

## **Appendix B | Calculations**

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## **Appendix B | Light Loss Factors**

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Light Loss Factors

	Type	Mean Lumen @ 25°C	BF	LDD (i)		RSDD (ii)	Total
Tiered Classroom	C1	2594	1	Category VI	0.86	0.88	0.7568
	C2	2594	1	Category VI	0.86	0.88	0.7568
	C3	2594	1	Category IV	0.885	0.976	0.86376
	C4	2040	1	Category IV	0.885	0.976	0.86376
	C5	1256	1	Category IV	0.885	0.976	0.86376
Library Reading Lounge	L1	2870	1	Category IV	0.88	0.976	0.85888
	L2	2750	1	Category IV	0.88	0.976	0.85888
	L3	2750	1	Category III	0.9	0.926	0.8334
	L4	2750	1	Category IV	0.88	0.976	0.85888
	L5	2750	1	Category IV	0.88	0.976	0.85888
	L6	2750	1	Category II	0.94	0.926	0.87044
	L7	1530	1	Category IV	0.88	0.926	0.81488
	L8	1530	1	Category IV	0.88	0.976	0.85888
	L9	NA	NA				NA
Roof Garden	R1	860	1	Category III	0.9	0.926	0.8334
	R2	1020	1	Category IV	0.88	0.926	0.81488
	R3	750	1	Category II	0.94	0.88	0.8272
	R4	NOT USED	1	NOT USED			NOT USED
	R5	NA	NA				NA
Student Gathering	S1	17600	1	Category V	0.93	0.976	0.90768
	S2	2750	1	Category IV	0.88	0.976	0.85888
	S3		1	Category V	0.93	0.976	0.90768
	S4	2870	1	Category IV	0.88	0.976	0.85888
	S5	11200	1	Category IV	0.88	0.976	0.85888
	S6	16100	1	Category IV	0.88	0.976	0.85888
	S7	477	1	Category V	0.93	0.976	0.90768

i - 12 month cycle, Clean Environment

ii - RCR = 1.5

iii - Assumed

iv - 35°C Per IES file

## **Appendix B | Lighting Power Density Calculations**

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### Tiered Classroom Lighting Power Density Calculation

Area:	2257
Allowable LPD (by Ashrae 90.1):	1.4
Allowable Watts (by Ashrae 90.1):	3159.80

Designed Wattage Consumption			
Luminaire Type	Quantity	Ballast Watts	Total Watts
C1	24	32.6	782.4
C2	24	32.6	782.4
C3	7	32.6	228.2
C4	22	36	792
C5	36	19	684
			<b>3269.00</b>
			<b>FAIL</b>
Watts over code			-109.2

### Library Lighting Power Density Calculation

Reading Area:	7659.5
Stack Area:	761
Allowable LPD Reading (by Ashrae 90.1):	1.2
Allowable LPD Stack (by Ashrae 90.1):	1.7
Allowable Watts (by Ashrae 90.1):	10485.1

75% of total

Designed Wattage Consumption			
Luminaire Type	Quantity	Ballast Watts	Total Watts
L1A (70w sp)	38	95	3610
L1B (70w fl)	2	95	190
L2A (Strip_2nd floor curvel)	9	65.2	586.8
L2B	9	65.2	586.8
L2C	8	65.2	521.6
L3 (3032)	30	32.6	978
L4 (Lightolier T5 Slot)	19	32.6	619.4
L5 (Elliptipar WW)	9	32.6	293.4
L6 (Tambient)	14	32.6	456.4
L7A (LP_Globe)	3	33.24	99.72
L7B	3	33.24	99.72
L7C	3	33.24	99.72
L8(KV 26W)	9	33.24	299.16
L9A	2	300	600
L9B	2	300	600
L9C	2	300	600
			0
			<b>8440.72</b>
			<b>PASS</b>
Watts to consume			2044.38

## Roof Garden Lighting Power Density Calculation

### TRADABLE

Allowable LPD walk <10ft (by Ashrae 90.1):	1	per sq ft
Area:	1022	
Allowable Watts (by Ashrae 90.1):	511	

Allowable LPD Entrance (by Ashrae 90.1):	30	per ft
Area:	30	
Allowable Watts (by Ashrae 90.1):	900	

Allowable LPD Overhangs (by Ashrae 90.1):	1.25	per sq ft
Area:	789	
Allowable Watts (by Ashrae 90.1):	986.25	

Allowable LPD Plazas (by Ashrae 90.1):	0.2	per sq ft	5	per ft
Area:	3019		89.6	
Allowable Watts (by Ashrae 90.1):	603.8	<b>OR</b>	336.00	

Total Wattage to Consume (not including façade)	3001.05
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Designed Wattage Consumption			
Luminaire Type	Quantity	Ballast Watts	Total Watts
R1	16	16	256
R2	10	22	220
R3	10	46	460
R4		Not Used	
			936
			<b>PASS</b>

Watts to consume 2065.05

### NOT TRADABLE

Allowable LPD Facade (by Ashrae 90.1):	0.2	per sq ft	5	per ft
Area:	2297		89.6	
Allowable Watts (by Ashrae 90.1):	229.7	<b>OR</b>	336.00	

Designed Wattage Consumption			
Luminaire Type	Quantity	Ballast Watts	Total Watts
R5	221	1	176
			0
			0
			176
			<b>PASS</b>

Watts to consume 53.7

**Student Gathering Lighting Power Density Calculation**

Total	
Corridor Area:	6055
Allowable Corridor LPD (by Ashrae 90.1):	0.5

Total	
Atrium Area:	8018.5
Allowable Atrium (1-3) LPD (by Ashrae 90.1):	1.3
Allowable Atrium (+3) LPD (by Ashrae 90.1):	1.3

Total Allowable Watts (by Ashrae 90.1):	20423.19
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**Designed Wattage Consumption**

Luminaire Type	Quantity	Ballast Watts	Total Watts
S1	20	283	5660.00
S2	115	32.1	3691.5
S3	50	35.1	2106
S4 (70 WMH)	4	95	380
S5 (175 MH)	4	198	792
S6 (250 MH)	12	284	3408
S7	54	14.3	772.2
S8			0
S9			
S10			0

16809.70	<b>PASS</b>
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Watts to consume      3613.49

Total Wattage Allowable	37069.14
Total Wattage consumed	29455.42
	<b>PASS</b>

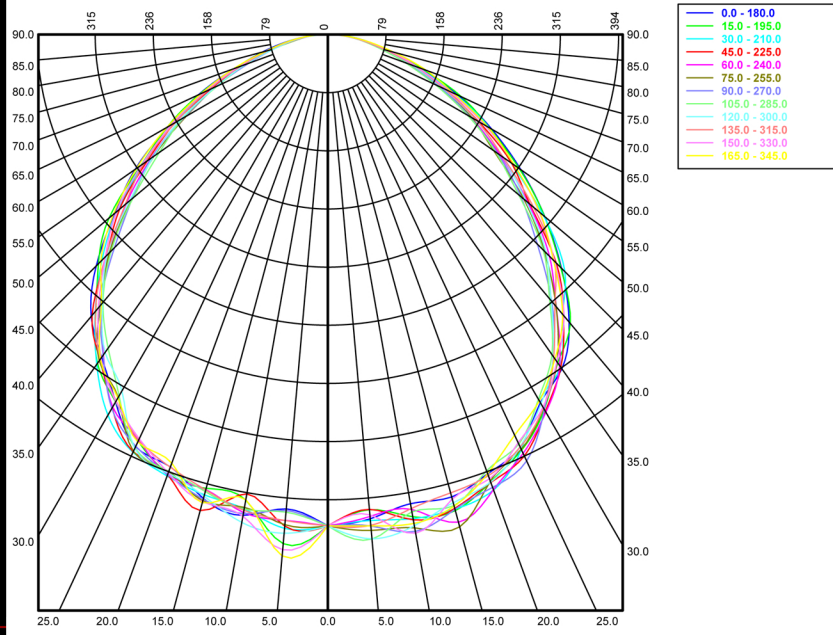
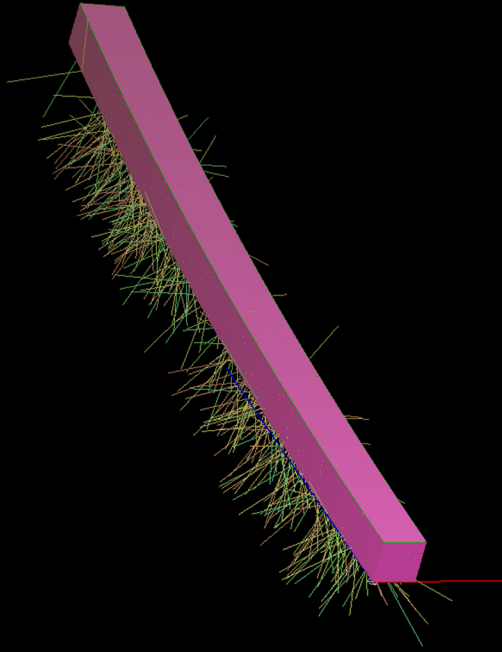
## **Appendix B | Photopia Models**

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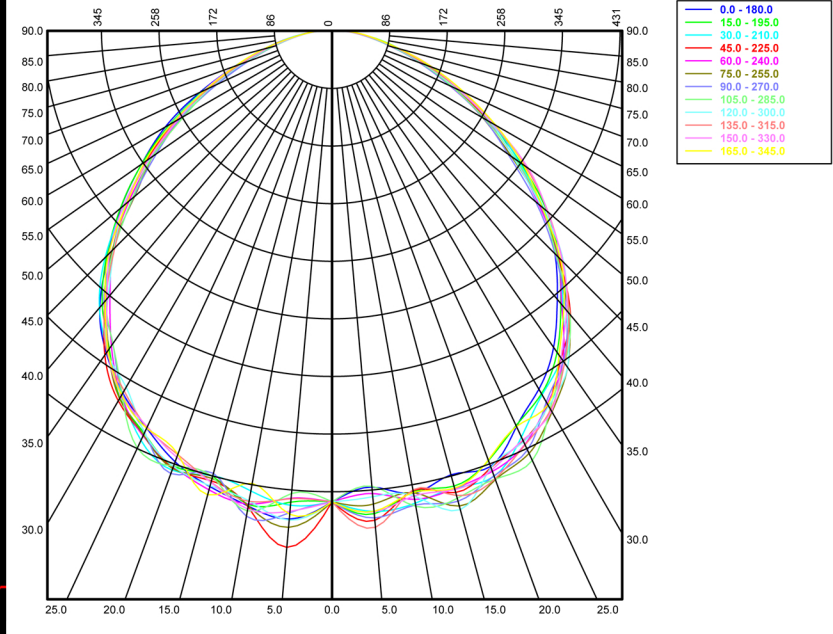
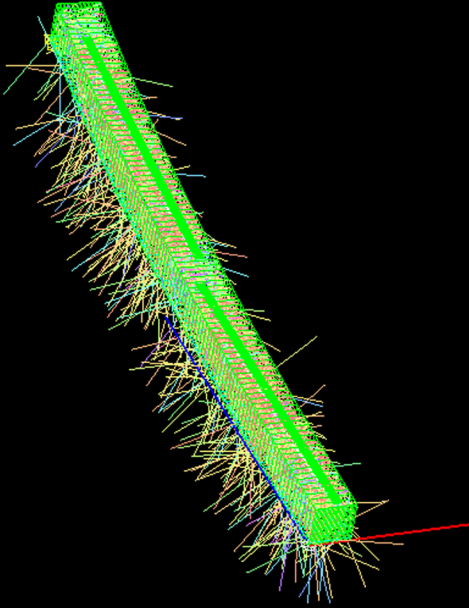


