wed 1/20/10								
146			Perimeter Walls	45 days	Mon 6/14/10								
147			Fireproofing	7 days	Mon 4/5/10								
148			VAV Installation	18 days	Mon 7/12/10								
149			Plumbing Rough-In	19 days	Fri 7/23/10								
150			Electrical/Power Rough-In	19 days	Tue 7/20/10								
151			Drywall	9 days	Tue 10/12/10								
152			Lv2 Core Rough-In	156 days	Mon 4/5/10								
153			Interior Walls	3 days	Mon 4/5/10								
154			Perimeter Walls	46 days	Fri 7/2/10								
155			VAV Installation	11 days	Tue 7/6/10								
156			Fireproofing	16 days	Mon 4/5/10								
157			Electrical/Power Rough-In	28 days	Fri 7/23/10								
158			Core Plumbing Rough-In	5 days	Mon 9/13/10								
159			Drywall	10 days	Tue 10/26/10								
160			Lv2 Finishes	110 days	Mon 10/25/10								
Project: Existing Schedule Summary Date: Tue 4/5/11			Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline		
			Split		External Tasks		Inactive Summary		Manual Summary		Progress		
			Milestone		External Milestone		Manual Task		Start-only				
			Summary		Inactive Task		Duration-only		Finish-only				
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ID		Task Mode	Task Name	Duration	Start		2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1	H2
161			Lv2 Labs	93 days	Mon 10/25/10									
162			Lv2 Core	99 days	Tue 11/9/10									
163			Lv1 Lab Rough-In	175 days	Fri 3/19/10									
164			Interior Walls	6 days	Fri 3/19/10									
165			Perimeter Walls	9 days	Wed 9/1/10									
166			Fireproofing	10 days	Tue 4/13/10									
167			VAV Installation	13 days	Thu 7/22/10									
168			Plumbing Rough-In	5 days	Wed 10/13/10									
169			Electrical/Power Rough-In	6 days	Wed 10/13/10									
170			Drywall	10 days	Fri 11/5/10									
171			Lv1 Core Rough-In	184 days	Tue 3/23/10									
172			Interior Walls	4 days	Tue 3/23/10									
173			Perimeter Walls	55 days	Fri 7/2/10									
174			VAV Installation	11 days	Mon 9/20/10									
175			Fireproofing	9 days	Wed 4/14/10									
176			Electrical/Power Rough-In	6 days	Wed 10/20/10									
177			Core Plumbing Rough-In	5 days	Wed 10/20/10									
178			Drywall	11 days	Fri 11/19/10									
179			Lv1 Finishes	101 days	Fri 11/19/10									
180			Lv1 Labs	85 days	Fri 11/19/10									
181			Lv1 Core	77 days	Thu 12/23/10									
182			Lv0 Areaway Rough-In & Finishes	278 days	Mon 2/22/10									
183			Lv0 Rough-In	198 days	Mon 2/22/10									
184			Fireproofing	9 days	Mon 2/22/10									
185			Interior Walls	7 days	Thu 2/25/10									
186			VAV Installation	9 days	Thu 9/9/10									
187			Electrical/Power Rough-In	5 days	Mon 10/25/10									
188			Plumbing Rough-In	5 days	Mon 10/25/10									
189			Drywall	8 days	Mon 11/15/10									
190			Lv0 Finishes	79 days	Fri 11/26/10									
191			Lv0 Finishes	79 days	Fri 11/26/10									
192			Material Sciences Rough-In & Finishes	322 days	Mon 12/14/09									
193			Lv3 Lab Rough-In	183 days	Mon 12/21/09									
194			Interior Walls	55 days	Mon 12/21/09									
195			Perimeter Walls	30 days	Mon 5/17/10									
196			Fireproofing	8 days	Wed 1/27/10									
197			VAV Installation	11.06 days	Thu 4/8/10									
198			Plumbing Rough-In	48 days	Thu 5/13/10									
199			Electrical/Power Rough-In	4 days	Mon 7/19/10									
200			Drywall	15 days	Thu 8/12/10									

Project: Existing Schedule Summa
Date: Tue 4/5/11

Task

Split

Milestone

Summary









Project Summary

External Tasks

External Milestone

Inactive Task









Inactive Milestone

Inactive Summary

Manual Task

Duration-only









Manual Summary Rollup

Manual Summary

Start-only

Finish-only









Deadline

Progress





ID		Task Mode	Task Name	Duration	Start	2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1
201			Lv3 Core Rough-In	170 days	Wed 3/3/10								
202			Interior Walls	32 days	Wed 3/3/10								
203			Perimeter Walls	35 days	Mon 5/17/10								
204			VAV Installation	18 days	Mon 5/17/10								
205			Fireproofing	26 days	Wed 3/24/10								
206			Electrical/Power Rough-In	8 days	Tue 7/6/10								
207			Plumbing Rough-In	38 days	Tue 7/6/10								
208			Drywall	5 days	Wed 10/20/10								
209			Lv3 Finishes	124 days	Fri 9/3/10								
210			Lab Finishes	106 days	Fri 9/3/10								
211			Core Finishes	111 days	Wed 9/22/10								
212			Lv2 Lab Rough-In	168 days	Wed 12/23/09								
213			Interior Walls	16 days	Wed 12/23/09								
214			Perimeter Walls	35 days	Mon 3/29/10								
215			Fireproofing	9 days	Mon 1/18/10								
216			VAV Installation	22 days	Mon 3/22/10								
217			Plumbing Rough-In	30 days	Mon 6/14/10								
218			Electrical/Power Rough-In	8 days	Mon 7/19/10								
219			Drywall	11 days	Fri 7/30/10								
220			Lv2 Core Rough-In	187 days	Mon 2/8/10								
221			Interior Walls	28 days	Mon 2/8/10								
222			Perimeter Walls	17 days	Fri 7/9/10								
223			VAV Installation	11 days	Wed 5/12/10								
224			Fireproofing	4 days	Thu 3/18/10								
225			Electrical/Power Rough-In	7 days	Wed 7/7/10								
226			Core Plumbing Rough-In	19 days	Mon 8/9/10								
227			Drywall	49 days	Thu 8/19/10								
228			Lv2 Finishes	115 days	Wed 9/29/10								
229			Lv2 Labs	102 days	Wed 9/29/10								
230			Lv2 Core	95 days	Wed 10/27/10								
231			Lv1 Lab Rough-In	229 days	Mon 12/14/09								
232			Interior Walls	46 days	Mon 12/14/09								
233			Perimeter Walls	105 days	Mon 4/12/10								
234			Fireproofing	10 days	Tue 2/9/10								
235			VAV Installation	9 days	Tue 9/21/10								
236			Plumbing Rough-In	5 days	Thu 9/23/10								
237			Electrical/Power Rough-In	2 days	Wed 9/29/10								
238			Drywall	8 days	Tue 10/19/10								
239			Lv1 Core Rough-In	204 days	Wed 2/10/10								
240			Interior Walls	4 days	Wed 2/10/10								
Project: Existing Schedule Summa Date: Tue 4/5/11			Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline		
			Split		External Tasks		Inactive Summary		Manual Summary		Progress		
			Milestone		External Milestone		Manual Task		Start-only				
			Summary		Inactive Task		Duration-only		Finish-only				
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ID		Task Mode	Task Name	Duration	Start		2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1	H2
241			Perimeter Walls	5 days	Fri 9/3/10									
242			VAV Installation	9 days	Wed 9/22/10									
243			Fireproofing	4 days	Mon 3/15/10									
244			Electrical/Power Rough-In	6 days	Fri 10/15/10									
245			Core Plumbing Rough-In	5 days	Fri 10/15/10									
246			Drywall	10 days	Tue 11/9/10									
247			Lv1 Finishes	91 days	Fri 10/29/10									
248			Lv1 Labs	88 days	Fri 10/29/10									
249			Lv1 Core	87 days	Thu 11/4/10									
250			Close-Out	39 days	Mon 4/11/11									
251			Material Sciences	31 days	Mon 4/11/11									
252			Level 3 Close-Out	0 days	Mon 4/11/11								4/11	
253			Level 2 Close-Out	0 days	Tue 4/26/11								4/26	
254			Level 1 Close-Out	0 days	Tue 5/24/11								5/24	
255			Life Sciences	22 days	Wed 5/4/11									
256			Level 3 Close-Out	0 days	Wed 5/4/11								5/4	
257			Level 2 Close-Out	0 days	Wed 5/18/11								5/18	
258			Level 1 Close-Out	0 days	Fri 6/3/11								6/3	
259			Level 0 Close-Out	0 days	Wed 5/11/11								5/11	
260			Building Turnover	0 days	Thu 7/7/11								7/7	

Project: Existing Schedule Summa
Date: Tue 4/5/11

Task



Project Summary



Inactive Milestone



Manual Summary Rollup



Deadline



Split



External Tasks



Inactive Summary



Manual Summary



Progress



Milestone



External Milestone



Manual Task



Start-only



Summary



Inactive Task



Duration-only



Finish-only



ID	Task Mode	Task Name	Duration	Start	Finish	Timeline									
						2008		2009		2010		2011			
						H2	H1	H2	H1	H2	H1	H2	H1	H2	
1		Design/Bid & Award/ Procurement	663 days	Mon 3/24/08	Wed 10/6/10										
2		Design Phase	426 days	Mon 3/24/08	Mon 11/9/09										
3		Bid/Award	376 days	Fri 5/30/08	Fri 11/6/09										
4		Notice To Proceed	0 days	Thu 7/3/08	Thu 7/3/08										
5		Submittal/Fabrication/Procurement	590 days	Thu 7/3/08	Wed 10/6/10										
6		Material Science Coordination Drawings	319 days	Mon 6/1/09	Thu 8/19/10										
7		Life Sciences Coordination Drawings	204 days	Mon 8/24/09	Thu 6/3/10										
8		Foundation	399 days	Tue 11/4/08	Fri 5/14/10										
9		Material Sciences Excavation and Shoring	75 days	Tue 11/11/08	Mon 2/23/09										
10		Life Sciences Excavation and Shoring	78 days	Tue 11/4/08	Thu 2/19/09										
11		Material Sciences Mini-Piles	87 days	Mon 11/24/08	Tue 3/24/09										
12		Life Sciences Mini Piles	111 days	Mon 11/17/08	Mon 4/20/09										
13		Foundation's & Slab - On - Grade	325 days	Mon 2/16/09	Fri 5/14/10										
14		CL BB - Y5	101 days	Mon 2/16/09	Mon 7/6/09										
15		CL Y5 - S5	137 days	Fri 5/1/09	Mon 11/9/09										
16		CL J - S5	228 days	Sat 3/21/09	Tue 2/2/10										
17		CL T - L	136 days	Tue 6/23/09	Tue 12/29/09										
18		Areaways & Cleanrooms	275 days	Mon 4/27/09	Fri 5/14/10										
19		CL 13 - 20	171 days	Fri 7/3/09	Fri 2/26/10										
20		Superstructure	204 days	Tue 7/7/09	Fri 4/16/10										
21		Material Sciences	159 days	Tue 7/7/09	Sun 2/14/10										
22		CL BB - W	26 days	Tue 7/7/09	Tue 8/11/09										
23		CL W - R	29 days	Tue 7/21/09	Fri 8/28/09										
24		CL R - J	24 days	Thu 8/20/09	Tue 9/22/09										
25		Shear Wall	130 days	Tue 8/18/09	Sun 2/14/10										
26		Life Sciences	105 days	Mon 10/19/09	Fri 3/12/10										
27		Shear Walls	99 days	Tue 10/27/09	Fri 3/12/10										
28		CL 12 - 16	21 days	Mon 10/19/09	Mon 11/16/09										
29		CL 16 - 21	36 days	Tue 11/17/09	Tue 1/5/10										
30		Core/Areaway	69 days	Tue 1/12/10	Fri 4/16/10										
31		Concrete Slabs	244 days	Tue 8/18/09	Fri 7/23/10										
32		Tunnel Phase CL A1 - LS	66 days	Fri 4/23/10	Fri 7/23/10										
33		Material Sciences	155 days	Tue 8/18/09	Mon 3/22/10										
34		CL BB - R	92 days	Tue 8/18/09	Wed 12/23/09										
35		CL R - M	117 days	Fri 10/9/09	Mon 3/22/10										
36		CL M - H	37 days	Thu 1/28/10	Fri 3/19/10										
37		Life Sciences	83 days	Mon 12/28/09	Wed 4/21/10										
Project: Proposed Schedule Summary Date: Tue 4/5/11		Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline					
		Split		External Tasks		Inactive Summary		Manual Summary		Progress					
		Milestone		External Milestone		Manual Task		Start-only							
		Summary		Inactive Task		Duration-only		Finish-only							
Page 1															

ID	Task Mode	Task Name	Duration	Start	Finish	2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1
38		CL 12 - 16	83 days	Mon 12/28/0	Wed 4/21/10								
39		CL 16 - 21	56 days	Wed 1/13/10	Wed 3/31/10								
40		CL 12 - 8	14 days	Fri 3/5/10	Wed 3/24/10								
41		Areaway Lv1 & Lv2	49 days	Mon 1/4/10	Thu 3/11/10								
42		Areaway Lv3	19 days	Fri 3/5/10	Wed 3/31/10								
43		Areaway Lv4	4 days	Tue 3/23/10	Fri 3/26/10								
44		Areaway Roof	30 days	Mon 4/19/10	Fri 5/28/10								
45		Single-Skin Enclosure	168 days	Mon 11/9/09	Wed 6/30/10								
46		Material Sciences North Elevation	165 days	Mon 11/9/09	Fri 6/25/10								
47		Precast Attach Steel	5 days	Mon 11/9/09	Fri 11/13/09								
48		Precast Panels	13 days	Mon 11/16/0	Wed 12/2/09								
49		Insulation/Air Barrier Precast Panels	38 days	Thu 3/4/10	Mon 4/26/10								
50		Ribbon Windows	130 days	Mon 12/28/0	Fri 6/25/10								
51		Material Sciences East Elevation	122 days	Wed 11/18/09	Thu 5/6/10								
52		Precast Attach Steel	1 day	Wed 11/18/0	Wed 11/18/0								
53		Precast Panels	5 days	Mon 11/23/0	Fri 11/27/09								
54		Insulation/Air Barrier Precast Panels	5 days	Mon 11/30/09	Fri 12/4/09								
55		Ribbon Windows	73 days	Tue 1/26/10	Thu 5/6/10								
56		Life Sciences East Elevation	160 days	Thu 11/19/09	Wed 6/30/10								
57		Precast Attach Steel	10 days	Mon 11/9/09	Fri 11/20/09								
58		Precast Panels	9 days	Thu 12/3/09	Tue 12/15/09								
59		Insulation/Air Barrier Precast Panels	65 days	Thu 4/1/10	Wed 6/30/10								
60		Ribbon Windows	68 days	Mon 3/29/10	Wed 6/30/10								
61		Life Sciences South Elevation	160 days	Thu 11/19/09	Wed 6/30/10								
62		Precast Attach Steel	5 days	Fri 11/20/09	Thu 11/26/09								
63		Precast Panels	5 days	Wed 12/16/0	Tue 12/22/09								
64		Insulation/Air Barrier Precast Panels	80 days	Mon 3/8/10	Fri 6/25/10								
65		Ribbon Windows	48 days	Mon 4/26/10	Wed 6/30/10								
66		Roofing	65 days	Mon 1/18/10	Sun 4/18/10								
67		Level 2 Green Roof	41 days	Mon 1/18/10	Mon 3/15/10								
68		Level 3 Green Roof	12 days	Wed 3/17/10	Thu 4/1/10								
69		Level 4 Green Roof	8 days	Thu 4/8/10	Sun 4/18/10								
70		Double-Skin Enclosure	290 days	Thu 11/26/09	Wed 1/5/11								
71		Material Science South Elevation	194 days	Thu 11/26/09	Tue 8/24/10								
72		Precast Attach Steel	5 days	Thu 11/26/09	Wed 12/2/09								
73		Precast Panels	13 days	Wed 12/23/0	Fri 1/8/10								
Project: Proposed Schedule Summary Date: Tue 4/5/11		Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline			
		Split		External Tasks		Inactive Summary		Manual Summary		Progress			
		Milestone		External Milestone		Manual Task		Start-only					
		Summary		Inactive Task		Duration-only		Finish-only					
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ID	Task Mode	Task Name	Duration	Start	Finish	2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1
74		Ribbon Windows	73 days	Mon 3/22/10	Wed 6/30/10								
75		Interior Ribbon Windows	73 days	Sat 5/15/10	Tue 8/24/10								
76		Insulation/Air Barrier Precast Panels	55 days	Mon 4/5/10	Fri 6/18/10								
77		Sunshade	4 days	Thu 7/15/10	Tue 7/20/10								
78		Life Science West Elevation	211 days	Mon 1/11/10	Mon 11/1/10								
79		Precast Attach Steel	5 days	Mon 2/1/10	Fri 2/5/10								
80		Precast Panels	13 days	Mon 1/11/10	Wed 1/27/10								
81		Insulation/Air Barrier Precast Panels	9 days	Mon 5/3/10	Thu 5/13/10								
82		Ribbon Windows	130 days	Mon 4/26/10	Fri 10/22/10								
83		Interior Ribbon Windows	100 days	Tue 6/15/10	Mon 11/1/10								
84		Sunshade	7 days	Tue 7/6/10	Wed 7/14/10								
85		Areaway Enclosure	215 days	Thu 3/11/10	Wed 1/5/11								
86		North Elevation	86 days	Fri 3/26/10	Fri 7/23/10								
87		Precast Attach Steel	4 days	Fri 3/26/10	Wed 3/31/10								
88		Precast Panels	4 days	Fri 5/14/10	Wed 5/19/10								
89		Ribbon Windows	15 days	Mon 5/31/10	Fri 6/18/10								
90		PH Louvers	31 days	Tue 6/1/10	Tue 7/13/10								
91		Insulation/Air Barrier Precast P	30 days	Mon 6/7/10	Fri 7/16/10								
92		Sunshade	3 days	Wed 7/21/10	Fri 7/23/10								
93		Soffit Exterior	182 days	Thu 3/11/10	Fri 11/19/10								
94		Exterior Miscellaneous Steel Fr	59 days	Thu 3/11/10	Tue 6/1/10								
95		Exterior Frame/Sheath	23 days	Wed 9/1/10	Fri 10/1/10								
96		Exterior Metal Panels	34 days	Tue 10/5/10	Fri 11/19/10								
97		Areaway Entrance Exterior	181 days	Wed 4/28/10	Wed 1/5/11								
98		Miscellaneous Steel Frame	5 days	Tue 6/1/10	Mon 6/7/10								
99		2nd Floor Windows	49 days	Tue 5/18/10	Fri 7/23/10								
100		Exterior Frame/Sheath	6 days	Wed 9/1/10	Wed 9/8/10								
101		Waterproofing	3 days	Thu 9/9/10	Mon 9/13/10								
102		Storefront	100 days	Wed 4/28/10	Tue 9/14/10								
103		Exterior Metal Panels	6 days	Wed 12/29/10	Wed 1/5/11								
104		Areaway Lightwell	151 days	Tue 6/1/10	Tue 12/28/10								
105		Exterior Miscellaneous Steel Fr	5 days	Tue 6/1/10	Mon 6/7/10								
106		Exterior Frame/Sheath	34 days	Thu 7/1/10	Tue 8/17/10								
107		Waterproofing	11 days	Wed 8/18/10	Wed 9/1/10								
108		Exterior Metal Panels	27 days	Mon 11/22/10	Tue 12/28/10								
109		West Elevation	80 days	Tue 3/30/10	Mon 7/19/10								
110		Precast Attach Steel	2 days	Tue 3/30/10	Wed 3/31/10								
111		Precast Panels	6 days	Mon 5/10/10	Mon 5/17/10								
Project: Proposed Schedule Summary Date: Tue 4/5/11		Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline			
		Split		External Tasks		Inactive Summary		Manual Summary		Progress			
		Milestone		External Milestone		Manual Task		Start-only					
		Summary		Inactive Task		Duration-only		Finish-only					
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ID	Task Mode	Task Name	Duration	Start	Finish	2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1
112		Ribbon Windows	19 days	Fri 5/28/10	Wed 6/23/10								
113		PH Louvers	17 days	Tue 6/8/10	Wed 6/30/10								
114		Insulation/Air Barrier Precast P	26 days	Mon 6/14/10	Mon 7/19/10								
115		Areaway Roofing	65 days	Mon 6/7/10	Fri 9/3/10								
116		Stair/Core Level 6 Roofing	4 days	Tue 6/15/10	Fri 6/18/10								
117		PH/Areaway Level 5 Roofing	40 days	Mon 6/7/10	Fri 7/30/10								
118		PH/Areaway Level 5 Roof T	9 days	Tue 8/24/10	Fri 9/3/10								
119		Life Sciences Rough-In & Finishes	318 days	Wed 1/20/10	Fri 4/8/11								
120		Lv3 Lab Rough-In	144 days	Fri 3/5/10	Wed 9/22/10								
121		Interior Walls	5 days	Fri 3/5/10	Thu 3/11/10								
122		Perimeter Walls	150 days	Thu 12/10/09	Wed 7/7/10								
123		Fireproofing	5 days	Tue 3/30/10	Mon 4/5/10								
124		VAV Installation	74 days	Fri 5/21/10	Wed 9/1/10								
125		Plumbing Rough-In	19 days	Fri 7/23/10	Wed 8/18/10								
126		Electrical/Power Rough-In	8 days	Tue 7/20/10	Thu 7/29/10								
127		Drywall	8 days	Mon 9/13/10	Wed 9/22/10								
128		Lv3 Core Rough-In	162 days	Fri 3/5/10	Mon 10/18/10								
129		Interior Walls	28 days	Fri 3/5/10	Tue 4/13/10								
130		Perimeter Walls	168 days	Thu 12/10/09	Mon 8/2/10								
131		VAV Installation	29 days	Mon 5/17/10	Thu 6/24/10								
132		Fireproofing	5 days	Tue 3/30/10	Sun 4/4/10								
133		Electrical/Power Rough-In	37 days	Tue 7/20/10	Wed 9/8/10								
134		Plumbing Rough-In	8 days	Tue 8/3/10	Thu 8/12/10								
135		Drywall	12 days	Fri 10/1/10	Mon 10/18/10								
136		Lv3 Finishes	127 days	Thu 9/23/10	Fri 3/18/11								
137		Lab Finishes	92 days	Thu 9/23/10	Fri 1/28/11								
138		Core Finishes	109 days	Tue 10/19/10	Fri 3/18/11								
139		Lv2 Lab Rough-In	198 days	Wed 1/20/10	Fri 10/22/10								
140		Interior Walls	5 days	Wed 1/20/10	Tue 1/26/10								
141		Perimeter Walls	177 days	Thu 12/10/09	Fri 8/13/10								
142		Fireproofing	7 days	Mon 4/5/10	Tue 4/13/10								
143		VAV Installation	39 days	Mon 7/12/10	Thu 9/2/10								
144		Plumbing Rough-In	19 days	Fri 7/23/10	Wed 8/18/10								
145		Electrical/Power Rough-In	19 days	Tue 7/20/10	Fri 8/13/10								
146		Drywall	9 days	Tue 10/12/10	Fri 10/22/10								
147		Lv2 Core Rough-In	156 days	Mon 4/5/10	Mon 11/8/10								
148		Interior Walls	3 days	Mon 4/5/10	Wed 4/7/10								
149		Perimeter Walls	192 days	Thu 12/10/09	Fri 9/3/10								
150		VAV Installation	4 days	Tue 7/6/10	Fri 7/9/10								
151		Fireproofing	16 days	Mon 4/5/10	Mon 4/26/10								
Project: Proposed Schedule Summary Date: Tue 4/5/11		Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline			
		Split		External Tasks		Inactive Summary		Manual Summary		Progress			
		Milestone		External Milestone		Manual Task		Start-only					
		Summary		Inactive Task		Duration-only		Finish-only					
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ID	Task Mode	Task Name	Duration	Start	Finish	2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1
152		Electrical/Power Rough-In	28 days	Fri 7/23/10	Tue 8/31/10								
153		Core Plumbing Rough-In	5 days	Mon 9/13/10	Fri 9/17/10								
154		Drywall	10 days	Tue 10/26/10	Mon 11/8/10								
155		Lv2 Finishes	110 days	Mon 10/25/10	Fri 3/25/11								
156		Lv2 Labs	93 days	Mon 10/25/10	Wed 3/2/11								
157		Lv2 Core	99 days	Tue 11/9/10	Fri 3/25/11								
158		Lv1 Lab Rough-In	175 days	Fri 3/19/10	Thu 11/18/10								
159		Interior Walls	6 days	Fri 3/19/10	Fri 3/26/10								
160		Perimeter Walls	198 days	Thu 12/10/09	Mon 9/13/10								
161		Fireproofing	10 days	Tue 4/13/10	Mon 4/26/10								
162		VAV Installation	40 days	Thu 7/22/10	Wed 9/15/10								
163		Plumbing Rough-In	5 days	Wed 10/13/10	Tue 10/19/10								
164		Electrical/Power Rough-In	6 days	Wed 10/13/10	Wed 10/20/10								
165		Drywall	10 days	Fri 11/5/10	Thu 11/18/10								
166		Lv1 Core Rough-In	184 days	Tue 3/23/10	Fri 12/3/10								
167		Interior Walls	4 days	Tue 3/23/10	Fri 3/26/10								
168		Perimeter Walls	201 days	Thu 12/10/09	Thu 9/16/10								
169		VAV Installation	5 days	Mon 9/20/10	Fri 9/24/10								
170		Fireproofing	9 days	Wed 4/14/10	Mon 4/26/10								
171		Electrical/Power Rough-In	6 days	Wed 10/20/10	Wed 10/27/10								
172		Core Plumbing Rough-In	5 days	Wed 10/20/10	Tue 10/26/10								
173		Drywall	11 days	Fri 11/19/10	Fri 12/3/10								
174		Lv1 Finishes	101 days	Fri 11/19/10	Fri 4/8/11								
175		Lv1 Labs	85 days	Fri 11/19/10	Thu 3/17/11								
176		Lv1 Core	77 days	Thu 12/23/10	Fri 4/8/11								
177		Lv0 Areaway Rough-In & Finishes	278 days	Mon 2/22/10	Wed 3/16/11								
178		Lv0 Rough-In	198 days	Mon 2/22/10	Wed 11/24/10								
179		Fireproofing	9 days	Mon 2/22/10	Thu 3/4/10								
180		Interior Walls	7 days	Thu 2/25/10	Fri 3/5/10								
181		VAV Installation	7 days	Thu 9/9/10	Fri 9/17/10								
182		Electrical/Power Rough-In	5 days	Mon 10/25/10	Fri 10/29/10								
183		Plumbing Rough-In	5 days	Mon 10/25/10	Fri 10/29/10								
184		Drywall	8 days	Mon 11/15/10	Wed 11/24/10								
185		Lv0 Finishes	79 days	Fri 11/26/10	Wed 3/16/11								
186		Lv0 Finishes	79 days	Fri 11/26/10	Wed 3/16/11								
187		Material Sciences Rough-In & Finishes	330 days	Wed 12/2/09	Tue 3/8/11								
188		Lv3 Lab Rough-In	190 days	Thu 12/10/09	Wed 9/1/10								
189		Interior Walls	55 days	Mon 12/21/09	Fri 3/5/10								
190		Perimeter Walls	142 days	Thu 12/10/09	Fri 6/25/10								
Project: Proposed Schedule Summary Date: Tue 4/5/11		Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline			
		Split		External Tasks		Inactive Summary		Manual Summary		Progress			
		Milestone		External Milestone		Manual Task		Start-only					
		Summary		Inactive Task		Duration-only		Finish-only					
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ID	Task Mode	Task Name	Duration	Start	Finish	2008		2009		2010		2011	
						H2	H1	H2	H1	H2	H1	H2	H1
191		Fireproofing	8 days	Wed 1/27/10	Fri 2/5/10								
192		VAV Installation	1 day	Fri 4/23/10	Fri 4/23/10								
193		Plumbing Rough-In	48 days	Thu 5/13/10	Mon 7/19/10								
194		Electrical/Power Rough-In	4 days	Mon 7/19/10	Thu 7/22/10								
195		Drywall	15 days	Thu 8/12/10	Wed 9/1/10								
196		Lv3 Core Rough-In	170 days	Wed 3/3/10	Tue 10/26/10								
197		Interior Walls	32 days	Wed 3/3/10	Thu 4/15/10								
198		Perimeter Walls	149 days	Tue 12/8/09	Fri 7/2/10								
199		VAV Installation	25 days	Mon 5/17/10	Fri 6/18/10								
200		Fireproofing	26 days	Wed 3/24/10	Wed 4/28/10								
201		Electrical/Power Rough-In	8 days	Tue 7/6/10	Thu 7/15/10								
202		Plumbing Rough-In	38 days	Tue 7/6/10	Thu 8/26/10								
203		Drywall	5 days	Wed 10/20/10	Tue 10/26/10								
204		Lv3 Finishes	124 days	Fri 9/3/10	Wed 2/23/11								
205		Lab Finishes	106 days	Fri 9/3/10	Fri 1/28/11								
206		Core Finishes	111 days	Wed 9/22/10	Wed 2/23/11								
207		Lv2 Lab Rough-In	168 days	Wed 12/23/09	Fri 8/13/10								
208		Interior Walls	16 days	Wed 12/23/09	Wed 1/13/10								
209		Perimeter Walls	96 days	Sat 1/2/10	Fri 5/14/10								
210		Fireproofing	9 days	Mon 1/18/10	Thu 1/28/10								
211		VAV Installation	40 days	Mon 3/22/10	Fri 5/14/10								
212		Plumbing Rough-In	30 days	Mon 6/14/10	Fri 7/23/10								
213		Electrical/Power Rough-In	8 days	Mon 7/19/10	Wed 7/28/10								
214		Drywall	11 days	Fri 7/30/10	Fri 8/13/10								
215		Lv2 Core Rough-In	235 days	Wed 12/2/09	Tue 10/26/10								
216		Interior Walls	28 days	Mon 2/8/10	Wed 3/17/10								
217		Perimeter Walls	174 days	Wed 12/2/09	Sun 8/1/10								
218		VAV Installation	38 days	Wed 5/12/10	Fri 7/2/10								
219		Fireproofing	4 days	Thu 3/18/10	Tue 3/23/10								
220		Electrical/Power Rough-In	7 days	Wed 7/7/10	Thu 7/15/10								
221		Core Plumbing Rough-In	19 days	Mon 8/9/10	Thu 9/2/10								
222		Drywall	49 days	Thu 8/19/10	Tue 10/26/10								
223		Lv2 Finishes	115 days	Wed 9/29/10	Tue 3/8/11								
224		Lv2 Labs	102 days	Wed 9/29/10	Thu 2/17/11								
225		Lv2 Core	95 days	Wed 10/27/10	Tue 3/8/11								
226		Lv1 Lab Rough-In	229 days	Mon 12/14/09	Thu 10/28/10								
227		Interior Walls	46 days	Mon 12/14/09	Mon 2/15/10								
228		Perimeter Walls	186 days	Sun 12/20/09	Fri 9/3/10								
229		Fireproofing	10 days	Tue 2/9/10	Mon 2/22/10								
230		VAV Installation	4 days	Tue 9/21/10	Fri 9/24/10								
Project: Proposed Schedule Summary Date: Tue 4/5/11		Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline			
		Split		External Tasks		Inactive Summary		Manual Summary		Progress			
		Milestone		External Milestone		Manual Task		Start-only					
		Summary		Inactive Task		Duration-only		Finish-only					
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ID	Task Mode	Task Name	Duration	Start	Finish								
						H2	H1	H2	H1	H2	H1	H2	H1
231		Plumbing Rough-In	5 days	Thu 9/23/10	Wed 9/29/10								
232		Electrical/Power Rough-In	2 days	Wed 9/29/10	Thu 9/30/10								
233		Drywall	8 days	Tue 10/19/10	Thu 10/28/10								
234		Lv1 Core Rough-In	230 days	Tue 1/5/10	Mon 11/22/10								
235		Interior Walls	4 days	Wed 2/10/10	Mon 2/15/10								
236		Perimeter Walls	178 days	Tue 1/5/10	Thu 9/9/10								
237		VAV Installation	4 days	Wed 9/22/10	Mon 9/27/10								
238		Fireproofing	4 days	Mon 3/15/10	Thu 3/18/10								
239		Electrical/Power Rough-In	6 days	Fri 10/15/10	Fri 10/22/10								
240		Core Plumbing Rough-In	5 days	Fri 10/15/10	Thu 10/21/10								
241		Drywall	10 days	Tue 11/9/10	Mon 11/22/10								
242		Lv1 Finishes	91 days	Fri 10/29/10	Fri 3/4/11								
243		Lv1 Labs	88 days	Fri 10/29/10	Tue 3/1/11								
244		Lv1 Core	87 days	Thu 11/4/10	Fri 3/4/11								
245		Close-Out	40 days	Mon 4/11/11	Fri 6/3/11								
246		Material Sciences	32 days	Mon 4/11/11	Tue 5/24/11								
247		Level 3 Close-Out	0 days	Mon 4/11/11	Mon 4/11/11								
248		Level 2 Close-Out	0 days	Tue 4/26/11	Tue 4/26/11								
249		Level 1 Close-Out	0 days	Tue 5/24/11	Tue 5/24/11								
250		Life Sciences	23 days	Wed 5/4/11	Fri 6/3/11								
251		Level 3 Close-Out	0 days	Wed 5/4/11	Wed 5/4/11								
252		Level 2 Close-Out	0 days	Wed 5/18/11	Wed 5/18/11								
253		Level 1 Close-Out	0 days	Fri 6/3/11	Fri 6/3/11								
254		Level 0 Close-Out	0 days	Wed 5/11/11	Wed 5/11/11								
255		Building Turnover	0 days	Thu 7/7/11	Thu 7/7/11								

Project: Proposed Schedule Summary
Date: Tue 4/5/11

Task

Split

Milestone

Summary

Project Summary

External Tasks

External Milestone

Inactive Task

Inactive Milestone

Inactive Summary

Manual Task

Duration-only

Manual Summary Rollup

Manual Summary

Start-only

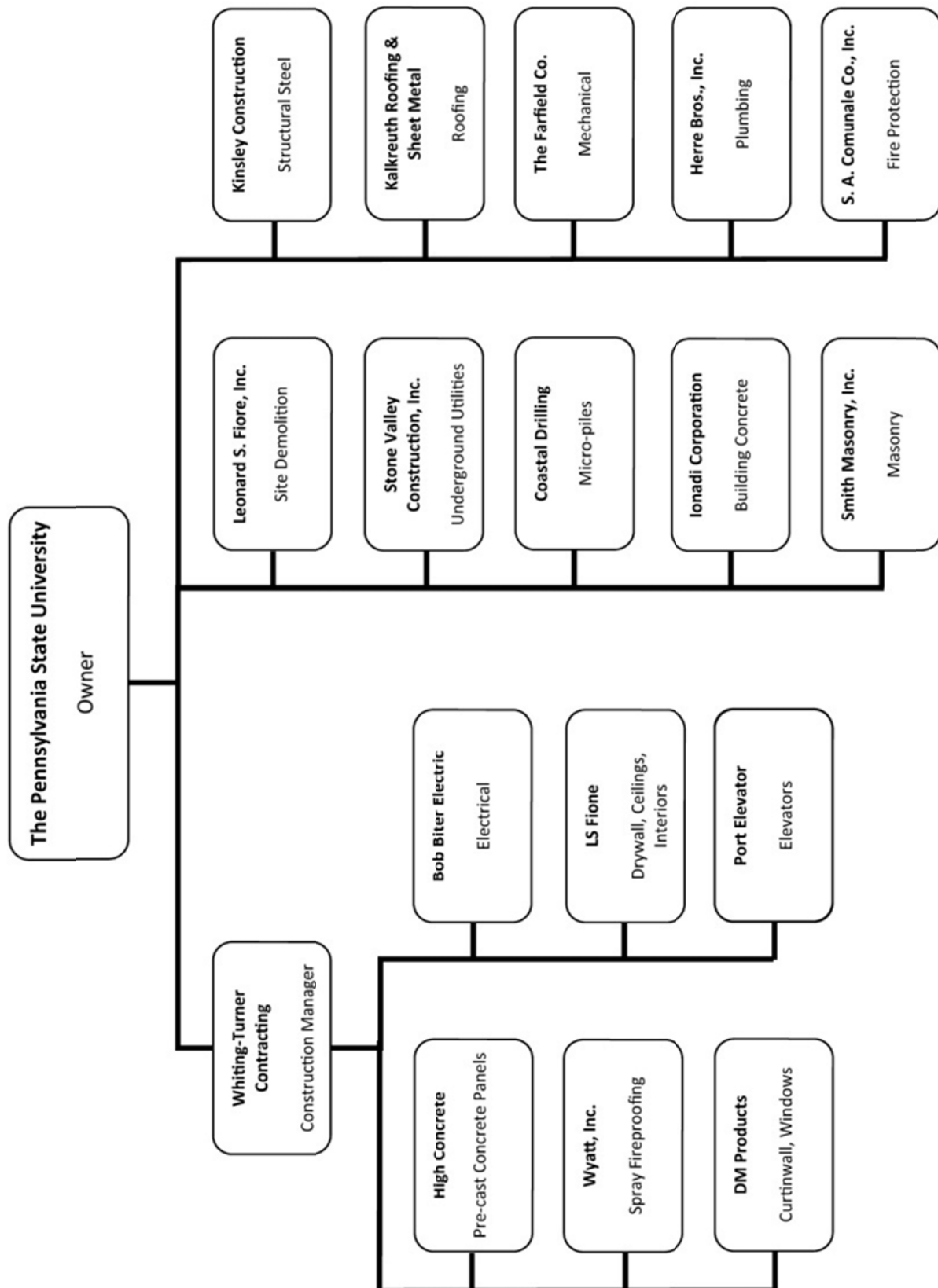
Finish-only

Deadline

Progress

Page 7

Project Delivery Tree



Existing Façade Estimate

Exterior Enclosure	Unit	Quantity	Unit Cost	Total Cost
<u>Precast Panels</u>				
Precast Panels with Brick Face	SF	91,539.00	60.00	\$5,492,340.00
Crane Size Increase	LS	1.00	50,000.00	\$50,000.00
On-Site Mock Up	Allow	1.00	100,000.00	\$100,000.00
Factory Pointing of Brick Face	SF	107,731.00	2.00	\$215,462.00
Precast Column Connections	EA	600.00	250.00	\$150,000.00
Total:				\$6,007,802.00
<u>Building Insulation</u>				
Rigid Insulation - 4" Soffit	SF	4,840.00	4.50	\$21,780.00
Insulation on back of Precast 3"	SF	107,979.00	6.25	\$674,868.75
EIFS	SF	3,020.00	15.00	\$45,300.00
Total:				\$741,948.75
<u>Caulking</u>				
Exterior Precast Panels	LF	11,256.00	3.50	\$39,396.00
Exterior Metal Panels	LF	8,456.00	3.50	\$29,596.00
Exterior Glass and Glazing	LF	20,094.00	3.50	\$70,329.00
Exterior Louvers	LF	8,456.00	3.50	\$29,596.00
Total:				\$168,917.00
<u>Metal Panels</u>				
Insulated Metal Panels - MP - 2	SF	0.00	22.00	\$0.00
Composite Metal Panel Soffits - MP - 1	SF	81,392.00	45.00	\$3,662,640.00
MP - 1 Panels @ Trellis	SF	6,086.00	55.00	\$334,730.00
Waterproofing at Metal Panels	SF	59,568.00	3.50	\$208,488.00
Masonry at Louvers adj. to Green Roof	SF	784.00	15.50	\$12,152.00
Masonry at Parapets	SF	3,757.00	15.50	\$58,233.50
Total:				\$4,276,243.50
<u>Light Gauge Metal Framing</u>				
Stud Framing at Metal Panels	SF	34,161.00	12.00	\$409,932.00
Stud Framing at Metal Panels - Reduced Scope	SF	25,046.00	8.00	\$200,368.00
Sub-Framing for Terra Cotta Panel	SF	28,271.00	16.50	\$466,471.50
Total:				\$1,076,771.50
<u>Louvers</u>				
Architectural Louvers - Building Façade	SF	4,672.00	50.00	\$233,600.00
Architectural Louvers - Green Roof	SF	784.00	12.50	\$9,800.00
Mechanical Louvers - OA Intake	SF	2,464.00	50.00	\$123,200.00



				Total:	\$366,600.00
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Windows

Exterior Windows - Ribbon System	SF	32,194.00	55.00	\$1,770,670.00
Metal Sunscreen	LF	3,880.00	150.00	\$582,000.00
Curtain Wall	SF	1,708.00	85.00	\$145,180.00
Exterior Windows - 2nd Floor Areas	SF	704.00	55.00	\$38,720.00
Storefront at Plaza	SF	1,400.00	45.00	\$63,000.00
Glass Entrance Doors				
Single	EA	10.00	2,500.00	\$25,000.00
Double	EA	6.00	6,000.00	\$36,000.00
Motor Operator Premium	EA	4.00	3,500.00	\$14,000.00
Remove/Replace Vestibule for Tunnel Tie-in	LS	1.00	45,000.00	\$45,000.00

				Total:	\$2,719,570.00
Total	\$15,357,852.75				

Revised Façade Estimate

Exterior Enclosure	Unit	Quantity	Unit Cost	Total Cost
<u>Precast Panels</u>				
Precast Panels with Brick Face	SF	91,539.00	55.00	\$5,034,645.00
Crane Size Increase	LS	1.00	50,000.00	\$50,000.00
On-Site Mock Up	Allow	1.00	100,000.00	\$100,000.00
Factory Pointing of Brick Face	SF	107,731.00	2.00	\$215,462.00
Precast Column Connections	EA	725.00	250.00	\$181,250.00
Metal Safety Grates	LF	1,584.50	30.22	\$47,883.59

				Total:	\$5,629,240.59
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Building Insulation

Rigid Insulation - 4" Soffit	SF	4,840.00	4.50	\$21,780.00
Polyethylene Vapor Barrier	SQ	10,797.00	9.34	\$100,843.98
Insulation Cavity Wall - 3"	SF	107,979.00	6.25	\$674,868.75
EIFS	SF	3,020.00	15.00	\$45,300.00
Total:				\$842,792.73



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Millenium Science Complex
University Park, PA

Paul Kuehnel

Mike Lucas

Sara Pace

Jon Brangan

Caulking

Exterior Precast Panels	LF	11,256.00	3.50	\$39,396.00
Exterior Metal Panels	SF	8,456.00	3.50	\$29,596.00
Exterior Glass and Glazing	LF	20,094.00	3.50	\$70,329.00
Interior Glass and Glazing	LF	10,047.00	3.50	\$35,164.50
Exterior Louvers	LF	8,456.00	3.50	\$29,596.00

Total: \$204,081.50

Metal Panels

Insulated Metal Panels - MP - 2	SF	0.00	22.00	\$0.00
Composite Metal Panel Soffits - MP - 1	SF	81,392.00	45.00	\$3,662,640.00
MP - 1 Panels @ Trellis	SF	6,086.00	55.00	\$334,730.00
Waterproofing at Metal Panels	SF	59,568.00	3.50	\$208,488.00
Masonry at Louvers adj. to Green Roof	SF	784.00	15.50	\$12,152.00
Masonry at Parapets	SF	3,757.00	15.50	\$58,233.50

Total: \$4,276,243.50

Light Gauge Metal Framing

Stud Framing at Metal Panels	SF	34,161.00	12.00	\$409,932.00
Stud Framing at Metal Panels - Reduced Scope	SF	25,046.00	8.00	\$200,368.00
Sub-Framing for Terra Cotta Panel	SF	28,271.00	16.50	\$466,471.50

Total: \$1,076,771.50

Louvers

Architectural Louvers - Building Façade	SF	0.00	50.00	\$0.00
Architectural Louvers - Green Roof	SF	0.00	12.50	\$0.00
Mechanical Louvers - OA Intake	SF	2,464.00	50.00	\$123,200.00

Total: \$123,200.00

Windows

Exterior Windows - Ribbon System	SF	32,194.00	55.00	\$1,770,670.00
Interior Windows (Applied to Double Skin)	SF	12,392.00	45.00	\$557,640.00
Metal Sunscreen	LF	2,295.50	150.00	\$344,325.00
Curtain Wall	SF	1,708.00	85.00	\$145,180.00
Solar Shades	LF	1,584.50	150.00	\$237,675.00
Exterior Windows - 2nd Floor Areas	SF	704.00	55.00	\$38,720.00
Storefront at Plaza	SF	1,400.00	45.00	\$63,000.00
Glass Entrance Doors				
Single	EA	10.00	2,500.00	\$25,000.00
Double	EA	6.00	6,000.00	\$36,000.00
Motor Operator Premium	EA	4.00	3,500.00	\$14,000.00



Remove/Replace Vestibule for Tunnel Tie-in	LS	1.00	45,000.00	\$45,000.00
				Total: \$3,277,210.00
Total	\$15,429,539.82			

VAV Take-Off and Estimate

Room Description	Existing VAV CFM	VAV CFM Capac.	Unit	Crew	Daily Output	Labor Hours	Bare Material	Bare Labor	Total
sp-N-302A-Copy	525	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-302B-Reception	525	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-302-Staff_Admin	525	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-305-IT_Staff_Office	220	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-306A-Conference	310	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-306B-Conference	425	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-307-Storage	85	200	Ea.	Q9	11.00	1.455	\$ 725.00	\$ 67.50	\$ 792.50
sp-N-308A-Seminar_Room	630	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-308B-Seminar_Room	630	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-309-IT_Staff_Office	220	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-310B-Kitchen	255	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-310-CafeCommons	2930	2000-4000	Ea.	Q9	6.00	2.67	\$ 435.00	\$ 124.00	\$ 559.00
sp-N-310C-Copy	510	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-310D-Mail	510	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-310E-Copy	510	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-314-Storage	85	200	Ea.	Q9	11.00	1.455	\$ 725.00	\$ 67.50	\$ 792.50
sp-N-315-Distinguished_Office	490	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-317-Staff_Assistant	660	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-n319-distinguished office	660	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-320-Staff_Assistant	660	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-321-	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$



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Staff_Assistant								755.00	93.00	848.00
sp-N-322-Faculty	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-323-Faculty	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-324-Student	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-325-Student	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-326-Student	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-327-Student	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-328-Student	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-329-Faculty	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-330-Faculty	420	600	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
sp-N-331-Lounge	840	1000	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-332-Faculty	290	400	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
sp-N-333-Faculty	580	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-334-Student	580	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-335-Student	580	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-336-Faculty	580	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-337-Faculty	290	400	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
sp-N-338-Lounge	630	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-339-Faculty	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-340-Faculty	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-341-Student	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-342-Student	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-343-Student	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-344-Student	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-345-Student	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-346-PHD_Office	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-347-PHD_Office	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-348-Staff_Office	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-349-Staff_Office	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	
sp-N-350-Staff_Office	600	800	Ea.	Q9	8.00	2.00	\$	\$	\$	
							755.00	93.00	848.00	



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sp-N-351-Staff_Office	600	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-352-Staff_Office	600	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-353-Staff_Office	600	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-355-Staff_Office	600	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-356-Staff_Office	600	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-J346- Janitor_Closet	600	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-P346-Electrical	600	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-P347-Electrical	600	800	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-N-Q301-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-Q302-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-Q303-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-Q304-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-Q305-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-Q306-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-Q307-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-Q308-Corridor	185	200	Ea.	Q9	11.00	1.455	\$ 725.00	\$ 67.50	\$ 792.50
sp-N-Q310-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-R323-Women	210	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-R324- Unisex_Restroom	210	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-R346-Men	210	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-T347-Telecom	210	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-N-Z301-Stair_N1	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-302A- Staf_Office	320	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-302B- Staff_Office	345	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-302C-Reception	345	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-302D-Copy	210	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-302- Staff_Admin	210	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-305- Grad_Student	480	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-306A- ConferenceLibrary	265	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50



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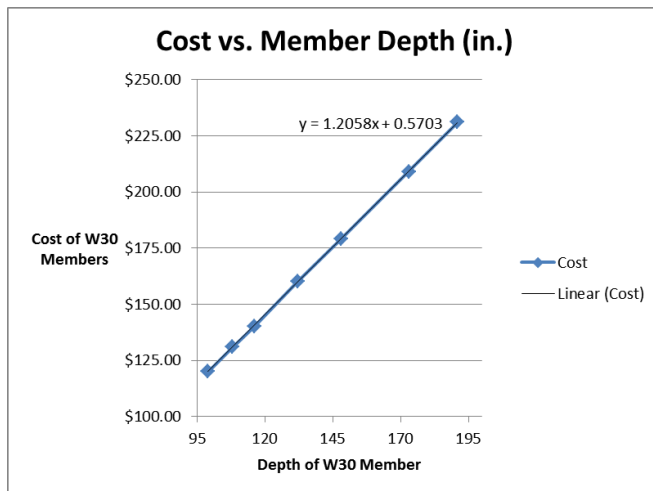
Jon Brangan

sp-W-306B-ConferenceLibrary	315	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-307-KitchenBreak	255	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-308A-Conference	310	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-308B-Conference	425	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-309-Post_Doc_Office	265	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-311-Faculty_Office	820	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-312-Faculty_Office	820	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-313-Faculty_Office	820	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-315-Faculty_Office	820	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-316-Faculty_Office	820	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-317-Faculty_Office	820	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-318-Hershey_MD	820	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-319-Hershey_MD	820	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-320-Senior_Post_Doc	840	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-338-Senior_Post_Doc	840	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-339-Hershey_MD	840	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-340-Faculty_Office	840	1000	Ea.	Q9	8.00	2.00	\$ 755.00	\$ 93.00	\$ 848.00
sp-W-341-Faculty_Office	560	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-342-Faculty_Office	560	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-343-Staff_Assistant	300	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-344-Distinguished_Office	210	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-345-Grad_Student	480	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-346-Storage	85	200	Ea.	Q9	11.00	1.455	\$ 725.00	\$ 67.50	\$ 792.50
sp-W-J337-Janitor_Closet	210	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-J338-Janitor_Closet	210	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-P338-Electrical	340	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-Q301-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-Q302-Corridor	370	600	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-Q303-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50
sp-W-Q304-Corridor	350	400	Ea.	Q9	10.00	1.60	\$ 735.00	\$ 74.50	\$ 809.50



								735.00	74.50	809.50
sp-W-Q305-Corridor	365	600	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
sp-W-Q306-Corridor	370	600	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
sp-W-R321-Women	210	400	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
sp-W-R337-Men	210	400	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
sp-W-T338-Telecom	210	400	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
sp-W-Z301-Stair_W1	350	400	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
sp-W-Z302-Stair_W2	350	400	Ea.	Q9	10.00	1.60	\$	\$	\$	
							735.00	74.50	809.50	
							Total Hours	206.89	Total	\$
										95,585.50
							Total Days	25.8608		
								75		

W30 x 90 Plotted Data



W30	Cost
99	120
108	131
116	140
132	160
148	179
173	209
191	231



Original Truss Take-Off and Estimate

TABLE: Material List 2 - By Section Property EXISTING													
Section	NumPieces	TotalLength	TotalWeight	Length	Unit	Crew	Daily Output	Labor Hours	Total Hours	Bare Material	Bare Labor	Bare Equipment	Bare Total
Text	Unitless	in	Kip	Ft									
W14X109	17	2176.101	19.532	181.34175	L.F.	E2	720	0.078	14.1446565	204.93	4.8	2.67	212.4
W14X120	24	755.114	7.497	62.92616667	L.F.	E2	960	0.058	3.64971767	145	2.44	1.63	149.07
W14X145	39	8974.024	107.609	747.8353333	L.F.	E2	984	0.057	42.626614	247.95	3.51	1.95	253.41
W14X159	24	2070.244	27.261	172.5203333	L.F.	E2	984	0.057	9.833659	271.89	3.51	1.95	277.35
W14X176	24	2070.244	30.217	172.5203333	L.F.	E2	912	0.061	10.5237403	300.15	3.78	2.1	306.03
W14X193	66	14859.651	237.379	1238.30425	L.F.	E2	984	0.057	70.5833423	330.03	3.51	1.95	335.49
W14X211	238	27550.464	480.472	2295.872	L.F.	E2	984	0.057	130.864704	360.81	3.51	1.95	366.27
W14X233	11	677.484	13.063	56.457	L.F.	E2	984	0.057	3.218049	398.43	3.51	1.95	403.89
W14X257	44	3696	78.836	308	L.F.	E2	984	0.057	17.556	439.47	3.51	1.95	444.93
W14X283	287	23457.779	550.046	1954.814917	L.F.	E2	984	0.057	111.42445	483.93	3.2	1.95	489.39
W14X311	4	1224.768	31.528	102.064	L.F.	E2	984	0.057	5.817648	531.81	3.51	1.95	537.27
W14X370	30	3441.853	105.842	286.8210833	L.F.	E2	984	0.057	16.3488018	632.7	3.51	1.95	638.16
W14X398	76	5434.208	179.812	452.8506667	L.F.	E2	984	0.057	25.812488	680.58	3.51	1.95	686.04
W14X426	36	1584	56.151	132	L.F.	E2	984	0.057	7.524	728.46	3.51	1.95	733.92
W14X455	13	1395.779	52.641	116.3149167	L.F.	E2	984	0.057	6.62995025	778.05	3.51	1.95	783.51
W14X550	96	3982	181.771	331.8333333	L.F.	E2	984	0.057	18.9145	940.5	3.51	1.95	945.96
W14X61	2	599.06	2.989	49.92166667	L.F.	E2	740	0.076	2.845535	104.31	3.51	1.95	109.77
W14X90	87	19460.619	143.881	1621.71825	L.F.	E2	984	0.057	123.250587	111	3.58	2.19	116.77
W14X99	13	754.997	6.176	62.91641667	L.F.	E2	984	0.057	3.58623575	169.29	3.51	1.95	174.75
W12X120	2	754.88	7.541	62.90666667	L.F.	E2	960	0.058	3.64858667	145	2.44	1.63	149.07
W30X90	4	1056	7.89	88	L.F.	E2	984	0.057	5.016	109.09	3.58	1.95	114.62
W14X120		809.25	97.11	67.4375	L.F.	E2	960	0.058	3.911375	145	2.44	1.63	149.07
W14X61		269.75	16.455	22.47916667									
Total			1220.8495	22.47916667				Total Hours	637.73064				
								Days	79.7163301				
													Cost
													\$4,112,631.06



Redesigned Truss Take-Off and Estimate

TABLE: Material List 2 - by Section Property REDESIGNED																
Section	NumPieces	TotalLength	TotalWeight	Length	Unit	Crew	Daily Output	Labor Hours	Total Hours	Bare Material	Bare Labor	Bare Equipment	Bare Total	Location	Cost	Issue
Text	Unitless	In	Kip	Ft												
W14x109	8	2813.864	25.257	234.4886667	L.F.	E2	720	0.078	18.290116	204.93	4.8	2.67	212.4	1.029	\$ 51,249.75	2009
W14x120	47	9974.685	99.03	831.22375	L.F.	E2	960	0.058	48.2109775	149.07	2.44	1.63	149.07	1.029	\$ 127,503.93	2011
W14x145	38	5250.737	62.962	437.5614167	L.F.	E2	984	0.057	24.9410008	247.95	3.51	1.95	253.41	1.029	\$ 114,098.03	2009
W14x159	15	2098.588	27.634	174.8823333	L.F.	E2	984	0.057	9.968293	271.89	3.51	1.95	277.35	1.029	\$ 49,910.22	2009
W14x176	4	1388.036	20.26	115.6696667	L.F.	E2	912	0.061	7.05584967	300.15	3.78	2.1	306.03	1.029	\$ 36,424.94	2011
W14x193	94	9746.747	155.702	812.2289167	L.F.	E2	984	0.057	46.2970483	330.03	3.51	1.95	335.49	1.029	\$ 280,397.02	2009
W14x211	266	32106.499	559.928	265.541583	L.F.	E2	984	0.057	152.50587	360.81	3.51	1.95	403.89	1.029	\$ 1,008,389.76	2009
W14x233	22	1359.692	26.218	113.3076667	L.F.	E2	984	0.057	6.458537	398.43	3.51	1.95	403.89	1.029	\$ 47,090.98	2009
W14x257	4	1392.76	29.708	116.0633333	L.F.	E2	984	0.057	6.61561	439.47	3.51	1.95	444.93	1.029	\$ 53,137.62	2009
W14x281	245	17495.571	410.242	1457.96425	L.F.	E2	984	0.057	83.1038623	483.93	3.2	1.95	489.39	1.029	\$ 794,208.77	2009
W14x313	13	1260.856	32.457	105.0713333	L.F.	E2	984	0.057	5.989066	531.81	3.51	1.95	537.27	1.029	\$ 58,088.77	2009
W14x370	32	4119.336	126.676	343.278	L.F.	E2	984	0.057	19.566846	632.7	3.51	1.95	638.16	1.029	\$ 225,419.21	2009
W14x398	65	4752	157.239	396	L.F.	E2	984	0.057	22.572	680.58	3.51	1.95	686.04	1.029	\$ 279,550.32	2009
W14x426	36	1584	56.151	132	L.F.	E2	984	0.057	7.524	728.46	3.51	1.95	733.92	1.029	\$ 99,686.89	2009
W14x550	104	6309	287.994	525.75	L.F.	E2	984	0.057	29.96775	940.5	3.51	1.95	945.96	1.029	\$ 511,761.29	2009
W14x90	146	24992.459	184.78	2082.704917	L.F.	E2	740	0.076	158.28574	111	3.58	2.19	116.77	1.029	\$ 250,250.18	2009
W30X90	4	1056	7.89	88	L.F.	E2	984	0.057	5.016	109.09	3.58	1.95	114.62	1.029	\$ 10,379.07	-
W14x342	2	601.438	17.191	50.11983333	L.F.	E2	984	0.057	2.858305	584.82	3.51	1.95	590.28	1.029	\$ 30,442.69	2009
Total			1143.6595	Tons				Total Hours	655.225331						\$ 3,967,985.69	
Savings			77.19	Tons	Saved!			Days	81.9031664					Savings	\$ 144,645.37	



Original 3rd Floor Lighting Take-Off and Estimate

Type of Luminaire	Quantity	Locations	Description	Lamps	Manufacturer & Series #	RS Means Material Cost	RS Means Labor Cost	Total Cost Per	Total (\$)
NF - 1	55	Typical Open Lab Corridor and endosed Corridors	1 x 4 Ceiling recessed fluorescent downlights	(2) 32W T8 Fluorescent	Ledallite/Voice #8914-D1-CR85T-1232-5	\$ 50.50	\$ 64.00	\$ 114.50	\$ 6,297.50
DC-1A	37	Open Corridors (8' width)	6"x6" square open aperture ceiling recessed fluorescent down lights	42W Triple Tube CFL	Kurt Versen Lighting - #H8643-SW-WT	\$ 65.00	\$ 50.50	\$ 115.50	\$ 4,273.50
NF - 1B	51	Typical Open Lab Corridor and endosed Corridors	1 x 4 Ceiling recessed fluorescent downlights	(2) 32W T8 Fluorescent	Ledallite/Voice #8914-D1-CR85T-1232-5	\$ 50.50	\$ 64.00	\$ 114.50	\$ 5,839.50
NF-5	6	Ground floor lobby elevator front ceiling	Recessed Linear Fluorescent Slot Lights with lens	(2) T8 Fluorescent Staggered	SELUXM100 Staggered/MARIS-278-OD	\$ 68.50	\$ 50.50	\$ 119.00	\$ 714.00
EL-5	1	Throughout	Ceiling Concealed retractable emergency/lighting fixture, in activating, the lamps rotate out and on	(2) 75W Quartz Halogen/GU-10 Bi-pin	Concealite/Chameleon #F5-REM-75-277VAC	\$ 26.50	\$ 15.05	\$ 41.55	\$ 41.55
SDF-6	2	Fire rating treated ceiling in typical elevator lobby	Compact fluorescent down lights with "fire rating ceiling recessed enclosure"	(2) 26W CFL	Lightroller/ Lyncaster Housing #1102T with Fire rated enclosure #16FRX2X10	\$ 110.00	\$ 50.50	\$ 160.50	\$ 321.00
DC-1A	33	Open Corridors (8' width)	6" x 6" square open aperture ceiling recessed fluorescent down lights	42W Triple Tube CFL	Kurt Versen Lighting - #H8643-SW-WT	\$ 59.50	\$ 70.50	\$ 130.00	\$ 4,290.00
DC-1	14	Open Corridors (5' width)	6" x 6" square open aperture ceiling recessed compact fluorescent down lights	32W Triple Tube CFL	Kurt Versen Lighting - #H8643-SW-WT	\$ 65.00	\$ 50.50	\$ 115.50	\$ 1,617.00
NF - 1	53	Typical Open Lab Corridor and endosed Corridors	1 x 4 Ceiling recessed fluorescent downlights	(2) 32W T8 Fluorescent	Ledallite/Voice #8914-D1-CR85T-1232-5	\$ 50.50	\$ 64.00	\$ 114.50	\$ 6,068.50
NF - 1Bd1	42	Typical opened laboratories in building perimeters	1 x 4 Ceiling recessed fluorescent downlights with 10% dimming ballasts	(3) 32W T8 Fluorescent	Ledallite/Voice #8914-D1-CR85T-1232-5	\$ 152.50	\$ 114.00	\$ 266.50	\$ 11,193.00
NF - 1B	72	Typical Open Lab Corridor and endosed Corridors	1 x 4 Ceiling recessed fluorescent downlights	(2) 32W T8 Fluorescent	Ledallite/Voice #8914-D1-CR85T-1232-5	\$ 50.50	\$ 64.00	\$ 114.50	\$ 8,244.00
NF-5	6	Ground floor lobby elevator front ceiling	Recessed Linear Fluorescent Slot Lights with lens	(2) T8 Fluorescent Staggered	SELUXM100 Staggered/MARIS-278-OD	\$ 68.50	\$ 50.50	\$ 119.00	\$ 714.00
SDF-6	2	Fire rating treated ceiling in typical elevator lobby	Compact fluorescent down lights with "fire rating ceiling recessed enclosure"	(2) 26W CFL	Lightroller/ Lyncaster Housing #1102T with Fire rated enclosure #16FRX2X10	\$ 110.00	\$ 50.50	\$ 160.50	\$ 321.00
Total						\$			\$ 49,934.55



Floor- By- Floor Lighting Savings

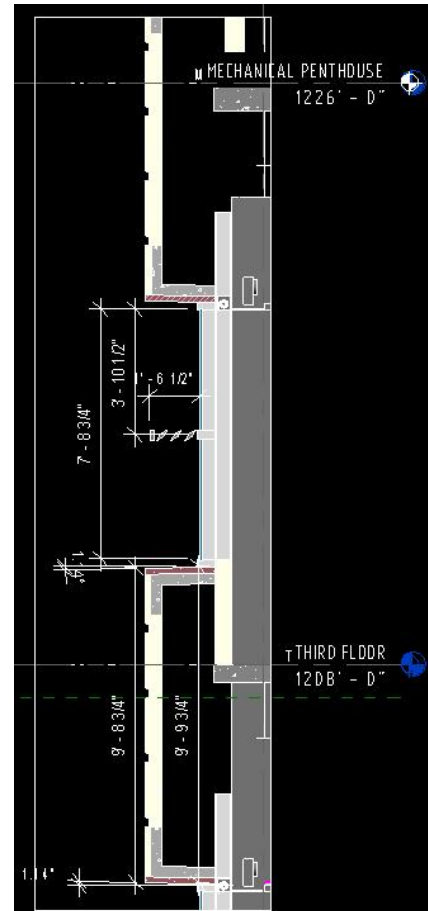
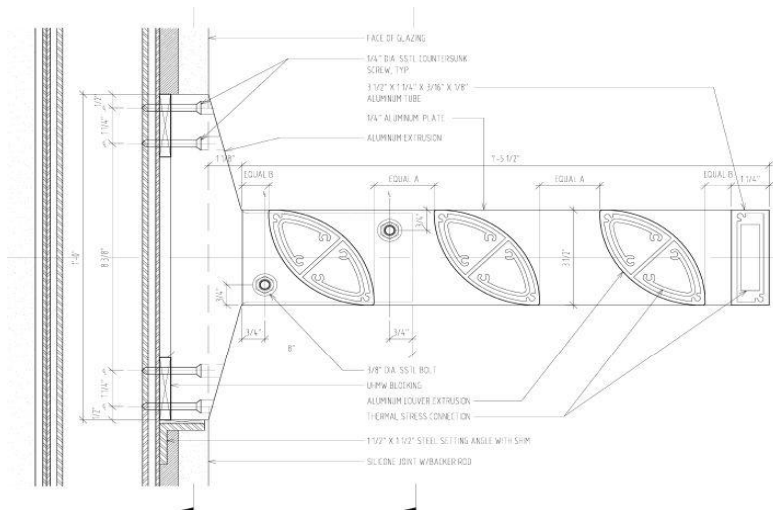
3rd Floor Material Sciences									
	Fixture	Quantity Added	Quantity Removed	RSMeans Mat. Cost	RSMeans Labor Cost	Total Cost Per Unit	Total		
3rd Floor Life Sciences	Corridor								
	NF - 1	0	53	\$ 50.50	\$ 64.00	\$ 114.50	\$ (6,068.50)		
	COR-D	53	0	\$ 31.50	\$ 47.50	\$ 79.00	\$ 4,187.00		
		53	53					Cost	\$ (1,881.50)
	Offices								
	NF - 1B	0	72	\$ 50.50	\$ 64.00	\$ 114.50	\$ (8,244.00)		
	OFF-D	0	0	\$ 1,566.00	\$ 47.50	\$ 1,613.50	\$ -		
		0	72					Cost	\$ (8,244.00)
	Study Areas								
	NF - 1Bd1	0	30	\$ 152.50	\$ 114.00	\$ 266.50	\$ (7,995.00)		
	STD-D	30	0	\$ 133.50	\$ 100.50	\$ 234.00	\$ 7,020.00		
		30	30					Cost	\$ (975.00)
	Conf. Rooms								
	NF - 1Bd1	0	18	\$ 152.50	\$ 114.00	\$ 266.50	\$ (4,797.00)		
	DC-4d1	0	12	\$ 126.00	\$ 103.50	\$ 229.50	\$ (2,754.00)		
	DC-1	0	4	\$ 65.00	\$ 50.50	\$ 115.50	\$ (462.00)		
	CFR-D	14	0	\$ 81.50	\$ 50.50	\$ 132.00	\$ 1,848.00		
	CFR-C	24	0	\$ 31.50	\$ 47.50	\$ 79.00	\$ 1,896.00		
		38	34					Cost	\$ (4,269.00)
3rd Floor Life Sciences	Corridor								
	NF - 1	0	55	\$ 50.50	\$ 64.00	\$ 114.50	\$ (6,297.50)		
	COR-D	55	0	\$ 31.50	\$ 47.50	\$ 79.00	\$ 4,345.00		
		55	55					Cost	\$ (1,952.50)
	Offices								
	NF - 1B	0	51	\$ 50.50	\$ 64.00	\$ 114.50	\$ (5,839.50)		
	OFF-D	0	0	\$ 1,566.00	\$ 47.50	\$ 1,613.50	\$ -		
		0	51					Cost	\$ (5,839.50)
	Study Areas								
	NF - 1Bd1	0	0	\$ 152.50	\$ 114.00	\$ 266.50	\$ -		
	STD-D	0	0	\$ 133.50	\$ 100.50	\$ 234.00	\$ -		
		0	0					Cost	\$ -
	Conf. Rooms								
	NF - 1Bd1	0	18	\$ 152.50	\$ 114.00	\$ 266.50	\$ (4,797.00)		
	DC-4d1	0	12	\$ 126.00	\$ 103.50	\$ 229.50	\$ (2,754.00)		
	DC-1	0	4	\$ 65.00	\$ 50.50	\$ 115.50	\$ (462.00)		
	CFR-D	14	0	\$ 81.50	\$ 50.50	\$ 132.00	\$ 1,848.00		
	CFR-C	24	0	\$ 31.50	\$ 47.50	\$ 79.00	\$ 1,896.00		
		38	34					Cost	\$ (4,269.00)
				Summary Costs	\$	(27,430.50)			

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Appendix E: Daylighting Results & Information

Existing Louver Detail



Solar Shade Cutsheets



Solar Shading Systems



All AWV solar shade devices are
licensed products of Colt International Ltd.



