Loyola/Notre Dame Library

Expansion & Renovation

Baltimore, MD

Thesis Mechanical Breadth

Solar Shading Analysis

Mechanical Breadth

Solar Shading Analysis

The newly constructed curtain wall façade for floors two and three was designed to have three layers of horizontal solar shades per floor attached at seems in the glass as seen below at the east entrance of the building:

In an effort to save energy, it is difficult to say if these aluminum sunshades are actually shading the interior gallery spaces (18,750 SF, excluding lower level) or if they merely exist as an architectural attraction around the perimeter of the addition.

Mechanical Breadth

The objective of this analysis will be to configure a way to

- Find alternative ways to save energy and cost of energy per year
- Minimize solar heat gain energy to save on the cost of cooling each floor
- Allow for indirect light to enter space with the right balance of
    - Solar shading
    - Use of light shelves

First, solar angles were calculated to determine the corresponding shading lengths for each month of the year between the hours of 7 AM and 5:00 PM using a solar angle calculation website: http://www.susdesign.com/sunangle/

Sun Angle Calculations

[See Appendix D.1 for Solar Angle Calculations]

INPUTS			
Longitude	76°40"0' West	**Time**	7:00 AM-5:00 PM
Latitude	39°11"0' North	**Time Zone**	R (GMT – 5:00)
Date	Jan. 15th-Dec. 15th	**Time Basis**	Clock Time
Year	2008	**Daylight Savings**	None
Elevation	10 Meters	**Zero Azimuth**	South

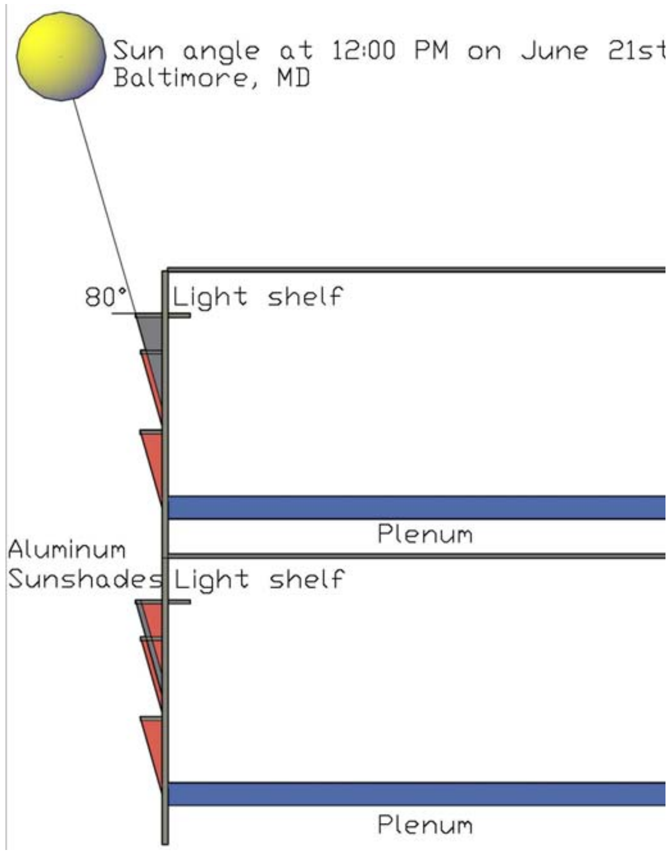
Outputs			
Altitude Angle	See Appendix D.4	**Declination**	11:50 AM
Azimuth Angle	See Appendix D.4	**Equation of Time (EOT)**	-0.11
Clock Time	11:50 AM	**Time of Sunrise**	*Varies
Solar Time	Declination-EOT	**Time of Sunset**	*Varies
Angles calculated from http://www.susdesign.com/sunangle/			

Mechanical Breadth

1. The existing design provided solar shading on the building façade, but not in appropriate places. Aluminum sunshades on the existing building range from 1'-2 ¾" to 1'-0" in width, not allowing for much shading. In addition to this, the sunshades are also shading spandrel and fritted glass in some areas. This may be saving some energy, but this is certainly not allowing for solar shading for the building occupants. Below are comparison calculations that determined adequate solar shade lengths between the existing and the proposed design. See existing shade lengths and corresponding drawing (figure A) below:

Existing Southern Façade				
Overhead Length (Ft)		**1**	**1.23**	**3**
Shade Length (Ft)	Jan	0.57	0.70	1.70
	Feb	0.78	0.96	2.33
	Mar	1.15	1.41	3.44
	Apr	1.79	2.21	5.38
	May	2.73	3.36	8.18
	Jun	**3.51**	**4.31**	**10.52**
	Jul	3.08	3.78	9.23
	Aug	2.09	2.58	6.28
	Sep	1.35	1.66	4.06
	Oct	0.90	1.11	2.70
	Nov	0.63	0.77	1.88
	Dec	0.52	0.64	1.56
	Average	**1.55**	**1.90**	**4.64**

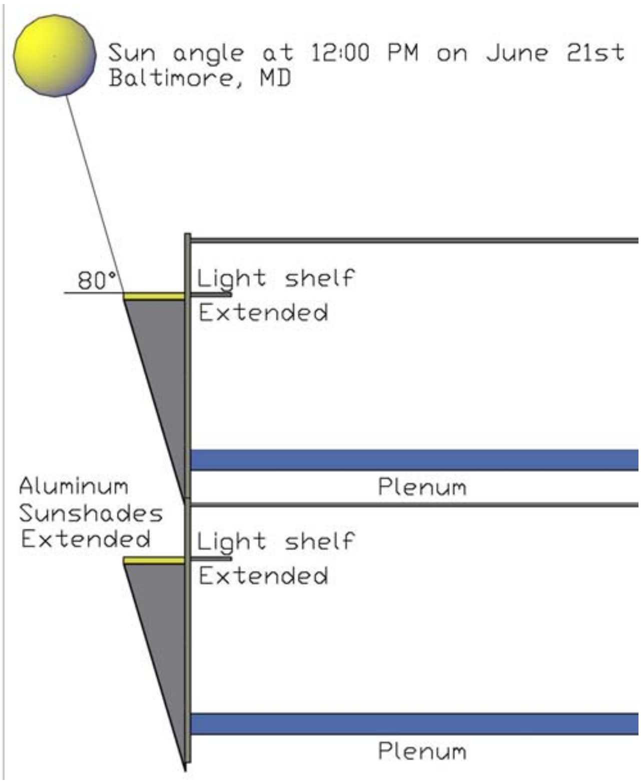
Figure A: Existing Southern Facade



Mechanical Breadth

2. The proposed design replaces the existing sunshade with a longer and wider style shade manufactured by Kawneer. The new length will allow the shades to shade the same area of the window in the summer while reducing the amount of solar heat gain entering through the glass. Reducing the number of shades also eliminates redundant shading. Though these shades may be a bit more expensive, fewer are needed to make up for the upfront cost. In addition, over time, these shades will be saving energy for summer cooling equipment, so this makes the investment a justifiable one. The light shelf, opposite of the sunshade has also been lengthened in the re-design. This will be discussed in Section E (Lighting Breadth) of this report.

Figure B: Proposed Southern Facade



Proposed Southern Façade				
Overhead Length (Ft)		**3**	**3**	**3**
Shade Length (Ft)	Jan	1.70	1.70	1.70
	Feb	2.33	2.33	2.33
	Mar	3.44	3.44	3.44
	Apr	5.38	5.38	5.38
	May	8.18	8.18	8.18
	Jun	**10.52**	**10.52**	**10.52**
	Jul	9.23	9.23	9.23
	Aug	6.28	6.28	6.28
	Sep	4.06	4.06	4.06
	Oct	2.70	2.70	2.70
	Nov	1.88	1.88	1.88
	Dec	1.56	1.56	1.56
	Average	**4.64**	**4.64**	**4.64**

[The last column of three foot overhead length remains unchanged shading the first floor]