# CUSTOM LUMINAIRE L2 PHOTOPIA OUTPUT

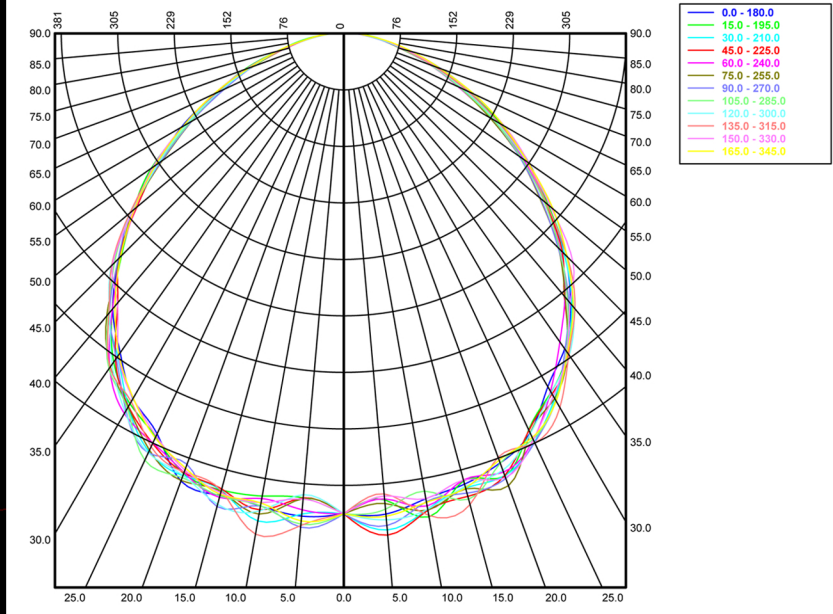
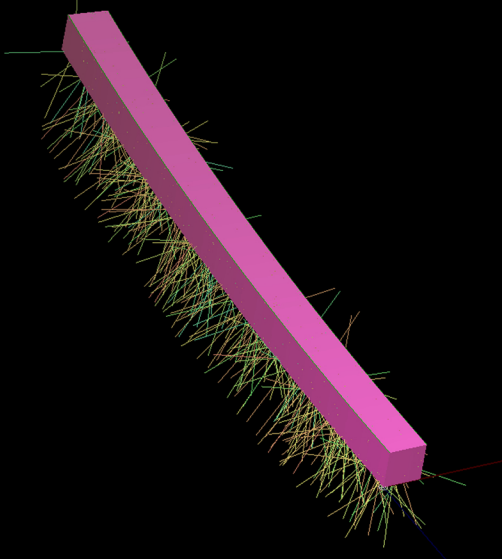
CUSTOM LUMINAIRE TYPE L2A



CUSTOM LUMINAIRE TYPE L2B



CUSTOM LUMINAIRE TYPE L2C



Curved Luminaire 1.ies

IESNA:LM-63-1995

[TEST] Photopia 3.0.1.876 PHOTOMETRIC REPORT

[DATE] Sun Apr 12 18:29:10 2009

[LUMINAIRE] PROJECT: Curved Luminaire 1

[LAMP] Fluor. 28W 4' Silhouette T5

[LAMPCAT] F28/T5

[OTHER] OPTIONS:

[OTHER] Performing lamp shadow check up to 500 tries.

[OTHER] Spawning 1 rays for each reaction.

[OTHER] Writing 1000 rays to a DXF file.

[OTHER] Random number generator seed: 8.

[OTHER] Tracing 10 reactions.

[OTHER] Stop tracing ray at 1.0% of initial magnitude.

[OTHER] Tracing 5000172 initial lamp rays.

[OTHER] Photometric test distance of 20.00 feet.

[OTHER]

[OTHER] LUMENS EXITING SYSTEM:

[OTHER] Lumens(%)      Reaction

[OTHER]      0( 0.0%)      0

[OTHER]      0( 0.0%)      1

[OTHER]      548( 9.4%)      2

[OTHER]      333( 5.7%)      3

[OTHER]      300( 5.2%)      4

[OTHER]      180( 3.1%)      5

[OTHER]      120( 2.1%)      6

[OTHER]      100( 1.7%)      7

[OTHER]      75( 1.3%)      8

[OTHER]      56( 1.0%)      9

[OTHER]      41( 0.7%)      10

[OTHER]      1756( 30.3%) Total

[OTHER]

[OTHER] LUMEN INTERACTION WITH SYSTEM:

[OTHER] Absorbed(%)      Incident(%)      Layer Name

[OTHER]      59( 1.0%)      934( 16.1%)      LAMP-F28T51

[OTHER]      2( 0.0%)      41( 0.7%)      LAMP-F28T52

[OTHER]      2717( 46.9%)      12143(209.4%)      REFL

[OTHER]      677( 11.7%)      10691(184.3%)      REFR

[OTHER]      3457( 59.6%)      23811(410.5%)      Total

[OTHER] Absorbed(%)      Incident(%)      Material Name

[OTHER]      61( 1.1%)      976( 16.8%)      PHOSGLAS

[OTHER]      2717( 46.9%)      12143(209.4%)      ACA470AV

[OTHER]      677( 11.7%)      10691(184.3%)      DIFFACR1

[OTHER]      3457( 59.6%)      23811(410.5%)      Total

[OTHER]

[OTHER] UNACCOUNTED LUMENS:

[OTHER]      reached interreflection limit: 299.14 ( 5.2%)

[OTHER]      fell below continuation minimum: 0.00 ( 0.0%)

[OTHER]      could not find in/out refractor facet: 286.98 ( 4.9%)

[OTHER]      reached try limit for scatter bounce: 0.00 ( 0.0%)

[OTHER]      lost elsewhere(i.e. outside distrib): 0.00 ( 0.0%)

TILT=NONE

2 2900 1 19 25 1 1 1.27468 10.5336 0.5

1 1 66

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90

0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360

665.77 658.77 645.66 648.8 633.59 616.85 576.22 553.1 508.87 447.89 383.95 319.58 256.49 195.03 134.08

Curved Luminaire 1.ies

89.2 55.41 26.64 4.87  
665.77 646.41 663.49 667.92 645.32 621.36 586.9 543.31 511.35 446.67 383.51 317.11 253.03 200.18 136.7  
90.34 54.65 26.55 4.26  
665.77 661.17 666.14 665.84 656.86 620.62 572.54 549.47 495.58 454.45 381.62 305.07 252.29 189.35 129.04  
86.56 52.55 24.05  
4.73  
665.77 646 667.87 664.93 645.91 630.32 589.85 550.77 497.06 437.93 357.44 304.43 236 176.74 126.61 82.47  
51.71 25.53 4.52  
665.77 655.65 653.54 684.14 656.55 626.27 591.14 548 481.55 424.73 354.32 286.33 224.69 171.99 119.67 76.9  
48.45 22.57 4.44  
665.77 674.59 678.98 690.8 644.22 620.32 584.76 541.83 481.21 415.46 346.77 274.72 224.93 166.01 114.05  
74.58 46.58 23.78  
4.07  
665.77 668.61 683.71 666.13 653.07 637.68 586.99 532.88 472.13 401.48 341.78 281.22 221.19 166.91 112.7  
75.05 46.47 22.02  
4.35  
665.77 686.49 656.93 661.01 629.17 612.53 570.88 529.74 467.53 412.87 337.6 278.11 218.87 160.73 111.99  
72.84 46.12 23.8 3.27  
665.77 685.89 675.84 657.04 645.48 616.82 577.82 532.74 470.91 418.48 350.33 290.26 231.71 172.12 122.66  
78.59 50.01 24.21  
5.32  
665.77 667.58 652.32 643.12 636.25 617.01 584.12 533.91 478.93 434.23 364.11 290.67 233.61 174.96 126.72  
80.51 48.67 24.6  
5.18  
665.77 653.42 686.29 651.77 640.75 610.62 583.45 541.42 498.16 434.97 373.94 308.87 246.3 180.71 130.4  
88.36 52.02 24.89 5.87  
665.77 668.45 672.77 661.7 633.31 599.11 573.3 536.69 494.96 432.57 375.38 308.78 250.55 187.66 142.28  
92.13 55.17 25.78 4.33  
665.77 645.38 661.7 651.08 623.59 616.3 575.07 534.18 498.69 443.87 377.37 318.67 250.43 193.55 135.19  
91.3 56.49 26.94 4.29  
665.77 692.68 640.61 636.61 632.78 608.06 574.77 543.91 489.16 439.44 387 309.06 251.65 191.6 134.3 88.24  
52.47 27.33 4.97  
665.77 671.7 652.75 645.86 636.6 624.64 595.68 545.76 490.17 432.76 372.42 303.94 244.23 183.07 134.24  
86.66 53.05 24.02 4.41  
665.77 668.78 632.16 667.8 634.62 623.89 584.33 538.18 496.7 424.34 368.39 298.5 238.79 173.2 124.68 78.9  
48.73 25.17 4.01  
665.77 660.95 657.8 638.5 635.05 606.6 582.96 530.04 477.7 417.63 356.87 292 230.62 168.55 117.76 76.83  
48.3 24.66 5.38  
665.77 666.92 650.66 654.26 630.14 623.32 568.01 539.94 480.14 418.8 347.56 287.75 221.62 167.89 117.21  
76.06 44 23.82 3.71  
665.77 647.77 658.97 652.03 634.7 615.53 585.17 530.62 479.05 408.92 346.17 291.18 224.11 166.61 114.28  
75.76 45.38 23.4 4.93  
665.77 649.77 653.14 641.25 629.86 618.51 565.67 518.97 473.54 414.99 344.36 278.56 227.1 165.59 119.58  
75.44 47.06 24.35  
4.97  
665.77 678.44 671.34 647.85 632.68 618.88 557.84 526.07 474.92 422.83 350.4 288.41 230.46 167.9 119.75  
75.34 49.45 22.61 4.02  
665.77 661.2 654.61 639.04 623.98 605.78 573.71 537.25 489.71 425.73 358.17 304.61 237.92 179.23 125.34  
83.59 52.16 24.5 5.92  
665.77 700.92 662.77 655.68 632.24 604.5 574.37 535.59 483.57 426.31 373.31 307.65 244.52 185.52 129.85  
87.46 51.54 25.67  
4.31  
665.77 709.26 639.99 656.86 618.09 609.19 568.72 537.24 477.04 434.92 379.22 316.43 251.73 188.62 136.11  
86.25 54.93 26.19  
5.58  
665.77 658.77 645.66 648.8 633.6 616.85 576.22 553.1 508.87 447.89 383.95 319.58 256.49 195.03 134.08 89.2

Curved Luminaire 2.ies

IESNA:LM-63-1995

[TEST] Photopia 3.0.1.876 PHOTOMETRIC REPORT

[DATE] Sun Feb 22 15:17:54 2009

[LUMINAIRE] PROJECT: Curved Luminaire 2

[LAMP] Fluor. 28W 4' Silhouette T5

[LAMPCAT] F28/T5

[OTHER] OPTIONS:

[OTHER] Performing lamp shadow check up to 500 tries.

[OTHER] Spawning 1 rays for each reaction.

[OTHER] Writing 1000 rays to a DXF file.

[OTHER] Random number generator seed: 8.

[OTHER] Tracing 25 reactions.

[OTHER] Stop tracing ray at 1.0% of initial magnitude.

[OTHER] Tracing 5000172 initial lamp rays.

[OTHER] Photometric test distance of 20.00 feet.