Architectural Solutions



Introduction

Front Page: Berlaymont, Brussels

Over 236,800 sq. ft. of controllable Colt Shadoglass louvers were installed onto the European Commission Headquarters. These act as a high performance secondary facade. The control system was supplied by Colt and adjusts the position of the blades in response to changing climatic conditions and available daylight.

INTRODUCTION

Excessive solar heat gain and solar glare can be a costly and unwanted hindrance for building owners. In addition, owners require designers to reduce heat gain, with solar shading recommended as a preventative measure unless glass areas are minimized.

AWV solar shading systems offer designers the opportunity for distinctive architectural impact, while reducing solar heat gain.

SOLAR RADIATION & LOUVERS

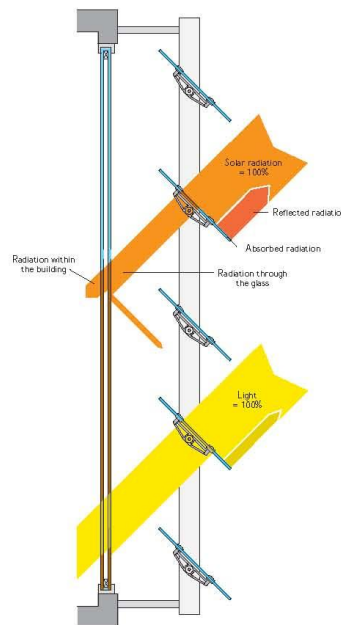
External solar shading is one of the most effective ways to control the internal conditions of a building.

Radiation from the sun is transmitted, absorbed and reflected by the blades. As a result, solar heat gain is prevented from passing into the building, minimizing ventilation requirements and reducing cooling loads. If a controllable system is installed, adjustable blades track the position of the sun, thereby reducing the numbers of days when the building overheats. Equally, in winter the blades may be adjusted in such a way that the building benefits from the heat from the sun, and they can be closed at night reducing heat loss.

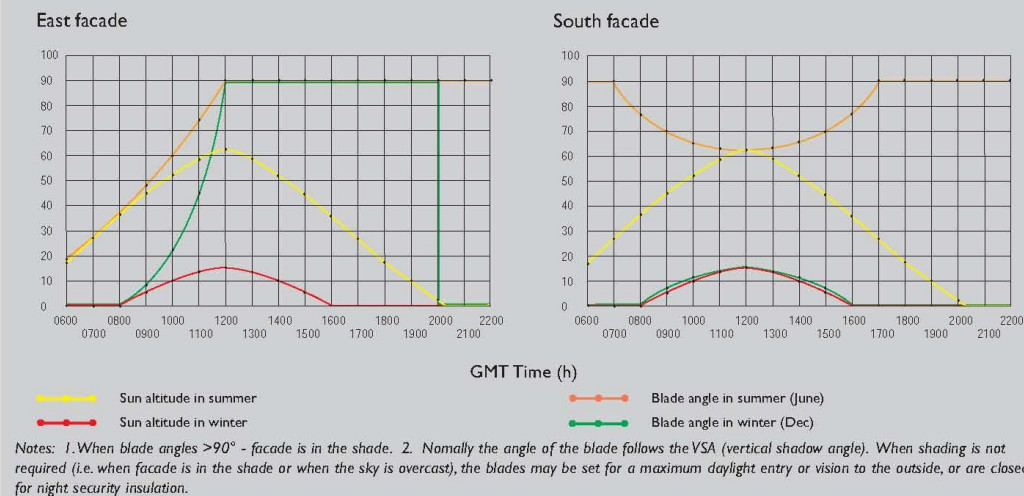
Simultaneously, daylight levels are enhanced, and levels of glare are reduced.

AWV's OFFER

- Calculation of sun angles and heat loads.
- Selection of the most appropriate system from a wide range of options.
- Solar Shading panels are available in various configurations, materials, finishes and coatings to meet the requirements of almost any project.
- Three advanced control options are available, ICS 4-Link for large or medium sized projects, Soltronic for smaller projects, and the innovative Girasol thermohydraulic system, which requires no external energy source.
- All systems are durable and reliable with low maintenance needs.



SUN PATH DIAGRAMS



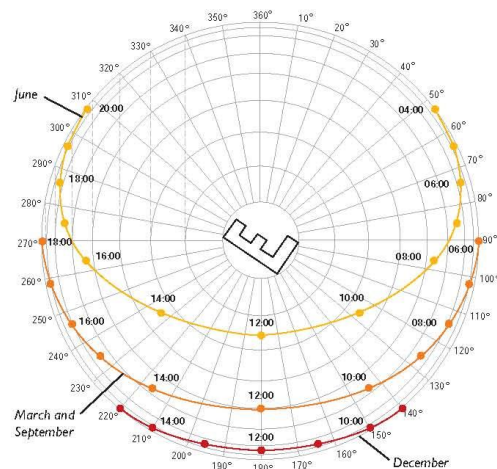
TOTAL CONTROL

Although fixed solar shading performs well on a South facing facade, performance is dramatically reduced on a East or West facing facade which receives a large amount of sunshine during the day.

A controllable shading system can best overcome this problem. Sun tracking blades follow the path of the sun, making sure the solar shading system always optimizes the amount of daylight entry.

On dull or overcast days the blades are controlled in such a way that if clouds pass over the building, the blades will automatically open to maximize daylight entry and then later revert back to their original position.

The Sun path diagram (right) for latitude 52°N shows the position of the sun throughout the day during the months of June, March/September and December.



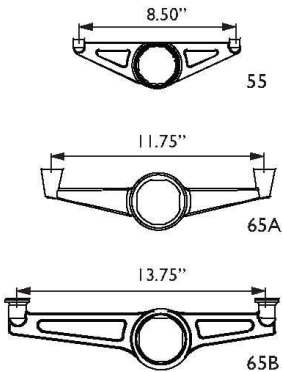
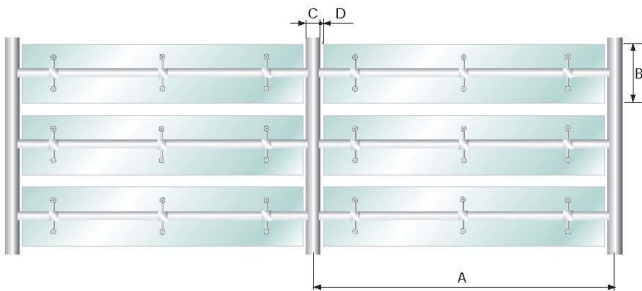
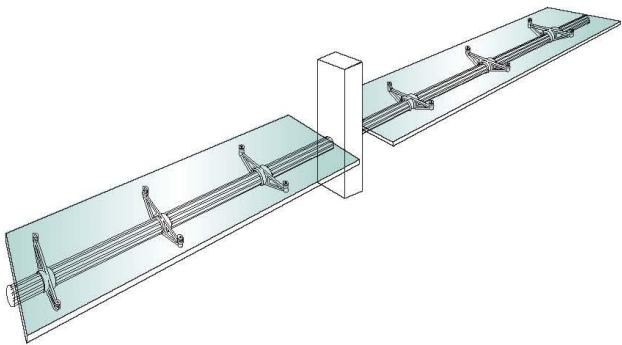
Carrier System I (LSI)

CARRIER SYSTEM I (LSI)

Intended for wider spans, Carrier System I incorporates a central aluminum torsion tube along the length of the blade, and is ideal for continuous facades, as well as for roofs.

For glass, cross sectional blade widths from 11.75" and up to 23.5" are available.

This carrier system is also suited for use with metal, fabric, wood, terracotta clay and translucent acrylic blades.



Glass Parameters Table

Dimensions	LSI - 55	LSI - 65A	LSI - 65B
A in. (max)	97.50	128.75	128.75
B in.	11.75 - 19.50	13.75 - 21.50	16.50 - 23.50
C in.	2.50	2.50	2.50
D in.	.50	.50	.50
Angle of rotation°	0 - 100	0 - 100	0 - 100
Torsion tube Ø in.	2.00	2.50	2.50

Note: Table to be used as a guide only. Allowable dimensions depend upon the specific requirements of the project.

Shadoglass

Shadoglass describes a fixed or controllable external solar shading system that incorporates glass blades. A Shadoglass shading system can reduce solar heat gain, lower air conditioning running costs, and lessen glare while maximizing the use of natural daylight. The glass blades are available in various colors, surface finishes and coatings to meet specific design requirements. This enables the designer to control the quality of light entering the building. Photovoltaic cells may be integrated into the glass so as to obtain further energy benefits.

Features and benefits

- Available as standard in widths of up to 23.50".
- Available in unsupported spans of up to 6.50 ft., supported spans of up to 13.00 ft. (depending on windloads and other criteria).
- Wide range of colors, surface finishes and coatings.
- All principal support components manufactured from corrosion-resistant extruded aluminum alloy with stainless steel fixings.
- Fixed or controllable.
- May permit the integration of photovoltaic cells.



Controls

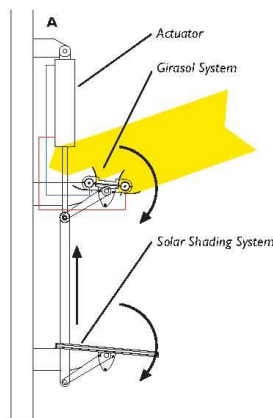
AWV Solar Shading systems may be controlled in three different ways:

- Hand control via lever or crank handle.
- Electrically operated via actuators, which require a controller such as ICS 4-Link, SolTronic or a client BMS.
- Self powered via a thermal hydraulic controller Colt Girasol. This operates autonomously and requires no additional source of power other than the sun.

GIRASOL

Girasol operates solar shading louvers without the need for electrical power or a sophisticated control system.

Absorber tubes, enclosed by mirrors, force a hydraulic cylinder to open or close the blades according to the position of the sun.



Tubes are filled with a special hydraulic fluid and as the sun moves over the building, there will be an imbalance of heat between the two tubes and the blades will open or close as appropriate.

ICS 4-LINK

ICS 4-Link is ideally suited to larger projects with more complex control requirements. It is a generic control system that can operate HVAC, smoke control and solar shading systems.

This product has a wide variety of operating modes, including sun tracking, daylighting optimization and PV illumination. It responds to timers and sensors to ensure that the building 'reacts' appropriately to the sun's position and to the weather.

Remote operation is available via an internal modem interface and a manual override is also possible.

SOLTRONIC

SolTronic is ideally suited for small to medium sized projects. It is a simplified version of ICS 4-Link and can control up to ten actuators in any single zone.

This product responds to external weather conditions, automatically calculating the position of the sun, and adjusts the position of the blades accordingly.





COMMISSIONING

Proper commissioning by experts is essential. We recommend that our specialist staff commission and certify the system.

MAINTENANCE & TESTING

AWV solar shading systems require virtually no maintenance.

All components of any system should be serviced at least once a year and tested monthly.

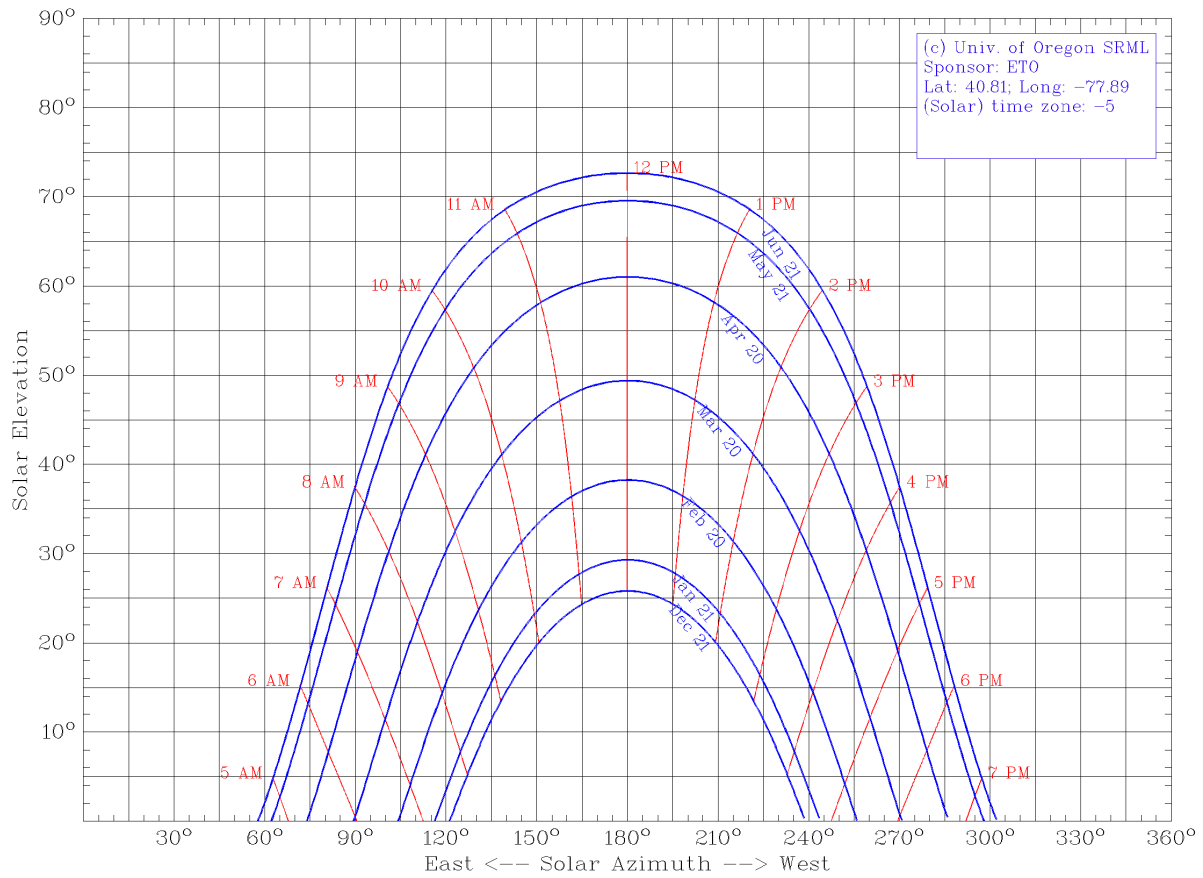


All AWV solar shade devices are licensed products of Colt International Ltd.



American Warming and Ventilating
7301 International Drive
Holland, OH 43528
Tel 419.865.5000
Fax 419.865.1375
www.awv.com





Daylight Integration with Electrical Lighting

Northwest Material Science Façade

Annual Savings kWh:

776.12

System Cost:

0.0

Energy Cost (per kWh):

0.08

Demand Charge (per kWh):

0.0

Peak Demand Time (0-24.0):

0.0

NOTE: All costs must be in the same units.

Savings Per Year:

62.089600000000004

Daysim EconomicAnalysis for Northwest Material Science Student Study Area.

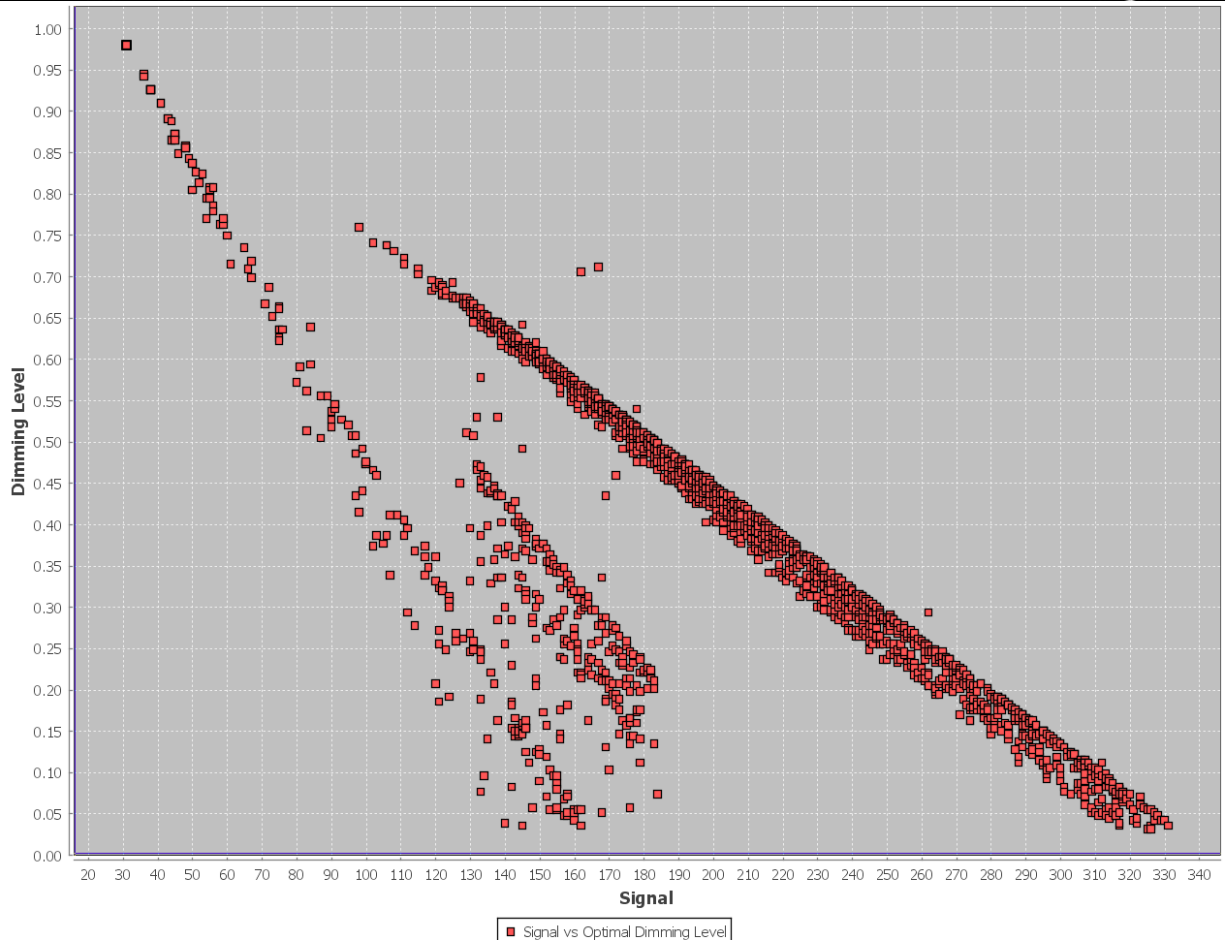
Controlled Zone	Grand Total	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base		152.76	132.84	146.12	132.84	152.76	146.12	146.12	152.76	139.48	152.76	146.12	99.63	1700.35
Optimal		103.06	81.83	77.92	55.8	60.56	51.34	50.25	56.15	69.23	86.09	98.78	67.86	858.92
Algorithm		112.71	90.36	81.25	60.73	65.83	52.45	51.88	62.35	72.94	90.46	105.83	77.35	924.22
Savings		40.04	42.47	64.86	72.1	86.92	93.67	94.23	90.4	66.53	62.29	40.28	22.27	776.12

Daysim Controled Zone Energy Table for Northwest Material Science Student Study Area.

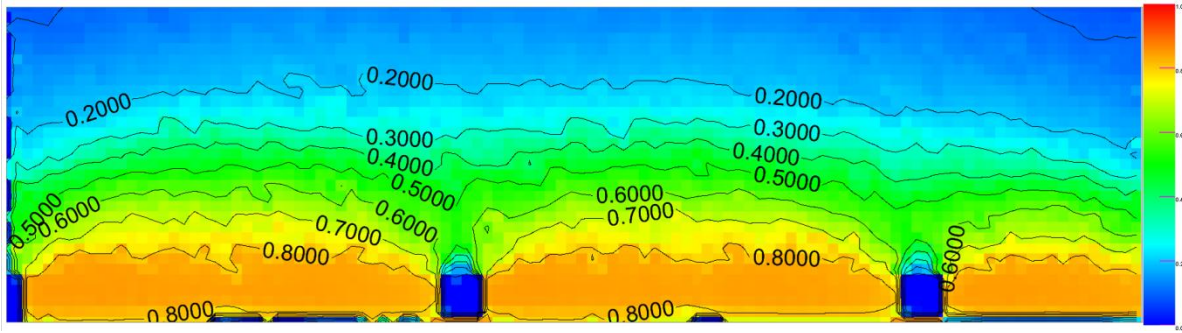
Controlled Zone	Grand Total	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base		229.71	199.75	219.72	199.75	229.71	219.72	219.72	229.71	209.73	229.71	219.72	149.81	2556.82
Optimal		180.01	148.74	151.52	122.71	137.51	124.94	123.85	133.1	139.49	163.04	172.38	118.04	1715.39
Algorithm		189.66	157.27	154.85	127.65	142.78	126.05	125.49	139.3	143.2	167.41	179.44	127.53	1780.69
Savings		40.04	42.47	64.86	72.1	86.92	93.67	94.23	90.4	66.53	62.29	40.28	22.27	776.12

Daysim Controled Zone Energy Table for Northwest Material Science Student Study Area.

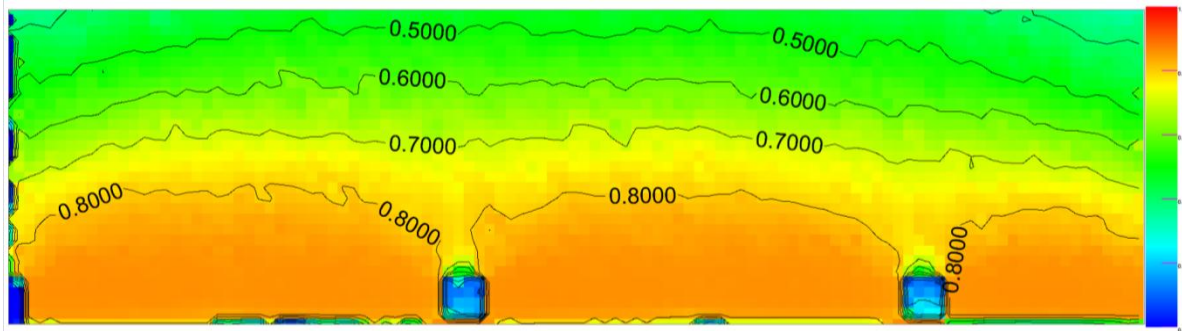




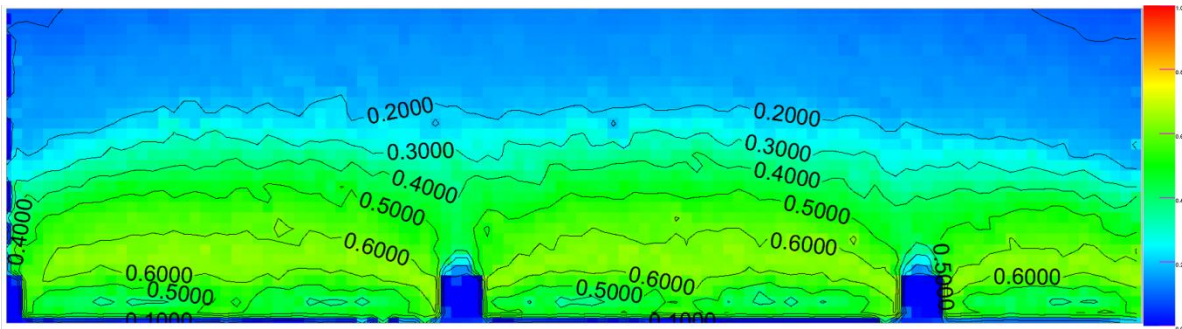
Dimming Level vs. Photosensor Signal for Northwest Facing Material Science Student Study Area.



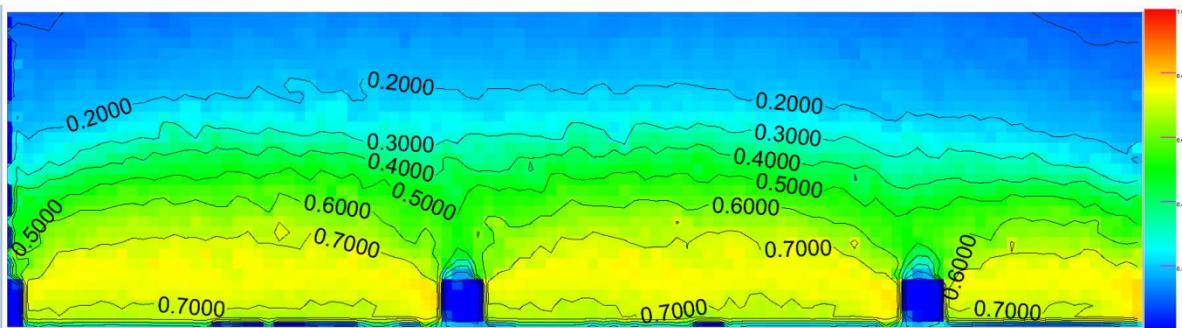
Daylight Autonomy for Northwest Facing Facade (322.8lux).



Continuous Daylight Autonomy for Northwest Facing Material Science Facade (322.8lux).

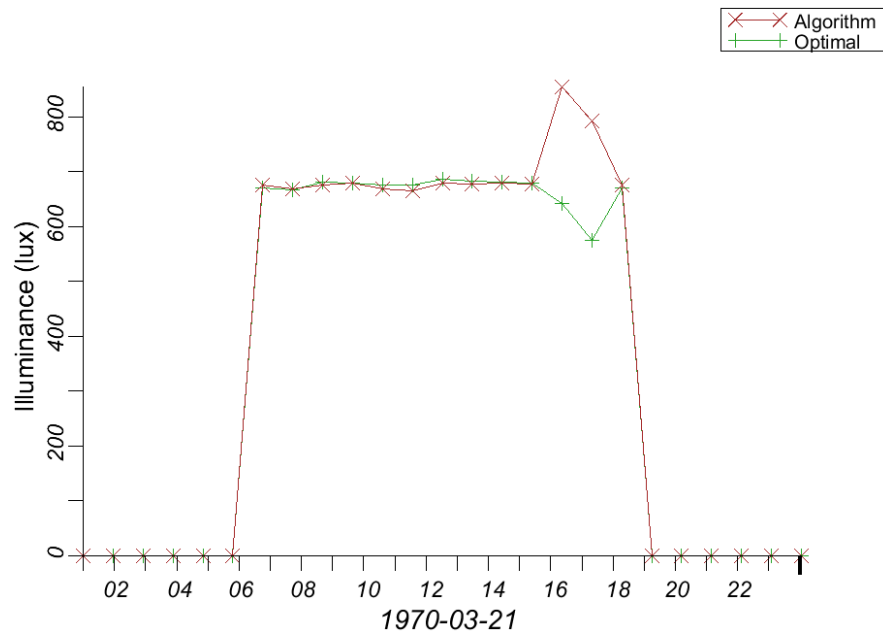


Daylight Illuminance for Northwest Facing Material Science Facade (322.8 to 1000lux).

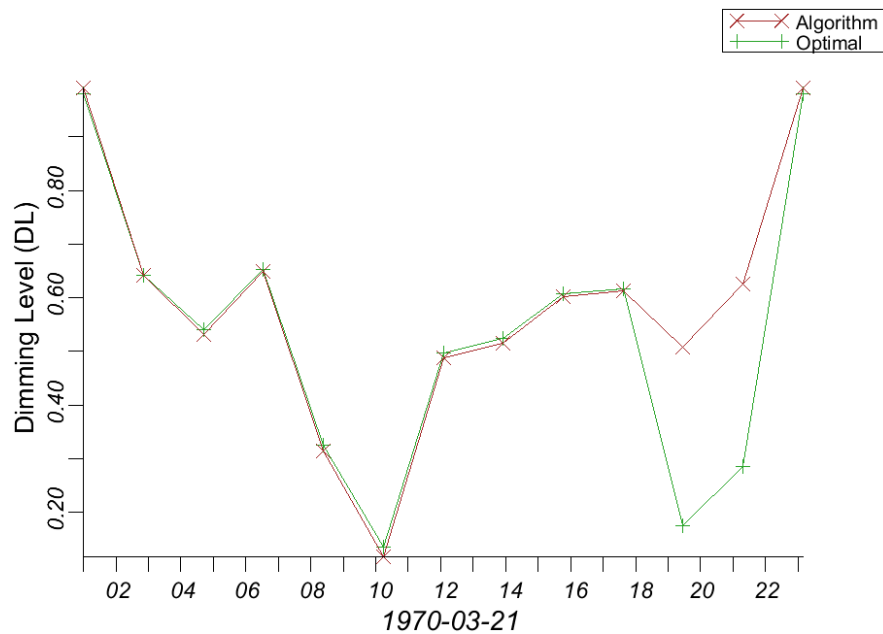


Useful Daylight Illuminance for Northwest Facing Material Science Facade (322.8 to 2000lux).



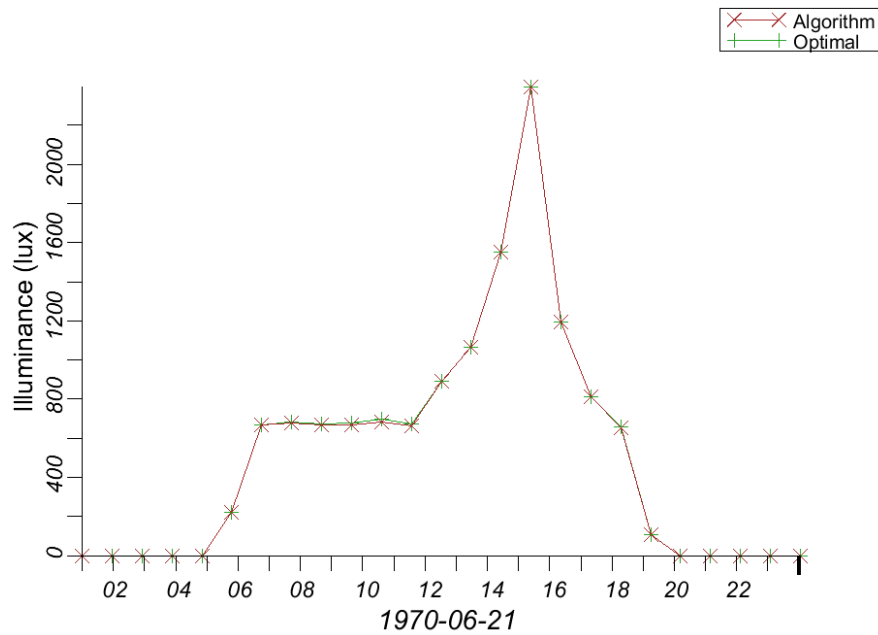


Daysim 'Illuminance Timeplot' for Northwest Material Science Façade (Fall & Spring Equinox).

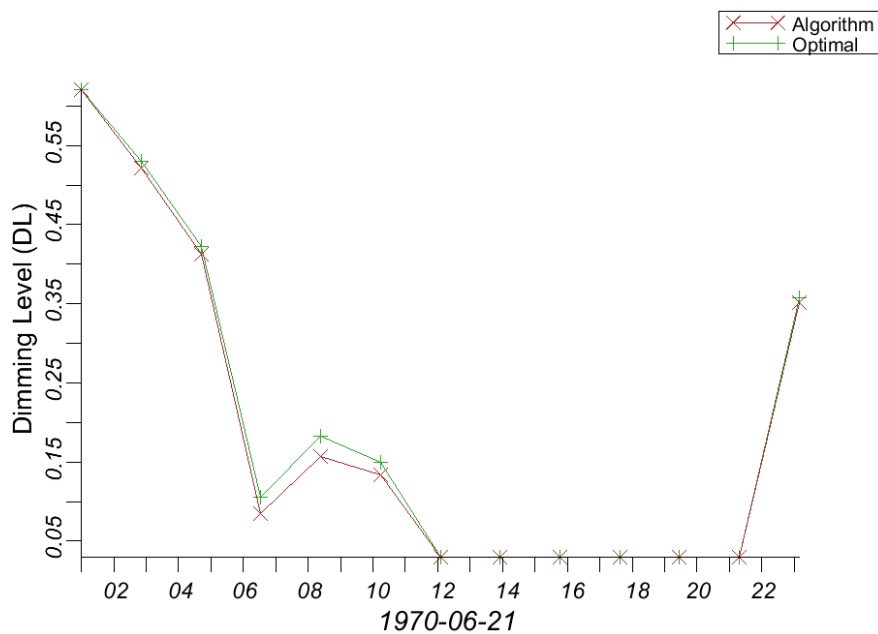


Daysim 'Dimming Timeplot' for Northwest Material Science Façade (Fall & Spring Equinox).

Summer Solstice: 7:00AM through 7:00PM

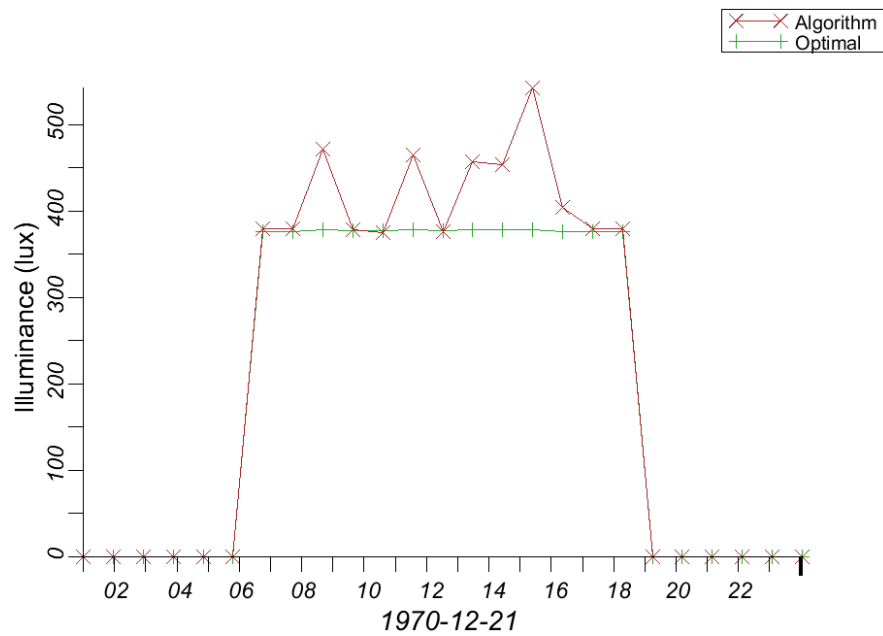


Daysim 'Illuminance Timeplot' Table for Northwest Material Science Façade (Summer Solstice).

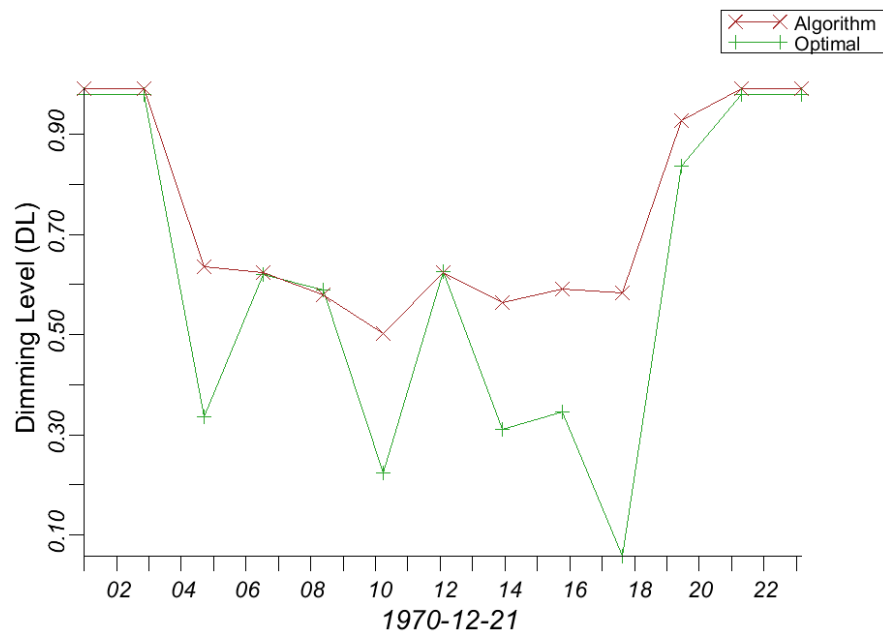


Daysim 'Dimming Timeplot' Table for Northwest Material Science Façade (Summer Solstice).





Daysim 'Illuminance Timeplot' Table for Northwest Material Science Façade (Winter Solstice).



Daysim 'Dimming Timeplot' Table for Northwest Material Science Façade (Winter Solstice).

Northeast Life Science Façade

Annual Savings kWh:

861.05

System Cost:

0.0

Energy Cost (per kWh):

0.08

Demand Charge (per kWh):

0.0

Peak Demand Time (0-24.0):

0.0

NOTE: All costs must be in the same units.

Savings Per Year:

68.884

Daysim Annual Energy Savings for Northeast Facing Life Science Façade Student Study Area.

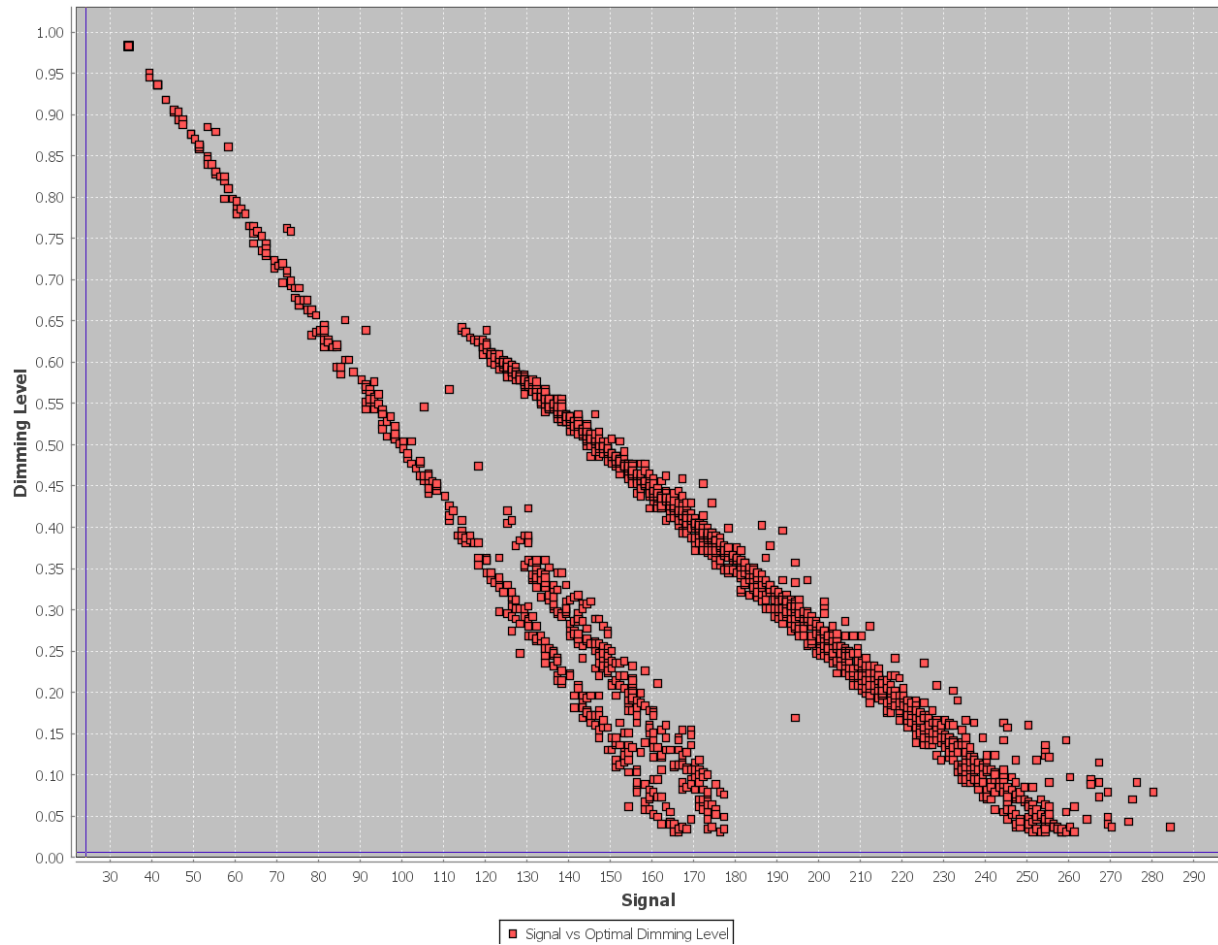
Energy Tables (KWh)													
Controlled Zone	Grand Total												
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	152.76	132.84	146.12	132.84	152.76	146.12	146.12	152.76	139.48	152.76	146.12	99.63	1700.35
Optimal	100.52	79.53	70.73	47.01	44.91	33.23	31.1	44.02	60.6	82.85	97.22	66.7	758.46
Algorithm	110.82	88.81	76.38	52.64	52.29	37.32	35.58	50.16	66.23	88.38	105.14	75.49	839.29
Savings	41.94	44.02	69.74	80.19	100.46	108.79	110.53	102.6	73.25	64.38	40.97	24.13	861.05

Daysim 'Controlled Zone Energy' Table for Northeast Facing Life Science Façade Student Study Area.

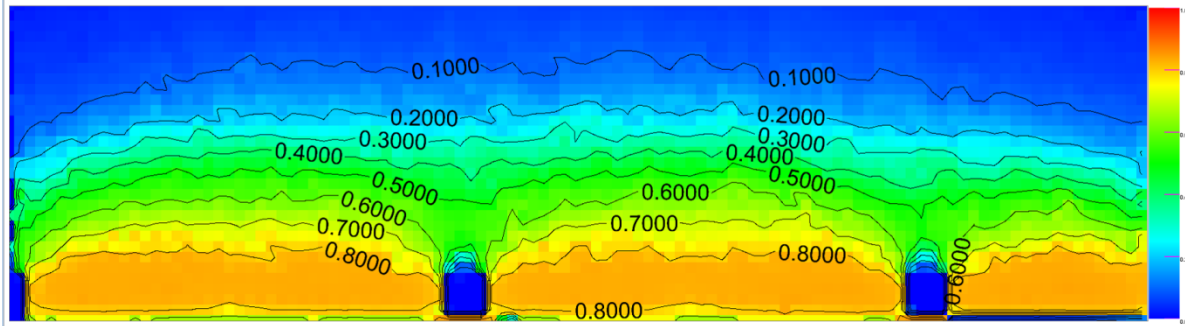
Energy Tables (KWh)													
Controlled Zone	Grand Total												
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	229.71	199.75	219.72	199.75	229.71	219.72	219.72	229.71	209.73	229.71	219.72	149.81	2556.82
Optimal	177.47	146.44	144.33	113.92	121.85	106.83	104.7	120.97	130.86	159.8	170.82	116.88	1614.93
Algorithm	187.77	155.73	149.98	119.55	129.24	110.92	109.18	127.11	136.48	165.32	178.75	125.68	1695.77
Savings	41.94	44.02	69.74	80.19	100.46	108.79	110.53	102.6	73.25	64.38	40.97	24.13	861.05

Daysim 'Controlled Zone & Corridor Energy' Table for Northeast Facing Life Science Façade Student Study Area.

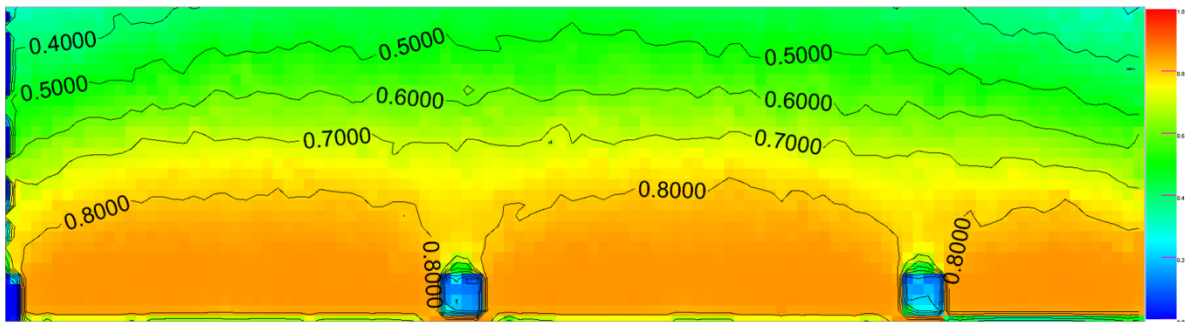




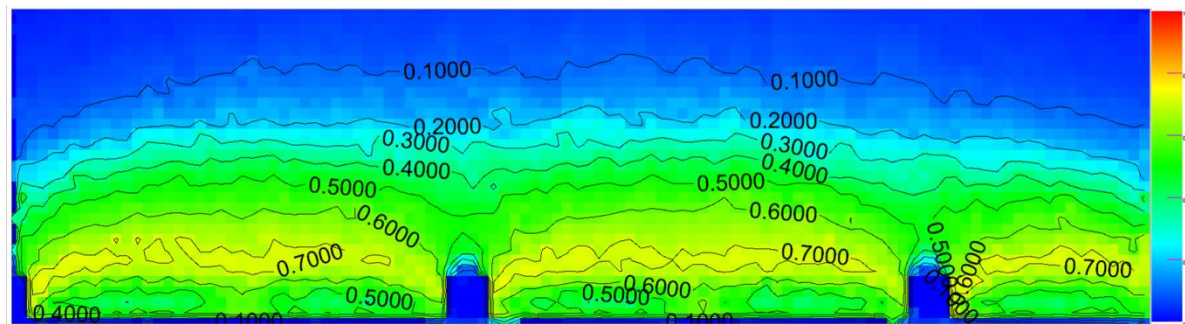
Daysim Photosensor Signal Vs. Dimming Level for Northeast Facing Life Science Student Study Area.



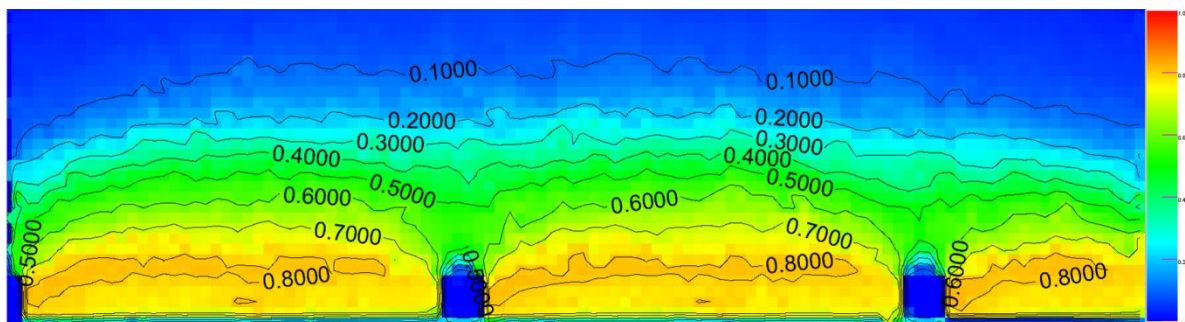
Daylight Autonomy for Northeast Facing Life Science Façade (322.8lux).



Continuous Daylight Autonomy for Northeast Facing Life Science Façade (322.8lux).

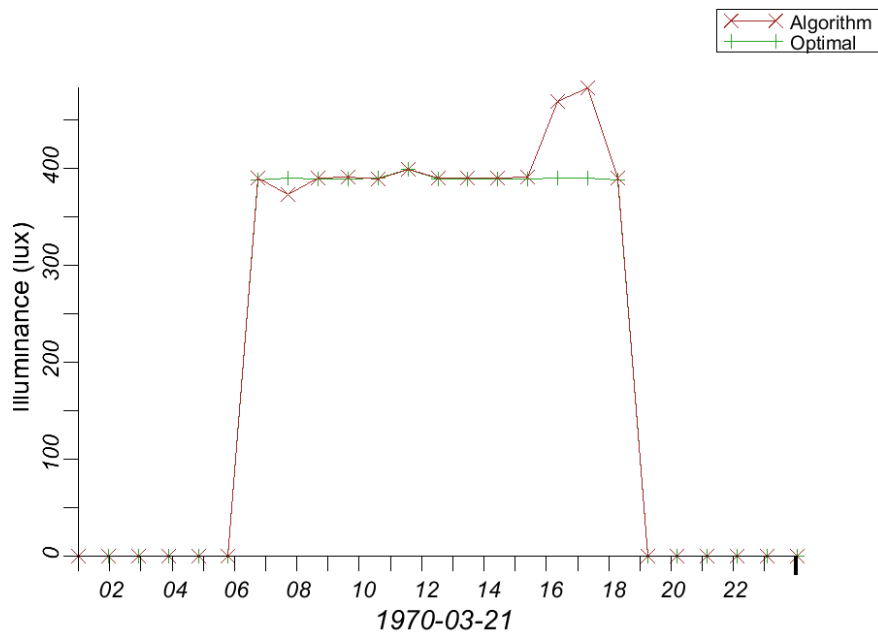


Useful Daylight Illuminance for Northeast Facing Life Science Façade (322.8 to 1000lux).

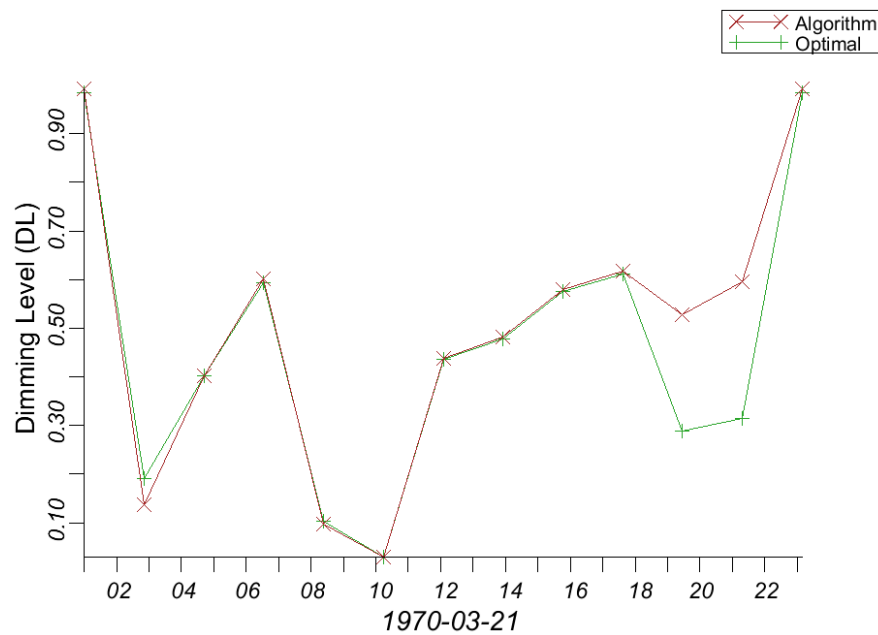


Useful Daylight Illuminance for Northeast Facing Life Science Façade (322.8 to 2000lux).



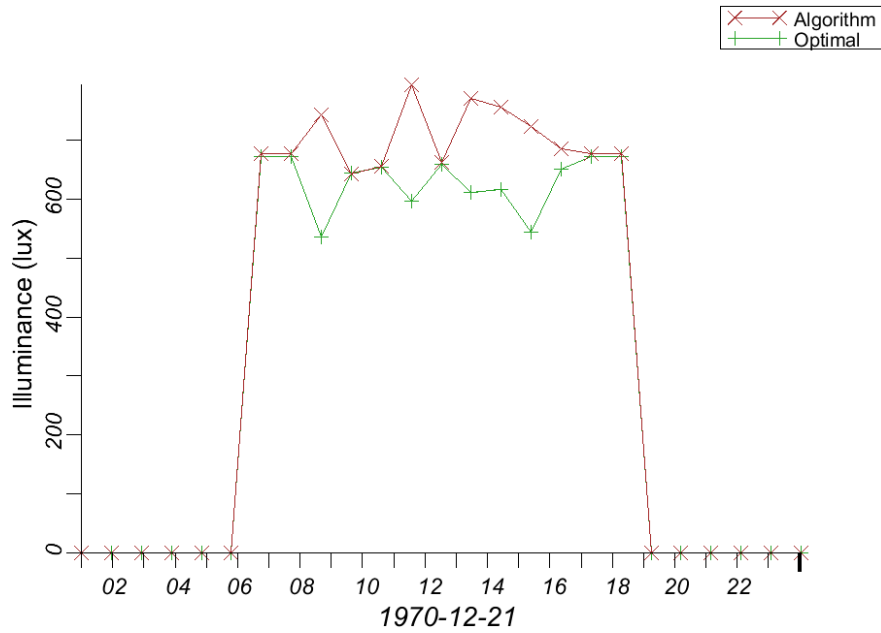


Daysim Illuminance Timeplot for Northeast Life Science Façade (Fall & Spring Equinox).

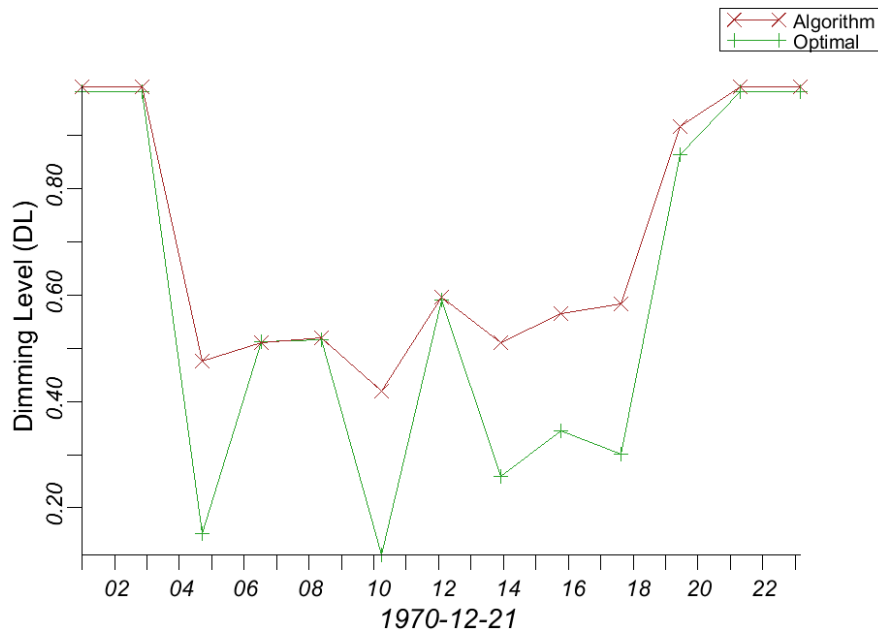


Daysim Dimming Timeplot for Northeast Life Science Façade (Fall & Spring Equinox).

Winter Solstice: 7:00AM through 7:00PM

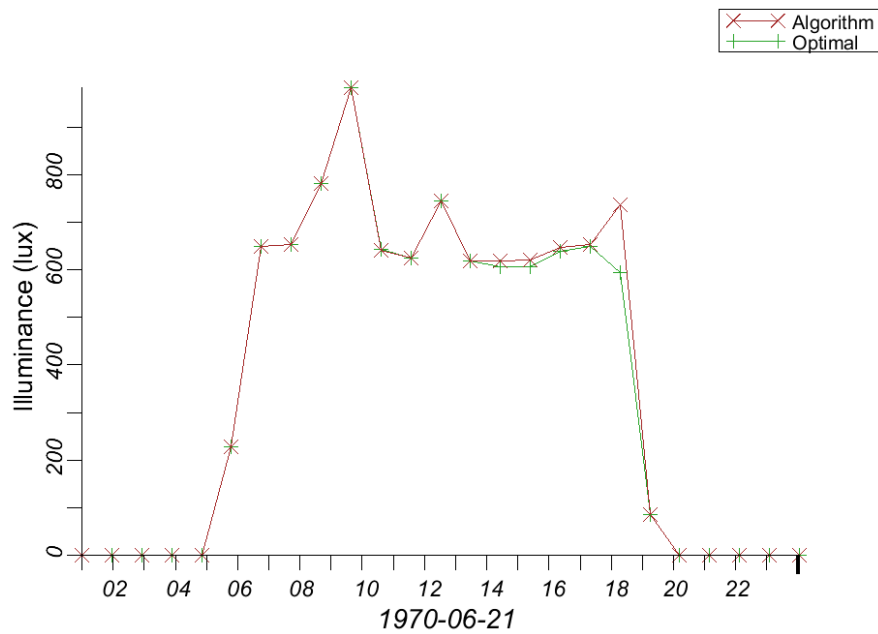


Daysim Illuminance Timeplot for Northeast Life Science Façade (Winter Solstice).