Mechanical Breadth

3. Below are solar heat gain calculations for the existing sunshades vs. the proposed sunshade design.

Existing Aluminum Sunshades

Southern Façade Area = Length of Shade X Length of Wall
=1.55 Ft X 112 Ft
= 173.05 SF at 1'-0", 212.85 SF at 1'-2 ¾", & 519.14 at 3'-0"

Total Shade Area = Southern Façade Area X Num. of Stories
= (173.05 SF X 2 Stories) = 346.1 SF (at 1'-0")
= (212.85 SF X 2 Stories) = 425.70 SF (at 1'2 ¾")
= (519.14 SF X 1 Story) = 519.14 SF (at 3'-0")

Total Window Area = Length of wall X Height of Glass
= 112 Ft X 10'-0" (clear glass)
= 1,120 SF on 1st Floor & 1,792 SF on 2nd and 3rd Floors (7'0" High Glass)

Area of Total Glass = 2,912 SF

Shade Ratio = Total Shade Area/Total Window Area
= 346.09 SF/2,912 SF = 11.9 %
= 425.70 SF/2,912 SF = 14.6%
= 519.14 SF/2,912 SF = 17.8%

Solar Heat Gain = (1-Asx)Atx*Fx at 1'-0", 1'2 ¾", and 3' Overhangs
(where Asx= Shade length X # of Stories X Length of Wall/Tot Clear Glass Win Area)X # of Clear days)

Southern Facade Area		173.05	212.85	519.14
Total Shade Area		346.09	425.70	519.14
Total Window Area (Excluding non-clear glass) (All Floors Excluding Lower Level)		2912	Excluding spandrel & fritted glass	
Shade Ratio		0.119	0.146	0.178
			Total Shade Ratio	**44.33%**
Solar Heat Gain (Btu) = (1-Asx)Atx*Fx **(See page 7 for Results)**				
South @ 95F, Reg. Double Glass				
Asx	Area of Shade (Shade length*# of stories*Length of Wall/Total Window Area)			
Atx	Area of Total Glass (SF)	2912	2912	2912
Fx	Solar Heat Gain Factor	75	75	75
Fn	North Solar Heat Gain Factor	29	29	29

Mechanical Breadth

Proposed Aluminum Sunshades

Southern Façade Area = Length of Shade X Length of Wall
=4.64 Ft X 112 Ft
= 519.14 SF at 3'-0", 519.14 SF at 3'-0", & 519.14 at 3'-0"

Total Shade Area = Southern Façade Area X Num. of Stories
= (519.4 SF X 1 Story) = 519.14 SF (at 3'-0")
= (519.14 SF X 1 Story) = 519.14 SF (at 3'-0")
= (519.14 SF X 1 Story) = 519.14 SF (at 3'-0")

Total Window Area = Length of wall X Height of Glass
= 112 Ft X 10'-0" (clear glass)
= 1,120 SF on 1^{st} Floor & 1,792 SF on 2^{nd} and 3^{rd} Floors (7'0" High Glass)

Area of Total Glass = 2,912 SF

Shade Ratio = Total Shade Area/Total Window Area
= 519.14 SF/2,912 SF = 17.8 %
= 519.14 SF/2,912 SF = 17.8%
= 519.14 SF/2,912 SF = 17.8%

Solar Heat Gain = (1-Asx)Atx*Fx at 3'-0", 3'-0", and 3'-0" Overhangs
(where Asx= Shade length X # of Stories X Length of Wall/Tot Clear Glass Win Area)X # of Clear days)

Southern Facade Area (Length of Shade*Length of Wall)		519.14	519.14	519.14
Total Shade Area (Southern Façade Area*# of Stories)		519.14	519.14	519.14
Total Window Area (Excluding non-clear glass) (All Floors Excluding Lower Level)		2912	Excluding spandrel & fritted glass	
Shade Ratio		0.178	0.178	0.178
			Total Shade Ratio	**53.48%**
Solar Heat GainX (Btu) = (1-Asx)Atx*Fx **(See page 7 for Results)**				
South @ 95F, Reg. Double Glass				
Asx	Area of Shade (Shade length*# of stories*Length of Wall/Total Window Area)			
Atx	Area of Total Glass (SF)			3024
Fx	Solar Heat Gain Factor			75
Fn	North Solar Heat Gain Factor			29

The existing building façade's shade ratio was 44.33%, but some of that shading was done over decorative glass, so that percent of shading may be reduced even further. A total of 9.15% of shading was added with the new three foot sunshade design.