[OTHER]

[OTHER] LUMENS EXITING SYSTEM:

[OTHER] Lumens(%) Reaction

[OTHER] 0( 0.0%) 0

[OTHER] 0( 0.0%) 1

[OTHER] 987( 17.0%) 2

[OTHER] 763( 13.2%) 3

[OTHER] 674( 11.6%) 4

[OTHER] 283( 4.9%) 5

[OTHER] 133( 2.3%) 6

[OTHER] 97( 1.7%) 7

[OTHER] 67( 1.2%) 8

[OTHER] 51( 0.9%) 9

[OTHER] 39( 0.7%) 10

[OTHER] 30( 0.5%) 11

[OTHER] 22( 0.4%) 12

[OTHER] 17( 0.3%) 13

[OTHER] 12( 0.2%) 14

[OTHER] 9( 0.2%) 15

[OTHER] 7( 0.1%) 16

[OTHER] 5( 0.1%) 17

[OTHER] 4( 0.1%) 18

[OTHER] 3( 0.1%) 19

[OTHER] 2( 0.0%) 20

[OTHER] 2( 0.0%) 21

[OTHER] 1( 0.0%) 22

[OTHER] 1( 0.0%) 23

[OTHER] 0( 0.0%) 24

[OTHER] 0( 0.0%) 25

[OTHER] 3220( 55.5%) Total

[OTHER]

[OTHER] LUMEN INTERACTION WITH SYSTEM:

[OTHER] Absorbed(%) Incident(%) Layer Name

[OTHER] 60( 1.0%) 968( 16.7%) LAMP-F28T51

[OTHER] 3( 0.1%) 49( 0.9%) LAMP-F28T52

[OTHER] 2347( 40.5%) 11404(196.6%) REFL

[OTHER] 5( 0.1%) 3861( 66.6%) REFR

[OTHER] 2416( 41.7%) 16284(280.8%) Total

[OTHER] Absorbed(%) Incident(%) Material Name

[OTHER] 63( 1.1%) 1017( 17.6%) PHOSGLAS

[OTHER] 2347( 40.5%) 11404(196.6%) ACA470AV

Curved Luminaire 2.ies

[OTHER] 5( 0.1%) 3861( 66.6%) ACRYLIC1  
[OTHER] 2416( 41.7%) 16284(280.8%) Total  
[OTHER]  
[OTHER] UNACCOUNTED LUMENS:  
[OTHER] reached interreflection limit: 4.58 ( 0.1%)  
[OTHER] fell below continuation minimum: 0.00 ( 0.0%)  
[OTHER] could not find in/out refractor facet: 158.03 ( 2.7%)  
[OTHER] reached try limit for scatter bounce: 0.00 ( 0.0%)  
[OTHER] lost elsewhere(i.e. outside distrib): 0.00 ( 0.0%)  
TILT=NONE  
2 2900 1 19 25 1 1 1.14657 9.08468 0.500046  
1 1 66  
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90  
0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360  
662.47 632.12 642.48 652.01 640.79 626.79 589.24 581.11 555.17 517.76 485.86 438.77 393.51 328.05 252.13  
160.97 77.37 20.09  
1.13  
662.47 694.15 649.99 650.64 649.93 677.64 652.8 666.78 666.81 669.41 639.34 608.09 541.59 452.34 348.59  
232.74 114.28 25.69  
1.81  
662.47 630.96 674.42 686.48 711.39 752.88 782.4 811.77 806.85 809.62 773.11 708.27 651.45 573.26 463.29  
302.42 123.9 31 2.26  
662.47 656.08 688.54 708.4 774.43 847.3 884.61 905.04 898.73 870.38 828.81 820.96 755.09 665.18 481.49  
277.49 121.17 31.33  
2.52  
662.47 657.37 710.31 779.26 841.56 901.73 935.02 942.38 915.59 880.45 917.78 867.6 800.54 668.9 439.67  
260.02 118.91 27.17  
1.53  
662.47 643.58 704.95 781.65 884.5 929.66 961.79 982.26 915.3 932.43 962.56 886 808.58 620.64 408.14 245.61  
108.37 26.52 2.43  
662.47 663.84 717.13 822.64 890.29 952.3 973.88 980.34 903.08 947.98 954.46 894.92 808.74 601.73 403.84  
247.59 105.55 25.59  
2.67  
662.47 680.82 716.39 789.34 860.78 916.68 935.51 974.79 905.82 906.88 946.44 869.47 817.36 641.04 418.49  
249.2 114.1 26.49  
1.89  
662.47 654.03 698.1 739.32 819.68 887.43 929.63 956.01 932.89 863.23 856.07 843.19 771.21 665.79 456.47  
267.41 117.27 27.77 2  
662.47 657.98 693.59 704.48 755.92 811.18 862.39 887.66 894.77 871.71 798.22 729.78 682.14 614.88 476.88  
282.65 124.16 28.83  
2.24  
662.47 651.54 671.45 674.24 705.84 710.5 736.31 772.18 786.68 767.21 752.04 693.39 582.21 462.88 367.72  
259.41 118.23 28.6  
1.84  
662.47 649.31 658.9 645.3 665.99 634.03 639.54 629.8 613.54 595.08 574.39 538.83 478.41 397.93 290.49  
172.28 83.08 22.06 1.68  
662.47 687.54 658.86 652.75 648.86 617.04 601.5 581.71 545.95 514.42 473.6 425.73 365.99 296 222.82 138.58  
64.56 16.34 1.42  
662.47 647.13 666.59 656.21 657.46 665.27 654.83 662.11 646.45 643.41 600.55 558.92 482.94 383.15 291.34  
201.15 102.61 23.11  
1.37  
662.47 690.77 665.07 687.89 715.69 727.01 749.96 758.07 758.98 719.54 658.54 598.25 579.86 536.58 444.39  
290.97 124.64 28.22  
2.03  
662.47 642.37 693.78 724.57 759.03 795.04 813.51 828.33 750.21 718.01 745.07 795.15 747.74 690.5 507.1  
290.21 118.83 28.26

Curved Luminaire 2.ies

2.65

662.47 627.31 704.61 756.69 815.53 826.38 842.48 769.91 759.78 830.52 909.34 910.82 838.48 699.62 469.52  
272.59 115.32 26.28

1.28

662.47 668.98 707.3 776.77 834.04 869.74 830.27 766.7 811.14 929.46 980.77 922.56 847.21 659.41 443.26  
258.92 109 24.53 2.13  
662.47 685.37 731.24 760.53 832.23 860.15 809.75 773.21 819.63 938.38 985.15 912.09 850.66 654.27 437.78  
251.29 108.73 23.44

1.53

662.47 668.64 699.51 746.06 800.56 864.36 838.77 773.98 788.74 875.78 947.23 907.43 839.49 674.66 453.26  
271.95 112.65 27.27

2.03

662.47 670.79 706.7 747.43 780.69 825.16 847.37 786.37 754.78 758.09 834.79 842.26 803.13 700.37 502.79  
289.17 128.84 30.06

2.59

662.47 668.01 666.02 708.69 739.58 753.88 783.46 817.06 743.68 702.24 661.8 687.36 671.75 617.89 505.57  
311.18 135.71 30.47

2.71

662.47 631.94 649.32 669.95 683.83 702.18 699.93 716.86 708.06 695.65 639.84 575.3 504.97 439.74 367.9  
260.5 131.74 29.28

1.89

662.47 655.4 660.54 645.35 649.58 635.52 616.13 604.89 593.09 556.43 537.06 499.72 440.53 368.83 266.63  
166.28 78.84 20.69

1.47

662.47 632.12 642.48 652.01 640.79 626.79 589.24 581.11 555.17 517.76 485.86 438.77 393.51 328.05 252.13  
160.97 77.37 20.09

1.13

Curved Luminaire 3.ies

IESNA:LM-63-1995

[TEST] Photopia 3.0.1.876 PHOTOMETRIC REPORT

[DATE] Sun Apr 12 18:03:59 2009

[LUMINAIRE] PROJECT: Curved Luminaire 3

[LAMP] Fluor. 28W 4' Silhouette T5

[LAMPCAT] F28/T5

[OTHER] OPTIONS:

[OTHER] Performing lamp shadow check up to 500 tries.

[OTHER] Spawning 1 rays for each reaction.

[OTHER] Writing 1000 rays to a DXF file.

[OTHER] Random number generator seed: 8.

[OTHER] Tracing 10 reactions.

[OTHER] Stop tracing ray at 1.0% of initial magnitude.

[OTHER] Tracing 5000172 initial lamp rays.

[OTHER] Photometric test distance of 20.00 feet.

[OTHER]

[OTHER] LUMENS EXITING SYSTEM:

[OTHER] Lumens(%)      Reaction

[OTHER]      0( 0.0%)      0

[OTHER]      0( 0.0%)      1

[OTHER]      549( 9.5%)      2

[OTHER]      322( 5.6%)      3

[OTHER]      320( 5.5%)      4

[OTHER]      182( 3.1%)      5

[OTHER]      120( 2.1%)      6

[OTHER]      101( 1.7%)      7

[OTHER]      73( 1.3%)      8

[OTHER]      55( 1.0%)      9

[OTHER]      40( 0.7%)      10

[OTHER]      1765( 30.4%) Total

[OTHER]

[OTHER] LUMEN INTERACTION WITH SYSTEM:

[OTHER] Absorbed(%)      Incident(%)      Layer Name

[OTHER]      64( 1.1%)      1013( 17.5%)      LAMP-F28T51

[OTHER]      3( 0.1%)      52( 0.9%)      LAMP-F28T52

[OTHER]      2692( 46.4%)      12369(213.3%)      REFL

[OTHER]      678( 11.7%)      10736(185.1%)      REFR

[OTHER]      3438( 59.3%)      24172(416.8%)      Total

[OTHER] Absorbed(%)      Incident(%)      Material Name

[OTHER]      67( 1.2%)      1065( 18.4%)      PHOSGLAS

[OTHER]      2692( 46.4%)      12369(213.3%)      ACA470AV

[OTHER]      678( 11.7%)      10736(185.1%)      DIFFACR1

[OTHER]      3438( 59.3%)      24172(416.8%)      Total

[OTHER]

[OTHER] UNACCOUNTED LUMENS:

[OTHER]      reached interreflection limit: 298.49 ( 5.1%)

[OTHER]      fell below continuation minimum: 0.00 ( 0.0%)

[OTHER]      could not find in/out refractor facet: 297.11 ( 5.1%)

[OTHER]      reached try limit for scatter bounce: 0.00 ( 0.0%)

[OTHER]      lost elsewhere(i.e. outside distrib): 0.07 ( 0.0%)

TILT=NONE

2 2900 1 19 25 1 1 1.13737 8.70466 0.5

1 1 66

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90

0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360

648.05 650.75 637.41 629.43 616.61 594.81 550.43 519.34 475.65 421.99 359.14 305.32 246.89 193.06 138.9