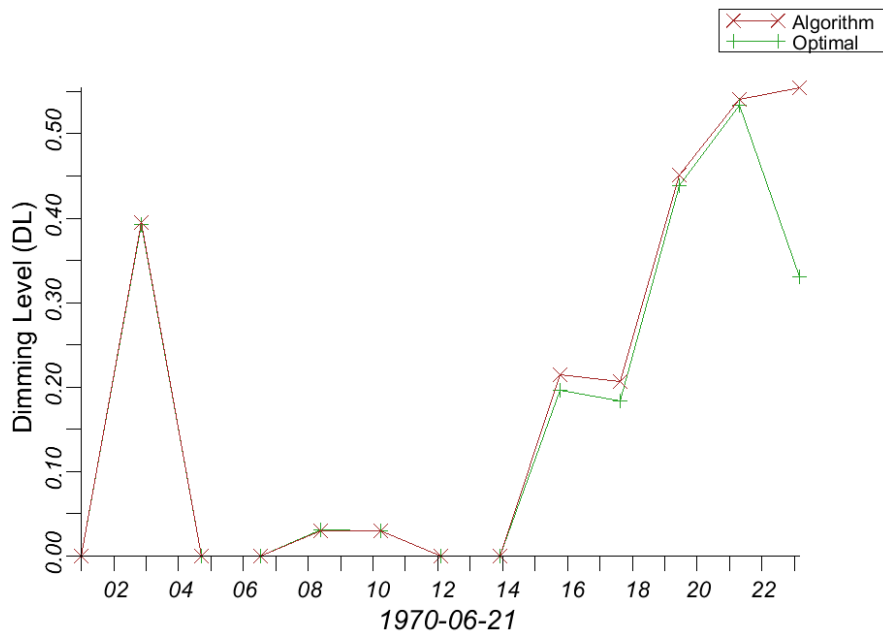


Daysim Dimming Timeplot for Northeast Life Science Façade (Winter Solstice).





Daysim Illuminance Timeplot for Northeast Life Science Façade (Summer Solstice).



Daysim Illuminance Timeplot for Northeast Life Science Façade (Summer Solstice).

Southeast Material Science Façade

Annual Savings kWh:

788.86

System Cost:

0.0

Energy Cost (per kWh):

0.08

Demand Charge (per kWh):

0.0

Peak Demand Time (0-24.0):

0.0

NOTE: All costs must be in the same units.

Savings Per Year:

63.1088

Daysim EconomicAnalysis for Southeast Material Science Student Study Area.

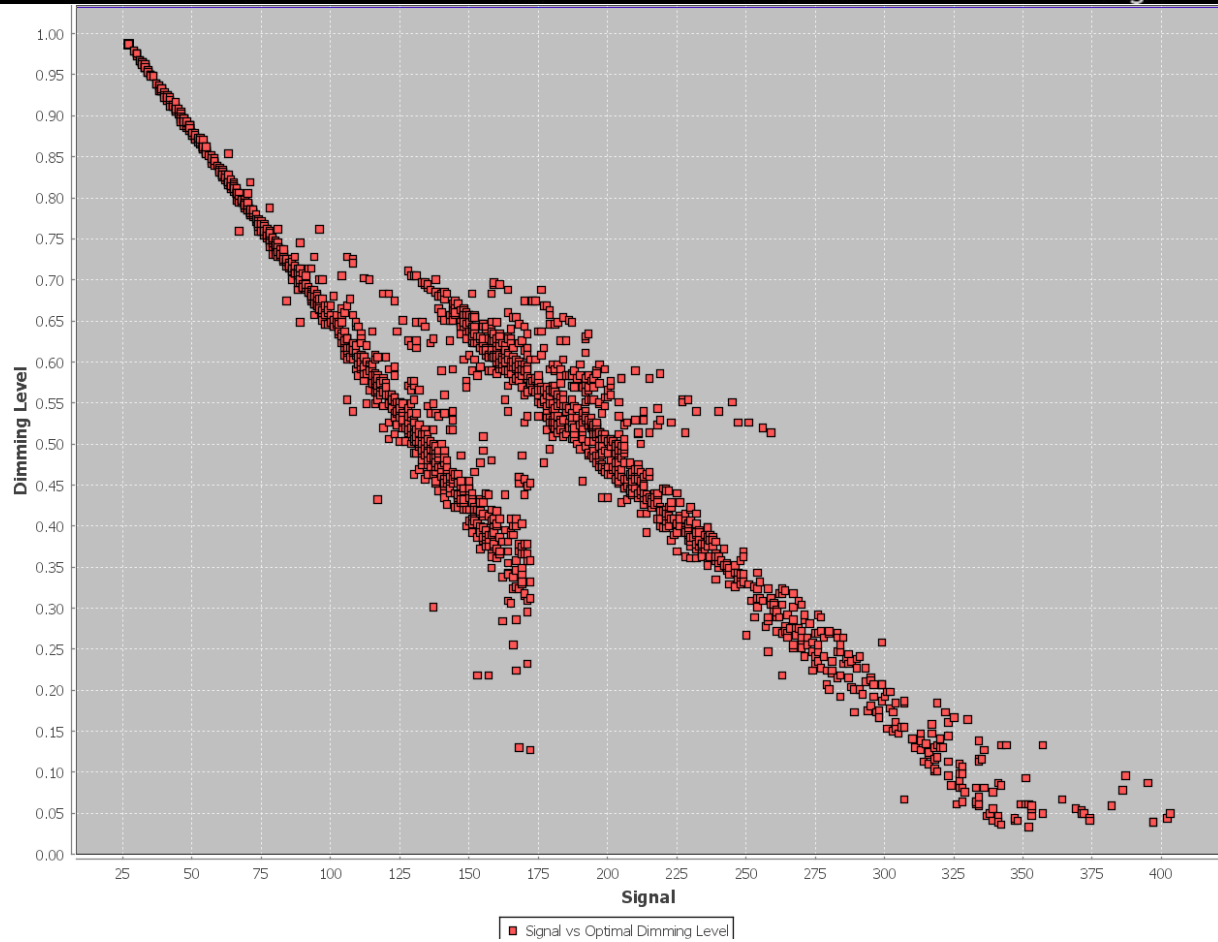
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	152.76	132.84	146.12	132.84	152.76	146.12	146.12	152.76	139.48	152.76	146.12	99.63	1700.35
Optimal	106.61	90.5	75.85	70.82	82.12	65.45	62.13	73.96	70.84	81.91	91.55	71.74	943.53
Algorithm	106.93	90.77	71.45	68.85	79.58	59.01	55.74	70.06	66.74	78.86	91.09	72.36	911.48
Savings	45.83	42.06	74.67	63.98	73.18	87.11	90.37	82.7	72.74	73.9	55.02	27.26	788.86

Daysim Controlled Zone Energy Table for Southeast Material Science Student Study Area.

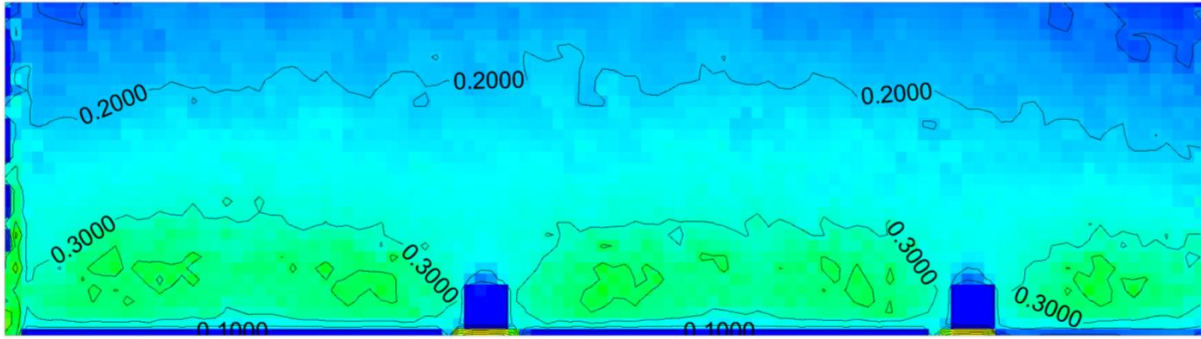
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	229.71	199.75	219.72	199.75	229.71	219.72	219.72	229.71	209.73	229.71	219.72	149.81	2556.82
Optimal	183.56	157.41	149.45	137.73	159.07	139.05	135.74	150.91	141.1	158.86	165.16	121.92	1800.0
Algorithm	183.88	157.68	145.05	135.77	156.53	132.61	129.34	147.01	136.99	155.8	164.69	122.54	1767.95
Savings	45.83	42.06	74.67	63.98	73.18	87.11	90.37	82.7	72.74	73.9	55.02	27.26	788.86

Daysim Controlled Zone Energy Table for Southeast Material Science Student Study Area.

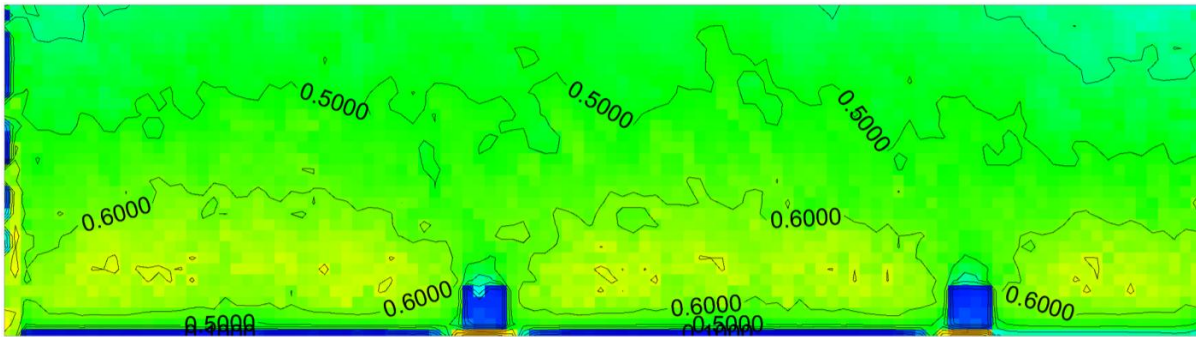




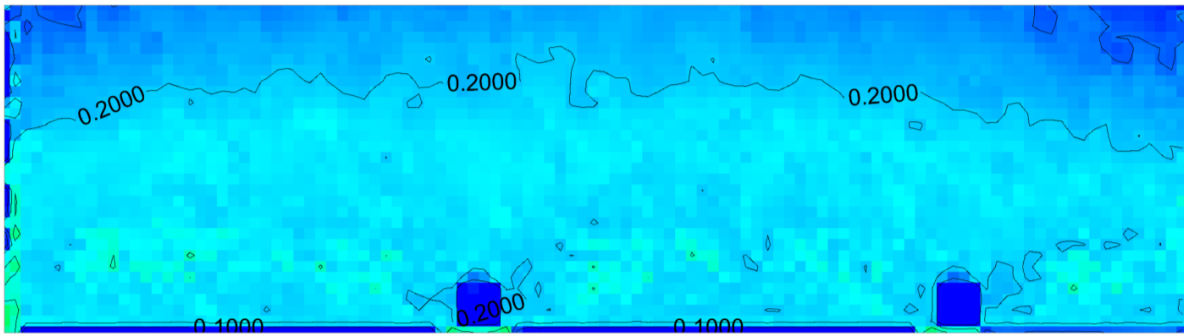
Dimming Level vs. Photosensor Signal for Southeast Facing Material Science Student Study Area.



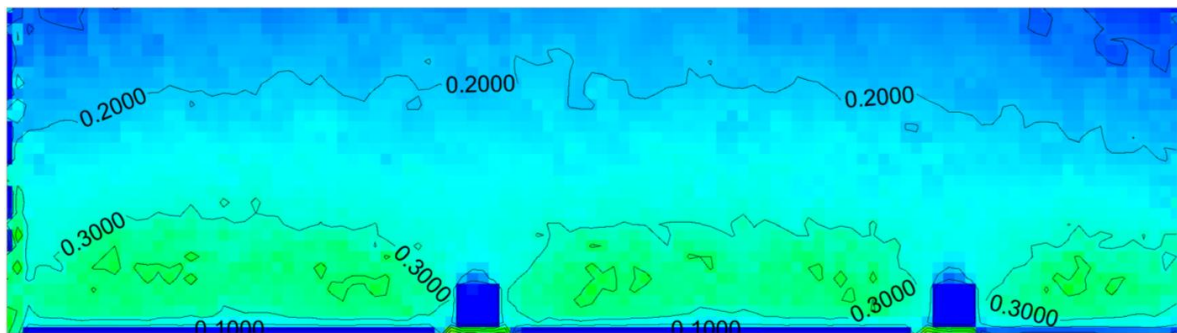
Daylight Autonomy for Southeast Facing Material Science Facade (322.8lux).



Continuous Daylight Autonomy for Southeast Facing Material Science Facade (322.8lux).

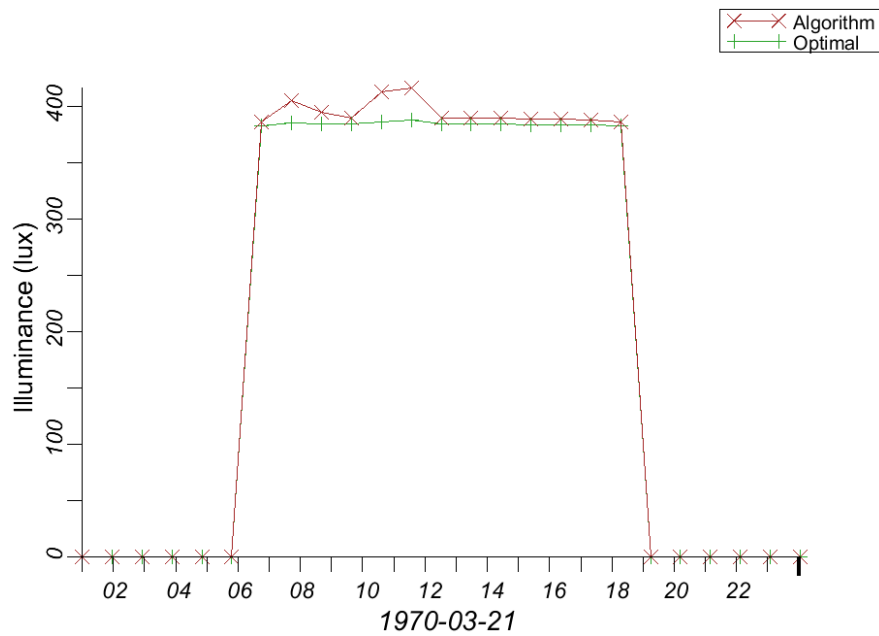


Daylight Illuminance for Southeast Facing Material Science Facade (322.8 to 1000lux).

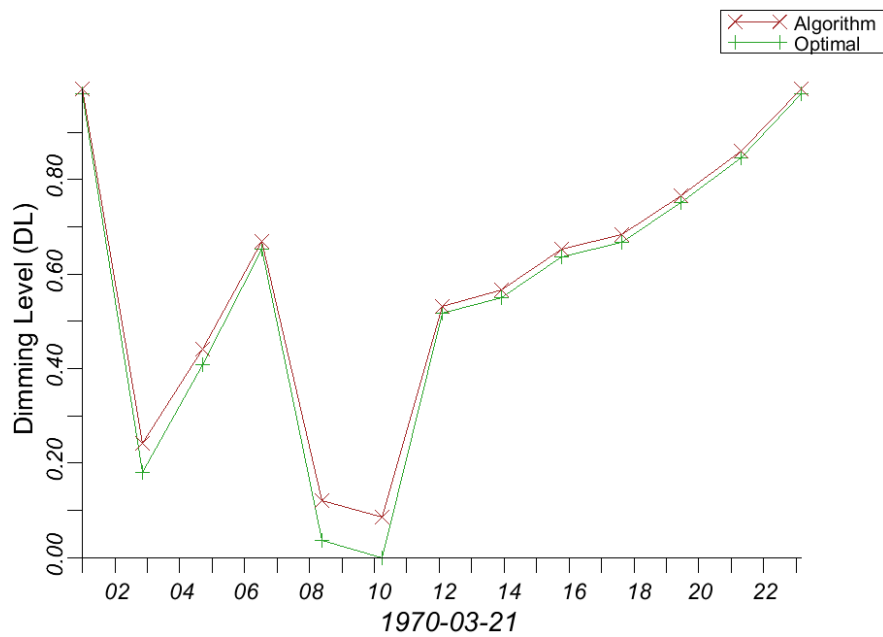


Useful Daylight Illuminance for Southeast Facing Material Science Facade (322.8 to 2000lux).



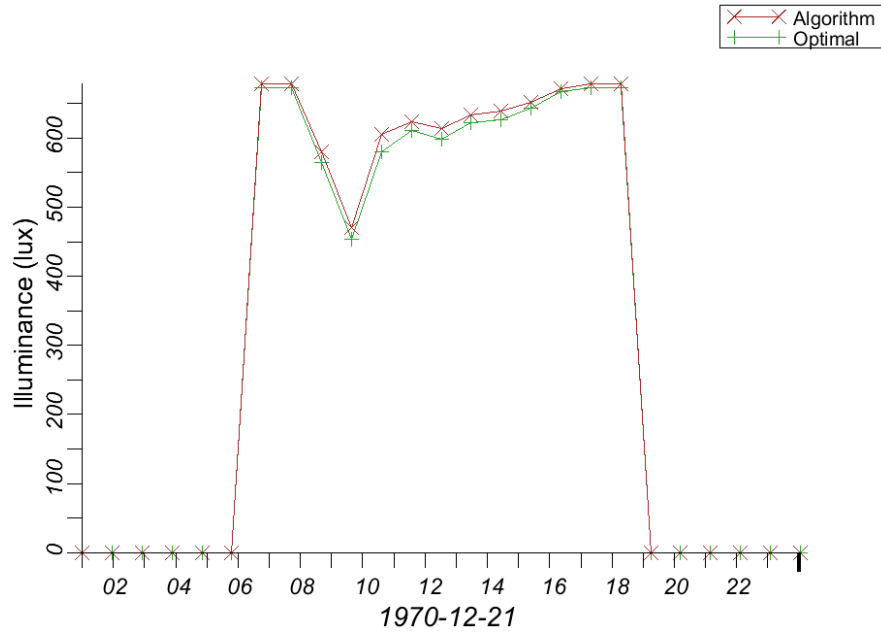


Daysim Illuminance Timeplot for Southeast Material Science Façade (Fall & Spring Equinox).

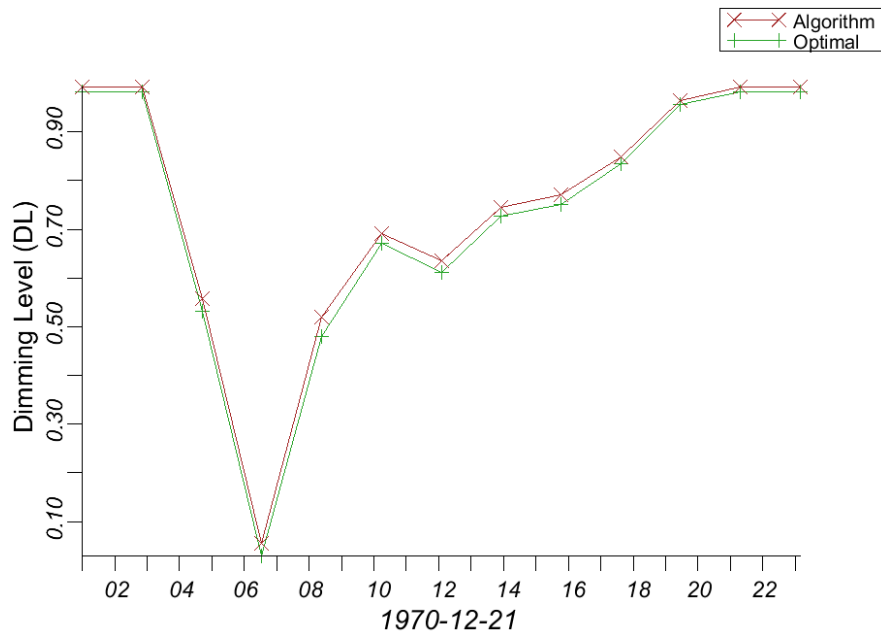


Daysim Dimming Timeplot for Southeast Material Science Façade (Fall & Spring Equinox).

Winter Solstice: 7:00AM through 7:00PM

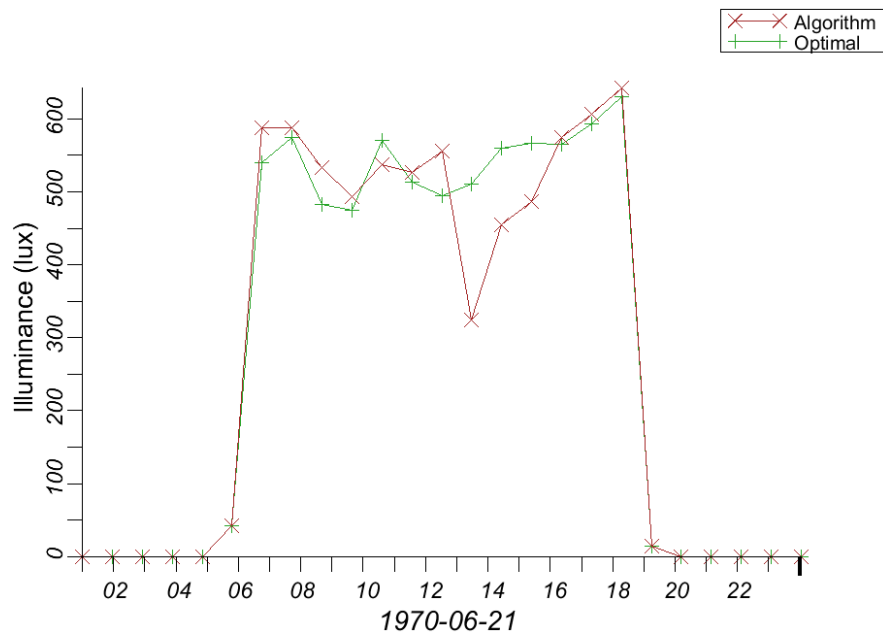


Daysim Illuminance Timeplot for Southeast Material Science Façade (Winter Solstice).

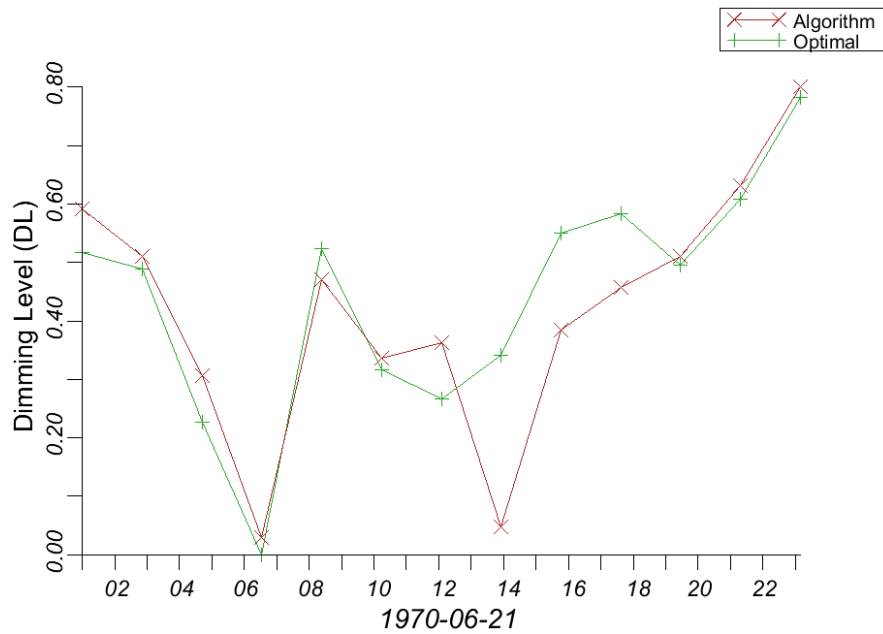


Daysim Dimming Timeplot for Southeast Material Science Façade (Winter Solstice)





Daysim Illuminance Timeplot for Southeast Material Science Façade (Summer Solstice).



Daysim Dimming Timeplot for Southeast Material Science Façade (Summer Solstice).

Southwest Life Science Façade

Annual Savings kWh:

703.35

System Cost:

0.0

Energy Cost (per kWh):

0.08

Demand Charge (per kWh):

0.0

Peak Demand Time (0-24.0):

0.0

NOTE: All costs must be in the same units.

Savings Per Year:

56.268

Daysim Annual Energy Savings for the Southwest Life Science Student Study Area.

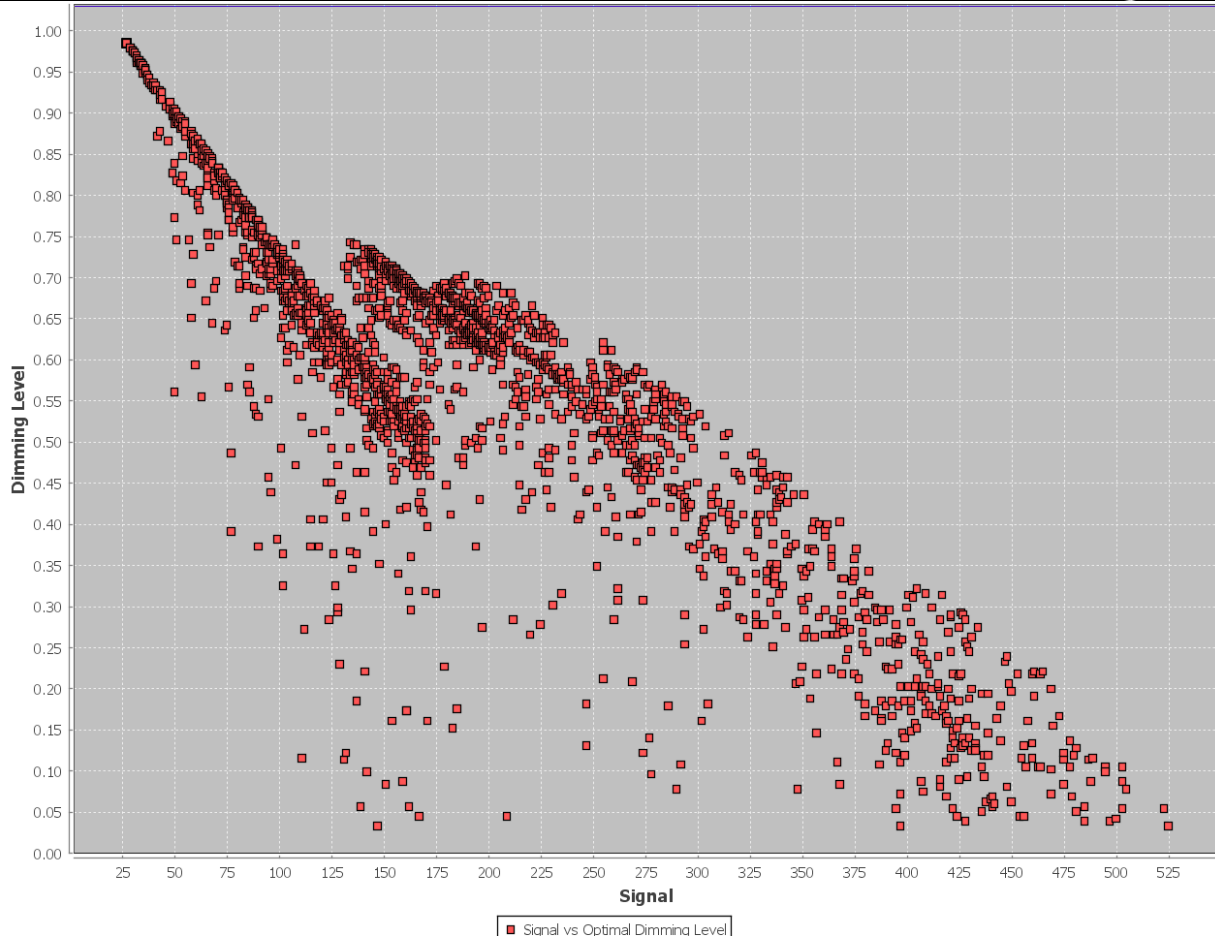
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	152.76	132.84	146.12	132.84	152.76	146.12	146.12	152.76	139.48	152.76	146.12	99.63	1700.35
Optimal	101.74	89.5	73.45	79.16	95.38	76.92	73.47	79.07	71.43	80.89	88.49	72.56	982.12
Algorithm	107.81	95.12	78.33	79.77	93.56	70.01	67.52	76.66	76.21	83.54	92.5	75.9	996.99
Savings	44.94	37.71	67.78	53.06	59.19	76.11	78.59	76.1	63.26	69.22	53.61	23.72	703.35

Daysim Controlled Zone Energy Table for the Southwest Life Science Student Study Area.

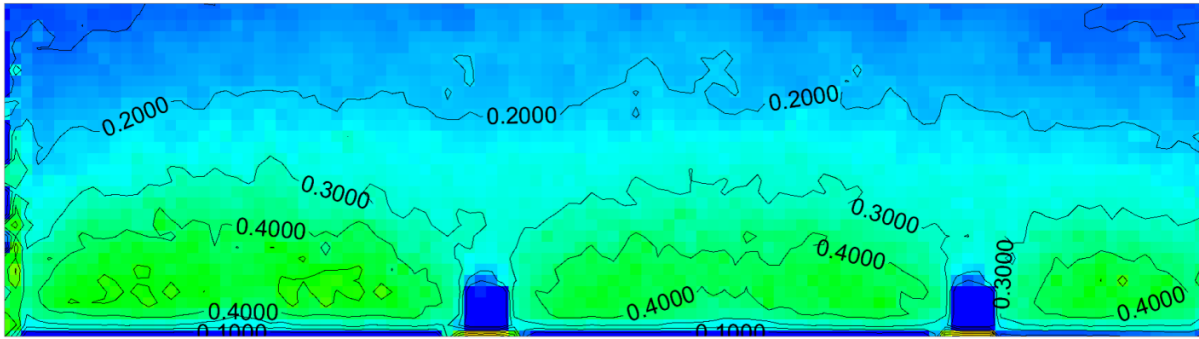
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	229.71	199.75	219.72	199.75	229.71	219.72	219.72	229.71	209.73	229.71	219.72	149.81	2556.82
Optimal	178.69	156.41	147.05	146.07	172.33	150.52	147.07	156.02	141.69	157.84	162.09	122.75	1838.59
Algorithm	184.76	162.03	151.94	146.68	170.51	143.61	141.12	153.61	146.47	160.49	166.1	126.09	1853.46
Savings	44.94	37.71	67.78	53.06	59.19	76.11	78.59	76.1	63.26	69.22	53.61	23.72	703.35

Daysim Controlled Zone & Corridor Energy Table for the Southwest Life Science Student Study Area.

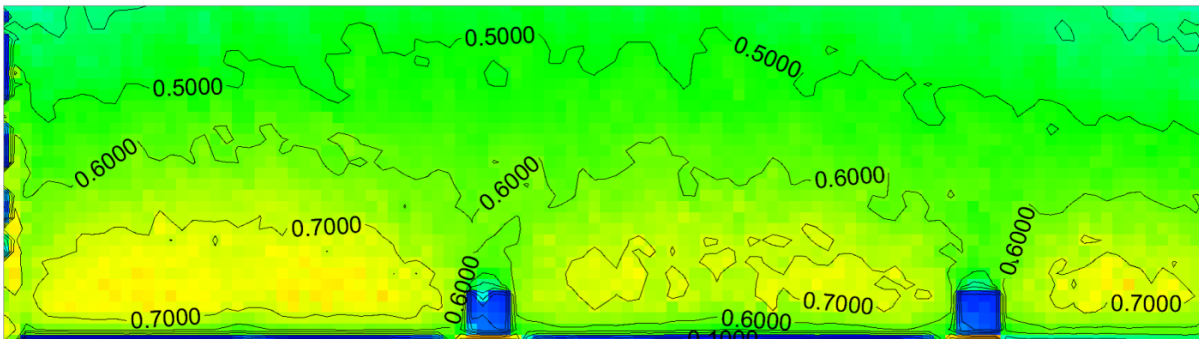




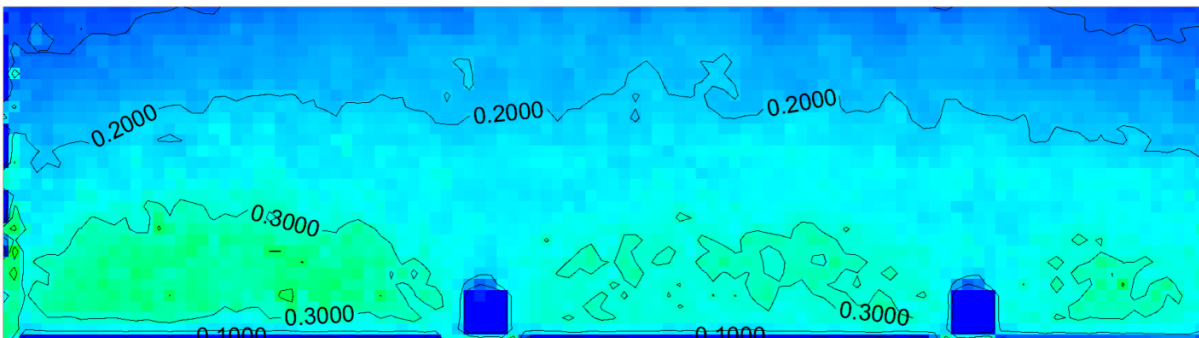
Daysim Photosensor Signal Vs. Dimming Level for the Southwest Life Science Student Study Area.



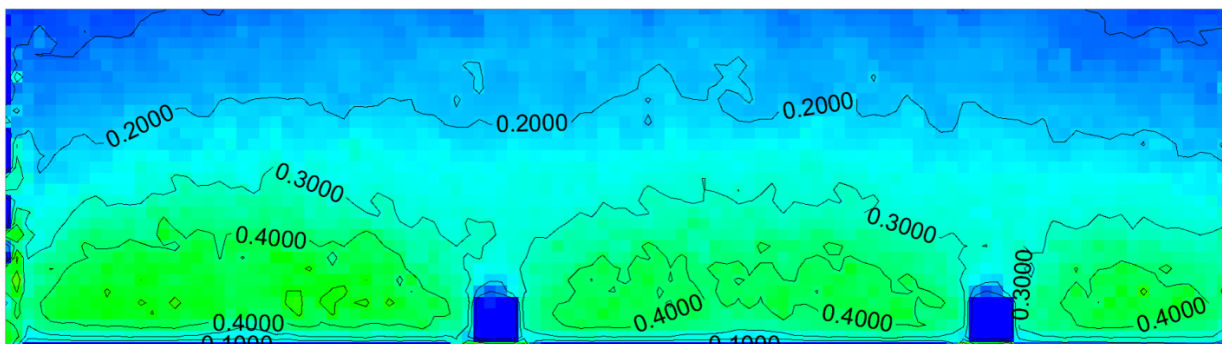
Daylight Autonomy for Southwest Facing Life Science Facade (322.8lux).



Continuous Daylight Autonomy for Southwest Facing Life Science Facade (322.8lux).

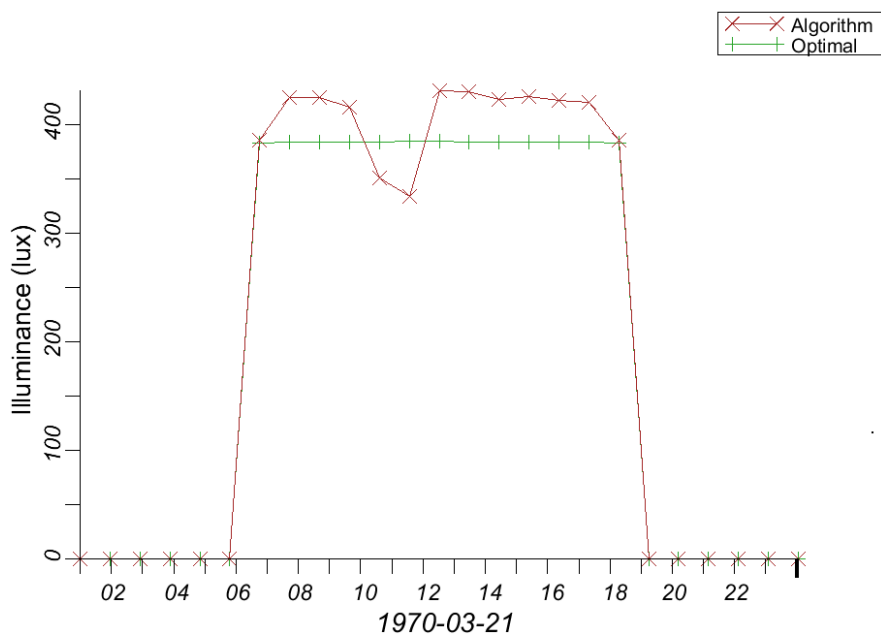


Useful Daylight Illuminance for Southwest Facing Life Science Facade (322.8 to 1000lux).

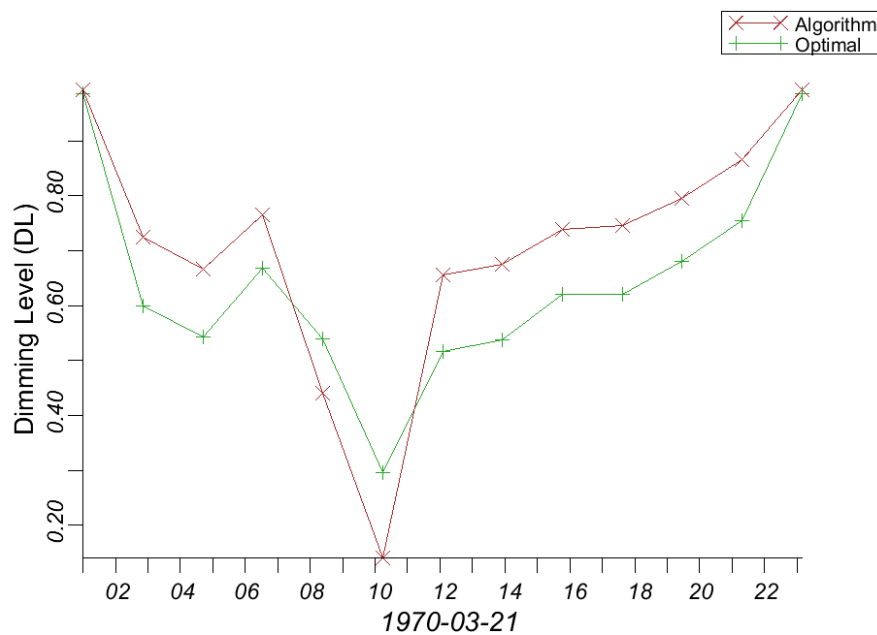


Useful Daylight Illuminance for Southwest Facing Life Science Facade (322.8 to 2000lux).



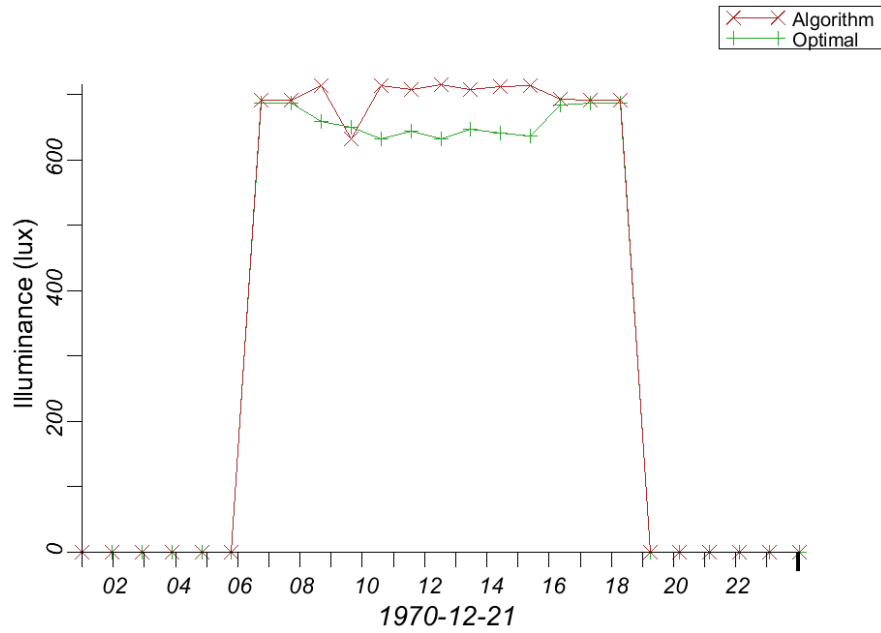


Daysim Illuminance Timeplot for Southwest Life Science Façade (Fall & Spring Equinox).

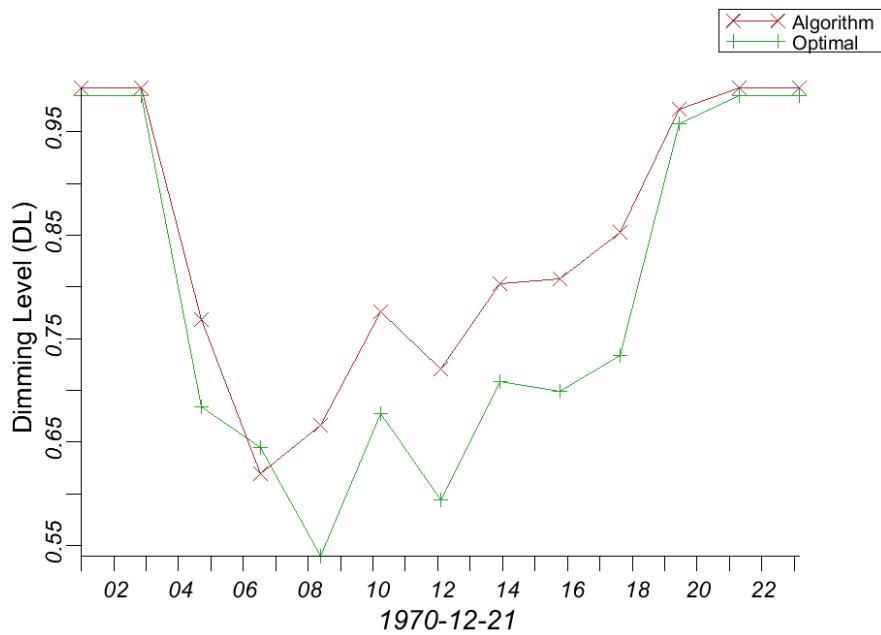


Daysim Dimming Timeplot for Southwest Life Science Façade (Fall & Spring Equinox).

Winter Solstice: 7:00AM through 7:00PM

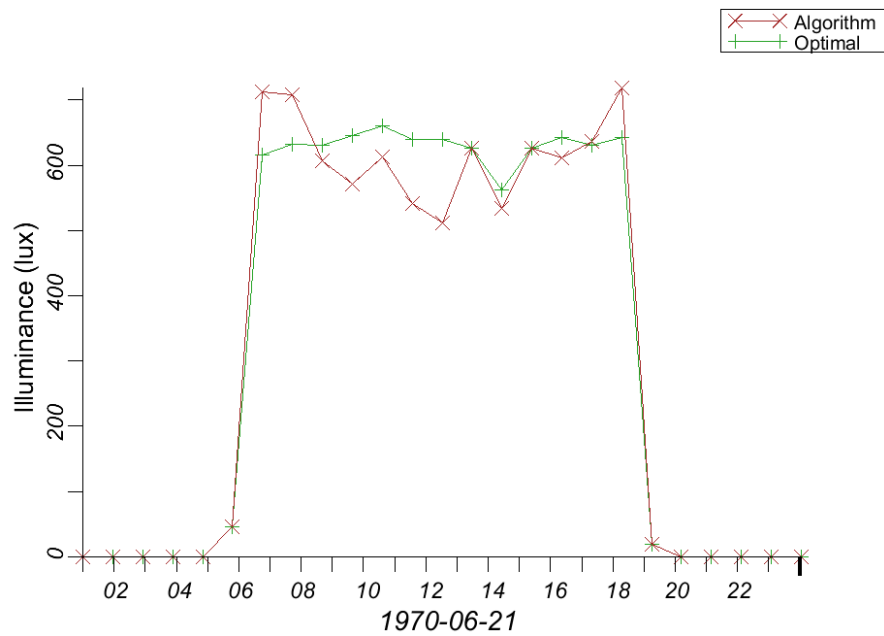


Daysim Illuminance Timeplot for Southwest Life Science Façade (Winter Solstice).

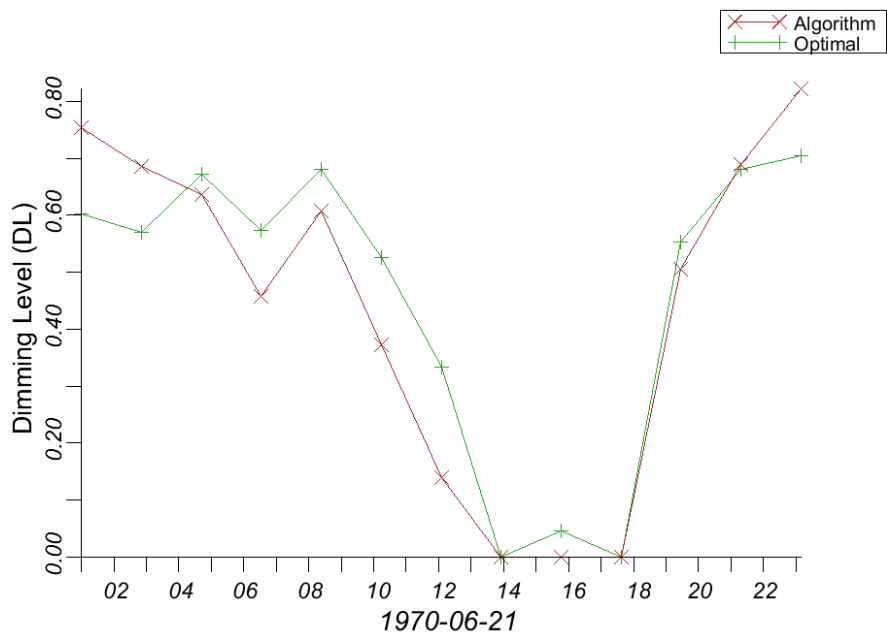


Daysim Dimming Timeplot for Southwest Life Science Façade (Winter Solstice).





Daysim Illuminance Timeplot for Southwest Life Science Façade (Summer Solstice).



Daysim Dimming Timeplot for Southwest Life Science Façade (Summer Solstice).

Appendix F: Comprehensive Luminaire Schedule



Luminaire Scehdule

Type	Image	Manufacturer	Catalog No.	Description	Location	Ballast	Lamp	VA	Input W	PF	BF	LLF	Voltage
CAN-Ua		Elliptipar	M152-210C-V-06-2-V00	Adjustable wall mounted cooper color finish metal halide uplight.	Cantilever Underside Wash	Phillips: AS205WQUADEE	(1) Philips: CDM210/T9/930/U/E	257.78	232.00	0.900	1.00	0.616	277V
CAN-Ub		Elliptipar	M151-070G-X-06-2-V00	Adjustable wall mounted cooper color finish metal halide uplight.	Cantilever Underside Wash	Phillips: 71A5237P	(1) Philips: CDM70/T6/842	94.44	85.00	0.900	1.00	0.575	277V
CAN-R		Cooper: Iris	P406TAT-MH4CMH 39T6E-E4CMHCB-MB	Recessed medium beamlens downlight with 4"x4" square aperature.	Exterior Plaza Entryways and Sidewalks	Phillips: 71A5037BP	(1) Philips: CDM35/T6/842	53.33	48.00	0.900	1.00	0.741	277V
CAN-W		Cooper: Iris	P406TAT-MH4CMH 39T6E-E4LWW-8H-SF-MTP4MB	Recessed Lens Wall Wash Luminaire with 4"x4" aperature.	Exterior Plaza Lobby Entryways	Phillips: 71A5037BP	(1) Philips: CDM35/T6/842	53.33	48.00	0.900	1.00	0.741	277V
CAN-L		Elliptipar	F164-T128-H-07-2-000	2' cantilevered-pole-mounted flourescent wall washing luminaire. Finish to match metal paneling.	Cantilever Octulous	Phillips - Centium: ICN-2S28	(1) Philips: F28T5/841/ALTO	31.86	31.50	0.989	0.99	0.626	277V
XPO-1		Louis Poulsen	Kipp Model 416 with post 4.5-12 Black	PSU Campus standard pole mounted luminaire. 12' post height/	Exterior Pathways	Phillips: 71A5337BP	(1) Philips: CDM 100W/840 Med ED17P CL ALTP+FB	131.11	118.00	0.900	1.00	0.658	277V
CFR-D		Cooper: Iris	P4-E4DLCBH-26TTT	4.5" x 4.5" recessed medium beam downlight luminaire with square opening.	Conference Rooms	Lutron EcoSystem: EC3DT4MWKU1S	(1) Philips: PL-T CFTR32W/GX24q	27.70	27.00	0.975	0.95	0.739	277V
CFR-C		Elliptipar	F306-T155-S-00-1-000	4' cove mounted luminaire with asymmetrical ceiling washing light distribution.	Conference Rooms	Lutron EcoSystem: EC5-T832-G-UNV-317L	(1) Philips: F32T8 ADV835 Alto II	37.86	35.23	0.931	1.17	0.988	277V
OFF-D12		Kuegar	Custom	2'x 12' Custom Integrated chilled beam luminaire.	Typical Private Offices	Philips: ICN-2S28-N	(6) Philips: F21T5 835 Alto 40PK	150.00	147.00	0.980	1.02	0.862	277V
OFF-D8		Kuegar	Custom	2'x 8' Custom Integrated chilled beam luminaire.	Typical Private Offices	Philips: ICN-2S28-N	(4) Philips: F21T5 835 Alto 40PK	100.00	98.00	0.980	1.02	0.862	277V
OFF-D4		Kuegar	Custom	2'x 4' Custom Integrated chilled beam luminaire.	Typical Private Offices	Philips: ICN-2S28-N	(2) Philips: F21T5 835 Alto 40PK	50.00	49.00	0.980	1.02	0.862	277V
STD-D		Lightolier	VPS1G12PR132277SO	1'x4' Recessed Fluorescent, 3" Deep, 12 Cell Parabolic Louvered Lens designed for intensive VDT use.	Student Study Areas	Advance Mark 7: IZT-3S32-SC	(1) Philips: F32T8 ADV835 Alto II	34.16	34.00	0.995	1.00	0.882	277V
COR-D		Lightolier	CFS1GHP132277SO	High Performance Recessed Fluorescent Direct/Indirect 1' x 4' with Perforated Basket.	Corridors	Phillips - Centium: ICN-2P32-SC	(1) Philips: F32T8 ADV835 Alto II	36.01	36.00	1.000	1.05	0.927	277V

Appendix G: Lighting Wiring Diagrams

Third Floor Life Science

See attached full size drawings (E-2.3BL “Exterior Plaza Lighting”) for overall wiring diagrams and lighting layout of corridors, student study areas, offices and areas affected by lighting design in the third floor.

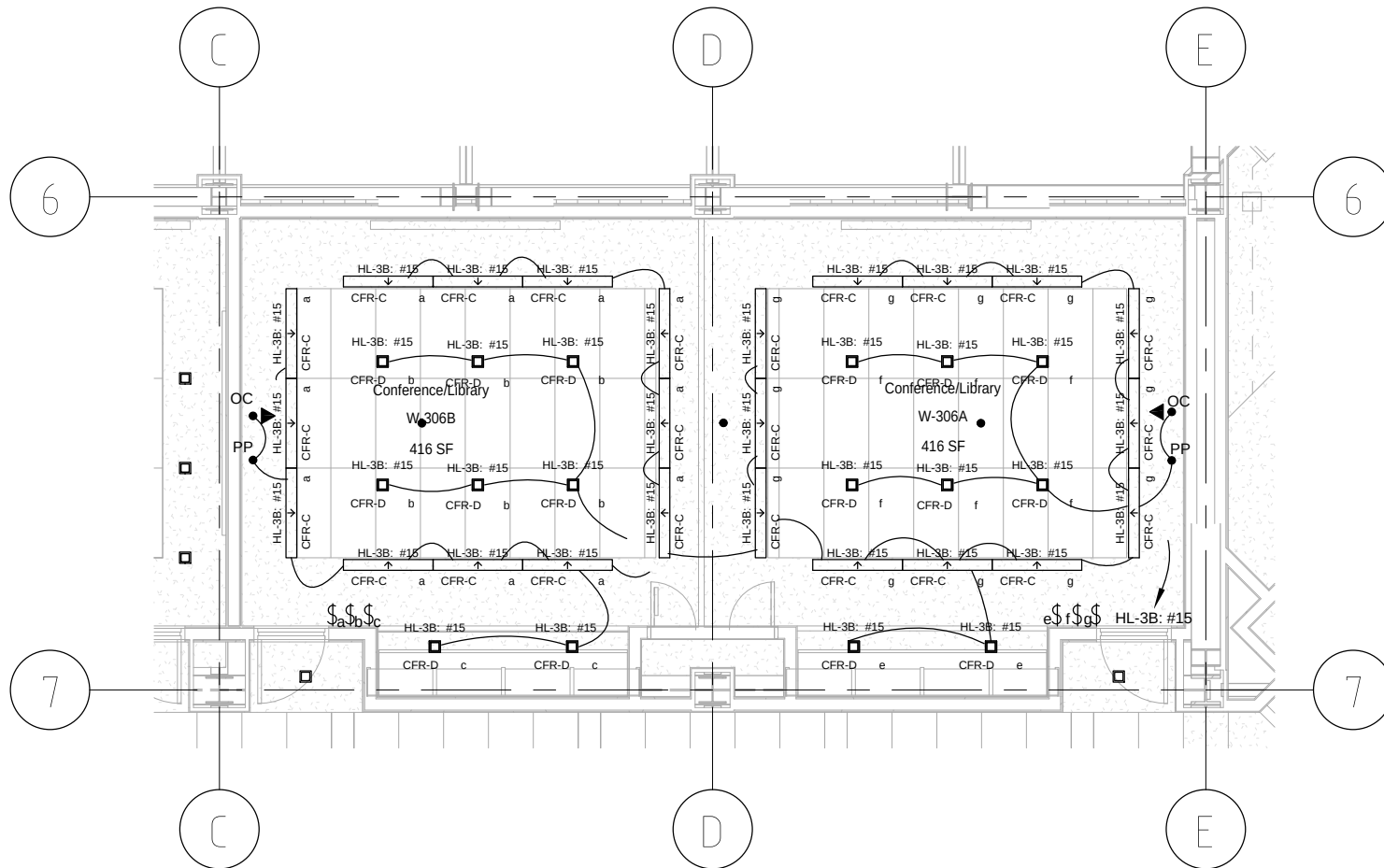
Third Floor Material Science

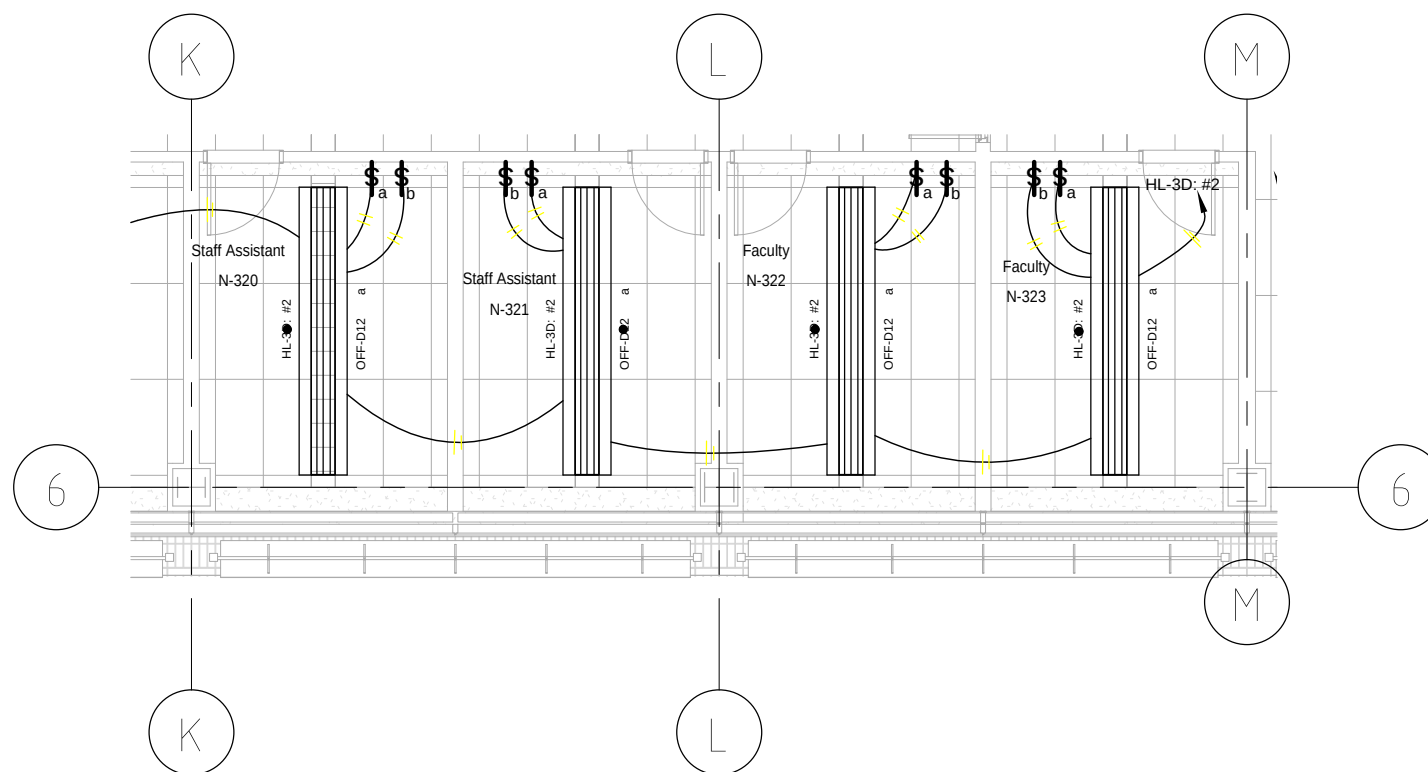
See attached full size drawings (E-2.3DL “Exterior Plaza Lighting”) for overall wiring diagrams and lighting layout of corridors, student study areas, offices and areas affected by lighting design in the third floor.

Exterior Courtyard

See attached full size drawings (E-6.3 “Exterior Plaza Lighting”) for overall wiring diagrams and lighting layout of the Exterior Plaza Area.







1
E-6.2 Typical Office Lighting Detail
1/8" = 1'-0"

Appendix H: Lighting Fixture Cutsheets

Typical Office: OFF-D4

See Appendix C: Energy Analysis for complete cutsheet information.

Properties

Connector Element (1) [Edit Type](#)

Electrical - Loads

System Type	Power - Unbalanced
Number of Poles	1
Power Factor State	Lagging
Load Classification	Lighting
Load Sub-Classificati...	
Voltage	277.00 V
Apparent Load Phase 1	50.00 VA
Apparent Load Phase 2	0.00 VA
Apparent Load Phase 3	0.00 VA
Power Factor	0.980000

Identity Data

Utility	
Connector Description	

[Properties help](#) [Apply](#)

OFF-D4 Revit Electrical Connector Properties.

Family Types

Name: OFF-D4

Parameter	Value	Formula	Lock
Constraints			
Default Elevation	4' 0"	=	☒
Electrical			
Wattage Comments	21W	=	
Lamp Quantity	2	=	☐
Lamp	F2LT5 ADV835 ALTO	=	
Electrical - Lighting			
Calculate Coefficient of Utilization ()	☒	=	
Coefficient of Utilization (default)		=	
Electrical - Loads			
Load Type	Lighting	=	
Apparent Load	49.00 VA	=	
Green Building Properties			
Response Daylight Sensor (default)	☐	=	
Photometrics			
Tilt Angle	-90.000°	=	☒
Photometric Web File	OFF-D.JES	=	
Light Loss Factor	0.86	=	
Initial Intensity	3000.00 lm	=	
Initial Color	3500 K	=	
Emit from Rectangle Width	0' 8"	=	☒
Emit from Rectangle Length	3' 11"	=	☒
Emit Shape Visible in Rendering	☐	=	
Dimming Lamp Color Temperature	<None>	=	
Color Filter	White	=	
Identity Data			
URL		=	
Model	AHC	=	
Mfr. Catalog #	Custom	=	
Manufacturer	Krueger	=	
Keynote	OFF-D4	=	
Description	2x8 Custom integrated Chilled Beam	=	
Ballast Manufacturer	Philips:	=	
Ballast	ICN-2528-N	=	
Assembly Code		=	
Type Comments		=	
Cost		=	

[New...](#) [Rename...](#) [Delete](#)

Parameters

[Add...](#) [Modify...](#) [Remove](#)

[OK](#) [Cancel](#) [Apply](#) [Help](#)

OFF-D4 Revit Family Type Data.