Mechanical Breadth

Energy Savings Comparison

Solar Heat Gain with Existing Shades				
Overhead Length		**1**	**1.23**	**3**
Jan.		1594748	1653442	1700321
Feb.		1538171	1618647	1682924
Mar.		1439394	1557899	1652550
Apr.		1265252	1450802	1599001
May		1013859	1296196	1521698
June		804819	1167636	1457418
July		1035461	1393564	1679582
Aug.		1332174	1576043	1770822
Sept.		1902732	2095104	2248752
Oct.		2258394	2397920	2509360
Nov.		1776052	1849028	1907314
Dec.		1607212	1661107	1704154
Total		**35,136,537**	**19,717,389**	**21,433,898**
Total Gain	**76,287,823.95**		**BTU**	

Solar Heat Gain with Proposed Shades				
Overhead Length		**3**	**3**	**3**
Jan.		1632861	1632861	1632861
Feb.		1590428	1590428	1590428
Mar.		1516346	1516346	1516346
Apr.		1385739	1385739	1385739
May		1197195	1197195	1197195
June		1040414	1040414	1040414
July		1267996	1267996	1267996
Aug.		1490531	1490531	1490531
Sept.		2027649	2027649	2027649
Oct.		2348995	2348995	2348995
Nov.		1823439	1823439	1823439
Dec.		1642209	1642209	1642209
Total		**18,963,801**	**18,963,801**	**18,963,801**
Total Gain	**56,891,404.33**		**BTU**	

19,396,419.62 BTU's SAVED/YEAR

Mechanical Breadth

4. Total cooling loads were also calculated in TRANE Trace software to verify if actual energy savings exist including other loads besides the natural sun alone. Two alternatives were compared.

- **Alternative 1:** Existing façade (with 3' overhang above the first floor and 1' and 1.23' wide solar shades along the second and third floor facades)
- **Alternative 2:** Proposed façade (with 3' overhang above first floor and 3' wide solar shades along the second and third floor facades
- **Alternative 3:** Incorporate an enthalpy wheel inside new air handling unit

Calculations to verify the total cooling capacity provided by James Posey Associates were performed in TRACE 700 by inputting the design criteria along with the necessary room dimensions for each floor (assuming each floor counts as one room since the floor plans are open gallery spaces which serve as study rooms).

Alternative 1: Existing Building Design Criteria *(As calculated and provided by James Posey Associates)*	
Interior	Summer - 75°F Winter - 70° F
Exterior	Summer - 95° F Winter - 0° F
Interior Load	Lighting – 1.5 Watts/SF Miscellaneous – 1.0 Watts/SF
Ventilation Load	15 CFM of outside air per person
People Density	50 SF per person
Wall "U" coefficient	0.28 BTU/(Hr)(SF)(°F)
Roof "U" coefficient	0.08 BTU/(HR)(SF)(°F)
Glass transmission coefficient	0.76 BTU/(HR)(SF)(°F)
Glass solar factor	0.75 BTU/(HR)(SF)(°F)
Total Cooling Capacity (BY DESIGN)	**1,356,000 btu/(HR)(SF)(°F) 113 Tons**

Mechanical Breadth

In **Alternative 2**, the length of the solar shades was changed to three feet to eliminate some of the sun's energy in hopes to reduce the amount of cooling while still providing an adequately day lighted space. The existing space is already a rather luminous space by sun penetration alone. Hopefully the sunshade width change will not sacrifice daylight circulation through these spaces. Light shelves will remain in place (but longer in length) on the second and third floors to aid in indirect daylight distribution.