Curved Luminaire 3.ies

95.07 55.75 32.6  
13.53  
648.05 631.52 662.33 624.78 635.44 590.16 559.28 525.75 478.86 424.46 359.52 302.41 244.42 189.2 136.77  
91.57 58.49 33.68  
10.24  
648.05 672.36 651.76 634.78 634.95 608.33 568.8 525.3 478.18 420.5 356.59 301.5 234.45 182.94 129.74 88.66  
54.16 29.72 11.08  
648.05 679.36 653.23 646.53 634.72 590.86 561.7 528.24 462.76 417.1 353.16 295.31 236.64 176.8 129.17  
84.58 54.54 30.73 11.53  
648.05 630.25 647.21 623.69 629.8 604.97 557.72 508.2 464.14 413.03 352.64 295.82 231.06 170.64 124.07  
80.82 53.8 29.16 10.81  
648.05 636.61 652.88 636.03 649.42 594.91 568.67 525.27 464.52 409.49 344.92 289.18 227.44 173 124.57  
80.02 51.3 28.93 10.72  
648.05 666.46 641.47 642.05 638.87 608.99 572.07 520.34 472.24 409.01 347.08 288.81 232.95 175.78 124.94  
81.67 51.56 26.02  
11.75  
648.05 644.23 627.12 650.52 616.96 603.91 571.43 523.64 469.53 411.46 352.92 292.04 233.02 173.03 125.58  
83.29 55.82 29.89  
10.24  
648.05 658.67 651.76 632.75 627.19 595.55 559.72 529.93 482.64 423.07 367.42 301.04 238.02 180.57 126.8  
87.28 53.25 30.7  
10.04  
648.05 623.52 660.2 657.94 608.41 609.57 582.99 528.99 485.17 426.78 357 301.96 241.38 184.56 129.15 86.3  
58.73 30.8 12.62  
648.05 626.37 637.15 623.77 637.74 605.15 565.34 525.39 474.9 437.41 364.97 304.75 249.96 191.8 137.75  
90.34 58.39 31 11.13  
648.05 653.71 642.29 634.66 612.65 601.43 572.76 525.96 481.29 425.76 368.54 303.09 248.23 194.13 138.48  
96.46 59.2 32.1  
10.63  
648.05 653.67 647.39 644.98 642.58 595.88 569.01 525.84 485.1 428.29 375.25 305.64 252.98 189.61 138.89  
93.09 58.86 31.21  
13.18  
648.05 629.02 633.62 637.88 631.66 600.44 576.91 541.19 485.84 424.25 370.39 316.88 246.21 189.6 142.64  
93.69 60.55 32.99  
13.31  
648.05 650.96 667.83 638.25 634.77 622.2 581.55 531.78 493.07 427.59 369.36 308.43 248.26 193.4 138.64  
93.52 57.36 32.72  
12.23  
648.05 628.91 652.64 636.33 630.65 610.23 581.14 536.96 474.32 429.43 364.57 306.62 242.43 186.72 131.44  
85.99 55.76 31.91  
11.49  
648.05 645.15 637.23 647.91 630.29 609.56 592.04 550.69 485.58 426.35 366.84 307.66 240.37 182.41 135.58  
85.97 53.63 29.03  
10.05  
648.05 629.9 658.47 639.65 641.77 620.3 581.93 549.09 497.55 427.08 370.27 298.69 236.38 182.61 129.08  
87.62 52.4 30.74 8.75  
648.05 668.66 647.31 660.87 618.52 624.26 587.73 534.93 491.59 430.22 374.64 300.49 237.48 177.76 131.3  
89.09 53.35 29.37  
11.24  
648.05 664.55 647.07 646.01 637.87 635.18 584.04 552.44 494.05 437.65 374.42 305.21 239.99 184.39 132.52  
87.06 53.69 28.98  
10.15  
648.05 624.63 654.03 657.83 634.41 624.22 589.81 544.84 491.41 443.94 371.62 305.5 244.64 184.32 132.75  
89.59 53.47 31.45  
11.27  
648.05 666.32 685.92 638.7 629.54 615.12 573.59 550.21 492.81 442.86 376.62 310.28 250.41 192.14 137.87



Curved Luminaire 3.ies

88.57 54.8 31.13

11.61

648.05 630.65 642.64 641.35 626.97 599.02 568.33 529.65 474.84 441.26 370.29 314.43 249.93 192.95 139.69

91.73 56.44 32.45

10.56

648.05 660.22 643.12 643.88 624.14 602.01 568.03 528.92 479.83 426.07 368.12 310.35 250.03 193.54 135.62

93.55 56.43 33.18

11.76

648.05 650.75 637.41 629.43 616.61 594.81 550.43 519.34 475.65 421.99 359.14 305.32 246.89 193.06 138.9

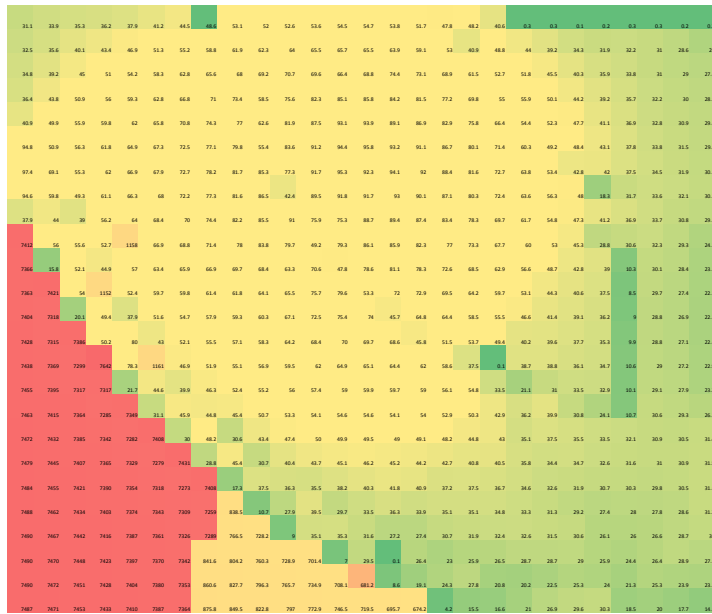
95.07 55.75 32.6

13.53

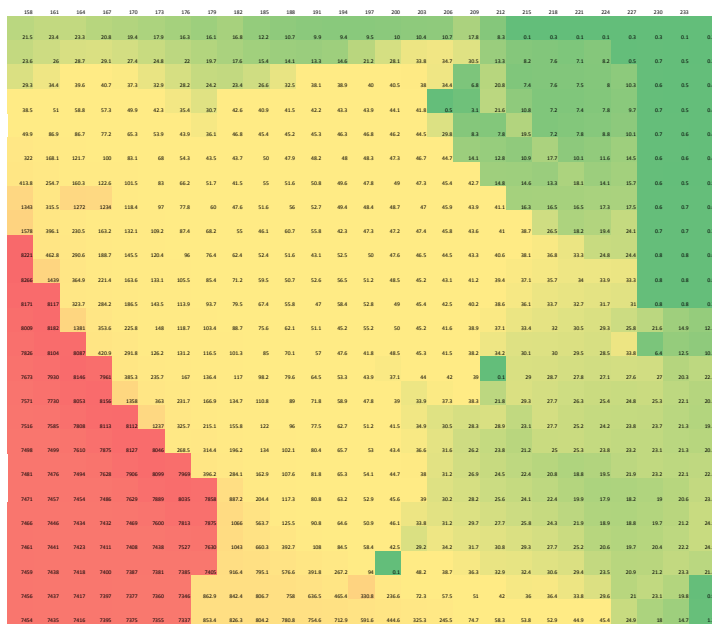
## **Appendix B | Daylighting Calculations**

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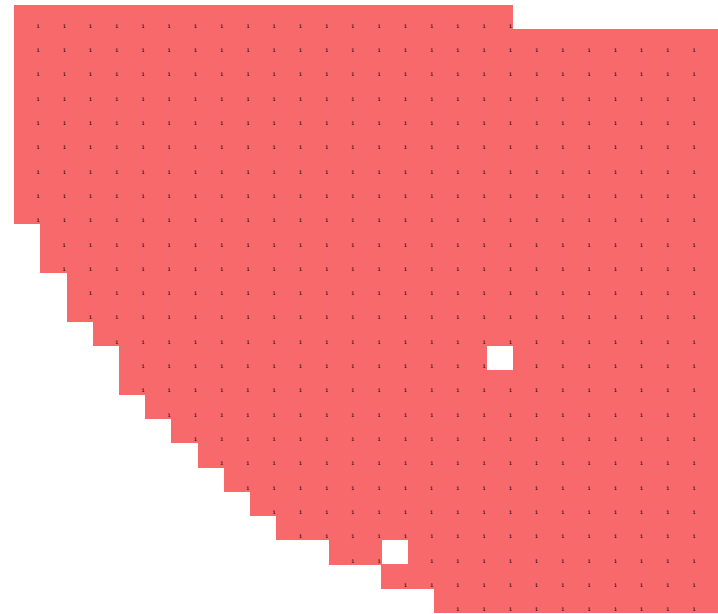
**LIBRARY DAYLIGHT CALCULATION POINTS FROM AGI (FC)**



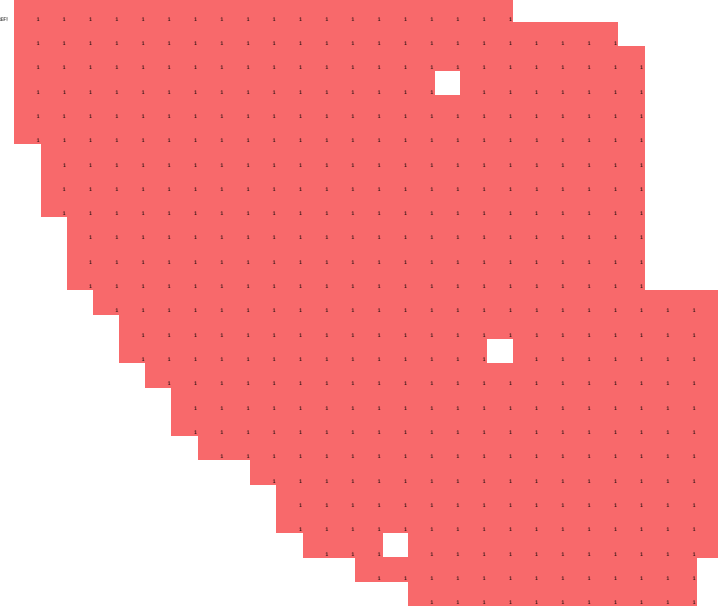
**LIBRARY DAYLIGHT CALCULATION POINTS FROM AGI (FC)**



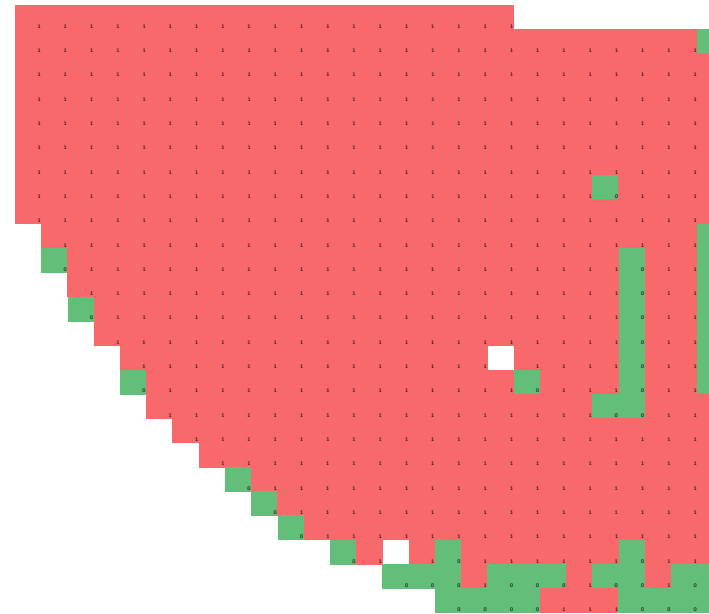
**EXCLUDE ALL POINTS GREATER THAN 600 FC AND LESS THAN 2 (THIS WILL EXCLUDE ALL EXTERIOR POINTS AND POINTS INSIDE OBJECTS)**



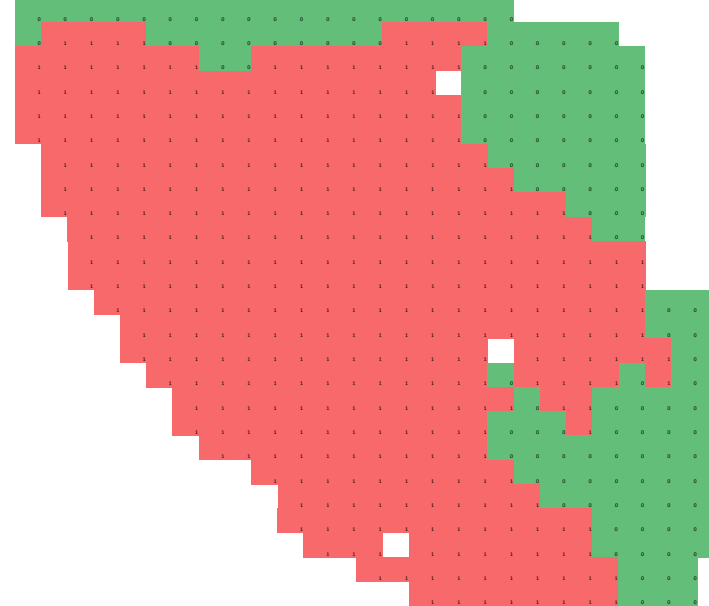
**EXCLUDE ALL POINTS GREATER THAN 400 FC AND LESS THAN 2 (THIS WILL EXCLUDE ALL EXTERIOR POINTS AND POINTS INSIDE OBJECTS)**