Typical Office: OFF-D8

See Appendix C: Energy Analysis for complete cutsheet information.

Properties

Connector Element (1) Edit Type

Electrical - Loads

System Type	Power - Unbalanced
Number of Poles	1
Power Factor State	Lagging
Load Classification	Lighting
Load Sub-Classificati...	
Voltage	277.00 V
Apparent Load Phase 1	100.00 VA
Apparent Load Phase 2	0.00 VA
Apparent Load Phase 3	0.00 VA
Power Factor	0.980000

Identity Data

Utility	
Connector Description	

[Properties help](#) Apply

OFF-D8 Revit Electrical Connector Properties.

Family Types

Name: OFF-D8

Parameter	Value	Formula	Lock
Constraints			
Default Elevation	4' 0"	=	☒
Electrical			
Wattage Comments	21W	=	
Lamp Quantity	4	=	
Lamp	F21T5 ADV835 ALTO	=	
Electrical - Lighting			
Calculate Coefficient of Utilization (Coefficient of Utilization (default))	☒	=	
Electrical - Loads			
Load Type	Lighting	=	
Apparent Load	98.00 VA	=	
Green Building Properties			
Response Daylight Sensor (default)	☐	=	
Photometrics			
Tilt Angle	-90.000°	=	☒
Photometric Web File	OFF-D.IES	=	
Light Loss Factor	0.86	=	
Initial Intensity	3000.00 lm	=	
Initial Color	3500 K	=	
Emit from Rectangle Width	0' 8"	=	☒
Emit from Rectangle Length	7' 11"	=	☒
Emit Shape Visible in Rendering	☐	=	
Dimming Lamp Color Temperature	<None>	=	
Color Filter	White	=	
Identity Data			
URL		=	
Model	AHC	=	
Mfr. Catalog #	Custom	=	
Manufacturer	Krueger	=	
Keynote	OFF-D4	=	
Description	2x8 Custom integrated Chilled Beam	=	
Ballast Manufacturer	Philips	=	
Ballast	ICN-2528-N	=	
Assembly Code		=	
Type Comments		=	
Cost		=	

OK Cancel Apply Help

Family Types

New... Rename... Delete

Parameters

Add... Modify... Remove

OFF-D8 Revit Family Type Data.



Typical Office: OFF-D12

See Appendix C: Energy Analysis for complete cutsheet information.

The screenshot shows the 'Properties' dialog box for an electrical connector. The 'Connector Element (1)' is selected. The 'Electrical - Loads' section is expanded, showing the following properties:

Property	Value
System Type	Power - Unbalanced
Number of Poles	1
Power Factor State	Lagging
Load Classification	Lighting
Load Sub-Classification	
Voltage	277.00 V
Apparent Load Phase 1	150.00 VA
Apparent Load Phase 2	0.00 VA
Apparent Load Phase 3	0.00 VA
Power Factor	0.980000

The 'Identity Data' section is also visible, showing 'Utility' and 'Connector Description'.

Figure 188: OFF-D12 Revit Electrical Connector Properties.

The screenshot shows the 'Family Types' dialog box for the OFF-D12 family. The 'Name' is set to 'OFF-D12'. The dialog is organized into several sections, each with a list of parameters, values, formulas, and lock status.

Section	Parameter	Value	Formula	Lock
Constraints	Default Elevation	4' 0"	=	☒
Electrical	Wattage Comments	21W	=	
	Lamp Quantity	6	=	
	Lamp	F21T5 ADV835 ALTO	=	
Electrical - Lighting	Calculate Coefficient of Utilization ()	☒	=	
	Coefficient of Utilization (default)		=	
Electrical - Loads	Load Type	Lighting	=	
	Apparent Load	147.00 VA	=	
Green Building Properties	Response Daylight Sensor (default)	☐	=	
Photometrics	Tilt Angle	-90.000°	=	☒
	Photometric Web File	OFF-D.IES	=	
	Light Loss Factor	0.86	=	
	Initial Intensity	3000.00 lm	=	
	Initial Color	3500 K	=	
	Emit from Rectangle Width	0' 8"	=	☒
	Emit from Rectangle Length	11' 11"	=	☒
	Emit Shape Visible in Rendering	☐	=	
	Dimming Lamp Color Temperature	<None>	=	
	Color Filter	White	=	
Identity Data	URL		=	
	Model	AHC	=	
	Mfr. Catalog #	Custom	=	
	Manufacturer	Krueger	=	
	Keynote	OFF-D4	=	
	Description	2x12 Custom integrated Chilled Beam	=	
	Ballast Manufacturer	Philips	=	
	Ballast	ICN-2S28-N	=	
	Assembly Code		=	
	Type Comments		=	
Cost		=		

OFF-D12 Revit Family Type Data.

Student Study Area: Type STD-D

VP PARABOLIC **VPA1G12PR132**

Page 1 of 2

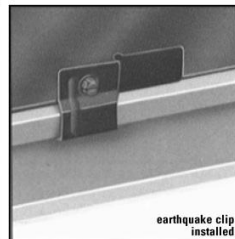
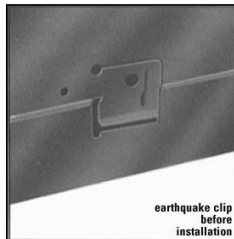
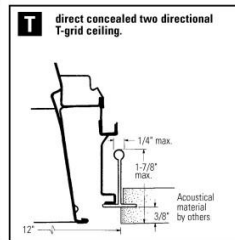
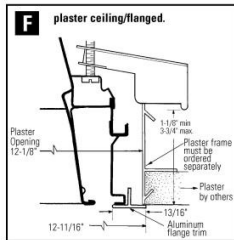
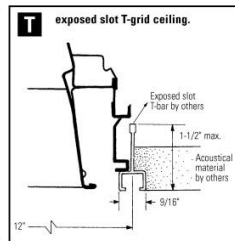
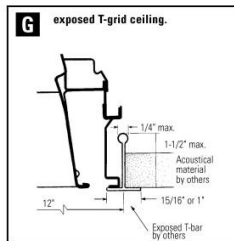
1'x4' RECESSED FLUORESCENT, 3" DEEP, 12 CELL (1 ROW) PARABOLIC LOUVER
STATIC OR AIR SUPPLY/RETURN, IES RP1 FOR INTENSE VDT USE (PREFERRED)

Features

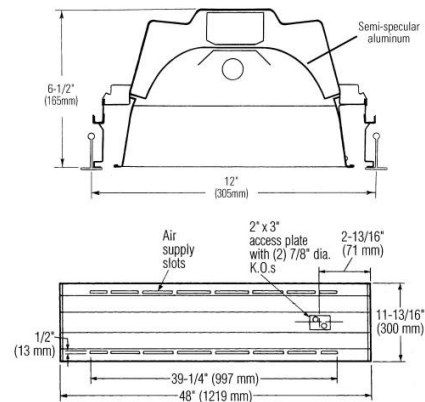
- Meets IES RP1 for lighting VDT areas with intense use.
- 72.0% efficient (T8).
- 1.6 spacing mounting ratio.
- Specular, low iridescence, pre-anodized aluminum louver.
- Vertical grain on louver eliminates reflected lamp image on cross baffle.
- Louver frame with positive light stop.
- Spring loaded latches (self centering).
- Reversible louver hinging.
- Louver has protective dust guard.
- Only 6-5/8" deep body.
- Black housing exterior for cooler ballast operating temperature.
- Turned-in edges for safe handling.
- Built-in earthquake clip (pat. no. 5,072,344).
- UL-Listed twin knockout access plate.
- Air closure strips (optional).
- Construction to meet NYC Code or Chicago Plenum is available.



MOUNTING METHODS



DIMENSIONS



Job Information	Type:
Job Name: Millennium Science Complex	STD-D
Cat. No.: VPS1G12PR13227TSO	
Lamp(s): (1) 32W T8	
Volts/Ballast: 277V	
Advance Mark 7:	
IZT-3S32-SC	

Lightolier a Genlyte Thomas Company www.lightolier.com
 Technical Information: (978) 657-7600 • Fax (978) 658-0595
 631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710
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LIGHTOLIER®



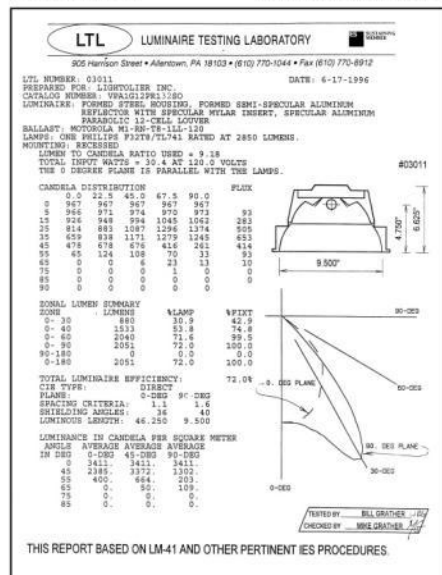
VP PARABOLIC **VPA1G12PR132**

Page 2 of 2

1'x4' RECESSED FLUORESCENT, 3" DEEP, 12 CELL (1 ROW) PARABOLIC LOUVER
STATIC OR AIR SUPPLY/RETURN, IES RP1 FOR INTENSE VDT USE (PREFERRED)

PHOTOMETRY

MODEL NO. VPA1G12PR132120S0

LER = FP - 59.4 IW - 30.4 BF - 0.88
Comparative yearly lighting energy cost per 1000 lumens = \$4.04

coefficients of utilization — zonal cavity method

room cavity ratio	20			20			20		
	RF	RC	RW	RF	RC	RW	RF	RC	RW
1	81	79	77	74	73	72	72	71	70
2	77	73	70	69	67	65	67	65	63
3	72	67	63	64	61	58	62	59	57
4	67	61	57	59	55	52	57	54	52
5	63	56	51	54	50	47	53	49	46
6	59	52	47	50	46	42	49	45	42
7	55	47	42	45	41	38	45	41	38
8	51	43	37	41	37	34	40	36	33
9	47	38	33	37	33	30	36	32	29
10	43	35	30	34	29	26	33	29	26

visual comfort probability

room size		ceiling height				ceiling height			
W	L	8.5	10.0	13.0	16.0	8.5	10.0	13.0	16.0
20	20	93	93	92	82	97	96	95	90
20	30	93	93	92	82	97	96	96	91
20	40	93	93	92	82	97	96	96	92
20	60	93	93	92	83	97	96	96	92
30	20	93	93	93	85	97	96	96	91
30	30	93	93	93	85	97	96	96	92
30	40	93	94	92	85	97	96	96	92
30	60	93	94	93	86	98	96	96	92
30	80	93	94	93	86	98	96	96	92
40	20	93	93	93	86	97	96	96	91
40	30	93	94	92	87	97	96	96	92
40	40	93	94	93	87	98	96	96	92
40	60	93	94	93	87	98	96	96	92
40	80	94	94	93	87	98	96	96	92
40	100	94	94	93	87	98	96	96	92
60	30	93	94	93	87	97	96	96	92
60	40	93	94	93	87	98	96	96	92
60	60	94	94	93	87	98	96	96	92
60	80	94	94	93	87	98	96	96	92
60	100	94	94	93	87	98	96	96	92
100	40	94	94	93	87	98	96	96	92
100	60	94	94	93	87	98	96	96	92
100	80	94	94	93	87	98	96	96	92
100	100	94	94	93	87	98	96	97	92

ORDERING INFORMATION

Explanation of Catalog Number. Example: VPA1G12PR132120S0GLR

VP	S	1	G	12	P	R	1	32	277	SO	
VP: 3" Deep Pre-anodized Aluminum Louver for intense VDT use	S: Static	1: 1 row of 12 cells	G: Grid (lay-in T bar) F: Flanged (overlap) Z: spline and plaster frame T: Slot grid or two-directional concealed T (see options)	12: 1 row of 12 cells	P: Low Irrescence Specular	R: Specular Reflective	1: Lamp Mag. T12	32: 32-T8 34-T12 (Nominal 48")	277: 1 Lamp Elec. T8 LOL Dimming *Instant Start Standard Other dimming options, consult factory.	SO: <20TH S0* <10TH HI*	Options: Add appropriate suffix to catalog no. ie: (GLR)

OPTIONS & ACCESSORIES

ACCESS PLATE: Top Wiring access plate is shipped with fixture as standard. When access plates are required in advance for wiring convenience, specify separately. Order Catalog Number: **ACP CSP**.

ELECTRICAL WIRING OPTIONS: Consult factory.

FUSING: Internal fast-blow fusing. SUFFIX: **GLR**.

Internal slow-blow fusing. SUFFIX: **GFM**.

RADIO INTERFERENCE FILTER: 120 or 277 volt, 50 or 60 Hz. One per fixture standard. SUFFIX: **RF**.

CONTINUOUS ROW INSTALLATION: For F type fixtures, half-width flanges are required between fixtures. Order Catalog Number: **1FCTRIM** (each joint).

SPLAY TRIM: For T ceiling type only. SUFFIX: **CT214 S2 SPLAY TRIM**.

AIR CLOSURE STRIPS: SUFFIX **ACS4** (factory installed).

DRYWALL KIT: Order Catalog Number: **FK91X4**. Request Folio QA30-10.

CHICAGO PLENUM: SUFFIX: **CP**.

SPECIFICATIONS

PERFORMANCE: In an installation of 1 lamp 32W luminaires in a room cavity ratio of 1, reflectance 80% ceiling, 50% wall, 20% floor, the C.U. shall not be less than .79 with a spacing to mounting ratio of 1.6 perpendicular to the lamps. To meet IES RP-1 preferred for VDT areas the VCP (visual comfort probability) shall not be less than 94 either crosswise or lengthwise, and the maximum average

brightness at 55°, 65°, 75° and 85° shall not exceed 664,109, 0, and 0 candelas per square meter respectively in the 0°, 45° and 90° horizontal planes. Candelas at nadir (0°) not to exceed 967.

AIR HANDLING: (VPA only) side air passages for air supply or air return.

Optional side closure strips. Air return is also provided through the lamp compartment through fixture body ends.

MATERIALS: Chassis parts are die-formed embossed cold rolled steel.

Housing: is embossed for rigidity with all edges turned-in for safe handling.

LOUVER: Pre-anodized aluminum (Coilzak® or equal).

FINISH: Louver—specular low iridescence pre-anodized reflector sheet.

REFLECTOR: Low-iridescence, semi-specular with low iridescence specular center section. **Chassis exterior**—black baked polyester enamel.

ELECTRICAL: Thermally protected class "P" ballast C.B.M. approved, non PCB. If K.O. is within 3" of ballast, use wire suitable for at least 90°.

LABELS: I.B.E.W./UL and C-UL.

Job Information	Type:
Lightolier a Genlyte Thomas Company	STD-D

Technical Information: (978) 657-7600 • Fax (978) 658-0595
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

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A0902

SECTION 2/Folio G05-10 REV. A

LIGHTOLIER®

Properties

Connector Element (1) Edit Type

Electrical - Loads

System Type	Power - Unbalanced
Number of Poles	1
Power Factor State	Lagging
Load Classification	Lighting
Load Sub-Classification ...	
Voltage	277.00 V
Apparent Load Phase 1	34.16 VA
Apparent Load Phase 2	0.00 VA
Apparent Load Phase 3	0.00 VA
Power Factor	0.995000

Identity Data

Utility	
Connector Description	

[Properties help](#) Apply

STD-D Revit Electrical Connector Properties.

Family Types

Name: STD-D

Parameter	Value	Formula	Locked
Constraints			
Default Elevation	4' 0"	=	☒
Electrical			
Wattage Comments	32	=	
Number of Lamps	1	=	☐
Lamp	F32T8 ADV835 Alto II	=	
Electrical - Lighting			
Calculate Coefficient of Utilization (default)	☒	=	
Coefficient of Utilization (default)		=	
Electrical - Loads			
Load Type	Lighting	=	
Apparent Load	34.16 VA	=	
Green Building Properties			
Response Daylight Sensor (default)	☒	=	
Photometrics			
Tilt Angle	-90.000°	=	☒
Photometric Web File	9814D1T232.ies	=	
Light Loss Factor	0.88	=	
Initial Intensity	3100.00 lm	=	
Initial Color	3500 K	=	
Emit from Rectangle Width	0' 10 1/16"	=	☒
Emit from Rectangle Length	3' 10"	=	☒
Emit Shape Visible in Rendering	☐	=	
Dimming Lamp Color Temperature Shift	<None>	=	
Color Filter	White	=	
Identity Data			
URL	www.ledalite.com/products/voice	=	
Model	VP Parabolic	=	
Mfr. Catalog #	VP-1-G-12-P-R-1-32-27750	=	
Manufacturer	Lightolier	=	
Keynote	STD-D	=	
Description	1x4 Ceiling Recessed Fluorescent Downlights	=	
Ballast Manufacturer	Advanced - Mark 7	=	
Ballast	IZT-132-SC	=	
Assembly Code		=	
Type Comments		=	
Cost		=	

Family Types: New..., Rename..., Delete

Parameters: Add..., Modify..., Remove

OK Cancel Apply Help

STD-D Revit Family Type Data.



Conference Room: Type CFR-D

IRIS®

DESCRIPTION

Energy Star qualified recessed medium beam downlight luminaire with 4 inch square aperture utilizing horizontal 26W DTT or 26/32W TTT compact fluorescent lamp. The electronic compact fluorescent ballast meets stringent Energy Star requirements including FCC Title 47 CFR part 18 for consumer equipment. Platform is suitable for direct contact with insulation and 2x8 residential construction. Platform and element combination produces square distribution with excellent light control and low aperture brightness.

Catalog #	P4-E4DLCBH-26TTT	Type
Project	Millennium Science Complex	CFR-D
Comments	Conference Room Downlight	Date
Prepared by	MWL	2/2/2011

SPECIFICATION FEATURES

Frame

Galvanized steel plaster frame with integral bar hanger receivers. Setscrews provide positive horizontal locking.

Collar

Matte black steel collar adjusts vertically for 1/2" - 1" thick ceilings and can be rotated +/- 7.5° thru the aperture. Integral gun sights facilitate the use of guide strings or laser lines. Shipped with a paint overspray protector installed in the collar.

Housing

Double wall aluminum housing painted matte black for a visually dark interior. Removable hinged top allows for top access. All fasteners are captive.

Optical Element

Mousetrap type springs pull flange tight to ceiling. Light trap eliminates spill light at edge of flange and reflector. Available in self-flanged or metal trim ring versions. May also be installed rimless using optional plastering lathing ring.

Gaskets

Closed cell gaskets achieve restrictive airflow requirements without additional caulking.

Bar Hangers

Captive preinstalled bar hangers adjust from 8-1/2" to 24" wide; pass thru feature allows shortening without removal. Captive nail penetrates standard and engineered lumber. Mounting flange levels platform with ceiling. Integral clip attaches directly to t-bar.

Primary Reflector

Miro® Erotek segmented upper reflector yields a smooth square beam with medium distribution. Accepts 26W DTT, 26/32W TTT compact fluorescent lamp.

Lower Reflector

Aluminum parabolic shielding prismatoid provides for 55° cutoff and is available in a wide range of semi specular Alzak® finishes. Corrugated Baffle: An optional embossed pattern that extends through the flange adding a subtle design element and reduces aperture brightness.

Junction Box

(7) 1/2" trade size pry outs, (3) integral clamps for non-metallic cable. Rated for (4) #12 thru branch circuits. Wago® type push wire connectors for field connections

Ballast

Energy Star thermally protected, current controlled rapid start 120VAC input ballast produces full light output and rated lamp life.

Lamp Socket

4 pin Gx24q3/4 base with rotary lock socket ensures positive lamp retention. Lamp socket locks into one of two positions accommodating different lamp lengths.

Lamp

Generic compact fluorescent lamp designations (by others)
- CFTR32W/GX24q 2700K
- CFTR32W/GX24q 3000K
- CFTR26W/GX24q 2700K
- CFTR26W/GX24q 3000K
Up to 12,000 hour rated average life. 82 CRI rated lamps provide excellent color and high visual comfort. Color temperature options offer 2700K warm or 3000K medium warm incandescent-like light.

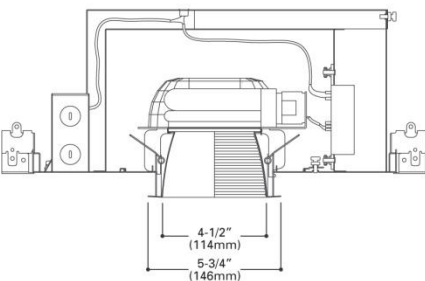
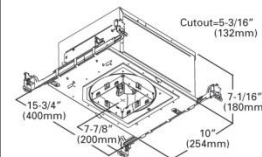
Code Compliance

Thermally protected, IP labeled, Energy Star qualified, cULus listed for protected damp locations and ASTM-E283 AIRTITE(tm). Suitable for direct contact with insulation. Meets EMI/RFI requirements per FCC part 18 consumer limits. Meets State of California Title 24, Washington State Energy Code, New York State Energy Conservation Construction Code, and International Energy Conservation Code.



P40832ICAT
P4081D26ICAT
P4081D32ICAT
E4DL E4DLCB
26W DTT, 26 or
32W TTT
Compact
Fluorescent

4 Inch Square Downlight



ORDERING INFORMATION: Complete unit consists of platform and optical element.

Platform	Optical Element	Finish	Flange	Accessories
P40832ICAT = 4" Square Aperture Energy Star IC Housing 26/32W P4081D26ICAT = 4" Square Aperture 26W Lutron TuWire Dimming, Energy Star IC Housing P4081D32ICAT = 4" Square Aperture 32W Lutron TuWire Dimming, Energy Star IC Housing	E4DL = 4" Square Aperture Lower Shielding Prismatoid, Open E4DLCB = 4" Square Aperture Corrugated Lower Shielding Prismatoid, Open	Alzak® Finishes H = Clear Haze WMH = Warm Haze WHH = Wheat Haze KH = Cognac Haze GPH = Graphite Haze CTH = Cobalt Haze CCH = Chocolate Haze BH = Black Haze Painted Finishes MW = Matte White MB = Matte Black	[Blank] = Metal Trim Ring, Matte White SF = Self Flanged, Matte White Flange (SPWF not available with corrugated baffle)	PLR4x4 = Plaster lathing ring for rimless RLA4x4 = Rimless adapter for solid ceiling surfaces EDC4x41 = Extended depth collar for 1" - 1-1/2" thick ceilings EDC4x42 = Extended depth collar for 1-1/2" - 2" thick ceilings MTR4MW = Metal trim ring, matte white MTR4MB = Metal trim ring, matte black MTR4SN = Metal trim ring, satin nickel MTR4AC = Metal trim ring, antique copper MTR4TBZ = Metal trim ring, tuscan bronze

COOPER Lighting
www.cooperlighting.com

Specifications and Dimensions subject to change without notice.
Consult your representative for additional options and finishes.

ENERGY DATA	
Min. Starting Temp -18°C	Sound Rating Class A
EMI/RFI Emissions FCC Part 18 Consumer Limits	
Input Frequency 50/60 Hz	Power Factor > 0.96
THD < 10%	Input Voltage 120V
26W	Input Power 26W
	Input Current 0.24A
32W	Input Power 36W
	Input Current 0.31A
ENERGY DATA - SOUND RATING	
Min. Starting Temp 10°C	
Sound Rating Inaudible in a 27dBa Ambient	
EMI/RFI Emissions FCC Part 18 Consumer Limits	
Input Frequency 60 Hz	Power Factor > 0.96
Input Voltage 120V	THD < 20%
26W Input Current	0.21A
32W Input Current	0.33A



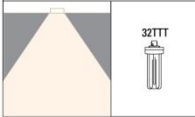
ADJ071553
02/29/2008 4:53:57 PM

Photometrics

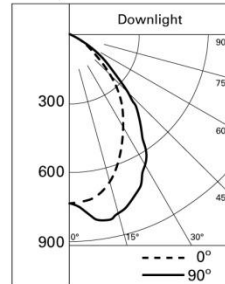
Photometric Results

Spacing Criterion = 1, 1.3
Efficiency = 50.6%

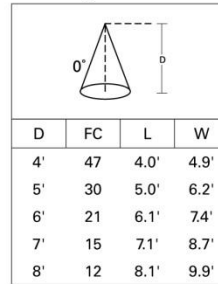
Test No. 254P232
Platform = P4
Element = E4DLH
Lumens = 2400
Lamp = CF32TTT/E/841



Candlepower Distribution



Cone of Light



Candelas

Vertical Angle	CD
90	0
85	2
75	15
65	44
55	113
45	248
35	396
25	525
15	650
5	704
0	711

Zonal Lumens Summary

Zone	Lumens	% Lamp	% Luminaire
0- 30	568	23.7	46.8
0- 40	856	35.7	70.5
0- 60	1162	48.4	95.7
0- 90	1214	50.6	100
90-180	0	0	0
0-180	1214	50.6	100

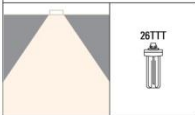
Coefficients of Utilization

Ceiling Wall % RCR	70 50 30 10	70 50 30 10	50 30 10	50 30 10	50 30 10	0
	Zonal cavity method -- floor reflectance = 20%					
0	60 60 60 60	59 59 59 59	56 56 56	54 54 54	52 52 52	51
1	57 55 53 52	55 54 52 51	52 51 50	50 49 48	48 47 47	46
2	53 50 47 45	52 49 47 45	47 45 44	46 44 43	44 43 42	41
3	49 45 42 40	48 45 42 39	43 41 39	42 40 38	41 39 37	37
4	46 41 38 35	45 41 37 35	40 37 35	38 36 34	37 35 34	33
5	43 38 34 31	42 37 34 31	36 33 31	35 33 31	35 32 30	30
6	40 35 31 28	39 34 31 28	33 30 28	33 30 28	32 30 28	27
7	38 32 28 26	37 32 28 26	31 28 26	30 27 25	30 27 25	24
8	35 30 26 24	35 29 26 23	29 26 23	28 25 23	28 25 23	22
9	33 28 24 22	33 27 24 22	27 24 21	26 23 21	26 23 21	20
10	31 26 22 20	31 25 22 20	25 22 20	25 22 20	24 22 20	19

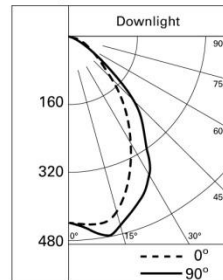
Photometric Results

Spacing Criterion = 1, 1.2
Efficiency = 39.5%

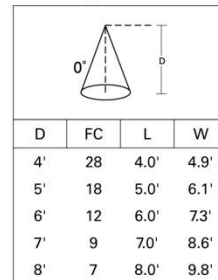
Test No. 254P229
Platform = P4
Element = E4DLH
Lumens = 1800
Lamp = CF26TTT/E/830



Candlepower Distribution



Cone of Light



Candelas

Vertical Angle	CD
90	0
85	1
75	8
65	24
55	61
45	140
35	239
25	338
15	427
5	442
0	438

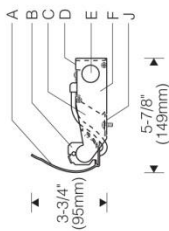
Zonal Lumens Summary

Zone	Lumens	% Lamp	% Luminaire
0- 30	339	18.8	47.6
0- 40	507	28.2	71.3
0- 60	682	37.9	95.9
0- 90	711	39.5	100
90-180	0	0	0
0-180	711	39.5	100

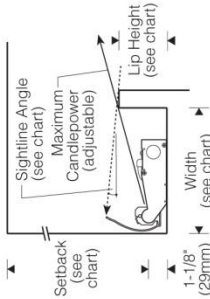
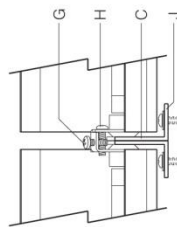
Coefficients of Utilization

Ceiling Wall % RCR	70 50 30 10	70 50 30 10	50 30 10	50 30 10	50 30 10	0
	Zonal cavity method -- floor reflectance = 20%					
0	47 47 47 47	46 46 46 46	44 44 44	42 42 42	40 40 40	40
1	44 43 42 41	43 42 41 40	40 40 39	39 38 38	38 37 37	36
2	41 39 37 35	41 38 37 35	37 36 34	36 35 33	35 34 33	32
3	39 36 33 31	38 35 33 31	34 32 30	33 31 30	32 31 29	29
4	36 32 30 28	35 32 29 28	31 29 27	30 28 27	29 28 26	26
5	34 30 27 25	33 29 27 25	29 26 24	28 26 24	27 25 24	23
6	32 27 24 22	31 27 24 22	26 24 22	26 24 22	25 23 22	21
7	30 25 22 20	29 25 22 20	24 22 20	24 22 20	23 21 20	19
8	28 23 21 19	27 23 20 19	23 20 18	22 20 18	22 20 18	18
9	26 22 19 17	26 21 19 17	21 19 17	21 18 17	20 18 17	16
10	25 20 18 16	24 20 17 16	20 17 16	19 17 16	19 17 16	15



**Lighting the Ceiling** Small concealed, integral**Style 306** 1:8 Scale**Cove**

1:10 Scale

**Joint** 1:4 Scale
(ballast compartment not shown for clarity)**Cove Dimensions**
(max. candlepower aimed 15° above horiz.)

Sight-line	0° (horiz. cutoff)	5°	10°
Width (inside)	10-5/8\" (270mm)	8-1/4\" (210mm)	6-3/4\" (171mm)
Lip (inside)	3-3/4\" (95mm)	3\" (76mm)	2-5/8\" (67mm)
Setback (varies)	Recommended minimum: 12\" T5 and T8, 18\" T5HO		

Note: Finish interior of cove matte white for best results.

Nominal Lamp Length	Luminaire Length	
	T5	T8
1 x 2'	23-1/16\" (586mm)	24-3/4\" (628mm)
1 x 3'	34-7/8\" (886mm)	36-3/4\" (932mm)
1 x 4'	46-11/16\" (1186mm)	48-3/4\" (1237mm)
1 x 5'	58-1/2\" (1486mm)	60-1/2\" (1537mm)
2 x 3'	69-1/2\" (1765mm)	73-3/16\" (1859mm)
2 x 4'	93-1/8\" (2365mm)	97-3/16\" (2468mm)
2 x 5'	116-5/8\" (2963mm)	120-7/8\" (3069mm)

Specifications

- A** Specular extruded aluminum reflector
B Stainless steel lamp holder/support brackets
C Aluminum sidearm with mounting tab
- D** Extruded aluminum ballast/wireway channel cover
E Conduit entry (one each end, conduit and connector by others)

- F** Extruded aluminum ballast/wireway compartment
G Rotation locking screw
H Joiner/alignment screw
- J** Mounting tab (fastener by others)
K Integral electronic ballast

Finish:

Reflector – extruded high purity aluminum with clear anodized specular finish. Sidearms and ballast/wireway compartment – mill finish aluminum. All luminaire hardware – stainless steel.

Mounting:

Lay-in installation requires only one fastener per joint (by others). Sidearms with mounting tabs can be base or wall mounted. Luminaires can be mounted individually or joined together to form a continuous row.

Reflector aiming is adjustable and is fixed in position by rotation locking screws at each sidearm. When mounted in a continuous row, joiner screws lock reflectors together allowing all in the row to be aimed together.

Standard:

UL listed or CSA certified for damp locations (Style 124 painted model with lens recommended for damp locations).

Electrical:

Use 90°C wire for supply connections.

Integral electronic HPF thermally protected class P ballast (with end-of-life protection for T5 lamps). Ballast/wireway compartment includes one conduit entry at each end. Channel cover removes for access to ballast and wiring. Luminaires may be butted end-to-end (connectors by others) for through wiring. Optional #12 AWG prewired modular through wiring with quick connectors.

Master/satellite combination is available (Configuration 3, see Ordering Information). Master supplied with 2-lamp ballast (wiring, conduit and connectors between master and satellite units by others).

Optional electronic dimming ballast: compatible dimmer switch required (by others). Consult sales representative for compatibility and specifications.

Optional integral emergency battery operates one lamp. Separate unswitched supply is required.

For complete ballast specifications, see Accessories Section.

10/10

*U.S. Patents 5,550,725 and D432,696; EPO 0710796.

**Features**

- Choose T5 for precise optical control or widely utilized T8
- Compact and flexible – effective indirect cove lighting for malls, offices, lobbies, conference rooms and corridors
- Adjustable – all reflectors in a row join and aim together; rotation locking screws secure position*
- Integral electronic ballast thru wiring for easy installation

Performance

Two parabolic reflector sections drive light across the ceiling from one edge. An elliptical section shields the lamp from normal viewing angles and redirects its light to a parabola. Glare is minimized and asymmetry of the beam is maximized resulting in high beam efficiency and superior surface uniformity.

For complete photometrics, visit theightingquotient.com



To Order

To form a Catalog Number

F 3 0 6 - A132 - S - 0 0 - 2 - 00 0
1 2 3 4 5 6 7 8

1 Source

F = Linear fluorescent

2 Style

306 = Small concealed, integral ballast

3 Lamp

Note: To order by overall row length, enter **ROW CODE** in place of Lamp Code below (see Row Charts on page C-20.2 for T8 or C-20.4 for T5). Row Code specifies a row complete with all necessary reflectors and ballasts.

A 1 32 = Lamp Code

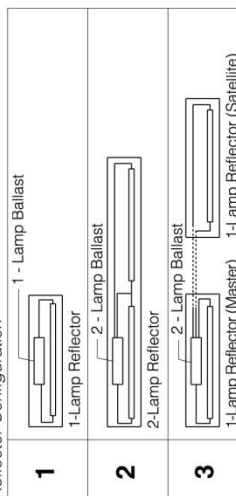
Lamp Wattage (see chart below)
Reflector Configuration, specify 1, 2 or 3
(see chart below)

A = T8 Fluorescent
T = T5 Fluorescent

Example: **A325** = two nominal 3' reflectors, each for use with one 25W T8 lamp; one 25W T8 lamp; one 2-lamp ballast



Reflector Configuration



Lamp Wattage

Lamp Length (nominal)	Lamp Wattage (Lamp Number)		
	T8	T5	T5HO
2'	17 (F17T8)	14 (F14T5)	24 (F24T5/HO)
3'	25 (F25T8)	21 (F21T5)	39 (F39T5/HO)
4'	32 (F32T8)	28 (F28T5)	55 (F54T5/HO)
5'	40 (F40T8)	35 (F35T5)	80 (F80T5/HO)

For complete lamp and ballast information, see Accessories Section.
Standard T5 lamp color is 3000K/80+ CRI. T8 lamps by others.

Project: **Millennium Science Complex**

4 Mounting

S = Sidearms with mounting tabs

5 Finish

00 = Bright anodized reflector with mill finish ballast compartment

6 Voltage /Ballast

Electronic Dimming*

1 = 120V T = 120V

2 = 277V V = 277V

3 = 347V (Canada)

* Consult sales representative for dimming 5' lamps (lamp codes **Ax40**, **Tx35**, **Tx80**) and for Reflector Configuration **3**. Availability for wattages and voltages varies with ballast manufacturer and control type – see thelightingquotient.com for additional dimming specifications and limitations.

7 Option (See Accessories Section for specifications)

00 = No options

0E = Integral emergency battery pack with indicator lamp and test button. Operates one lamp. Available in nominal 4', 6' and 8' units only (lamp codes **A132**, **A225**, **A232**, **A332**, **T128**, **T221**, **T228**, **T328**, **T155**, **T239**, **T255** and **T355**).

OK = Prewired modular #12 AWG through wiring with quick connectors

EK = Combination of emergency battery pack and prewired modular through wiring as described above

XX = For modification not listed, include detailed description. Consult factory prior to specification.

8 Destination Requirement

0 = UL listed or CSA certified for U.S.

J = UL listed or CSA certified for Canada

Example

F306 - A240 - S - 00 - 1 - 0E0

Small concealed fluorescent consisting of one nominal 10' luminaire, for use with two 40W T8 lamps. Integral 120V electronic 2-lamp ballast. Sidearm with mounting tabs. Supplied with integral emergency battery pack. UL listed or CSA certified for U.S.

Style 306

Type: **CFR-C**

Accessories

Order separately. See Accessories Section for specifications.

AFK000X 0 = Ballast fuse kit

0 = U.S.

J = Canada



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elliptipar from The Lighting Quotient
114 Boston Post Road, West Haven, Connecticut 06516, USA
Voice 203.931.4455 • Fax 203.931.4464 • thelightingquotient.com

elliptipar
There is no equal™

12/09





Lighting the Ceiling Small concealed, integral

To order by Row Code - T8 lamps

When the Style 306 small concealed fluorescent is run continuously in **straight** coves, **elliptipar** offers the option of specifying and ordering the entire row as one catalog number. Ordering by row eliminates the need to calculate length, type and quantity of reflectors.

Steps to specify Row Code:

1. Determine clear inside length of cove.
2. Round up to nearest foot and find the nominal row length in chart.
3. Determine what lengths/wattages of lamps will be used and select the corresponding lamp combination codes.

Example: If only 3' and 4' lamps are to be used on the project, specify row codes ending with **A**, **B** and/or **D** only. If for a given nominal row length a preferred lamp combination is not listed, select the next shorter row that is available in the desired lamp combination.

Once the nominal row length and lamp combination has been found in the chart, note the actual overall row length (last column).

6. Consider the unlighted length at each end of the row (subtract the overall row length from the clear inside length, and divide the remainder by two). It is generally recommended that the unlighted length at each end be between 6" and 12".

7. Enter the four character Row Code in place of the Lamp Code described on page C-20.1. The remainder of the catalog number is formed as shown on page C-20.1.

Features

- Time saving - simplifies specification and ordering
- One catalog number - includes all necessary reflectors to install row
- Assured fit - all you need is the clear inside length of the cove

T8 Fluorescent

3 Row Code

Note: Enter row code in place of Lamp Code described on page C-20.1.

R - - - = Row Code

Lamp Combination*

- A = All nominal 3' lamps
- B = All nominal 4' lamps
- C = All nominal 5' lamps
- D = Nominal 3' and 4' lamps
- F = Nominal 3' and 5' lamps
- G = Nominal 4' and 5' lamps

Nominal Row Length in feet, between 3' and 50' **

* Not all lamp combinations are available for each nominal row length (see chart).

** Nominal row lengths over 50' can be formed by combining shorter row lengths (example: a nominal 60' row can be ordered as two nominal 30' rows).

Example

F306 - R16C - S - 00 - 2 - 000

Nominal 16' long row of Style 306 small concealed T8 fluorescent using only nominal 5' (40W) lamps. Row includes one nominal 10' reflector for use with two 5' lamps, one nominal 5' reflector for use with one 5' lamp and integral 277V electronic ballasts. Overall row length is 15' 1-3/8".

Style 306

Nominal Row Length (feet)	Lamp Combination	Nominal 3' Luminaire (1 x nominal 3' lamp)	Nominal 4' Luminaire (1 x nominal 4' lamp)	Nominal 5' Luminaire (1 x nominal 5' lamp)	Nominal 6' Luminaire (2 x nominal 3' lamps)	Nominal 8' Luminaire (2 x nominal 4' lamps)	Nominal 10' Luminaire (2 x nominal 5' lamps)	Overall Row Length
04	A	1						3' 0-3/4"
05	B		1					4' 0-3/4"
06	C			1				5' 0-1/2"
07	A				1			6' 1-3/16"
08	D	1	1					7' 1-1/2"
09	B					1		8' 1-3/16"
09	F	1		1				8' 1-1/4"
10	A	1						9' 1-15/16"
10	G		1	1				9' 1-1/4"
11	C						1	10' 0-7/8"
11	D		1		1			10' 1-15/16"
12	D	1				1		11' 1-15/16"
12	F			1	1			11' 1-11/16"
13	A				2			12' 2-3/8"
13	B		1			1		12' 1-15/16"
14	D	1	1					13' 2-11/16"
14	F	1					1	13' 1-5/8"
14	G			1		1		13' 1-11/16"
15	D				1	1		14' 2-3/8"
15	F	1		1	1			14' 2-7/16"
15	G		1				1	14' 1-5/8"
16	C			1			1	15' 1-3/8"
16	D	1	1			1		15' 2-11/16"
17	B				1	2		16' 2-3/8"
17	F						1	16' 2-1/16"
18	D	1			1	1		17' 3-1/8"
18	F			1	2			17' 2-7/8"
18	G		1	1		1		17' 2-7/16"
19	A				3			18' 3-9/16"
19	D		1		1	1		18' 3-1/8"
19	F	1		1			1	18' 2-1/8"
19	G					1	1	18' 2-1/16"
20	D	1					2	19' 3-1/8"
20	F	1				1		19' 2-13/16"
20	G		1	1			1	19' 2-1/8"



Properties

Connector Element (1) Edit Type

Electrical - Loads

System Type	Power - Unbalanced
Number of Poles	1
Power Factor State	Lagging
Load Classification	Lighting
Load Sub-Classification ...	
Voltage	277.00 V
Apparent Load Phase 1	37.86 VA
Apparent Load Phase 2	0.00 VA
Apparent Load Phase 3	0.00 VA
Power Factor	0.931000

Identity Data

Utility	
Connector Description	

[Properties help](#) Apply

CFR-C Revit Electrical Connector Properties.

Family Types

Name: CFR-C

Parameter	Value	Formula	Lock
Constraints			
Default Elevation	4' 0"	=	☒
Electrical			
Number of Lamps	1	=	☐
Lamp	F32T8 ADV835 Alto II	=	
Wattage Comments	32	=	
Electrical - Lighting			
Calculate Coefficient of Utilization (d)	☒	=	
Coefficient of Utilization (default)		=	
Electrical - Loads			
Load Type	Lighting	=	
Apparent Load	37.86 VA	=	
Dimensions			
Tilt	0.000°	=	☒
Fixture Length	4' 0"	=	☒
Identity Data			
URL	http://www.TheLightingQuotient.com/	=	
Model	F306-A132-S-00-2-000	=	
Manufacturer	Elliptipar	=	
Keynote	CFR-C	=	
Description	4' cove mounted luminaire with asymmetrical ceiling	=	
Ballast Manufacturer	Lutron - EcoSystem	=	
Ballast	EC5-T832-G-UNV-317L	=	
Assembly Code		=	
Type Comments		=	
Cost		=	

Family Types: New..., Rename..., Delete

Parameters: Add..., Modify..., Remove

OK Cancel Apply Help

Revit CFR-C Family Type Data.



LIGHTOLIER®

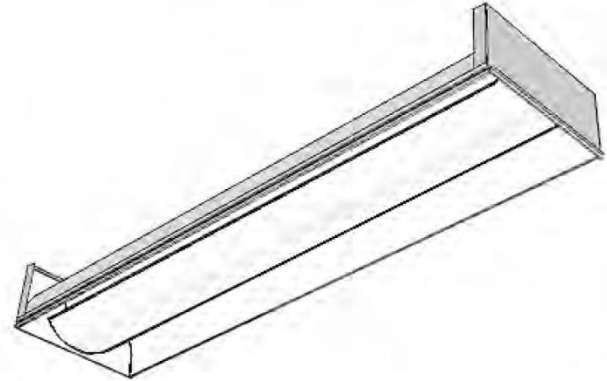
Coffaire HP CFS1GHP

Page 1 of 2

High Performance Recessed Fluorescent Direct/Indirect
1' x 4' with Perforated Basket ~ Static 1 or 2 Lamp T8 or T5

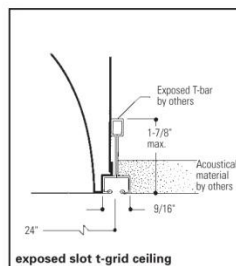
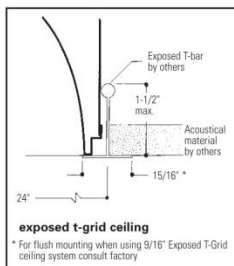
Features

- Direct/indirect lamp shield appearance with soft contoured interior.
- Perforated mesh lamp basket with unique TransOptix lens.
- Body 95% reflective Flat White Powder Coated.
- 95% Internal Mirror reflector.
- 69.1% efficient (2 lamp 32W T8).
- 77.4% efficient (2 lamp 28W T5).
- Only 4-31/32" deep.
- Same fixture fits both G and T ceiling types.
- Fits flush to face of slot grid (T) ceiling.
- Injection molded light stop at basket ends.
- Ballast accessible thru lamp compartment from room side.
- Perforated lamp shield hinges from either side.
- Can be continuous row mounted.
- Wiring access plate standard.
- 2 earthquake clips standard.
- Housing is 20 gauge steel, meets NYC Code requirements.
- Construction to meet Chicago Plenum requirements is available.

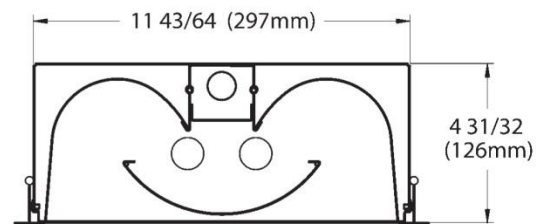


Patent number 6,746,325

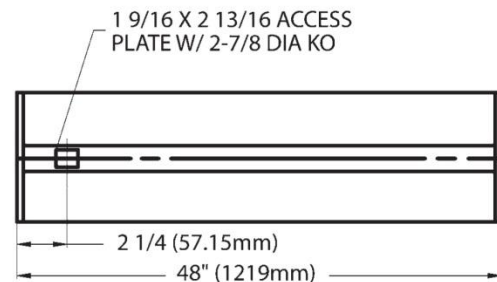
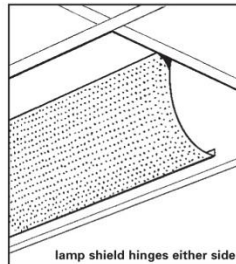
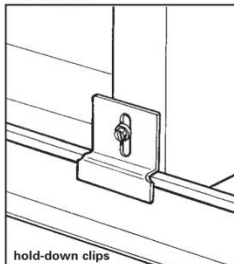
Mounting Methods



Dimensions



Features



Job Information

Type: COR-D

Job Name: Millennium Science Complex

Cat. No.: CF-S-1-G-HP-1-32-277-SO

Lamp(s): (1) F32T8

Volts/Ballast: 277V

For Factory Technical Information: (978) 657-7600 • Fax (978) 658-0595
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06/09

Section 5/Folio M15-61

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Coffaire HP CFS1GHP

Page 2 of 2

High Performance Recessed Fluorescent Direct/Indirect
1' x 4' with Perforated Basket ~ Static 1 or 2 Lamp T8 or T5

Model No. CFS1GHP232UNVHI

LER = FP - 65.7 IW - 57.4 BF - 0.88
Comparative yearly lighting energy cost per
1000 lumens = \$3.65

Report Number: G2009088

Catalog Number: CFS1GHP232UNVHI

Lamps: (2) F32T8/ADV/841/ALTO

Luminaire: Coffaire HP 1' x 4' with 95%
reflective white reflectors and
perforated basket.

Ballast: B232I-UNV-HP-B

Report is based on 3100 Lumens per lamp.

Efficiency: 69.1%

CIE Type-Direct-Indirect

Plane: 0-Deg 90-Deg

Spacing Criteria: 1.2

Shielding Angles: 90 90

Plane: 0-Deg 90-Deg

Luminous Length: 46.920 10.920

COEFFICIENTS OF UTILIZATION -
ZONAL CAVITY METHOD, EFFECTIVE
FLOOR CAVITY REFLECTANCE 0.20

RC	80	50	30	10	30	10
RW	70	50	30	10	30	10
1	72	72	69	68	66	64
2	69	63	59	60	56	53
3	63	56	50	53	48	45
4	58	50	44	47	42	38
5	53	44	38	42	37	33
6	49	40	34	38	33	29
7	46	36	30	35	30	26
8	42	33	27	32	27	23
9	40	30	25	29	24	21
10	37	28	23	27	22	19

CANDELA DISTRIBUTION

	0.0	45.0	90.0	FLUX
0	1631	1637	1637	
5	1613	1621	1630	154
15	1543	1547	1559	438
25	1419	1417	1428	655
35	1239	1229	1255	776
45	1014	1005	1050	785
55	757	758	792	681
65	491	490	502	486
75	525	236	224	248
85	50	51	51	59
90	0	0	0	

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% FIXT
0-30	1247	20.1	29.1
0-40	2023	32.6	47.2
0-60	3490	56.3	81.5
0-90	4283	69.1	100.0
90-180	0	0.0	0.0
0-180	4283	69.1	100.0

LUMINANCE DATA IN CANDELA/SQ. METER

AVERAGE IN DEG.	AVERAGE 0-DEG.	AVERAGE 45-DEG.	AVERAGE 90-DEG.
45	4337	4298	4491
55	3991	3996	4176
65	3513	3506	3592
75	2944	2757	2617
85	1735	1770	1770

Model No. CFS1GHP228120WA

LER = FP - 67.6 IW - 55.4 BF - 0.93
Comparative yearly lighting energy cost per
1000 lumens = \$3.55

Report Number: G2009092

Catalog Number: CFS1GHP228120VWA

Lamps: (2) F28T5/835/ALTO

Luminaire: Coffaire HP 1' x 4' with 95%
reflective white reflectors and
perforated basket.

Ballast: WA Energy Saver System

Report is based on 2600 Lumens per lamp.

Efficiency: 77.4%

CIE Type-Direct-Indirect

Plane: 0-Deg 90-Deg

Spacing Criteria: 1.2

Shielding Angles: 90 90

Plane: 0-Deg 90-Deg

Luminous Length: 46.920 10.920

CANDELA DISTRIBUTION

	0.0	45.0	90.0	FLUX
0	1530	1530	1530	
5	1516	1530	1530	145
15	1453	1450	1461	411
25	1335	1329	1343	615
35	1167	1157	1184	730
45	956	948	989	740
55	716	714	743	642
65	465	459	462	456
75	235	218	208	231
85	45	50	50	56
90	0	0	0	

ZONAL LUMEN SUMMARY

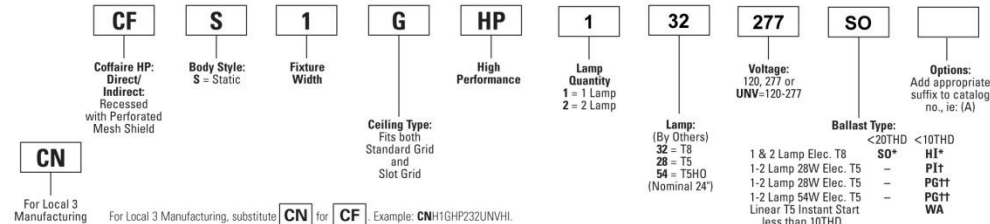
ZONE	LUMENS	% LAMP	% FIXT
0-30	1170	22.5	29.1
0-40	1900	36.5	47.2
0-60	3282	63.1	81.5
0-90	4026	77.4	100.0
90-180	0	0.0	0.0
0-180	4026	77.4	100.0

LUMINANCE DATA IN CANDELA/SQ. METER

AVERAGE IN DEG.	AVERAGE 0-DEG.	AVERAGE 45-DEG.	AVERAGE 90-DEG.
45	4089	4054	4230
55	3775	3764	3917
65	3327	3284	3306
75	2746	2547	2430
85	1561	1735	1735

Ordering Information

Explanation of Catalog Number. Example: CFS1GHP232UNVHI



Options/Accessories

Fusing: Internal fast blow fusing: SUFFIX: A

Internal slow blow fusing: SUFFIX: C

Drywall Kit: Order Catalog Number: FK91X4

Electrical Wiring Options: Consult factory.

Chicago Plenum: SUFFIX: C

Specifications

Performance: In an installation of 2 lamp 32W luminaires in a room cavity ratio of 1, with reflectance 80% ceiling, 50% wall, 20% floor, the C.U. shall not be less than .72. To reduce glare the average brightness at 65° shall not exceed 3592 candelas per square meter. To control veiling reflections, luminaire output in the 30°-90° zone shall not be less than 70.9%.

Materials: Chassis parts are die-formed code gauge steel.

Lamp Shield: 22 gauge steel perforated mesh lamp shield with unique TransOptix lens.

Finish: Chassis exterior - White baked polyester enamel. Rust preventative undercoating. **Cavity** - 95% reflective white baked polyester enamel. **Reflector** - 95% reflective Miro aluminum reflector. **Lamp Shield** - 95% reflective white baked polyester enamel.

Specifications (continued)

Electrical: Thermally protected class "P" ballast C.B.M. approved, non PCB. If K.O. is within 3" of ballast, use wire suitable for at least 90°. UL Listed for damp locations.

Labels: I.B.E.W./UL and ULc Listed.

This product may have a mercury containing lamp. Manage in accord with Disposal Laws. See: www.lamprecycle.org

Job Information

Type: COR-D

For Factory Technical Information: (978) 657-7600 • Fax (978) 658-0595
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Section 5/Folio M15-61

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Properties

Connector Element (1) Edit Type

Electrical - Loads

System Type	Power - Unbalanced
Number of Poles	1
Power Factor State	Lagging
Load Classification	Lighting
Load Sub-Classification ...	
Voltage	277.00 V
Apparent Load Phase 1	36.01 VA
Apparent Load Phase 2	0.00 VA
Apparent Load Phase 3	0.00 VA
Power Factor	0.999222

Identity Data

Utility	
Connector Description	

[Properties help](#) Apply

COR-D Revit Electrical Connector Properties.

Family Types

Name: COR-D N/E

Parameter	Value	Formula	Locked
Constraints			
Default Elevation	4' 0"		☒
Electrical			
Wattage Comments			
Lamp	F32T8 ADV835 Alto II		
Emergency	☒		
Electrical - Lighting			
Calculate Coefficient of Utilization (default)	☒		
Coefficient of Utilization (default)			
Electrical - Loads			
Load Type	Lighting		
Apparent Load	36.01 VA		
Photometrics			
Tilt Angle	-90.000°		☒
Photometric Web File	COR-D.IES		
Light Loss Factor	0.93		
Initial Intensity	3100.00 lm		
Initial Color	3500 K		
Emit from Rectangle Width	0' 10 1/16"		☒
Emit from Rectangle Length	3' 10"		☒
Emit Shape Visible in Rendering	☐		
Dimming Lamp Color Temperature Shift	<None>		
Color Filter	White		
Identity Data			
URL	http://www.lightolier.com/MKACatpdfs/CFS1GHP.		
Model	Coffaire HP		
Mfr. Catalog #	CF-S-1-G-HP-1-32-277-SO		
Manufacturer	Lightolier		
Lamp Quantity	1		☒
Lamp Code	F32T8 ADV835 ALTO II		
Keynote	COR-D		
Description	1x4 Ceiling Recessed Fluorescent Downlights		
Ballast Manufacturer	Phillips		
Ballast	ICN-2P32-SC		
Assembly Code			
Type Comments			
Cost			

OK Cancel Apply Help

COR-D Revit Family Type Data.

Office: OFF-D

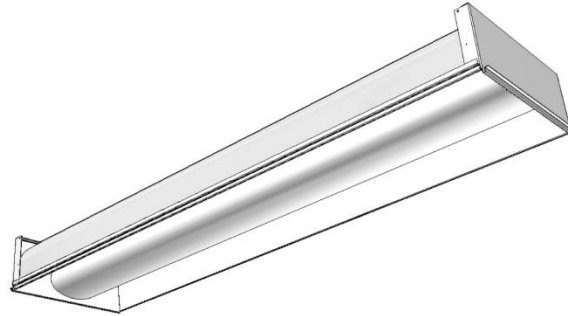
HP90 Recessed Fluorescent **H9S1GLR132 or 232**

Page 1 of 2

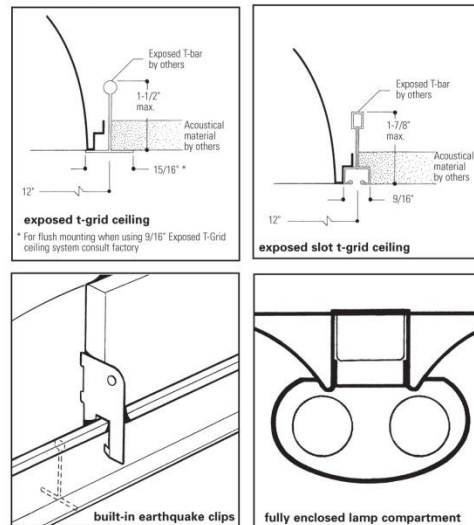
Direct/Indirect – 1' x 4' with Acrylic Linear Prismatic Lens
Static, 1 or 2 Lamp T8

Features

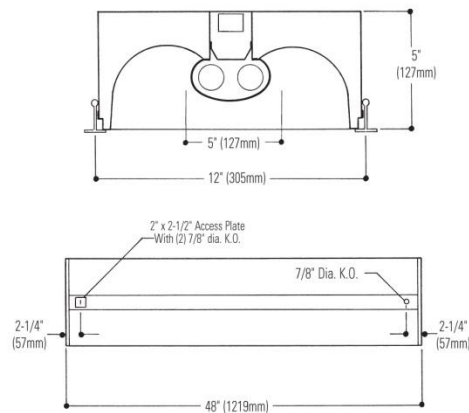
- 78.4% efficient (2 lamp, 32W T8).
- 77.8% efficient (1 lamp, 32W T8).
- Direct/indirect appearance with soft contoured interior.
- Lens encloses lamp compartment.
- Translucent DR acrylic high light transmission linear prismatic lens.
- Tension screws secure ends to body.
- Same fixture fits both G and T ceiling types.
- Fits flush to face of slot grid (T) ceiling types.
- Lamp shield opens from either side.
- 95% reflective specular aluminum reflector.
- Ballast accessible from room side.
- Built-in earthquake clips.
- Can be continuous row mounted.
- Wiring access plate standard.
- Optional DALI ballast iGEN TECHNOLOGY accepts digital dimming controllers, scene controllers and automatic control devices.
- Construction to meet NYC Code or Chicago Plenum available.



Mounting Methods



Dimensions



Job Information Type: OFF-D

Job Name: Millennium Science Complex
Cat. No.: HP-90-S1-GLR-132-277-SO
Lamp(s): (1) F32T8
Volts/Ballast: 277

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Section 5/Folio M32-19 Rev. A

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HP90 Recessed Fluorescent **H9S1GLR132 or 232**

Page 2 of 2

Direct/Indirect – 1' x 4' with Acrylic Linear Prismatic Lens
Static, 1 or 2 Lamp T8**Model No. H9S1GLR132UNVHI**LER = FP - 72.2 IW - 29.4 BF - 0.88
Comparative yearly lighting energy cost per
1000 lumens = \$3.32Report Number: G2010170
Catalog Number: H9S1GLR132UNVHI
Lamps: (1) F32 T8
Luminaire: HP90 1' x 4' with linear
prismatic lens.
Ballast: IOP1S32-SC
Report is based on 3100 Lumens per lamp.
Efficiency: 77.8%
CIE Type-Direct-Indirect
Plane: 0-Deg 90-Deg
Spacing Criteria: 1.2 1.5
Shielding Angles: 90 90
Plane: 0-Deg 90-Deg
Luminous Length: 47.040 11.040**CANDELA DISTRIBUTION**

	0.0	45.0	90.0	FLUX
0	740	740	740	
5	731	739	745	70
15	704	728	749	206
25	651	701	746	323
35	573	654	721	409
45	475	589	679	450
55	361	504	563	430
65	240	355	339	320
75	123	167	141	165
85	27	35	35	39
90	0	0	3	

**COEFFICIENTS OF UTILIZATION –
ZONAL CAVITY METHOD. EFFECTIVE
FLOOR CAVITY REFLECTANCE 0.20**

RC	80	50	30	10
RW	70	50	30	10
1	85	81	77	76
2	77	70	65	62
3	70	61	55	52
4	64	54	47	41
5	58	48	41	35
6	54	43	36	30
7	50	39	32	27
8	46	35	29	24
9	43	32	26	21
10	40	30	23	19

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% FIXT
0- 30	600	19.3	24.9
0- 40	1008	32.5	41.8
0- 60	1889	60.9	78.3
0- 90	2413	77.8	100.0
90-180	0	0.0	0.0
0-180	2413	77.8	100.0

LUMINANCE DATA IN CANDELA/SQ. METER

AVERAGE IN DEG.	AVERAGE 0-DEG.	AVERAGE 45-DEG.	AVERAGE 90-DEG.
45	2004	2485	2865
55	1878	2622	2929
65	1694	2506	2393
75	1418	1925	1625
85	924	1198	1198

Model No. H9S1GLR232UNVHILER = FP - 72.0 IW - 59.4 BF - 0.88
Comparative yearly lighting energy cost per
1000 lumens = \$3.33Report Number: G2010210
Catalog Number: H9S1GLR232UNVHI
Lamps: (2) F32 T8
Luminaire: HP90 1' x 4' with linear
prismatic lens.
Ballast: ICN-2P32-SC
Report is based on 3100 Lumens per lamp.
Efficiency: 78.4%
CIE Type-Direct-Indirect
Plane: 0-Deg 90-Deg
Spacing Criteria: 1.2 1.4
Shielding Angles: 90 90
Plane: 0-Deg 90-Deg
Luminous Length: 47.040 11.040**CANDELA DISTRIBUTION**

	0.0	45.0	90.0	FLUX
0	1603	1603	1603	
5	1587	1596	1608	152
15	1526	1552	1580	439
25	1408	1463	1519	676
35	1239	1332	1417	834
45	1028	1156	1265	889
55	787	948	1022	824
65	532	659	667	624
75	278	337	309	340
85	64	71	70	82
90	0	0	0	

**COEFFICIENTS OF UTILIZATION –
ZONAL CAVITY METHOD. EFFECTIVE
FLOOR CAVITY REFLECTANCE 0.20**

RC	80	50	30	10
RW	70	50	30	10
1	85	81	78	76
2	77	71	65	62
3	70	62	55	52
4	64	55	48	41
5	59	49	42	36
6	54	44	37	30
7	50	40	33	27
8	47	36	29	24
9	44	33	27	22
10	41	30	24	20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% FIXT
0- 30	1267	20.4	26.1
0- 40	2101	33.9	43.2
0- 60	3814	61.5	78.5
0- 90	4861	78.4	100.0
90-180	0	0.0	0.0
0-180	4861	78.4	100.0

LUMINANCE DATA IN CANDELA/SQ. METER

AVERAGE IN DEG.	AVERAGE 0-DEG.	AVERAGE 45-DEG.	AVERAGE 90-DEG.
45	4338	4878	5338
55	4094	4931	5316
65	3756	4652	4709
75	3205	3885	3562
85	2191	2431	2396

Ordering Information

Explanation of Catalog Number. Example: H9S1GLR232UNVHI

HP90 HP90 Direct/Indirect Recessed	S Body Style: S = Static	1 Fixture Width	G Ceiling Type: Fits both Standard Grid and Slot Grid	L Acrylic Lens	R Reflector: Specular Aluminum	1 Lamp Quantity 1=1 Lamp 2=2 Lamp	32 Lamp: (By Others) 32-T8 32W * (Nominal 48") * 28W T8 available	277 Voltage: 120, 277 or UNV=120-277	SO Ballast Type: 1 or 2 Lamp Elec. T8 1 or 2 Lamp Elec. T8 LOL Dimming T8 *Instant Start Standard †Program Start Other dimming options. Consult factory. NOTE: For T8 UNV, you must use HI Ballast Code.	Options: Add appropriate suffix to catalog no., ie: (A) <10THD HI * P2 † PS
H9 Standard HP90										
HY For NYC Code – I.B.E.W. Manufactured										

Options/Accessories**Fusing:** Internal fast blow fusing: SUFFIX: A.
Internal slow blow fusing: SUFFIX: C.**Drywall Kit:** Order Catalog Number: FK91X4.**Electrical Wiring Options:** Consult factory.**For motion or light sensor:** See Folio OA20-10.**Specifications****Performance:** In an installation of 2 lamp 32W luminaires in a room cavity ratio of 1, with reflectance 80% ceiling, 50% wall, 20% floor, the C.U. shall not be less than .81. To reduce glare the average brightness at 65° shall not exceed 4709 candelas per square meter. To control veiling reflections, luminaire output in the 30°-90° zone shall not be less than 73.9%.**Materials:** Chassis parts are die-formed code gauge steel.**Lamp Shield:** Linear prismatic translucent DR acrylic lens.**Specifications (continued)****Finish:** Chassis exterior – baked white polyester enamel.**Cavity** – baked white polyester enamel. Rust preventative undercoating. **Reflector** – low iridescence specular aluminum 95% reflectance.**Electrical:** Thermally protected class "P" ballast C.B.M. approved, non PCB. If K.O. is within 3" of ballast, use wire suitable for at least 90°.