[All cooling coil peak results from TRACE analysis may be found in Appendix D.2-3]

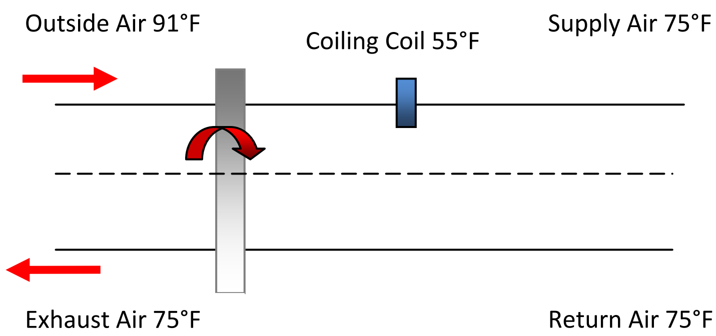
After completing the second alternative, 21tons of total cooling energy was conserved for the first, second, and third floors of the addition. These results are acceptable. Since the existing sunshades were not supplying very much shade or energy savings, it is a safe re-design analysis to lengthen the shades by two to three feet. This will eliminate much of the distracting direct sunlight also. The original design also provides light shelves to do this on floors two and three. A longer, louvered sunshade will only enhance this idea while balancing the right amount of foot-candles and BTU's coming in and out. Choosing a sunshade with louvers may also be a consideration since they still filter in some direct daylight.

If more energy conservation is desired to reduce life cycle costs for cooling the addition space, another way to do this would be to utilize renewable resources by introducing an enthalpy wheel **(Alternative 3)**. Enthalpy wheels are becoming more and more popular, especially because they are efficient with conserving energy in air-conditioned spaces.

- The wheel is positioned in a duct system such that it is divided into two half moon sections
- Stale air from the conditioned space is exhausted through one half while outdoor air is drawn through the other half in a counter flow pattern
- At the same time, the wheel is rotated slowly (2 to 20 RPM)
- Sensible heat is transferred as the metallic substrate picks up and stores heat from the hot air stream and gives it up to the cold one
- Latent heat is transferred as the medium condenses moisture from the air stream that has the higher humidity ratio

Mechanical Breadth

The schematic below gives a better idea of how this will work in a VAV system on a typical Baltimore summer day.



Alternative 3 includes adjusted load distribution when using a 0.80 efficient enthalpy wheel. Energy savings is now even better combining the new solar shade design and incorporating an enthalpy wheel in the new variable air volume air handling unit. Here is the new and improved load distribution.

[All cooling coil peak results from TRACE analysis may be found in Appendix D.4]

After the third design alternative, it is now safe to say that over 30 tons of cooling energy will be saved by implementing an enthalpy wheel in conjunction with the solar shading re-design. Though this new alternative may be saving BTU's/Hr to cool the space, a first cost investment in an enthalpy wheel is not cheap. Justification for purchasing an enthalpy wheel would be the energy cost savings over the course of three to five years, which will in turn be paying for the first cost of an enthalpy wheel. Below are the cost comparisons for each of the alternatives based on the electricity cost of $0.09/kWh. Energy loads were calculated from the solar shade and TRACE analyses.

Mechanical Breadth

Cost Savings From Solar Energy Alone

Typical Calculation

1 kWh=3413 BTU

January: 1,644,676 BTU X 1 kWh/3413 BTU=481.89 kWh

Unit Cost of Electricity: $0.09/kWh

January: $0.09 kWh X 481.89 kWh =

$43.37 Savings

Energy Savings per Month		
	BTU	**$/kWh**
Jan	1644676	$43.37
Feb	1606628	$42.37
Mar	1540201	$40.61
Apr	1423090	$37.53
May	1254029	$33.07
Jun	1113449	$29.36
Jul	1340081	$35.34
Aug	1539621	$40.60
Sep	2066373	$54.49
Oct	2377082	$62.68
Nov	1838129	$48.47
Dec	1653058	$43.59
Total	**19396417**	**$511.48**

If the amount of energy saved from solar heat gain reduction could be calculated as a cost savings, then for an entire year $511.48 would be saved. Every little bit counts.