**FOR ALL POINTS "X" TO BE COUNTED (2<X<600) CHECK TO SEE IF THEY ARE GREATER THAN 25FC, IF SO MARK AS "1"**

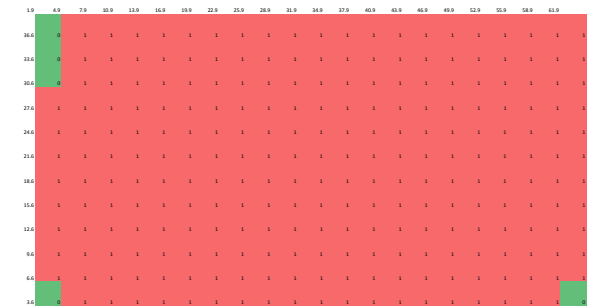


**FOR ALL POINTS "X" TO BE COUNTED (2<X<600) CHECK TO SEE IF THEY ARE GREATER THAN 25FC, IF SO MARK AS "1"**

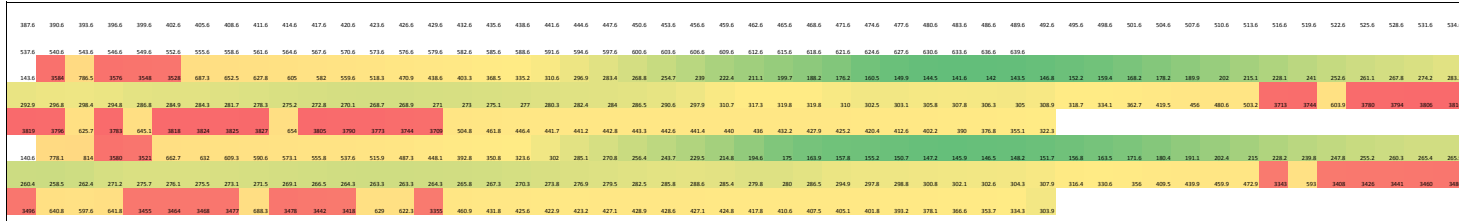


SUM OF THOSE > 25FC	SUM OF VALID POINTS TO BE COUNTED	% OF TOTAL POINTS OVER 25FC
1724	2163	0.79704

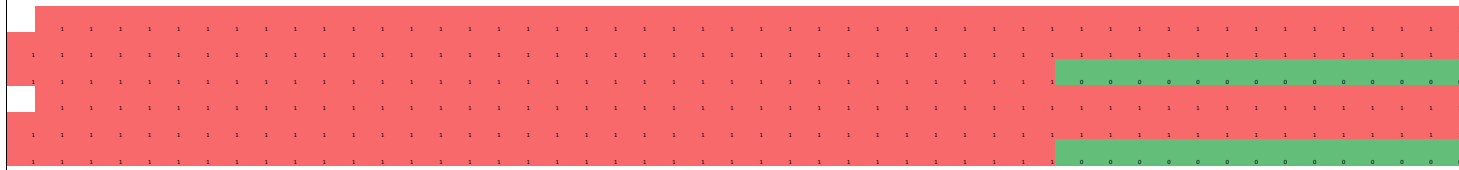
**TIERED CLASSROOM**



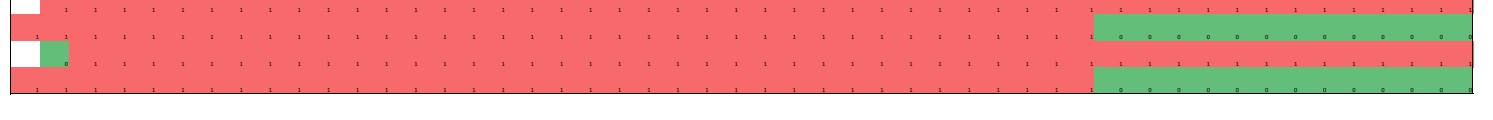
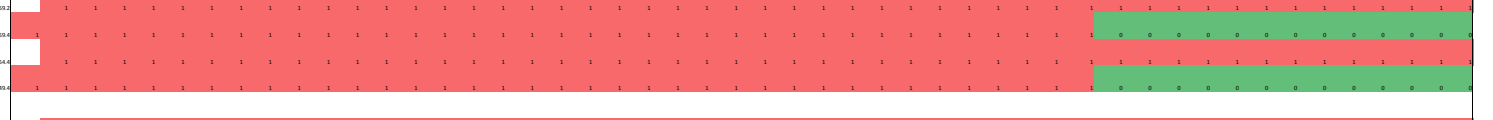
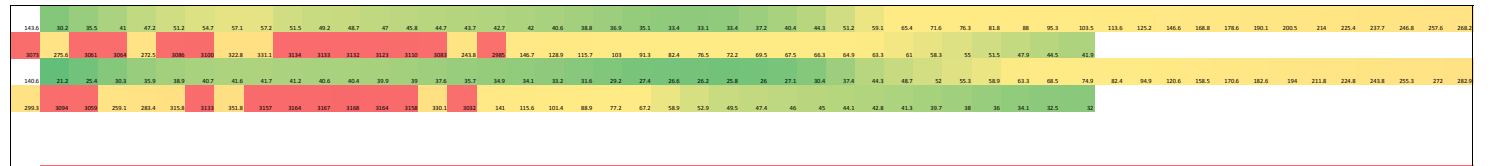
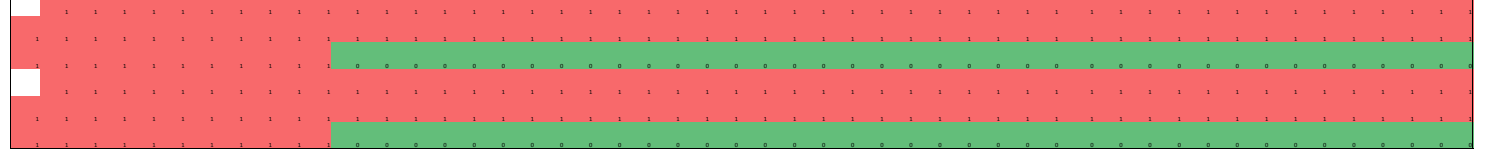
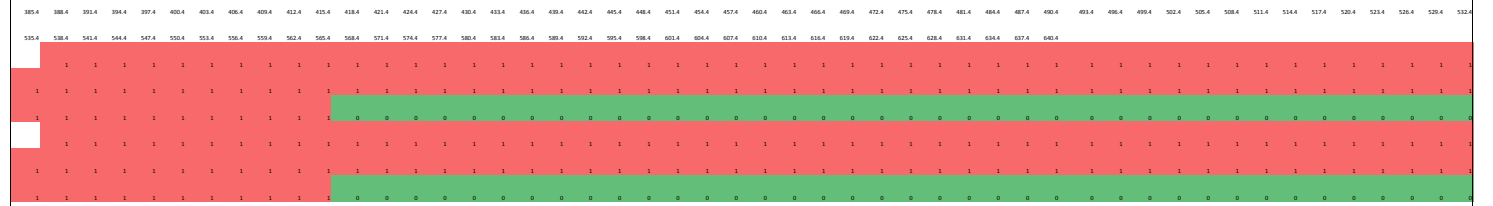
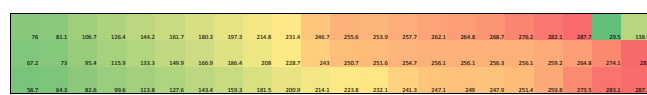
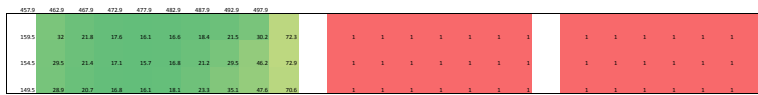
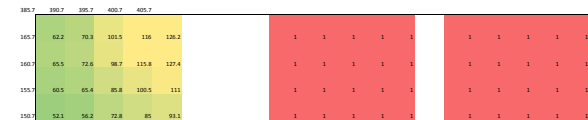
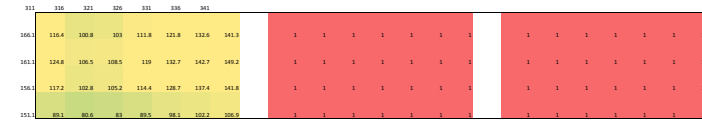
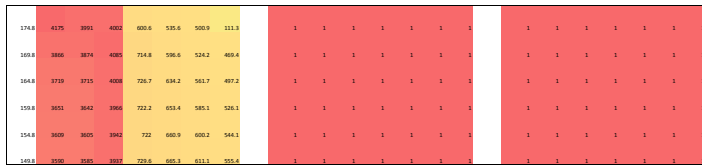
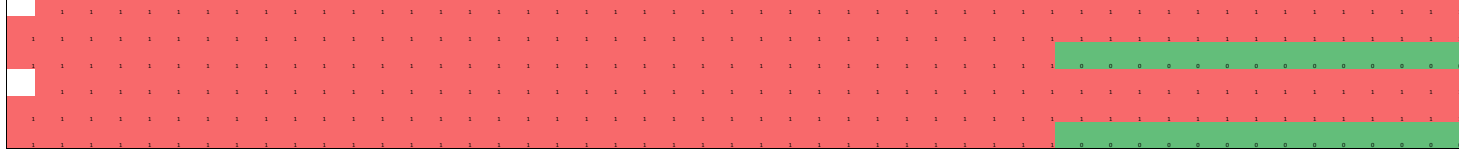
### STUDENT GATHERING DAYLIGHT CALCULATION POINTS FROM AGI (FC)



**EXCLUDE ALL POINTS GREATER THAN 600 FC AND LESS THAN 2 (THIS WILL EXCLUDE ALL EXTERIOR POINTS AND POINTS INSIDE OBJECTS)**



**FOR ALL POINTS "X" TO BE COUNTED (2 < X < 600) CHECK TO SEE IF THEY ARE GREATER THAN 25FC, IF SO MARK AS "I"**



## **Appendix B | Structural Calculations**

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# STRUCTURAL CALCULATION\_LIBRARY\_BEAMS

(sw of deck)		(roof load)		(sw of deck)		(roof load)		(sw of deck)		(roof load)		
1.2		1.6		1.2		1.6		1.2		1.6		
Total lb/ft		Total lb/ft		Total lb/ft		Total lb/ft		Total lb/ft		Total lb/ft		
100		1516.72304		100		1516.72304		100		1516.723		
PSF	20		1.6		20		1.6		20		1.6	
Span	ft	in	8.24306 98.91672		ft	in	8.24306 98.91672		ft	in	8.24306 98.91672	
Length	14				42				25.1667			
Mu	moment simple		24.773143 37.1597145		moment simple		222.958287 334.43743		moment simple		80.05299 120.0795	
Vu	10.6170613				31.8511838				19.08546			
Δ	moment simple		0.00672811 0.03364054 PASS		moment simple		0.89748955 0.18152232 PASS		moment simple		0.115701 0.082996 PASS	
live	I/360		0.46666667		I/360		1.4		I/360		1.4	
total	0.7				1.6				1.6			
total	0.46666667				1.6				1.6			
total	0.7				1.6				1.6			
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total	0.7				1.6				1.6			
total	0.7				1.6				1.6			
total	0.7				1.6				1.6			