UL Listed for damp locations.

Labels: I.B.E.W./UL and ULc Listed.

This product may have a mercury containing lamp. Manage in accord with Disposal Laws. See: www.lamprecycle.org

Job Information**Type:** OFF-D**PHILIPS**
LIGHTOLIER®For Factory Technical Information: (978) 657-7600 • Fax (978) 658-0595 12/10
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Properties

Connector Element (1) Edit Type

Electrical - Loads

System Type: Power - Unbalanced

Number of Poles: 1

Power Factor State: Lagging

Load Classification: Lighting

Load Sub-Classificati...: ☐

Voltage: 277.00 V

Apparent Load Phase 1: 27.70 VA

Apparent Load Phase 2: 0.00 VA

Apparent Load Phase 3: 0.00 VA

Power Factor: 0.975000

Identity Data

Utility: ☐

Connector Description:

Properties help Apply

Figure 189: CFR-D Revit Electrical Connector Properties.

Family Types

Name: CFR-D

Parameter	Value	Formula	Lock
Constraints			
Default Elevation (default)	4' 0"	=	☐
Electrical			
Lamp	PL-T CFTR32W/GX24q	=	
Wattage Comments	32	=	
Electrical - Lighting			
Calculate Coefficient of Utilization (d)	☒	=	
Coefficient of Utilization (default)		=	
Electrical - Loads			
Load Type	Lighting	=	
Apparent Load	27.70 VA	=	
Dimensions			
Depth	0' 8"	=	☒
Diameter	0' 7 1/4"	=	☒
Photometrics			
Tilt Angle	90.000°	=	☒
Photometric Web File	P4-E4DLCBH-261TTT.jes	=	
Light Loss Factor	0.74	=	
Initial Intensity	1400.00 lm	=	
Initial Color	3500 K	=	
Dimming Lamp Color Temperature S	<None>	=	
Color Filter	White	=	
Identity Data			
URL	http://www.kurtversen.com/Catalog/Leafs/Sect	=	
Model	H8632-SW-WT	=	
Manufacturer	Kurt Verson	=	
Light Fixture Type	DC-1	=	
Description	4.5" x 4.5" recessed medium beam downlight lumi	=	
Ballast Manufacturer	Lutron EcoSystem	=	
Ballast	EC5-T832-G-UNV-317L	=	
Assembly Code	D5020220	=	
Keynote	CFR-D	=	
Type Comments		=	
Cost		=	

Family Types: New..., Rename..., Delete

Parameters: Add..., Modify..., Remove

OK Cancel Apply Help

Figure 190: CFR-D Revit Family Type Data.





The Building Stimulus

Paul Kuehnel

Mike Lucas

Sara Pace

Jon Brangan

Exterior Plaza: CAN-Ua

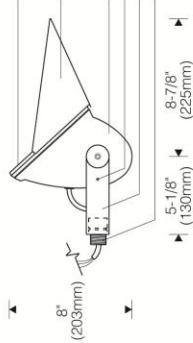
Millenium Science Complex

University Park, PA

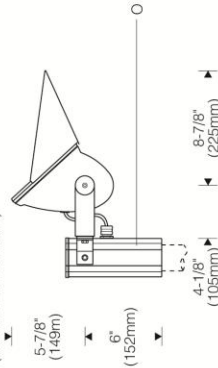
Style 152

Uplighting Large outdoor, remote

V Mount 1:10 Scale



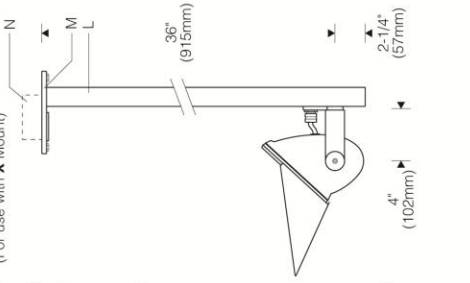
Side-Mount Slipfitter 1:12 Scale (For use with X Mount)



Wattage	Source	Length
150	MH	12-1/16" (306mm)
300-500	Halogen	
210-400	MH	17-13/16" (452mm)
900, 1000	Halogen	24-7/8" (632mm)
2x400	MH	

*Yoke includes (2) 9/32" diameter holes at 12" (305mm) centers for supplemental mounting support (1/4" fasteners by others).

Cantilever 1:12 Scale (For use with X Mount)



Tungsten Halogen

Metal Halide



Specifications

- A** Mirrored extruded aluminum door with silicone gasket
- B** Cutoff visor (included)
- C** Clear, flat, thermal and impact resistant tempered glass lens
- D** Tamper-resistant captive door screws
- E** Die-cast aluminum end plates
- F** Locking set screw
- G** Aluminum yoke
- H** 1/2" NPT nipple
- J** Aluminum reveal plates (black)
- K** Specular extruded aluminum reflector
- L** 1-1/2" x 2" aluminum arm
- M** Welded aluminum mounting plate with splice access cover
- N** Recessed outlet box
- O** Accessory extruded aluminum slipfitter for 2-3/8" O.D. pole or tenon

Finish:

Exterior surfaces – 6 stage pretreatment and electrostatically applied thermoset polyester powder coating for a durable abrasion, fade and corrosion resistant finish. Choice of semi-gloss colors (see ordering information).

Reflector and internal end plates – extruded high purity aluminum with clear anodized specular finish. All hardware and components – non-corrosive stainless steel or aluminum. Door secured with captive tamper-resistant (#10 Torx) screws in stainless steel threaded reflector inserts to prevent seizing. Yoke attaches with recessed hex socket screws.

Mounting:

1/2" NPT nipple (wet location outlet box or fitting by others). Aluminum cantilever mounting assembly ordered separately; specify **X** mount. Suitable backing structure required.

Accessory slipfitter ordered separately. Top-mount for single unit, or side-mount for one or two (back-to-back) units; specify **X** mount. Fits 2-3/8" O.D. stanchion, pole or tenon (by others).

Standard:

UL listed or CSA certified for wet locations.

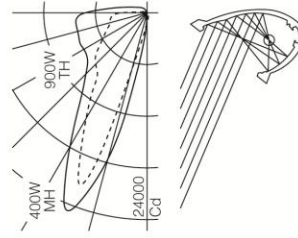
REV. 8/08

Features

- Compact yet powerful – up to 1000W halogen, 2x400W metal halide for uplifting large vaults, canopies or arches
- Lamp support on mogul base lamps ensures arc tube is in optical center
- Built to last – all aluminum and stainless steel components, tempered glass lens, tamper-resistant door screws

Performance

Two parabolic reflector sections drive light across the overhead plane from one edge. An elliptical section redirects its light to a parabola and shields the lamp. Asymmetry is maximized resulting in high beam efficiency and superior surface uniformity. The fast "runback" minimizes wasted spill light. Wide lateral distribution permits greater spacings.



For complete photometrics, visit www.elliptipar.com

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To Order

To form a Catalog Number

M 1 5 2 - 210C - V - 06 - 2 - V 0 0

1 2 3 4 5 6 7 8

1 Source

M = Metal halide
T = Tungsten halogen

2 Style

152 = Large outdoor, remote ballast

3 Lamp

Lamp Code	Watt-age	Lamp Number	Volt-ages	Remote Distance
Ceramic Arc Tube Pulse Start Metal Halide (90+ CRI)				
210C	210	CDM210/T9/930/U/E	2, U	30' (9m)
315C	315	CDM315/T9/930/U/E	2, U	30' (9m)
Ceramic Arc Tube Pulse Start Metal Halide (80+ CRI)*				
150G	150	CDM150/T6/830	1, 2 T, U	15' (4.5m) 5' (1.5m)
250C	250	CMH250/U/830/R	A, B	50' (15m)
400C	400	CMH400/U/830/R	A, B	50' (15m)
240C	2x400	(2) CMH400/U/830/R	A, B	50' (15m)
Quartz Arc Tube Pulse Start Metal Halide (68 CRI)*				
250P	250	MS 250W/H75/ T15/PS/740	A, B 2, U	50' (15m) 16' (4.8m)
320P	320	MS 320W/H75/ T15/S/PS/740	A, B 2, U	50' (15m) 16' (4.8m)
350P	350	MS 350W/H75/ T15/PS/740	A, B 2, U	50' (15m) 16' (4.8m)
Tungsten Halogen				
0300	300	Q300T3	A	
0350	350	Q350T3/CL/HIR	A	
0500	500	Q500T3	A	
0900	900	Q900T3/CL/HIR	B, G	
1000	1000	Q1000T3	A, F, G	

For complete lamp and ballast information, see Accessories Section.
* Use only clear metal halide horizontal or universal position lamp with compact envelope. Standard lamp colors are 3000K for Ceramic Arc Tube Pulse Start lamps and 4000K for Quartz Arc Tube Pulse Metal Halide lamps.



Project: Millennium Science Complex

4 Mounting

V = External yoke with 1/2" NPT nipple (wet location outlet box or fitting by others)
X = External yoke for use with accessory cantilever or slipfitter (order separately)

5 Finish

02 = Semi-gloss white
06 = Dark bronze
07 = Silver
08 = Semi-gloss black
12 = Green
99 = Custom RAL or computer matched color to be specified, consult sales representative.

6 Voltage

Electronic (Metal Halide only):
1 = 120V
2 = 277V
T = 120V dim*
U = 208-277V dim*
Magnetic and Tungsten Halogen:
A = 120V
B = 277V
F = 220V (TH)
G = 240V (TH)
*100-50% dimming, 0-10V compatible controls by others. Consult factory for dimming the 210W lamp.

7 Option (See Accessories Section for specifications)

V0 = Cutoff visor included, no other options
VL = Micro-prismatic tempered glass lens (replaces clear, flat lens, offers smoother light pattern at reduced peak candlepower)
VR = Halogen standby lamp with relay field connected at remote ballast, 100W maximum (lamp included). Not available for 2x400W.
VX = For modification not listed, include detailed description. Consult factory prior to specification.
Note: Cutoff visor included unless specified otherwise.

8 Standard

0 = UL, Underwriters Laboratories
J = CSA, Canadian Standards Association

Example

M152 - 0400 - V - 07 - B - V00

Large outdoor model for use with 400 watt ceramic arc tube pulse start metal halide lamp. External yoke with 1/2" NPT nipple. Silver powder coat finish. Remote 277V ballast in weatherproof enclosure. UL, Cutoff visor included.

Style 152

Type: CAN-Ua

Accessories

Order separately. See Accessories Section for specifications.

AC = Cantilever, 36" (914mm) setback (for use with X mount unit)
0 = UL
J = CSA
5 Finish
L = single unit
U = double unit (back to back)

ASF T10 = Top-mount slipfitter, for 2-3/8" O.D. pole, stanchion or tenon (for use with single X mount unit)
5 Finish

ASF S0 = Side-mount slipfitter, for 2-3/8" O.D. pole, stanchion or tenon (for use with X mount units)
1 = single unit
2 = double unit (back to back)
5 Finish

AE V000 = External vertical blade baffle, black, for lengthwise shielding
2 = 25° shielding
4 = 45°
C = 300W-350W TH; 150W MH (not for use with 500W TH)
D = 210-400W MH
F = 900W, 1000W TH, 2x400W MH

AXF = Wet location color filter assembly, interchangeable frame with striped color glass, visor.
Not suitable for all lamp wattages. Consult factory for complete specifications and ordering information.

AFK000X 0 = Ballast fuse kit
0 = UL
J = CSA

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REV. 7/09



Exterior Plaza: CAN-UB

Style 151

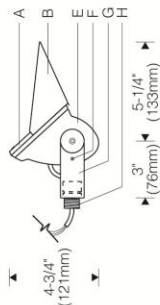
Uplighting

Small outdoor, remote

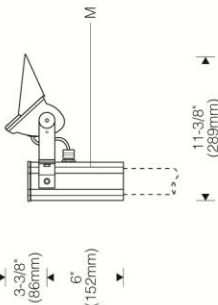


V Mount

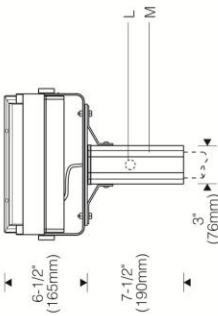
1:8 Scale



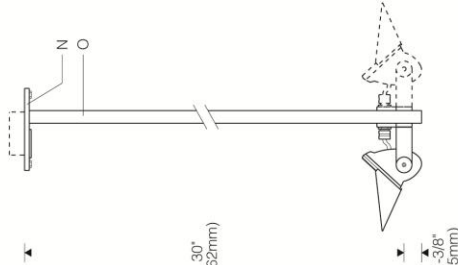
Side-Mount Slipfitter

1:12 Scale
(For use with X Mount)

Top-Mount Slipfitter

1:12 Scale
(For use with X Mount)

Cantilever

1:12 Scale
(For use with X Mount)

Specifications

- A** Mitred extruded aluminum door frame with silicone gasket
- B** Cutoff visor (included)
- C** Micro-prismatic, thermal and impact resistant tempered glass lens
- D** Tamper-resistant captive door screws
- E** Die-cast aluminum end plates
- F** Locking set screw
- G** Aluminum yoke

Finish:

Exterior surfaces – 6 stage pretreatment and electrostatically applied thermoset polyester powder coating for a durable abrasion, fade and corrosion resistant finish. Choice of semi-gloss colors (see ordering information).

Reflector – extruded high purity aluminum with clear anodized specular finish. All hardware and components – non-corrosive stainless steel or aluminum. Door secured with captive tamper-resistant (#10 Torx) screws in stainless steel threaded reflector inserts to prevent seizing. Yoke attaches with recessed hex socket screws.

Mounting:

1/2" NPT nipple (wet location outlet box and outlet box cover or fitting by others).

Aluminum cantilever mounting assembly ordered separately; specify **X** mount. Suitable backing structure required.

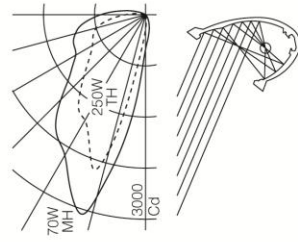
Accessory slipfitter ordered separately. Top-mount for single unit, or side-mount for one or two (back-to-back) units; specify **X** mount. Fits 2-3/8" O.D. stanchion, pole or tenon (by others).

Features

- Compact size, minimal setbacks and wide spacings – ideal for unobtrusive uplighting of soffits, canopies, vaults
- Durable and secure – thermal and impact resistant lens, tamper-resistant fasteners, set screw in yoke locks aiming
- Precured silicone gaskets, unique flush cord entry – seal out dirt and moisture, maintain performance

Performance

Two parabolic reflector sections drive light across the overhead plane from one edge. An elliptical section redirects its light to a parabola and shields the lamp. Asymmetry is maximized resulting in high beam efficiency and superior surface uniformity. The fast "runback" minimizes wasted spill light. Wide lateral distribution permits greater spacings.



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Electrical:

Use 90°C wire for supply connections. Leads exit reflector through watertight flush cord entry and silicone coated fiberglass sleeving with 8" (2m) exposed beyond nipple. 60" (1.5m) leads for **X** mount.

Tungsten halogen – recessed single contact (RSC) or DC bayonet lampholders retained with patented clamping supports for maximum heat dissipation.

Metal halide – G12 lampholder for use with single ended lamp. Remote high reactance autotransformer ballast (-20°F/-30°C starting) or electronic ballast (5°F/-15°C starting). Die-cast aluminum weatherproof ballast enclosure includes four 1/2" NPT threaded entries. Electronic ballast provides improved voltage regulation, energy savings and automatic shut-off feature to eliminate end-of-life lamp cycling. Optional remote ballast for dry indoor location.

For complete ballast specifications, see Accessories Section.

Standard:

UL listed or CSA certified for wet locations.

To Order

To form a Catalog Number

M 1 5 1 - 070G - X - 06 - 2 - V 0 0
1 2 3 4 5 6 7 8

1 Source

M = Metal halide
T = Tungsten halogen

2 Style

151 = Small outdoor, remote ballast

3 Lamp

Lamp Code	Wattage	Lamp Number	Voltages	Remote Distance
Ceramic Arc Tube Pulse Start Metal Halide (80+ CRI)* 				
035G	35	CDM35/T6/830	1, 2	15' (4.5m)
			A, B	10' (3m)
070G	70	CDM70/T6/830	1, 2	15' (4.5m)
			A, B	20' (6m)
150G	150	CDM150/T6/830	1, 2	15' (4.5m)
			A, B	10' (3m)
Tungsten Halogen 				
0100	100	Q100DC	A	
0150	150	Q150DC	A	
0200	200	Q200T3	A	
0250	250	Q250DC	A	

* For complete lamp and ballast information, see Accessories Section.
* Standard lamp color is 3000K/80+ CRI.

4 Mounting

V = External yoke with 1/2" NPT nipple (wet location outlet box and outlet box cover or fitting by others)
X = External yoke for use with accessory cantilever or slipfitter (order separately)

5 Finish

02 = Semi-gloss white
06 = Dark bronze
07 = Silver
08 = Semi-gloss black
12 = Green
99 = Custom RAL or computer matched color to be specified, consult sales representative.

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10/10

Project: **Millennium Science Complex**

6 Voltage/Ballast

Electronic
1 = 120V
2 = 277V
Magnetic
A = 120V
B = 277V

7 Option

(see Accessories Section for specifications)
V0 = Cutoff visor included, no other options
VD = Remote ballast for dry indoor location (not for use with 150W magnetic)
VH = Long distance remote metal halide magnetic ballast
35W: 15' minimum up to 50' maximum (4.5m - 15m)
70W: up to 50' maximum (15m)
150W: up to 50' maximum (15m)
VR = Halogen standby lamp with relay field connected at remote ballast. Lamp included (wattage varies).
VX = For modification not listed, include detailed description. Consult factory prior to specification.
Note: Cutoff visor included unless specified otherwise.

8 Destination Requirement

0 = UL listed or CSA certified for U.S.
J = UL listed or CSA certified for Canada

Example

M151 - 150G - X - 06 - 1 - VDJ

Small outdoor model for use with 150 watt metal halide lamp. External yoke for use with accessory cantilever or slipfitter (order separately). Dark bronze powder coat finish. Remote encapsulated 120V electronic ballast suitable for dry indoor location. UL listed or CSA certified for Canada. Cutoff visor included.

Style 151

Type: **CAN-Ub**

Accessories

Order separately. See Accessories Section for specifications.

AC ☐ 30 ☐ = Cantilever, 30" (760mm) setback (for use with X mount unit)
0 = U.S.
J = Canada
5 Finish
S = single unit
V = double unit (back to back)

ASF ☐ T10 = Top-mount slipfitter, for 2-3/8" O.D. pole, stanchion or tenon (for use with single X mount unit)
5 Finish

ASF ☐ S ☐ 0 = Side-mount slipfitter, for 2-3/8" O.D. pole, stanchion or tenon (for use with X mount units)
1 = single unit
2 = double unit (back to back)
5 Finish

AXF = Wet location color filter assembly, interchangeable frame with stripped color glass visor.
Maximum 200W TH, 70W CMH.
Note: Consult factory for complete specifications and ordering information.

AEBV ☐ 0D0 = External vertical blade baffle, black for lengthwise shielding
2 = 25° shielding
4 = 45°

AFK000X ☐ 0 = Ballast fuse kit
0 = U.S.
J = Canada

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elliptipar from The Lighting Quotient
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Voice 203.931.4455 • Fax 203.931.4464 • theLightingquotient.com

Exterior Plaza: CAN-R

IRIS®

DESCRIPTION

Recessed medium beam lens downlight luminaire with 4 inch square aperture utilizing horizontal T6 G12 ceramic metal halide lamp. Modular platform can be reconfigured from below the ceiling to accept a broad range of lamp modules and optical elements. Platform is suitable for shallow plenum commercial construction. Insulation must be kept 3" from top and sides of housing. Platform + module + element combination produces square distribution with excellent light control and low aperture brightness.

Catalog #	P406TAT-MH4CMH-39T6E-E4CMHCB-MB	Type	CAN-R
Project	Millennium Science Complex	Date	3/9/2011
Comments			
Prepared by	MWL		

SPECIFICATION FEATURES

Frame

Galvanized steel plaster frame with integral bar hanger receivers. Set-screws provide positive horizontal locking.

Collar

Matte black steel collar adjusts vertically for 1/2" - 1" thick ceilings and can be rotated +/- 7.5° thru the aperture. Integral gun sights facilitate the use of guide strings or laser lines. Shipped with a paint overspray protector installed in the collar.

Lamp Module

Installed or removed thru the aperture or from the top and allows lamp orientation at 0°, 90°, 180° and 270° positions.

Housing

Steel housing painted matte black for a visually dark interior. Removable hinged top allows for top access. All fasteners are captive.

Gaskets

Closed cell gaskets achieve restrictive airflow requirements without additional caulking.

Optical Element

Mousetrap type springs pull flange tight to ceiling. Light trap eliminates spill light at edge of flange and reflector. Available in self-flanged or metal trim ring versions. May also be installed rimless using optional plastering lathing ring.

Bar Hangers

Captive preinstalled bar hangers adjusts from 8-1/2" to 24" wide; pass thru feature allows shortening without removal. Captive nail penetrates standard and engineered lumber. Mounting flange levels platform with ceiling. Integral clip attaches directly to t-bar.

Butterfly Bracket

Provides 3" of vertical adjustment and accept 1/2" EMT, C channel or bar hangers.

Primary Reflector

Miro® segmented upper reflector yields a smooth square beam with medium distribution. Accepts 20W, 39W or 70W T6 G12 ceramic metal halide lamps and will not accept lower CRI type lamps.

Lower Reflector

Aluminum parabolic shielding prismatoid with integral diffuse glass lens provides for 55° cutoff and is available in a wide range of semi specular Alzak® finishes. Corrugated Baffle: An optional embossed pattern that extends through the flange adding a subtle design element and reduces aperture brightness.

Junction Box

(7) 1/2" trade size pry outs, (3) integral clamps for non-metallic cable. Rated for (8) #12 thru branch circuits. Wago® type push wire connectors for field connections

Ballast

Universal input electronic ballast provides full light output and rated lamp life. Provides noise free operation and starting. Offers excellent line voltage regulation resulting in increased color stability and flicker free operation.

Thermal Protector

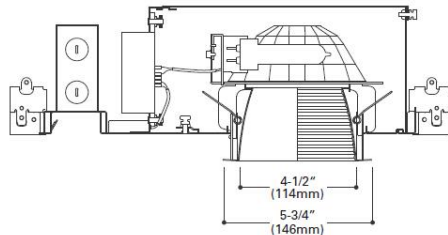
Self-resetting thermal protector protects against improper lamping and direct contact with insulation.

Lamp Socket

Pulse rated ceramic G12 lampholder connects to ballast with electrical quick connects.

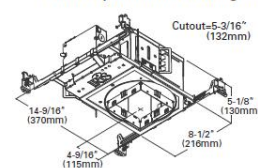
Code Compliance

Thermally protected and cULus listed for protected wet locations and ASTM-E283 AIRTITE(tm).



P406TAT
MH4CMH20T6E
MH4CMH39T6E
MH4CMH70T6E
E4CMH
E4CMHCB
20/39/70W T6
Ceramic Metal
Halide

4 Inch Square Lens Downlight



ENERGY DATA		Min. Starting Temp -30°C	
Sound Rating Class A	EMV/RFI Emissions FCC 18C		
Input Frequency 50/60 Hz	Power Factor > 0.99		
Input Voltage 160V - 305V	THD < 10%		
20W	Input Power	20W	Nominal
	Input Current	120V 0.20A	277V 0.09A
39W	Input Power	44W	Nominal
	Input Current	120V 0.37A	277V 0.16A
70W	Input Power	77W	Nominal
	Input Current	120V 0.65A	277V 0.28A

ORDERING INFORMATION: Complete unit consists of platform, lamp module and optical element.

Platform	Lamp Module	Ballast Option	Optical Element	Finish	Flange	Accessories
	MH4CMH					
P406TAT = 4" Square Aperture Non-IC Housing P406TCP = 4" Square Aperture Non-IC Chicago Plenum Housing	20T6E = 20W T6 G12 CMH 120-277 UNV 39T6E = 39W T6 G12 CMH 120-277 UNV 70T6E = 70W T6 G12 CMH 120-277 UNV		Alzak® Finishes H = Clear Haze WMH = Warm Haze WHH = Wheat Haze KH = Cognac Haze	[Blank] = Metal Trim Ring, Matte White SF = Self Flanged SFWF = Self Flanged, Matte White Flange (SFWF not available with corrugated baffle)		Accessories PLR4x4 = Plaster lathing ring for rimless RLA4x4 = Rimless adapter for solid ceiling surfaces EDC4x41 = Extended depth collar for 1" - 1-1/2" thick ceilings EDC4x42 = Extended depth collar for 1-1/2 - 2" thick ceilings L4X4HEX = Matte black hex cell louver MTR4MW = Metal trim ring, matte white MTR4MB = Metal trim ring, matte black MTR4SN = Metal trim ring, satin nickel MTR4AC = Metal trim ring, antique copper MTR4TBZ = Metal trim ring, tuscan bronze
MH4CMH = Horizontal Ceramic Metal Halide, Lamp Module	E4CMH = 4" Square Aperture Lower Shielding Prismatoid, Lens E4CMHCB = 4" Square Aperture Corrugated Lower Shielding Prismatoid, Lens		BH = Black Haze Painted Finishes MW = Matte White MB = Matte Black			

COOPER Lighting
www.cooperlighting.com

Specifications and Dimensions subject to change without notice.

Consult your representative for additional options and finishes.

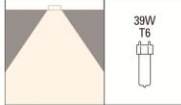
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P406TAT-MH4CMH20T6E-E4CMH

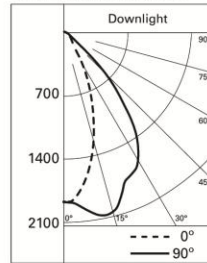
Photometric Results

Spacing Criterion = .6, 1.3
Efficiency = 59.9%

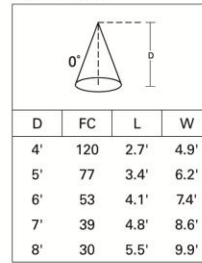
Test No. P11040
Platform = P4
Element = E4CMH
Lumens = 3300
Lamp = CMH39/T6/G12



Candlepower Distribution



Cone of Light



Candelas

Vertical Angle	CD
90	0
85	3
75	15
65	37
55	76
45	127
35	222
25	658
15	1259
5	1778
0	1852

Zonal Lumens Summary

Zone	Lumens	% Lamp	% Luminaire
0- 30	1198	36.3	60.6
0- 40	1623	49.2	82.2
0- 60	1918	58.1	97.1
0- 90	1976	59.9	100
90-180	0	0	0
0-180	1976	59.9	100

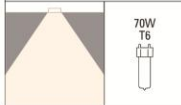
Coefficients of Utilization

Ceiling Wall % RCR	70 50 30 10	70 50 30 10	50 30 10	50 30 10	50 30 10	0
Zonal cavity method -- floor reflectance = 20%						
0	71 71 71 71	70 70 70 70	67 67 67	64 64 64	61 61 61	60
1	68 66 64 63	66 64 63 62	62 61 60	60 59 58	58 57 56	55
2	64 60 58 55	62 59 57 55	57 55 54	56 54 52	54 53 51	50
3	60 56 52 50	59 55 52 49	53 51 49	52 50 48	50 49 47	46
4	57 52 48 45	55 51 47 45	50 47 44	48 46 44	47 45 43	42
5	53 48 44 41	52 47 44 41	46 43 41	45 42 40	44 42 40	39
6	50 45 41 38	50 44 40 38	43 40 37	42 39 37	41 39 37	36
7	48 42 38 35	47 41 37 35	40 37 35	40 37 34	39 36 34	33
8	45 39 35 32	44 39 35 32	38 35 32	37 34 32	37 34 32	31
9	43 37 33 30	42 36 33 30	36 32 30	35 32 30	35 32 30	29
10	41 34 31 28	40 34 31 28	34 30 28	33 30 28	33 30 28	27

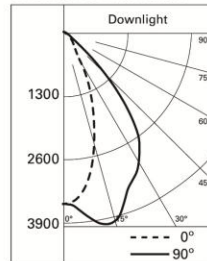
Photometric Results

Spacing Criterion = .7, 1.3
Efficiency = 59.9%

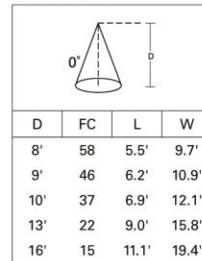
Test No. P11038
Platform = P4
Element = E4CMH
Lumens = 6600
Lamp = CMH39/T6/G12



Candlepower Distribution



Cone of Light



Candelas

Vertical Angle	CD
90	0
85	4
75	28
65	70
55	142
45	239
35	422
25	1231
15	2361
5	3363
0	3470

Zonal Lumens Summary

Zone	Lumens	% Lamp	% Luminaire
0- 30	2331	35.3	60.3
0- 40	3167	48	81.9
0- 60	3753	56.9	97
0- 90	3868	58.6	100
90-180	0	0	0
0-180	3868	58.6	100

Coefficients of Utilization

Ceiling Wall % RCR	70 50 30 10	70 50 30 10	50 30 10	50 30 10	50 30 10	0
Zonal cavity method -- floor reflectance = 20%						
0	70 70 70 70	68 68 68 68	65 65 65	62 62 62	60 60 60	59
1	66 64 63 61	65 63 61 60	61 59 58	58 57 57	56 56 55	54
2	62 59 56 54	61 58 56 54	56 54 52	54 53 51	53 51 50	49
3	59 54 51 49	57 54 51 48	52 50 47	51 48 47	49 47 46	45
4	55 50 47 44	54 50 46 44	48 46 43	47 45 43	46 44 42	41
5	52 47 43 40	51 46 43 40	45 42 40	44 41 39	43 41 39	38
6	49 44 40 37	48 43 39 37	42 39 36	41 38 36	40 38 36	35
7	47 41 37 34	46 40 37 34	39 36 34	39 36 34	38 35 33	32
8	44 38 34 32	43 38 34 31	37 34 31	36 33 31	36 33 31	30
9	42 36 32 29	41 35 32 29	35 31 29	34 31 29	34 31 29	28
10	40 34 30 27	39 33 30 27	33 30 27	32 29 27	32 29 27	26



IRIS®

DESCRIPTION

Recessed lens wall wash luminaire with 4 inch square aperture utilizing horizontal T6 G12 ceramic metal halide lamp. Modular platform can be reconfigured from below the ceiling to accept a broad range of lamp modules and optical elements. Platform is suitable for shallow plenum commercial construction. Insulation must be kept 3" from top and sides of housing. Platform + module + element combination produces smooth vertical illumination with a minimal downlight component.

Catalog #	P406TAT-MH4CMH-39T6E-E4L-WW-BH-SF-MTR-4MB	Type
Project	Millennium Science Complex	CAN-W
Comments		Date
Prepared by	MWL	

SPECIFICATION FEATURES

Frame

Galvanized steel plaster frame with integral bar hanger receivers. Setscrews provide positive horizontal locking.

Collar

Matte black steel collar adjusts vertically for 1/2" - 1" thick ceilings and can be rotated +/- 7.5° thru the aperture. Integral gun sights facilitate the use of guide strings or laser lines. Shipped with a paint overspray protector installed in the collar.

Lamp Module

Installed or removed thru the aperture or from the top and allows lamp orientation at 0°, 90°, 180° and 270° positions.

Housing

Steel housing painted matte black for a visually dark interior. Removable hinged top allows for top access. All fasteners are captive.

Gaskets

Closed cell gaskets achieve restrictive airflow requirements without additional caulking.

Optical Element

Mousetrap type springs pull flange tight to ceiling. Light trap eliminates spill light at edge of flange and reflector. Available in self-flanged or metal trim ring versions. May also be installed rimless using optional plastering lathing ring.

Bar Hangers

Captive preinstalled bar hangers adjust from 8-1/2" to 24" wide; pass thru feature allows shortening without removal. Captive nail penetrates standard and engineered lumber. Mounting flange levels platform with ceiling. Integral clip attaches directly to t-bar.

Butterfly Bracket

Provides 3" of vertical adjustment and accept 1/2" EMT, C channel or bar hangers.

Primary Reflector

Miro® segmented upper reflector. Accepts 20W, 39W or 70W T6 G12 ceramic metal halide lamps and will not accept lower CRI lamp type.

Lower Reflector

Specular aluminum kicker reflector integral with angle cut parabolic shielding prismatoid and glass spread lens. Provides smooth vertical illumination with a minimal downlight component. Available in a wide range of semi specular Alzak® finishes.

Junction Box

(7) 1/2" trade size pry outs, (3) integral clamps for non-metallic cable. Rated for (8) #12 thru branch circuits. Wago® type push wire connectors for field connections

Ballast

Universal input electronic ballast provides full light output and rated lamp life. Provides noise free operation and starting. Offers excellent line voltage regulation resulting in increased color stability and flicker free operation.

Thermal Protector

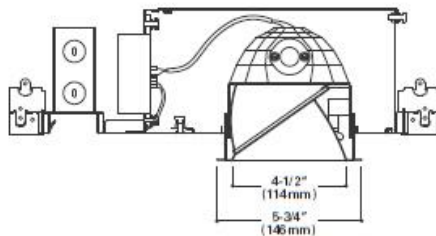
Self-resetting thermal protector protects against improper lamping and direct contact with insulation.

Lamp Socket

Pulse rated ceramic G12 lampholder connects to ballast with electrical quick connects.

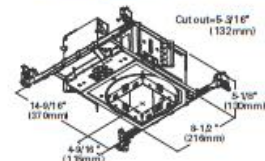
Code Compliance

Thermally protected and cULus listed for protected wet locations and ASTM-E283 AIRTITE(tm).



P406TAT
MH4CMH20T6E
MH4CMH39T6E
MH4CMH70T6E
E4LWW
20/39/70W T6
Ceramic Metal
Halide

4 Inch Square Lens Wall Wash



EMERGENCY DATA	Mix. Starting Temp. -30°C
Sound Rating Class A	EMC/RFI Emissions FCC 18C
Input Frequency 50/60 Hz	Power Factor > 0.9
Input Voltage 100V - 350V	THD < 10%
20W	Input Power 26W
39W	Input Power 44W
70W	Input Power 77W

ORDERING INFORMATION: Complete unit consists of platform, lamp module and optical element.

Platform	Lamp Module	Ballast Option	Optical Element	Finish	Flange	Accessories
P406TAT = 4" Square Aperture Non-IC Housing	MH4CMH = Horizontal Ceramic Metal Halide, Lamp Module	20T6E = 20W T6 G12 CMH 120-277 UNV 39T6E = 39W T6 G12 CMH 120-277 UNV 70T6E = 70W T6 G12 CMH 120-277 UNV		Alzak® Finishes H = Clear Haze WHH = Warm Haze WHI = Wheat Haze KH = Cognac Haze GPH = Graphite Haze CTH = Cobalt Haze CCH = Chocolate Haze BH = Black Haze Painted Finishes MW = Matte White MB = Matte Black	[Blank] = Metal Trim Ring, Matte White SF = Self Flanged SFWF = Self Flanged, Matte White Flange	PLR4x4 = Plaster lathing ring for rimless RLA4x4 = Rimless adapter for solid ceiling surfaces MTR4MW = Metal trim ring, matte white MTR4MB = Metal trim ring, matte black MTR4SN = Metal trim ring, satin nickel MTR4AC = Metal trim ring, antique copper MTR4TBZ = Metal trim ring, tuscan bronze
P406TCP = 4" Square Aperture Non-IC Chicago Plenum Housing		E4LWW = 4" Aperture Lower Shielding Prismatoid, Lens Wall Wash				

COOPER Lighting
www.cooperlighting.com

Specifications and Dimensions subject to change without notice.
Consult your representative for additional options and finishes.

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02/27/2008 9:25:00 AM

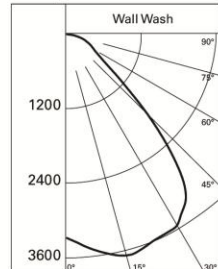
Exterior Plaza: CAN-W

P406TAT MH4CMH20T6E E4LWW

Photometric Results

Efficiency = 51.0%
Test No. P11176
Platform = P406TAT
Element = E4LWWH
Lumens = 6600
Lamp = CMH70/T6/G12

Candlepower Distribution



Candelas

CD Wall	Vertical Angle
0	90
42	85
246	75
428	65
687	55
1901	45
3324	35
3582	25
3676	15
3421	5
3271	0

Zonal Lumens Summary

Zone	Lumens	% Lamp	% Luminaire
0- 30	1854	28.1	55.1
0- 40	2527	38.3	75
0- 60	3177	48.1	94.3
0- 90	3368	51	100
90-180	0	0	0
0-180	3368	51	100

Single Unit Footcandles

		3' from wall (distance from fixture along wall)			
DD		1'	2'	3'	
1	29	14	5	2	
2	40	25	10	4	
3	75	44	15	6	
4	77	52	20	7	
5	53	42	21	9	
6	36	31	19	9	
7	24	22	16	9	
8	18	16	12	8	
9	13	12	10	7	
10	10	9	8	6	

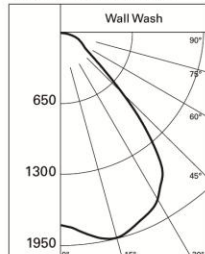
Multiple Unit Footcandles

		3' from wall (spacing between fixtures)				4' from wall (spacing between fixtures)			
		3'	4'	5'		4'	5'		
		34	18	34	31	11	31	15	7
		50	34	50	45	21	45	24	15
		88	57	88	81	33	81	32	22
		94	72	94	85	42	85	50	32
		74	69	74	62	45	62	55	40
		57	58	57	46	41	46	47	40
		46	47	46	35	35	35	39	37
		37	37	37	28	39	28	32	32
		30	30	30	23	24	23	27	28
		25	25	25	19	20	19	23	23

Photometric Results

Efficiency = 51.7%
Test No. P11174
Platform = P406TAT
Element = E4LWWH
Lumens = 3300
Lamp = CMH39/T6/G12

Candlepower Distribution



Candelas

CD Wall	Vertical Angle
0	90
19	85
117	75
196	65
297	55
822	45
1628	35
1859	25
1962	15
1837	5
1779	0

Zonal Lumens Summary

Zone	Lumens	% Lamp	% Luminaire
0- 30	978	29.6	57.4
0- 40	1312	39.7	76.9
0- 60	1615	48.9	94.7
0- 90	1705	51.7	100
90-180	0	0	0
0-180	1705	51.7	100

Single Unit Footcandles

		2' from wall (distance from fixture along wall)			
DD		1'	2'	3'	
1	37	13	4	1	
2	73	27	6	2	
3	71	37	8	3	
4	41	29	10	3	
5	24	19	10	4	
6	15	13	8	4	
7	10	9	6	3	
8	7	6	5	3	
9	5	5	4	3	
10	4	4	3	2	

Multiple Unit Footcandles

		2' from wall (spacing between fixtures)				3' from wall (spacing between fixtures)			
		2'	3'	4'		3'	4'		
		45	29	45	40	14	40	16	9
		87	60	87	78	25	78	22	16
		90	81	90	78	37	78	39	27
		65	65	65	49	39	49	45	36
		47	48	47	33	32	33	36	34
		35	35	35	24	24	24	29	29
		26	27	26	18	18	18	23	24
		20	20	20	14	14	14	19	19
		16	16	16	11	11	11	16	16
		13	13	13	9	9	9	13	13





The Building Stimulus

Paul Kuehnel

Mike Lucas

Sara Pace

Jon Brangan

Exterior Plaza: CAN-L

Millenium Science Complex

University Park, PA



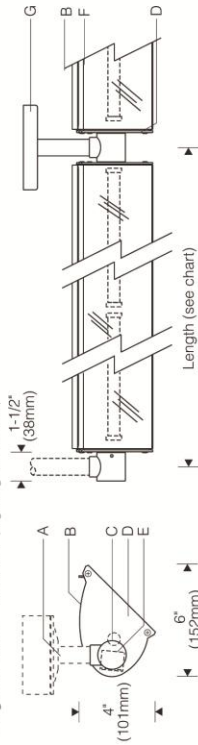
Lighting the Vertical

Medium outdoor, integral

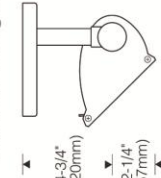
T5 Fluorescent

Style 164

Style F164 1:8 Scale (Lighting downward)

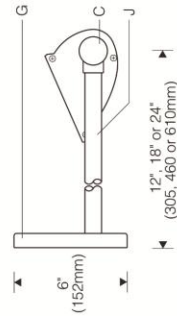


Surface Hanger

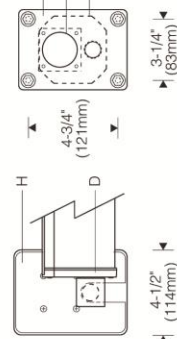


Cantilever Hanger

(Lighting upward)



Mounting Plate



Lamp Length	Length (center of hubs)
1 x 2'	25-1/4" (640mm)
1 x 3'	37" (940mm)
1 x 4'	48-3/4" (1240mm)
1 x 5'	60-5/8" (1540mm)
2 x 3'	72" (1830mm)
2 x 4'	96" (2440mm)

Specifications

- A** 1/2" fittings, rigid conduit supports (by others)
- B** Specular extruded aluminum reflector
- C** Aluminum hubs with silicone o-ring gaskets (ordered separately)
- D** Die-cast aluminum end plates
- E** Integral electronic ballast / internal wireway
- F** UV and impact resistant acrylic snap-on lens with silicone gasket
- G** Cantilever, pendant or surface hangers with hubs (ordered separately)
- H** Aluminum cover (conceals fasteners)
- J** Tubular steel arm or stem
- K** Die-cast aluminum mounting plate (fasteners by others)
- L** Outlet box access with gasketed cover (electrical feed only)
- M** Outlet box (by others)

Finish:

Exterior surfaces - 6 stage pretreatment and electrostatically applied thermoset polyester powder coating for a durable abrasion, fade and corrosion resistant finish. Choice of semi-gloss colors (see ordering information).
Reflector - extruded high purity aluminum with clear anodized specular finish. All hardware and components - non corrosive stainless steel or aluminum.
Snap-on lens - composite of impact resistant and UV stabilized acrylic. Silicone gasket for watertight operation when facing upward or downward.

Electrical:

Use 90C° wire for supply connections and through wire.
Electrical feed hanger (optional) mounts over recessed outlet box (by others) with gasketed access cover. Internal wireway allows supply wiring to be fed through mounting hub to adjacent units. Locate electrical feed at end of row.
Integral electronic HPF thermally protected class P ballast rated for 0°F/-18°C starting.

For complete ballast specifications, see Accessories Section.

REV. 6/07

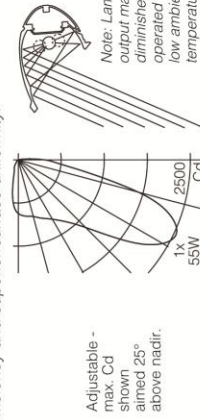
U.S. Patent 7,213,949

Features

- Reflector optimized for T5 - precise optical control for lighting facades, walls and signs from minimal setbacks
- Snap-on acrylic lens - watertight, facing up or down
- Rugged all aluminum, stainless steel construction - polyester powder coat exceeds 1000 hour salt spray test
- Versatile - surface, cantilever or pendant mount; thru wiring

Performance

Two parabolic reflector sections drive light down (or up) the vertical plane from one edge. An elliptical section redirects its light to a parabola and shields the lamp from normal viewing angles. The fast 'runback' minimizes glare and spill light. Asymmetry of the beam is maximized resulting in high beam efficiency and superior surface uniformity.



Adjustable - max. Cd shown aimed 25° above nadir.

For complete photometrics, see www.elliptipar.com.

elliptipar

To Order

To form a Catalog Number

F 1 6 4 | T128 | H | 07 | 2 | 00 | 0
1 2 3 4 5 6 7 8

1 Source

F = Linear fluorescent

2 Style

164 = Medium outdoor, integral ballast

3 Lamp

T1 28 = T5 Fluorescent Lamp Code

Lamp Wattage (see chart below)

Lamp Configuration

T1 = Single-lamp cross section, 1-lamp in length
T2 = Single-lamp cross section, 2-lamp in length
D2 = Dual-lamp cross section, 1-lamp in length
D4 = Dual-lamp cross section, 2-lamp in length
Example: T255 = Nominal 8' (2.4m) housing with (2) 54W T5HO lamps (in length)



Length (nominal)	T5		T5HO *	
	Code	Lamp(s)	Code	Lamp(s)
2' (0.6m)	T114	1 x F14T5	T124	1 x F24T5/HO
	D214	2 x F14T5	D224	2 x F24T5/HO
	T121	1 x F21T5	T139	1 x F39T5/HO
3' (0.9m)	D221	2 x F21T5	D239	2 x F39T5/HO
	T128	1 x F28T5	T155	1 x F54T5/HO
4' (1.2m)	D228	2 x F28T5	D255	2 x F54T5/HO
	T135	1 x F35T5	T180	1 x F80T5/HO
5' (1.5m)	D235	2 x F35T5	D280	2 x F80T5/HO
	T221	2 x F21T5	T239	2 x F39T5/HO
6' (1.8m)	D421	4 x F21T5	D439	4 x F39T5/HO
	T228	2 x F28T5	T255	2 x F54T5/HO
8' (2.4m)	D428	4 x F28T5	D455	4 x F54T5/HO

For complete lamp and ballast information, see Accessories Section.

Standard T5 lamp color is 3000K / 80+ CRI. T8 lamps by others.

* NEW T5HO amalgam lamps are available that produce > 90% of full light output over a broader temperature range than standard lamps - see www.elliptipar.com or consult factory for specifications.

Project: Millennium Science CComplex

4 Mounting

H = For use with mounting hubs (1/2" rigid conduit supports or fittings supplied by others), or

For use with accessory surface, pendant or cantilever hangers.

Note: Order either hubs only or hubs with hangers separately. For reflector positions other than horizontal, consult factory.

5 Finish

02 = Semi-gloss white

06 = Dark bronze

07 = Silver

08 = Semi-gloss black

12 = Green

99 = Custom RAL or computer matched color to be specified, consult sales representative.

6 Voltage/Ballast

Electronic

1 = 120V

2 = 277V

3 = 347V (Canada)*

* Consult sales representative for availability of 347V.

Dimming

Application is limited due to minimum 50°F (10°C) starting temperature; consult factory.

7 Option

00 = No options

V0 = Extruded aluminum cutoff visor

(Suggested when additional shielding is desired - see Uplighting page U-2.2 for additional information.)

XX = For modification not listed, include detailed description. Consult factory prior to specification.

8 Standard

0 = UL, Underwriters Laboratories

J = CSA, Canadian Standards Association

Example

F164 - T255 - H - 12 - 1 - 000

Medium outdoor fluorescent for use with two 54W T5HO lamps in nominal 8 foot reflector. For use with mounting hubs (1/2" rigid conduit supports by others) or accessory hangers. Green powder coat finish. Integral 2-lamp 120V electronic ballast. UL.

(Order end kit and intermediate mounting hubs or hangers separately.)

Style 164

Type: CAN-L

Hubs Only (order separately)

For use with 1/2" rigid conduit or fittings (supplied by others). Order one hub end kit for each individually mounted luminaire or each row. For a continuous row, order one intermediate hub for each additional luminaire in the row. Example: a row of five reflectors requires 1 hub end kit and 4 intermediate hubs. Note: Locate electrical feed at end of row.

HOD 00 000 = End kit (includes 2 mounting hubs)

HOC 00 000 = Intermediate mounting hub

Hubs with Hangers (order separately)

Order one hanger end kit for each individually mounted luminaire or each row. For a continuous row, order one intermediate hanger for each additional luminaire in the row. Example: two rows of four reflectors requires 2 end kits and 6 intermediate hangers. Note: Hubs included. End kit includes one electrical feed hanger - locate at end of row.

HB 00 000 = Outdoor surface hanger

A = Intermediate
B = End kit

HB 00 000 = Outdoor pendant hanger

Length, in inches, specify 12, 18, 24, 30, 36, 42, or 48

F = Intermediate
G = End kit

HB D 07 2 0 = Outdoor cantilever hanger

0 = UL
J = CSA

12 = 12" (305mm)
18 = 18" (460mm)
24 = 24" (610mm)

C = Intermediate
D = End kit

The external shapes of the asymmetric reflectors are trademarks of elliptipar. Certain products illustrated may be covered by applicable patents and patents pending. For a list of patents, see Contents pages. These specifications supersede all prior publications and are subject to change without notice. © 2007 elliptipar.

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REV. 7/07



Kipp Post

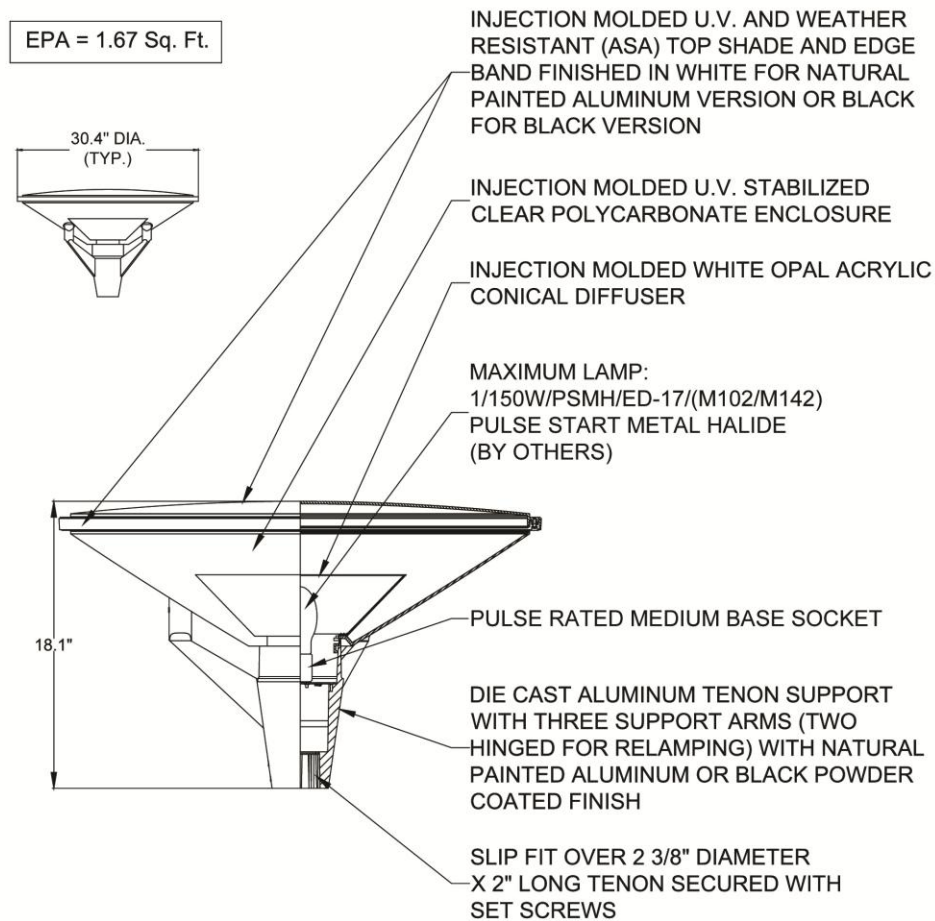
metal halide

Design: Alfred Homann

Type: XPO-1

Project: Millennium Science Complex

Catalog Number: KIP-1-150-MH-ed17



**louis
poulsen**

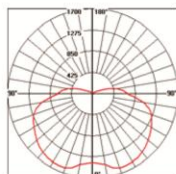
Louis Poulsen Lighting, Inc., 3260 Meridian Parkway, Fort Lauderdale, FL 33331 Telephone: (954) 349-2525 Fax: (954) 349-2550

www.louispoulsen.com

Kipp Post

post tops/poles & cable hung

metal halide



Photometric Report: KIP-Conical-175W-HID.IES
 Report No.: LP2750
 Poulsen Report No.: KIP-Conical-175W-HID.IES
 Luminaire: Kipp, Conical
 Lamp: 1/175W/MH
 Efficiency: 58.7%
 Cutoff Classification: Semi-cutoff
 Description: All data shown are per 15000 lumens. This report can be used for calculation on all versions listed below. Use only actual lumen data when calculating.

Candlepower Distribution

Vertical Angle	Candela
0	1385
5	1413
15	1540
25	1598
35	1576
45	1503
55	1401
65	1307
75	1168
90	697
120	7
150	1
180	1

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0-30	1304	8.7	14.8
0-40	2285	15.2	25.9
0-60	4658	31.1	52.9
0-90	7852	52.3	89.1
90-120	947	6.3	10.8
90-130	950	6.3	10.8
90-150	955	6.4	10.8
90-180	956	6.4	10.9
0-180	8808	58.7	100.0

Design

Alfred Homann

Concept

Kipp Post emits symmetrical, downward illumination. The relationship between the slightly curved design of the top shade and the calculated distance to the light source ensures a uniform and wide distribution of light. The design of the internal diffuser ensures an optimal and glare free illumination.

Finish

Natural painted aluminum or black, powder coated.

Material

Diffuser: Injection molded white opal acrylic. Top shade: Black or white, injection molded ASA. Enclosure: Injection molded clear polycarbonate. Frame: Die cast aluminum.

Mounting

Post top: Mounted on dual round aluminum (DRA) or round straight aluminum (RSA) pole.

Weight

Max. 24 lbs.

Label

cUL, Wet location. IBEW.

Product code	Light source	Voltage	Finish	Distribution	Transition to pole
KIP	1/150W/CMH/T-6 G12 1/150W/MH/EO-17 medium 1/85W/QL	120/277V 120V 277V	BLK NAT PAINT ALU	OPAL	T-DRA-5"-3" T-RSA-4.5"

Specification notes:

a. QL variants provided with 120V or 277V HF integral generator and can only be used with RSA-4.5" pole.
 b. CMH and MH variants provided with one 120/277V F-can style ballast to be mounted in RSA-4.5" or DRA-5"-3" poles.

Info notes:

I. Black top shade is provided with black finish.
 II. White top shade is provided with natural painted aluminum finish.
 III. Enclosure is U.V. stabilized polycarbonate.
 IV. For pole selection, refer to Pole page.
 V. The comparable EU version has the following classification: Ingress Protection Code: IP66.



Appendix I: Lighting Control Cutsheets

Student Study Area& Conference Room: LOS-CUS

Sensors	LOS-CUS Series	Occupant Sensors
---------	----------------	------------------

LOS-CUS 1 08/04/08

Ultrasonic Ceiling Mount Sensor



The LOS-CUS Series ceiling-mount ultrasonic sensors can integrate into Lutron systems or function as stand-alone controls using a Lutron power pack. Any movement within the sensor's range causes a shift in the original emitted frequency. The sensor's receiver identifies any change in frequency as motion and either turns the lights on or maintains lights on.

Features

- Intelligent, continually adapting ultrasonic sensor
- Snap-locks to ceiling-mounted cover plate
- Excellent minor motion sensitivity
- Non-Volatile Memory: settings saved in protected memory are not lost during power outages
- 500 to 2000 sq.ft. (46 to 186 m²) coverage when mounted on an 8 - 12 ft. (2.4 to 3.7 m) ceiling
- Affords choice of turning lights off or dimming to a preset level in the unoccupied state when integrated with a Lutron system.

Models Available

Cat. No.	Color	Coverage	Field of View
LOS-CUS-500-WH	White	500 sq.ft. (46 m ²)	180°
LOS-CUS-1000-WH	White	1000 sq.ft. (93 m ²)	180°
LOS-CUS-2000-WH	White	2000 sq.ft. (186 m ²)	360°

Self-Adaptive Feature

Designed to meet the challenges found in a wide variety of spaces, the LOS-CUS Series provides reliable detection with high minor motion detection. The intelligent, continually adapting sensor technology eliminates manual sensitivity and timer adjustments during installation and over the life of the product. The internal microprocessor analyzes the information from the ultrasonic technology and determines the optimum setting to use in order to properly cover the space. Should the room be reconfigured (e.g., new furniture), the software will adapt to continue to provide correct time out for the lights.

LUTRON® SPECIFICATION SUBMITTAL

Page 1

Job Name:	Model Numbers:	
Millenium Science Complex	LOS-CUS-1000	
Job Number: Building Stimulus	LOS-CUS-500	

Sensors

LOS-CUS Series

Occupant Sensors

LOS-CUS 2 09.04.08

Specifications

Timer Adjustment

- Automatic mode: Continually adapting sensor automatically adjusts settings to the space
- Manual mode: 8 to 30 minutes
- Test mode: 8 seconds

LED Lamp

- Green: ultrasonic motion detected

Housing

- Rugged, high-impact, injection-molded plastic
- Color-coded leads 6 in. (15 cm)

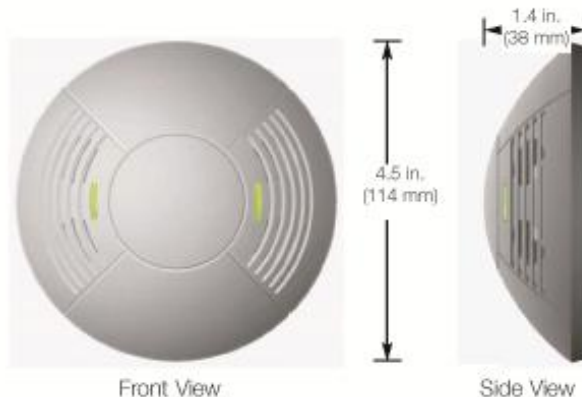
Power

- Operating voltage: 20 - 24 V_{DC}, PELV (Class 2: USA) low-voltage
- Operating current: 33 mA nominal
- Control output: 20 - 24 V_{DC} active high logic control signal with short-circuit protection, open collector when unoccupied
- UL and CUL listed

Operating Environment

- Temperature: 32 to 104 °F (0 to 40 °C)
- Relative humidity: less than 95%, non-condensing
- For indoor use only

Dimensions



OLUTRON[®] SPECIFICATION SUBMITTAL

Page 2

Job Name:	Millenium Science Complex	
Job Number:	Building Stimulus	Model Numbers:
		LOS-CUS-1000
		LOS-CUS-500



Sensors

LOS-CUS Series

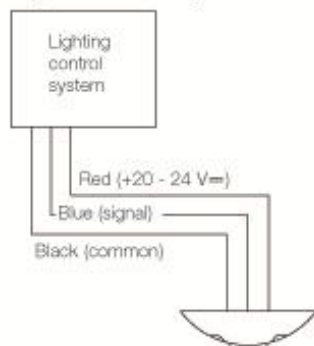
Occupant Sensors

LOS-CUS 3 09.04.08

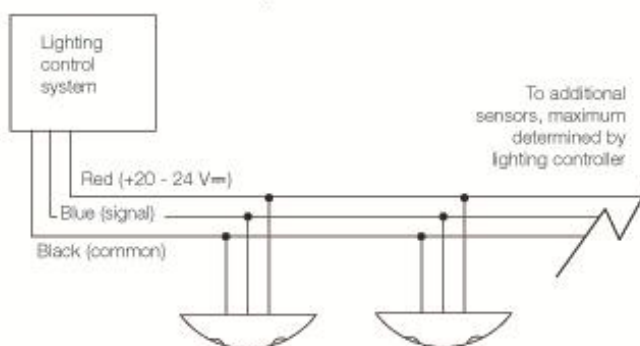
Wiring

Note: Power pack may be required when interfaced to lighting control system; see below.