Mechanical Breadth

Cost Savings from Cooling Energy

ALTERNATIVE 1

[Typical Calculation using Data from TRACE analysis, Existing Shades]

EXISTING Net Total (BTU/h): 1,272,908

[1,272,908 BTU/h] X [24 h/1 day] X [30 days/month] = 916,493,760 BTU/month

[EXPENDED BY COOLING ENERGY, May-Sept]

Total Energy/year: 916,493,760 BTU/month X 5 months = 4,582,468,800 BTU's

1 kWh=3,413 BTU

4,582,468,800 BTU X 1 kWh/3413 BTU = 1,342,651.28 kWh

Unit Cost of Electricity: $0.09/kWh

Annual Existing Cost: $0.09 kWh X 1,342,651.28 kWh =

Total Cost = $120,838.61

[Calculations continued on next page]

Mechanical Breadth

Cost Savings from Cooling Energy Continued

ALTERNATIVE 2

[Typical Calculation using Data from TRACE analysis, 3' Shades]

PROPOSED Net Total (BTU/h): 1,149,716

[1,272,908 BTU/h] X [24 h/1 day] X [30 days/month] = 827,795,520 BTU/month

[EXPENDED BY COOLING ENERGY, May-Sept]

Total Energy/year: 827,795,520 BTU/month X 5 months = 4,138,977,600 BTU's

1 kWh=3,413 BTU

4,138,977,600 BTU X 1 kWh/3413 BTU = 1,212,709.52 kWh

Unit Cost of Electricity: $0.09/kWh

Annual Existing Cost: $0.09 kWh X 1,212,709.52 kWh =

Total Cost = $109,143.86

[Calculations continued on next page]

Mechanical Breadth

Cost Savings from Cooling Energy Continued

ALTERNATIVE 3

[Typical Calculation using Data from TRACE analysis, with enthalpy wheel]

PROPOSED Net Total (BTU/h): 935,786

[935,786 BTU/h] X [24 h/1 day] X [30 days/month] = 637,765,920 BTU/month

[EXPENDED BY COOLING ENERGY, May-Sept]

Total Energy/year: 637,765,920 BTU/month X 5 months = 3,368,829600 BTU's

1 kWh=3,413 BTU

3,368,829600 BTU X 1 kWh/3413 BTU = 987,058.19 kWh

Unit Cost of Electricity: $0.09/kWh

Annual Existing Cost: $0.09 kWh X 987,058.19 kWh =

Total Cost = $88,835.24

TOTAL SAVINGS FOR 18,750 SF OF SPACE IN NEW ADDITION

ALTERNATIVE 2: $11,694.75+511.48 = $12,206.23

ALTERNATIVE 3: $32,003.37+511.48 = $32,514.85

Mechanical Breadth

Conclusion

After thoroughly calculating the energy expended for three different alternatives, the 18,750 SF space has the potential to save a maximum of $32,514.85 per year with the new design options mentioned!

- Alternative ways to save energy and cost of energy per year were found
- Solar heat gain energy was minimized to save on the cost of cooling each floor
- Direct and indirect distribution was determined in further detail in the following section (Lighting Breadth)
  - Solar shading
  - Use of light shelves

Sun Table for Baltimore, MD				W 76°40”0’ , N 39°11”0’
Calculations from http://www.susdesign.com/sunangle/				
	Hour	Altitude	Azimuth	
Jan. 15th 2008	7:00	-5.17	66.77	
	8:00	5.1	57.27	
	9:00	14.26	46.55	
	10:00	21.8	34.15	
	11:00	27.1	19.93	
	12:00	29.56	4.28	
	13:00	28.81	-11.72	
	14:00	24.96	-26.81	
	15:00	18.54	-40.2	
	16:00	10.18	-51.79	
	17:00	0.46	-61.89	
Feb. 15th 2008	7:00	-0.65	73.95	
	8:00	10.21	64.1	
	9:00	20.14	52.95	
	10:00	28.57	39.81	
	11:00	34.77	24.21	
	12:00	37.87	6.44	
	13:00	37.31	-12.05	
	14:00	33.21	-29.28	
	15:00	26.25	-44.13	
	16:00	17.3	-56.62	
	17:00	7.05	-67.32	
Mar. 15th 2008	7:00	7.4	81.46	
	8:00	18.71	71.32	
	9:00	29.3	59.67	
	10:00	38.55	45.4	
	11:00	45.49	27.44	
	12:00	48.87	5.86	
	13:00	47.78	-16.71	
	14:00	42.53	-36.71	
	15:00	34.34	-52.81	
	16:00	24.36	-65.69	
	17:00	13.38	-76.5	
Apr. 15th 2008	7:00	16.61	89.46	
	8:00	28.19	79.5	
	9:00	39.35	67.81	
	10:00	49.46	52.64	
	11:00	57.31	31.48	
	12:00	60.85	3.32	