# STRUCTURAL CALCULATION\_Library Girder

Girder/Beam Type	Original					Redesign				
	Length (ft)	lbs/ft	Weight	Beam Type	Length (ft)	lbs/ft	Weight			
W16x31	28	31	868	W24x62	28	62	1736			
W24x44	24	44	1056	W24x76	24	76	1874			
W24x54	27	54	1269	W24x62	27	62	1674			
W24x68	39	68	2652	W24x48	39	48	1044			
W24x84	33	84	2772	W36x65	33	65	1755			
W24x68	24	68	1632	W24x84	24	84	2016			
W16x26	26	26	676	W24x44	14	44	1166			
W16x31	29.42	31	912.02	W14x30	24.5	30	735			
W18x40	34.89	40	1395.6	W18x35	35	35	925			
W24x50	41.16	50	2058	W24x62	42	62	2604			
W24x60	42.17	60	2500.8	W24x68	48	68	3264			
W24x55	43.36	55	2384.8	W18x40	38.5	40	1540			
W24x55	44.55	55	2450.25	W16x31	25	31	775			
W24x84	45.72	94	4237.68	W12x22	12	22	264			
		<b>total</b>	<b>29546.01</b>			<b>total</b>	<b>24880</b>			

	Girder	Beams In	Self Weight	Length of Beam	Weight Of Beam	Roof Area	Self Weight	Live Load	Total Load (lbs)
1	W12x14	14	7	387.5	574	10945.5	57400	10874.6	
2	W14x30	30	12.25	1802	817	18274	81700	153848.8	
3	W16x31	31	12.5	387.5	575	12019.5	57500	106423.4	
4	W18x40	40	19.75	770	189	20592.5	18900	51751	
5	W16x35	35	17.5	62.5	1030.5	10117	103050	297020.4	
6	W12x14	14	7	387.5	530	8695.5	63000	180738.6	

Girder Size		PSF	(sw of deck + Beams)	(roof load)	Total lb/f	PSF	(sw of deck + Beams)	(roof load)	Total lb/f	
Lmax		1.2	39.2407407	1.6	100	394.61074	1.2	163.01652	100	900.6181E
Mu		moment	simple	371.8111		866.8061	moment	simple	1225.201915	
Vu		53.0873				448.5102				
Δ		moment	simple	Pass?	Δ	live	moment	simple	Pass?	Δ
live		0.0061534	0.03076688E PASS	1/360	1/240	1/360	0.00735926	0.017953 PASS	1/240	1/240
total		0.0074908	0.03740386E PASS	0.93333333	1.4	0.9	0.00670521	0.03026015 PASS	1.1	1.65
<b>Girder Size</b>		<b>W24x62</b>				<b>Girder Size</b>	<b>W36x135</b>			
Girder Size		PSF	(sw of deck + Beams)	(roof load)	Total lb/f	PSF	(sw of deck + Beams)	(roof load)	Total lb/f	
Lmax		1.2	42.25	1.6	100	640.38667	1.2	124.395833	100	7530.775
Mu		moment	simple	461.5464		361.4772	moment	simple	542.2158	
Vu		76.9244				90.36593				
Δ		moment	simple	Pass?	Δ	live	moment	simple	Pass?	Δ
live		0.0024295	0.02257734 PASS	1/360	1/240	1/360	0.0027226	0.01096128 PASS	1/240	1/240
total		0.0053589	0.02994338 PASS	0.8	1.2	1.3	0.00487445	0.0243727 PASS	0.8	1.2
<b>Girder Size</b>		<b>W24x76</b>				<b>Girder Size</b>	<b>W24x84</b>			

# STRUCTURAL CALCULATION\_STUDENT GATHERING

PSF	(sw of deck)	(roof load)	Total lb/ft	PSF	(sw of deck)	(roof load)	Total lb/ft
1.2	4.5	1.6	685.666667	1.2	4.5	1.6	685.666667

Span	ft	in	Span	ft	in
18.3333333	220		18.3333333	220	

Lmax	40.5	Lmax	30
40.5		30	

Mu	moment	simple	140.583094	Mu	moment	simple	77.1375
93.7220625	140.583094			51.425	77.1375		

Vu	13.88475	Vu	10.285
13.88475		10.285	

Δ	live	live	live	total	live	live	total
0.01637172	0.08185862	PASS	I/360	I/240	0.00835147	0.04175736	PASS
0.02005536	0.10027681	PASS	1.35	2.025	0.01023055	0.05115277	PASS

Beam size **W18x35**

PSF	(sw of deck)	(roof load)	Total lb/ft	PSF	(sw of deck)	(roof load)	Total lb/ft
1.2	4.5	1.6	685.666667	1.2	4.5	1.6	685.666667

Span	ft	in	Span	ft	in
18.3333333	220		18.3333333	220	

Lmax	35.55	Lmax	24
35.55		24	

Mu	moment	simple	108.318406	Mu	moment	simple	49.368
72.2122706	108.318406			32.912	49.368		

Vu	12.187725	Vu	8.228
12.187725		8.228	

Δ	live	live	live	total	live	live	total
0.01646783	0.08233916	PASS	I/360	I/240	0.00342076	0.01710381	PASS
0.02017309	0.10086547	PASS	1.185	1.7775	0.00419043	0.02095217	PASS

Beam size **W16x26** up from W12x16

PSF	(sw of deck)	(roof load)	Total lb/ft	PSF	(sw of deck)	(roof load)	Total lb/ft
1.2	4.5	1.6	685.666667	1.2	4.5	1.6	685.666667



## **Appendix B | HVAC Calculations**

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# MECHANICAL CALCULATION\_ASHRAE METHOD\_LIBRARY

## Atrium Roof Area (Replaced)

Total Area (ft <sup>2</sup> )	U
311	0.283723

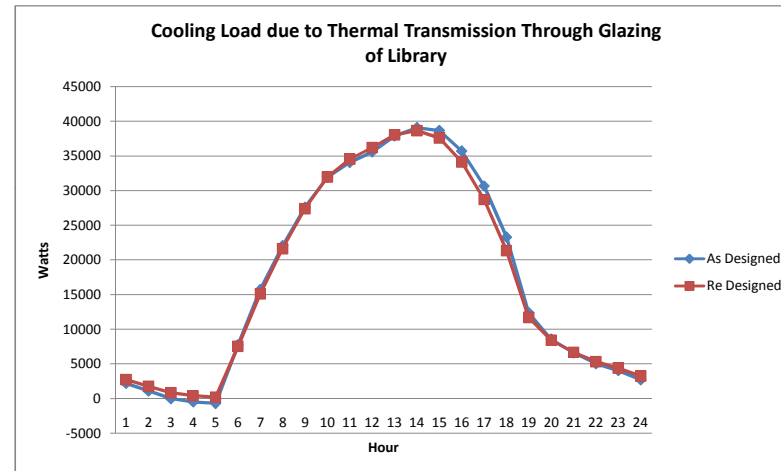
W/m<sup>2</sup> °C or Btu/hr-sq ft °F  
ASHRAE PG 23 (25)

## Atrium Clerestory Glazing Area As Designed

Glazing Type	Façade Direction	Total Area (ft <sup>2</sup> )	SHGC	U	SC
GL-1A+B	3	1362	0.38	1.55	0.44
GL-2A+B	3	3010	0.3078	1.55	0.35397

## Atrium Clerestory Glazing Area Re Designed

Glazing Type	Façade Direction	Total Area (ft <sup>2</sup> )	SHGC	U	SC
GL-1A+B	3	1362	0.31	1.187380755	0.3565
GL-2A+B	3	3010	0.2349	1.187380755	0.270135
Masonry Glass Skylight	Hor	311.00	0.56	2.7237408	0.45



## As Designed Load Roof Conduction (W)

July 40N Latitude																									
Hour		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		-42.44592	-50.6435	-58.8411	-67.0386	-67.0386	-67.0386	-42.4459	14.93703	88.71511	162.4932	228.0737	293.6542	334.6421	359.2347	359.2347	334.6421	293.6542	228.0737	154.2956	72.31998	23.13459	-1.4581	-17.8532	-34.2484

## As Designed Load Glazing Conduction (W)

July 40N Latitude																									
Hour		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	GL-1A+B	-819.3956	-1015.52	-1211.65	-1211.65	-1211.65	-1211.65	-1211.65	-1015.52	-819.396	-623.268	-231.013	-34.8852	357.37	357.37	553.4976	553.4976	357.37	357.37	161.2424	-231.013	-427.14	-623.268	-623.268	-819.396
	GL-2A+B	-1810.852	-2244.29	-2677.73	-2677.73	-2677.73	-2677.73	-2677.73	-2244.29	-1810.85	-1377.41	-510.535	-77.0958	789.7824	789.7824	1223.222	1223.222	789.7824	789.7824	356.3433	-510.535	-943.974	-1377.41	-1377.41	-1810.85
	<b>TOTAL</b>	<b>-2630.248</b>	<b>-3259.81</b>	<b>-3889.38</b>	<b>-3889.38</b>	<b>-3889.38</b>	<b>-3889.38</b>	<b>-3889.38</b>	<b>-3259.81</b>	<b>-2630.25</b>	<b>-2000.68</b>	<b>-741.548</b>	<b>-111.981</b>	<b>1147.152</b>	<b>1147.152</b>	<b>1776.719</b>	<b>1776.719</b>	<b>1147.152</b>	<b>1147.152</b>	<b>517.5857</b>	<b>-741.548</b>	<b>-1371.11</b>	<b>-2000.68</b>	<b>-2000.68</b>	<b>-2630.25</b>

## As Designed Load Glazing Transmission (W)

July 40N Latitude																									
Hour		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	GL-1A+B	1744.481	1577.456	1410.432	1243.407	1169.174	4212.737	7070.717	9112.131	10856.61	12155.69	12452.63	12749.56	13102.17	13529.01	13157.84	12100.02	10522.56	7887.282	4212.737	3321.938	2857.98	2523.93	2171.322	1930.064
	GL-2A+B	3101.484	2804.533	2507.582	2210.632	2078.654	7489.753	12570.91	16200.3	19301.79	21611.4	22139.31	22667.23	23294.12	24052.99	23393.1	21512.42	18707.88	14022.66	7489.753	5906.016	5081.154	4487.253	3860.357	3431.429
	<b>TOTAL</b>	<b>4845.965</b>	<b>4381.989</b>	<b>3918.014</b>	<b>3454.039</b>	<b>3247.827</b>	<b>11702.49</b>	<b>19641.62</b>	<b>25312.43</b>	<b>30158.4</b>	<b>33767.09</b>	<b>34591.94</b>	<b>35416.79</b>	<b>36396.29</b>	<b>37582</b>	<b>36550.95</b>	<b>33612.44</b>	<b>29230.45</b>	<b>21909.95</b>	<b>11702.49</b>	<b>9227.954</b>	<b>7939.134</b>	<b>7011.183</b>	<b>6031.68</b>	<b>5361.493</b>

## Re Designed Load Glazing Conduction (W)

July 40N Latitude																									
Hour		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	GL-1A+B	-627.6998	-777.944	-928.188	-928.188	-928.188	-928.188	-928.188	-777.944	-627.7	-477.456	-176.968	-26.7239	273.764	273.764	424.008	424.008	273.764	273.764	123.5201	-176.968	-327.212	-477.456	-477.456	-627.7
	GL-2A+B	-1387.207	-1719.24	-2051.28	-2051.28	-2051.28	-2051.28	-2051.28	-1719.24	-1387.21	-1055.17	-391.096	-59.0594	605.0145	605.0145	937.0515	937.0515	605.0145	605.0145	272.9775	-391.096	-723.133	-1055.17	-1055.17	-1387.21
	Masonry Glass Block	-407.4809	-486.177	-564.874	-643.571	-643.571	-643.571	-407.481	143.3955	851.6651	1559.935	2189.508	2819.081	3212.564	3448.654	3448.654	3212.564	2819.081	2189.508	1481.238	694.2718	222.0921	-13.9978	-171.391	-328.784
	<b>TOTAL</b>	<b>-2014.907</b>	<b>-2497.19</b>	<b>-2979.47</b>	<b>-2979.47</b>	<b>-2979.47</b>	<b>-2979.47</b>	<b>-2979.47</b>	<b>-2497.19</b>	<b>-2014.91</b>	<b>-1532.63</b>	<b>-568.064</b>	<b>-85.7833</b>	<b>878.7785</b>	<b>878.7785</b>	<b>1361.059</b>	<b>1361.059</b>	<b>878.7785</b>	<b>878.7785</b>	<b>396.4976</b>	<b>-568.064</b>	<b>-1050.35</b>	<b>-1532.63</b>	<b>-1532.63</b>	<b>-2014.91</b>