Single Sensor to System



2 or More Sensors to System



Power Supply Options

Lutron Lighting Control System

Digital microWATT™

EcoSystem®

GRAFIK 5000 / 6000 / 7000

GRAFIK Eye® 3000 / 4000

HomeWorks®

LCP128™

microWATT®

RadioRA®

RadioTouch®

Softswitch128®

Power Pack Required?

No

No

No, when used with seeTouch® wallstations with occupant sensor connections.

Yes

Yes

No, when used with seeTouch wallstations with occupant sensor connections.

No

Yes

No

No, when used with seeTouch wallstations with occupant sensor connections.

LUTRON SPECIFICATION SUBMITTAL

Page 3

Job Name:

Millenium Science Complex

Job Number:

Building Stimulus

Model Numbers:

LOS-CUS-1000

LOS-CUS-500

Sensors

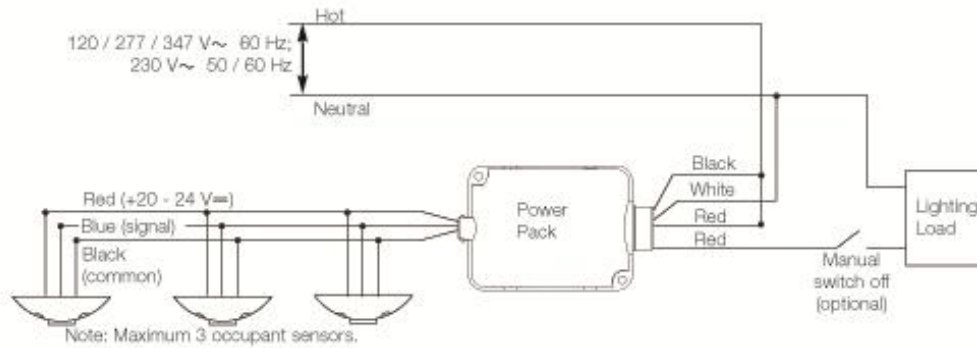
LOS-CUS Series

Occupant Sensors

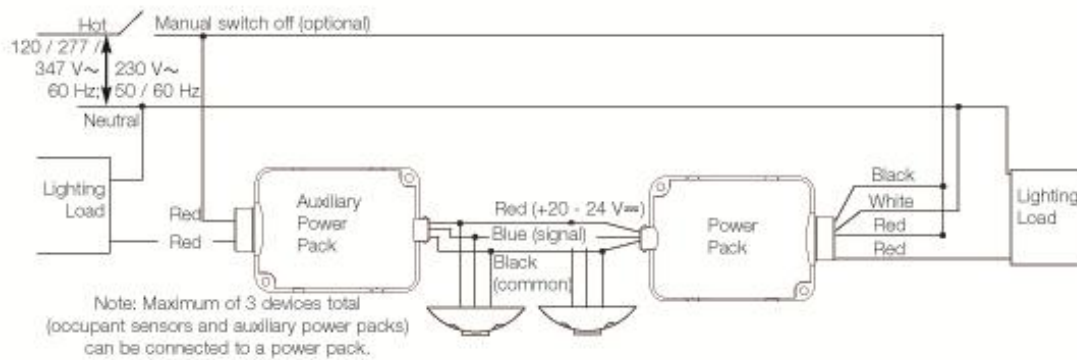
LOS-CUS 4 09.04.08

Wiring: Stand-Alone Control

1 to 3 Sensors with Power Pack



Switching Multiple Loads with Auxiliary Power Packs



OLUTRON SPECIFICATION SUBMITTAL

Page 4

Job Name:	Millenium Science Complex	Model Numbers:	LOS-CUS-1000	
Job Number:	Building Stimulus		LOS-CUS-500	



Sensors

LOS-CUS Series

Occupant Sensors

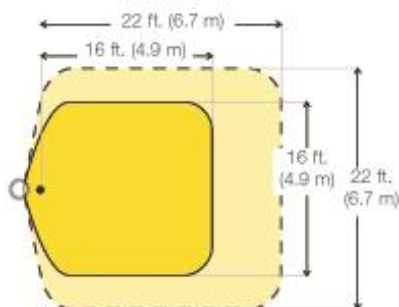
LOS-CUS 5 09/04/08

Installation

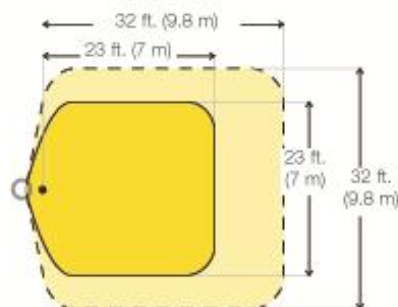
Sensor Placement

- Mount the sensor so the grilles face the open portion of the room and are not facing a nearby wall, window, or other obstructing object.
- Keep the occupant sensor away from air flow from ventilation outlets, windows, fans, etc.
- If installing a 180° occupant sensor (500 and 1000 models), place the sensor on the same wall as the doorway so that traffic in a hallway will not affect the sensor; otherwise, place in center of room.
- Closely follow the diagrams shown concerning major and minor motion coverage. The sensor can detect major motion (such as a person taking a half-step) at a greater distance than it can detect minor motion (such as writing or typing at a desk).
- Decrease total coverage area by 15% for "soft" rooms (for example, heavy draperies or heavy carpeting).

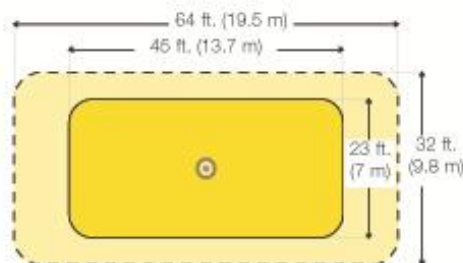
Range Diagrams



LOS-CUS-500



LOS-CUS-1000



LOS-CUS-2000

OLUTRON SPECIFICATION SUBMITTAL

Page 5

Job Name:	Millenium Science Complex	
Job Number:	Building Stimulus	
Model Numbers:	LOS-CUS-1000	
	LOS-CUS-500	

Sensors

LOS-CUS Series

Occupant Sensors

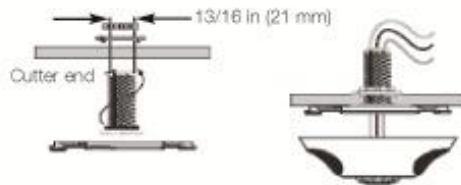
LOS-CUS 6 09.04.08

Installation

Mounting

Normal Mounting

Twist and lock threaded mounting post onto cover plate. Drill through ceiling tile with assembly, using cutter end of the threaded mounting post. Secure with washer and nut.



Mounting to Non-Standard Ceiling or Fixture

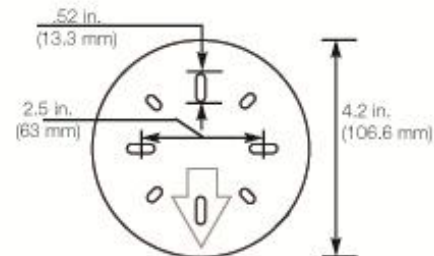
Mount twist-lock cover plate using mounting screws, nuts, and washers (included). Drill/punch wire routing hole through ceiling tile at center of cover plate.



Wire Lengths

# Sensors	1	2	3	1	2	1
# Aux. PP	0	0	0	1	1	2
22 AWG	750 ft.	375 ft.	250 ft.	375 ft.	250 ft.	250 ft.
0.5 mm ²	365 m	180 m	120 m	90 m	120 m	120 m
20 AWG	1200 ft.	600 ft.	400 ft.	600 ft.	400 ft.	400 ft.
0.75 mm ²	730 m	365 m	240 m	365 m	240 m	365 m
18 AWG	2400 ft.	1200 ft.	800 ft.	1200 ft.	800 ft.	800 ft.

Mounting Plate Dimensions



OLUTRON SPECIFICATION SUBMITTAL

Page 6

Job Name:	Millenium Science Complex	Model Numbers:	LOS-CUS-1000	
Job Number:	Building Stimulus		LOS-CUS-500	



Sensors

LOS-CUS Series

Occupant Sensors

LOS-CUS 7 09.04.08

Sensor Adjustments

Override Settings

	A	Off (Default)	On
Auto/Manual	☐	1 Automatic (Normal)	Manual on/off (Override)
Threshold	☐	2 Auto Threshold Adjustment	High Sensitivity (Low turn-on threshold)
LED Motion Indicator	☐	3 Lights indicate motion	Disable LED Indicator
Reset Learned Settings	☐	4 Retain Settings (Normal)	Erase all learned settings, Restart Learning (Toggle On)
	ON		
	B	Off	On
Strong Airflow Compensation	☐	1 Disable Compensation (Normal)	Enable Compensation
Over Doorway Installation	☐	2 No (Normal)	Yes (Use increased turn-on threshold)
Timer Adjust	☐	3 Adjust Timer Automatically	Use Manual Setting (No adjustment)
Auto Sensitivity	☐	4 Adjust Sensitivity Automatically	Adjust Sensitivity Manually
	ON		

Timer Test Mode

1. Remove the retainer cover.
2. Rotate the black timer adjustment knob to about midway (12 o'clock).
3. Return setting to minimum setting (full CCW).



Factory Settings



12 o'clock



Full CCW

Note: The timer will remain in the 8-second test mode for 1 hour, then automatically reset to 8 minutes.

4. To manually take the timer out of the 8-second test mode, turn the timer adjustment approximately 1/16" clockwise to make the setting slightly above minimum (just above the 8-minute setting).

Factory Settings



OLUTRON SPECIFICATION SUBMITTAL

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Job Name:	Millenium Science Complex	Model Numbers:	LOS-CUS-1000
Job Number:	Building Stimulus		LOS-CUS-500

Student Study Area: LRF2-DCRB-WH

Radio Powr Savr™

LRF2-DCRB-WH

Wireless Daylight Sensor

369-244a 1 02.16.10

Wireless Daylight Sensor

Lutron's wireless daylight sensor is a battery-powered sensor that automatically controls lights via RF communication to compatible dimming or switching devices. This sensor mounts to the ceiling and measures light in the space. The sensor then wirelessly transmits the light level to the associated dimming or switching devices that automatically control the lights to balance light level in the space. The sensor combines both convenience and exceptional energy savings along with ease of installation.



Features

- Lutron's reliable proportional daylight open loop control
- Light range (0–10,000 fc)
- Photopic response matches human eye
- Designed to give a linear response to changes in viewed light level
- Wireless daylight sensor has simple calibration
- One sensor is capable of switching, stepped dimming, and continuous dimming of multiple zones
- Intuitive test mode provides instant system verification
- 10-year battery life
- Multiple ceiling mount methods available for different ceiling materials
- Works seamlessly with Radio Powr Savr™ Occupancy and Vacancy Sensors and Pico™ wireless controls
- Front accessible test buttons make setup easy
- Each sensor can be added to up to 10 compatible RF dimming and switching devices for spaces with multiple zones of lighting
- RoHS compliant
- Capable of override for a maximum of 2 hours

Models Available:

- LRF2-DCRB-WH 434 MHz Daylight Sensor

Compatible RF Devices:

- For use with Lutron® products only
- Communicates to the following wireless Lutron systems:
 - Maestro Wireless®
 - GRAFIK Eye® QS Wireless

LUTRON® SPECIFICATION SUBMITTAL

Page

Job Name:

Model Numbers:

Job Number:



Radio Powr Savr™

LRF2-DCRB-WH

Wireless Daylight Sensor

369-244a 2 02.16.10

Specifications

Standards

- FCC Approved. Complies with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.
- IC (RSS-210)
- Meets CA Title 24 requirements

Power / Performance

- Operating voltage: 3 V $\frac{1}{2}$
- Operating current: 7 μ A
- Requires one CR 2450 lithium battery
- 10-year battery life
- Non-volatile memory (settings are stored during power loss)

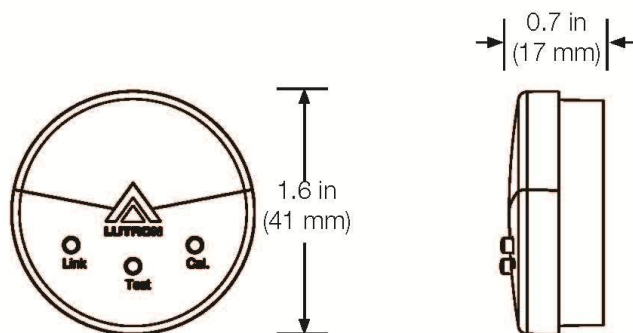
Environment

- Temperature: 32 °F to 104 °F (0 °C to 40 °C)
- For indoor use only

Range

- Local load controls must be located within 60 ft (18 m) line of sight, or 30 ft (9 m) through walls, of a daylight sensor

Dimensions



LUTRON® SPECIFICATION SUBMITTAL

Page

Job Name:

Model Numbers:

Job Number:

Radio Powr Savr™

LRF2-DCRB-WH

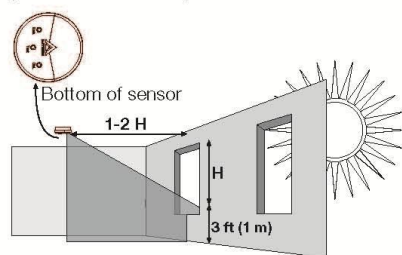
Wireless Daylight Sensor

369-244a 3 02.16.10

Mounting

Location for average size areas

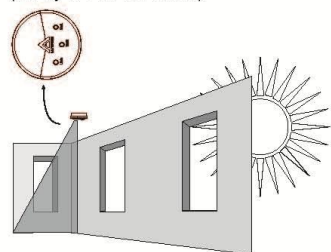
Arrow points towards the area viewed by the sensor (towards windows)



H = Effective Window Height

Location for narrow areas (corridors, private offices)

Arrow points towards the area viewed by the sensor (away from window)



Installation

Determine the Daylight Sensor Mounting Location using the diagrams at left:

- The arrow on the daylight sensor points toward the area viewed by the sensor.
- Place the daylight sensor so its viewing area is centered on the nearest window at a distance from the window of one to two times the effective window height (H).
- The effective window height (H) starts at the window sill or 3 ft (1 m) up from the floor, whichever is higher, and ends at the top of the window.
- Ensure that the view of the daylight sensor is not obstructed.
- Do not position the daylight sensor in the well of a skylight or above indirect lighting fixtures.
- For narrow areas where the daylight sensor cannot be placed 1-2 (H) from windows, place sensor near windows facing into the space.

Daylight Sensor Communication

- A sensor can communicate with up to 10 local load devices
- A single local load device or zone can have only one daylight sensor communicate to it

LUTRON SPECIFICATION SUBMITTAL

Page

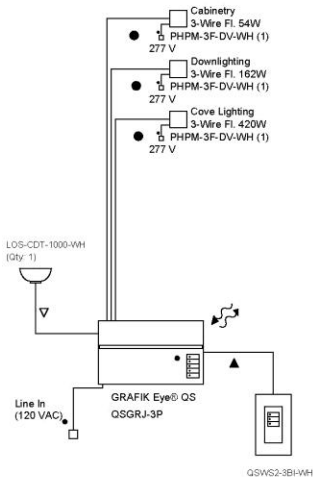
Job Name:	Model Numbers:
Job Number:	



Conference Room: Lutron Grafik Eye Lighting Control System

GRAFIK Eye® QS

One Line Diagram



Wiring Notes:

● 2 #12 AWG (2.5 mm²)
▽ 3 #18 AWG (1.0 mm²)

▼ 2 #18 AWG (1.0 mm²)
□ 120 VAC Input Power

■ 277 VAC Input Power

▲ Lutron GRX-CBL-346S or GRX-PCBL-346S
★ Only connect 3 wires (Common, mux, mux)

Lutron

Project Name: Millennium Science Complex

Project Number:

Page: 1

GRAFIK Eye. QS

Bill of Materials

Description	Model Number	Qty.
GRAFIK Eye® QS Wireless Control Unit	QSGRJ-3P	1
GRAFIK Eye® QS Faceplate Kit	QSGFP-WH-NST	1
Occupancy Sensor, Dual Tech, 1000 sq ft, active high, 20-24 VDC, white	LOS-CDT-1000-WH	1
Power Module	PHPM-3F-DV-WH	3
QS 3-Button Wallstation, insert	QSW2-3BI-WH	1

Lutron

Project Name: Millennium Science Complex**Project Number:****Page:** 2

GRAFIK Eye® QS

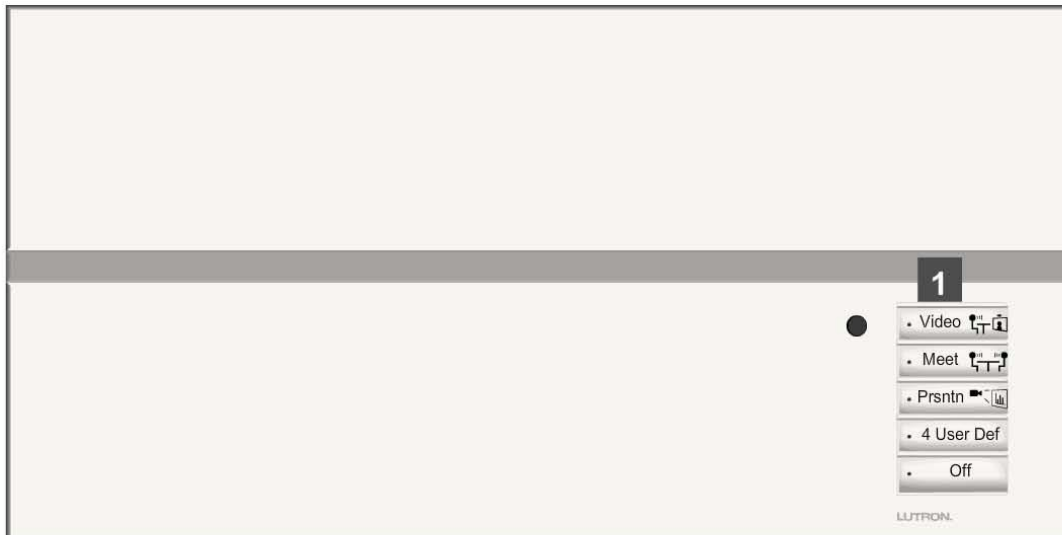
Button Kit Engraving Form

Project Information

Project Name: Millennium Science Complex
Installer Company: _____
Installer Name: _____
Phone: _____

Shipping Information

Name: _____
Company: _____
Address: _____
City: _____ State: _____ Zip: _____
Phone: _____ Fax: _____



Type:	Model Number:	Engraving Certificate Number:	Button color:
1 Scene Control			white (WH)

Lutron Electronics Co. Inc.
Dept 309 engraving
7200 Suter Road
Coopersburg, PA 18036
www.lutron.com
Phone: 610.282.3800



Project Name: Millennium Science Complex

Lutron Project #:

P.O.#:

Lutron Order #:

Page: 3

GRAFIK Eye. QS

Load Schedule

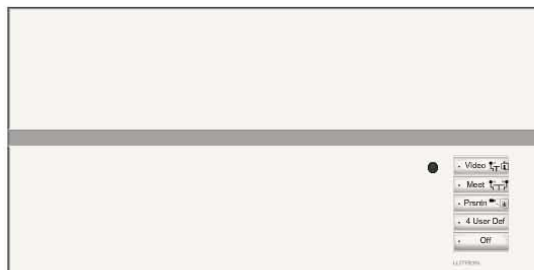
Model Number: QSGRJ-3P**Phase Control Zones**

Zone	Name	Load Type	No. Fixtures	Wattage/Fixture	Total Wattage
1	Cove Lighting	3-Wire Fl.	12	35	420
2	Downlighting	3-Wire Fl.	6	27	162
3	Cabinetry	3-Wire Fl.	2	27	54

Lutron**Project Name:** Millennium Science Complex**Project Number:****Page:** 4

GRAFIK Eye® QS

Preset Dimming Control



GRAFIK Eye® QS with lid closed.



GRAFIK Eye® QS with lid open.

Actual colors may vary slightly.

Light Zones:	Colors:
3	Faceplate: white (WH)
Shade Groups:	Stripe: gray (GR)
0	Buttons: white (WH)
Model Number:	
Unit:	QSGRJ-3P Quantity: 1



SPECIFICATION SUBMITTAL

Project Name: Millennium Science Complex

Project Number:

Page: 5

GRAFIK Eye® QS

Full-size Image

Actual colors may vary slightly.

Selected Wall Color

**Benjamin Moore**
Paints

Affinity Colors:
Fusion
www.mylutronpaints.com



**LUTRON®**

Project Name: Millennium Science Complex

Project Number:

Page:

6

*Actual color may differ slightly; please refer to paint chips for most accurate representation.

Conference Room: PP-230H Power Pack

Sensors

PP Series

Power Packs

PP-1 06/09/05

PP Series Power Packs



PP-120H
PP-230H
PP-277H
PP-347H



PP-SH

Power switch packs provide both the 24 V $\overline{\text{---}}$ power supply to operate Lutron sensors as well as the 20 A line voltage relay to control the load in one compact housing. The unit can be placed outside or inside the junction box with a simple twist-on nut. The auxiliary relay model can be used with line voltage power packs to switch additional loads.

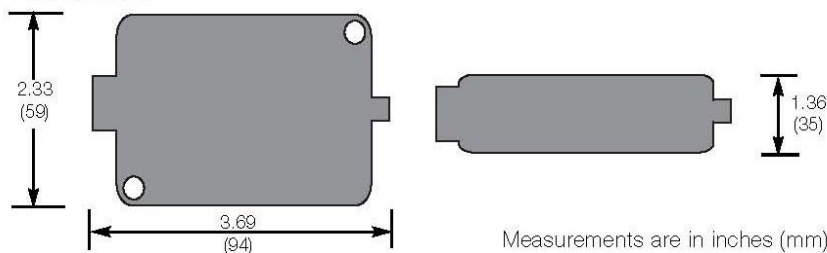
Features

- High-impact UL94 5 VA flammability-rated plastic case construction.
- Relay: Class B (130°C) insulating material; silver alloy contacts.
- 120 V, 277 V, or 347 V $\overline{\text{---}}$ transformer: 60 Hz; 230 V transformer: 50 Hz.
- 24 V $\overline{\text{---}}$ nominal output; 100 mA nominal, full wave rectified and filtered.
- 7" wire leads, 18 AWG input; 7" leads, 16 AWG contacts.
- Relay contact rating:
 - 20 A: 120/230/277 V ballast
 - 15 A: 347 V ballast
 - 15 A: 120 V incandescent
- Complies with requirements for use in a compartment handling conditioned air (plenum).
- Supports up to 3 devices, including occupant sensors and PP-SH units.
- Operating environment: 32°F to 104°F (0°C to 40°C); less than 90% relative humidity, non-condensing.
- For indoor use only.

Model Numbers

Catalog Number	Power Input	Control Input	Power Output
PP-120H	120 V $\overline{\text{---}}$, 60 Hz	24 V $\overline{\text{---}}$, 5 mA	24 V $\overline{\text{---}}$, 100 mA
PP-230H	230 V $\overline{\text{---}}$, 50 & 60 Hz	24 V $\overline{\text{---}}$, 5 mA	24 V $\overline{\text{---}}$, 100 mA
PP-277H	277 V $\overline{\text{---}}$, 60 Hz	24 V $\overline{\text{---}}$, 5 mA	24 V $\overline{\text{---}}$, 100 mA
PP-347H	347 V $\overline{\text{---}}$, 60 Hz	24 V $\overline{\text{---}}$, 5 mA	24 V $\overline{\text{---}}$, 100 mA
PP-SH	N/A	24 V $\overline{\text{---}}$, 5 mA	N/A

Dimensions



OLUTRON® SPECIFICATION SUBMITTAL

Page 1

Job Name: Millennium Science Complex	Model Numbers: PP-277H
Job Number:	

Sensors

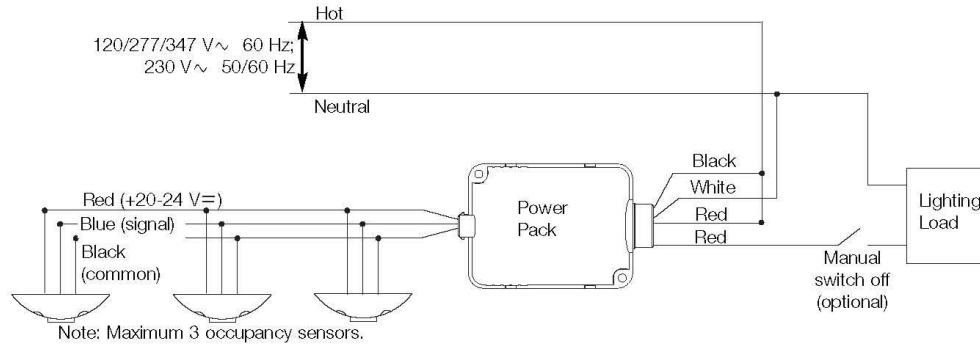
PP Series

Power Packs

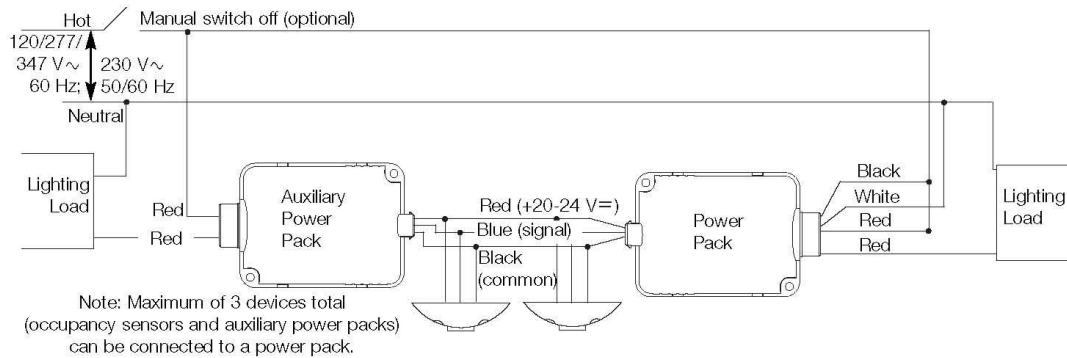
PP-2 06.09.05

Wiring

1 to 3 Sensors with Power Pack



Switching Multiple Loads with Auxiliary Power Packs



Job Name:	Model Numbers:	
Millennium Science Complex	PP-277H	
Job Number:		



Sensors

PP Series

Power Packs

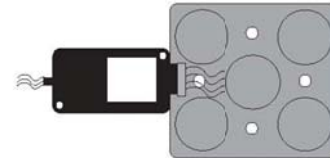
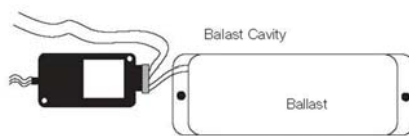
PP-3 06.09.05

Mounting



Fits inside junction box or standard fluorescent fixture ballast cavity

Mount with 6/32 x 1.25" pan head screws



Mounts to standard 4" x 4" junction box through knockout with 1/2" EMT threaded nipple.

Note: Always turn power off and lock out during unit installation.
Always install unit in accordance with applicable national and local electrical codes.

Installation

- Wire according to appropriate Wiring Diagram.
- Warning: Risk of electrical shock from energized equipment.
Always turn power OFF and lock out during unit installation.
Always install units in accordance with applicable national and local electrical codes.

OLUTRON® SPECIFICATION SUBMITTAL

Page **3**

Job Name: Millennium Science Complex	Model Numbers: PP-277H
Job Number:	

Appendix J: Lamp Cutsheets

Philips: F32T8 ADV835 Alto II



Advantage™ T8

F32T8 ADV835 ALTO

Philips Advantage T8 lamps offer high lumen output in an environmentally responsible lamp.

Product data

• Product Data

Product number	139881
Full product name	F32T8 ADV835 ALTO II
Short product name	F32T8 ADV835 ALTO II
Pieces per Sku	1
Skus/Case	25
Bar code on pack	046677139889
Bar code on case	50046677139884
Logistics code(s)	927869783601

• General Characteristics

Base	Medium Bi-Pin [Medium Bi-Pin Fluorescent]
Base Information	Green Base
Bulb	T8
Energy Saving	Energy Saving
Rated Avg Life [12-Hr Prog St]	36000 hr
Rated Avg Life [12-Hr Inst St]	30000 hr
Rated Avg Life [3-Hr Prog St]	30000 hr
Rated Avg Life [3-Hr Inst St]	24000 hr

• Electrical Characteristics

Watts	32 W
-------	------

• Environmental Characteristics

Mercury (Hg) Content	1.7 mg
Picogram per Lumen Hour	24 p/LuHr

• Light Technical Characteristics

Color Code	Advantage 835 [CCT of 3500K]
Color Rendering Index	85 Ra8
Color Designation	Advantage 835
Color Temperature	3500 K
Initial lumen	3100 Lm
Design Mean Lumens	3000 Lm

• Product Dimensions

Nominal Length [inch]	48
-----------------------	----

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Philips: F21T5/835/ALTO/40PK



T5 Standard

21W/835 Min Bipin T5 HE ALTO UNP

Philips T5 fluorescent lamps featuring ALTO® Lamp Technology offer increased energy savings and low toxicity in a slim profile

Product data

• Product Data

Product number	230821
Full product name	21W/835 Min Bipin T5 HE ALTO UNP
Short product name	F21T5/835/ALTO 40PK
Pieces per Sku	1
eop_pck_cfg	40
Sku/Case	40
Bar code on pack	46677230821
Bar code on case	2008410030134
Logistics code(s)	927990883522
tpd_ilcos_cd	FDH-21/35/1B-L/P-G5-16
eop_net_weight_pp	78.000 gr

• General Characteristics

System Description	High Efficiency
Base	Miniature Bipin
Base Information	Green [Green Base]
Bulb	T5 [16 mm]
Rated Avg. Life	24000 hr
Life to 10% fail	19000 hr
Preheat EL,3h	
LSF HF Preheat	85 %
20000h Rated,3h	
LSF HF Preheat	95 %
12000h Rated,3h	
LSF HF Preheat	97 %
8000h Rated,3h	
LSF HF Preheat	98 %
6000h Rated,3h	
LSF HF Preheat	98 %
4000h Rated,3h	
LSF HF Preheat	99 %
2000h Rated,3h	
LSF HF Preheat	94 %
16000h Rated,3h	

• Electrical Characteristics

Watts	21 W
Lamp Voltage EL	125 V
25°C	
Lamp Current EL	0.170 A
25°C	
Dimmable	Yes
Lamp Wattage EL	20.7 W
35°C	
Lamp Current EL	0.170 A
35°C	
Lamp Voltage EL	123 V
35°C	
Lamp Wattage EL	21.3 W
25°C, Rated	
Lamp Wattage EL	21 W
25°C, Nominal	

• Environmental Characteristics

Energy Efficiency	A
Label (EEL)	
Mercury (-lg)	1.4 mg
Content	

• Light Technical Characteristics

Color Code	835 [CCT of 3500K]
Color Rendering	85 Ra8
Index	
Color Designation	White
Color Temperature	3500 K
Chromaticity Coordinate X	409 -

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T5 Standard

Chromaticity Coordinate Y	397 -
Initial Lumens	2100 Lm
Luminance Average EL 25°C	1.5 cd/cm ²
Lum Efficacy Rated HF 25°C	90 Lm/W
Lum Efficacy Rated HF 35°C	101 Lm/W
LLMF HF 20000h	88 %
Rated	
LLMF HF 16000h	90 %
Rated	
LLMF HF 12000h	91 %
Rated	
LLMF HF 8000h	93 %
Rated	
LLMF HF 6000h	94 %
Rated	
LLMF HF 4000h	95 %
Rated	
LLMF HF 2000h	96 %
Rated	

Luminous Flux EL 25°C, Rated	1920 Lm
Luminous Flux EL 25°C, Noninal	1920 Lm
Design Temperature	35 C

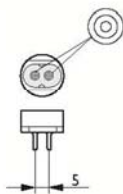
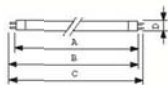
• Product Dimensions

Base Face to Base	849.0 mm
Face A	
Insertion length B	853.7 (min), 856.1 (max) mm
Overall Length C	863.2 mm
Diameter D	17 mm

• Measuring Conditions

Calibration Current	0.170 A
HF Generator Rated Voltage	246 V
Resistor	725 ohm

Dimensional drawing

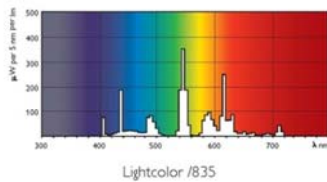
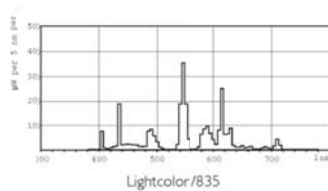


Product	A (Max)	B (Min)	B (Max)	C (Max)	D (Max)
TLS HE F21T5/B5 HE Alto	849.0	853.7	856.1	863.2	17



T5 Standard

Photometric data



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www.philips.com/lighting

2011, March 18
data subject to change

Philips: PL-T CFTR32W/GX24q



PL-T Triple 4-Pin Base Energy Advantage

PL-T XEW 26W/835/4P ALTO 21W

Philips Linear Compact Fluorescent Lamps offer designers, specifiers and end-users new levels of efficiencies and versatility in sizes, configurations and application possibilities. With so many elegant fixtures available to complement their small size, high light output and advanced technology, Philips Energy Advantage lamps are fast becoming the preferred choice when maximum efficiency and sleek design solutions are required.

Product data

• Product Data

Product number	407809
Full product name	PL-T XEW 26W/835/4P ALTO 21W
Short product name	PL-T 26W/835/XEW/4P/ALTO 21W
Pieces per Sku	1
Sku/Case	10
Bar code on pack	46677407803
Bar code on case	50046677407808
Logistics code(s)	927905383520
eop_net_weight_pp	64.000 gr

• General Characteristics

Base	GX24q-3
Base Information	4P
Life to 10% fail	10000 hr
Preheat EL3h	

• Electrical Characteristics

Watts	26 W
Lamp Wattage EL	21 W
Lamp Voltage EL	72 V
Lamp Current EL	0.300 A

• Environmental Characteristics

Mercury (Hg) Content	1.4 mg
----------------------	--------

• Light Technical Characteristics

Color Code	835 [CCT of 3500K]
Color Rendering Index	82 Ra8
Color Designation	White
Color Temperature	3500 K
Chromaticity Coordinate X	412 -
Chromaticity Coordinate Y	402 -
Initial Lumens	1400 Lm
Luminous Efficacy	66 Lm/W
Lamp EL	
Lumen Maintenance EL 2000h	92 %
Lumen Maintenance EL 5000h	87 %

• Product Dimensions

Base Faceto Base Face A	86.7 mm
Insertion Length B	111.0 mm
Overall Length C	126.7 mm
Diameter D	41.0 mm

PHILIPS
sense and simplicity



Philips: F28T5/841/ALTO



Philips T5 Fluorescent Lamps featuring ALTO® Lamp Technology

Ideal for general, decorative and architectural lighting in offices, retail stores, hotels, schools and hospitals

T5 Lamps



† This lamp is better for the environment because of its reduced mercury content. All Philips ALTO® lamps give you end-of-life options which can simplify and reduce your lamp disposal costs depending on your state and local regulations.

* Fluorescent lamps that are TCLP compliant reduce the amount of pollutants released into the environment.

Powerful, environmentally-responsible ultra-slim lamps

Philips T5 Fluorescent Lamps featuring ALTO® Lamp Technology offer increased energy savings and low toxicity in a slim profile.

Sustainable lighting solution

- Less mercury combined with energy efficiency and long life reduces the impact on the environment
- Our green end-caps mean you are using ALTO® environmentally-responsible lamps
- Just 1.4mg of mercury

Miniaturization

- Slim profile lamp and ballast

Operated on programmed start electronic ballasts only

Philips T5 warranty period: 36 months

PHILIPS
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Philips T5 Fluorescent Lamps featuring ALTO® Lamp Technology

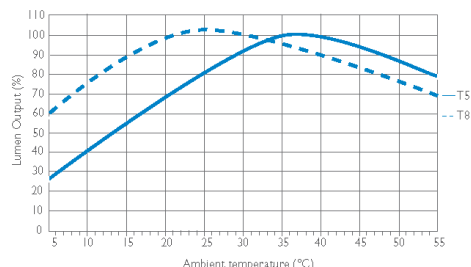
Ordering, Electrical and Technical Data (Subject to change without notice)

Product Number	Ordering Code	Watts	Bulb	Base	Pkg. Qty.	Color Temp (K)	CRI	Nom. Length (In.)	Rated Avg. Life (Hrs.)	Approx. Initial Lumens ^{1,2}	Design Lumens ⁴
23077-1	F14T5/830/ALTO	14	T5	Min. Bipin	40	3000K	85	22	25,000	1350	1275
23079-7	F14T5/835/ALTO	14	T5	Min. Bipin	40	3500K	85	22	25,000	1350	1275
23080-5	F14T5/841/ALTO	14	T5	Min. Bipin	40	4100K	85	22	25,000	1350	1275
23081-3	F21T5/830/ALTO	21	T5	Min. Bipin	40	3000K	85	34	25,000	2100	2000
23082-1	F21T5/835/ALTO	21	T5	Min. Bipin	40	3500K	85	34	25,000	2100	2000
23083-9	F21T5/841/ALTO	21	T5	Min. Bipin	40	4100K	85	34	25,000	2100	2000
23084-7	F28T5/830/ALTO	28	T5	Min. Bipin	40	3000K	85	46	25,000	2900	2750
23085-4	F28T5/835/ALTO	28	T5	Min. Bipin	40	3500K	85	46	25,000	2900	2750
23086-2	F28T5/841/ALTO	28	T5	Min. Bipin	40	4100K	85	46	25,000	2900	2750
23088-8	F35T5/830/ALTO	35	T5	Min. Bipin	40	3000K	85	58	25,000	3650	3450
23091-2	F35T5/835/ALTO	35	T5	Min. Bipin	40	3500K	85	58	25,000	3650	3450
23095-3	F35T5/841/ALTO	35	T5	Min. Bipin	40	4100K	85	58	25,000	3650	3450

- 1) Average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently.
- 2) Approximate initial lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions.
- 3) For expected lamp lumen output, commercial ballast manufacturers can advise the appropriate ballast factor for each of their ballasts when they are informed of the designated lamp. The ballast factor is a multiplier applied to the designated lamp lumen output.
- 4) Design lumens are the approximate lamp lumen output at 40% of the lamp's rated average life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions.
- 5) Average life under engineering data with lamps turned off and restarted once every 12 operating hours.

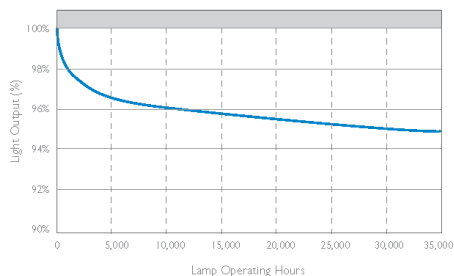
Lumens vs. Ambient Temperature

T5 Lamp



Energy Lumen Maintenance

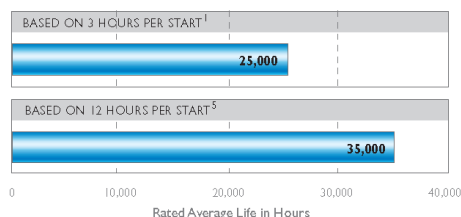
T5 Lamp



Rated Average Life

T5 Lamp

Programmed Start Ballast



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MasterColor® CDM ED17 Protected

MasterColor CDM 100W/830 Med ED17P CL ALTO+FB

Range of protected, high-efficiency long life ceramic metal halide lamps with a stable color over lifetime and a crisp, sparkling light to be used in open fixtures.

Product data

• Product Data

Product number	233684
Full product name	MasterColor CDM 100W/830 Med ED17P CL ALTO+FB
Short product name	CDM 100W/830 Med ED17P CL ALTO+FB
Pieces per Sku	1
Skus/Case	12
Bar code on pack	046677233686
Bar code on case	50046677233681
Logistics code(s)	928601137601

• General Characteristics

Base	Medium [Single Contact Medium Screw]
Base Information	Brass [Brass Base]
Bulb	ED17P [Protected]
Bulb Material	Hard Glass
Bulb Finish	Clear
Operating Position	Universal [Any or Universal (U)]
Main Application	General Lighting
RatedAvgLife(See Family Notes)	16000 hr

• Electrical Characteristics

Watts	100 W
Lamp Voltage	101 V
Lamp Current	1.1 A
Ignition Time	10 s
Ignition Supply Voltage	235 V
Re-ignition Time [min]	10 min

• Environmental Characteristics

Mercury (Hg) Content	5.8 mg
----------------------	--------

• Light Technical Characteristics

Color Code	830 [CCT of 3000K]
Color Rendering Index	80 (min), 85 (nom) Ra8
Color Designation	Warm White
Color Temperature technical	3000 K
Chromaticity Coordinate X	2800 (min), 3000 (nom), 3200 (max) K
Chromaticity Coordinate Y	.421 (min), .430 (nom), .439 (max) -
Initial Lumens	.386 (min), .392 (nom), .398 (max) -
Luminous Efficacy Lamp	8600 Lm
Lumen Maintenance 2000h	86 Ln/W
Lumen Maintenance 5000h	86 %
Design Mean Lumens	79 %
	6450 Lm

• UV-related Characteristics

PET (NIOSH)	322 h.klx
Damage Factor D/fc	.201 -

• Product Dimensions

Light Center Length L	3.438 in
Max Overall Length (MOL) - C	5.438 in

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Philips: CDM70/T6/842 and CDM35/T6/842





Philips MasterColor®
Ceramic Metal Halide
4000K Tubular
Single-Ended T6 Lamps

*Ideal for retail display
lighting, general and indirect
lighting, wall washing and
fiberoptic systems*

CDM/T6

4000K

A compact solution for retail displays

The Philips MasterColor® 4000K Tubular Single-Ended T6 lamp is a compact, energy efficient, ceramic metal halide lamp that provides crisp, sparkling light.

Excellent color

- 84–96 CRI (color rendering index)
- Color stability over life within $\pm 200\text{K}$
- Lamp to lamp color consistency over life

Total cost of ownership benefits

- High lamp efficacy (up to 94 LPW)
- Energy-efficient alternative to incandescent/halogen
- Improved lumen maintenance over standard metal halide

Application versatility

- Universal operating position
- Compact lamp dimensions for high beam intensities

FadeBlock™

- Lamps feature integrated UV blocking medium for reduced fading of fabrics and paintings

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Philips MasterColor® Ceramic Metal Halide 4000K Tubular
Single-Ended T6 Lamps

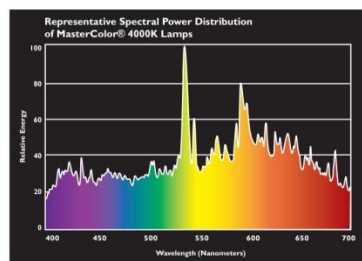
CDM/T6

Ordering Data

Product Number	Ordering Code	Pkg. Qty.	Nom. Watt.	ANSI Ballast Code	Approx. Initial Lumens ¹	Approx. Mean Lumens ²	CRI
20886-8	CDM35/T6/842	12	39	M130/E	3300	2800	84
28137-8	CDM70/T6/942	12	70	M139/E	6600	4620	92
37369-6	CDM150/T6/942	12	150	M142, M102/E	12,700	8900	96

Electrical and Technical Data

Lamp Operating Volt. (rms)(Nom.) ³	85 (39W)
	88 (70W)
	96 (150W)
Initial Lamp Volt. Range (rms) ⁴	77-93 (39W)
	80-100 (70W)
	85-105 (150W)
Lamp Operating Current (Amps) Nominal (rms)	0.46 (39W)
	0.98 (70W)
	1.8 (150W)
Lamp Current Crest Factor (Maximum)	1.8
Warm-up to 80% Full Brightness	2 minutes
Restrike Time for Hot Lamps	4-8 minutes
Ballast Open Circuit Voltage	198 RMS Min.
Pulse Peak Volts	3000-4000
Pulse Width @ 90% Peak	2 Micro Sec. Minimum
Pulse Repetition Rate (Minimum) ⁵	2 per Half Cycle
Minimum Operating Temp.	-30°C (-22°F)



- 1) Measured at 100 hrs. life. Approximate lumen values listed are for vertical operation of the lamp.
- 2) Approximate lumen output at 40% of lamp rated average life.
- 3) Measured at rated lamp watts on a linear reactor. LPW does not include ballast losses.
- 4) Measured with the lamp operating at rated watts.
- 5) Option-Pulse Width @ 90% Peak, 1 micro second minimum with 2 pulses per half cycle.
- 6) Rated average life is the life obtained, on the average, from large representative groups of lamps in laboratory tests under controlled conditions at 10 or more operating hours per start. It is based on survival of at least 50% of the lamps and allows for individual lamps or groups of lamps to vary considerably from the average.

Physical Characteristics

Bulb Size	T-6
Bulb Finish	Clear
Base	G-12 Bi-Pin
Max. Overall Length (MOL)	3 1/4" (39W/70W)
	4 1/2" (150W)
Light Center Length (LCL)	2 3/8"
Arc Length	0.2" (5mm) (39W)
	0.275" (7mm) (70W)
	0.354" (9mm) (150W)
Arc Tube Material	Polycrystalline Alumina
Max. Bulb Temp.	500°C (932°F) (39W/70W)
	650°C (1202°F) (150W)
Max. Base Temp.	280°C (536°F) (39W/70W)
	250°C (482°F) (150W)
Max Bulb to Base Eccentricity	3"
Max. Arc Tube to Base Eccentricity	3"

Operating Characteristics

Rated Average Life, Hours. ⁶	6000 (39W)
	12,000 (70W/150W)
Correlated Color Temp. (CCT) ²	4200K
CIE Chromaticity Approx. ²	x-.365, y-.364 (39W)
	x-.372 y-.379 (70W)
	x-.375 y-.363 (150W)
Efficacy (lpw)	81 (39W)
	94 (70W)
	85 (150W)

Operating Position

Universal-Enclosed Luminaires Only

Note: Use CDM35T6/842 lamps only on thermally protected electronic ballast.

WARNINGS, CAUTIONS AND OPERATING

INSTRUCTIONS for MasterColor® Ceramic Metal Halide Lamps: Single-Ended CDM-T G12, CDM-TC G8.5 (Universal); Double-Ended CDM-TD RX7 (Horizontal ± 45°, Enclosed Fixtures Only)

WARNING: These lamps can cause serious skin burn and eye inflammation from short wave ultraviolet radiation if outer envelope of the lamp is broken or punctured. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available. This lamp complies with FDA radiation performance standard 21 CFR subchapter J, (USA/21 CFR 1040.30 Canada/SOR/DORS/80-381)

If the outer bulb is broken or punctured, turn off at once and replace the lamp to avoid possible injury from hazardous short wave ultraviolet radiation. Do not scratch the outer bulb or subject it to pressure as this could cause the outer bulb to crack or shatter. A partial vacuum in the outer bulb may cause glass to fly if the envelope is struck.

WARNING: The arc-tube of metal halide lamps are designed to operate under high pressure and at temperatures up to 1000° C and can unexpectedly rupture due to internal or external factors such as a ballast failure or misapplication. If the arc-tube ruptures for any reason, the outer bulb may break and pieces of extremely hot glass might be discharged into the surrounding environment. If such a rupture were to happen, **THERE IS A RISK OF PERSONAL INJURY, PROPERTY DAMAGE, BURNS AND FIRE.** Certain lamps that will retain all the glass particles should inner arc-tube rupture occur are commercially available from Philips Lighting Company.

RELAMP FIXTURES AT OR BEFORE THE END OF RATED LIFE. Allowing lamps to operate until they fail is not advised and may increase the possibility of inner arc tube rupture.

This lamp contains an arc tube with a filling gas containing less than 10 nCi of Kr-85 and is distributed by Philips Lighting Company, a division of Philips Electronics North America Corporation, Somerset, New Jersey, 08875.

CAUTION: TO REDUCE THE RISK OF PERSONAL INJURY, PROPERTY DAMAGE, BURNS AND FIRE RESULTING FROM AN ARC-TUBE RUPTURE THE FOLLOWING **LAMP OPERATING INSTRUCTIONS** MUST BE FOLLOWED:

LAMP OPERATING INSTRUCTIONS:

1. RELAMP FIXTURES AT OR BEFORE THE END OF RATED LIFE. Allowing lamps to operate until they fail is not advised and may increase the possibility of inner arc tube rupture.
2. Use only in fully enclosed fixtures capable of withstanding particles of glass having temperatures up to 1000° C. Lens/diffuser material must be heat resistant. Consult fixture manufacturer regarding the suitability of the fixture for this lamp.
3. Do not operate a fixture with a missing or broken lens/diffuser.
4. Operate lamp only within specified limits of operating position.
5. Before lamp installation/replacement, shut power off and allow lamp and fixture to cool to avoid electrical shock and potential burn hazards.
6. Use only auxiliary equipment meeting Philips and/or ANSI standards. Use within voltage limits recommended by ballast manufacturer.
 - A. Operate lamp only within specified limits of operation.
 - B. For total supply load refer to ballast manufacturers electrical data.
7. Operate CDM-T (G12 base) lamps only on thermally protected ballasts.
8. Operate CDM-TC lamps (G8.5 base) only on thermally protected electronic ballasts.
9. Operate CDM-T (G12 base) 39W/842 lamps only on thermally protected electronic ballasts.
10. Periodically inspect the outer envelope. Replace any lamps that show scratches, cracks or damage.
11. If a lamp bulb support is used, be sure to insulate the support electrically to avoid possible decomposition of the bulb glass.
12. Protect lamp base, socket and wiring against moisture, corrosive atmospheres and excessive heat.
13. Time should be allowed for lamps to stabilize in color when turned on for the first time. This may require several hours of operation, with more than one start. Lamp color is also subject to change under conditions of excess vibration or shock and color appearance may vary between individual lamps.
14. Lamps may require 4 to 8 minutes to re-light if there is a power interruption.
15. Take care in handling and disposing of lamps. If an arc tube is broken, avoid skin contact with any of the contents or fragments.



Specifications are subject to change without notice.
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P-589 I

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Philips: CDM210/T9/930/U/E



MasterColor® CDM
Elite MW System

*Ideal for architectural facade
lighting, illumination of
pedestrian areas, indoor
retail outlets, warehouses,
manufacturing facilities*

MasterColor® CDM

The next generation of white light

MasterColor® CDM Elite MW. The medium wattage CDM lighting system that gives superior, long-lasting white light for both indoor and outdoor use.

Light quality

- Excellent color rendering of CRI 90+
- Crisp, white light in 3000K and 4200K
- Stable color performance over entire life
- New socket design provides higher optical efficiency

Philips "Green Flagship Product"

- Low mercury, no lead
- Up to 120 lm/w
- Efficient electronic ballast that uses less energy than magnetic options
- 93% ballast efficacy

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MasterColor® CDM Elite MW

Ordering, Electrical and Technical Data (Subject to change without notice)

Product Number	Lamp Ordering Code	Nom. Watts	ANSI Code	Approx. Initial Lumens ¹	Approx. Mean Lumens ²	Efficacy (lm/w)	Color Temp. (Kelvin)	CRI	Burn Position	Rated Avg. Life (Hrs.) ³	Lumen Maint. 20khr (%)
22062-4	CDM Elite MW 210/T9/930/U/E	210	C183/E	24,200	22,100	115	3000	90+	Universal	24,000	80
21831-3	CDM Elite MW 315/T9/930/U/E	315	C182/E	37,800	34,700	120	3000	90+	Universal	30,000	80
22063-2	CDM Elite MW 210/T9/942/U/E	210	C183/E	23,100	20,800	110	4200	90+	Universal	20,000	80
22064-0	CDM Elite MW 315/T9/942/U/E	315	C182/E	36,200	32,600	115	4200	90+	Universal	24,000	80
23806-3	CDM Elite MW 210/T9/930/U/O	210	C183/O	23,100	20,700	110	3000	90+	Universal	20,000	80
23807-1	CDM Elite MW 315/T9/930/U/O	315	C182/O	36,200	32,500	115	3000	90+	Universal	20,000	80
23808-9	CDM Elite MW 210/T9/942/U/O	210	C183/O	22,100	19,900	105	4200	90+	Universal	20,000	80
23809-7	CDM Elite MW 315/T9/942/U/O	315	C182/O	34,700	31,200	110	4200	90+	Universal	20,000	80

All lamps are dimmable to 50% power (0-10V).

Product Number	Ballast Ordering Code	Input Voltage Range	Input Current Max. Operating	Power Factor	Peak Ignition Voltage	Normal Ballast Size Housing (mm)	Case Material	Ballast Weight	Ballast to Lamp Distance (max) ⁴
IZTMH210315RLF	Elite MW 210W	200-277V	1.2 @ 208V, 0.9 @ 277V	>0.90	3.5 kV	208 x 124 x 56	Metal case with flying leads	4.3 lb	30 (1In max load)
IZTMH210315RLF	Elite MW 315W	200-277V	1.8 @ 208V, 1.3 @ 277V	>0.90	3.5 kV	208 x 124 x 56	Metal case with flying leads	4.3 lb	30 (1In max load)

1) Measured at 100 hours of life in a vertical operating position. Measured at rated lamp watts on electronic ballast. Lumens per watt does not include ballast losses.

2) Approximate lumen output at 40% of lamp rated average life.

3) Rated average life is obtained at 50% survival rate. All MasterColor® CDM Elite MW ceramic metal halide lamps are designed for 30,000 hours. Based on data available at this time, the current rated average life is as published. Contact your sales representative for new updates.

4) 30ft w/ typical 18 gauge 1kV wire recommended.

WARNINGS, CAUTIONS, AND OPERATING INSTRUCTIONS FOR MASTERCOLOR® CDM ELITE MEDIUM WATT CERAMIC METAL HALIDE TUBULAR SINGLE-ENDED LAMPS

WARNING: These lamps can cause serious skin burn and eye inflammation from short wave ultraviolet radiation if outer envelope of the lamp is broken or punctured. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available. This lamp complies with FDA radiation performance standard 21 CFR subchapter J (USA: 21 CFR 1040.20 Canada: SOR/DORS/90-381)

If the outer bulb is broken or punctured, turn off at once and replace the lamp to avoid possible injury from hazardous short wave ultraviolet radiation. Do not scratch the outer bulb or subject it to pressure as this could cause the outer bulb to crack or shatter. A partial vacuum in the outer bulb may cause glass to fly if the envelope is struck.

WARNING: The arc-tube of metal halide lamps are designed to operate under high pressure and at temperatures up to 1000° C and can unexpectedly rupture due to internal or external factors such as a ballast failure or misapplication. If the arc-tube ruptures for any reason, the outer bulb may break and pieces of extremely hot glass might be discharged into the surrounding environment. If such a rupture were to happen, THERE IS A RISK OF PERSONAL INJURY, PROPERTY DAMAGE, BURNS AND FIRE.

RELAMP FIXTURES AT OR BEFORE THE END OF RATED LIFE.

Allowing lamps to operate until they fail is not advised and may increase the possibility of inner arc tube rupture. This lamp contains an arc tube with a filling gas containing less than 30 mCi of K-85 and is distributed by Philips Lighting Company, a division of Philips Electronics North America Corporation.

CAUTION: TO REDUCE THE RISK OF PERSONAL INJURY, PROPERTY DAMAGE, BURNS AND FIRE RESULTING FROM AN ARC-TUBE RUPTURE THE FOLLOWING LAMP OPERATING INSTRUCTIONS MUST BE FOLLOWED:

LAMP OPERATING INSTRUCTIONS:

1. Relamp fixtures at or before the end of rated life. Allowing lamps to operate until they fail is not advised and may increase the possibility of inner arc tube rupture.
2. If the lamp is marked on the base with /E, use only in enclosed fixture capable of withstanding particles of glass having temperatures up to 1000°C. If the lamp is marked on the base with /O, lamp should retain all the glass particles should inner arc tube rupture occur.
3. Before lamp installation/replacement, shut power off and allow lamp and fixture to cool to avoid electrical shock and potential burn hazards.
4. Use only auxiliary equipment meeting Philips and/or ANSI standards. Use within voltage limits recommended by ballast manufacturer:

A. Operate lamp only within specified limits of operation.

B. For total supply load refer to ballast manufacturer's electrical data.

C. All Pulse Start lamps require a socket rated to withstand a 4,000 volt pulse.

5. Periodically inspect the outer envelope. Replace any lamps that show scratches, cracks or damage.

6. If a lamp bulb support is used, be sure to insulate the support electrically to avoid possible decomposition of the bulb glass.

7. Protect lamp base, socket and wiring against moisture, corrosive atmospheres and excessive heat.

8. Time should be allowed for lamps to stabilize in color when turned on for the first time. This may require several hours of operation with more than one start. Lamp color is also subject to change under conditions of excess vibration or shock and color appearance may vary between individual lamps.

9. Lamps may require 10 minutes to re-light if there is a power interruption.

10. Take care in handling and disposing of lamps. If an arc tube is broken, avoid skin contact with any of the contents or fragments.

11. Use this lamp only in fixtures that contain a Pulse Start metal halide ballast and are specifically designed for use with Pulse Start metal halide lamps.



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Appendix K: Ballast Data

Philips: IZT-3S32-SC



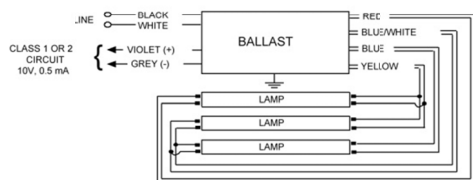
Electrical Specifications

IZT-3S32-SC@277V

Brand Name	MARK 7 0-10V
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp ("F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
F17T8	3	17	50/10	0.20	16/54	0.03/1.00	10	0.99	1.7	1.85
F25T8	3	25	50/10	0.28	16/76	0.03/1.00	10	0.99	1.7	1.32
* F32T8	3	32	50/10	0.34	18/93	0.03/1.00	10	0.99	1.7	1.08

Wiring Diagram



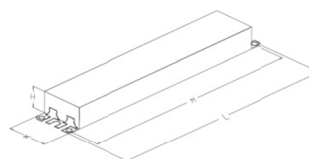
Diag. 57A

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.		in.	cm.
Black	22	55.9	Yellow/Blue		0
White	22	55.9	Blue/White	46	116.8
Blue	26	66	Brown		0
Red	46	116.8	Orange		0
Yellow	26	66	Orange/Black		0
Gray	36	91.4	Black/White		0
Violet	36	91.4	Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.7 "	1.18 "	8.90 "
9 1/2	1 7/10	1 9/50	8 9/10
24.1 cm	4.3 cm	3 cm	22.6 cm

Revised 05/27/2004



Data is based upon tests performed by Philips Lighting Electronics N.A. in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

PHILIPS LIGHTING ELECTRONICS N.A.

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Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5885



Philips: ICN-2P32-N



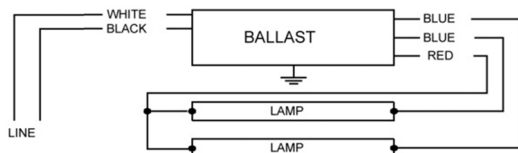
Electrical Specifications

ICN-2P32-N @ 277V

Brand Name	CENTIUM
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Parallel
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/°C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
* F32T8	1	32	0/-18	0.13	36	1.05	10	0.99	1.6	2.92
F32T8	2	32	0/-18	0.22	55	0.89	10	0.99	1.6	1.59

Wiring Diagram



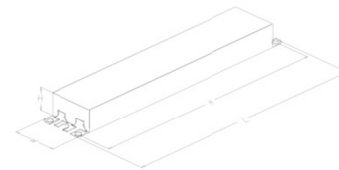
Diag. 64-A

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.		in.	cm.
Black	28	71.1	Yellow/Blue		0
White	45	114.3	Blue/White		0
Blue	24	61	Brown		0
Red	24	61	Orange		0
Yellow		0	Orange/Black		0
Gray		0	Black/White		0
Violet		0	Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.5 "	1.3 "	1.0 "	8.9 "
9 1/2	1 3/10	1	8 9/10
24.1 cm	3.3 cm	2.5 cm	22.6 cm

Revised 04/08/2009



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PHILIPS LIGHTING ELECTRONICS N.A.

10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018

Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance

Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

**ICN-2P32-N @ 277V**

Brand Name	CENTIUM
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Parallel
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications**Notes:****Section I - Physical Characteristics**

- 1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.
- 1.2 Ballast shall be provided with integral leads color-coded per ANSI C82.11.

Section II - Performance Requirements

- 2.1 Ballast shall be _____ (Instant, Rapid or Programmed) Start.
- 2.2 Ballast shall provide Independent Lamp Operation (ILO) for Instant Start ballasts allowing remaining lamp(s) to maintain full light output when one or more lamps fail.
- 2.3 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power (except T8/HO and FT5 ballasts).
- 2.4 Ballast shall operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% (voltage and frequency). IntelliVolt models shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency).
- 2.5 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz ("GCN" models between 20 kHz and 30kHz) to avoid interference with infrared devices and eliminate visible flicker.
- 2.6 Ballast shall have a Power Factor greater than 0.98 for primary lamp.
- 2.7 Ballast shall have a minimum ballast factor for primary lamp application as follows: 0.75 for Low Watt, 0.85 for Normal Light Output and 1.20 for High Light.
- 2.8 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.
- 2.9 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.
- 2.10 Ballast shall have a Class A sound rating for all 4-foot lamps and smaller.
- 2.11 Ballast shall have a minimum starting temperature of _____ [-18C (0F) for standard T8 and Long Twin Tube lamps, 10C (50F) for standard T12 lamps, 0C (32F) for Slimline T8 lamps and "GCN" models, -29C (-20F) for T8/HO lamps.] for primary lamp application. Ballast shall have a minimum starting temperature of 60F (16C) for energy-saving lamps.
- 2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.
- 2.13 ICN models shall have lamp striation reduction feature.