Appendix D.1

	13:00	58.56	-25.86	
	14:00	51.47	-48.67	
	15:00	41.74	-64.95	
	16:00	30.75	-77.24	
	17:00	19.25	-87.49	
May. 15th 2008	7:00	22.72	96.57	
	8:00	34.33	87.29	
	9:00	45.84	76.4	
	10:00	56.71	61.7	
	11:00	65.7	38.58	
	12:00	69.87	2.07	
	13:00	66.42	-35.56	
	14:00	57.75	-59.92	
	15:00	47	-75.21	
	16:00	35.54	-86.37	
	17:00	23.94	-95.76	
Jun. 15th 2008	7:00	24.37	101.05	
	8:00	35.91	92.33	
	9:00	47.51	82.35	
	10:00	58.77	68.99	
	11:00	68.68	46.94	
	12:00	74.08	6.1	
	13:00	70.61	-39.09	
	14:00	61.37	-64.78	
	15:00	50.3	-79.55	
	16:00	38.73	-90.09	
	17:00	27.16	-99.01	
July 15th 2008	7:00	22.25	100.11	
	8:00	33.8	91.2	
	9:00	45.39	81.04	
	10:00	56.57	67.64	
	11:00	66.37	46.43	
	12:00	71.99	9.6	
	13:00	69.52	-33.05	
	14:00	60.97	-60	
	15:00	50.18	-75.89	
	16:00	38.69	-87.08	
	17:00	27.08	-96.36	
Aug. 15th 2008	7:00	18.1	93.35	
	8:00	29.7	83.69	
	9:00	41.06	72.45	
	10:00	51.6	57.79	
	11:00	60.17	36.55	
	12:00	64.48	6.22	
	13:00	62.38	-26.39	
	14:00	55.04	-50.9	
	15:00	45.02	-67.52	

	16:00	33.86	-79.72	
	17:00	22.29	-89.79	
Sept. 15th 2008	7:00	13.02	82.85	
	8:00	24.36	72.48	
	9:00	35	60.3	
	10:00	44.24	44.91	
	11:00	50.92	24.91	
	12:00	53.51	0.69	
	13:00	51.15	-23.65	
	14:00	44.64	-43.89	
	15:00	35.48	-59.47	
	16:00	24.88	-71.77	
	17:00	13.55	-82.19	
Oct. 15th 2008	7:00	7.28	72.42	
	8:00	17.97	61.88	
	9:00	27.58	49.61	
	10:00	35.39	34.8	
	11:00	40.48	17.1	
	12:00	41.95	-2.55	
	13:00	39.46	-21.87	
	14:00	33.55	-38.83	
	15:00	25.18	-52.9	
	16:00	15.23	-64.62	
	17:00	4.32	-74.82	
Nov. 15th 2008	7:00	0.85	64.88	
	8:00	10.89	54.76	
	9:00	19.65	43.15	
	10:00	26.55	29.64	
	11:00	30.89	14.2	
	12:00	32.08	-2.41	
	13:00	29.92	-18.81	
	14:00	24.76	-33.72	
	15:00	17.24	-46.64	
	16:00	8.04	-57.74	
	17:00	-2.28	-67.51	
Dec. 15th 2008	7:00	-4.11	63.06	
	8:00	5.77	53.47	
	9:00	14.42	42.57	
	10:00	21.31	30.04	
	11:00	25.85	15.85	
	12:00	27.51	0.54	
	13:00	26.06	-14.8	
	14:00	21.7	-29.09	
	15:00	14.95	-41.74	
	16:00	6.41	-52.74	
	17:00	-3.4	-62.41	