## Re Designed Load Glazing Transmission (W)

July 40N Latitude																									
Hour		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	GL-1A+B	1413.426	1278.098	1142.77	1007.442	947.2963	3413.274	5728.887	7382.897	8796.323	9848.875	10089.46	10330.04	10615.73	10961.57	10660.84	9803.765	8525.667	6390.491	3413.274	2691.525	2315.613	2044.957	1759.265	1563.791
	GL-2A+B	2366.922	2140.301	1913.681	1687.061	1586.341	5715.864	9593.587	12363.39	14730.31	16492.91	16895.79	17298.67	17777.09	18356.23	17852.63	16417.37	14277.07	10701.51	5715.864	4507.223	3877.723	3424.482	2946.062	2618.722
	Masonry Glass Block	988.1353	858.1175	780.1068	702.0961	650.089	1391.191	2782.381	4381.6	5902.808	7163.981	8152.116	8685.189	8802.205	8477.161	7736.059	6552.897	5031.689	3393.465	2171.297	1807.247	1560.214	1391.191	1235.169	1105.151
	<b>TOTAL</b>	<b>4768.483</b>	<b>4276.517</b>	<b>3836.558</b>	<b>3396.599</b>	<b>3183.726</b>	<b>10520.33</b>	<b>18104.86</b>	<b>24127.89</b>	<b>29429.44</b>	<b>33505.77</b>	<b>35137.37</b>	<b>36313.9</b>	<b>37195.03</b>	<b>37794.97</b>	<b>36249.53</b>	<b>32774.03</b>	<b>27834.43</b>	<b>20485.46</b>	<b>11300.44</b>	<b>9005.995</b>	<b>7753.55</b>	<b>6860.63</b>	<b>5940.496</b>	<b>5287.664</b>

<b>As Designed</b>	2173.271	1071.531	-30.2085	-502.381	-708.593	7746.069	15709.8	22067.56	27616.86	31928.91	34078.47	35598.46	37878.08	39088.39	38686.9	35723.8	30671.25	23285.17	12374.37	8558.726	6591.154	5009.044	4013.145	2696.997
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<b>Re Designed</b>	2753.576	1779.329	857.0895	417.1306	204.2576	7540.86	15125.39	21630.7	27414.53	31973.14	34569.3	36228.12	38073.81	38673.74	37610.59	34135.09	28713.2	21364.24	11696.93	8437.931	6703.204	5328.004	4407.87	3272.757
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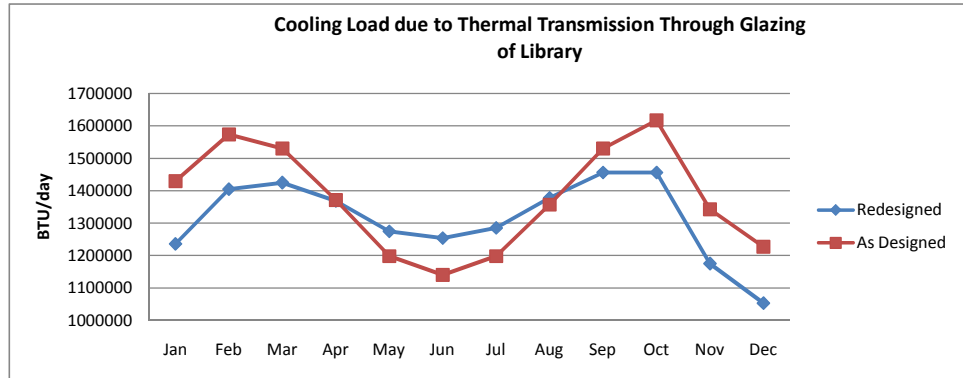
# MECHANICAL CALCULATION\_NREL METHOD\_LIBRARY

## Library As-design Glazing Properties

Glazing Type	Façade Direction	Total Area (ft <sup>2</sup> )	SHGC
GL-1A+B	S	1362	0.38
GL-2A+B	S	3010	0.3078

## Library Redesign Glazing Properties

Glazing Type	Façade Direction	Total Area (ft <sup>2</sup> )	SHGC
GL-1A+B	S	1362	0.31
GL-2A+B	S	3010	0.2349
Masonry Glass Skylight	Hor	311.00	0.56



S	990	1090	1060	950	830	790	830	940	1060	1120	930	850	950
S	990	1090	1060	950	830	790	830	940	1060	1120	930	850	950

Asdesigned	1429597.62	1574001.42	1530680	1371836.1	1198551.54	1140790.02	1198552	1357396	1530680	1617323	1342955	1227432	1371836
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S	990	1090	1060	950	830	790	830	940	1060	1120	930	850	950
S	990	1090	1060	950	830	790	830	940	1060	1120	930	850	950
H	680	1000	1310	1700	1940	2080	2000	1820	1490	1100	720	540	1260

1117976.31	1230903.21	1197025	1072805.55	937293.27	892122.51	937293.3	1061513	1197025	1264781	1050220	959878.7	1072806
118428.8	174160	228149.6	296072	337870.4	362252.8	348320	316971.2	259498.4	191576	125395.2	94046.4	219441.6

Redesigned total	1236405.11	1405063.21	1425175	1368877.55	1275163.67	1254375.31	1285613	1378484	1456524	1456357	1175615	1053925	1292247
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# MECHANICAL CALCULATION\_ASHRAE METHOD\_STUDENT GATHERING

## Atrium Roof Area (Replaced)

Total Area (ft <sup>2</sup> )	U
5258	0.283723

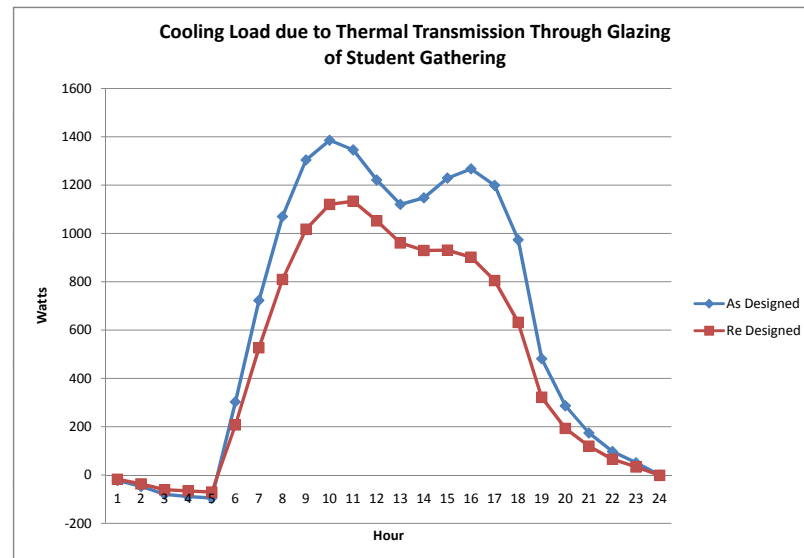
W/m<sup>2</sup> °C or Btu/hr-sq ft °F  
ASHRAE PG 23 (25)

## Atrium Clerestory Glazing Area As Designed

Glazing Type	Façade Direction	Total Area (ft <sup>2</sup> )	SHGC	U	SC
GL-1	1	3433	0.38	1.55	0.44
GL-1	3	1847	0.38	1.55	0.44
GL-1	2	378	0.38	1.55	0.44
GL-1A+B	1	3507	0.31	1.55	0.4532
GL-1A+B	2	729	0.31	1.55	0.4532
GL-2A+B and GL-INT	3	1873	0.051076	1.55	0.4532

## Atrium Clerestory Glazing Area Re Designed

Glazing Type	Façade Direction	Total Area (ft <sup>2</sup> )	SHGC	U	SC
GL-1	1	3433	0.25	1.220890411	0.2875
GL-1	3	1847	0.25	1.220890411	0.2875
GL-1	2	378	0.25	1.220890411	0.2875
GL-1A+B	1	3507	0.25	1.220890411	0.2875
GL-1A+B	2	729	0.25	1.220890411	0.2875
GL-2A+B and GL-INT	3	1873	0.051076	1.55	0.0587374
Kalwall	5	5258.00	0.09	0.283723	0.1035



## As Designed Load Roof Conduction (W)

July 40N Latitude		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Hour		-717.6227	-856.217	-994.811	-1133.41	-1133.41	-1133.41	-717.623	252.5366	1499.884	2747.232	3855.986	4964.739	5657.71	6073.493	6073.493	5657.71	4964.739	3855.986	2608.638	1222.696	391.1308	-24.6518	-301.84	-579.029

## As Designed Load Glazing Conduction (W)

July 40N Latitude		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Hour																									
GL-1		-2065.334	-2559.69	-3054.04	-3054.04	-3054.04	-3054.04	-2559.69	-2065.33	-1570.98	-582.281	-87.9302	900.7718	900.7718	1395.123	1395.123	900.7718	900.7718	406.4208	-582.281	-1076.63	-1570.98	-1570.98	-2065.33	
GL-1		-1111.178	-1377.14	-1643.11	-1643.11	-1643.11	-1643.11	-1377.14	-1111.18	-845.21	-313.275	-47.3076	484.6273	484.6273	750.5948	750.5948	484.6273	484.6273	218.6598	-313.275	-579.243	-845.21	-845.21	-1111.18	
GL-1		-227.4094	-281.841	-336.273	-336.273	-336.273	-336.273	-281.841	-227.409	-172.977	-64.1137	-9.6818	99.18198	99.18198	153.6139	153.6139	99.18198	99.18198	44.75009	-64.1137	-118.546	-172.977	-172.977	-227.409	
GL-1A+B		-2109.854	-2614.86	-3119.87	-3119.87	-3119.87	-3119.87	-2614.86	-2109.85	-1604.85	-594.833	-89.8256	920.1884	920.1884	1425.195	1425.195	920.1884	920.1884	415.1814	-594.833	-1099.84	-1604.85	-1604.85	-2109.85	
GL-1A+B		-438.5752	-543.551	-648.527	-648.527	-648.527	-648.527	-543.551	-438.575	-333.599	-123.648	-18.672	191.2795	191.2795	296.2553	296.2553	191.2795	191.2795	86.30375	-123.648	-228.624	-333.599	-333.599	-438.575	
GL-2A+B and GL-INT		-1126.819	-1396.53	-1666.24	-1666.24	-1666.24	-1666.24	-1396.53	-1126.82	-857.108	-317.685	-47.9736	491.4493	491.4493	761.1608	761.1608	491.4493	491.4493	221.7379	-317.685	-587.396	-857.108	-857.108	-1126.82	
<b>TOTAL</b>		<b>-7079.169</b>	<b>-8773.61</b>	<b>-10468.1</b>	<b>-10468.1</b>	<b>-10468.1</b>	<b>-10468.1</b>	<b>-8773.61</b>	<b>-7079.17</b>	<b>-5384.72</b>	<b>-1995.84</b>	<b>-301.391</b>	<b>3087.498</b>	<b>3087.498</b>	<b>4781.943</b>	<b>4781.943</b>	<b>3087.498</b>	<b>3087.498</b>	<b>1393.054</b>	<b>-1995.84</b>	<b>-3690.28</b>	<b>-5384.72</b>	<b>-5384.72</b>	<b>-7079.17</b>	