Section III - Regulatory Requirements

- 3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).
- 3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.
- 3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.
- 3.4 Ballast shall comply with ANSI C82.11 where applicable.
- 3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- 3.6 Ballast shall comply with NEMA 410 for in-rush current limits.
- 3.7 ICN models shall meet NEMA Premium/CEE requirements for Super T8 rebates
- 3.8 Ballast shall meet RoHS Compliance Standards

Section IV - Other

- 4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.
- 4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C.
- 4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.



Note: Energy saving T8 lamps (25W, 28W or 30W) may experience lamp striations if operated on ballasts not rated for their use.

Revised 04/08/2009



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Philips: ICN-3P32-SC



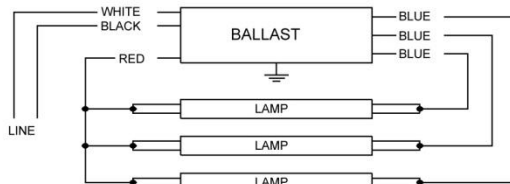
ICN-3P32-SC@277V

Brand Name	CENTIUM
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Parallel
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F .
F32T8	2	32	0/-18	0.24	65	1.01	10	0.98	1.7	1.55
* F32T8	3	32	0/-18	0.31	84	0.88	10	0.99	1.7	1.05

Wiring Diagram



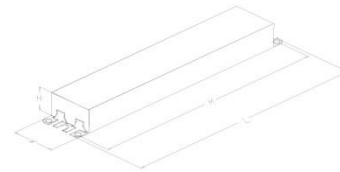
Diag. 65

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.		in.	cm.
Black	25.0		Yellow/Blue		
White	25.0		Blue/White		
Blue	31.0		Brown		
Red	37.0		Orange		
Yellow			Orange/Black		
Gray			Black/White		
Violet			Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.7 "	1.18 "	8.90 "
9 1/2	1 7/10	1 9/50	8 9/10
24.1 cm	4.3 cm	3 cm	22.6 cm

Revised 04/08/2009



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Electrical Specifications

Notes:

Section I - Physical Characteristics

- 1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.
- 1.2 Ballast shall be provided with integral leads color-coded per ANSI C82.11.

Section II - Performance Requirements

- 2.1 Ballast shall be _____ (Instant, Rapid or Programmed) Start.
- 2.2 Ballast shall provide Independent Lamp Operation (ILO) for Instant Start ballasts allowing remaining lamp(s) to maintain full light output when one or more lamps fail.
- 2.3 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power (except T8/HO and FT5 ballasts).
- 2.4 Ballast shall operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% (voltage and frequency). IntelliVolt models shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency).
- 2.5 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz ("GCN" models between 20 kHz and 30kHz) to avoid interference with infrared devices and eliminate visible flicker.
- 2.6 Ballast shall have a Power Factor greater than 0.98 for primary lamp.
- 2.7 Ballast shall have a minimum ballast factor for primary lamp application as follows: 0.75 for Low Watt, 0.85 for Normal Light Output and 1.20 for High Light.
- 2.8 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.
- 2.9 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.
- 2.10 Ballast shall have a Class A sound rating for all 4-foot lamps and smaller.
- 2.11 Ballast shall have a minimum starting temperature of _____ [-18C (0F) for standard T8 and Long Twin Tube lamps, 10C (50F) for standard T12 lamps, 0C (32F) for Slimline T8 lamps and "GCN" models, -29C (-20F) for T8/HO lamps,] for primary lamp application. Ballast shall have a minimum starting temperature of 60F (16C) for energy-saving lamps.
- 2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.
- 2.13 ICN models shall have lamp striation reduction feature.

Section III - Regulatory Requirements

- 3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).
- 3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.
- 3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.
- 3.4 Ballast shall comply with ANSI C82.11 where applicable.
- 3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- 3.6 Ballast shall comply with NEMA 410 for in-rush current limits.
- 3.7 ICN models shall meet NEMA Premium/CEE requirements for Super T8 rebates
- 3.8 Ballast shall meet RoHS Compliance Standards

Section IV - Other

- 4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.
- 4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C.
- 4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

ICN-3P32-SC@277V	
Brand Name	CENTIUM
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Parallel
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Note: Energy saving T8 lamps (25W, 28W or 30W) may experience lamp striations if operated on ballasts not rated for their use.

Revised 04/08/2009



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Lutron: ICN-2S28-N

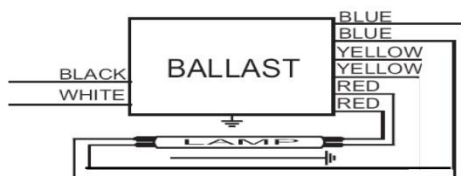


Electrical Specifications

ICN-2S28-N@277	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F .
F14T5	1	14	0/-18	0.07	17	1.07	10	0.98	1.7	6.29
F14T5	2	14	0/-18	0.13	33	1.04	10	0.98	1.7	3.15
* F21T5	1	21	0/-18	0.10	25	1.06	10	0.98	1.7	4.24
F21T5	2	21	0/-18	0.17	49	1.02	10	0.98	1.7	2.08
F28T5	1	28	0/-18	0.12	31	1.05	10	0.98	1.7	3.39
F28T5	2	28	0/-18	0.23	61	1.00	10	0.98	1.7	1.64
F28T5/ES (25W)	1	25	32/00	0.11	30	1.00	10	0.98	1.7	3.33
F28T5/ES (25W)	2	25	32/00	0.21	57	1.00	10	0.98	1.7	1.75

Wiring Diagram

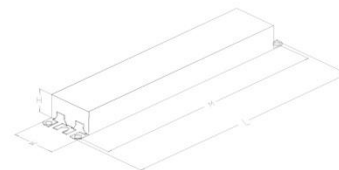


The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.		in.	cm.
Black	23	58.4	Yellow/Blue		0
White	23	58.4	Blue/White		0
Blue	27	68.6	Brown		0
Red	27	68.6	Orange		0
Yellow	42	106.7	Orange/Black		0
Gray		0	Black/White		0
Violet		0	Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.5 "	1.3 "	1.0 "	8.9 "
9 1/2	1 3/10	1	8 9/10
24.1 cm	3.3 cm	2.5 cm	22.6 cm

Revised 09/07/2010



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**ICN-2S28-N@277**

Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications**Notes:****Section I - Physical Characteristics**

- 1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.
 1.2 Ballast shall be provided with integral leads or poke-in wire trap connectors color-coded per ANSI C82.11.

Section II - Performance Requirements

- 2.1 Ballast shall be Programmed Start.
 2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.
 2.3 Ballast shall operate from 50/60 Hz input source of _____ (120V through 277V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency).
 2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.
 2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.
 2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.
 2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.
 2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.
 2.9 Ballast shall have a Class A sound rating.
 2.10 Ballast shall have a minimum starting temperature of _____ {-18C (0F) or -28C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.
 2.11 Ballast shall provide Lamp EOL Protection Circuit.
 2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.
 2.13 Four-lamp ballast shall have (semi-independent or independent) lamp operation.

Section III - Regulatory Requirements

- 3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).
 3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.
 3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.
 3.4 Ballast shall comply with ANSI C82.11 where applicable.
 3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
 3.6 Ballast shall comply with UL Type CC rating.
 3.7 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

- 4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.
 4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.
 4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

Revised 09/07/2010



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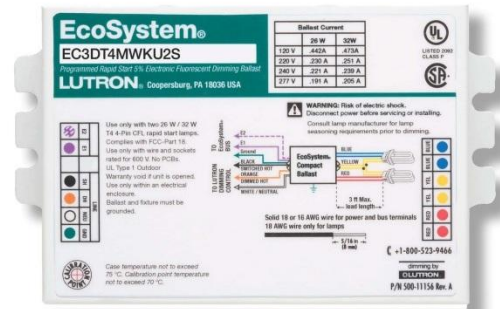


EcoSystem Digital Ballasts

EcoSystem compact ballasts provide high-performance dimming for any compact fluorescent application, including within an *EcoSystem* Lighting Control System. *EcoSystem* compact ballasts offer 100% to 5% dimming, providing both energy savings and lighting flexibility.

Features

- Continuous, flicker-free dimming from 100% to 5%
- Compatible with *EcoSystem* Digital Bus control, GRAFIK Eye® QS Control Unit, and Quantum® software, allowing for integration into an existing/planned *EcoSystem* Lighting Control System.
- Supports standard 3-wire line-voltage phase control technology.
- Programmed rapid start design ensures full-rated lamp life while dimming and cycling.
- Lamps turn on to any dimmed level without flashing to full brightness.
- Low harmonic distortion throughout the entire dimming range.
- Frequency of operation ensures that ballast does not interfere with infrared devices.
- Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure.
- Ultra-quiet operation.
- Protected from miswires of any input power to control lead, or from lamp leads to each other and/or ground.
- End-of-lamp-life protection circuitry ensures safe operation throughout entire lamp life
- Nonvolatile memory restores all ballast settings after power failure
- 100% performance tested at factory.
- 5-year limited warranty with *Lutron* field service commissioning (3-year standard warranty) from date of purchase. For additional Warranty information, please visit <http://www.lutron.com/ResourceLibrary/warranty/Limited%20Comm.pdf>



EcoSystem ballast case type K

LUTRON® SPECIFICATION SUBMITTAL

Page 1

Job Name:	Millennium Science Complex		
Job Number:	Building Stimulus	Model Numbers:	EC3DT4MWKU1S

EcoSystem®

Compact Fluorescent Ballasts

Digital Dimming Ballasts

369-339 B 10.20.10 2

Specifications

Standards

- UL Listed (evaluated to the requirements of UL935)
- UL Type 1 Outdoor for damp locations
- CSA Certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4 kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

Performance

- Operating Voltage: 120, 220/240, 277 V~ at 50 or 60 Hz
- Grounding: ballast and fixture must be grounded for proper dimming
- Dimming Range: 100% to 5% measured relative light output
- Lamp Starting: programmed rapid start
- Lamp Current Crest Factor: less than 1.7
- Light Output Variation: Constant $\pm 2\%$ light output for line voltage variations of $\pm 10\%$
- Lamp Life: Average lamp life meets or exceeds specified lamp ratings
- Power Factor: 0.95 minimum
- Total Harmonic Distortion (THD): Less than 10%
- Inaudible in a 27 dBA ambient
- Maximum Inrush Current: 3 A per ballast at 277 V~, 7A per ballast at 120 V~
- Standby power: Less than 1 W

Environment

- Minimum lamp starting temperature: 50 °F (10 °C)
- Relative humidity: less than 90% non-condensing
- Sound Rating: inaudible in a 27 dB ambient
- Maximum ballast case temperature: 167 °F (75 °C)

Ballast Wiring & Mounting

- Ballast is grounded by the specified terminal or by a mounting screw to the fixture
- Terminal blocks on the ballast accept the following wire gauges:

Power Wiring and *EcoSystem* Bus:

one 16 AWG (1.31 mm²) or 18 AWG (0.82 mm²) solid per terminal

Lamp Wiring:

one 16 AWG (1.31 mm²) or 18 AWG (0.82 mm²) solid per terminal

- Only one wire per terminal
- Ballast mounts using two mounting tabs or studs within a fluorescent fixture
- Wiring from the ballast to lamp sockets shall not exceed 3 ft (.91 m) for T4 compact lamps
- Ballast does not have sensor terminals

Lamp Seasoning

Refer to lamp manufacturer for lamp seasoning requirements prior to dimming

LUTRON® SPECIFICATION SUBMITTAL

Page **2**

Job Name:	Model Numbers:	
Millennium Science Complex	EC3DT4MWKU1S	
Job Number:	Building Stimulus	



EcoSystem®

Compact Fluorescent Ballasts

Digital Dimming Ballasts

369-339 B 10.20.10 3

EcoSystem Compact Fluorescent Ballast Models

Lamp Type	Lamp Watts	No. of Lamps	Model	Case Size	Input Voltage (VAC)	Input Current (A)	Input Power (W)	Ballast Factor (BF)	System Lumens (lm)	System Efficacy (lm/W)	Ballast Efficacy Factor	Relative Efficacy (RSE)
T4 4-Pin Quad-Tube or Triple-Tube 	18 W	1	EC3DT418KU1S (Studded)	K	120	0.18	21.3	0.95	1140	53.5	4.46	0.80
				K	220	0.10	21.1	0.95	1140	54.0	4.50	0.81
			EC3DT418KU1 (Non-studded)	K	240	0.09	21.4	0.95	1140	53.3	4.44	0.80
				K	277	0.08	20.8	0.95	1140	54.8	4.57	0.82
		2	EC3DT418KU2S (Studded)	K	120	0.34	41.1	0.95	2280	55.5	2.31	0.83
				K	220	0.18	39.6	0.95	2280	57.6	2.40	0.86
			EC3DT418KU2 (Non-studded)	K	240	0.17	39.4	0.95	2280	57.9	2.41	0.87
				K	277	0.15	39.9	0.95	2280	57.1	2.38	0.86
	26 W	1	EC3DT4MWKU1S (Studded)	K	120	0.22	26.4	0.95	1710	64.8	3.60	0.94
				K	220	0.12	26.8	0.95	1710	63.9	3.55	0.92
			EC3DT4MWKU1 (Non-studded)	K	240	0.11	26.9	0.95	1710	63.7	3.54	0.92
				K	277	0.10	27.0	0.95	1710	63.4	3.52	0.92
		2	EC3DT4MWKU2S (Studded)	K	120	0.43	51.6	0.95	3420	66.3	1.84	0.96
				K	220	0.23	49.9	0.95	3420	68.5	1.90	0.99
			EC3DT4MWKU2 (Non-studded)	K	240	0.21	50.6	0.95	3420	67.5	1.88	0.98
				K	277	0.19	51.4	0.95	3420	66.6	1.85	0.96
T4 4-Pin Triple-Tube 	32 W	1	EC3DT4MWKU1S (Studded)	K	120	0.29	34.8	0.95	2280	65.5	2.73	0.87
				K	220	0.15	33.0	0.95	2280	69.1	2.88	0.92
			EC3DT4MWKU1 (Non-studded)	K	240	0.14	33.6	0.95	2280	67.9	2.83	0.90
				K	277	0.12	33.2	0.95	2280	68.6	2.86	0.91
		2	EC3DT4MWKU2S (Studded)	K	120	0.55	66.0	0.95	4560	69.1	1.44	0.92
				K	220	0.29	64.5	0.95	4560	70.7	1.47	0.94
			EC3DT4MWKU2 (Non-studded)	K	240	0.26	63.0	0.95	4560	72.3	1.51	0.96
				K	277	0.24	65.5	0.95	4560	69.7	1.45	0.93
	42 W	1	EC3DT442KU1S (Studded)	K	120	0.36	43.2	0.95	3040	70.4	2.20	0.92
				K	220	0.20	42.9	0.95	3040	70.8	2.21	0.93
			EC3DT442KU1 (Non-studded)	K	240	0.18	42.7	0.95	3040	71.2	2.23	0.93
				K	277	0.15	42.6	0.95	3040	71.3	2.23	0.94
		2	EC3DT442KU2S (Studded)	K	120	0.73	87.6	0.95	6080	69.4	1.08	0.91
				K	220	0.39	85.9	0.95	6080	70.8	1.11	0.93
			EC3DT442KU2 (Non-studded)	K	240	0.35	85.1	0.95	6080	71.5	1.12	0.94
				K	277	0.31	85.4	0.95	6080	71.2	1.11	0.93

NOTE: The "S" at the end of the ballast model number indicates a studded option. Remove the "S" for a non-studded ballast.

LUTRON® SPECIFICATION SUBMITTAL

Page **3**

Job Name:	Millennium Science Complex	
Job Number:	Building Stimulus	
Model Numbers:	EC3DT4MWKU1S	

EcoSystem®

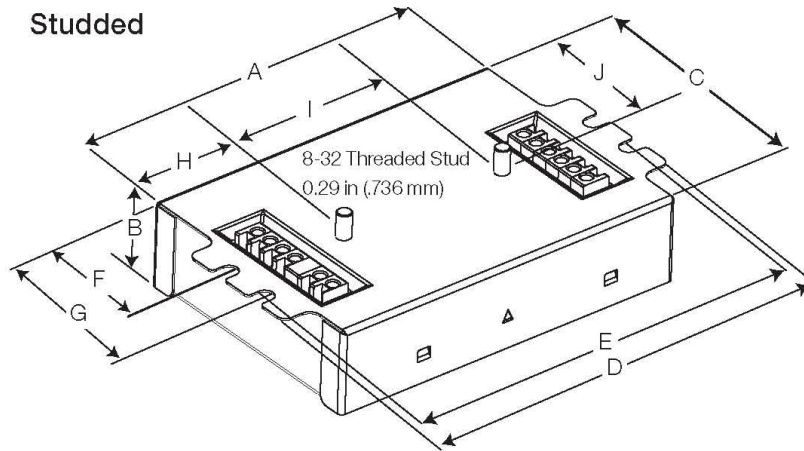
Compact Fluorescent Ballasts

Digital Dimming Ballasts

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EcoSystem Compact Fluorescent Ballast Case Dimensions

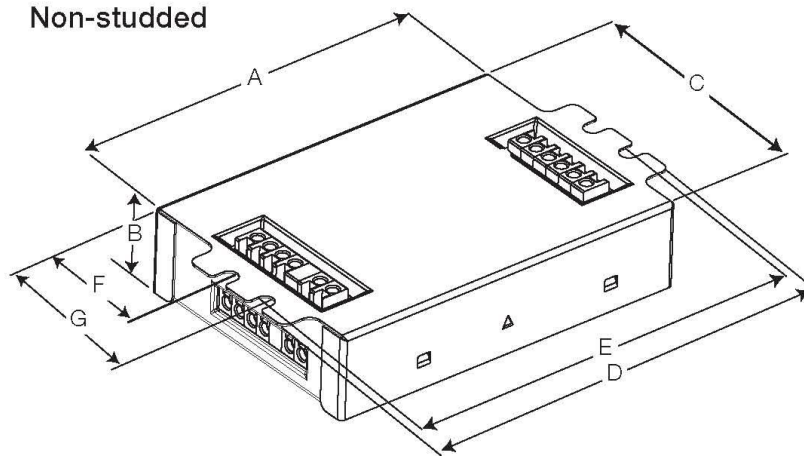
Studded



A	4.20 in (107 mm)
B	1.00 in (25 mm)
C	3.00 in (76 mm)
D	4.90 in (124 mm)
E	4.60 in (117 mm)
	(mounting centers)
F	1.42 in (36 mm)
G	1.99 in (51 mm)
H	1.09 in (28 mm)
I	2.00 in (51 mm)
J	1.60 in (41 mm)

NOTE: Studded version does not have side connectors.

Non-studded



A	4.20 in (107 mm)
B	1.00 in (25 mm)
C	3.00 in (76 mm)
D	4.90 in (124 mm)
E	4.60 in (117 mm)
	(mounting centers)
F	1.42 in (36 mm)
G	1.99 in (51 mm)

LUTRON SPECIFICATION SUBMITTAL

Page **4**

Job Name:	Millennium Science Complex	
Model Numbers:	EC3DT4MWKU1S	
Job Number:	Building Stimulus	



EcoSystem®

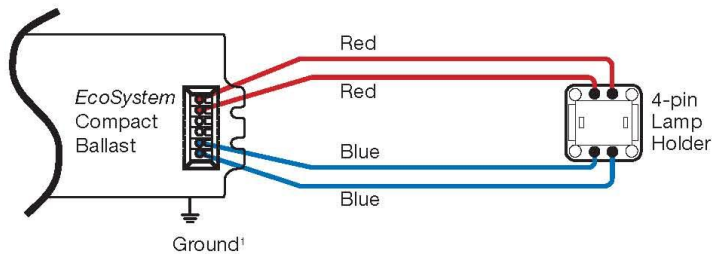
Compact Fluorescent Ballasts

Digital Dimming Ballasts

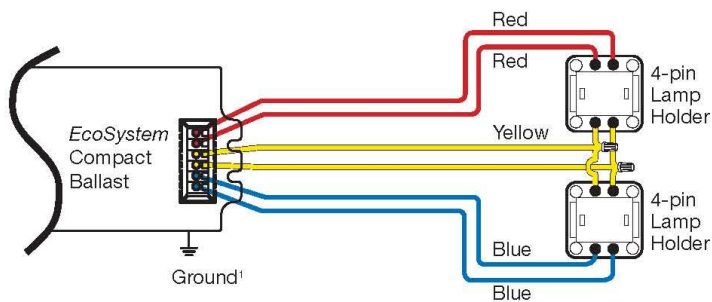
369-339 B 10.20.10 5

Lamp Wiring Diagrams

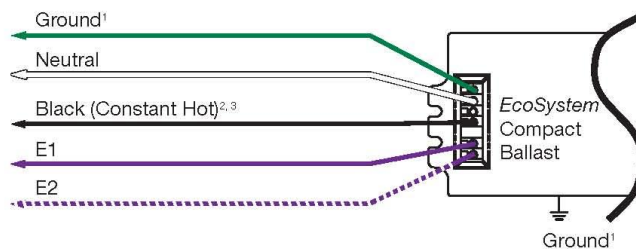
One Compact Fluorescent Lamp



Two Compact Fluorescent Lamps



EcoSystem Power Wiring Diagrams



¹ Ballast is grounded via the case or terminal.

² Wire colors shown are for *Lutron* controls and ballasts only. Dimming control wires may not match ballast wire colors.

³ The Constant Hot must not be wired to a switching device.

Note: For T4 compact lamps, maximum lamp-to-ballast wire length is 3 ft (.91 m) to guarantee proper performance.

LUTRON® SPECIFICATION SUBMITTAL

Page **5**

Job Name: Millennium Science Complex	Model Numbers: EC3DT4MWKU1S
Job Number: Building Stimulus	

EcoSystem®

Compact Fluorescent Ballasts

Digital Dimming Ballasts

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EcoSystem Bus Wiring Diagrams

EcoSystem Bus Overview

- The *EcoSystem* Bus wiring (E1 and E2) connects the digital ballasts together to form a lighting control system
- Each *EcoSystem* Bus supports up to 64 digital ballasts, 32 occupant sensors, 8 daylight sensors, and 64 wallstations or IR receivers
- Sensors do not directly connect to *EcoSystem* compact ballasts
- E1 and E2 (*EcoSystem* bus wires) are polarity insensitive and can be wired in any topology
- An *EcoSystem* Bus Supply provides power for the *EcoSystem* Bus and supports system programming
- All *EcoSystem* Bus programming is completed by using the *EcoSystem* Programmer, GRAFIK Eye® QS Control Unit with *EcoSystem* Lighting Control System, or Quantum™ Software

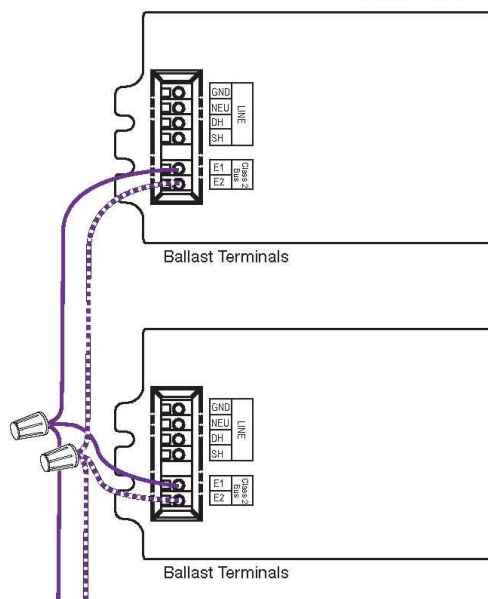
EcoSystem Bus Wiring

- *EcoSystem* Ballast Bus terminals only accept one 16 AWG (1.31 mm²) or 18 AWG (0.82 mm²) solid wire
- Make sure that the supply breaker to the Digital Ballast and *EcoSystem* Bus Supply is OFF when wiring
- Connect the two conductors to the two Digital Ballast terminals E1 and E2 as shown
- Using two different colors for E1 and E2 will reduce confusion when wiring several ballasts together
- The *EcoSystem* Bus may be wired Class 1 or Class 2. Consult applicable electrical codes for proper wiring practices

Notes

- The *EcoSystem* Bus Supply does not have to be located at the end of the Digital Loop
- E1 and E2 wires are not polarity sensitive
- *EcoSystem* Bus length is limited by the wire gauge used for E1 and E2 as follows:

Wire Gauge	Bus Length (max)
12 AWG (3.31 mm ²)	2200 ft (670 m)
14 AWG (2.08 mm ²)	1400 ft (427 m)
16 AWG (1.31 mm ²)	900 ft (274 m)



To the *EcoSystem* Bus Supply & up to 64 total ballasts

LUTRON® SPECIFICATION SUBMITTAL

Page **6**

Job Name:	Millennium Science Complex	
Job Number:	Building Stimulus	
Model Numbers:	EC3DT4MWKU1S	



EcoSystem®

Compact Fluorescent Ballasts

Digital Dimming Ballasts

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EcoSystem Ballast Wiring: Line Voltage Dimmers

EcoSystem Ballasts and 3-wire dimmers

- Lutron® 3-wire dimmers only control the ballasts they are wired to; EcoSystem ballasts do not support grouping of 3-wire control input.

3-Wire Control Wiring

- Make sure that the supply breaker to the Digital Ballast is OFF when wiring.
- Wire as shown

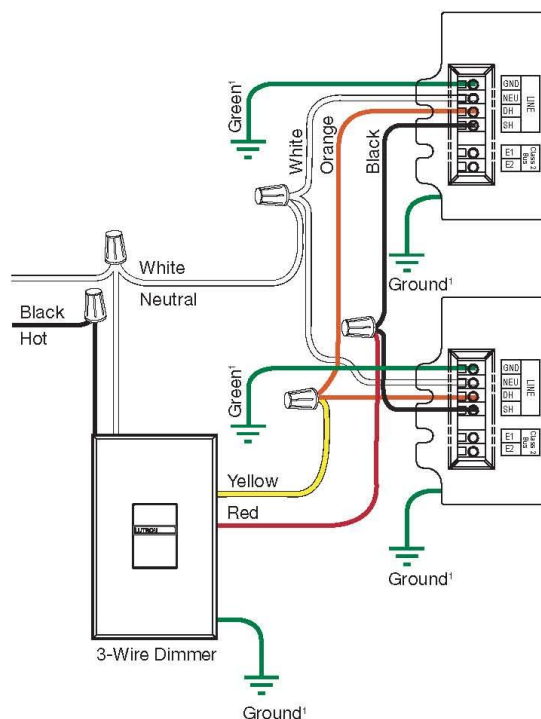
Line input	Connects to
Hot	Dimmer Black Wire
Neutral	Dimmer White Wire

Dimmer wire	Connects to
Yellow	Ballast Orange (DH)
Red	Ballast Black (SH)
White	Ballast White (NEU)
Green	Earth Ground (GND)

- EcoSystem ballast line voltage and 3-wire input terminals only accept one 16 AWG (1.31 mm²) or 18 AWG (0.82 mm²) solid wire.

Emergency and 3-wire

- EcoSystem ballasts controlled by a wallbox dimmer should not be used for emergency/egress lighting unless an external emergency ballast is used in the fixture. See Lutron App. Note #50.
- EcoSystem ballasts may be used for emergency/egress lighting when controlled by a Lutron dimming panel (GP); where the panel is a dedicated emergency panel.



¹ Ballast is grounded via the case or terminal

Notice

3-Wire control turns off digital ballasts when the control is in the off position.

LUTRON® SPECIFICATION SUBMITTAL

Page 7

Job Name:	Millennium Science Complex	
Job Number:	Building Stimulus	
Model Numbers:	EC3DT4MWKU1S	

EcoSystem®

Compact Fluorescent Ballasts

Digital Dimming Ballasts

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ELECTRICIANS AND CONTRACTORS

Ballast/Socket Leads

Lead lengths from ballast to socket must not exceed 3 ft (.91 m) for T4 linear lamps.

Lamp Sockets

Lamp sockets as per IEC 60400 are required to ensure positive lamp-pin to socket contact. T4 compact sockets must be the 4-pin type, and must be used with 4-pin compact lamps.

Ballast Operating Temperature

Ballast case temperature must not exceed 167 °F (75 °C) at any point on ballast. Calibration point temperature must not exceed 158 °F (70 °C).

Wiring and Grounding

Ballast and lighting fixture must be effectively grounded. Ballasts must be installed per national and local electrical codes.

FACILITIES MANAGERS

PERFORMANCE

Lamp Seasoning Requirements

Some fluorescent lamp manufacturers recommend that new fluorescent lamps be operated at full output ("seasoned") before they can be dimmed to render lamp impurities inert, ensuring proper dimming performance and average rated lamp life. Please contact your lamp manufacturer for seasoning requirements.

SERVICE

Replacement Parts

Use replacement parts with exact *Lutron* model numbers. Consult Lutron if you have any questions.

Further Information

For further information, please visit us at www.lutron.com/ballasts or contact our 24-hour Technical Support Center at 1-800-523-9466.

LUTRON® SPECIFICATION SUBMITTAL

Page **8**

Job Name:	Model Numbers:	
Millennium Science Complex	EC3DT4MWKU1S	
Job Number:	Building Stimulus	



Lutron: EC5-T832-G-UNV-317L

EcoSystem®

Five Control Input

Digital Dimming Ballasts

EcoSystem Ballasts 1 06.25.10

EcoSystem Multiple Control Input Ballasts

Digital electronic dimming ballasts maximize the benefits of a lighting management system. *EcoSystem* Ballasts offer 100% to 10% dimming; ideal for use where saving energy, increasing flexibility, and maximizing productivity are the goals of the lighting design.



EcoSystem case type G

Features

- Continuous, flicker-free dimming from 100% to 10%
- Provides power for and responds to one occupancy sensor, one photo sensor, and one personal control input (infrared receiver or wallstation)
- Communicates status and sensor inputs over the *EcoSystem* Bus
- Programmed rapid start design ensures full rated lamp life while dimming and cycling
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range
- Frequency of operation ensures that ballast does not interfere with infrared devices
- End-of-lamp-life protection circuitry ensures safe operation throughout entire lamp life
- Ultra-quiet operation
- Nonvolatile memory restores all ballast settings after power failure
- Ballasts maintain consistent light output for linear lamp lengths (i.e. 4 ft., 3 ft., 2 ft. have same relative output)
- Protected from miswires of any input power to control lead, or from lamp leads to each other and/or ground
- 100% performance tested at factory



EcoSystem case type J

LUTRON SPECIFICATION SUBMITTAL

Page 1

Job Name:	Model Numbers:	
Millennium Science Complex	EC5 T832 G UNV 317L	
Job Number: Buildign Stimulus		

EcoSystem®

Five Control Input

Digital Dimming Ballasts

EcoSystem Ballasts 2 06.25.10

Specifications

Standards

- California Energy Commission (CEC) Listed
- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Some models are NOM Listed
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4 kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

Performance

- Operating Voltage: 120, 220/240, 277 V~ at 50 or 60 Hz
- Grounding: ballast and fixture must be grounded for proper dimming
- Dimming Range: 100% to 10% measured relative light output
- Lamp Starting: programmed rapid start
- Lamp Current Crest Factor: less than 1.7
- Light Output Variation: Constant $\pm 2\%$ light output for line voltage variations of $\pm 10\%$
- Lamp Life: Average lamp life meets or exceeds specified lamp ratings
- Power Factor: 0.95 minimum
- Total Harmonic Distortion (THD): Less than 20%
- Inaudible in a 27 dBA ambient
- Maximum Inrush Current: 3 A per ballast at 277 V~, 7A per ballast at 120 V~
- Class 2 Output: +20 V=, 50mA maximum (one daylight sensor, one keypad and one occupancy sensor can be connected)

Environment

- Minimum lamp starting temperature: 50 °F (10 °C)
- Relative humidity: less than 90% non-condensing
- Sound Rating: inaudible in a 27 dB ambient
- Maximum ballast case temperature: 75 °C (167 °F)

Ballast Wiring & Mounting

- Ballast is grounded by a mounting screw to the fixture
- Terminal blocks on the ballast accept the following wire gauges:
Power Wiring, Lamp Wiring, and EcoSystem Bus:
only one #18 AWG solid per terminal
Class 2 Sensors:
only one #22 AWG solid per terminal
- Only one wire per terminal
- Class 2 sensor wiring must be separated from all power and Class 1 wiring, consult all applicable local and national codes
- Ballast mounts using two screws (or sheet metal feature and one screw) within a fluorescent fixture
- Wiring from the ballast to lamp sockets shall not exceed 7 ft. for T8, T5, and T5HO lamps
- Wiring from the ballast to lamps sockets shall not exceed 3 ft. for T5 Twin Tube lamps

Lamp Seasoning

Refer to lamp manufacturer for lamp seasoning requirements prior to dimming

LUTRON® SPECIFICATION SUBMITTAL

Page 2

Job Name:	Model Numbers:	
Millennium Science Complex	EC5 T832 G UNV 317L	
Job Number: Buildign Stimulus		



EcoSystem®

Five Control Input

Digital Dimming Ballasts

EcoSystem Ballasts 3 06.25.10

EcoSystem Ballasts for linear and U bend T8 Lamps

Lamp	No. of Lamps	Model	Case Size	Input Voltage (VAC)	Input Current (A)	Input Power (W)	Ballast Factor (BF)	System Lumens (lm)	System Efficacy (lm/W)	Ballast Efficacy Factor	Relative Efficacy (RSE)
	1	EC5 T832 J UNV 1	J	277 240 120	0.11 0.13 0.26	31.6 31.0 31.3	0.85 0.85 0.85	2550 2550 2550	81 82 81	2.69 2.74 2.72	0.86 0.87 0.87
	2	EC5 T832 G UNV 2L	G	277 240 120	0.22 0.25 0.49	59.6 57.6 58.8	0.85 0.85 0.85	5100 5100 5100	86 89 87	1.43 1.48 1.45	0.91 0.94 0.93
				277 240 120	0.21 0.25 0.49	57.4 59.0 59.1	0.85 0.85 0.85	5100 5100 5100	89 86 86	1.48 1.44 1.44	0.95 0.92 0.92
				277 240 120	0.31 0.36 0.72	86.5 84.0 85.9	0.85 0.85 0.85	7650 7650 7650	88 89 89	0.98 1.01 0.99	0.94 0.97 0.95
	3	EC5 T832 G UNV 3L	G	277 240 120	0.41 0.47 0.95	105.7 106.5 106.8	1.17 1.17 1.17	10,530 10,530 10,530	100 99 99	1.11 1.10 1.10	1.06 1.05 1.05
				277 240 120	0.41 0.47 0.95	105.7 106.5 106.8	1.17 1.17 1.17	10,530 10,530 10,530	100 99 99	1.11 1.10 1.10	1.06 1.05 1.05
				277 240 120	0.41 0.47 0.95	105.7 106.5 106.8	1.17 1.17 1.17	10,530 10,530 10,530	100 99 99	1.11 1.10 1.10	1.06 1.05 1.05
	1	EC5 T825 J UNV 1	J	277 240 120	0.10 0.11 0.23	27.6 27.0 26.9	0.85 0.85 0.85	1828 1828 1828	66 68 68	3.08 3.15 3.16	0.77 0.79 0.79
	2	EC5 T825 J UNV 2	J	277 240 120	0.18 0.20 0.41	48.9 49.0 49.0	0.85 0.85 0.85	3665 3665 3665	75 75 75	1.74 1.73 1.73	0.87 0.87 0.87
				277 240 120	0.18 0.20 0.41	48.9 49.0 49.0	0.85 0.85 0.85	3665 3665 3665	75 75 75	1.74 1.73 1.73	0.87 0.87 0.87
				277 240 120	0.18 0.20 0.41	48.9 49.0 49.0	0.85 0.85 0.85	3665 3665 3665	75 75 75	1.74 1.73 1.73	0.87 0.87 0.87
	1	EC5 T817 J UNV 1	J	277 240 120	0.08 0.08 0.17	20.6 20.0 20.1	0.85 0.85 0.85	1190 1190 1190	68 60 70	4.13 4.25 4.23	0.70 0.72 0.72
	2	EC5 T817 J UNV 2	J	277 240 120	0.13 0.15 0.31	36.2 37.0 37.0	0.85 0.85 0.85	2380 2380 2380	66 64 64	2.35 2.30 2.30	0.80 0.78 0.78
				277 240 120	0.13 0.15 0.31	36.2 37.0 37.0	0.85 0.85 0.85	2380 2380 2380	66 64 64	2.35 2.30 2.30	0.80 0.78 0.78
				277 240 120	0.13 0.15 0.31	36.2 37.0 37.0	0.85 0.85 0.85	2380 2380 2380	66 64 64	2.35 2.30 2.30	0.80 0.78 0.78
				277 240 120	0.13 0.15 0.31	36.2 37.0 37.0	0.85 0.85 0.85	2380 2380 2380	66 64 64	2.35 2.30 2.30	0.80 0.78 0.78
				277 240 120	0.13 0.15 0.31	36.2 37.0 37.0	0.85 0.85 0.85	2380 2380 2380	66 64 64	2.35 2.30 2.30	0.80 0.78 0.78

LUTRON® SPECIFICATION SUBMITTAL

Page **3**

Job Name:	Model Numbers:	
Millennium Science Complex	EC5 T832 G UNV 317L	
Job Number: Buildign Stimulus		

EcoSystem®

Five Control Input

Digital Dimming Ballasts

EcoSystem Ballasts 4 06.25.10

EcoSystem Ballasts for linear and U bend T8 Lamps: Reduced Wattage

Lamp	No. of Lamps	Model	Case Size	Input Voltage (VAC)	Input Current (A)	Input Power (W)	Ballast Factor (BF)	System Lumens (lm)	System Efficacy (lm/W)	Ballast Efficacy Factor	Relative Efficacy (RSE)
F32T8 (48 in) 	1	EC5 T8RW J UNV 1 30 W	J	277	0.11	28.9	0.85	2350	81	2.94	0.88
				240	0.12	28.7	0.85	2350	82	2.96	0.89
				120	0.24	29.2	0.85	2350	80	2.91	0.87
		EC5 T8RW J UNV 1 28 W		277	0.10	26.3	0.85	2202	84	3.23	0.90
				240	0.11	26.2	0.85	2202	84	3.24	0.91
				120	0.22	26.5	0.85	2202	83	3.21	0.90
		EC5 T8RW J UNV 1 25 W		277	0.09	24.8	0.85	2061	83	3.43	0.86
				240	0.10	24.5	0.85	2061	84	3.47	0.87
				120	0.21	24.9	0.85	2061	83	3.41	0.85
	2	EC5 T8RW J UNV 2 30 W	J	277	0.19	52.5	0.85	4701	90	1.62	0.97
				240	0.22	52.5	0.85	4701	90	1.62	0.97
				120	0.44	53.4	0.85	4701	88	1.59	0.96
		EC5 T8RW J UNV 2 28 W		277	0.18	48.9	0.85	4403	90	1.74	0.97
				240	0.20	48.6	0.85	4403	91	1.75	0.98
				120	0.42	50.0	0.85	4403	88	1.70	0.95
		EC5 T8RW J UNV 2 25 W		277	0.17	46.6	0.85	4123	88	1.82	0.91
				240	0.19	45.9	0.85	4123	90	1.85	0.93
				120	0.38	46.5	0.85	4123	89	1.83	0.91
	3	EC5 T8RW G UNV 3L 30 W	G	277	0.28	76.3	0.85	7051	92	1.11	1.00
				240	0.32	76.3	0.85	7051	92	1.11	1.00
				120	0.65	78.1	0.85	7051	90	1.09	0.98
		EC5 T8RW G UNV 3L 28 W		277	0.26	71.1	0.85	6605	93	1.20	1.00
				240	0.30	70.4	0.85	6605	94	1.21	1.01
				120	0.60	71.6	0.85	6605	92	1.19	1.00
		EC5 T8RW G UNV 3L 25 W		277	0.25	67.9	0.85	6184	91	1.25	0.94
				240	0.28	67.4	0.85	6184	92	1.26	0.95
				120	0.58	69.0	0.85	6184	90	1.23	0.92

Reduced wattage lamps may exhibit light to moderate striations (moving bands of bright and dark spots) across the lamp at certain dimming levels. While striations do not harm the lamp or ballast, it can be distracting in fixtures where the lamp is directly visible.

CLUTRON® SPECIFICATION SUBMITTAL

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Job Name:	Model Numbers:	
Millennium Science Complex	EC5 T832 G UNV 317L	
Job Number: Buildign Stimulus		



EcoSystem®

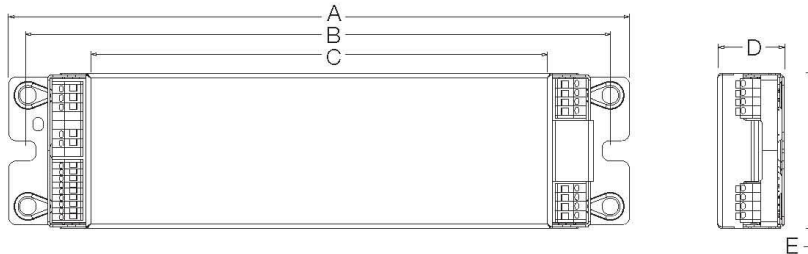
Five Control Input

Digital Dimming Ballasts

EcoSystem Ballasts 8 06.25.10

EcoSystem Ballast Case Dimensions

G Case



G Case Dimensions

A = 9.5 in (241 mm)

B = 8.9 in (226 mm)

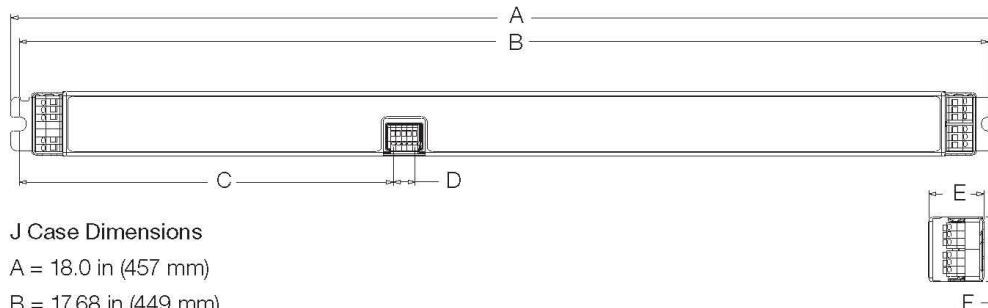
C = 7.1 in (180 mm)

D = 1.0 in (25 mm)

E = 2.38 in (60 mm)

G case ballasts ship with 36 in. leads for lamp connections and 18 in. leads for Hot, Neutral, E1 and E2 connections

J Case



J Case Dimensions

A = 18.0 in (457 mm)

B = 17.68 in (449 mm)

C = 6.82 in (173 mm)

D = .394 in (10 mm)

E = 1.0 in (25 mm)

F = 1.18 in (30 mm)

LUTRON® SPECIFICATION SUBMITTAL

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Job Name:	Model Numbers:	
Millennium Science Complex	EC5 T832 G UNV 317L	
Job Number: Buildign Stimulus		

EcoSystem®

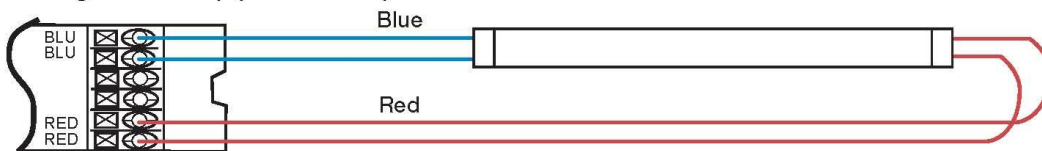
Five Control Input

Digital Dimming Ballasts

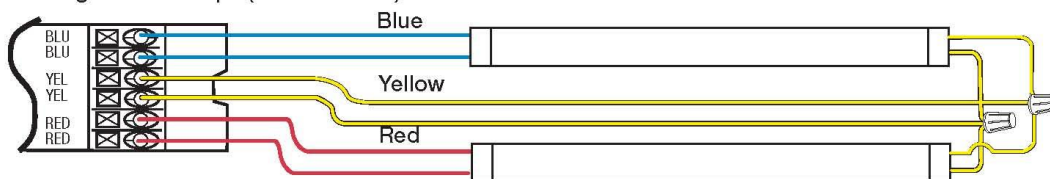
EcoSystem Ballasts 9 06.25.10

EcoSystem Ballast Wiring Diagrams - T8, T5, T5 HO

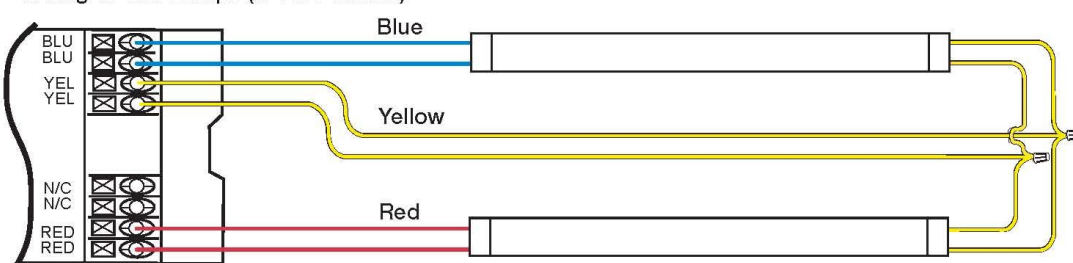
Wiring to One Lamp (J case shown)



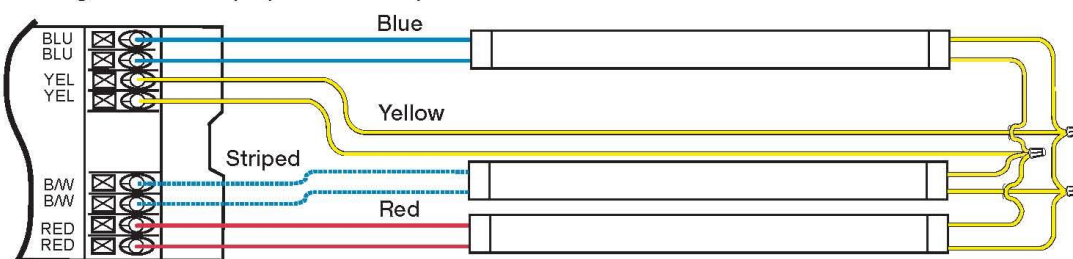
Wiring to Two Lamps (J case shown)



Wiring to Two Lamps (G case shown)



Wiring to Three Lamps (G case shown)



NOTICE

- Maximum ballast to lamp socket lead length is 7 feet (2 m)
- Wire colors shown are labeled on the ballast, but may vary depending upon fixture construction

LUTRON® SPECIFICATION SUBMITTAL

Page 6

Job Name:	Millennium Science Complex	
Job Number:	Buildign Stimulus	
Model Numbers:	EC5 T832 G UNV 317L	



EcoSystem Ballast Wiring: EcoSystem Bus

EcoSystem Bus Overview

- The *EcoSystem* Bus wiring (E1 and E2) connects the digital ballasts together to form a lighting control system
- Each *EcoSystem* Bus supports up to 64 digital ballasts, 32 occupant sensors, 8 daylight sensors, and 64 wallstations or IR receivers
- E1 and E2 (*EcoSystem* bus wires) are polarity insensitive and can be wired in any topology
- An *EcoSystem* Bus Supply provides power for the *EcoSystem* Bus and supports system programming
- All *EcoSystem* Bus programming is completed by using the *EcoSystem* Programmer

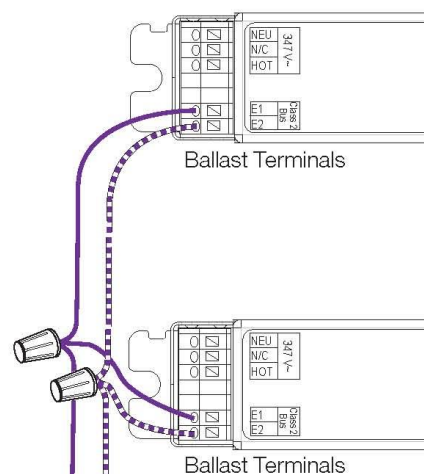
EcoSystem Bus Wiring

- Ballast *EcoSystem* Bus terminals only accept one #18 AWG solid wire
- Make sure that the supply breaker to the Digital Ballast and *EcoSystem* Bus Supply is OFF when wiring
- Connect the two conductors to the two Digital Ballast terminals E1 and E2 as shown
- Using two different colors for E1 and E2 will reduce confusion when wiring several ballasts together
- The *EcoSystem* bus may be wired Class 1 or Class 2. Consult applicable electrical codes for proper wiring practices

Notes

- The *EcoSystem* Bus Supply does not have to be located at the end of the Digital Loop
- E1 and E2 wires are not polarity sensitive
- *EcoSystem* Bus length is limited by the wire gauge used for E1 and E2 as follows:

Wire Gauge	Bus Length (max)
12 AWG	2200 ft (670 m)
14 AWG	1400 ft (427 m)
16 AWG	900 ft (274 m)



To the *EcoSystem*
Bus Supply & up
to 64 total ballasts

LUTRON® SPECIFICATION SUBMITTAL

Page 7

Job Name:	Model Numbers:	
Millennium Science Complex	EC5 T832 G UNV 317L	
Job Number: Buildign Stimulus		

EcoSystem®

Five Control Input

Digital Dimming Ballasts

EcoSystem Ballasts 14 06.25.10

EcoSystem Ballast Wiring: Occupancy Sensor

Wiring to a Lutron Occupant Sensor (LOS-XX)

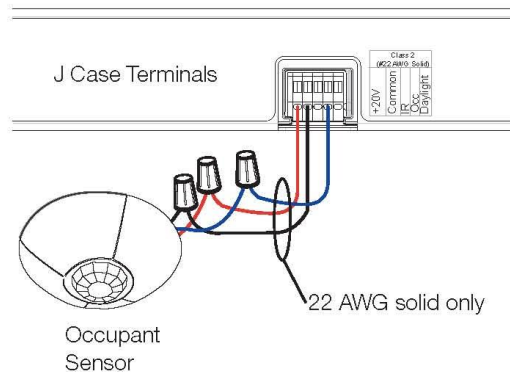
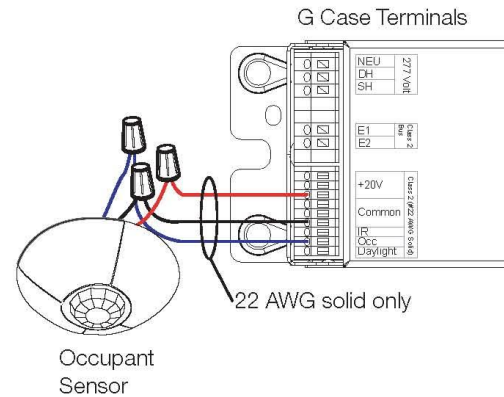
- Sensor wiring summary:

Sensor Wire	Ballast Terminal	Terminal Color
Red	+20 V $\overline{\text{---}}$	Red
Black	Common	Black
Blue	Occ	Blue

- Make sure that the supply breaker to the Digital Ballast is OFF when wiring
- Connect the three conductors to the three ballast terminals as shown
- Occupant sensor must be placed within 50 feet (15 m) of the ballast
- Ballast Class 2 terminals only accept one 22 AWG solid wire

Notes

- Only applies to ballasts with an integral sensor connection
- Occupant sensors from other manufacturers may be used with *EcoSystem* ballasts if the sensor meets the following criteria:
Vin = +20 V $\overline{\text{---}}$, current draw less than 35 mA
- If other manufacturer's occupant sensors are used terminal colors and sensor wire colors may not match
- All sensor and wallstation wiring is Class 2. Follow all applicable national and local codes for proper circuit separation and protection.



LUTRON® SPECIFICATION SUBMITTAL

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Attention Electricians and Fixture Manufacturers

Ballast/Socket Leads

Lead lengths from ballast to socket must not exceed 7 feet (2 m) for linear lamps (T5, T5HO, T8). Lead lengths must not exceed 3 feet (1 m) for T5 twin tube lamps.

Lamp Sockets

Lamp sockets as per IEC 60400 are required to ensure positive lamp-pin to socket contact.

Mounting for T5 and T5HO Lamps

Mount lamps 3/8 in. ± 1/8 in. away from the grounded metal surface.

Mounting for T8 & T5 Twin Tube Lamps

Mount lamps 1/2 in. ± 1/4 in. away from the grounded metal surface.

Having a lamp too close to the grounded metal will reduce lamp life. Having a fluorescent lamp too far away from the grounded metal will make the lamp flicker or not turn on at all.

Lamp Seasoning Requirements

Consult lamp manufacturer's recommendations on lamp seasoning prior to dimming.

Further Information

For further information please visit www.lutron.com/ecosystem or contact our 24-hour Technical Support Center at 1-800-523-9466

LUTRON® SPECIFICATION SUBMITTAL

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Job Name:	Model Numbers:	
Millennium Science Complex	EC5 T832 G UNV 317L	
Job Number: Buildign Stimulus		

Philips: ICN-4S54-90C2LS



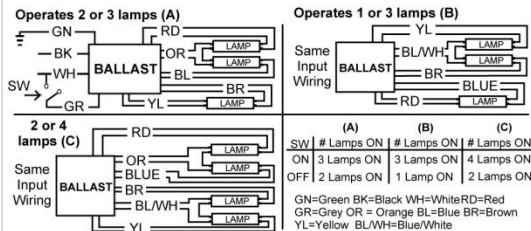
ICN4S5490C2LS@277

Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series/Parallel
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F .
F54T5/HO	1	54	-20/-29	0.24	62	0.99	30	0.90	1.7	1.60
* F54T5/HO	2	54	-20/-29	0.43	117	0.99	10	0.98	1.7	0.85
F54T5/HO	3	54	-20/-29	0.66	179	1.00	10	0.98	1.7	0.56
F54T5/HO	4	54	-20/-29	0.86	234	1.00	10	0.98	1.7	0.43

Wiring Diagram

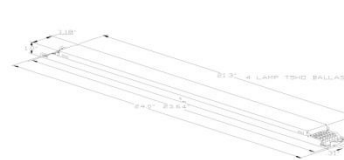


The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.		in.	cm.
Black	0	0	Yellow/Blue	0	0
White	0	0	Blue/White	0	0
Blue	0	0	Brown	0	0
Red	0	0	Orange	0	0
Yellow	0	0	Orange/Black	0	0
Gray	0	0	Black/White	0	0
Violet	0	0	Red/White	0	0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
24 "	1.18 "	1 "	23.64 "
24	1 9/50	1	23 16/25
61 cm	3 cm	2.5 cm	60 cm

Revised 09/10/2010



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Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886



**ICN4S5490C2LS@277**

Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series/Parallel
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications**Notes:****Section I - Physical Characteristics**

- 1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.
 1.2 Ballast shall be provided with integral leads or poke-in wire trap connectors color-coded per ANSI C82.11.

Section II - Performance Requirements

- 2.1 Ballast shall be Programmed Start.
 2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.
 2.3 Ballast shall operate from 50/60 Hz input source of _____ (120V through 277V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency).
 2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.
 2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.
 2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.
 2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.
 2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.
 2.9 Ballast shall have a Class A sound rating.
 2.10 Ballast shall have a minimum starting temperature of _____ {-18C (0F) or -28C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.
 2.11 Ballast shall provide Lamp EOL Protection Circuit.
 2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.
 2.13 Four-lamp ballast shall have (semi-independent or independent) lamp operation.

Section III - Regulatory Requirements

- 3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).
 3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.
 3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.
 3.4 Ballast shall comply with ANSI C82.11 where applicable.
 3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
 3.6 Ballast shall comply with UL Type CC rating.
 3.7 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

- 4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.
 4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.
 4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

Revised 09/10/2010



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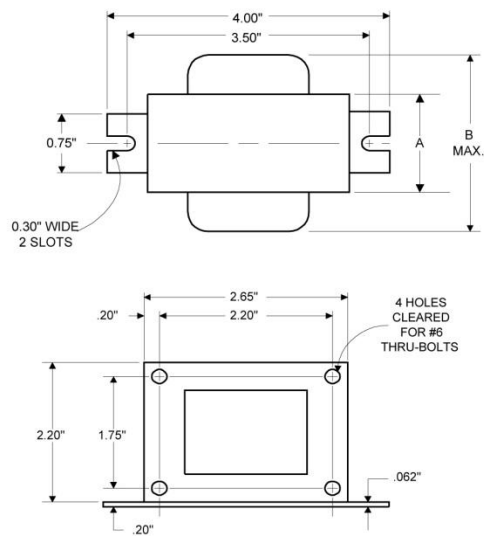
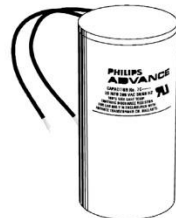
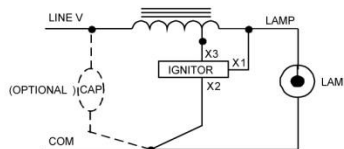
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Philips: M98/M143

PHILIPS ADVANCE	Metal Halide Lamp Ballast	Catalog Number 71A5237P For 70W M98/M143 60 Hz R-HPF Status: Active																																																																																																																																																																														
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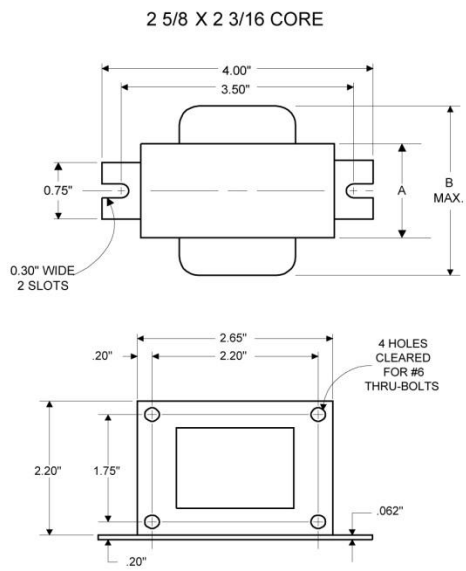
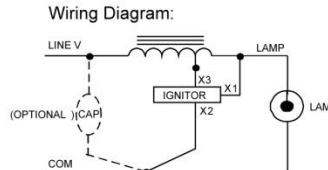
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Revised: 07/31/09



		Metal Halide Lamp Ballast		Catalog Number 71A5337P For 100W M90/M140 60 Hz R-HPF Status: Active																																																																																																																																																																																																																			
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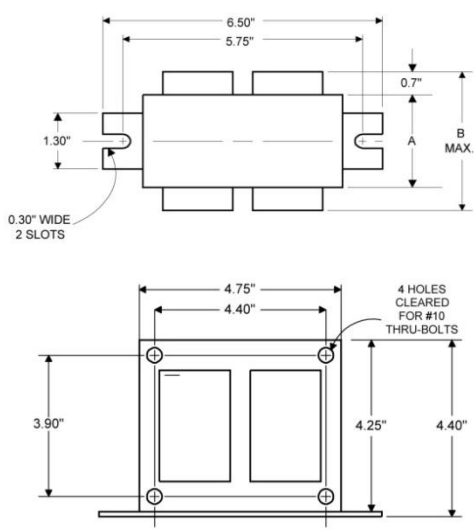
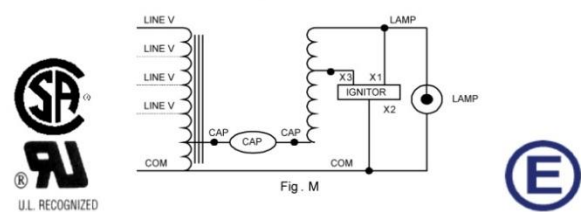
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Revised: 07/31/09

Philips: AS205WQUADEE

		Metal Halide Lamp Ballast		Catalog Number AS205WQUADEE For 205W C184 ALLSTART 60 Hz SUPER-CWA Status: Active																																																																																																																																																																																
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Revised: 09/16/10



Appendix L: Panelboard Cutsheets

Eaton Cutler-Hammer: Pow-R-Line 1a

EATON**Cutler-Hammer**June 2006
Sheet 0821**Panelboards
Pow-R-Line 1a****22.1-1**

General Description — Pow-R-Line 1a

Pow-R-Line 1a

Pow-R-Line 1a

General Description**Panelboard Ratings****Voltage:**

- 240 Vac maximum.

Main Lugs:

- 100 – 400 amperes.

Main Breakers:

- 100 – 400 amperes.

Branch Breakers:

- 15 – 100 amperes
(Bolt-on or plug-on chassis).

Short Circuit Current Ratings (Symmetrical)

- 240 Vac: 10 kA and 22 kA fully rated.
- 240 Vac: 22 – 200 kA series rated.

Service

- 3-phase, 4-wire 208Y/120 V and 240/120 V Delta.
- Single-phase, 3-wire 120/240 V.
- Single-phase, 2-wire 120 V.
- 3-phase, 3-wire 208 and 240 V.

Suitable for service entrance applications when specified.

Mains

For available mains, refer to Table 22.1-1.

Main breakers, 100 amperes, Types BAB and QBH are horizontally mounted, same as branch breakers. All other main breakers are vertically mounted.

Branch Circuits

For available branch devices, refer to Table 22.1-2.

Main Lugs Only

The short circuit rating of the MLO assembled panelboard will be fully rated based upon the lowest rated branch device or may be series rated with an approved upstream device.

Main lugs only ampere ratings: 100, 225 and 400.