1600 SunShade®

Saving Energy, Money and Time

Elmhurst Public Library, Elmhurst, IL
Architect: Lohan Associates, Chicago, IL
Glazing Contractor: Arcadia Products, Northbrook, IL

The addition of sunshades to buildings has frequently caused problems for contractors, costing money and time. Kawneer's 1600 SunShade® is the first sunshade which integrates easily into 1600 Wall System®1 or 1600 Wall System®5. Economical, easy-to-install and incorporating a variety of design choices, 1600 SunShade® can be used in a number of applications, both in single-story and multi-story structures.

Aesthetics

In addition to shading interiors and conserving energy, 1600 SunShade® provides a number of texture and design elements for your building, meaning you won't have to compromise style for substance. Outriggers (brackets), for example, which complement the building shape and structure, are available in several shapes. Louvers can be air foil (wing-shaped), cylindrical, square or flat. And fascias or outermost elements can be rounded, square or air foil.

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Economy

1600 SunShade® is pre-engineered and easily assembled using screw spine joinery, then attached to a channel that is bolted to the 1600 Wall vertical mullion. The result is a 30-inch projection from the face of the glass, providing generous shade for interiors of both small and large buildings.

The considerable savings in fabrication and attachment time compared with custom sunshades creates economies in budgets and construction schedules. In turn, these savings allow for the use of sunshades on even the most modest of structures.

Colorado Plains Medical Center, Fort Morgan, CO
Architect: Davis Partnership Architects, Denver, CO
Glazing Contractor: El Paso Glass-Denver, Inc., Aurora, CO

Performance

The anchorage design is capable of handling 60 psf combined vertical load of wind and snow based on attachment points of five feet on center. For loading or attachment conditions greater than this, please consult with your Kawneer representative regarding a design solution.

Energy Savings

The 1600 SunShade® reduces the solar heat gain on the glazing, thus lowering cooling costs, a benefit acknowledged by the International Energy Conservation Code. The reduction is measured by the projection factor, a function of the horizontal projection and height of the window, which takes into account the shading effect, thus reducing the dependence on glass coatings alone to manage the solar heat gain.

LEED Credits

Credits are given for providing building occupants a connection between indoors and the outdoors through the introduction of daylight and views into occupied areas of the building. The 1600 SunShade® can assist in achieving maximun daylighting while minimizing direct sunlight penetration and solar heat gain.

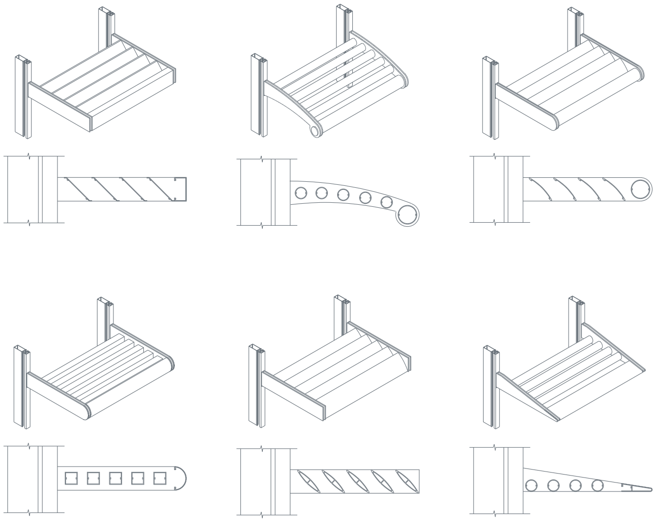
For the Finishing Touch

Permadonic Anodized finishes are available in Class I and Class II in seven different colors.

Painted Finishes, including fluoropolymer that meet or exceed AAMA 2605, are offered in many standard choices and an unlimited number of specially-designed colors.

Solvent-free powder coatings add the "green" element with high performance, durability and scratch resistance that meet the standards of AAMA 2604.

These drawings illustrate just a few of the ways 1600 SunShade® outriggers, louver blades and fascias can be combined to create an almost infinite variety of design elements.



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