## As Designed Load Glazing Transmission (W)

July 40N Latitude		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Hour																									
GL-1		841.9914	841.9914	420.9957	420.9957	420.9957	17681.82	35784.63	49537.16	57957.07	59220.06	53887.45	42380.23	30452.02	25680.74	21611.11	18523.81	15436.51	11507.22	6595.599	4490.621	3508.297	2666.306	1824.315	1262.987
GL-1		1434.508	1208.007	981.5058	679.504	453.0027	2114.012	3775.022	5209.531	6417.538	7399.043	8531.55	13816.58	21140.12	27859.66	32087.69	32842.69	29973.68	22348.13	10947.56	7399.043	4983.029	3548.521	2642.515	1887.511
GL-1		293.581	247.2261	200.8712	139.0647	92.7098	432.6457	772.5817	1066.163	1313.389	1514.26	1653.325	1807.841	1807.841	2240.487	3692.94	5253.555	6227.008	5794.363	2487.713	1606.97	1066.163	772.5817	540.8072	386.2908
GL-1A+B		885.9452	885.9452	442.9726	442.9726	442.9726	18604.85	37652.67	52123.11	60982.56	62311.48	56700.49	44592.57	32041.68	27021.33	22739.26	19490.79	16242.33	12107.92	6939.904	4725.041	3691.438	2805.493	1919.548	1328.918
GL-1A+B		583.1778	491.0971	399.0164	276.2421	184.1614	859.4199	1534.678	2117.856	2608.953	3007.97	3468.373	5616.923	8594.199	11325.93	13044.77	13351.7	12185.35	9085.296	4450.567	3007.97	2025.775	1442.598	1074.275	767.3392
GL-2A+B and GL-INT		1498.343	1261.762	1025.182	709.7414	473.1609	2208.084	3943.008	5441.35	6703.113	7728.295	8438.036	9226.638	9226.638	11434.72	18847.58	26812.45	31780.64	29572.56	12696.48	8201.456	5441.35	3943.008	2760.105	1971.504
<b>TOTAL</b>		<b>5537.547</b>	<b>4936.029</b>	<b>3470.544</b>	<b>2668.52</b>	<b>2067.003</b>	<b>41900.83</b>	<b>83462.59</b>	<b>115495.2</b>	<b>135982.6</b>	<b>141181.1</b>	<b>132679.2</b>	<b>117440.8</b>	<b>103262.5</b>	<b>105562.9</b>	<b>112023.3</b>	<b>116275</b>	<b>111845.5</b>	<b>90415.48</b>	<b>44117.83</b>	<b>29431.1</b>	<b>20716.05</b>	<b>15178.51</b>	<b>10761.57</b>	<b>7604.55</b>

## Re Designed Load Glazing Conduction (W)

July 40N Latitude		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Hour																									
GL-1		-1626.804	-2016.19	-2405.58	-2405.58	-2405.58	-2405.58	-2016.19	-1626.8	-1237.42	-458.646	-69.2601	709.512	709.512	1098.898	1098.898	709.512	709.512	320.126	-458.646	-848.032	-1237.42	-1237.42	-1626.8	
GL-1		-875.2426	-1084.74	-1294.23	-1294.23	-1294.23	-1294.23	-1084.74	-875.243	-665.748	-246.758	-37.2629	381.727	381.727	591.2219	591.2219	381.727	381.727	172.2321	-246.758	-456.253	-665.748	-665.748	-875.243	
GL-1		-179.1238	-221.998	-264.873	-264.873	-264.873	-264.873	-221.998	-179.124	-136.249	-50.5005	-7.62608	78.12279	78.12279	120.9972	120.9972	78.12279	78.12279	35.24836	-50.5005	-93.3749	-136.249	-136.249	-179.124	
GL-1A+B		-1661.871	-2059.65	-2457.43	-2457.43	-2457.43	-2457.43	-2059.65	-1661.87	-1264.09	-468.533	-70.753	724.8059	724.8059	1122.585	1122.585	724.8059	724.8059	327.0264	-468.533	-866.312	-1264.09	-1264.09	-1661.87	
GL-1A+B		-345.4531	-428.139	-510.826	-510.826	-510.826	-510.826	-428.139	-345.453	-262.767	-97.3938	-14.7074	150.6654	150.6654	233.3518	233.3518	150.6654	150.6654	67.97898	-97.3938	-180.08	-262.767	-262.767	-345.453	
GL-2A+B and GL-INT		-1126.819	-1396.53	-1666.24	-1666.24	-1666.24	-1666.24	-1396.53	-1126.82	-857.108	-317.685	-47.9736	491.4493	491.4493	761.1608	761.1608	491.4493	491.4493	221.7379	-317.685	-587.396	-857.108	-857.108	-1126.82	
Kalwall		-717.6227	-856.217	-994.811	-1133.41	-1133.41	-1133.41	-717.623	252.5366	1499.884	2747.232	3855.986	4964.739	5657.71	6073.493	6073.493	5657.71	4964.739	3855.986	2608.638	1222.696	391.1308	-24.6518	-301.84	-579.029
<b>TOTAL</b>		<b>-5815.314</b>	<b>-7207.25</b>	<b>-8599.18</b>	<b>-8599.18</b>	<b>-8599.18</b>	<b>-8599.18</b>	<b>-7207.25</b>	<b>-5815.31</b>	<b>-4423.38</b>	<b>-1639.52</b>	<b>-247.583</b>	<b>2536.282</b>	<b>2536.282</b>	<b>3928.215</b>	<b>3928.215</b>	<b>2536.282</b>	<b>2536.282</b>	<b>1144.35</b>	<b>-1639.52</b>	<b>-3031.45</b>	<b>-4423.38</b>	<b>-4423.38</b>	<b>-5815.31</b>	

## Re Designed Load Glazing Transmission (W)

July 40N Latitude		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Hour																									
GL-1		550.1648	550.1648	275.0824	275.0824	275.0824	11553.46	23382.01	32368.03	37869.68	38694.93	35210.55	27691.63	19897.63	16780.03	14120.9	12103.63	10086.36	7518.919	4309.625	2934.212	2292.353	1742.189	1192.024	825.2473
GL-1		937.3208	789.3228	641.3248	443.9941	295.9961	1381.315	2466.634	3403.955	4193.277	4834.602	5278.596	5771.923	5771.923	7153.238	11790.51	16773.11	19881.07	18499.75	7942.561	5130.598	3403.955	2466.634	1726.644	1233.317
GL-1		191.8285	161.5398	131.2511	90.86614	60.57743	282.6947	504.8119	696.6404	858.1802	989.4313	1140.875	1847.612	2826.947	3725.512	4290.901	4391.863	4008.206	2988.486	1463.954	989.4313	666.3517	474.5232	353.3683	252.4059
GL-1A+B		562.0239	562.0239	281.012	281.012	281.012	11802.5	23886.02	33065.74	38685.98	39529.01	35969.53	28288.54	20326.53	17141.73	14425.28	12364.53	10303.77	7680.993	4402.521	2997.461</				

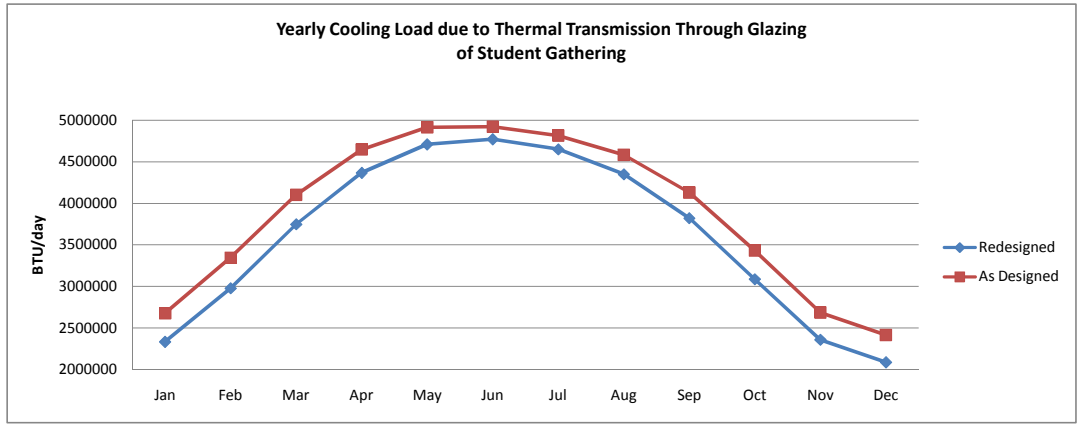
# MECHANICAL CALCULATION\_NREL METHOD\_SG

## Atrium Clerestory Glazing Area

Glazing Type	Façade Direction	Total Area (ft <sup>2</sup> )	SHGC
GL-1	E	3433	0.38
GL-1	W	1847	0.38
GL-1	S	378	0.38
GL-1A+B	E	3507	0.31
GL-1A+B	S	729	0.31
GL-2A+B and GL-INT	W	1873	0.051076

## Atrium Clerestory Glazing Area

Glazing Type	Façade Direction	Total Area (ft <sup>2</sup> )	SHGC
GL-1	E	3433	0.25
GL-1	W	1847	0.25
GL-1	S	378	0.25
GL-1A+B	E	3507	0.25
GL-1A+B	S	729	0.25
GL-2A+B and GL-INT	W	1873	0.051076
Kalwall	HOR	5258.00	0.09



E	410	560	720	870	960	1010	1000	940	800	630	410	340	720
W	410	550	710	850	950	1020	1020	930	790	610	400	330	720
S	990	1090	1060	950	830	790	830	940	1060	1120	930	850	950
E	410	560	720	870	960	1010	1000	940	800	630	410	340	720
S	990	1090	1060	950	830	790	830	940	1060	1120	930	850	950
W	410	550	710	850	950	1020	1020	930	790	610	400	330	720

	1506777.3	1985119.3	2583047	3085305.9	3372311.1	3420145.3	3324477	3085306	2654798	2080788	1530694	1339358	2511296
	665334	698600.7	657941.4	532267.2	417681.9	362237.4	380718.9	469430.1	587711.7	657941.4	643156.2	628371	558141.3
	502440.9692	661946.0388	861327.4	1028807.699	1124510.741	1140461.25	1108560	1028808	885253.1	693847.1	510416.2	446614.2	837401.6
<b>As-designed Total</b>	<b>2674552.269</b>	<b>3345666.039</b>	<b>4102316</b>	<b>4646380.799</b>	<b>4914503.741</b>	<b>4922843.95</b>	<b>4813756</b>	<b>4583544</b>	<b>4127763</b>	<b>3432576</b>	<b>2684267</b>	<b>2414343</b>	<b>3906838</b>

E	410	560	720	870	960	1010	1000	940	800	630	410	340	720
W	410	550	710	850	950	1020	1020	930	790	610	400	330	720
S	990	1090	1060	950	830	790	830	940	1060	1120	930	850	950
E	410	560	720	870	960	1010	1000	940	800	630	410	340	720
S	990	1090	1060	950	830	790	830	940	1060	1120	930	850	950
W	410	550	710	850	950	1020	1020	930	790	610	400	330	720
T	680	1000	1310	1700	1940	2080	2000	1820	1490	1100	720	540	1260

	392772.6	553667.4	780813	1012690.8	1164121.2	1220907.6	1178318	1041084	837599.4	600989.4	411701.4	335986.2	795009.6
	1093050	1440050	1873800	2238150	2446350	2481050	2411650	2238150	1925850	1509450	1110400	971600	1821750
	498150	523057.5	492615	398520	312727.5	271215	285052.5	351472.5	440032.5	492615	481545	470475	417892.5
	351171.6692	462654.7388	602008.6	719065.7989	785955.6407	797103.948	774807.3	719065.8	618731	484951.4	356745.8	312152.6	585286.1
<b>Redesigned Total</b>	<b>2335144.269</b>	<b>2979429.639</b>	<b>3749237</b>	<b>4368426.599</b>	<b>4709154.341</b>	<b>4770276.55</b>	<b>4649828</b>	<b>4349772</b>	<b>3822213</b>	<b>3088006</b>	<b>2360392</b>	<b>2090214</b>	<b>3619938</b>