Main Circuit Breakers

The short circuit rating shown is that of the main breaker only. The short circuit rating of the assembled panelboard is the rating of the lowest fully rated main or branch device or the rating of an approved series rated combination

Table 22.1-1. Main Circuit Breakers

Breaker Frame Amperes	Breaker Type	Interrupting Rating (kA Symmetrical) at 240 V
100	BAB	10
100	QBHW	22
100	EHD	18
150	FDB	18
225	FD	65
225	HFD	100
225	FDC	200
225	EDB	22
225	EDS	42
225	ED	65
225	EDH	100
225	EDC	200
250	JD	65
250	HJD	100
250	JDC	200
400	DK	65
400	KD	65
400	HKD	100
400	KDC	200

Table 22.1-2. Branch Circuit Breakers

Breaker Type	Ampere Rating	Number of Poles	Interrupting Rating (kA Symmetrical)		
			120 V	120/240 V	240 V
BAB, HOP	15 – 70	1	10	—	—
BAB, HOP	15 – 100	2	—	10	—
BAB, HOP	15 – 100	2, 3	—	—	10
BAB-D ①, HOP-D ①	15 – 60	1, 2	10	10	—
BAB-C ②, HOP-B ②	15 – 30	1, 2	10	10	—
BABRP ③	15 – 30	1, 2	10	10	—
BABRSP ③	15 – 30	1, 2	10	10	—
QBGF, QBGFEP	15 – 50 ④	1, 2	10	10	—
QPGF, QPGFEP	15 – 50 ④	1, 2	10	10	—
QBAF ⑤, QBAG ⑤	15 – 20	1, 2	10	10	—
QBHW	15 – 70	1	22	—	—
QBHW	15 – 100	2	—	22	—
QBHW	15 – 100	2, 3	—	—	22
QBHGF, QBGFEP	15 – 30	1, 2	22	22	—
QPHGF, QPHGFEP	15 – 30	1, 2	22	22	—
QBHAF ⑥, QBHAG ⑥	15 – 20	1, 2	22	22	—

① HID (High Intensity Discharge) rated breaker.

② Switching Neutral breaker. 1-pole device requires 2-pole space, 2-pole device requires 3-pole space.

③ Solenoid operated breaker.

④ 50 ampere is 2-pole only.

⑤ Arc fault breaker.

⑥ Arc fault breaker with GFCI.

Series Rated Combinations

Refer to series rating tables beginning on Page 22.0-11 for the approved series rated combinations available for the branch circuit breakers listed in Table 22.1-2.

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**22.1-2 Panelboards
Pow-R-Line 1a****Eaton | Cutler-Hammer**June 2006
Sheet 0822**Technical Data — Pow-R-Line 1a****22****Pow-R-Line 1a Specifications****Bussing**

100 – 400 amperes: Tin-plated aluminum is standard, copper is available as an option.

Boxes

Boxes are made from code-gauge galvanized steel.

Blank ends are supplied as standard, knockouts are available upon request.

EZ Trim

Trims are made from code-gauge steel and painted ANSI 61 gray.

All panelboards have door-in-door as standard with multi-point catch and lock, and concealed mounting hardware.

Modifications**Table 22.1-3. Sub-Feed Lugs (Main Lugs Only)**

Amperes	Panel Height Addition
100	0 Inches (0 mm)
225	0 Inches (0 mm)

Table 22.1-4. Through-Feed Lugs

Amperes	Information
100	See Table 22.1-6
225	See Table 22.1-6
400	See Table 22.1-6

Table 22.1-5. Sub-Feed Breakers (One Per Panel)

Ampere Rating	Breaker Type	Interrupting Rating (kA Symmetrical) at 240 V
150	FDB	18
225	FD	65
225	HFD	100
225	FDC	200
225	EDB	22
225	EDS	42
225	ED	65
225	EDH	100
225	EDC	200
250	JD	65
250	HJD	100
250	JDC	200
400	DK	65
400	KD	65
400	HKD	100
400	KDC	200

Shunt Trips

Shunt trips are available on breakers. BAB, HQP, QBHW and QPHW require one additional pole space for shunt trip, i.e., 1-pole is 2-pole size, 2-pole is 3-pole size and 3-pole is 4-pole size.

Ground Bar

Standard bolted in box. Aluminum is standard. Copper is available as an option.

Enclosures

Types 1, 12, 3R, 4 and 4X.

TVSS

Integrated onto panelboard chassis. For complete product description and available ratings, refer to **Section 36**.

Box Sizing and Selection

Box size for all Type 1 panelboards are available from **Table 22.1-6**.

Instructions

1. Select the rating and type of mains required.
2. Count total number of branch circuit poles (including spaces) required in the panelboard. Do not count main breaker poles. Convert 2- or 3-pole branch breakers to single-poles, i.e., 3-pole breaker, count as three poles.

Note: For horizontal mounted mains (BAB Type), use main lug table, include space in branch section for mains.

3. Using correct table, type of mains and ampere rating per Step 1, find total number of poles.

Note: Where total number of poles (Step 2) fall between number in table, use the next higher number.

4. Read box size across columns to the right.

Top and Bottom Gutters (minimum)

5-1/2 inches (139.7 mm).

Side Gutters

20-inch (508.0 mm) wide box:
6-1/2 inches (165.1 mm).

Table 22.1-6. Type 1 Panelboards — Dimensions in Inches (mm)

Ampere Rating of Mains	Main Breaker Type Mounting Position		Maximum Number of Branch Circuits Including Provisions	Box Dimensions ①②		
				Height	Width	Depth
100 Amperes						
100 A ③ Main Lugs or Main Breaker	EHD, FDB, FD, HFD, FDC Vertical	18	36 (914.4)	20 (508.0)	5.75 (146.1)	
		30	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		42	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		48	60 (1524.0)	20 (508.0)	5.75 (146.1)	
100 A ③ Main Lugs or Main Breaker with 100 A Through-Feed Lugs or Sub-Feed Breaker	EHD, FDB, FD, HFD, FDC Vertical	18	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		30	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		42	60 (1524.0)	20 (508.0)	5.75 (146.1)	
		48	60 (1524.0)	20 (508.0)	5.75 (146.1)	
225 Amperes						
225 A ④ Main Lugs or Main Breaker	EDB, EDS, ED, EDH, EDC, FD, HFD, FDC Vertical	18	36 (914.4)	20 (508.0)	5.75 (146.1)	
		30	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		42	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		48	60 (1524.0)	20 (508.0)	5.75 (146.1)	
225 A ④ Main Lugs or Main Breaker with 225 A or 100 A Sub-Feed Lugs or Breaker	EHD, FDB, FD, HFD, FDC, EDB, EDS, ED, EDH, EDC Vertical	18	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		30	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		42	60 (1524.0)	20 (508.0)	5.75 (146.1)	
		48	60 (1524.0)	20 (508.0)	5.75 (146.1)	
400 Amperes						
400 A Main Lugs or Main Breaker	DK, KD, HKD, KDC Vertical	18	60 (1524.0)	20 (508.0)	5.75 (146.1)	
		30	60 (1524.0)	20 (508.0)	5.75 (146.1)	
		42	72 (1828.8)	20 (508.0)	5.75 (146.1)	
		48	72 (1828.8)	20 (508.0)	5.75 (146.1)	
400 A Main Lugs or Main Breaker with 225 A or 100 A Sub-Feed Lugs or Breaker	DK, KD, HKD, KDC Vertical	Mains	18	60 (1524.0)	5.75 (146.1)	
			30	72 (1828.8)	5.75 (146.1)	
	EHD, FDB, FD, HFD, FDC, EDB, EDS, ED, EDH, EDC Vertical	Sub-Feed Breakers	42	72 (1828.8)	5.75 (146.1)	
			48	90 (2286.0)	5.75 (146.1)	

^① Smaller panelboard box sizes are available if required. Contact Eaton for application information.

^② Add 8 inches (203.2 mm) for TVSS.

^③ For horizontal mounted mains (BAB Type), use main lug table, include space in branch section for mains.

^④ JD, HJD, JDC is same space requirement as 400 ampere DK, HKD, KDC.



Eaton Cutler-Hammer: Pow-R-Line 2a

EATON**Cutler-Hammer**June 2006
Sheet 0823**Panelboards
Pow-R-Line 2a****22.2-1****General Description — Pow-R-Line 2a****Pow-R-Line 2a**

Pow-R-Line 2a

General Description**Panelboard Ratings****Voltage:**

- 240 Vac maximum.
- 480Y/277 Vac maximum.

Note: PRL2a panelboards are suitable for use on 3-phase, 3-wire applications when derived from a 3-phase, 4-wire 480Y/277 Vac service where the neutral is not brought to the panelboard. For 3-phase, 3-wire 480 Vac Delta services use a PRL3a panelboard.

- 250 Vdc maximum.

Main Lugs:

- 100 – 400 amperes.

Main Breakers:

- 100 – 400 amperes.

Branch Breakers:

- 15 – 100 amperes (bolt-on).

Short Circuit Current Ratings (Symmetrical)

- 240 Vac: 65 kA fully rated.
- 240 Vac: 100 – 200 kA series rated.
- 480Y/277 Vac: 14 kA fully rated.
- 480Y/277 Vac: 22 – 150 kA series rated.
- 250 Vdc: 10 kA and 14 kA fully rated.

Service

- 3-phase, 4-wire 208Y/120 V and 240/120 V Delta and 480Y/277 V.
- Single-phase, 3-wire 120/240 V.
- Single-phase, 2-wire 120 V.
- 3-phase, 3-wire 208 and 240 V.
- 2-wire 125 Vdc.
- 2-wire 250 Vdc.

Suitable for service entrance applications when specified.

Mains

For available mains, refer to **Table 22.2-1**.

The GHB main breaker is horizontally mounted, same as branch breakers. All other main breakers are vertically mounted.

Branch Circuits

For available branch devices, refer to **Table 22.2-2**.

Main Lugs Only

The short circuit rating of the MLO assembled panelboard will be fully rated based upon the lowest rated branch device or may be series rated with an approved upstream device.

Main lugs only ampere ratings: 100, 225 and 400.

Main Circuit Breakers

The short circuit rating shown is that of the main breaker only. The short circuit rating of the assembled panelboard is the rating of the lowest fully rated main or branch device or the rating of an approved series rated combination.

Table 22.2-1. Main Circuit Breakers

Breaker Frame (Amperes)	Breaker Type	Interrupting Rating (kA Symmetrical)		
		240 V	480Y/277 V	125/250 Vdc
100	GHB®	65	14	14
100	EHD	18	14	10
150	FDB	18	14	10
225	FD	65	35	10
225	HFD	100	65	22
225	FDC	200	100	22
225	ED	65	—	—
250	EDH	100	—	—
250	EDC	200	—	—
250	JD	65	35	10
250	HJD	100	65	22
250	JDC	200	100	22
400	DK	65	—	10
400	KD	65	35	10
400	HKD	100	65	22
400	KDC	200	100	22

① At 480 V, use on 480Y/277 V systems only.

Table 22.2-2. Branch Circuit Breakers

Breaker Type	Ampere Rating	Number of Poles	Interrupting Rating (kA Symmetrical)				
			120 V	240 V	277 V	480Y/277 V	125/250 Vdc
GHB®	15 – 100	1	65	—	14	—	14
GHB®	15 – 100	2, 3	—	65	—	14	14
GHQ	15 – 20	1	65	—	14	—	—
HGHB	15 – 30	1	65	—	25	—	—
GHQRSP®	15 – 20	1, 2	65	65	14	14	—
GHBS®	15 – 30	1, 2	65	65	14	14	—
GHGFEF	15 – 60	1	—	—	14	—	—

② At 480 V, use on 480Y/277 Vac systems only.

® Solenoid operated breaker.

Series Rated Combinations

Refer to series rating tables beginning on **Page 22.0-11** for the approved series rated combinations available for the branch circuit breakers listed in **Table 22.2-2**.

CA08104001E

For more information visit: www.EatonElectrical.com

**22.2-2 Panelboards
Pow-R-Line 2a****Technical Data — Pow-R-Line 2a****22****Technical Data****Bussing**

100 – 400 amperes: Tin-plated aluminum is standard, copper is available as an option.

Boxes

Boxes are made from code-gauge galvanized steel.

Blank ends are supplied as standard, knockouts are available upon request.

EZ Trim

Trims are made from code-gauge steel and painted ANSI 61 gray.

All panelboards have door-in-door as standard with multi-point catch and lock, and concealed mounting hardware.

Modifications**Table 22.2-3. Sub-Feed Lugs (Main Lugs Only)**

Amperes	Panel Height Addition
100	0 Inches (0 mm)
225	0 Inches (0 mm)

Table 22.2-4. Through-Feed Lugs

Amperes	Information
100	See Table 22.2-6
225	See Table 22.2-6
400	See Table 22.2-6

**Table 22.2-5. Sub-Feed Breakers
(One Per Panel)**

Ampere Rating	Breaker Type	Interrupting Rating (kA Symmetrical)	
		240 V	480V/277 V
150	FDB	18	14
225	FD	65	35
225	HFD	100	65
225	FDC	200	100
225	ED	65	—
225	EDH	100	—
225	EDC	200	—
250	JD	65	35
250	HJD	100	65
250	JDC	200	100
400	KD	65	35
400	HKD	100	65
400	KDC	200	100

Shunt Trips

Shunt trips are available on breakers. GHB breakers with shunt trips require 3-pole frame.

Ground Bar

Standard bolted in box. Aluminum is standard. Copper is available as an option.

Enclosures

Types 1, 12, 3R, 4/4X.

TVSS

Integrated onto panelboard chassis. For complete product description and available ratings, refer to **Section 36**.

Box Sizing and Selection

Box size for all Type 1 panelboards are available from **Table 22.2-6**.

Instructions

- Using description on the required panelboard, select the rating and type of mains required.
- Count total number of branch circuit poles (including spaces) required in the panelboard. Do not count main breaker poles. Convert 2- or 3-pole branch breakers to single-poles. i.e., 3-pole breaker, count as three poles.

Note: For horizontal mounted mains (GHB Type), use main lug table, include space in branch section for mains.

Table 22.2-6. Type 1 Panelboards — Dimensions in Inches (mm)

Ampere Rating of Mains	Main Breaker Type Mounting Position	Maximum Number of Branch Circuits Including Provisions	Box Dimensions ①②			
			Height	Width	Depth	
100 A Panelboards						
100 A ③ Main Lugs or Main Breaker	EHD, FDB, FD, HFD, FDC Vertical	18	36 (914.4)	20 (508.0)	5.75 (146.1)	
		30	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		42	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		48	60 (1524.0)	20 (508.0)	5.75 (146.1)	
100 A ③ Main Lugs or Main Breaker with 100 A Through-Feed Lugs or Sub-Feed Breaker	EHD, FDB, FD, HFD, FDC Vertical	18	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		30	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		42	60 (1524.0)	20 (508.0)	5.75 (146.1)	
		48	60 (1524.0)	20 (508.0)	5.75 (146.1)	
225 A Panelboards						
225 A ③ Main Lugs or Main Breaker	ED, EDH, EDC, FD, HFD, FDC Vertical	18	36 (914.4)	20 (508.0)	5.75 (146.1)	
		30	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		42	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		48	60 (1524.0)	20 (508.0)	5.75 (146.1)	
225 A ③ Main Lugs or Main Breaker with 225 A or 100 A Through-Feed Lugs or Sub-Feed Breaker	EHD, FDB, FD, HFD, FDC, ED, EDH, EDC Vertical	18	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		30	48 (1219.2)	20 (508.0)	5.75 (146.1)	
		42	60 (1524.0)	20 (508.0)	5.75 (146.1)	
		48	60 (1524.0)	20 (508.0)	5.75 (146.1)	
400 A Panelboards						
400 A Main Lugs or Main Breaker	DK, KD, HKD, KDC Vertical	18	60 (1524.0)	20 (508.0)	5.75 (146.1)	
		30	60 (1524.0)	20 (508.0)	5.75 (146.1)	
		42	72 (1828.8)	20 (508.0)	5.75 (146.1)	
		48	72 (1828.8)	20 (508.0)	5.75 (146.1)	
400 A Main Lugs or Main Breaker with 225 A or 100 A Through-Feed Lugs or Sub-Feed Breaker	DK, KD, HKD, KDC Vertical	Main	18	60 (1524.0)	20 (508.0)	5.75 (146.1)
			30	72 (1828.8)	20 (508.0)	5.75 (146.1)
			42	72 (1828.8)	20 (508.0)	5.75 (146.1)
			48	90 (2286.0)	20 (508.0)	5.75 (146.1)
	EHD, FDB, FD, HFD, FDC, ED, EDH, EDC Vertical	Sub-Feed Breaker	18	90 (2286.0)	20 (508.0)	5.75 (146.1)
			30			
			42			
			48			

① Smaller panelboard box sizes are available if required. Contact Eaton for application information.

② Add 8 inches (203.2 mm) for TVSS.

③ For horizontal mounted mains (GHB Type), use main lug table, include space in branch section for mains.

④ JD, HJD, JDC is same space requirement as 400 ampere DK, HKD, KDC.

EATON**Cutler-Hammer**June 2006
Sheet 0324

Eaton Cutler-Hammer: Pow-R-Line 4

EAT-N**Cutler-Hammer**June 2006
Sheet 0829**Panelboards
Pow-R-Line 4****22.4-1****General Description — Pow-R-Line 4****Pow-R-Line 4****PRL4B**
Circuit Breaker
Panelboard**PRL4F**
Fusible
Panelboard**General Description****Panelboard Ratings****Voltage:**

- 240 V, 480 V or 600 Vac maximum.
- 250 Vdc maximum.

Main Lugs:

- 250 – 1200 amperes.

Main Breakers:

- 250 – 1200 amperes.

Main Switches:

- 200 – 1200 amperes.

Branches (Bolt-on):

- Breakers 15 – 1200 amperes.
- Fusible switches
30 – 1200 amperes.

Short Circuit Current Ratings (Symmetrical)

- 240 Vac: 10 – 200 kA fully rated.
- 240 Vac: 22 – 200 kA series rated.
- 480 Vac: 14 – 200 kA fully rated.
- 480 Vac: 22 – 150 kA series rated.
- 250 Vdc: 10 – 22 kA fully rated.

Service

- 3-phase, 4-wire 208Y/120 V,
240/120 V Delta and 480Y/277 V.
- Single-phase, 3-wire 120/240 V.
- Single-phase, 2-wire 120 V.
- 3-phase, 3-wire 120, 240,
480 and 600 V.
- 2-wire 125 Vdc.
- 2-wire 250 Vdc.

Suitable for service entrance
applications when specified.

Bussing

250 – 1200 amperes tin-plated
aluminum is standard, copper is
available as an option. Density rated
bus is also available as an option.

Main Lugs Only

The short circuit rating of the MLO
assembled panelboard will be fully
rated based upon the lowest rated
branch device or may be series rated
with an approved upstream device.

Main lugs only ampere ratings:
250, 400, 600, 800 and 1200.

Main Circuit Breakers

The short circuit rating shown is that
of the main breaker only. The short
circuit rating of the assembled panel-
board is the rating of the lowest fully
rated main or branch device, or the
rating of an approved series rated
combination.

Table 22.4-1. Main Circuit Breakers — Type PRL4B

Breaker Frame Amperes	Breaker Type	Interrupting Rating (kA Symmetrical)			
		240 V	480 V	600 V	250 Vdc
250	JD	65	35	18	10
250	HJD	100	65	25	22
250	JDC	200	100	35	22
250	LCL	200	200	—	—
400	DK	65	—	—	10
400	KD ①	65	35	25	10
400	CKD ①②	65	35	25	10
400	HKD ①	100	65	35	22
400	CHKD ①②	100	65	35	22
400	KDC ①	200	100	65	22
400	LCL ①	200	200	—	—
400	LA-P	200	200	200	③
600	LGE	65	35	18	22
600	LGH	100	65	35	22
600	LD ①	65	35	25	22
600	CLD ①②	65	35	25	22
600	HLD ①	100	65	35	25
600	CHLD ①②	100	65	35	25
600	LDC ①	200	100	50	25
600	CLDC ②	200	100	50	25
800	MDL ①	65	50	25	22
800	CMDL ①②	65	50	25	22
800	HMDL ①	100	65	35	25
800	CHMDL ①②	100	65	35	25
800	ND ①	65	50	25	—
800	CND ①③	65	50	25	—
800	HND ①	100	65	35	—
800	CHND ①③	100	65	35	—
800	NDC ①	200	100	65	—
800	CNDC ①③	200	100	65	—
800	NB-P	200	200	200	③
1200	ND ①	65	50	25	—
1200	CND ①③	65	50	25	—
1200	HND ①	100	65	35	—
1200	CHND ①③	100	65	35	—
1200	NDC ①	200	100	65	—
1200	CNDC ①	200	100	65	—

① Available with integral ground fault protection.

② 100% rated circuit breaker.

③ 100,000 AIC based on NEMA test procedure.

Main Fusible Switches

The short circuit rating shown is that
of the main switch only. The short
circuit rating of the assembled panel-
boards is the rating of the lowest fully
rated main or branch device or the
rating of an approved series rated
combination. (Fuses are not included.)

400 and 600 ampere switches with
shunt trip will be rated 100 kA.

Note: Circuit breaker panelboards are
designated PRL4B. Fusible Switch panel-
boards are designated PRL4F.

Table 22.4-2. Main Fusible Switches

Switch Rating Amperes	Fuse Class	Interrupting Rating (kA Symmetrical)		
		240 V	600 V	250 Vdc
Switches Rated 240 Vac, 250 Vdc				
200	R, T	200	—	10
400	R, T	200	—	10
600	R, T	200	—	—
800	L	200	—	—
1200	L	200	—	—
Switches Rated 600 Vac				
200	R, J, T	200	200	—
400	R, J, T	200	200	—
600	R, J, T	200	200	—
800	L	200	200	—
1200	L	200	200	—

22.4-2 Panelboards
Pow-R-Line 4

Cutler-Hammer

June 2006
Sheet 0830

Technical Data — Pow-R-Line 4

22

Table 22.4-3. Branch Circuit Breakers

Breaker Type	Ampere Rating	Number of Poles	Interrupting Rating (kA Symmetrical)						
			120 V	120/240 V	240 V	480 V	600 V	125 Vdc	250 Vdc
BAB	15 – 70	1	10	—	—	—	—	—	—
BAB	15 – 100	2	—	10	—	—	—	—	—
BAB	15 – 100	2, 3	—	—	10	—	—	—	—
QBGF, QBGFEP	15 – 50 ①	1, 2	10	10	—	—	—	—	—
QBHW	15 – 70	1	22	—	—	—	—	—	—
QBHW	15 – 100	2	—	22	—	—	—	—	—
QBHW	15 – 100	2, 3	—	—	22	—	—	—	—
QBHGF, QBHGFEP	15 – 30	1, 2	22	22	—	—	—	—	—
GHB ②③	15 – 100	1	—	—	65	14	—	14	—
GHB ②	15 – 100	2, 3	—	—	65	14	—	—	14
GHQ ②③	15 – 20	1	—	—	65	14	—	—	—
HGHB ②③	15 – 30	1	—	—	65	25	—	—	—
GHBGFEP	15 – 60	1	—	—	65	—	—	—	—
EHD	15 – 100	1	—	—	14	14	—	10	—
EHD	15 – 100	2, 3	—	—	18	14	—	—	10
FDB	15 – 150	2, 3	—	—	18	14	14	—	10
FD ②	15 – 100	1	—	—	65	35	—	10	—
FD	15 – 225	2, 3	—	—	65	35	18	—	10
HFD ②	15 – 100	1	—	—	65	65	—	10	—
HFD	15 – 225	2, 3	—	—	100	65	25	—	22
FDC	15 – 225	2, 3	—	—	200	100	35	—	22
FB-P	15 – 100	2, 3	—	—	200	200	200	—	④
EDB	100 – 225	2, 3	—	—	22	—	—	10	—
EDS	100 – 225	2, 3	—	—	42	—	—	10	—
ED	100 – 225	2, 3	—	—	65	—	—	10	—
EDH	100 – 225	2, 3	—	—	100	—	—	10	—
EDC	100 – 225	2, 3	—	—	200	—	—	10	—
JD	70 – 250	2, 3	—	—	65	35	18	—	10
HJD	70 – 250	2, 3	—	—	100	65	25	—	22
JDC	70 – 250	2, 3	—	—	200	100	35	—	22
LCL	125 – 250	2, 3	—	—	200	200	—	—	—
DK	250 – 400	2, 3	—	—	65	—	—	—	10
KD	100 – 400	2, 3	—	—	65	35	25	—	10
CKD ⑤	100 – 400	3	—	—	100	65	35	—	22
HKD	100 – 400	2, 3	—	—	100	65	35	—	22
CHKD ⑤	100 – 400	3	—	—	100	65	35	—	22
KDC	100 – 400	2, 3	—	—	200	100	65	—	22
LCL	200 – 400	2, 3	—	—	200	200	—	—	—
LA-P	125 – 400	2, 3	—	—	200	200	200	—	④
LGE	250 – 600	3	—	—	65	35	18	—	22
LGH	250 – 600	3	—	—	100	65	35	—	22
LD	300 – 600	2, 3	—	—	65	35	25	—	22
CLD ⑤	300 – 600	3	—	—	65	35	25	—	22
HL	300 – 600	2, 3	—	—	100	65	35	—	25
CHLD ⑤	300 – 600	3	—	—	100	65	35	—	25
LDC	300 – 600	2, 3	—	—	200	100	50	—	25
CLDC ⑤	300 – 600	3	—	—	200	100	50	—	25
MDL	300 – 800	2, 3	—	—	65	50	25	—	22
CMDL ⑤	300 – 800	3	—	—	65	50	25	—	22
HMDL	300 – 800	2, 3	—	—	100	65	35	—	25
CHMDL	300 – 800	3	—	—	100	65	35	—	25
ND	400 – 800	2, 3	—	—	65	35	25	—	—
CND ⑤	400 – 800	3	—	—	65	35	25	—	—
HND	400 – 800	2, 3	—	—	100	65	35	—	—
CHND ⑤	400 – 800	3	—	—	100	65	35	—	—
NDC	400 – 800	2, 3	—	—	200	100	65	—	—
CNDC ⑤	400 – 800	3	—	—	200	100	65	—	—
NB-P	400 – 800	2, 3	—	—	200	200	200	—	—
ND	600 – 1200	2, 3	—	—	65	35	25	—	—
CND ⑤	600 – 1200	3	—	—	65	35	25	—	—
HND	600 – 1200	2, 3	—	—	100	65	35	—	—
CHND ⑤	600 – 1200	3	—	—	100	65	35	—	—
NDC	600 – 1200	2, 3	—	—	200	100	65	—	—
CNDC ⑤	600 – 1200	3	—	—	200	100	65	—	—

① 50 amperes is 2-pole only.

② 1-pole breaker rated 277 Vac.

③ At 480 V, use on 480Y/277 Vac system only.

④ 100,000 AIC based on NEMA test procedure.

⑤ 100% rated breaker. Requires copper bus. K- and N-Frame breakers require density rated copper bus. Not available in Type 12, 4 and 4X enclosures.



Table 22.4-4. Branch Fusible Switches (Fuses are not included)

Switch Rating Amperes	Mounting	Fuse Class	Interrupting Rating (kA Symmetrical)		
			240 V	600 V	250 Vdc
Switches Rated 240 Vac, 250 Vdc					
30/30	Twin	R	200	—	10
60/60	Twin	R	200	—	10
100/100	Twin	R	200	—	10
200/200	Twin	R, T	200	—	10
100	Single	R	200	—	10
200	Single	R, T	200	—	10
400	Single	R, T	200	—	10
600	Single	R, T	200	—	—
800	Single	L	200	—	—
1200	Single	L	200	—	—
Switches Rated 600 Vac					
30/30	Twin	R, J	200	200	—
60/60	Twin	R, J	200	200	—
100/100	Twin	R, J	200	200	—
200/200	Twin	J, T	200	200	—
100	Single	R, J	200	200	—
200	Single	R, J, T	200	200	—
400	Single	R, J, T	200	200	—
600	Single	R, J, T	200	200	—
800	Single	L	200	200	—
1200	Single	L	200	200	—

Note: Twin branch switches of different ampere ratings are available, i.e., 30/60, 30/100, 60/100.

Circuit Breaker Trip Units

Circuit breakers will have thermal-magnetic trip units with the following exceptions:

- 100% rated breakers and all N frame breakers have Digitrip RMS 310 solid state trip units as standard.
- K, L and M frame 3-pole circuit breakers are optionally available with the Digitrip RMS 310 solid state trip unit.
- The trip function options for the Digitrip RMS 310 include LS and LSI. Main circuit breakers can also include the LSG and LSIG integral ground fault trip functions.
- Digitrip OPTIM trip units are not available in panelboard construction.

Series Rated Combinations

Refer to the series rating tables beginning on **Page 22.0-11** for the approved series rated combinations available for the branch circuit breakers listed in **Table 22.4-3**.

Modifications

Enclosures

Types 12, 3R, 4/4X.

Ground Bar

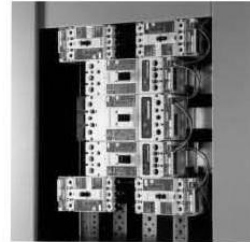
Standard bolted in box with (3) #6 – 300 kcmil terminals. Aluminum is standard. Copper is available as an option.

Trims

Door-in-door trim is available as an option for Type 1 enclosures.

IQ Energy Sentinel™

A UL listed compact, microprocessor-based, breaker mounted device designed to monitor power and energy readings (kW, kWh and kW demand). Device mounts directly to the load side of an F-, J- or K-Frame feeder breaker without requiring additional panel height.



IQ Energy Sentinel

Eaton's Cutler-Hammer IQ Energy Sentinel is shipped with the panel interior and includes instructions for customer installation.

All that is necessary to complete an IQ Energy Sentinel installation is to feed the load conductors through it; connect a neutral wire; and run the shielded twisted pair wire for communications. The IQ Energy Sentinel has a nonvolatile memory, is powered by the circuit breaker, and can be applied on 3-phase, 4-wire or single-phase, 3-wire systems.

Power and energy information from IQ Energy Sentinels can be communicated to a personal computer, a panel-mounted Breaker Interface Module (BIM II), building management or distributed control systems.



IQ Energy Sentinel

Note: The application of the IQ Energy Sentinel in panelboards is limited to PRL4B feeders. Minimum box width of 36 inches (914.4 mm). Single mounting only for all J- and K-Frame breakers equipped with IQ Energy Sentinels.

For enhanced metering data, the IQ Power Sentinel is available. See **Section 3**.

Transient Voltage Surge Suppression

Integrated onto panelboard chassis. For complete product description and available ratings, refer to **Section 36**.

22.4-4 Panelboards Pow-R-Line 4

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Panel Layout and Dimensions — Pow-R-Line 4B

22

Main Lug (MLO), Main Breaker, Neutral, Through-Feed (TFL) and Sub-Feed Lug (SFL) "X" Space Requirements

(For compression lugs, or other configurations not shown, refer to Eaton.)

● = Blank means no bus under cover to meet NEC cable bending space.

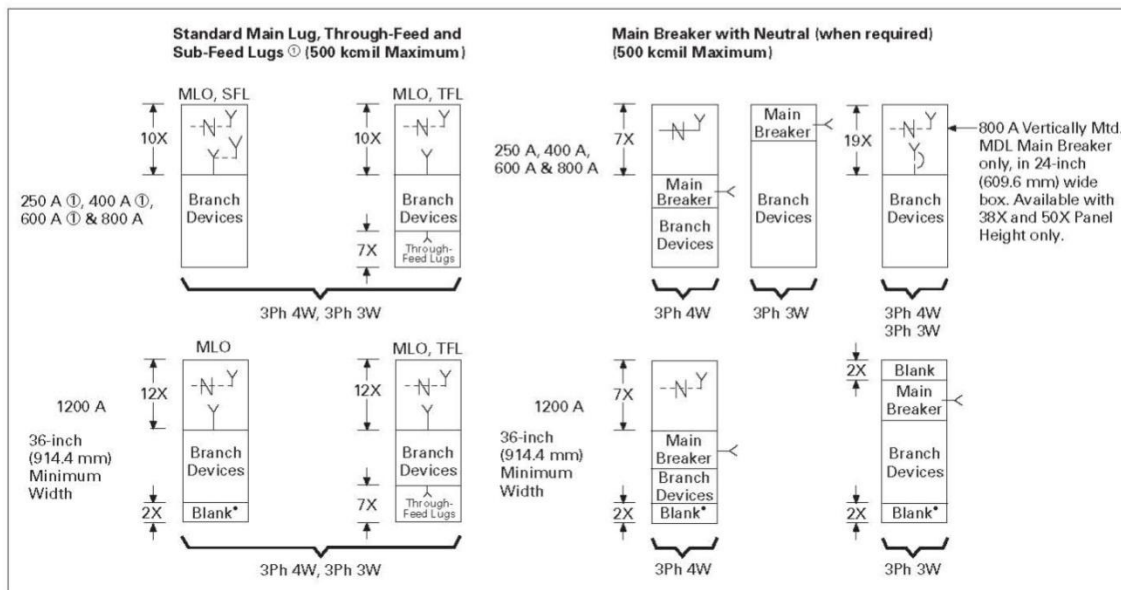


Figure 22.4-1. "X" Space Requirements — Dimensions in Inches (mm)

① Sub-Feed Lugs are available 250 – 600 amperes. For 600 ampere use 1200 ampere "X" space.

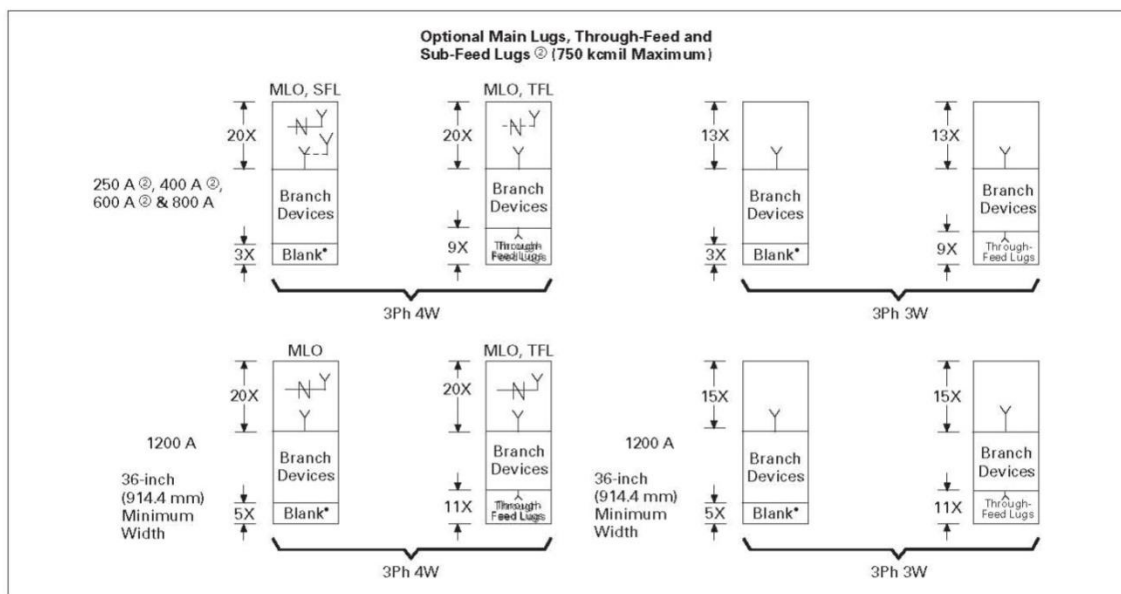


Figure 22.4-2. "X" Space Requirements — Dimensions in Inches (mm)

② Sub-Feed Lugs are available 250 – 600 amperes. For 600 ampere use 1200 ampere "X" space.

For more information visit: www.EatonElectrical.com

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Breaker (PRL4B) Type Distribution Panelboards 600 Vac, 250 Vdc

Panel Layout and Dimensions

To determine the dimensions of a given panelboard enclosure, make a layout sketch by fitting together the main branch and lug modules according to the appropriate tables in the layout guide. Assign "X" units to each module as shown and obtain a total "X" number.

The height of the enclosure is related to the total "X" units in the layout as shown in **Figure 22.4-3**. Three standard box heights are available to accommodate any and all layout arrangements. "X" unit totals that do not exactly match those in **Table 22.4-5** must be rounded off to the next higher standard (26X, 38X, 50X).

When a calculated "X" total for a panel exceeds 50X, the panel must be split into two or more separate sections with "X" space for through-feed lugs figured in for all but one section. If a neutral is required, a separate neutral bar and appropriate "X" space must be included in each section.

Layout Example

- 1 — PRL4B panelboard, 480Y/277 V, 3-Phase, 4-Wire, 65 kA, 800 amperes, main lug, consisting of:
 - 12 — 20 A/1-Pole HFD
 - 2 — 250 A/3-Pole HJD
 - 1 — 400 A/3-Pole HKD

20 A/1P	20 A/1P	1X
20 A/1P	20 A/1P	1X
20 A/1P	20 A/1P	1X
20 A/1P	20 A/1P	1X
20 A/1P	20 A/1P	1X
20 A/1P	20 A/1P	1X
250 A/3P		3X
250 A/3P		3X
400 A/3P		4X
Main Lugs	800 A	10X
Neutral		
TOTAL =		26X

Note: For TVSS Unit add 10X.

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- From layout guide, total "X" height of panel = 26X, (which is a design standard and no rounding off is necessary).
- From **Table 22.4-5**, enclosure height for 26X panel = 57 inches (1447.8 mm).
- Width = 24 inches (609.6 mm) — directly from layout guide.
- Total enclosure depth = 11.30 inches (287.0 mm) — standard for all PRL4 panelboards.



22.4-6

Panelboards
Pow-R-Line 4

Eaton

Cutler-Hammer

June 2006
Sheet 0834

Panel Layout and Dimensions — Pow-R-Line 4B

22

Table 22.4-5. Standard Panel and Box —
Dimensions in Inches (mm)

Panel Height	Box Height	Box Width	Box ① Depth
26X	57 (1447.8)	24 (609.6) ②	10.4 (264.2)
38X	73.5 (1866.9)	24 (609.6) ②	10.4 (264.2)
50X	90 (2286.0)	24 (609.6) ②	10.4 (264.2)
38X	73.5 (1866.9)	36 (914.4)	10.4 (264.2)
50X	90 (2286.0)	36 (914.4)	10.4 (264.2)
38X	73.5 (1866.9)	44 (1117.6)	10.4 (264.2)
50X	90 (2286.0)	44 (1117.6)	10.4 (264.2)

① Box depth is 10.40 inches (264.2 mm), cover adds .90 inches (22.9 mm) for overall enclosure depth of 11.30 inches (287.0 mm).

② 800 amperes maximum bus size in 24 inches (609.6 mm) wide box.

Note: Flush trims available on PRL4B panels with Door-in-Door enclosure only.

Top and Bottom Gutters (minimum)

10.62 inches (269.9 mm)

Side Gutters (minimum)

- 24-inch (609.6 mm) Wide Box:
5 inches (127.0 mm)
- 36-inch (914.4 mm) Wide Box:
6 inches (152.4 mm)
- 44-inch (1117.6 mm) Wide Box:
8 inches (203.2 mm)

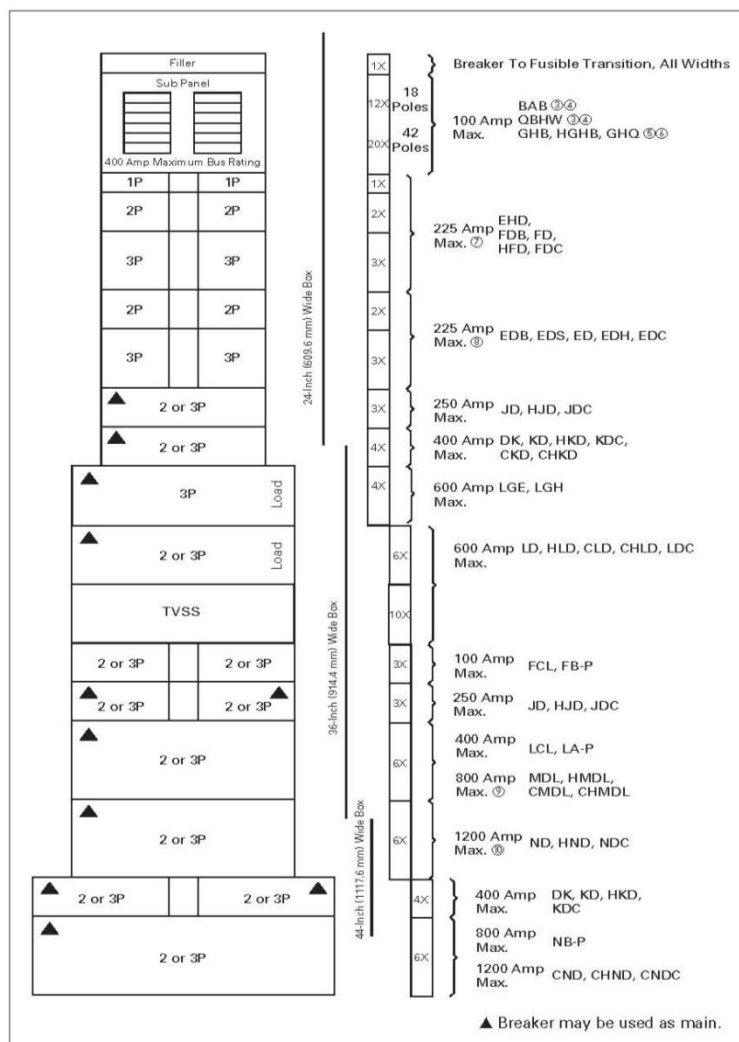


Figure 22.4-3. Layout for Branch and Horizontally Mounted Main Devices

- ③ BAB and QBHW breakers with shunt trips require one additional pole space, i.e., 1-pole is 2-pole size, 2-pole is 3-pole size, and 3-pole is 4-pole size.
- ④ If panel contains only BAB or QBHW branch breakers, use a PRL1a panelboard.
- ⑤ GHB, HGHB or GHQ breakers cannot be mixed on same subchassis as BAB, QBHW.
- ⑥ If panel contains only GHB, HGHB or GHQ branch breakers, use a PRL2a panelboard.
- ⑦ When only one single-pole breaker of the group is required on either side of chassis, the single-pole breaker space required changes from 1X to 2X.
- ⑧ Minimum 36-inch (914.4 mm) wide box is required if optional #6 – 300 kcmil lug is required.
- ⑨ MDL main breaker in 24-inch (609.6 mm) wide box, refer to Page 22.4-1.
- ⑩ Optional 750 kcmil terminal requires 44-inch (1117.6 mm) wide box.

Note: See Page 22.4-4 for MLO or Neutral and Vertically Mounted Mains space requirements.





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Panelboards Pow-R-Line 4

22.4-7

June 2006
Sheet 0835

Panel Layout and Dimensions — Pow-R-Line 4F

Main Lug (MLO), Main Switch, Neutral Through-Feed Lug (TFL) and Sub-Feed Lug (SFL) "X" Space Requirements

(For other configurations refer to Eaton.)

● = Blank means no bus under cover to meet NEC cable bending space.

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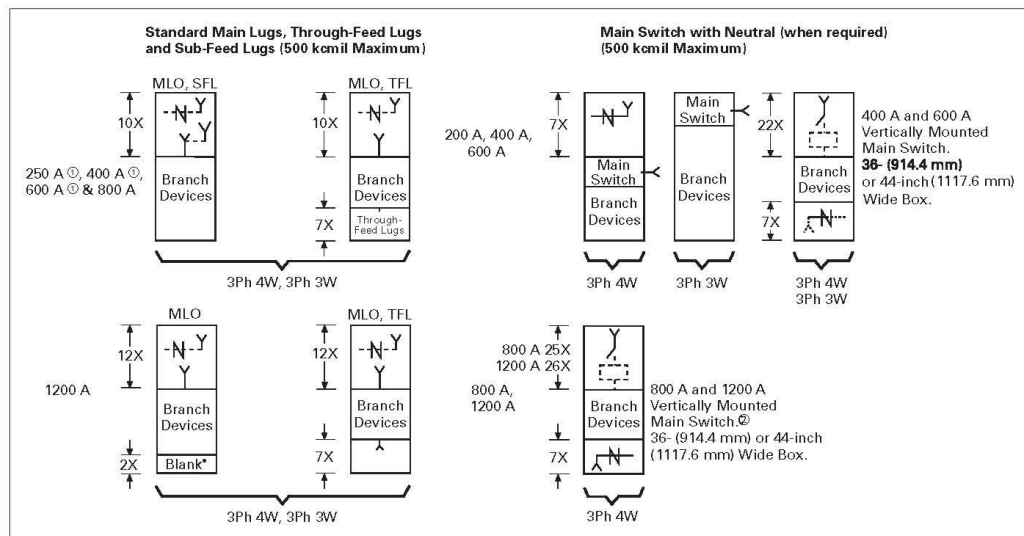


Figure 22.4-4. "X" Space Requirements — Dimensions in Inches (mm)

① Sub-feed lugs are available 250 – 600 amperes, for 600 ampere use 1200 ampere "X" space.

② 800 and 1200 ampere mains available only in vertical mounting.

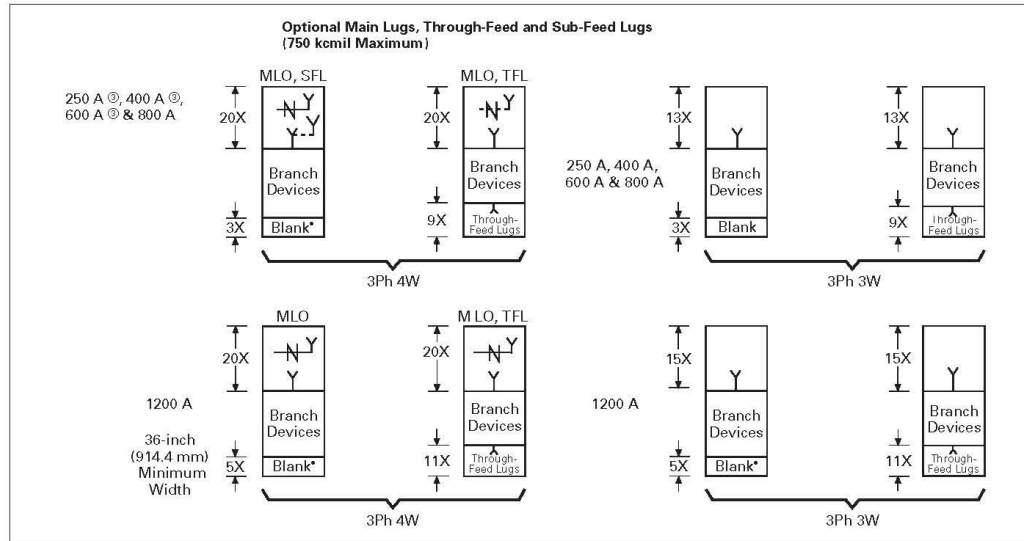


Figure 22.4-5. "X" Space Requirements — Dimensions in Inches (mm)

① Sub-feed lugs are available 250 – 600 amperes, for 600 ampere use 1200 ampere "X" space.

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22.4-8 Panelboards
Pow-R-Line 4

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Sheet 0836

Panel Layout and Dimensions — Pow-R-Line 4F

22

Fusible (PRL4F) Type Distribution
Panelboards 600 Vac, 250 Vdc

Panel Layout and Dimensions

To determine the dimensions of a given panelboard enclosure, make a layout sketch by fitting together the main branch and lug modules according to the appropriate tables in the layout guide. Assign "X" units to each module as shown and obtain a total "X" number.

The height of the enclosure is related to the total "X" units in the layout as shown in **Figure 22.4-6**. Three standard box heights are available to accommodate any and all layout arrangements. "X" unit totals that do not exactly match those in **Table 22.4-6** must be rounded off to the next higher standard (38X, 50X).

When a calculated "X" total for a panel exceeds 50X, the panel must be split into two or more separate sections with "X" space for through-feed lugs figured in for all but one section. If a neutral is required, a separate neutral bar and appropriate "X" space must be included in each section.

Layout Example

1 – PRL4F, 3-Phase, 4-Wire, 208Y/120 V complete with 400 A main switch and the following branches:

- 1 – 200 A/3-Pole
- 2 – 100 A/3-Pole
- 2 – 30 A/3-Pole

Panel to have short-circuit rating of 100,000 amperes symmetrical.

400 A Neutral		7X
30 A/3P	30 A/3P	4X
100 A/3P	100 A/3P	4X
200 A/3P		6X
400 A 3-Pole Main Switch (Vertically Mounted)		22X
Total =		43X

Note: In the above example, if a horizontally mounted 400 A main switch was used, the enclosure size would be:
73.50 inches H x 44.00 inches W x 11.30 inches D (1866.9 mm H x 1117.6 mm W x 287.0 mm D).

- From layout guide, "X" height of panel = 43X.
- Rounded off to next higher standard = 50X.
- From **Table 22.4-6**, enclosure height for 50X panel = 90 inches (2286.0 mm).
- Width = 36 inches (914.4 mm) since no switch in the assembly requires a 44-inch (1117.6 mm) wide enclosure.
- Total enclosure depth = 11.30 inches (287.0 mm) — standard for all PRL4 panelboards.

Cabinet Specifications

Boxes: Code-gauge commercial galvanized sheet steel (no knockouts).





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Sheet 0837Panelboards
Pow-R-Line 4

22.4-9

Panel Layout and Dimensions — Pow-R-Line 4F

Table 22.4-6. Standard Panel and Box —
Dimensions in Inches (mm)

Panel Height	Box Height	Box Width	Box ① Depth
38X	73.5 (1866.9)	36 (914.4)	10.40 (264.2)
50X	90 (2286.0)	36 (914.4)	10.40 (264.2)
38X	73.5 (1866.9)	44 (1117.6)	10.40 (264.2)
50X	90 (2286.0)	44 (1117.6)	10.40 (264.2)

① Box depth is 10.40 inches (264.2 mm), cover adds .90 inches (22.9 mm) for overall enclosure depth of 11.30 inches (287.0 mm).

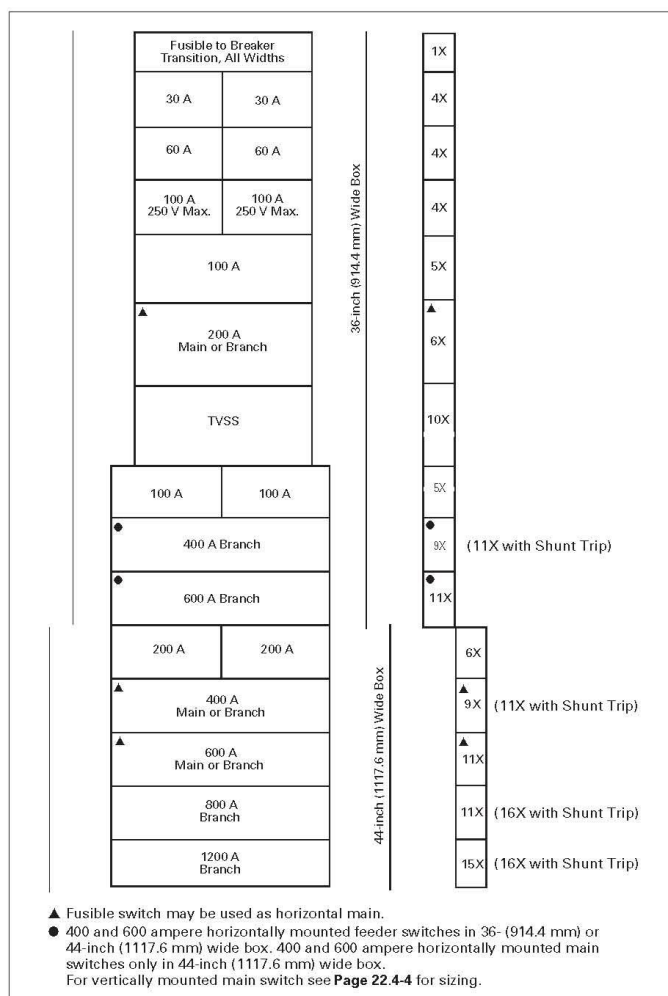
Note: Flush trims are available on PRL4F panels with door-in-door enclosure only.

Top and Bottom Gutters (minimum)

- 10.625 inches (269.9 mm)

Side Gutters (minimum)

- 36-inch (914.4) wide box:
 - 200 A maximum — 8 inches (203.2 mm)
 - 400 – 1200 A maximum — 6 inches (152.4 mm)
- 44-inch (1117.6 mm) wide box:
 - 200 A maximum — 10 inches (254.0 mm)
 - 400 – 1200 A maximum — 8 inches (203.2 mm)

Figure 22.4-6. Branch and Horizontally Mounted Main Fusible Switch Layout —
Dimensions in Inches (mm)

Note: See **Page 22.4-7** for MLO or Neutral and Vertically Mounted Main Space Requirements.

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Eaton Cutler-Hammer: Pow-R-Command 750



Cutler-Hammer

January 2008
Sheet 0921

Lighting Control System Pow-R-Command Pow-R-Command 750

23.3-1

General Description

Pow-R-Command 750



Pow-R-Command 750 Panel

General Description

Eaton's Cutler-Hammer Pow-R-Command 750 is a microprocessor-based programmable lighting control system. The Pow-R-Command 750 can be used as a stand-alone panel, or the user has the option to connect up to three expansion panels to the 750 creating its own stand-alone subnetwork.

Components

- Intelligent power switching equipment.
- LCD programming display and keypad.
- Integration components.

Intelligent Power Switching Equipment

Pow-R-Command 750 Panelboards

Pow-R-Command 750 Panelboards are offered from 100 through 225 amperes in main lug and main breaker configurations. Available voltages are 120/240, 208Y/120 and 480Y/277, single-phase and 3-phase. The panelboard utilizes both branch mounted standard breakers through 100 amperes, and controllable thermal-magnetic breakers which are controlled by the Pow-R-Command 750 System Controller. The Pow-R-Command 750 controllers provide the ability to directly operate up to eight breaker control buses. Such a capability allows a single controller to directly operate up to 168 GHQRSP and BABRSP controllable circuit breakers, with individual control and status feedback of each controllable breaker.

The System Controller also includes load override, holiday scheduling, one-shot or event schedules, off warning to tenants by blinking lights, memory loss protection, power failure/brownout protection, hardware diagnostics, a real-time clock and 16 dry contact switch inputs.

The Pow-R-Command 750 Panelboard is listed UL 67 for panelboards and UL 916 for energy management equipment.

23



23.3-2 Lighting Control System Pow-R-Command Pow-R-Command 750

Operational Description — System Configurations

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January 2008
Sheet 0922

Pow-R-Command 750

23



PRC750 LCD Display



Pow-R-Command 750 Panel



Pow-R-Command Expansion Panel

System Description

The Pow-R-Command 750 system is the premier stand-alone solution to automated lighting control. It provides automated switching of up to 168 branch circuit breakers.

Stand-Alone Subnetwork

Connect up to three expansion panels to the Pow-R-Command 750 giving you the ability to individually control 168 total smart breakers with a single Pow-R-Command 750 controller.

LCD Display and Keypad

The Pow-R-Command 750 LCD display and keypad provides local programming, override, and diagnostic functions.

Memory Loss Protection

Time schedules, time-of-day clock, day/date, and system configuration parameters are protected from memory loss if there is a power failure. The memory loss protection is rated for 10 years.

Power Failure/Brownout Recovery

When system input power drops below normal, the system will not lose its programmed information. Upon return of normal power, breaker positions scheduled during the power failure period are immediately updated. No operator interaction is required.

Astronomical Real-Time Clock

Time-of-day, day/date, automatic leap year and daylight savings time adjustments are provided as standard.

Time Scheduling

The Pow-R-Command 750 supports 50 time schedules as control functions. Any of the 50 local time schedules in a Pow-R-Command 750 controller can be set to control smart breakers in its own panel or the expansion panels connected to it.

Holiday Scheduling

The Pow-R-Command 750 supports 30 local holiday definitions. Like normal time schedules, these definitions can be set to control breakers in its own panel or the expansion panels connected to it.

Input to Output Switch Matrix

The Pow-R-Command 750 offers 16 input switches and other lighting controls. With the Input to Output Switch Matrix feature, an input control terminated on the 750 controller can have discrete control of any breaker(s) in its own panel as well as any expansion panel connected to it.

Message/Alarms

The system will maintain an alarm log. The log will record where the alarm occurred, alarm reason, date and time of the alarm. The log is maintained in non-volatile memory. The alarm log can store up to 300 alarms.

Daylighting Optimization

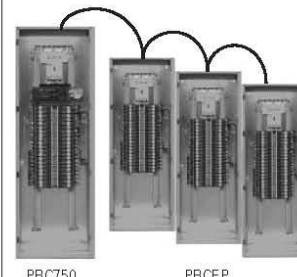
Daylighting optimization is available using a combination of inputs on the Pow-R-Command 750 controller or a Switch Override Controller and dimming cable.

System Configurations

System Architecture

Designed primarily for stand-alone applications, the Pow-R-Command 750 is perfect for smaller lighting control solutions for your building. Each Pow-R-Command 750 Integrated Panelboard can support up to three additional expansion panels (EP).

How to Apply These Products —
PRC750 Integrated Controller
Subnet Communication



One PRC750 can control up to three additional 42-circuit Pow-R-Command expansion panels (PRCEP) for a total of 160 remote controllable breakers.

Figure 23.3-1. System Architecture

For more information visit www.eaton.com

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Cutler-Hammer

January 2008
Sheet 0923Lighting Control System Pow-R-Command
Pow-R-Command 750

23.3-3

Technical Data

Technical Data

Panelboard Ratings

- Voltage:
 - 240 Vac
 - 480Y/277 Vac
- Main lugs:
 - 100 through 225 amperes
- Main breakers:
 - 100 through 225 amperes
- Branches:
 - 15 through 100 amperes
 - Controllable from 15 through 30 amperes

Interrupting Capacity (Symmetrical)

- 240 Vac: 65 kA maximum fully rated.
- 240 Vac: 100 kA maximum series rated.
- 480Y/277 Vac.

Service

- 3-phase, 4-wire 208Y/120 V, 480Y/277 Vac and 240/120 V Delta.
- Single-phase, 3-wire, 120/240 V.

Mains

For available mains, refer to **Table 23.3-1**.

Branch Circuits

For available branch circuit devices, refer to **Table 23.3-2**.

Main Lugs Only

The short circuit rating of the MLO assembled panelboard will be fully rated based upon the lowest rated branch device or may be series rated with an approved upstream device.

- Main lugs only ampere ratings: 100 and 225.

Main Circuit Breakers

The short circuit rating shown is that of the main breaker only. The short circuit rating of the assembled panelboard is the rating of the lowest fully rated main or branch device or the rating of an approved series rating combination.

Branch Circuit Breakers

The type GHQRSP and BABRSP are the controllable circuit breakers. Controllable breakers are available in 1- and 2-pole styles, from 15 through 30 amperes. Non-controlled circuit breakers can be located within the panelboard chassis.

Table 23.3-2. Branch Circuit Breakers

Breaker Type	Ampere Rating	Number of Poles	Interrupting Rating (kA Symmetrical)				
			120 V	120/240 V	240 V	277 V	480 V
BAB	15 – 70	1	10	—	—	—	—
BAB	15 – 100	2	—	10	—	—	—
BAB	15 – 100	2, 3	—	—	10	—	—
BAB-D ^①	15 – 60	1, 2	10	10	—	—	—
BAB-C ^②	15 – 30	1, 2	10	10	—	—	—
BABRSP ^③	15 – 30	1, 2	10	10	—	—	—
GHQRSP ^④	15 – 20	1, 2	—	—	65	14	14
QBGF ^⑤ , QBGFEP ^⑤	15 – 50 ^⑥	1, 2	10	10	—	—	—

^① HID (High Intensity Discharge) rated breaker.

^② Switching neutral breaker. 1-pole device requires 2-pole space; 2-pole device requires 3-pole space.

^③ Controllable breaker.

^④ GFCI for 5 mA personnel protection.

^⑤ GFP for 30 mA equipment protection.

^⑥ 50 ampere devices are available as 2-pole only.

Series Ratings

Eaton has tested the GHQRSP and BABRSP controllable circuit breakers for Series Rated Combinations up to 200 kAIC with breakers or fuses. For a complete listing of available series ratings, see **Section 22** (Panelboards) Series Ratings **Tables 22.0-6** through **22.0-16**.

Table 23.3-1. Main Circuit Breakers

Breaker Type	Frame Ampere Rating	Interrupting Rating (kA Symmetrical)	
		240 V	480Y/277 V
EHD	100	18	14
FDB	150	18	14
FD	225	65	35
HFD	225	100	65
FDC	225	200	100
ED	225	65	—
EDH	225	100	—
EDC	225	200	—
JD	250	65	35
HJD	250	100	65
JDC	250	200	100

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Appendix M: Lutron Presentation Comments (12.07.2010)

General:

- Tell story of building architecture influence on lighting.
- Orientation of spaces in building and site.
- Think interior design with material colors.
- Perhaps take a look at a lab space for lighting design.
- Provide more Data (i.e. – proof that daylight will deviate cost and some energy).
- Use tools (AGI32 & Radiance) to provide story of daylight harvesting.

Louvers & Daylighting:

- Investigate study of louvers and daylighting into space more before bashing louvers.
- Be sure to investigate solutions that are feasible for all facades.
- If façade design is to change, include exterior view of building to display new design from what a pedestrian would see.

Student Study Area:

- If uplighting were used, the corridor may not need lighting.
- Reinforce design for these spaces.
- High cabinets could be used for highlighting corridor wall.
- Balancing of space environment between exterior wall/glazing and corridor wall.
- Energy Savings: Control task lighting when no one is in the space.
- Night-Time control is important.
- Exterior view during evenings is important.

Conference Room:

- Provide source of research.
- Linear fixture is not viable solution for Video Conferencing.
- Don't wash a wall behind the user in the V.C. Situation.
- Make sure lighting and colors don't compete with necessary lighting for vertical illumination.
- Determine video camera location to design lighting appropriately.
- Look into materials and colors.
- Video conferencing equipment not present; assume use of a mobile station.

Cantilever Plaza:

- Unique features? Intent? Night-Time memorability?
- "Oculus" (i.e. – Void) is interesting in the space.
- They do not believe that the meandering path was designed to discourage use.
 - It's like being drawn to the "Naughty Garden."
- By highlighting the Oculus, there is an opportunity to use ambient for light the plaza; creating a moon-like glow.
- Uplighting the cantilever would be wise.

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